

MASTER

Communicating daily life behavioral patterns

using sensor data and local process models to inform people about their common behavior

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Communicating daily life behavioral patterns

Using sensor data and local process models to inform people about
their common behavior

Master Thesis

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Final version

Abstract

A lot of what people do on a day comes forth out of habits. Habits thus need to be taken into account when persons want to change their behavior, for example for increasing health or wellbeing. However, habits are activities that happen automatically, so people are not aware of all their habits. Automatic registration of a person's behavior and using this data to compute frequent patterns, a small group of activities that often occur in a particular order, can be of use here.

Currently, techniques that observe behavior and that can find patterns are available. They are however not focused on usage by a general audience. In this thesis, sensor logs and the Local Process Model Discovery tool are used, which provide patterns presented in process models. Process models are not a natural language and also not a generally known language. Therefore, this thesis presents a method to create natural language texts from the models provided by the tool, that are understandable for a broad audience.

To make sure that the created text is understandable for a broad audience, people's own descriptions of routines (found on YouTube) are analyzed. Attention has been paid to both information given about the routines and presentation of the routines. The findings are used to make the structure of and information in the Local Process Models closer to people's descriptions. A test is performed with adapting the behavior represented by the models by placing constraints on the number of activities that is allowed between activities in a pattern. Furthermore, it is explained how hierarchy of activities, frequencies of patterns and activities and conditions for activities can be included in the models. Finally, a text creation method has been developed based on the extended models and with people's own descriptions in mind. The method tries to present the activities that occurred as sequential as possible. In case of for example choices between activities or activities occurring at the same time, it is expressed without explicitly mentioning the ordering relations such as choices or parallelism.

This thesis makes a first step in presenting behavioral patterns to a general audience. Evaluation showed that the created text correctly presents the information in the patterns and that the text should be understandable for a general audience.

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Astrid van den Bos, November 2017

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Chapter 1

Introduction

This thesis presents the result of a graduation project for the Master Business Information Systems at the Eindhoven University of Technology (TU/e). The graduation project is performed within the Philips Research Personal Health group and the TU/e Architecture of Information Systems group.

The Philips Research Personal Health group conducts research in order to develop products that improve people's quality of life, valuing health and wellbeing. They focus on a healthy life, personal care, home living and interactive living. (Philips, 2017)

The first section of this chapter gives some context information for the topic of this thesis. The next section describes the problem statement. The third section deals with the research questions and method and the last section discusses the thesis outline.

1.1 Thesis context

A lot of what people do on a day is not consciously chosen, but instead comes forth out of habits. Research of psychologists has shown that habits, which they define as processes in which a certain cue or context automatically leads to particular behavior, have great influence on people's lives. It was found that habitual behavior often even takes precedence over what someone intends to do. (Gardner, 2012) For example, someone might, without thinking, start eating from a bowl of crisps at a party, while they actually intended to eat less crisps.

For changing behavior, for example to increase health or wellbeing (which, as mentioned, are goals of Philips Personal Health), it is thus important to take into account the habits someone has. However, most people will not remember all the details of what they normally do, especially taking into account that a lot of things are done without really thinking about it. Automatic registration of and communication about behavior that someone often performs can be helpful for this. Below some psychological research about habits and changing behavior is discussed, to explain in which way having information about regular behavior can be helpful. Next, the work that Philips and the TU/e have already put in obtaining such information is discussed.

1.1.1 Changing behavior by changing habits

Habits come to existence by frequently performing particular behavior in a particular context or after a particular cue (Gardner, 2012). Lally and Gardner explore how to change behavior by changing habits. They say that it is important to start new habits, as well as to make sure that undesirable habits are stopped. In the paper, suggestions are made about how to accomplish this. (Lally & Gardner, 2013)

One suggestion of Lally and Gardner is a form of tracking behavior, by *self-monitoring*, in order to help changing habits. With self-monitoring people themselves keep track of specific behavior. According to the authors it can help with:

- identifying unwanted behavior and finding out where, in which situation, new behavior can be implemented.
- checking compliance with the plan for new behavior.
- seeing in which situation unwanted behavior (still) occurs and thus when a person needs to pay extra attention to not perform certain behavior (and instead perform the new type of behavior).
- providing feedback on someone's behavior. Feedback can be internal, by the fact that the person tracks the behavior and awareness is gained, and external if other people comment on the information. The feedback can help to keep up the motivation for performing the new behavior.
- reviewing the behavioral goals and keeping them realistic.

(Lally & Gardner, 2013)

Instead of self-monitoring, a system that automatically monitors behavior and then shows what behavior has been seen could be much more practical. It can monitor all behavior instead of only some specific behavior, it does not forget to track any behavior and the system is possibly more objective and precise in tracking behavior.

1.1.2 Ongoing research at Philips and the TU/e

Understanding that a system that tracks behavior can have many different uses and benefits, employees of Philips have performed experiments with tracking behavior using sensors in houses. Sensors were for example placed at cupboards, water boilers and TVs and also movement sensors were placed in different rooms. The data of all these sensors is collected in a log. An example of a (fictional) sensor log can be found in figure 1.1. Five observations are shown of three different sensors. One sensor observes motion in the kitchen, another one power usage by the microwave and another opening or closing of the fridge. Each observation has a value associated with it, such as 'open' for the sensor at the fridge. The observations also have a time stamp, thus it can be seen that the observations were made one after the other, between 09:25 and 09:30 hours.

Tax, Sidorova, Haakma, and van der Aalst, from the TU/e and Philips, have been working on an algorithm that finds patterns, named *local process models* (LPMs), in data such as the smarthome data. The Local Process Model Discovery tool tries to discover frequent behavioral patterns, consisting mostly of between three and five activities, in event-logs. (Tax, Sidorova, et al., 2016b) An event-log is a collection of ordered *events*. Events can for instance be the occurrence of activities, observations or changes. Explanation about the exact components of an

<i>sensor observation</i>	<i>datetime</i>	<i>value</i>
...
kitchen motion	27-05-2016 09:25:34	1
opening/closing fridge	27-05-2016 09:26:19	open
opening/closing fridge	27-05-2016 09:26:56	close
microwave power usage	27-05-2016 09:28:07	75
kitchen motion	27-05-2016 09:29:49	1
...

Figure 1.1: Example of smarthome data in a log

event-log can be found in chapter 2. The patterns the algorithm finds are expressed in *process models*. A process model is a visual way of presenting in which order certain activities occurred or can/should occur. An example of a process model can be found in figure 1.2. It expresses that opening or closing the fridge happens before the microwave uses power (more information about process models is given in chapter 2). Such a model could be found by the LPM algorithm for the log in figure 1.1.

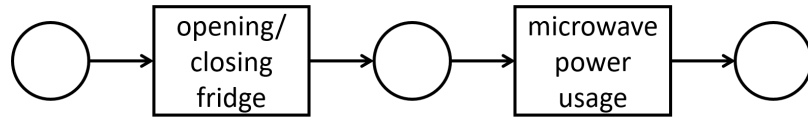


Figure 1.2: Example of a process model

The algorithm of Tax, Sidorova, et al. is especially meant for event-logs in which the ordering is not very structured (Tax, Sidorova, et al., 2016b). This fits well with human behavior, since human behavior is also not necessarily structured. People do many different things at different days and not necessarily always do things in the same order. When looking at a lot of activities at the same time, it might thus seem there is no common order of activities at all. However, it might be that particular things always happen in the same way, for example making coffee might always be the first thing someone does when entering the kitchen in the morning. Focusing at small groups of activities might thus reveal that there are some patterns after all. While the method to find these patterns in small groups of activities is still in development, the first results were promising. The algorithm was able to find interesting patterns where algorithms looking at all activities at the same time could not find any pattern (Tax, Sidorova, et al., 2016b).

1.2 Problem statement

The problem statement given by Philips is to create textual descriptions of someone's common, usual or routine behavior using Philips' smarthome logs. Text is something that people use often in their daily lives and that most people are comfortable with. An important requirement for these texts is that they have to be readable for general people, thus no special knowledge or skills should be required for understanding the text. The list of observations made by the sensors thus has to be translated, in some way, to (readable) text. This problem is illustrated in figure 1.3. A log with observations of the sensors goes into a black box and then the black box produces textual descriptions of common behavior.

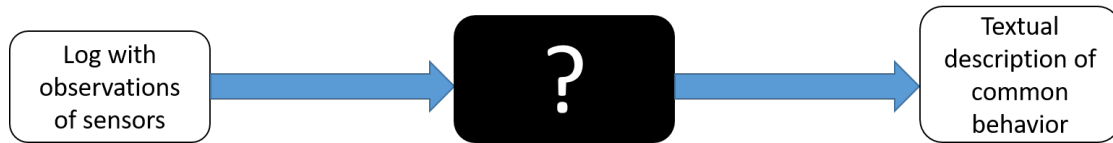


Figure 1.3: From sensor observations to text

No requirements were given for the techniques used in the black box, so any techniques of the wide research field about behavior recognition and finding patterns could be used, see for example (Kim, Helal, & Cook, 2010), (Rodríguez, Cuéllar, Lilius, & Calvo-Flores, 2014), (Chen, Hoey, Nugent, Cook, & Yu, 2012) and (Zhao & Bhowmick, 2003). For several reasons it has been decided to use the local process model technique of Tax, Sidorova, et al. (2016b). First, the algorithm has been made with the type of data of Philips in mind, and is thus very suitable for this type of data, both in format (log) and content (unstructured human behavior). Also, the algorithm focuses on small recurring patterns involving multiple activities, which fits with the goal of describing common behavior. Furthermore, it is possible to adapt the algorithm, because the code is fully available in the open source program *ProM* (see (van Dongen, Weijters, & van der Aalst, 2005) for more information about ProM). Also, Philips already invested in this method, so developing it further towards something focused on end users is beneficial.

Figure 1.4 illustrates the problem to get from sensor observations to textual descriptions of common behavior using the LPM algorithm. The arrows in the figure symbolize processing of the data and the blocks represents the output after each processing step. The process starts with the given log containing sensor observations. The LPM algorithm, or if necessary an adapted version of the LPM algorithm, processes the log and produces process models of frequent behavioral patterns. Finally, these process models are converted to text, which results in textual descriptions of someone’s common behavior.

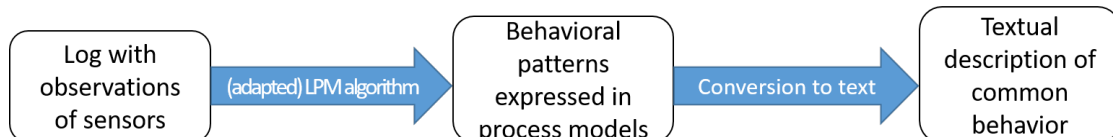


Figure 1.4: From sensor observations to text, using the LPM algorithm

The problem statement is as follows:

How to create a textual description of someone’s common behavior such that people in general can understand the text (easily), using a log with sensor observations and the Local Process Mining algorithm.

1.3 Research questions and method

In order to create a textual description about common behavior, thus to arrive at the third text box in figure 1.4, it is first necessary to know what the text should be like. It has to be

known what type of *information* people expect or would like in a description of common behavior and also what *presentation* of that information is suitable for a general audience. In terms of information, it is for example necessary to know what people expect to learn from the description and what kind of ordering relations between activities they expect or understand. In terms of presentation, it is for example necessary to know the structure of the descriptions and the types of words used. The first research question of this thesis is therefore:

1. *How should common behavior be textually described to a general audience?*
 - (a) *What type of information do people in general expect in a description of common behavior?*
 - (b) *What type of textual presentation of common behavior is suitable for people in general?*

Once this is known, it has to be checked if and in what way the behavioral patterns (represented in the second text box of figure 1.4) found by the LPM algorithm are different in terms of information and presentation from how common behavior should be textually described. An obvious difference in presentation is that the patterns are expressed in process models and not in text. Most likely, the output of the LPM algorithm is in several ways different from what is expected by or suitable for a general audience in terms of information and presentation. The second research question is therefore:

2. *How is the way common behavior should be textually described to a general audience different from how the LPM algorithm, using sensor logs, describes common behavior?*
 - (a) *What are differences in the type of information about common behavior?*
 - (b) *What are differences in the presentation of common behavior?*

The difference between process models and text can be overcome by translating the information that the models provide into text (represented by the second arrow in figure 1.4). In order to overcome other differences in information and presentation, it can be necessary to make an adapted version of the LPM algorithm (represented by the first arrow in figure 1.4) such that the patterns it provides are as close as possible to the requirements of a general audience. The third research question is therefore:

3. *How can the differences between the output of the LPM algorithm and how common behavior should be textually described to a general audience be overcome?*
 - (a) *In what ways can the LPM algorithm be adapted to produce output closer to the requirements of a general audience?*
 - (b) *How can the information in the models provided by the LPM algorithm be translated to text suitable for a general audience?*

In order to obtain answers to the first research question, descriptions of routines made by people themselves have been found and analyzed. During analysis, attention was paid to what information is provided in the descriptions and in what way it is provided. The findings are then compared to the information and presentation of patterns found by the LPM algorithm. This provides answers to the second research question. For research question 3a, the differences that are found are analyzed in further detail, and several ways of adapting the LPM algorithm are discussed in order to come to an output that is closer to people's descriptions. Finally, in order to reach the goal of making textual descriptions of common behavior and to provide an answer to research question 3b, a method to create text from the models found by the algorithm has

been developed. The text created is evaluated by comparing it to the text created by an already existing method, not focused on a general audience (Leopold, Mendling, & Polyvyanyy, 2012).

1.4 Thesis outline

Chapter 2 provides some background information about LPMs and other theories and techniques used in this thesis. The approach for analyzing people's own descriptions of routines and the results are presented in chapter 3. A comparison between the findings of chapter 3 and the output of LPM algorithm is made in chapter 4. Several adaptations to the LPM algorithm are discussed in chapters 5 and 6. The method to create text is presented in chapter 7 and the method is evaluated in chapter 8. Finally, conclusions are drawn, limitations are discussed and ideas for future work are presented in chapter 9.

Chapter 2

Preliminaries

This chapter explains some theories and techniques used in this thesis. The first section discusses the XES standard for event-logs. Next, information about sensor data is given. Then, the fields of sequential pattern mining and process discovery are introduced. The fourth section explains some different ordering relations that can exist between activities. Next, different notations that are used for process models in this thesis are explained. Finally, the LPM algorithm is discussed in more detail.

2.1 XES event-logs

XES is an IEEE standard for event-logs. Figure 2.1 contains the metamodel of the XES format. The components that stand out are Log, Trace, Event, Attribute and Extension. Extension is out of scope for this thesis so will not be discussed further. For the others, figure 2.2 contains the descriptions as they are given in the standard. A log contains thus information about a process, expressed in traces, events and/or attributes. A trace represents one execution of a process and events are activities that are observed and performed in a process. The order of the events in the log represents the order in which they occurred. Attributes can provide extra information about a log, trace or event. An example is the date and time (*dateTime* in the UTC time format of ISO 8601) of an event. (IEEE Computational Intelligence Society, 2016)

2.2 Data collected with sensors

To be able to describe the behavior of a person, the behavior first needs to be monitored. Tracking someone's behavior can be done in different ways such as via manual logging by the person itself or an observer, or via sensor-based automated logging, for example through wearable devices, smart home environments, or interaction with smart products. Each method of data collection has its own advantages and disadvantages. However, for tracking behavior it is preferable that data collection happens automatically (otherwise the system will not be scalable) and does not get noticed by the user. For example, van Kasteren mentions that elderly consider wearable sensors to be annoying or forget to wear the sensors (van Kasteren, 2008). Sensors in the environment are well suited for automatic inconspicuous observation of behavior. Philips has

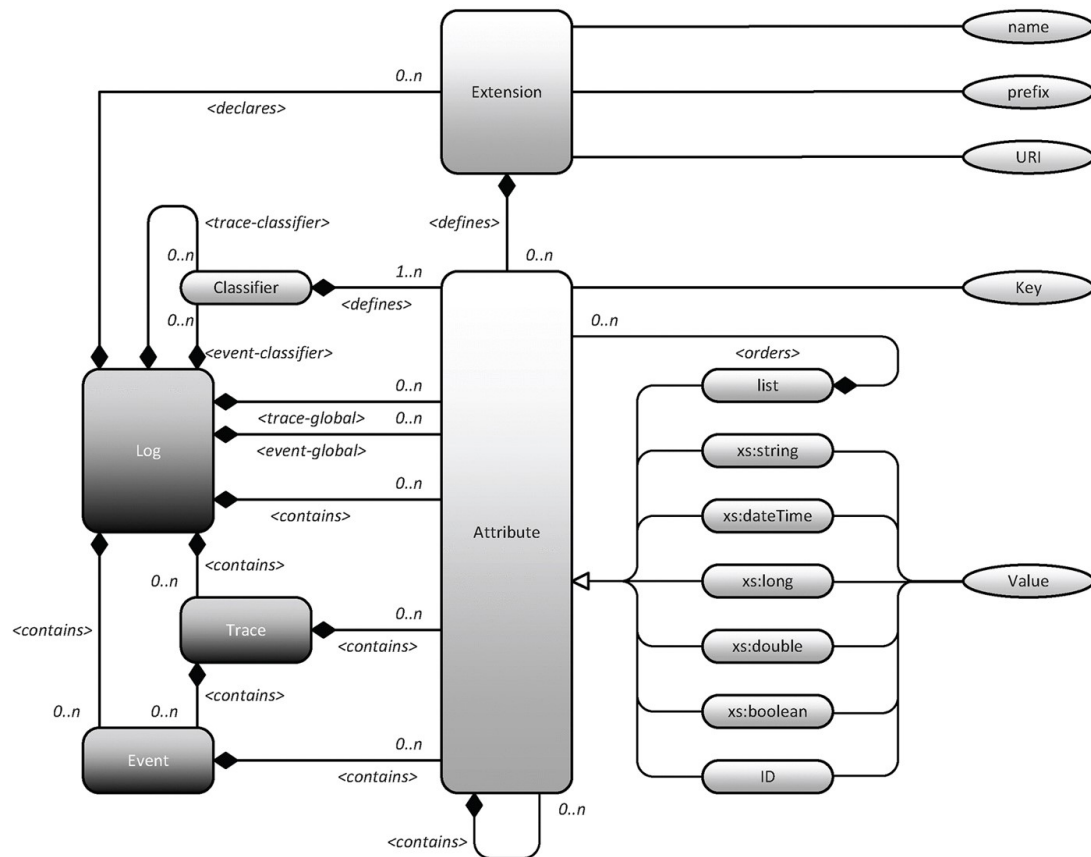


Figure 2.1: Overview of the XES metadata structure, from (IEEE Computational Intelligence Society, 2016)

therefore been collecting data using several sensors in different houses. These “smarthomes” keep track of people’s behavior.

2.2.1 Smarthomes

Cook, Crandall, Thomas, and Krishnan say the following about smarthomes: “*Computer software uses sensors and artificial intelligence techniques to perceive and reason about the state of the home’s physical environment and its residents, and then initiates action to achieve specified goals.*” (Cook et al., 2013). This statement immediately shows that not all smarthomes are the same in terms of setup, functionality or goals. In fact, where one smarthome might be mostly focused on automatic regulation of lights and temperature, another, as the ones mentioned from Philips, is mostly focused on tracking behavior in the house and using that information for, for instance, supporting behavioral change. See (Cook et al., 2013) and (van Kasteren, Noulas, Englebienne, & Kröse, 2008) for two examples how a smarthome can be set up.

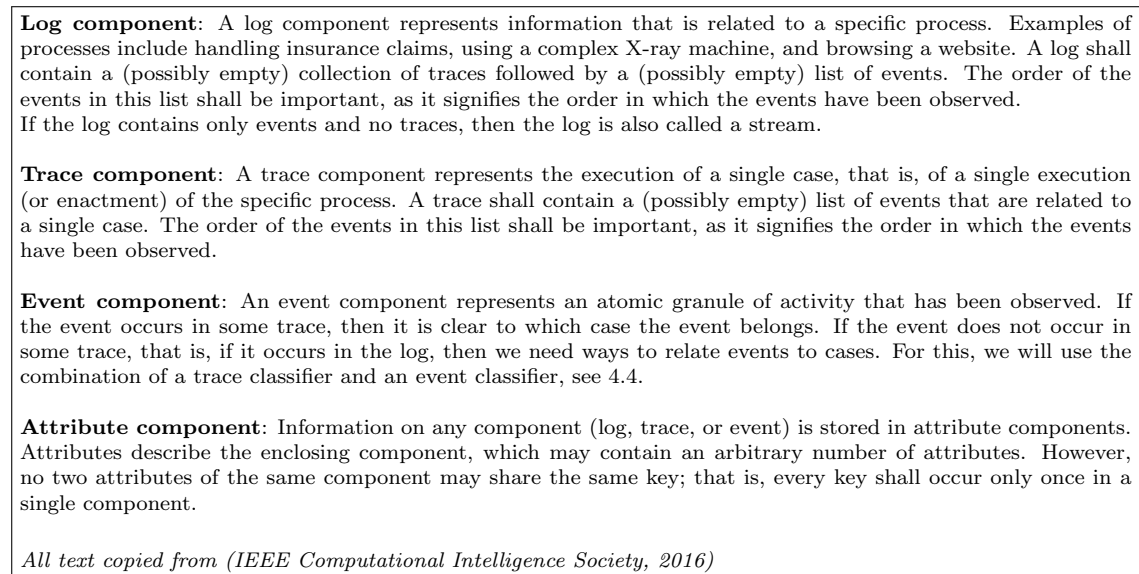


Figure 2.2: Explanations of the XES components

2.2.2 Smart home sensor data

Each time when a sensor makes an observation, it will log this with a value and `dateTime`. The value depends on the type of sensor that makes the observation. For example, a sensor measuring changes in power usage, will log the number indicating the new amount of power used. A movement sensor will simply log that movement has been observed. Overall it can be said that the data produced by the sensors is a log with on each line a sensor ID, `(date)timestamp` and a value.

During the installation process of the sensors in the house, also some data about the sensors needs to be collected. It is important that at least for each sensor is noted where it is placed and what it measures, otherwise it is hard to find out what all the observations mean.

A fictional example of some sensors and some observations can be found in figure 2.3. Figure 2.3a shows some information about the sensors that the house contains. There is a motion sensor in the kitchen, a power sensor on the microwave in the kitchen and a sensor keeping track of opening and closing the fridge in the kitchen. Figure 2.3b shows a small list of observations made by the sensors. It is for example possible to see that the first observation is made by sensor 1, the kitchen motion sensor, which registered motion at the 27th of May 2016 at 09:25:34 hours.

2.2.3 Log format

The LPM miner asks for a XES file as input, thus the sensor log has to be converted to XES. Depending on the file type of the sensor log, this does not have to be a difficult conversion. Conversion can be done using for example the program *ProM*, which has a function that translates a CSV file into a XES file. This conversion could even be included in the LPM algorithm. A sensor log contains observations in the order in which they occurred, thus in principle, the sensor

<i>sensor ID</i>	<i>sensorType</i>	<i>location</i>	<i>object</i>
1	motion	kitchen	kitchen
2	power	kitchen	microwave
3	open/close	kitchen	fridge
...

(a) Set of sensors in a house

<i>sensorID</i>	<i>datetime</i>	<i>value</i>
...
1	27-05-2016 09:25:34	1
3	27-05-2016 09:26:19	open
3	27-05-2016 09:26:56	close
2	27-05-2016 09:28:07	75
1	27-05-2016 09:29:49	1
...

(b) List of observations from sensors

Figure 2.3: Example of sensors in a smarthome

log contains all the information that is required for a XES log. The `dateTime` information, values and any other available information (for example about the sensor type) can be added as attributes. The sensor log does not contain trace information, and this is also not required in the XES format, however, currently the LPM algorithm is substantially slower with large traces. Therefore, it is practical to automatically create traces, even though this might mean that observations that belong to each other are split, because behavior is actually a continuous process. Also, some cleaning of the log can be needed. It might be known that some sensors malfunctioned or perhaps some values are impossible for certain sensors etc.

2.3 Sequential pattern mining and process discovery

The LPM algorithm has characteristics of the fields of sequential pattern mining and process discovery (Tax, Sidorova, et al., 2016b).

The goal of pattern mining is to find (hidden) patterns in a database that are interesting or useful. Sequential pattern mining, specifically, is about finding sub-sequences in sequential data. Whether a found sub-sequence is interesting can be determined by for example its frequency or length. (Fournier-Viger, Lin, Kiran, Koh, & Thomas, 2017)

Process discovery is a technique that produces a process model from an event-log. Process discovery does not only look for activities in sequence, but also for, for example, concurrent activities or for a choice between activities. Furthermore, it aims to make a model that represents the process from the start to the end of the traces. Two possible ways, among others, to determine the quality of a discovered model, are calculating the *fitness* and *precision*. Fitness checks if the behavior that is present in the log is represented in the model, while precision checks if the behavior represented by the model is also present in the log. Process discovery is part of the field of process mining, which also involves *conformance checking*, comparing the data in the event-log with an existing process model, and using an event-log for *enhancement* of an existing process model, by correcting deviations of the model compared to the data and by adding data from the attributes, for example about resources. (van der Aalst, 2012).

By combing elements of both sequential pattern mining and process discovery, the LPM algorithm is very suitable for sensor logs of human behavior. The LPM algorithm looks for multiple ordering relations, just as in process discovery, but looks at local patterns, just as in sequential pattern mining (Tax, Sidorova, et al., 2016b). Searching for more behavior than only sequential behavior is good, because it is very likely that people do not only perform activities in sequence, but also,

for instance, perform multiple activities at the same time. However, because of high variability in human behavior it is very unlikely that a complete model, from start to end of a trace, can be found with both high fitness and precision. If the model allows for (almost) all the behavior in the log by allowing activities to occur in many different situations (high fitness), then it is likely that the model also allows for a lot of behavior that is not in the log (low precision). On the other hand, if the model is quite restrictive in when activities are allowed to occur (high precision), then most likely much behavior in the log is not represented (low fitness). By searching for regular behavior on a smaller scale, instead of from start to end of a trace, it is more likely that models can be found that score well on both metrics. Small regular patterns, that might be present in the variable behavior, can then be found.

2.4 Process modeling constructs

Different process model languages (different ways of modeling processes) often have different constructs that indicate the order in which activities can be performed and different interpretations for what seem by name the same constructs. Most languages (at least) support sequences, splits and joins ('and' and 'or') and iterations (loops). However, even these constructs are sometimes interpreted differently between languages. The paper of van der Aalst, ter Hofstede, Kiepuszewski, and Barros aims to give generalized descriptions for the constructs, or patterns, used and/or required for business process modeling. (van der Aalst et al., 2003)

<p>Pattern 1 (Sequence) Description. An activity in a workflow process is enabled after the completion of another activity in the same process. Synonyms. Sequential routing, serial routing.</p> <p>Pattern 2 (Parallel split) Description. A point in the workflow process where a single thread of control splits into multiple threads of control which can be executed in parallel, thus allowing activities to be executed simultaneously or in any order. Synonyms. AND-split, parallel routing, fork.</p> <p>Pattern 3 (Synchronization) Description. A point in the workflow process where multiple parallel sub-processes/activities converge into one single thread of control, thus synchronizing multiple threads. It is an assumption of this pattern that each incoming branch of a synchronizer is executed only once (if this is not the case, then see Patterns 1315 (Multiple Instances Requiring Synchronization)). Synonyms. AND-join, rendezvous, synchronizer.</p> <p>Pattern 4 (Exclusive choice) Description. A point in the workflow process where, based on a decision or workflow control data, one of several branches is chosen. Synonyms. XOR-split, conditional routing, switch, decision.</p> <p>Pattern 5 (Simple merge) Description. A point in the workflow process where two or more alternative branches come together without synchronization. It is an assumption of this pattern that none of the alternative branches is ever executed in parallel (if this is not the case, then see Pattern 8 (Multi-merge) or Pattern 9 (Discriminator)). Synonyms. XOR-join, asynchronous join, merge.</p> <p><i>All text copied from (van der Aalst et al., 2003)</i></p>
--

Figure 2.4: Basic ordering constructs

An ordering construct can say something about the way two activities are related to each other, but can also deal with more activities or groups of activities. For example, a person might be choosing between eating an apple, eating a banana or eating both a peach and an orange. There are three options, two options in which one piece of fruit is eaten and one in which two pieces of fruit are eaten. An option is also called a thread or branch, and such a thread can again consist of one or more activities.

The first patterns described by van der Aalst et al., and indicated to be ‘basic patterns’, can be found in figure 2.4. In a sequence activities follow after each other. With a parallel split and synchronization, several activities, or branches of activities, are executed at the same time or in arbitrary order. The exclusive choice and simple merge allow for choosing exactly one activity (or one branch of activities) from several (branches of) activities. Furthermore, it is mentioned that most process mining languages at least support structured cycles, a loop with one entry and one exit point. In a loop, one or more activities can be performed multiple times. (van der Aalst et al., 2003)

A more advanced construct, related to the exclusive choice, is the inclusive choice. With an exclusive choice, only one branch can be performed, while for an inclusive choice one or more, and even all, (branches of) activities can be performed. This is called Multi-choice by van der Aalst et al. Synchronization options are to wait and only continue with the next activities until all activated branches are completed, to execute the next activities each time a branch finishes or to perform the next activities only for the branch that finishes first and ignore the other branches. (van der Aalst et al., 2003)

2.5 Process modeling languages

A process model is a way to visualize a process and different process modeling languages exist for making such models. This section introduces process trees and Petri nets, which are used by the LPM algorithm. Furthermore, BPMN is explained, which is used in chapter 8.

2.5.1 Process trees

Process trees are a special case of a tree data structure. Mathematical definitions of process trees can be found in for example (Leemans, 2017) and (Buijs, 2014).

A process tree consists of nodes representing an operator and nodes representing an activity. Leaves are always activity nodes and non-leaf nodes are always operator nodes. The operators are the ordering constructs in the trees and thus indicate the order in which activities can be performed. Below is explained how the operators of process trees relate to the constructs explained in section 2.4. An activity can be a *silent activity*, labeled as τ , which means a step is made in the model, but nothing happens in the real execution of the process. (Leemans, 2017)

The operators that a process tree supports, depend a bit on which definition is taken. The definition of, for example, Leemans (2017) and Buijs (2014) each define one type of operator that the other one does not define. The following operators are defined by both and represent all basic constructs, the structured loop and the inclusive choice of section 2.4:

- Sequence (\rightarrow): As pattern 1 in figure 2.4, the sequence operator means that an activity is only enabled after the previous activity is finished. All children of a sequence operator

need to be performed one after the other in the process, from left to right.

- Concurrency (\wedge): The concurrency operator represents both pattern 2, parallel split or AND-split, and pattern 3, synchronization or AND-join, of figure 2.4. All children of the concurrency operator need to be performed, but the performance of these children can overlap.
- Exclusive choice (\times): The exclusive choice from process trees is both pattern 4, exclusive choice or XOR-split, and pattern 5, simple merge or XOR-join, of figure 2.4. One, and only one, of the children of the exclusive choice operator needs to be performed in the process.
- Inclusive choice (\vee): The inclusive choice means, just as the multi-choice pattern in section 2.4, that one or more children of the operator are performed, in any order, possibly at the same time. The process continues when all the chosen children are performed.
- Loop (\odot): The loop is a structured cycle, with one entry and exit point, but is slightly differently defined by Leemans and Buijs. In the definition of Leemans the loop consists of a *loop body*, the first child of the loop operator, and a *loop redo*, the other child(ren) of the loop operator. The loop body, so the first child, is at least performed once. The other children can optionally be performed. If they are performed, then this happens one by one, each time followed by performance of the loop body. For example, if ‘A’ is the loop body and ‘B’ and ‘C’ are part of the loop redo, then a possible execution would be A-C-A-B-A-B-A-C-A. In the definition of Buijs, a loop has exactly three children, in which the first can be seen as the loop body, the second as the loop redo and the third as an activity that is performed once, when the loop is finished. In this thesis the definition of Leemans is used.

(Leemans, 2017) (Buijs, 2014)

For the concurrency, interleaving, exclusive choice and inclusive choice operator, the order of the children has no influence on how the process can be executed. The children of these operators can namely be performed in any order. The tree in figure 2.5a for example, represents the same process as the tree in figure 2.5b. However, for the sequence operator the order of children does matter, since children are performed from left to right. Tree 2.5c does not represent the same process as tree 2.5d, since according to tree 2.5c, activity A is executed first and then B, while according to tree 2.5d, activity B is executed first and then A. For the loop operator, it matters which child is the first child, since this child will be performed at least once and also after each other child that is performed. The order of the other children of a loop operator has no influence on how the process can be executed. Tree 2.5e and tree 2.5f represent the same process, while tree 2.5g represents a different process. (Leemans, 2017)

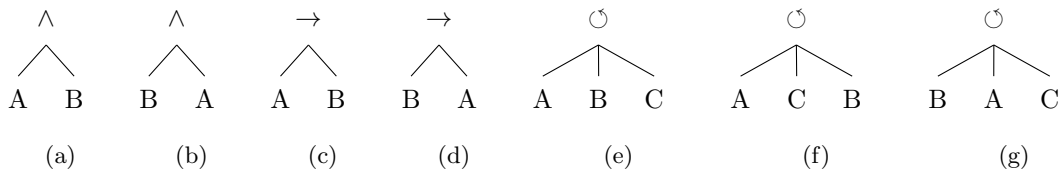


Figure 2.5: Different or the same process?

2.5.2 Petri nets

Petri nets are another way in which a process can be visualized. Mathematical and elaborate descriptions can be found in for example (Murata, 1989) and (Reisig, 2012), however for this thesis it suffices to know a few basic things, explained here.

Petri nets consist of *places*, visualized as circles, and *transitions*, visualized as boxes, that can be connected with each other via arcs, visualized as arrows. Arcs go from a transition to a place or from a place to a transition and arcs have weights (assumed to be one if no weight is mentioned). Transitions represent events and places represent conditions. The presence of a *token*, visualized by a black dot, in a place means that the condition of that place holds. It is also possible to have multiple tokens in a place. In that case each of them represents an available item or resource. A *marking* is the number of tokens (zero or more) that is present in each place and represents the state of the system. (Murata, 1989)

Each transition has a set of incoming places, which are places that point an arc towards that transition, and of outgoing places, which are places to which the transition points an arc. Assuming arcs of weight one, a transition can be executed, is *enabled*, if all its incoming places contain (at least) one token. If a transition is executed, is *fired*, then it removes one token from each incoming place and produces one token in each outgoing place. In case of weights of more than one, the number of tokens needed to enable the transition, and taken and produced when firing, is equal to the weight of the arcs. (Murata, 1989) Petri nets can also have silent transitions, which are represented by completely black boxes (Reisig, 2012). In Petri nets that show patterns found in sensor data, transitions represent activities (or observations) and have a *label* that describes the activity. Looking at the ordering constructs explained in section 2.4, Petri nets can express all the patterns that are discussed.

Figure 2.6 contains an example of a Petri net. The first place on the left contains a token. Activity A is enabled, because all the incoming places of activity A, in this case only the first place on the left, contain a token. If activity A is fired, then the token from the first place is removed and one token is produced in all its outgoing places, in this case the second place. This enables activity B. Firing activity B removes the token from the second place and produces one in the third place. This enables the two silent activities. Firing the one on top takes the token from the third place and produces one in the second place, enabling activity B again. Firing the one on the right takes the token from the third place and produces one in the fourth place. If this happens, no activities are enabled anymore and the process is finished. In the whole process, Activity A is thus fired first and once in total. Activity B is fired after activity A and at least once, but possibly more often, before the process is finished.

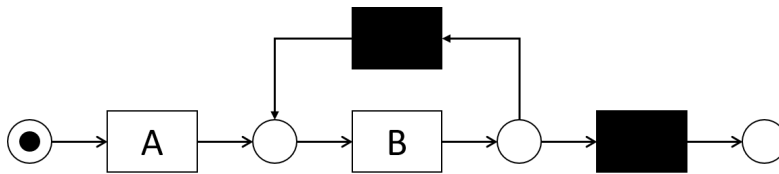


Figure 2.6: Example of a Petri net

2.5.3 BPMN

The process modeling language BPMN (Business Process Model and Notation) is elaborately documented in for example (Chinosi & Trombetta, 2012) and (Object Management Group, 2011). Below it is shortly introduced.

BPMN makes a difference between *events* and *activities*. Events are represented by circles and depending on the type of border a circle has and if and what type of icon a circle contains, they represent different types of events, such as start or end events, messages or signals. A circle without icon in it and with a normal border is a start event. A circle without icon in it and with a thick border is an end event. Activities are represented by boxes and depending on icons, can also be of different types, such as tasks or sub-processes. A box without icon is a task. BPMN can express all the ordering constructs discussed in section 2.4. *Gateways*, represented by diamonds, indicate for example choices or parallelism. Parallel splits and joins are expressed by a plus in the diamond, exclusive choice by a cross in the diamond (or an empty diamond) and inclusive choice by a circle in the diamond. Sequence is indicated by arrows. (Chinosi & Trombetta, 2012)

Figure 2.7 contains an example of a BPMN model. It represents the same process as the Petri net in figure 2.6. Note that a loop can be made using a parallel join and split and a sequence arrow.

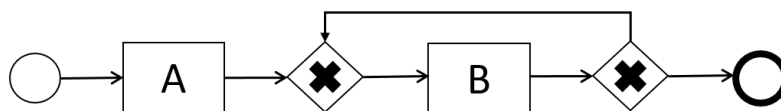


Figure 2.7: Example of BPMN model

2.6 Local Process Model algorithm

The LPM algorithm takes a XES event-log as input and uses process trees to build the frequent behavioral patterns step by step. The algorithm works in rounds in which each time a set of candidate process trees is evaluated. The first round starts with a process tree for each activity in the log. These will thus be trees of only one node. Roughly speaking, the algorithm works as follows:

1. The algorithm receives a group of candidate process trees.
2. The candidate process trees are evaluated using particular metrics.
3. The process trees that are above a threshold according to those metrics are selected.
4. If the selection is empty or if the current round number is equal to or bigger than the maximum number of rounds allowed, the algorithm stops and gives the current selection as output. Else, the selected process trees are expanded.
5. The expanded process trees are sent to step 1 as new candidate process trees and the algorithm continues with step 1 again.

(Tax, Sidorova, et al., 2016b)

Two things need to be explained in more detail here, namely the method of expansion of the trees and the metrics used to evaluate the trees. However, first it should be mentioned that the LPM algorithm uses only part of the functionality that process trees allow for. In term of activities, the LPM algorithm does not allow silent activities in the process tree. Furthermore it only uses four operators, namely sequence (\rightarrow), exclusive choice (\times), concurrency (\wedge) and loop (\circ). (Tax, Sidorova, et al., 2016b)

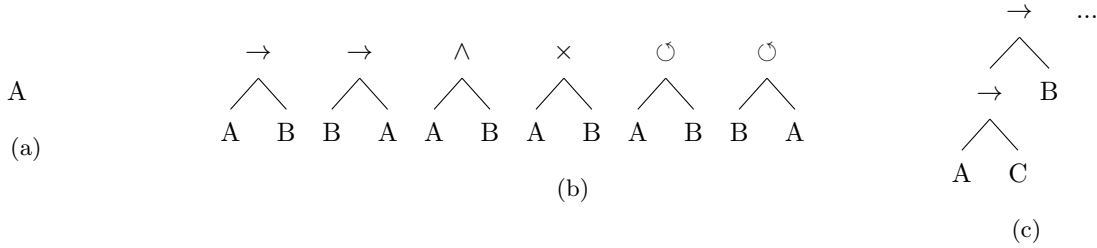


Figure 2.8: Tree expansion

Expanding trees is done by putting an operator node in the place of an activity node and making the activity node a child of this new operator node. As second child of the operator node, a new activity is added to the tree. Figure 2.8 illustrates the expansion of a tree. The tree in figure 2.8a contains only one activity, activity A, and figure 2.8b shows the expansions of the tree. Activity B represents any of the other activities that the log contains. If the log contains 10 activities, then there will be 9 sets of these trees, namely activity A combined with each of the other activities. Note that two trees are created for the sequence and loop operator, since the order of the children is of influence on the process the tree represents. Figure 2.8c shows a tree that would be created in the second round of expansion. (Tax, Sidorova, et al., 2016b)

Five quality metrics are used to evaluate a process tree against an event-log. First, the process trees that need to be evaluated, are translated into Petri nets, because there are many analysis techniques available for Petri nets. The Petri nets should have one starting place and one finish place. (Tax, Sidorova, et al., 2016b) Note that although the created process trees do not contain silent transitions, it might be needed to use silent transitions in the Petri net in order to express the same behavior as the tree.

To check if the behavior in the log is represented by the model, the technique of *alignments* is used. The goal of this technique is to execute a model from start to end in a way that is as closest as possible to how it happens in the event-log. If a trace exactly follows the process described in the model, then the end of the model can be reached with *synchronous moves*. Both in the log and in the model the same steps are made in the same order. However, the events in a trace do not necessarily follow the order of the model. In this case it might be necessary to skip executing an activity of the log or to fire an activity in the model while nothing happens in the log. Skipping an event in the log is called *move on log*, since only a step forward is made in the log and not in the model. Firing a transition without making a step in the log is called *move on model*. Moves on log or model should be prevented as much as possible, to make sure that the process is executed in an order that is as close as possible to the log. The LPM algorithm does not allow moves on the model at all (except in case of a silent transition), to prevent the possibility that partially executed traces are counted as fully executed. (Tax, Sidorova, et al., 2016b)

Because the behavior of a small tree can occur more than once in a trace, the final state of a

Petri net is connected to the first state, using a silent transition. In this way, when a model has finished, it can be executed from the beginning again. Figure 2.9 shows how the start and end places are connected for the Petri net in figure 2.6. (Tax, Sidorova, et al., 2016b)

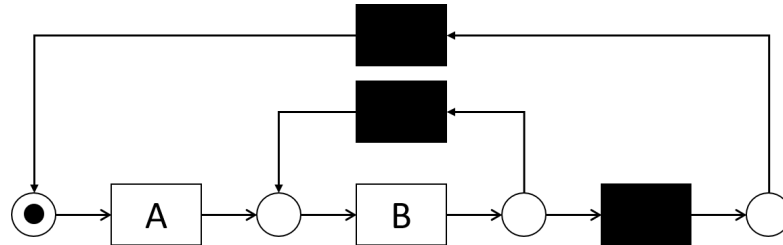


Figure 2.9: Example of a Petri net in which the final state is connected to the first state

All the events that are not present in the process tree are removed from (a copy of) the log. In this way, the log only contains events that are relevant for the model that needs to be evaluated. Then, an alignment is made for each trace, in such a way that as few log moves as possible are necessary (for the exact procedure see section V of (Tax, Sidorova, et al., 2016b)).

Using the created alignments, the following quality metrics are calculated for a model:

- **Support:** How often the model could be executed. This thus represents how often the pattern has been observed in the event-log.
- **Confidence:** How often the occurrence of an activity in the alignments was a synchronous move with the model, divided by the number of occurrences of that activity in total in the log. This thus indicates if an activity often occurs in the ordering context of this model, or occurs more often in (an)other context(s). For a model with multiple activities, the total confidence is the harmonic mean of each individual activity's confidence score.
- **Language fit:** The behavior that is possible according to the model and that is also seen in the alignments (for example B only happens after A), relative to all the behavior that is possible according to the model (for example B can happen before or after A). In general, if a model allows for far more behavior than is seen in the event-log, the model is too unspecific. On the other hand, if the event-log itself contains a lot of different traces, then the model should also allow for a wider variety of behavior.
- **Determinism:** A measure that looks at the number of activities that is enabled at the same time, thus the number of different routes that can be taken in each state during execution of the model. The idea behind this is that if less options are possible, future behavior can be better predicted.
- **Coverage:** The percentage of events in the log that are of the activity types contained in the process tree.

(Tax, Sidorova, et al., 2016b)

Cut-off points can be determined for each of the quality criteria. Furthermore, the model is given an overall score by taking the weighted average of all the single scores. When the final selection of trees has been made, the trees are given as output to the user as Petri nets.

Chapter 3

How people describe routines

This chapter takes the (possible) user as starting point for the way their (or someone else's) common behavior should be described. Behavior could be described in different ways and especially process models can describe complex behavioral patterns with a lot of dependencies. While the descriptions of behaviors to the users should represent what has been seen in the data, they should also be communicated in a way that people in general, without any knowledge about process models, can easily understand. In this chapter is analyzed how people describe their own routines (to others), to serve as an indication of how people think and communicate about their common behavior. It is analyzed what type of information people express when communicating about their routines and the type of language they use. The first section discusses the data used and the approach taken, sections two and three discuss the results of the analysis, section four provides a summary of the findings and the last section discusses some limitations of the research.

3.1 Approach

This section explains which data has been analyzed and how. An initial analysis was performed to get an idea of what type of information the data contained and based on that the overall analysis approach has been determined.

3.1.1 Data

The source of descriptions of common behavior was chosen to be videos on YouTube in which vloggers described their morning routine. A vlog is “*a video blog: a record of your thoughts, opinions, or experiences that you film and publish on the internet*” (CambridgeDictionary, 2017). In the videos, the vloggers showed and explained what their mornings usually looked like, using footage of things the vlogger did during a particular morning and a voice-over to explain what was going on.

An advantage of these videos was that they all followed relatively the same format in which the morning routine was filmed and the vlogger described in a voice-over what was (usually) happening. This made it easy to follow the same analysis method for each source. Also, the

videos were easy to find and there were plenty available. Furthermore, the videos had transcripts that were automatically provided by YouTube, which meant that these did not have to be made manually. Another advantage was that the videos give the opportunity to check if what is told is in compliance with what can be seen. In addition, these descriptions were obtained outside of a research or experimental setting, which otherwise might have influenced how people communicated.

The first 10 videos in which someone described their morning routine (searching YouTube on ‘morning routine’) were downloaded together with the transcripts automatically provided by YouTube. Figure 3.1 contains a part of a such a transcript. The transcripts turned out to not be perfect, but most of the time it was clear what the person said or meant. In case of important sentences that were not clear, the text has been manually corrected. Appendix A.1 contains the video transcripts in which the important auto-translation mistakes have been manually corrected. These texts are also analyzed and marked according to the approach explained in the next sections. For reference, the original, unedited, transcripts are included in appendix A.2.

I usually go to bed really really 0:16	got my new bedding I got it in and I 0:36
late so I wind up waking up super tired 0:19	just moved into my new apartment so I 0:38
and then I realized I woke up way too 0:21	wanted to show you guys be making my bed 0:40
early two hours later now after a 0:27	let’s just be real right now I like to 0:42
hundred yawns later I get out of bed I 0:29	brush my teeth in the morning as soon as 0:44
can’t move on without showing you my 0:31	I get out of bed brush my teeth get that 0:46
Christmassy Sox can’t do it then I just 0:33	nasty taste out of my mouth

Figure 3.1: Part of the transcript of ‘Winter Morning Routine’

Table B.1 in appendix B gives information about the analyzed videos, such as the amount of views and an estimation of the age of the vloggers. All videos are from young women, estimated to be in their teens or twenties. All videos are viewed over 150,00 times and some even more than a million times. It is possible that one person watches several of these videos and watches one video at different locations, which means the number of unique persons that watched these videos is smaller than the sum of all views. Furthermore, it is possible that not all persons watched the complete video. However, with such amount of views it can still be said that these videos reach quite a large audience.

3.1.2 Initial (exploratory) analysis approach

Having downloaded the videos and the transcripts, it was not known yet what should be paid attention to when analyzing these. Therefore, an initial analysis of some of the video texts has been performed. Since the main information provided by LPMs is the way in which activities

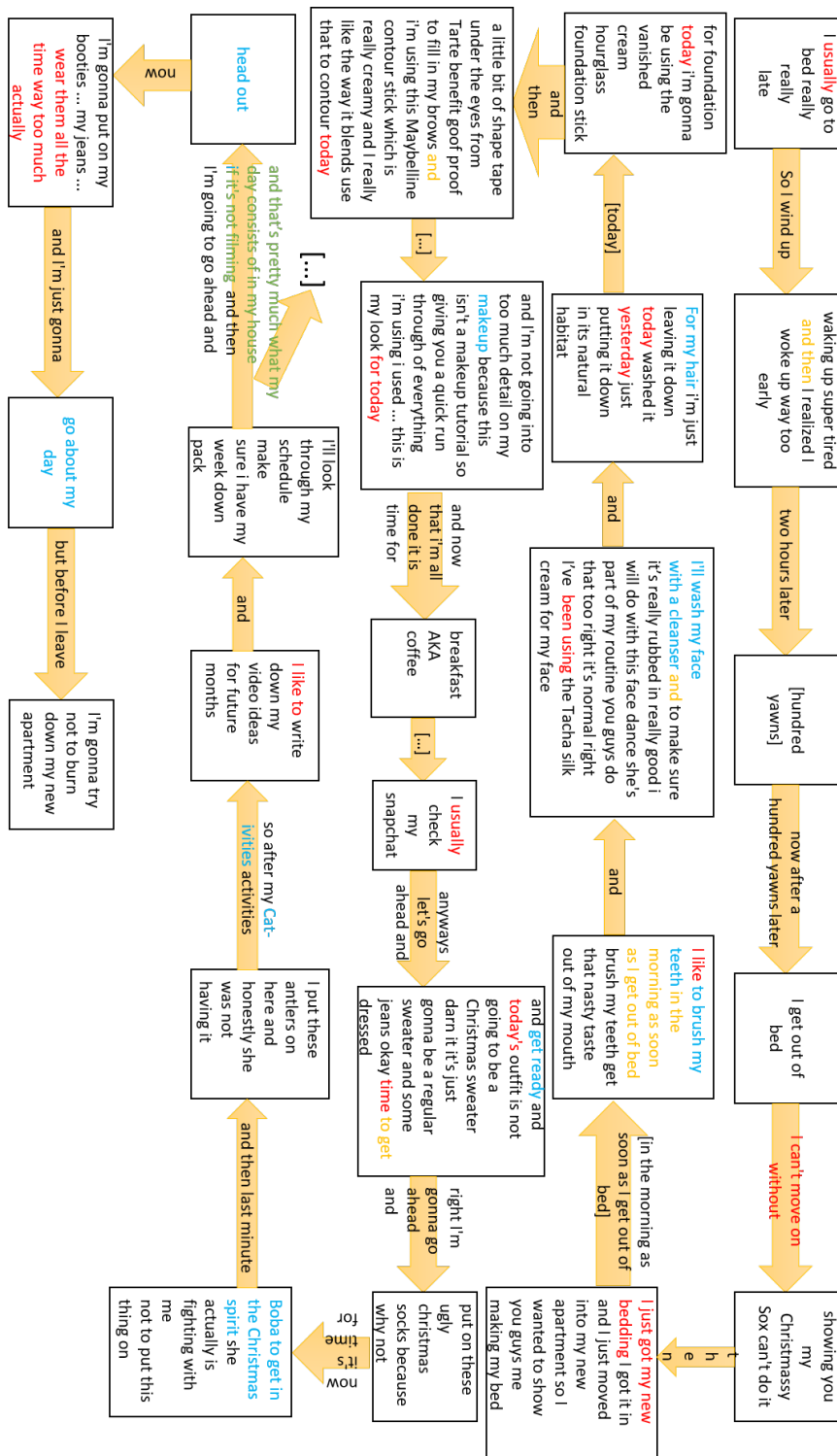


Figure 3.2: Visualized order of activities of 'Winter Morning Routine'

are ordered, the first attention point in analyzing the texts was how people expressed the order of activities in their routine. This was done by visualizing the ordering, placing the activities in boxes and the words indicating order in arrows. Next, these overviews were studied for other components that stood out. The question was if there was any other type of information present in the texts except for activities and their order.

It was found that there were indeed other types of words present in the texts. They could be grouped in three categories: words indicating frequency, hierarchy and conditions. The words in the frequency category indicate how often an activity is included in the routine (so routines are not always preformed in exactly the same way). The hierarchy category contains activities for which is mentioned that they consist of several steps. The main activity can be seen as being on a higher conceptual level than the steps to perform that activity. Words are categorized as a condition if they convey that certain activities only occur in a particular situation.

Figure 3.2 contains an example of the result of this method. The text in figure 3.1 is part of the original transcript for which the overview was made. To be able to present the order of activities in a correct way, sometimes words have been added to the text (between square brackets). All the words indicating order are in the arrows or colored yellow (depending on what was practical for the picture). Words indicating frequency are in red. These are words such as ‘usually’ and ‘today’. Words indicating hierarchy are indicated in blue. For example, the person mentions she is going to head out the door, but then mentions some other activities (such as putting on boots), which can be understood as being part of heading out the door. Also, the person says she is not going to explain everything she does for makeup. Putting on makeup is thus an activity that consists of several smaller steps. Furthermore, the text contains one condition. The person says that what she discussed so far is what her day (morning) looks like, *if it's not filming*. So, on the days she is filming a vlog (except for this one about her morning routine), she follows another process than if she is not filming.

3.1.3 Analysis approach

Following the observations from the initial analysis, all video texts are analyzed paying attention to words indicating activities, order and frequency of activities, whether some activities are said to consist of several sub-activities and if conditions are given for certain behavior. Each type of word is marked or colored as follows:

- Bold text: activities.
- Yellow marked text: words indicating order.
- Red text: words indicating frequency.
- Blue marked text: activities said or suggested to consist of sub-activities.
- Green marked text: sentences containing a condition.
- Indentation of lines: these lines contain sub-activities.

Unmarked text is information that is not relevant for the way in which the routine is described. An example is if the person explains why she uses makeup from a certain brand.

Next, all marked (groups of) words, except for the activities, are written down in a list. If (groups of) words were the same (for example ‘and then’), then all the repetitions were brought back to one mention in the list, with the number of times these words were seen. Next, the

words were analyzed to see if any sub-categories could be found. For the words indicating order, it was analyzed which types of order people use. It has been tried to look at this objectively, without any prior categories in mind. However, being very familiar with process models and the constructs used, it is impossible not to get influenced by these ideas and not to interpret texts at least a bit through a process model view. The general process of finding sub-categories was placing (groups of) words, using similar expressions or with similar meaning, close to each other, which automatically created different groups. These groups could then be further analyzed and split or, if they all had something in common, they were given a category name.

Analyzing the video texts is the first part of the approach. The next part focuses on the activities in the videos. A video is played without sound and notes are made of everything the person does. This is then compared to the activities that the person mentions in the voice-over. In this way in can be checked if what the video shows is the same as what is said. Furthermore, some guesses are made for how these activities would be registered if sensors were placed in the house.

3.2 Video text analysis

This section presents the results of analyzing the video texts. All the (groups of) words as found in the texts in appendix A.1 have been written down separately and have then been categorized. Each sub-section below deals with one of the main types of words, indicating order, frequencies, sub-activities or conditions.

3.2.1 Words indicating order

Figure 3.3 contains an overview of all the (groups) of words used in the video texts to indicate order. Four main categories were found using the approach explained in section 3.1.3, namely words indicating sequence, parallelism, choice¹ and loop. Table 3.1 shows for the sub-categories how many words of this type have been seen in the video texts. The words in the sequence category are divided in sub-sub-categories.

	basic words	152
	going to/ahead	9
	moving on	5
	time to/for	17
sequence	before	2
	once something is done	35
	first/start	19
	total	239
parallelism		10
loop		3
choice		9
total		261

Table 3.1: Amount of words indicating order

¹No difference has been made between inclusive and exclusive choice at this point, since the context in which words are used can determine what type of choice it is. This context is analyzed later on.

Most words indicating order (see figure 3.3a) were of sequential nature (91%). Overall the routines were described as consisting of a lot of activities in sequence. The cases of parallelism, loops and choices were all mentioned as part of the overall sequence of the activities in the morning routine.

Sequence is more than half of the time indicated with short words such as ‘and’, ‘then’ and ‘and then’. The word ‘and’ in theory does not indicate sequence, but in practice it can often be interpreted as such, for example in “I always wake up and check my social medias.” (figure A.14) and “Then I grab my bag and I head out the door.” (figure A.5). In both cases ‘and’ seems short for ‘and then’. Except for these basic words, expressions such as ‘going ahead’, ‘moving on’ and ‘time to’ are also used. For ‘time to’, it should be mentioned that it does not refer to a specific time, but is just used as an expression. Interestingly, people sometimes also refer to the fact that they finished the previous activity, with sentences like ‘once [the activity] is done ...’. This mostly seems to occur when some extra information is given about the current activity, before the next one follows. Examples are “... and I brush my teeth. I don’t know what my toothbrush is. Colgate I think. Who knows, there’s a bunch of toothbrushes at the toothbrush store and I just buy toothbrushes when I need them. And then, once I’ve brushed my teeth, I go ahead and brush through my hair.” (figure A.30) and “And then of course I got to take Jasper out on a little walk so he’s being such a good boy about leash him up and walk him around the neighborhood. So after our walk I like to do a quick workout at home.” (figure A.26). Furthermore, when people start talking about their routine, they often indicate it by using ‘first’ or ‘starting’.

For a small number of activities is indicated that they occur in parallel, mostly expressed by ‘while’ (see figure 3.3b). More specifically, five out of the ten persons mentioned, one to three times, activities happening at the same time. Figure B.1 contains the context in which the words were used. Most of the time parallelism concerned something happening in the background, while the person was working on something else. Examples are listening to music in the background and getting ready (brushing teeth etc.) (figure A.5) and working on preparing part of a dish while another part is cooking in the background (figures A.8 and A.9). Eating breakfast and working on emails (figure A.10) most likely means having a bite of breakfast and then typing while chewing. So, it could be said that the person indeed is doing two things at the same time, just as for figure A.19 where a person dances and brushes her teeth at the same time (although it can be questioned if it really happens at the same time or each in turn). Finally, in two sentences (figures A.14 and A.16) two (or more) persons are involved and parallelism occurs because the other persons are working on something else than the vlogger is working on. Even though a person might not pay attention to both activities all the time, overall it can be said that activities are really occurring at the same time.

Only two persons explicitly mentioned repeating an activity, so a loop, indicated by ‘multiple times’ or ‘a few tries’ (see figure 3.3c). One person explained that at some days someone needs to be woken up multiple times before getting out of bed (figure A.16). The same person mentions trying several outfits before finding the right one (figure A.16). Another person mentions that a few tries are needed for getting out of the door with a puppy in the right way (figure A.22).

Choices are also not mentioned often. The only indication of choices was a few occurrences of the word ‘or’ in the video texts of three persons (note that ‘or’ might have been used more often, but then in a context which was not relevant). However, taking a closer look at the sentences in which ‘or’ occurred, and the context in which they were said, shows that most sentences do not really represent choices. Table 3.2 shows the sentences and an interpretation of what they could mean. In the first four sentences ‘or’ is more used to give examples of what the person could do, than to actually express a choice. The sentences do not seem to mention all the activities that are

<p>basic words and (66), now (4), then (13), and then (60), and now, and then also, but then, but I then, I also (2), followed with, next, and then next</p> <p>going to/ahead and then I'm going to go ahead and, so I just went ahead and, and then I go ahead and , but I just go ahead and, let's go ahead and, I'm gonna go ahead and, and then I'm going to go ahead and, and then I'll go ahead and, but I'm just gonna be</p> <p>moving on and then moving on, next I'm moving on to, I can't move on without, and then I'll move on to, and move on to</p> <p>time to/for so then it's time to, then it's time to, and then it's time to, time to, it's time for, now it's time for, so now it's time for, and then it is time to, time for, all that good stuff and then I obviously know it's time to, because now it's time for, and then it's time for, and then it's time to, time to, and now it's time to, but it's time to, now time for me</p> <p>before but before I leave I'm gonna, before I</p> <p>once something is done and now that I'm all done it is time for, and then once I've brushed my teeth I go ahead and, now after a hundred yawns later, so after, after that, now that my makup is done I'm going to, once I'm done washing my body and shaving and doing all the other stuff, then once all that stuff is done, once the makeup is done, after my outfit is picked out, after brushing it out, and after my hair is dry I move on to, once my hair is fully protected, once my onions are ready, once your tomatoes are placed go ahead and, and once it is out, after about eating breakfast, and after all that's done, and so after I'm done cooking my eggs I then, and then after I end up with that, after breakfast we're going to go, and once I'm done with that, once I'm done with my breakfast, and once I'm done with that it is time to find, and once the makeup is done, when I eventually, and then my tea is ready, two hours later, and then after I feed Rooster his breakfast it is time to, and then after I blend it all up, and then when I'm done it is time, so after our walk, and then afterwards, now it's been 15 minutes so it's time to, and by the time I finish making a cereal</p> <p>first/start first thing I do in the morning, so first I start, in the morning as soon as I get out of bed, begins with, now starting with, so first I start out with, you just start by, to start, I first, and I first start by, when I first make up in the morning, right when I wake up, first things first, when I wake up first, firstly, first thing I always do, got to start off, the first thing that I always like to do, so I'm starting with</p>

(a) Words indicating sequence

while something else is happening while (8), when, and

(b) Words indicating parallelism

a few tries it takes multiple times someday, and sometimes it takes a few tries, it still takes a few tries
--

(c) Words indicating a loop

choice or (10)

(d) Words indicating choice

Figure 3.3: Words in the videos texts indicating order

possible at that moment, because of words such as 'anything', 'like', 'normally' and 'whatever'. It seems like several activities can be chosen, such as working on emails and doing something

else at the computer, so in that way the sentences could be interpreted as an inclusive choice, but there are more options than mentioned. In the fifth and sixth sentence ‘or’ is closer to the meaning of ‘about’ or ‘around’. For instance, a person might take two or three Weet-Bix blocks (a sort of breakfast cereal), but also two and a half or some broken pieces. The only sentence in which there seems to be an actual exclusive choice is the last one. Most likely the options are that the person is woken up by the alarm or wakes up before the alarm (although it is not phrased in this way exactly). However, it is a choice in the sense that one or the other activity is performed, but not a conscious choice, since a person cannot consciously decide to wake up.

1. “then I’ll finish off any of my emails or anything I need to do on the computer” (figure A.23)	inclusive-choice(emails, ...)
2. “I normally have toast with like peanut butter or Vegemite but I felt like Weet-Bix” (figure A.4)	inclusive-choice(toast with peanut butter, toast with Vegemite, Weet-Bix, ...)
3. “I normally watch YouTube or I go on Netflix” (figure A.4)	inclusive-choice(watch YouTube, watch Netflix, ...)
4. “add some powdered sugar and syrup or honey or fruit or Nutella or whatever floats your boat” (figure A.26)	inclusive-choice(powdered sugar, syrup, honey, fruit, Nutella, ...)
5. “I have two Weet-Bix or three” (figure A.4)	exclusive-choice(1-5)
6. “wake up by myself around nine or nine-thirty” (figure A.25)	exclusive-choice(8:30h-10:00h)
7. “I set my alarm or wake up by myself” (figure A.25)	exclusive-choice(wake up by alarm, wake up by myself)

Table 3.2: Sentences of the videos with the word ‘or’

3.2.2 Words indicating frequency

In the morning routine videos, words were used that indicated frequency of activities. Even though the persons were describing a routine, these words expressed that the routine was not always performed in the same way. Figure 3.4 contains all words in the videos indicating frequencies. Several categories were found, using the approach explained in section 3.1.3. Table 3.3 shows the amount of words per sub-category (and sub-sub-category).

Many of the words (53%) indicate that activities are performed with some kind of regularity or that it is regular that they are performed sporadically or never. Examples of words used are ‘always’, ‘usually’, ‘sometimes’ and ‘never’. In most of these cases, persons mentioned or suggested that particular activities were (almost) always done, for example for brushing teeth and having breakfast. It is not clearly mentioned in all texts that something always happens, but it is suggested by the way the activities are mentioned and because a routine is being described. Some examples of sentences of the videos can be found in figure B.2. Other activities were said to be only sometimes performed, such as editing videos (figure A.18) or leaving for a meeting (figure A.23), or never, such as making the bed (figure A.4).

Furthermore, the same activities can also be performed in different ways, for example the type of breakfast or outfit can be different each day. The way in which the activity is performed can thus stay stable for a while, but change relatively often (10%), indicated by words such as ‘lately’, ‘my current favorite’ and ‘for the past few weeks’. It is also possible that some actions

are performed differently each day (28%). Breakfast can depend on ‘whatever’ a person ‘feels like’ having ‘today’. Figure B.3 contains some example sentences of this type.

Lastly, there are a few mentions of specific times or periods and duration (9%), such as at what time someone gets up, how long something needs to cook or the season of the year. Some of these can also be interpreted as condition, which is discussed in section 3.2.4. Duration says something about how frequent an observation can occur within a routine (if the activity is observed multiple times by the sensors).

regular	always	30	
	often	19	
	sometimes	6	
	specific frequency	1	
	never/hardly ever	6	
	total		62
some period	lately	7	
	just started	2	
	change once in a while	3	
	total		12
changes often	whatever	18	
	today	15	
	total		33
specific time (period)			10
	total		117

Table 3.3: Amount of words indicating frequency

3.2.3 Activities consisting of several sub-activities

Activities can consist of multiple sub-activities, for example an activity such as cooking dinner consists of a lot of different steps. In total 47 activities were broken down in smaller steps, across all videos. Common activities with sub-activities were preparing/eating breakfast, applying makeup and going over different types of social media. Figure B.4 contains an overview of all activities in the videos for which sub-activities were mentioned.

In most cases, there were only two levels of activities mentioned, so a main activity with some sub-activities. An example is taking a shower, which consisted of using shampoo, using conditioner, body washing and shaving (figure A.6). Another example is heading out the door, which consisted of grabbing an apple, grabbing keys, putting on a blazer, putting on a jacket and putting on a scarf (figure A.20). Most often the details immediately followed after mentioning the overall activity. In some cases there was some (non-activity) context information in between mentioning the overall activity and the details. There was also a case in which four main activities were mentioned in order (‘washing hair’, ‘makeup’, ‘making breakfast’, ‘eating’), after they were each discussed separately (figure A.25). However, the person later also mentioned performing other activities in between those four activities. The reference to those four activities upfront was mostly about explaining that the person liked to shower first such that her hair could dry while performing the rest of the morning routine.

Only three times, three levels of activities were mentioned. In figure A.8 a person starts explaining

always every single day, always (12), daily, almost every single day, one page a day, well not always, wear them all the time way too much actually, I can use it more regularly on daily basis, always like to do, every single day, everyday morning basic, do every single morning or when I'm going somewhere, can't move on without, I have to (4), of course, of course I got to

usually usually (12), normally (5), usually not, typically

sometimes somedays, sometimes (4), or sometimes I also

specific frequency 3 to 4 mornings out of the week

never/hardly ever never (3), it's very rare for me, just for this video, only lit this because I was filming

(a) Words indicating that activities (do not) occur regularly in general

lately recently, lately, I've been using, my current favorite, my latest go to, recently I've been into, for the past few weeks

just started first time, I just got my new bedding

change once in a while sometimes I'll change it up, like every two week or three weeks I go in and out of coffee and tea, routines changes like every month

(b) Words indicating that activities occur regularly for some period

whatever whatever I'm doing that day, whatever (5), I felt like, whatever I feel like, or something like that (2), everything like that, I just felt like that, or whatever floats your boat, I had scrambled eggs, but other days, I like to, didn't want you to think that every morning I wake up and make myself a frittata a lot of times also I'll just walk youtube and eat something super easy, other really awesome breakfasts that I like to make

today yesterday, today, for today, today's, for the day, on this day, this morning I decided, on this day in particular, this morning, for that day, so this morning, this particular day (2), on this particular day, right now at the moment

(c) Words indicating that actions change every day/often

specific time/period in the morning (4), for the spring time, it's normally like twelve o'clock now, around 1030am, for about 20 to 25 minutes, 15 minutes, 2 hours

(d) Words indicating that activities occur at or least a specific time (period)

Figure 3.4: Words in the video texts indicating frequency

how to make a certain dish with certain steps and then in figure A.9 adds a level by explaining how to make a certain part of the dish. In figure A.11 a person 'goes on her phone', and then 'goes through social media' and 'looks at her app', where going of social media consists of 'checking Instagram' and 'checking Twitter'. In figure A.22 a person 'feeds herself breakfast', where she tells that she makes breakfast, and the steps of doing that, and, though not specifically mentioned, she eats breakfast.

No specific words are used to indicate that people are discussing steps of a main activity. Marking an activity as an activity with sub-steps is mostly based on interpretation of the text and context. This can mean that people are not specifically aware of that they are explaining sub-steps.

3.2.4 Sentences containing a condition

For some activities was mentioned that it depended on the context whether they were performed or not. However, it was only mentioned a few times (by five out of ten people, between one and tree times). Figure B.5 contains an overview of all sentences in the videos that expressed a condition. Most mentioned influence for certain activities in the routine was whether the person was working, filming and/or leaving the house (figures A.3, A.5, A.8, A.21 and A.23). These are all conditions that have to do with an activity. However, also the weather was mentioned as a condition (beautiful weather meant laying down next to the pool) (figure A.15) and feeling hungry (this meant making some special breakfast) (figure A.8). The weather is something external to the person and not measured with sensors in a house. A feeling is something that can't be measured with sensors at all. Words used to indicate the dependencies are, among others, 'if', 'because', 'when' and 'depending'.

Except for the sentences in figure B.5, some of the frequency indications in figure 3.4d could also be seen as conditions. For example, 'in the morning', can be interpreted as 'each morning', which represents a frequency, however, it can also be interpreted as 'if it is morning', which makes it a condition. The titles of the videos (see table B.1) also contain these kinds of conditions. There are winter and spring routines and before school and weekend routines. This suggests people have different routines depending on the season or type of day. In the same way, 'around 1030 am', in figure 3.4d, can be interpreted as 'each time it is around 1030 am' (frequency) or 'if it is around 1030 am' (time related condition). A sentence identified as containing a choice by use of the word 'or' (see figure 3.2) can also be interpreted as condition. Waking up 'around nine or nine-thirty' is a time related condition for waking up.

3.3 Video footage analysis

Table B.2 contains a comparison of what was said in the 'Winter Morning Routine' video and what could be seen in the video. Furthermore, the table contains a column with a guess of sensor observations that could have been made if the house contained sensors. There is no special reason for taking this video, it was just the first in the list.

A first observation is that understanding the details of what happened will be quite hard using sensors. For example, the details of waking up, stretching, looking at the time on a phone, laying down again, getting out of bed and tidying the bed will most likely not be picked up by sensors. A movement sensor in the bedroom would only see whether there is movement or not. Another example is that, when the person is in the bathroom, the voice-over explains all the steps of how makeup is applied. However, sensors would only be able to observe that someone enters the bathroom, switches on the light, switches off the light and leaves the bathroom. Depending on the sensitivity of the sensors they might or might not observe some movements made while applying the makeup. Sensors thus indicate that something happened at a certain location, but what happened exactly cannot be determined by the sensors.

One the other hand, the video also shows activities that are not mentioned, but could be observed by sensors. For example, it is not mentioned that the person walks from one room to the other. These movements are also partly cut from the video itself. Furthermore, the person mentions making coffee and adding creamer, but the video shows several steps involved, such as opening the fridge and using the coffee machine, which would also be observed by the sensors, but which

are not specifically mentioned. Moving to a different room or getting creamer from the fridge might be considered uninteresting or trivial.

Another example of activities that happen in the video but are not mentioned occurs when the person is preparing to head out the door. The person gets up from the couch and says she is going “ahead and head out now”. Then she shows and says that she puts on her shoes. Next she indirectly says that she blows out the candle by mentioning that she tries not to burn the apartment down. However, before that she suddenly has a backpack on her back, which she didn’t show or mention getting. Then she gets some keys from a hanger next to the door, before she actually leaves the house. Getting her keys is not mentioned and in fact looks like an automatic action, so she might not even have realized that she does it. She also does not mention that she really leaves the house at this moment. Perhaps this is because she was already talking about leaving the house and the steps involved, and that this last step, actually leaving the house is considered trivial.

3.4 Summary

Remember that the first research question of this thesis is *How should common behavior be textually described to a general audience?* and contains sub-questions about *information* and *presentation*. This chapter tried to get answers to these questions by analyzing people’s own descriptions of their routines. Below a summary is given of all the observations and findings of sections 3.2 and 3.3, grouped according to whether they say something about the information or presentation of the routine description.

These are findings related to what type of information people in general expect in a description of common behavior:

- Four main categories of words indicating order were found: sequence, parallelism (activities happening at the same time), loop (repetition of an activity) and choice (inclusive and exclusive, although not very clearly). Sequential words were used most often. Words indicating parallelism, loops and choices were only mentioned in some of the videos. This suggests that people mostly expect patterns of activities in sequence.
- There were words that indicated the frequency in which activities were included in the routine. In most cases things were said to be always or often included and in some cases sometimes or never. There were also activities that were performed in different ways each day or changed every once in a while, such as what breakfast a person had.
- Sometimes activities were said to consist of sub-activities. Often two levels were mentioned, but a few times the sub-activities were said to consist of smaller steps themselves again, providing three levels of activities.
- Sometimes conditions were mentioned for performing an activity. This could be the performance of another activity, but could also for example be related to the weather, a feeling, the season, the time, or the type of day.
- Sensors will not be able to (exactly) observe many of the activities that are discussed in the videos. For example, a motion sensor in the bedroom registers when a person moves around in that room, but cannot register what a person is actually doing, for example making the bed or changing clothes.

- People do not discuss everything they do during the routine. Reason might be that they are not aware of that they do something, that they consider it too trivial to mention, that it was already mentioned indirectly, or that they don't think it is important.

These are findings related to what type of textual presentation of common behavior is suitable for people in general:

- Overall the routines were described as activities following each other in sequence. The cases of parallelism, loops and choices were all part of the overall sequence of the activities in the morning routine.
- The most frequent words indicating order were 'and', 'and then' and 'then'. Sometimes an expression referring back to the previous activity was used ('once [the activity] is done'), mostly in cases where some extra information was given in between two activities. At the beginning of the routine 'first' or 'starting' were often used.
- Parallelism was mostly indicated using 'while'.
- Loops were indicated by 'multiple times' and 'a few tries'.
- Choice (both inclusive and exclusive) was indicated by 'or'.
- Examples of words used to indicate frequency were:
 - 'always', 'usually', 'sometimes' and 'never', suggesting these activities (do not) occur regularly in general.
 - 'recently' and 'for the past few weeks', suggesting that (the way of performing) an activity changes once in a while.
 - 'whatever', 'feel like' and 'today', suggesting that (the way of performing) an activity can change from day to day.
- If an activity was said to contain sub-activities, the steps were mostly discussed immediately after mentioning the main activity, without any special words to indicate that these were sub-activities.
- Words indicating conditions were for example 'if', 'because', 'when' and 'depending'.

3.5 Limitations

Analyzing videos in which vloggers describe their morning routine gives in no way a full answer to the question of how common behavior should be described to a general audience. First of all, there is not one answer to this question. Improving the text in one way might mean compromising the readability of the text in another way. Furthermore, there are always differences between people, thus what might be good for some persons might not work for other persons. Moreover, determining what is 'the best' is in general not possible for this kind of topics, because it is not an exact topic. Aside from these issues, there are some clear limitations to using the videos in this analysis.

First of all, how people communicate about routines themselves might not be the way in which routines should be communicated to them. There might be another way that they did not think about, but find clearer. Also, in the videos, the vloggers communicate to others, but perhaps if they would write a description for themselves they might do it differently. It is assumed that

the descriptions in these videos are at least understandable for the audience (supported by the amount of views of the videos).

Second, these videos present only one way of communicating about routines. They use footage of their actions and a voice-over to tell what happens. The fact that they record their descriptions for a voice-over might have influence on the way people speak. Other types of videos are possible, for example with people speaking at the moment of performing the activity, or perhaps without footage of the activities, just someone talking about the routine. Outside of videos or speaking, written communication is of course also possible, which might be different again. The goal of this thesis is also to make text, thus in that sense, spoken word might not be completely representative of what the text should be like.² Furthermore, a selection of 10 videos is quite small and might not be representative for all the videos of this type. In general, a selection of habit descriptions by people themselves does not necessarily contain all possible ways in which such descriptions could be and are made.

Third, the videos are all from young women, which descriptions do not necessarily represent how other groups of people would describe their habits. Men or older people might use different words and structures.

Furthermore, people might not have a complete overview of their routine. It might be that people are not aware of, or paying attention to, underlying structures of routines. For example, they might be performing two activities at the same time, but not notice, and thus communicate, it as such. The routine might be less sequential than presented. People might sometimes mix up the order of (small) activities and might for instance not notice certain choices they make and not be aware of all variations in their routine. Parallelism, choices, loops and conditions might occur more frequently in the routines than people mention or show in the video.

The analysis method used for the video texts also has its limitations. Everything is marked and counted by hand, since it was necessary to interpret the text to get the proper markings. Automatic counts would for example not have made a difference between ‘and’ in an ordering context or ‘and’ used in different ways³. Automatic word count methods are most likely also not (fully) able to see which words form an expression together. However, working by hand and trusting on interpretation to mark words in the right way means that mistakes have most likely been made. Care has been taken to mark all relevant words and to place them in the right category, but some things could have been overlooked. Also, text and natural language in general is sometimes ambiguous, so might have been interpreted differently from how the vlogger meant it.

Finally, the video footage analysis was very limited. Only one video has been analyzed, because of time restraints. Even though the intuition is that the same conclusions could be drawn for the other videos as well (because all videos have been viewed at least once at some point), this has not been checked. Furthermore, the way in which sensors would have observed the behavior could only be estimated, because this information was not available.

²On the other hand, if the descriptions should ever have to be converted to spoken word, this should cause less of a problem.

³For example, in the text of figure 3.1 there is a part where the person gives some extra information about making her bed (“I just got my new bedding. I got it in and I just moved into my new apartment, so I wanted to show you guys [me] making my bed”). This part was considered not to be part of the routine, and ‘and’ is also not really used to indicate order, so the ‘and’ has not been counted as word indicating order.

Chapter 4

Comparison

This chapter compares how people describe routines themselves with how activities are observed by sensors and interpreted and presented by the LPM algorithm. The first section discusses differences between how humans and sensors observe activities. Next, the ordering relations in the routine descriptions and used by the LPM algorithm are discussed. In section three, the general structure of a routine is compared with LPMs and section four discusses information that is included in people’s videos but not in the LPMs. Section five discusses the presentation of the patterns and the last section provides a summary of the chapter.

4.1 Sensors and hierarchy of activities

In the analyzed videos, activities are observed and described by humans, while this thesis is about automatically creating descriptions using a sensor log and the LPM algorithm. In chapter 3 was concluded that sensors observe different activities than people mention. For example, sensors are able to observe movement in the bedroom but not a specific activity such as making the bed. On the other hand sensors register activities that people might consider uninteresting, such as the exact steps of making coffee. This difference between sensors and humans is actually a problem of hierarchy. Activities can be expressed at many levels, even down to the level of moving arms or legs, and sensors do not necessarily observe activities at the level that people find relevant.

Determining “right” level of hierarchy, what activities are interesting or informative, is not really possible, since what is “right” differs per situation and person. Furthermore, sensors might simply not be able to recognize some (levels of) activities. However, it is clear that current sensor observations do not match the activities discussed by people, thus that there is room for improvement. Section 6.1.1 discusses this topic further.

4.2 Ordering constructs

Four main types of order relations between activities were found in the routines: sequence, parallelism, loop and choice. This is equal to the operators the LPM miner uses for making process trees. Sequence means, both in process trees as in the routines, that one activity is

followed by the other, and can easily be recognized in the sensor logs. The other three constructs are discussed below.

4.2.1 Parallelism

At some places in the videos, people mentioned that activities were happening at the same time. However, sensors are only able to log what happens at one moment exactly. Although different sensors can observe something at the same time, most activities take longer than one moment and it is thus not automatically clear that activities occur at the same time. Suppose a person puts on the sound installation and listens to the music while putting on and working at the computer. Depending on the observations that are made, the LPM algorithm will find different patterns. If power usage of the sound installation and computer are only observed when they are put on, then, in the log, an observation of power usage by the sound installation will be followed by an observation of power usage by the computer. This will be recognized as sequential behavior where first the sound installation is used and then the computer. If power usage is observed multiple times, then the event-log will contain intertwined observations of sound installation and computer usage. Depending on the order in which observations occur, the LPM algorithm will interpret this as a concurrency pattern or a loop pattern.

Between finding a sequential, concurrency or loop pattern, the concurrency pattern fits the reality best. However, from a sentence expressing that the sound installation is used and then the computer, people are still able to deduce that they listened to music while working at the computer, because they know that both activities occur for a longer period of time. Also, a loop of using the sound installation and computer can still be interpreted as such, although this might be less intuitive. Overall, it should thus not have to be a problem to find and/or communicate patterns with parallelism.

4.2.2 Loop

Only two of ten persons explicitly mentioned repetition of activities in the videos. An example was trying on several outfits before finding the right one. However, in principle activities such as watching YouTube videos, preparing sandwiches, answering emails or brushing one's teeth could also be seen as repeating the same activity multiple times. On the other hand, trying several outfits can also be seen as one activity, namely the activity of getting dressed. Whether something is a loop thus depends on the level at which an activity is observed.

It can be said that the three cases of loops in the videos fit in the loop body and loop redo structure that is used in loops of process trees. In the case of one person waking another, the first activities of both persons (waking the person up and getting out of bed) should be considered as one activity and would be the loop body. The loop redo would be the person getting into bed again. In the other two cases 'getting dressed' and 'getting out of the door' would be the loop body, and 'getting undressed' and 'getting in the house' would be the loop redo. However, while the loop definition fits in these cases, it can also be imagined that only one activity is repeated, or that it is only observed as one activity. Putting on different outfits can also be seen as one activity. The loop redo would then be a silent activity. Looking at the LPMs found in chapter 5 shows that a newer version of the LPM algorithm (than presented in (Tax, Sidorova, et al., 2016b)) indeed allows for silent activities in loops.

4.2.3 Choice

The process trees made by the LPM algorithm use exclusive choice operators (Tax, Sidorova, et al., 2016b) and in a newer version, in ProM, also inclusive choice operators are available. In the videos it was not very clear if/when choices were described, but in the log it will probably still look like it. In some situations, persons gave some options (not all) of different things they would normally do at that moment. So, in terms of sensor observations it can most likely be seen as a set of activities (which is dynamic over time) of which each day one or some activities are observed in a random order. This would be recognized as an inclusive choice. In other sentences only one option was chosen, for example the amount of breakfast cereal bars (which might not be observed by the sensors, but it is just an example). In this case the log will contain one of the options each day, which would be recognized as an exclusive choice. So, it is best to let the LPM algorithm search for both inclusive and exclusive choices.

4.3 Structure of a routine

In chapter 3 was observed that the routines were mostly described as activities following each other in sequence. A few cases of parallelism, loops and choices were mentioned, but they were mentioned as part of the overall sequence. In process trees this can be represented by a tree with a sequence operator as root. The root then has a lot of children that are leaves, thus activity nodes, and a few children that are operator nodes with sub-children. A maximum of three levels of activities were mentioned in the video texts, which implies a tree of four levels or less (where the first level, the root, represents the routine).

LPMS are different in two ways. First, they do not represent a full, and mostly sequential, routine, but are small patterns consisting of a few activities (mostly a maximum of five), where also other operators than a sequence operator can be the root. However, the events in the human behavior sensor logs are so unstructured that it is not possible to discover good quality models of a full routine (section 2.3 explains this in more detail). The patterns can instead be seen as sub-trees that are part of a complete routine, which makes it appropriate that the root of a tree is allowed to be of any operator type. Furthermore, the fact that trees only contain a small amount of activities makes it unlikely that trees of more than four levels are found.

Second, in the videos, if activities were mentioned directly after each other, they were also performed directly after each other. In a model however, because of the way in which models are evaluated, the activities that follow each other directly in the model, do not necessarily follow each other directly in the log. If the model for example shows a sequence of A and B, it is possible that in the log all kinds of other activities that are not in the pattern, say C till Z, are observed in between A and B. People most likely do not expect this from the patterns. Chapter 5 discusses this further.

4.4 Extra information

The LPMS provide information about the order of activities and, by the outcomes of different quality metrics, about frequency of activities and patterns. However, in the descriptions of the morning routines was found that people provide more information than that. The next subsections discuss this.

4.4.1 Hierarchy

It was noticed that people use hierarchy when describing their routines. They start with saying that they do some activity and then explain how they actually do that activity with some steps. An example is a person taking a shower, which consists of, in sequence, using shampoo, using conditioner, washing their body and shaving (figure A.6). Figure 4.1 shows that the hierarchy relation between the activities can be expressed in a tree, where taking a shower is the parent, and the sub-activities are the children. There are some problems with this picture however. First of all, the ordering of the children is not indicated. Secondly, this tree would not be allowed to be a process tree, because in a process tree only leaf nodes are allowed to be activities. This fact also means that the LPM algorithm does not look for (thus does not find) hierarchy in activities (assuming the information is present in the log). Section 6.1.2 discusses this further.

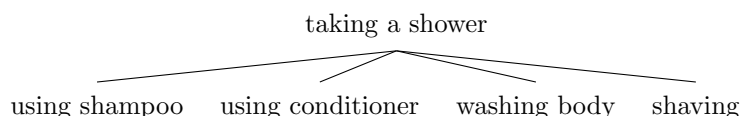


Figure 4.1: Example of an activity with sub-activities in tree format

4.4.2 Frequencies

In the videos words were used that indicated that the routine was not the same every day. People had a main routine that they always followed, but there also was some variation. These differences in frequency should be included in the descriptions of common behavior.

The LPM algorithm calculates how often patterns and activities occur, because this is part of evaluating potential patterns. A problem for including the frequency information in the text is the fact that these are numbers, while people use words. Moreover, the words used are qualitative indications, such as ‘often’, and not quantitative, such as ‘once a week’. Translating numbers to qualitative words is not straightforward. Numbers express a precise amount, while qualitative words only provide an indication. Furthermore, for the number that are available it is not known whether they mean that something occurs (relatively) often or rarely. It can for example depend on the type of activity. More about this topic can be found in section 6.2.

Mostly, people spoke about things that they (almost) always did. The LPM algorithm finds exactly this behavior, because the goal of the algorithm is to find frequent patterns. However, people also mentioned things they only did once in a while. These activities might not turn up in the patterns, because they are too infrequent, while they can still be considered relevant by the person. People also mentioned that they performed the same activity in a different way. If there is really a lot of variation in what the sensors observe, then they might not recognize it as the same activity, and not even as a choice. More about infrequent, but relevant, behavior can be found in section 6.3.

4.4.3 Conditions

Some activities were said to only be performed in a certain context, such as performance of other activities, a certain type or time of day, certain kind of weather, a certain season or

having a particular mood. The LPM algorithm finds ordering relations between activities, thus conditions related to activities can be found. However, the LPM algorithm does not take into account information about time or other information, such as the values of the observations. Therefore, activity related conditions are the only ones the LPM algorithm finds. This topic is discussed further in section 6.3.

4.5 Models and text

The LPM algorithm provides Petri nets as output and works with process trees in the background. Most people are not used to reading such models and might feel intimidated if they would have to read them, especially bigger and more complicated models. Even if they would be able to quickly learn how to read these models, it is not realistic to assume that people (in general) would like to learn this.

People in the videos used (spoken) natural language and (natural language) text is the required output for this thesis, thus the models have to be translated to text. The findings as summarized in section 3.4 about the words in the videos and the structure of the text, can be used for developing a text creation method. Chapter 7 discusses how text can be created.

4.6 Summary and limitations

This chapter compared how people describe routines themselves with how activities are observed by sensors and interpreted and presented by the LPM algorithm. This provides answers to the second research question of this thesis about differences between how common behavior should be described to a general audience and how the LPM algorithm, using sensor logs, describes common behavior.

The following has been discussed in this chapter about differences in type of information:

- Sensors sometimes observe activities at a different level of hierarchy than humans do.
- The morning routines contain the same ordering constructs as the LPM algorithm, and in general it is possible to recognize these relations in sensor logs.
- The patterns the LPM algorithm finds can be seen as part of a bigger routine and thus have a suitable structure. However, what people most likely do not expect from the patterns, is that, in between activities of a pattern, other activities, that are not in the pattern, are allowed to occur.
- The LPM algorithm is not able to find or represent hierarchy of activities, while people do express this.
- The LPM algorithm provides frequency information, but in numbers, which provide a different type of information than the qualitative words used by people. Infrequent activities can still be considered relevant by people, but are less likely to turn up in the in the patterns.
- The LPM algorithm is able to find conditions of activities, but not other types of conditions that people sometimes mentioned.

In terms of differences in presentation, the LPM algorithm presents the patterns in models, while people in the videos use (spoken) natural language. Furthermore, a requirement for this thesis is to have descriptions of common behavior in (natural language) text, thus the models have to be translated to text.

At this point, people's and LPMs' descriptions of common behavior have only been compared based on the analysis results of chapter 3. For future work, more differences could be found and described, for example by comparing LPMs with people's descriptions of another source.

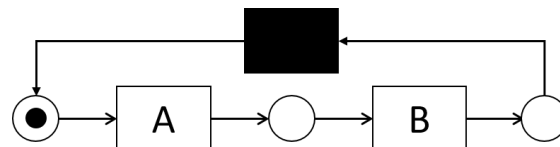
Chapter 5

Constraint-based LPMs

In chapter 4 (section 4.3) was discussed that, in the videos, activities that are mentioned closely to each other, are also performed closely to each other, while in the models, because of the model evaluation method, this is not necessarily the case. The first section of this chapter explains the evaluation method in more detail and discusses disadvantages of this method. The next two sections discuss the approach and results of a test that has been performed with placing constraints on the number of non-pattern activities that is allowed to occur in between activities of the pattern. The last two sections provide a summary and explain limitations of the test.

5.1 Problem

Part of evaluating the models involves counting for each model how often the behavior of that model is seen in the log. This is done using alignments made for the model, with traces from which all non-model activities have been removed. Figure 5.1 contains a small example. The model that needs to be evaluated is a sequence of A and B. Suppose the trace in the event-log is [A, C, D, E, F, G, B]. The trace, without activities that are not in the model, is then [A, B]. Both A and B can be executed in the model in this order, so it results in an alignment of two synchronous moves (and performance of the back loop to get the token back to the place where it started). The same alignment would be made for the trace [A, B] in the event-log. This example thus shows that the model is equally supported by a trace in the log in which A and B follow each other directly, as by a trace in the log where other activities occur between A and B.



Trace in event-log: [A, C, D, E, F, G, B]

Alignment: $\frac{trace}{model} \parallel \begin{array}{|c|c|} \hline A & B \\ \hline A & B \\ \hline \end{array} \parallel \begin{array}{|c|} \hline >> \\ \hline \tau \\ \hline \end{array}$

Figure 5.1: Model with alignment

The fact that activities seem to directly follow each other in the model, but do not necessarily follow each other directly in real life, is most likely quite confusing for a general audience. The routine descriptions analyzed in chapter 3 suggested that people expect that discussed activities follow each other directly and do not consider (or at least do not mention) long-term dependencies. The discovered patterns are thus likely to be interpreted incorrectly.

It is certainly possible that there are some long-term dependencies between the activities that people perform. These can be very interesting, especially because people might be less aware of relations between activities that are not performed directly after each other. An example of a possible long-term dependency is switching on the lights when entering a room and switching them off when the activities for that room are performed. Another possible scenario is that if a person did not eat much in the morning, they might be more likely to take a snack later on the day. On the other hand, not all relations that are found between activities might be meaningful. In fact, by allowing other activities in between activities that are part of the pattern, all activities in a trace can in some way be related to each other in a model. Activities that happen often will automatically provide much support for models, while they might be completely unrelated to each other in real life. The effect of the model evaluation method not taking non-model activities into account, is that models that are supported by “weak” (long-term) but many relations between activities are valued higher than models that are supported by less but “strong(er)” (short-term) relations between activities.

Not all patterns that can be found in the data are thus interesting for users. Pei, Han, and Wang also mention this. They say that while there can be many sequential patterns in a database, often only a subset of patterns is relevant for users, and that is best, both for presenting the results as for computation time, to focus on this subset while looking for the patterns. This focus can be obtained by implementing constraints in the search algorithm. For example, a constraint could be placed on the time that is allowed to or should be in between the first and last event of a pattern or in between each event of a pattern. (Pei et al., 2007)

The notion of constraints can be used to discover models in which activities of a pattern are not interrupted by other activities. If constraints are placed on the number of non-model activities that is allowed to occur in between activities of the model, it is possible to control whether patterns are only supported by activities following each other directly or also by activities that follow each other in the long term. The hypothesis is that by constraining the number of non-model activities, the patterns that are found are more interesting.

5.2 Approach

A small test has been conducted to test the influence of placing constraints on the number of activities in a trace, in the log, that are not in the pattern. Some code has been written to enforce the constraint and this code has been tested on a real log from a smarthome.

5.2.1 Data

The log used for testing is from one of the smarthomes in the Philips smarthome dataset. It was a 1-person household and the data was collected over 15 days. The original log-file has been edited a bit to limit the running time of the algorithm (to about 3 to 5 hours, compared to not finishing in more than 24 hours). All repeating observations have been deleted, so when

for example living room motion had been seen twice after each other, it was brought back in the log to only one occurrence (the first one). This significantly decreased the running time of the algorithm, while still maintaining the order of activities as they were. To limit running time further, traces of one day have been made, even though cutting human behavior into traces is not ideal (because behavior does not have a clear start and end point). Observations from sensors that measured periodically and thus did not represent an activity have been removed, as well as sensors for which was indicated that they were not used (they occurred only a few times, most likely for testing). An overview of the sensors in the eventual log and the amount of observations they made can be found in the appendix in figure C.1.

5.2.2 Pattern evaluation algorithm

The evaluation method of the models is part of discovering the models, because only models of a certain quality are extended or given as output. Therefore, the evaluation method is adapted to include a test if the constraint holds for the model. In short, the adapted evaluation method works as follows: For each event in the original trace is checked whether the activity it represents is present in the model or not. If it is not in the model, but the model is being executed (a synchronous move has been made since the last backloop), then costs are charged. In case the activity of an event is in the model and the event is a synchronous move according to the alignment, then the activity is counted locally. In the activity is in the model, but the event is a log move and the model is being executed, costs are charged. Each time when the model execution is finished (when a backloop is reached or at the end of the trace) and the costs made at some point were not too high, the activities and pattern are counted. The amount of costs is reset after each synchronous move, but a flag is raised if the costs were too high. Note that in this way the algorithm checks that the number of non-synchronous activities in between two synchronous activities is not too high, but that it does not keep track of the overall number of activities that do not fit in the pattern. Pseudo-code and a more detailed explanation of the adapted model evaluation algorithm can be found in appendix C.2.

5.2.3 Test settings

The LPM algorithm has been run twice for the log described above, once without any constraints on non-model activities and once allowing no non-model activities in between. In the second case, events thus had to follow each other in the log exactly as in the model, otherwise they were not counted as supporting the model. Other settings were: maximum number of transitions in LPMS: 4; number of LPMS to discover: 50; do not allow duplicate transitions; operators: sequence, concurrency, inclusive choice, exclusive choice, loop; minimum number of occurrences in log: 1; minimum determinism: 0.5; projections: none. Different from the standard settings is finding 50 instead of 100 models, including the inclusive choice operator and putting the minimum number of occurrences at 1 instead of 15. This last change has been made because the dataset is not that big and patterns might not be very frequent.

It is likely that the models with the highest overall score are presented to the users of a smarthome, although other criteria such as frequency of a pattern are also possible. Below, the five models with the highest overall weighted score, discovered with and without constraints, are compared on their scores per quality metric, structure and type of activities. Furthermore, the models found without constraints are evaluated using constraints. In this way it can be seen if they are still strongly supported if no non-model activities are allowed in between.

5.3 Results

Figures 5.2 and 5.3 contain the five models with the highest overall weighted score discovered *without* constraints. Figures 5.4 and 5.5 contain the five models with the highest overall weighted score discovered *with* constraints. The transitions contain the label of the sensor (with sensor ID) and the confidence information (how often the activity fitted in the pattern/how often the activity occurred in the log). The next three sub-sections discuss the differences between the models. The fourth sub-section discusses the scores of the models mined without constraints when they are evaluated with constraints.

5.3.1 Structure of the models

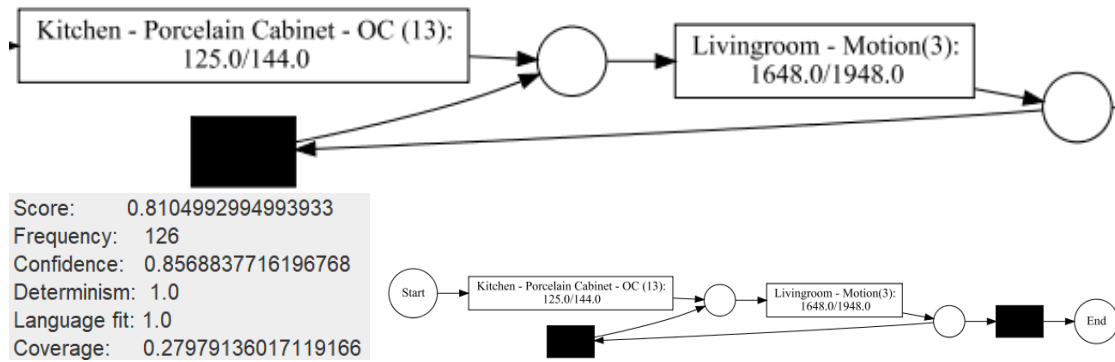
The first thing that can be noticed when comparing the non-constrained and constrained models is the difference in structure. The five best models that were mined without constraints all have the structure of one activity followed by another activity that is possibly repeated. From the 50 models mined without constraints, 37 had this structure (sequence and a loop, of which five models had the loop first). The 13 other models all had one activity in sequence with a choice between two activities of which one could be executed multiple times (sequence and choice with loop, of which three models had the choice with loop first, see figure 5.6 for an example). On the other hand, the five best models mined with constraints all consist of two activities in sequence. Also models with structures such as in figures 5.2a and 5.6 were found (39 in total), including loops thus, however, the confidence numbers showed that no real loops were found. The activity in the loop (possibly in combination with the activity that could be chosen instead of the loop) occurred as often as the activity that was in sequence with the loop (and other possible activity) (see figure 5.7 for an example).

When only looking at the models, at first sight it seems that the models mined without constraints give more information than the one's mined with constraints. A structure with a loop, such as 'A followed by one or more times B' covers more behavior than 'A followed by B'. However, because of the way the models were evaluated, 'A followed by one or more times B' actually means 'A followed by other activities of which at least one is B', while in the model mined with constraints 'A followed by B' means exactly 'A directly followed by B'. A model of 'A directly followed by B' is more specific about the behavior that is allowed than 'A followed by other activities of which at least one is B', and the models mined with constraints are in that way thus more informative.

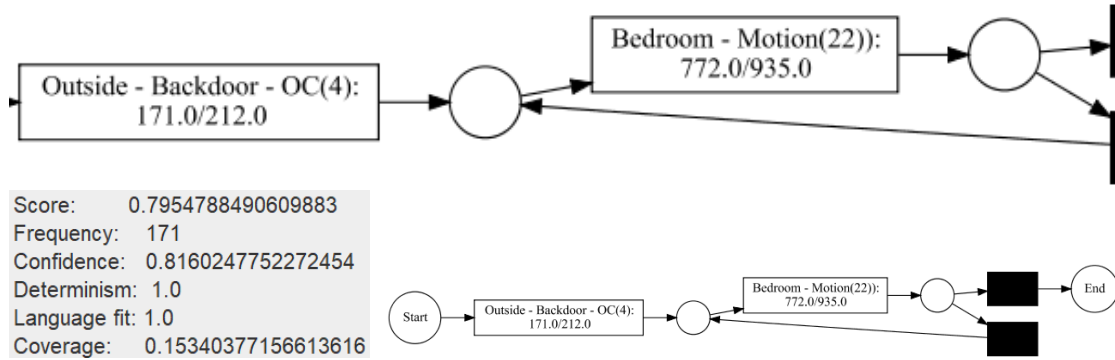
5.3.2 Score of the models

A second big difference is the overall (weighted) score of the models. The five best models that were mined without constraints have overall scores between 0.77 and 0.82. The five best models that were mined with constraints have lower overall scores, between 0.58 and 0.62. This is mostly influenced by the confidence levels, that are around 0.8 for models mined without constraints and lower than 0.2 for all the models mined with constraints. Indeed, for the non-constrained models a higher percentage of observations of that activity type in the log fits in the model. For example for the first non-constrained model the numbers are 125/144 (87%) and 1648/1948 (85%), while for the first constrained model the numbers are 111/212 (52%) and 111/935 (12%).

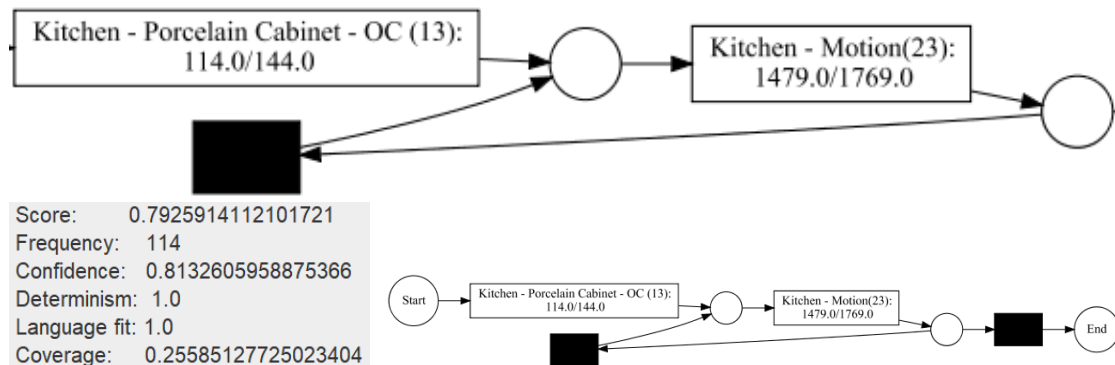
However, as explained in section 5.3.1, the models mined with constraints, are more specific in the behavior that they describe (there are more restrictions on the behavior that supports the



(a) LPM non-constrained model 1



(b) LPM non-constrained model 2



(c) LPM non-constrained model 3

Figure 5.2: LPM non-constrained models 1-3

model). It thus makes sense that less observations of activities fit with the models. So, while the confidence is lower, the pattern is more specific, thus also more informative in that way.

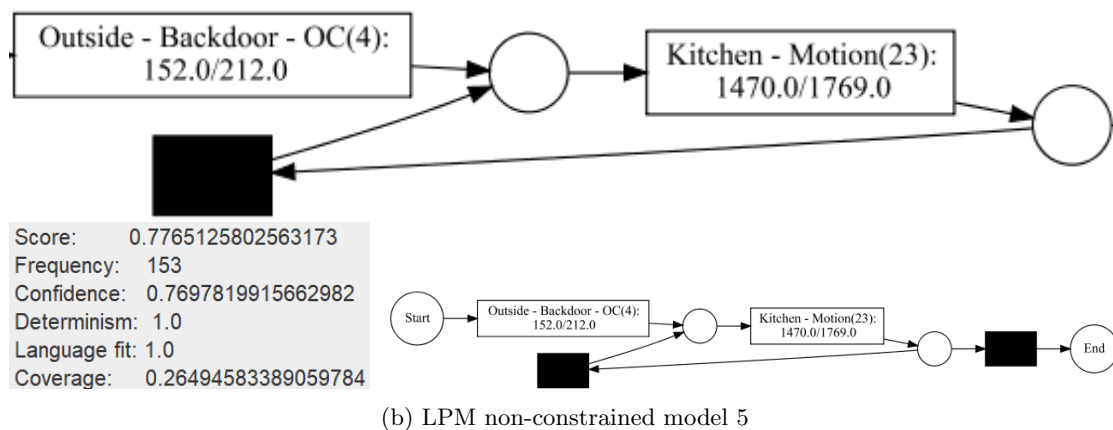
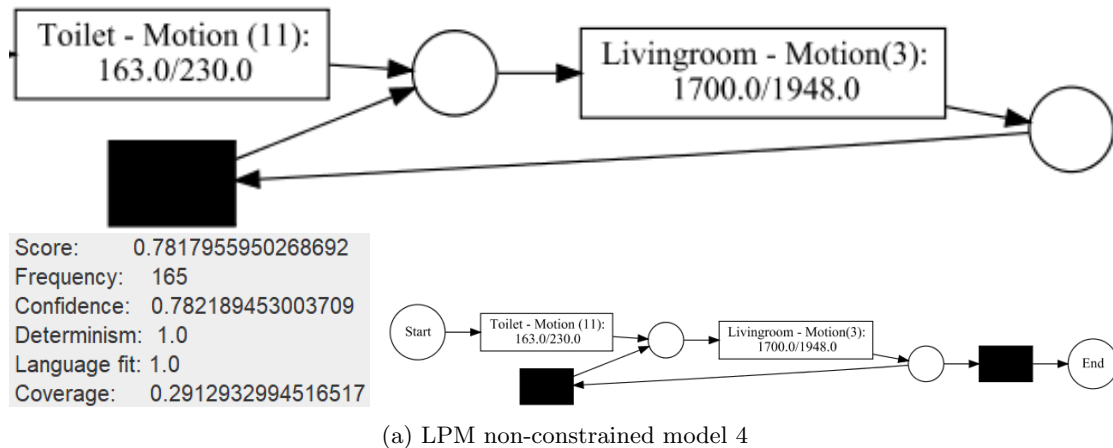


Figure 5.3: LPM non-constrained models 4-5

5.3.3 Type of activities in the models

The models mined without constraints give information about six different sensors, of which two sensors are twice the first in a model (opening/closing the kitchen porcelain cabinet and outside back door) and two sensors are twice last in a model (living room and kitchen motion). The models provide thus information about a very selective set of behavior. On the other hand, the models mined with constraints give information about nine different sensors (only the outside back door is repeated, once as first activity, once as second) and provide thus information about a wider set of behavior.

Furthermore, the pairs of sensors in the models mined with constraints are more related to each other when looking at the floor plan of the house (see figure C.2). Indeed, the back door gives entrance to the bedroom, the bathroom is next to the cubicle room and the kitchen is next to the living room. It also makes sense that proximity to the house is followed by opening the backdoor. For the motion in the toilet room followed by changes in power usage of the TV in the bedroom, it is possible that the person moved from one room to the other without triggering any of the motion sensors in between. The models without constraints relate the kitchen porcelain cabinet to the kitchen, as well as the living room. The model with the living room is even more

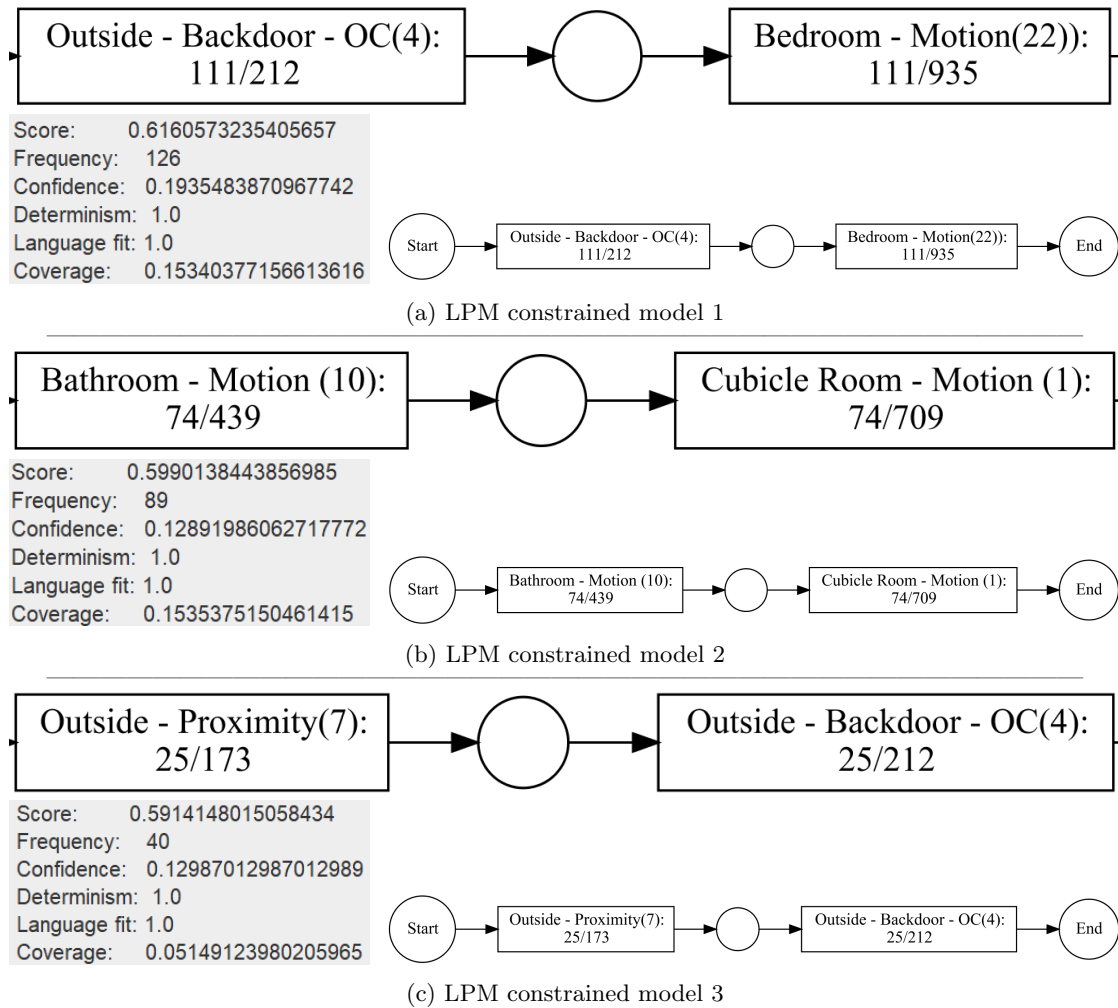


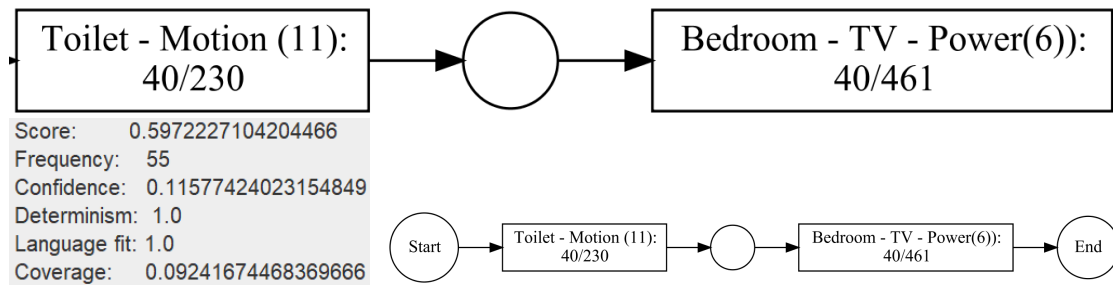
Figure 5.4: LPM constrained models 1-3

supported than the model with the kitchen, while the living room is further away, though, it is possible that this is caused by the kitchen motion sensor not observing that a person walks by. In the same way, the back door is related to the bedroom as well as the kitchen, while the kitchen is further away.

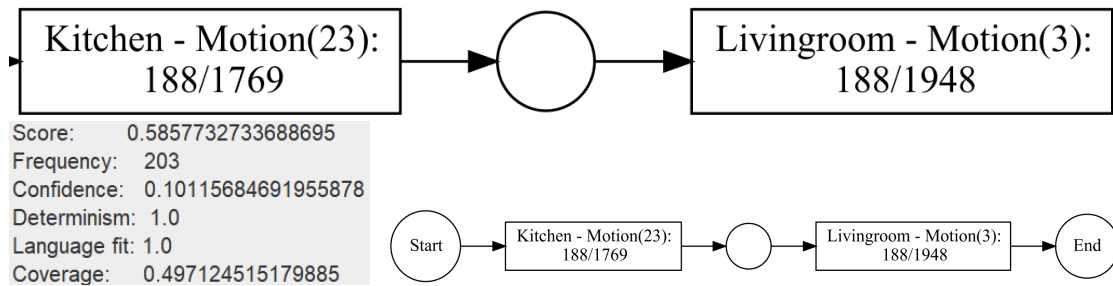
The models mined with constraints thus combine, as could be expected, indeed activities that follow each other more closely. Also, because some more far-off relations are ignored, more room is made for different kinds of activities. Again, it can be said that the models mined with constraints are more informative.

5.3.4 Evaluating non-constrained models with constraints

This section tests how the models mined without constraints (figures 5.2 and 5.3) score if they are evaluated using the constraints. All model executions in which non-model activities happened



(a) LPM constrained model 4



(b) LPM constrained model 5

Figure 5.5: LPM constrained models 4-5

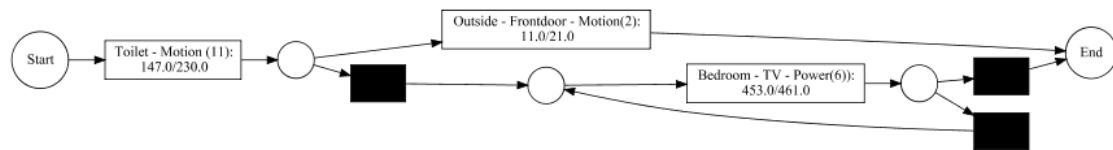


Figure 5.6: Example of a model starting with one activity followed by a choice between two activities, of which one is in a loop

in between activities of the pattern are then not counted as supporting the model.

Table 5.1 contains both the scores of the models mined without constraints and the scores when the models are evaluated with constraints. It can be seen that the confidence numbers are substantially lower. Much less observations of the particular activity type are represented by the model than before. This is exactly what should be expected, since the requirements on the behavior are more restrictive. The mean confidence and overall weighted scores for the best five models mined without constraints, but evaluated with constraints, are all lower than the best five models mined with constraints.

5.4 Summary

When looking at the structure and confidence score of the models discovered without constraints, they seem to be more informative, because they represent more behavior in the log than models discovered with constraints. However, taking into account the non-model activities that are

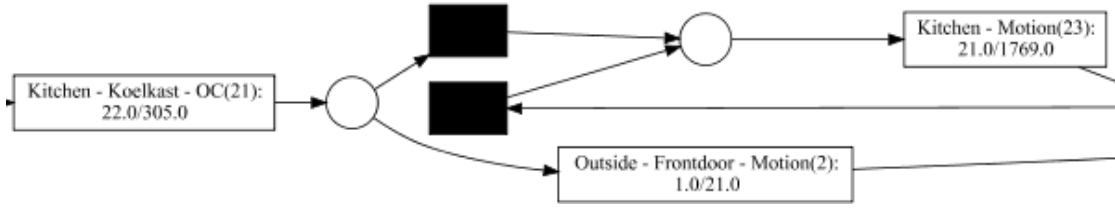


Figure 5.7: Example of a model starting with one activity followed by a choice between two activities, of which one in a loop, but where the activity in the loop is never repeated

model	confidence activity 1	confidence activity 2	confidence mean	weighted score
figure 5.2a no constraints	125/144	1648/1948	0.86	0.81
figure 5.2a with constraints	12/144	12/1948	0.01	0.56
figure 5.2b no constraints	171/212	772/935	0.82	0.80
figure 5.2b with constraints	18/212	18/935	0.03	0.57
figure 5.2c no constraints	114/144	1479/1769	0.81	0.79
figure 5.2c with constraints	7/144	7/1769	0.01	0.56
figure 5.3a no constraints	163/230	1700/1948	0.78	0.78
figure 5.3a with constraints	17/230	17/1948	0.02	0.56
figure 5.3b no constraints	152/212	1470/1769	0.77	0.78
figure 5.3b with constraints	1/212	1/1769	0.00	0.55

Table 5.1: Scores of models mined without constraints compared to when they are evaluated with constraints

allowed, the models mined with constraints provide more specific and interesting information about the behavior in the log. The models mined with constraints furthermore represent patterns concerning a wider range of activities, and find relations between activities that are more directly related to each other in term of the floor plan of the house. When evaluating the models, mined without constraints, using constraints, they scored lower in terms of confidence and overall weighted score than the best models mined with constraints. Mining with constraints is thus a relevant extension to the LPM algorithm.

5.5 Limitations

This test has been performed on a single small data set of one specific household. It provides a first indication of the benefits of introducing constraints on non-model activities, however more test are needed, on bigger datasets of different households and also on other types of datasets, to make firmer conclusion. Furthermore, the person of the house had received some visitors, which means that some actions were not performed by the person itself. However, distinguishing observations of several persons is a whole challenge in itself. It is assumed that the few observations because of visitors have no influence on the overall data.

It would be interesting to extend the code in such a way that it also sets a limit on the *total* amount of non-synchronous events that is allowed between synchronous events, instead of only a maximum for the amount between two events. Furthermore, instead of setting a maximum,

setting a minimum would also be interesting, because that makes it possible to focus on long-term relations. Next to constraints on non-model activities, other constraints might also improve the patterns found. Pei et al. (2007) describe several types of constraints, of which several might be interesting to explore, such as placing constraints on the time in between activities. Ensuring that activities happen in a certain time-window is also a way to make sure that patterns represent activities that are closely related to each other. The information about time-windows could even be used as extra information in the pattern descriptions.

A difference between the original evaluation method and the one with constraints that has not been specifically mentioned yet is the way they deal with log-moves. The original method allows log-moves, while the method with constraints does not. It has been chosen to disallow log-moves in the constrained method (in the same way as non-model activities are not allowed), because it is one more way to make sure that behavior that supports the model exactly occurred as in the model. This choice does not influence the results of the test of this chapter, because all repetitions of activities were removed. However, if the same activity occurs multiple times in a row, then not allowing log-moves gives a problem for the current way of making alignments. To explain this, say the trace $[A, A, B]$ needs to be evaluated for the model in figure 5.1. The important point here is that when making the alignments, the first activity in the trace that *can* be executed, *is* executed. The alignment for the trace $[A, A, B]$ is thus: *trace*: $[A, A, B, >>]$, *model*: $[A, >>, B, \tau]$. Normally, evaluating without constraints, this trace would be interpreted as executing the model once. On the other hand, applying the constraints that A and B cannot be interrupted by a log-move, the trace is seen as not containing the behavior of the model at all. However, the trace does contain A and B without anything else in between, but then the first A needs to be skipped instead of the second A. This means that, if repeating activities are present in the log, either the alignment method needs to be adapted or log-moves need to be allowed.

Finally, there are still some problems in the code. Effort has been put in fixing these problems, but the adapted code and the overall LPM algorithm builds and depends on so much other code, that the problems could not be found. If looking closely at the numbers in the models of figures 5.2, 5.3, 5.4 and 5.5, it can be seen that the frequency of the pattern is not always in agreement with the amount of observations that were said to fit in the model. There were also some unequal confidence numbers in the models mined with constraints (e.g. 75 observations followed by only 74), which has been solved by evaluating the models a second time using the evaluation code separate from the LPM algorithm. The effect of the counting mistakes is that the models that now came forward as having the highest overall score would possibly not be the best if no counting mistakes were made. However, this does not mean that the whole test is untrustworthy. The differences between 50 models with and without constraints were big enough to support the conclusions made in this chapter. It is very likely that some small changes in the counts would not produce very different models.

Chapter 6

Extending the LPM algorithm

This chapter proposes several ways in which the LPM algorithm can be extended such that the models that it provides as output are closer to people's descriptions of routines. The first section discusses how to deal with hierarchy of activities. Next, the frequency information currently provided by the LPM algorithm is discussed and how this can be used in text. Third, ways of finding conditions are discussed.

6.1 Hierarchy of activities

In chapter 4, two problems considering hierarchy of activities are discussed. The first problem is that the sensors do not always observe activities at a level that is interesting for people. The second problem is that the LPM algorithm at this moment is not able to find or represent activities at different levels. Both problems are further discussed in this section and some solutions are proposed.

6.1.1 Recognizing activities at different levels

Sensors do not necessarily observe activities in the way people do. This gives some problems, discussed in the first section below. Ideas to solve some of the problems are discussed next.

Problems

It is possible that activities are observed at a higher level than preferred, for example in the case of bedroom movement. Here it is more informative if lower-level activities were recognized such as getting out of bed and making the bed (which both involve bedroom motion, but provide more information than that). It is also possible that activities are observed at a lower level than preferred and that it would be more informative if a higher-level activity was recognized. The sensors might register small steps, while it is more interesting what those small steps accomplish. For example, it is quicker and clearer to say that someone makes coffee than to mention opening the cupboard, getting a cup, closing the cupboard, putting coffee and water in the coffee machine etc. Depending on the situation it might be interesting to know all the steps taken for making

coffee. However, for example in a description of a morning routine it is clearer to only say that the person makes coffee, than to write down all the steps and to let the readers themselves deduce that the steps are about coffee making.

Sensors that register activities at a high level do not only cause activity descriptions with less (interesting) information, but also have influence on the patterns that are found. If two different activities are observed in the same way by sensors, then they are presented to the LPM algorithm as being the same activities. However, if the two different activities occur in different contexts, then for each pattern that is supported by one activity, the other activity will not fit and thus decrease the score of the pattern. Furthermore, activities that are observed at a low level form a pattern together and might therefore not be combined with other activities. If small activities are grouped into one activity, then relations with other (higher-level) activities can be found.

Solutions

The place to start with recognizing the “right” activities is with the sensors used in the house. With data collection it is important to keep in mind the kind of activities that the user expects to be recognized and what the sensors can detect (Kamei et al., 2008). Adding sensors in more movable objects, such as cups, plates or storage boxes, might provide useful information for example (Okadome et al., 2007).

However, also the information in the log itself can be used for getting more information about the activities that occurred. The goal is to annotate some activities with more specific activity information, while some other observations should be annotated with information about a higher-level activity that they belong to. These annotations could then be included in the event-labels provided to the LPM algorithm, such that different activities are indeed presented as different activities and a few small activities are brought back to one activity. An option is to provide annotations manually, for example, identifying the higher-level activity that a pattern of low-level activities presents. However, it would be more convenient if these annotations can be automatically created. Context information that is available about the observations can be used for this.

Each observation at least has a time stamp and value. The fact that an observation is made during a different time period can be an indication that it represents different actions. For example, in the morning a closet might be opened to get oatmeal for breakfast and in the evening the same closet might be opened to get rice for making dinner. Tax, Alasgarov, Sidorova, and Haakma worked on a method to refine labels based on differences in time. The labels do not have names that indicate the specific activities, instead they are numbered 1 and 2 (Tax, Alasgarov, et al., 2016), but it is a first step. Furthermore, the values that the sensors registered can help to specify activity descriptions. In this way differentiation can be made between for example opening and closing a cupboard.

Except for time and value information, for each observation at least the type and location/object of the sensor should be indicated, otherwise it is not known what is actually observed. However, the context information for observations could easily be increased, by providing some basic information about the layout of the house and sensor placement during installation of the sensors. Appendix D contains some more details about this topic. Figure D.1 gives an overview of context information that can be expected to be known for each observation, but that is not all traditionally and/or explicitly included in the sensor log. Examples are the object and location type. By combining the data of different observation, implicit information can be found. For

example, if for each sensor it is *individually* known what its location is, then it is implicitly known that there exists a *group* of sensors that are all in a particular location. This can be an indication of that certain observations belong together. Furthermore, a person might sit at different couches, but since they are both a couch it can still be seen as representing the activity of sitting. Another indication that activities belong together can be if they are in between two similar observations, for example shower on and off.

The context information of an observation can also be used together with domain information about activities. Chen, Nugent, and Wang note that a sensor only observes one particular part of a situation, and that for recognizing activities it is necessary to combine data of several sensors. They suggest recognizing activities using a conceptual activity model, which is shown in figure 6.1. In the core, an activity has an ID, name and a description. Furthermore, an activity has several properties. The properties are divided in in three groups, the context (time, actor, location, resources, environment activities), causal and/or functional relations (conditions, effects, goal, duration) and interrelationships between activities. This information can then be used to combine different sensor observations. The models should be made using general or personal domain knowledge. (Chen, Nugent, & Wang, 2012)

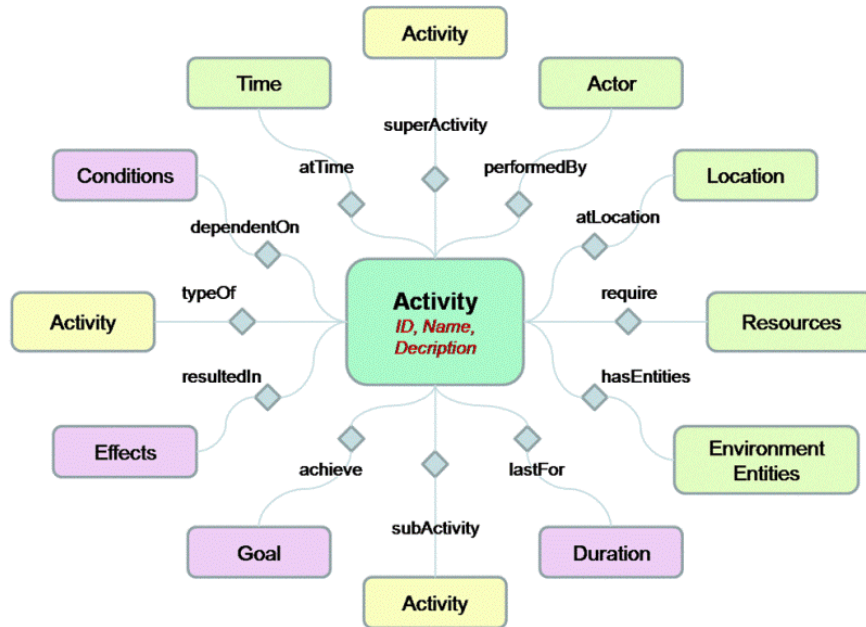


Figure 6.1: The conceptual activity model from (Chen, Nugent, & Wang, 2012)

If some observations already contain annotations from some source (for example by manual labeling), then these annotations can be used to also provide annotations for other observations in the log. Tax, Sidorova, Haakma, and van der Aalst have worked on using data that contains high-level labels for some low-level activities. They use this to also deduce high-level labels for low-level activities without high-level labels. (Tax et al., 2018)

If labels are changed automatically, then it is important to check if the changes improve the models. Tax, Sidorova, Haakma, and van der Aalst have worked on a method to evaluate if label-splits improved the process model that was found (Tax, Sidorova, et al., 2016a).

6.1.2 Hierarchy in LPMs

Figure 4.1 showed that the relation between activities and sub-activities is just like the parent and child relations in process trees. However, the order of the sub-activities was missing in the figure. Furthermore, a node is not allowed to be both an activity and operator in process trees. Figure 6.2 contains two possible tree representations of an activity and its sub-activities together with an operator. Figure 6.2a in principle models the relation between ‘taking a shower’ and the sub-activities, but it in an indirect way. The sub-activities are not direct children of the main activity, but grandchildren. In figure 6.2b the relation between the activity and its sub-activities is direct, with the sub-activities as direct children of the main activity. The tree in figure 6.2b is most practical. The parent activity is an activity but also an operator. There is no need to look at two different trees nodes for the activity name and operator. Also, it is still quite close to the set-up of process trees. Non-leaf nodes are still operators, only they can have an added activity name.

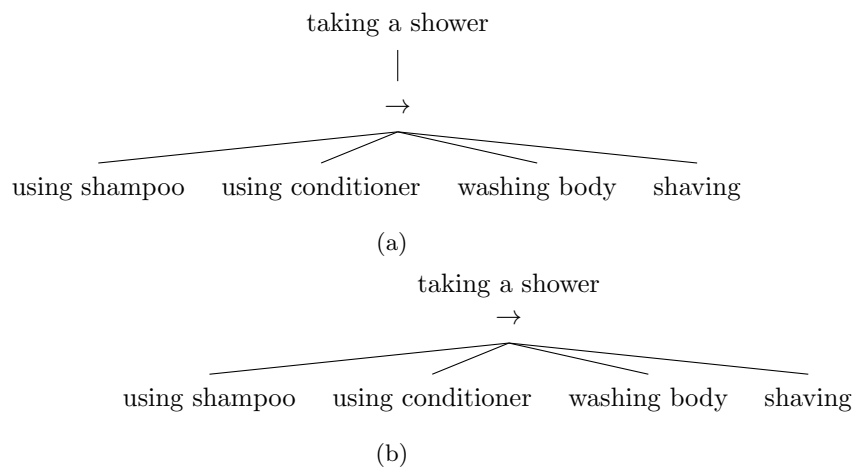


Figure 6.2: Two options for an activity with sub-activities including an operator

It is thus proposed that the LPM algorithm allows process trees in which operator nodes be activities nodes at the same time. It is then also possible to mine patterns with hierarchy. However, evaluating activities at multiple levels does require a lot of extra trees to be evaluated, so this is quite unrealistic because processing time would strongly increase. Therefore, it is more realistic if labels are changed at log-level or that higher-level activities are added when the model is already found.

6.2 Expressing frequency

Chapter 4 explained that the LPM algorithm provides frequency information for the patterns and activities, but in numbers, while people use qualitative words. The first section below looks at precisely what frequency information the LPM algorithm provides. Next, some difficulties of expressing frequency information in text are discussed.

6.2.1 Frequency information in LPMs

Of the quality metrics of LPMs (explained in chapter 2), two metrics give an indication of the frequency of activities and patterns. The *support* or *frequency* represents how often the complete pattern has been seen in the data. *Confidence* expresses how often the performance of an activity fits within the pattern, relative to how often the activity is performed in total in the data. In ProM, LPMs are, among other information, shown with the confidence for each activity (undivided) and the frequency of the complete LPM. The LPM algorithm can thus annotate process tree activity nodes with their confidence and roots with the frequency of the complete pattern.

For each pattern is known:

- how often it occurred
- how often it occurred relative other patterns

For each activity is known:

- how often it occurred in total
- how often it occurred in total compared to how often other activities occurred in total
- how often it occurred in a particular pattern
- how often it occurred in a particular pattern compared to how often it occurred in other contexts
- how the ratio between occurring in a particular pattern versus in other contexts is compared to this ratio for other activities

To give some examples of these numbers, figure 6.3 contains two LPMs. The model in figure 6.3a has a frequency of 111 and the model in figure 6.3b has a frequency of 74. Pattern 6.3a is thus 1.5 times as frequent as pattern 6.3b. It can be seen that in the complete log the backdoor was used 212 times, which compared to the other activities is not very much. Bedroom motion occurred 939 times, bathroom motion 439 times and cubicle room motion 709 times. Somewhat more than half the amount of times that the backdoor was used, it was followed by motion in the bedroom. On the other hand, only about 1 out of 8 times bedroom motion was preceded by use of the backdoor. About 1 out of 6 times motion in the bathroom was followed by motion in the cubicle room and only about 1 out of 10 times cubicle room motion was preceded by bathroom motion.

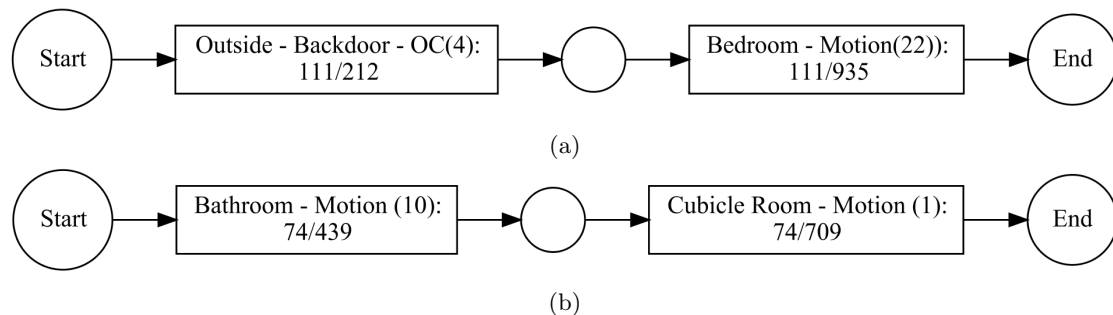


Figure 6.3: Examples of LPMs

The most interesting numbers are the ones that are quite different from other numbers. For example, using the back door occurs much less frequent in the log than motion in the bedroom, kitchen or living room. Also, the ratio of the back door occurring in the context of these models compared to other models is higher than the ratio for the other activities. Furthermore, it is interesting to see that motion in the bedroom room occurs most often in the log.

It is possible to compare the frequencies within one person's dataset, but it could also be imagined that numbers are compared across all the users, or a sub-group of users, of the system. An example would be to inform someone about how active they are compared to other persons.

6.2.2 How to express frequency in text

If the frequency and confidence are included in nodes of process trees, then it is possible to use this information for expressing frequency in the text. There are several choices to make about how to include the information in the text. A first choice is whether to use numbers, either directly the numbers of the tree or some translation to percentages or ratios, or to translate the numbers to qualitative words, such as 'often' and 'sometimes'.

Translating numbers into qualitative words is not straightforward. First of all, words indicating frequency can be interpreted differently in different situations, for different types of activities and by different people. For example, it can be said with high certainty that, for all people, eating *once a day* is not seen as eating often. On the other hand, going to the cinema *once a day* could most likely be seen as very often. However, if a person is a movie reviewer, then going to the cinema once a day might be normal. The movie reviewer then goes to a cinema often compared to other people, but it is not often for the movie reviewer. So, the qualitative word that can best be chosen to represent a numerical value can depend on the type of activity and the person. It might also depend on the situation, for example, in summer it might be normal to swim in a pool each day, while in winter it does not happen at all. When choosing the word for the frequency, all these factors thus need to be taken into account. Information about these factors might be obtained by comparing frequencies across a population or with domain knowledge.

Second, even for the same activity, the same type of person and in the same situation, people can still have a different interpretation of how much 'often' or 'sometimes' is. One person might say 'often' is 10 times and 'sometimes' 3 times, while another person might say that 'often' means 20 times and 'sometimes' 6 times. A lot of research has been performed about translating words such as 'a lot', 'probably' and 'sometimes' into numerical representations. This research is thus not about translating numbers to words, but words to numbers. However, this does not matter, since they both deal with the same translation problem. An extensive review about translating linguistic quantifiers (such as 'a lot' and 'few') into numerical representations using imprecise, or *fuzzy*, quantification can be found in (Delgado, Ruiz, Sánchez, & Vila, 2014). Furthermore, Clark has reviewed several studies about uncertainty expressions (such as 'possible', 'likely' and 'very likely'). One of the conclusions was that people are internally consistent in which quantities they associate with which linguistic quantifiers. It was not clear if there were difference between persons. (Clark, 1990) Teigen and Brun conclude from several studies that within a certain group, for example doctors, there is reasonable agreement about the meaning of words indicating probability or uncertainty, however that between groups there are a lot of differences. At the same time is mentioned that individual differences can be very big in any way, with an example in which a doctor says to a patient that a cure is 'possible'. One party might interpret this as 5% chance and the other as 70%. (Teigen & Brun, 2003) Bocklisch, Bocklisch, and Krems propose a method for translating frequency expressions (such as 'sometimes' and 'often') into numbers

using estimations by participants in experiments and fuzzy sets. They recommend using different translations for different topics (such as psychology or economy) since interpretation of words can be different in each context. They also mention that when giving opinions or expressing uncertainty people prefer to use words over numbers. (Bocklisch et al., 2012) Using qualitative words might in this way thus be preferable over numbers, but on the other hand, these words are quite ambiguous.

Also a choice has to be made about which frequency information is provided and which not. The people describing their morning routines did not give frequency information about every activity. Most likely things that happen always do not need frequency indication, while the frequencies that are different from the average frequencies are worth mentioning.

6.3 Finding conditions

In chapter 3 was seen that sometimes activities only happen if certain conditions are true. Some activities might only occur at certain times (for example in the morning) or certain days (for example during the weekend). Some activities might only occur if certain other activities also occur (for example someone only puts on makeup if they leave the house that day). Also, the time, type of day, weather or feelings might be of influence on the type of activities.

Chapter 4 explained that the LPM algorithm only finds activity related conditions. Dependencies in activities could show up in the models automatically and can be found when paying attention to the two numbers determining the confidence. If (almost) all occurrences of a certain activity fit in a model, then the other activities (or at least one of them) form(s) a condition for that particular activity to happen. Take for example the model in figure 6.4 (which is only illustrative and not one of the mined LPMs). It shows that every time when the microwave was used, first the fridge was opened. The condition is thus that the microwave is only used if the fridge has been opened. On the other hand, opening of the fridge is sometimes also followed by other activities than using the microwave. As discussed in chapter 5, the LPM algorithm is able to find relations between activities that are performed directly after each other, but also between activities that are interrupted by other activities in between. In this way, a difference can be made between short- and long-term conditions. It is important then, that it is made very clear whether it involves short- or long-term relations, to avoid misinterpretation.

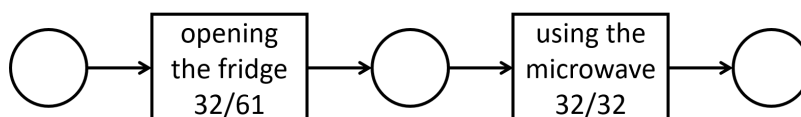


Figure 6.4: Model that shows a condition

Activities that depend on time, time periods or the (type of) day could possibly be found using the techniques from Tax, Alasgarov, et al. The method splits observations of one sensor into two groups based on time (Tax, Alasgarov, et al., 2016). The difference in time between the groups can indicate a condition.

Another, but less elegant and practical, possibility for finding conditions related to time, is to take one log and run it with differently sized traces. For example, run with the trace being: a week, all weekdays or weekend days of a certain week, all the same days (all Mondays as one

trace), a day, the morning/afternoon/evening/night of a day, an hour of a day or the same hour of all days etc. It might turn out that the models show clear differences in activities that occur, for example that only in the weekend there is a model that starts with watching television. However, this method would take a lot of runs of the algorithm, thus a lot of time. Also, the fact that the traces are cut in a pre-determined way makes that not all peculiarities might be found.

It is also possible to check for each model the days and times of the observations that fit with the model. If one day and/or time is prominent, then this might be a condition (e.g. a person only does something at a particular day).

For conditions that are not activity or time related, other data is needed. Mannhardt, de Leoni, Reijers, and van der Aalst worked on a method to find conditions using data attributes. In chapter 4 was discussed that some things that people do are too infrequent to show up in the patterns, but can still be relevant. Mannhardt et al. explain that infrequent behavior in an event-log is often seen as noise and filtered out, but that not all infrequent behavior should be seen as noise. Instead, infrequent behavior might only be infrequent because the *conditions* for that behavior to happen are not often fulfilled. Knowing about this infrequent behavior and when it happens does actually provide interesting information about a process. Therefore, the authors developed a method that distinguishes noise from interesting infrequent behavior, by finding data-driven decisions with the help of data attributes. (Mannhardt et al., 2017) This method thus both deals with infrequent behavior and finding conditions.

In the future, when more data and apparatus are coupled together, the weather at the time might be taken into account when interpreting the sensor data. However, there are a lot of possible influences of the weather that could be tested and it is not realistic to test all of these. Therefore, this kind of information is most useful if there is already some domain knowledge present about the influence of the weather, perhaps such as the conceptual activity model in figure 6.1.

Finding conditions based on feelings is very difficult, unless the person provides information about feelings (which could then be used as trainings data perhaps), because feelings cannot be observed by sensors.

In order to include conditions in the text about common behavior, the information needs to be included in the output of the LPM algorithm. Just as frequency information, it could be added as extra information to the nodes of the process tree.

It is assumed that conditions are found for activities. If a condition is found for a complete pattern, then it is thus a condition for each activity in the pattern.

6.4 Summary and limitations

This chapter discussed theories and techniques that could be used for finding and expressing information about hierarchy and frequency of activities and conditions. For identifying activities at different levels, among others, the possibility of using domain knowledge has been discussed. Furthermore, research has been discussed about the translation between frequency expressed in numbers and qualitative words. In addition, methods to find activity and time related conditions, as well as other types of conditions, were discussed. The information that is found can be added as attribute to the nodes of the process trees.

All these suggestions need further work. For example, methods for finding activity labels are not mature yet. Also, more research is needed for translating frequencies in the right way and for

conditions it is for example also important how they can be expressed in proper sentences. Next to this, each method will have its own limitations. An example of a limitation is that domain knowledge will get outdated after a while. People's behavior can change over the years. Perhaps in the future people do not cook themselves anymore, but will instead always order dinner. The activity of eating can then be associated with opening of the front door, instead of using the stove. Furthermore, new types of activities can be introduced to people's lives, which then also need to be recognized. For example, a new form of entertainment could be using a virtual reality headset, which might be recognized with particular movement patterns. A database with domain knowledge will thus need updates in order to keep functioning correctly, which someone has to provide.

Chapter 7

Method for text creation

This chapter explains a way to translate the process trees that the (adapted) LPM algorithm creates into text. First the requirements for the text are discussed. Then, the input is described in more detail. Next, the text creation method is explained. Finally, a summary is given and limitations are discussed.

7.1 Requirements for the text

A goal of this thesis is to develop a method for automatically creating textual descriptions of someone's common behavior, that are understandable for a broad audience. Patterns, expressed in process models, found by the LPM algorithm have been chosen as representing someone's common behavior. The requirements for the description of such a pattern are as follows:

- The description should correctly and non-ambiguously present the information in the model.
- The description should be easy to read and understand for a general audience.
- The description should be grammatically correct.

7.2 Input

The visual output of the LPM miner consists of Petri nets and Petri nets are also used in the mining process, but in the basis, the LPM algorithm creates process trees. The Petri nets are a translation of the process trees originally created. As was seen in chapter 6, it is easy to add information about hierarchy, frequency and conditions to process trees. Also, process trees have operators that explicitly indicate the ordering of activities, while in Petri nets, the order needs to be determined by looking at the in- and output places of transitions, the available tokens etc. Process trees will therefore be used to base the text on.

It is assumed that the nodes in the process tree have information about the operator and/or activity, frequency, and condition as attributes and that the information is in a certain format. The activity labels are, for now, assumed to fit after the pronoun "you", for example "take

a shower” or “have breakfast”. Frequency information is assumed to have been translated to qualitative words and to only be present if the information was considered interesting (for example if an activity was rare compared to other activities). The same assumption is made for conditions. Depending on what type of frequency and condition information is available, the placement in the sentence might have to be changed from how it is proposed in this chapter.

The process trees received as input for making text have the following structure:

- All leaves are activity nodes.
- All non-leaf nodes are operator nodes and possibly also activity nodes.
- The operator nodes are of type: Sequence (\rightarrow), Concurrency (\wedge), Exclusive choice (\times), Inclusive choice (\vee) or Loop (\odot).
- A root node can be of any operator type.
- A loop operator has one (non-silent) child, other operators have two (non-silent) children.
- An activity node possibly contains information about the frequency of the activity.
- A root node possibly contains information about the frequency of the complete tree.
- An activity node possibly contains information about a condition for that activity.

Figure 7.1 contains an example of a tree that could be given as input. Note that it contains a frequency for the activity ‘eat bread’.

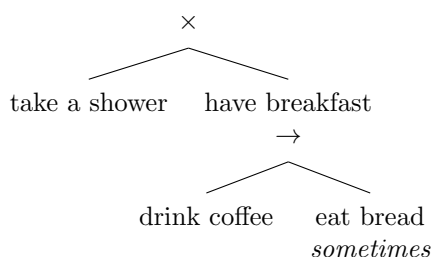


Figure 7.1: Example of a tree that could be given as input

7.3 Text creation method

The vloggers of the videos mainly discussed sequences of activities. Other ordering relations such as choices were one part of the sequence. Therefore, it is attempted to present activities also as sequential as possible in the text, by going over the tree from the root to the leaves, from left to right. The tree is seen as consisting of different building blocks, that can each separately be translated to text. For example, in the tree of figure 7.1, the nodes ‘drink coffee’, ‘eat bread’ and ‘have breakfast’ are each separately a building block of the tree, but together they are a sub-tree, which is also a building block of the tree. Putting all the blocks of text together forms the complete description of the tree. Thus, first the nodes can be translated to text and then these parts of texts can be combined into describing the sub-tree, etc.

The two most basic parts of a process tree are activity nodes and operator nodes. The following pseudo-code shows how they can be translated:

```

define activityText(node):
.   text = ""
.   if node.condition != empty:           // if the node has a condition
.       text += node.condition + ", "    // add condition (e.g. 'if you made breakfast, ')
.   if node.freqText != empty:           // if the node has a frequency
.       text += node.freqText + " "     // add frequency (e.g. 'often ')
.   if node.activity != empty:           // if the node has an activity label
.       text += "you " + node.activity  // add the activity (e.g. 'you eat breakfast')
.   return text

define operatorText(node):
.   if node.operatorType == →:
.       text = " and then "
.   elseif node.operatorType == ^:
.       text = " while "
.   elseif node.operatorType == ×:
.       text = " or "
.   elseif node.operatorType == ∨:
.       text = " and/or "
.   elseif node.operatorType == ○:
.       text = " multiple times"
.   return text

```

The text for the node ‘drink coffee’ (of figure 7.1) thus is “you drink coffee” and the text for the node ‘eat bread’ is “sometimes you eat bread”. The operator for the ‘have breakfast’ node is translated with “and then”. Combining activity nodes and an operator node gives a two-level tree. The following pseudo-code shows how such a two-level tree can, in general, be translated into text:

```

define twoLevelTree(root, children):
.   text = ""
.   if root.activity != empty: //if the operator has an activity label
.       text += "when " + activityText(root) + ", " //mention that for that activity
.                                               the person does the following things:
.   text += activityText(children[-2]) + operatorText(root) +
.   activityText(children[-1]) //the two children separated by the operator
.   return text

```

The activity of having breakfast can thus be described as “when you have breakfast, you drink coffee and then sometimes you eat bread”. However, this way of making sentences does not work in all cases. A loop has only one activity thus needs a different type of sentence. Furthermore, if a non-activity operator has a non-activity operator as child, this leads to problems with text creation, because there is no activity to mention as building block. An option could be to refer to the sub-activities instead of to the parent-activity. However, figures 7.2a and 7.2b show that this can lead to ambiguous sentences. The meaning of a sentence, and the tree represented by that sentence, is different depending on which activities are assumed to belong together in the sentence (this is indicated by brackets). Therefore, all non-root operators preferably are always also an activity. Possibly this can be accomplished by methods such as discussed in section 6.1.

However, if no activity label can be found for an operator, then there are several options to deal with this in the text:

- If the root of a pattern is sequential, then the sub-trees can be dealt with in different sentences, because they happen one after the other (in contrast with a choice, in which any of the activities can happen first). The tree in figure 7.2a for example, could be translated as “You perform A and/or you perform B. Then you perform C.”, which makes sure that the sentence is not interpreted as in figure 7.2b.
- A loop with only one (non-silent) activity can be treated as a single activity instead of a subtree.
- In case the operator node without activity name is of the same type as its parent and the parent does have an activity name, merging is also an option. Figures 7.2c and 7.2d show that merging operators of the same type does not change the behavior that is allowed.
- In other cases, it is necessary to have an activity name to be able to make proper sentences. Then, an option is to give the operator an abstract name such as ‘activity 1’. A disadvantage is however that it makes the text more abstract and possibly hard or unpleasant to read.

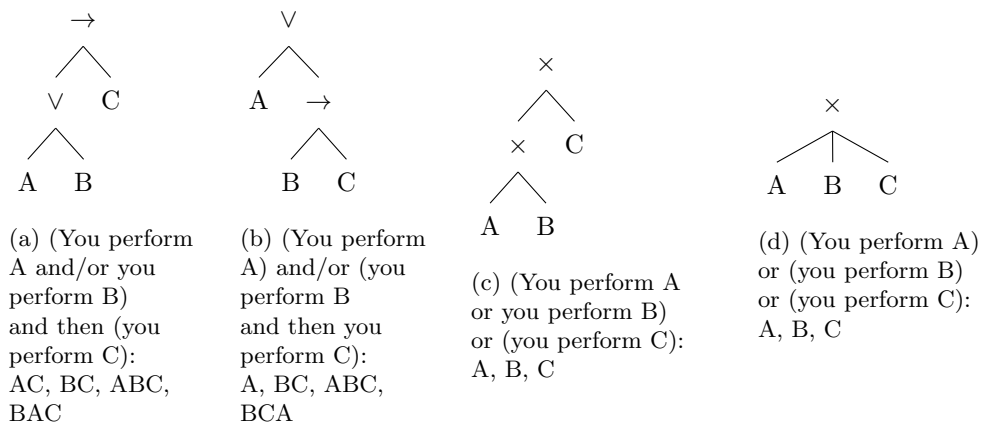


Figure 7.2: Different interpretations of sentences

The `twoLevelTree` function thus needs to be extended with some exceptions. Also, the `activityText` function needs to be able to give abstract names to operator nodes that need a name. Furthermore, note that merging operators can lead to an operator having more than two children. Extra children can be easily added in the text, using commas. For example, if having breakfast in figure 7.1 also included eating cereals and eating an apple, the text would become “when you have breakfast, you drink coffee, you eat cereals, you eat an apple and then sometimes you eat bread”.

Assuming all exceptions have been taken care of and each two-level tree can be translated into a proper sentence, several descriptions of two-level trees can be combined into a description of a tree with more activities and levels. The following pseudo-code shows a recursive function that walks through the tree and creates a description of the complete tree:

```
define createText(currentOperator):
.   sentence = twoLevelTree(currentOperator, currentOperator.children) + "."
```

```

.   makeFirstLetterCaptial(sentence)
.   print(sentence) //print the sentence for the current two-level tree
.   for child in currentOperator.children:
.       if child has children //if the child of the current operator has children
.           createText(child) //print the sentence with the children of the child
createText(root)

```

In this way all the children of a root are mentioned and next, each of the children of the root are dealt with. In case one of the children of the root contains children again, those children are dealt with before the next child of the root. Especially with a sequential root, this method makes sure that what happens first is also discussed first. The text created for the tree in figure 7.1 is as follows: “You take a shower or you have breakfast. When you have breakfast, you drink coffee and then sometimes you eat bread.” The complete code to create text, dealing with all the exceptions, can be found in appendix E.

7.4 Summary and limitations

This section presented a text creation method for the adapted LPMs. The method walks recursively through the tree and each building block of the tree is translated to text according to fixed structures. Developing a complete and end-user-ready text creation method would have cost a lot of time and also was not expected or the aim for this thesis. Therefore, this chapter presented a simple text creation method, using fixed structures and expecting input of a certain format. Below some ideas are provided for improving the code.

First, placement of frequencies and conditions in the sentences needs to be improved, because now sentences sometimes become ambiguous. Also, there is no possibility yet to include frequency of the complete pattern in the text.

Another point of improvement would be if texts could be made using different pronouns. The text can then be adapted to the reader, for example using “you” for the person living in the house and “he” or “she” when a caretaker reads the text. The verbs of activity labels would have to be changed into the proper form.

Removing repeating words, such as “you” or frequencies or conditions that are the same for multiple activities, would also improve the test. Rules about natural language would have to determine when this is appropriate or not.

Furthermore, some more variation could be introduced into the text. Text with a standard structure and using the same words each time can feel robotic and as a collection of loose sentences. A text with a lot of variation is closer to human descriptions and reads with more flow, especially for bigger trees or when reading multiple patterns one after the other. On the other hand, using different expressions for the same patterns can also be confusing. It could make the reader wonder if something else is meant. A simple way to create some variation in word choice would be to randomly choose a synonym (for example those that were also used by people themselves in the video’s). Changing word order is more difficult, since it might change the meaning or emphasis of a sentence.

Chapter 8

Evaluation

In this chapter the text creation method introduced in chapter 7 is evaluated. The first section evaluates the method based on the requirements that are defined in section 7.1. The next section compares the method with an existing text creation method, that creates text from BPMN models (Leopold et al., 2012).

8.1 LPMs in text

The text creation method of chapter 7 has been created for LPMs in process tree format. Therefore, some of the LPMs mined for in chapter 5 are used for evaluation. Figure 8.1 contains process trees for each type of structure that was found in the LPMs of the test house. The activity labels have been adapted to represent real activities instead of type of sensor (for example ‘Kitchen - Porcelain Cabinet - OC (13)’ has been changed into ‘open or close the kitchen porcelain cabinet’). It is assumed that with the installation process this kind of labels are immediately given. The text created for the process tree is placed next to the tree.

The first requirement of the text is that it should correctly and non-ambiguously present the information in the process tree. Some notes can be made here. First of all, the interpretation of the loop is not completely the same. In the Petri net/process tree the activity can be performed one or more times, while the text suggests the activity is always performed more than once. However, the confidence of the activities in the models does suggest that at least most often the activity is performed more than once. In case that “false” loops are found (if the activity in the loop occurs equally often as the other activity), this can be taken into account with making the text. Furthermore, including a sentence piece describing a nameless loop that has one (non-silent) activity, in a sentence of another nameless operator makes the sentence not fully unambiguous. In principle sentences such as ‘you perform A or you perform B multiple times’ could be interpreted as performing both A and B multiple times, while only B is meant. However, this interpretation can be seen as less straightforward. Another remark can be made about the way in which motion sensors are described as activity. Translations as ‘move in the toilet room’ or ‘move in the living room’ do not sound very natural. Unfortunately, it is hard to find a general description that works well. It is not possible to say that someone uses the toilet for example, because the person can also clean the toilet or place a new towel next to the sink. For the living room it could be said that the person does something in the living room, however,

this sounds less good for the toilet room or the bedroom. Other ideas also have their problems. For instance, replacing ‘move’ by ‘are’ does not work well for sentences such as ‘then you are in the living room multiple times’ and saying that someone triggered the motion sensor (‘then you trigger the motion sensor in the toilet room’) sounds very abstract and indirect. However, while the word-choice could be improved, the sentences do provide the information of the tree. Therefore, overall it can be said that the sentences present the information in the model correctly and non-ambiguously.

Note that with other types of trees, such as with an inclusive choice instead of a loop in figure 8.1b, it is needed to find higher-level activity labels in order for them to be correctly and clearly translated.

The second requirement for the description is that it should be easy to read and understand by a general audience. Since the descriptions have been based on how people describe routines and since the sentences do not contain or refer to complicated ordering structures (such as mentioning inclusive choices), it is assumed that they are indeed easy to read and understand.

The third requirement is that the descriptions should be grammatically correct, which they are (if the activity labels are provided in the expected format).

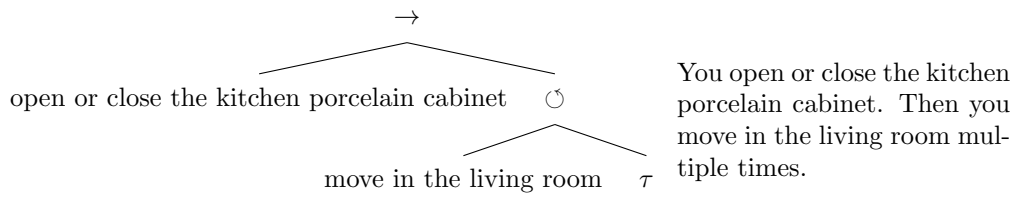
The trees translated for the comparison between methods in the next section shows that the text creation method of this thesis can properly deal with hierarchy of activities in trees (see the trees in figures 8.4 and 8.5 and the texts in figures 8.7 and 8.8). It is less abstract if activity descriptions are found for each operator, however, the information of the tree can also be communicated using abstract names. A remark can be made about using ‘when’ for saying that an activity contains sub-activities (‘when you perform activity 1, you ...’). This might suggest that activity 1 is an action in itself, and that while that action happens, the sub-activities are performed. Using ‘for’ might be clearer (‘for performing activity 1, you ...’), however, this would need a change in verb, which is not coded at this moment.

Figure 8.2 contains a tree with frequency information and a tree with conditions. Also these sentences meet the requirements. However, depending on for which activities frequencies and conditions are added, it might create some ambiguous sentences. For example, if the tree in figure 8.2b only contained the condition ‘if it is sunny outside’, the sentence would become “Then if it is sunny outside, you move outside before the front door or you use the TV in the bedroom multiple times.”. In this case, it seems like the condition also holds for using the TV, while this is not the case. The same happens when only the first activity contains a frequency. More specific placement rules are needed to make sure that no ambiguous sentences are made.

8.2 Comparison with another method

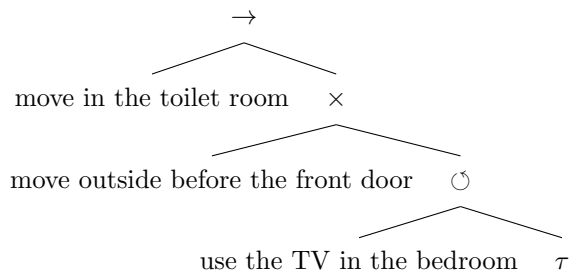
Leopold et al. (2012) developed a method to translate BPMN models to natural language texts. This section compares their method with the method of this thesis. Their method is much more elaborate and developed than the one presented in this thesis and also their audience is a bit different. This will be discussed further on. Despite the differences, it is still interesting to compare texts created by the two different methods for the same model.

Figure 8.3 contains one of the BPMN models that the authors used to evaluate their BPMN translation method. This model can, in a quite straightforward way, be translated to a process tree by mapping the sequence flows and gateways in the BPMN model to operators in a process



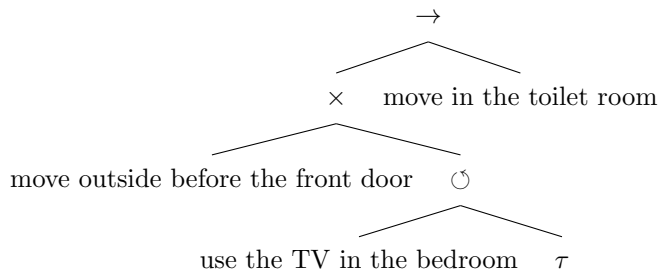
You open or close the kitchen porcelain cabinet. Then you move in the living room multiple times.

(a) Tree and text for non-constrained model 1



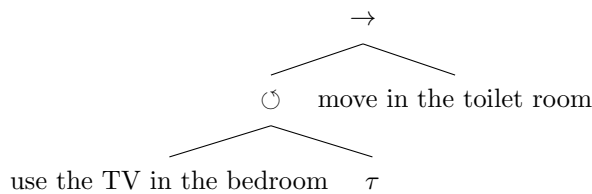
You move in the toilet room. Then you move outside before the front door or you use the TV in the bedroom multiple times.

(b) Tree and text for non-constrained model 13



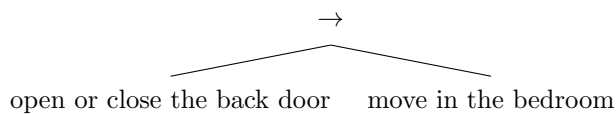
You move outside before the front door or you use the TV in the bedroom multiple times. Then you move in the toilet room.

(c) Tree and text for non-constrained model 26



You use the TV in the bedroom multiple times. Then you move in the toilet room.

(d) Tree and text for non-constrained model 29



You open or close the back door and then you move in the bedroom.

(e) Tree and text for constrained model 1

Figure 8.1: Translations of LPMs

tree. Figure 8.4 contains the process tree representation of the BPMN model in figure 8.3. To test if the tree is a right translation, the program ProM has been used to create a BPMN model from

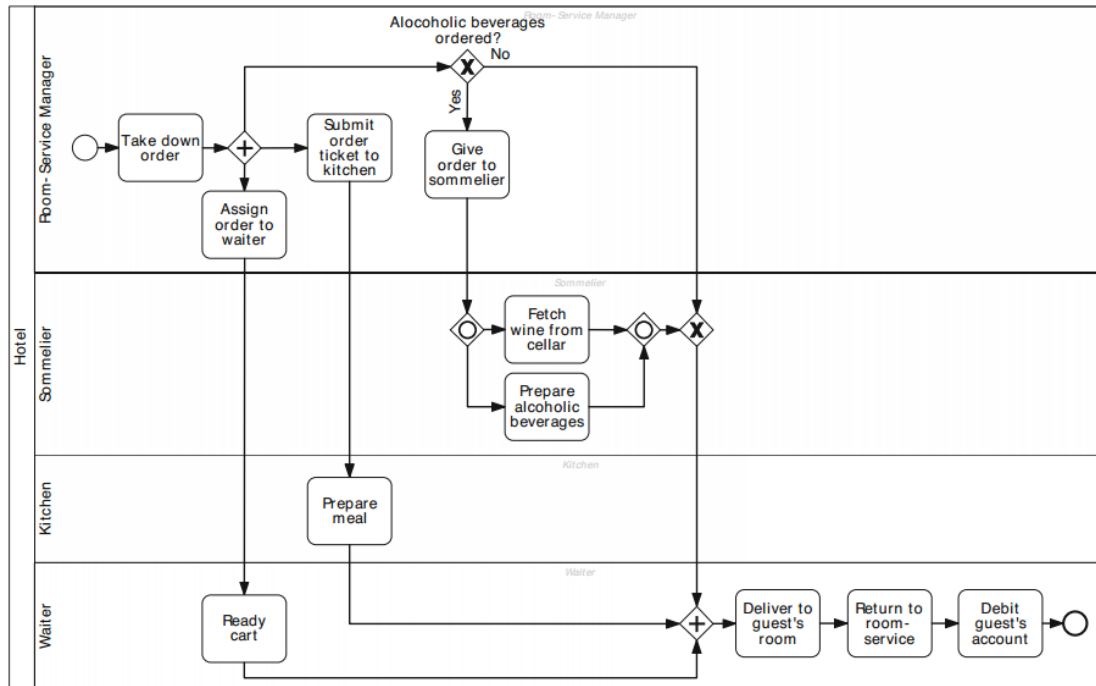


Figure 8.3: A test BPMN model of (Leopold et al., 2012)

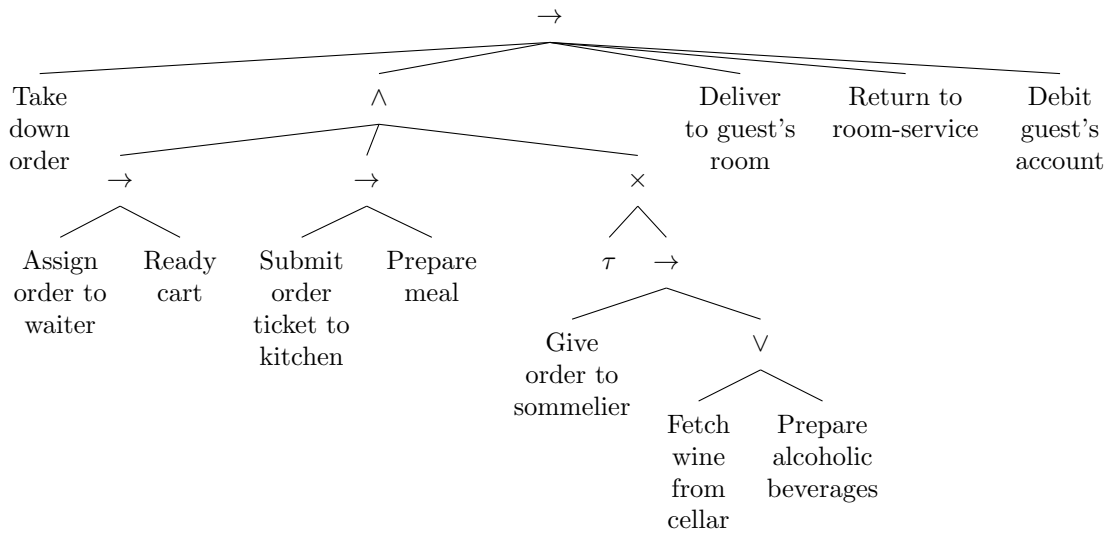


Figure 8.4: Process tree for the model in figure 8.3

providing a one-sentence overview of all activities of one operator, and then later introduces the sub-activities. This method has been chosen because the persons in the analyzed videos did it in this way. What is found to be better understandable depends on the audience. The

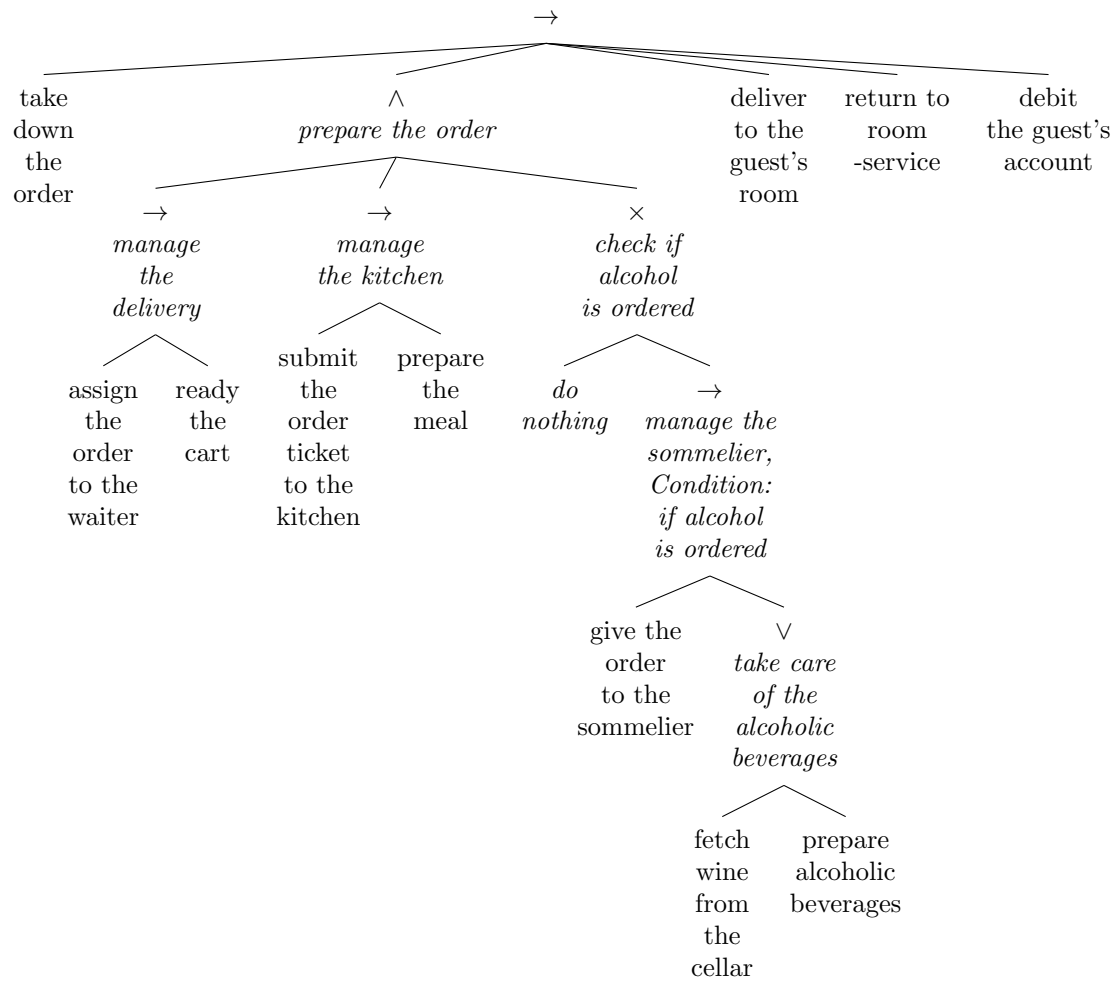


Figure 8.5: Edited process tree for the model in figure 8.3

indented audience for the BPMN translation method is employees, with or without experience in modeling, of a company that uses process models for documenting their operations (Leopold et al., 2012). This is a smaller group than people from all over society, including young and old people and people outside of a process oriented company. The construction with bullet points and indentation might not be easily interpretable for such a broad audience.

Regarding the requirements determined for the text creation method, the method of this thesis is not able to take into account the information about different persons that perform the activities and is only able to create grammatically correct sentences with some pre-editing of labels. Also, the sentences of the BPMN translation method contain more variation and are more natural. However, these are all things that can be fixed by extending the current algorithm of the method of this thesis. On the other hand, the text by the BPMN translation method is not (easily) understandable for a general audience due to the structure of the text (with bullet points and indentation), while the text-structure by the method of this thesis is suitable for a general audience. Furthermore, the BPMN translation method can deal with conditions, but does not

deal with frequencies (although this can be added).

The process begins, when the Room-Service Manager takes down an order. Then, the process is split into 3 parallel branches:

- In case alcoholic beverages are ordered, the Room-Service Manager gives the order to the sommelier. Afterwards, one or more of the following paths is executed:
 - The Sommelier fetches the wine from the cellar.
 - The Sommelier prepares the alcoholic beverages.
- The Room-Service Manager assigns the order to the waiter. Subsequently, the Waiter readies the cart.
- The Room-Service Manager submits the order ticket to the kitchen. Then, the Kitchen prepares the meal.

Once all 3 branches were executed, the Waiter delivers to the guest's room. Afterwards, he returns to the room-service. Finally, the Waiter debits the guest's account.

Figure 8.6: Text created by (Leopold et al., 2012) for the model in 8.3

You Take down order. Then you perform activity 1, you perform activity 2 and you perform activity 3 all at the same time. Then you Deliver to guest's room. Then you Return to room-service. Then you Debit guest's account.

When you perform activity 1, you Assign order to waiter and then you Ready cart.

When you perform activity 2, you Submit order ticket to kitchen and then you Prepare meal.

When you perform activity 3, you Skip activity or you perform activity 4.

When you perform activity 4, you Give order to sommelier and then you perform activity 5.

When you perform activity 5, you Fetch wine from cellar and/or you Prepare alcoholic beverages.

Figure 8.7: Text created for the model in figure 8.4

You take down the order, you prepare the order, you deliver to the guest's room, you return to room-service and then you debit the guest's account.

When you prepare the order, you manage the delivery, you manage the kitchen and you check if alcohol is ordered all at the same time.

When you manage the delivery, you assign the order to the waiter and then you ready the cart.

When you manage the kitchen, you submit the order ticket to the kitchen and then you prepare the meal.

When you check if alcohol is ordered, you do nothing or if alcohol is ordered, you manage the sommelier.

When you manage the sommelier, you give the order to the sommelier and then you take care of the alcoholic beverages.

When you take care of the alcoholic beverages, you fetch the wine from the cellar and/or you prepare alcoholic beverages.

Figure 8.8: Text created for the model in figure 8.5

8.3 Summary and limitations

This chapter evaluated the text creation method by translating some LPMs into text and by comparing it with another text creation method. The method of this thesis is quite inflexible, which causes that sentences do not always sound very natural, however, the sentences do provide the correct information in grammatically correct sentences and in a way that should be understandable for a broad audience. There are some problems with adding frequency and conditions to sentences in a non-ambiguous way, since it is not always clear for which activities this information holds. Compared to the other method that has been tested, especially the fact that the user does not need (explicit) knowledge about ordering structures such as parallelism (because these structures are not explicitly mentioned) gives the method of this thesis an advantage over the other method.

This evaluation could be improved by testing the sentences with people. This was however not feasible within the time available for making this thesis. Due to working within a company, many time-consuming regulations had to be followed for having experiments with people, such as requesting permission from an ethical commission. This would have required to have a reasonably mature product at a too early stage in the process of making this thesis.

Furthermore, both methods can be evaluated more elaborately with more models, representing all the possible structures.

Chapter 9

Conclusion

This thesis started with explaining that a big part of people's behavior comes forth out of habits and that habits thus need to be taken into account when people want to change their behavior. A method to get insight into someone's habits is to keep track of behavior with sensors in a house and to search for patterns in the observations that are made. Philips and the TU/e were already working on obtaining sensor logs and a method to find frequent behavioral patterns called Local Process Models. However, a step towards communication to a general audience had not been made yet. The behavioral patterns were presented in process models and not in a language easy to understand for everyone. This thesis looked at how to create textual descriptions of someone's common behavior in a way that people in general can understand, using the methods already researched by Philips and the TU/e. The research was divided over three research questions.

The first research question was: *How should common behavior be textually described to a general audience?* This question consisted of two sub-questions about the type of information people expect in a description of common behavior and what type of textual presentation is suitable for people in general. It was found that people mostly talk about activities in sequence. Sometimes they spoke of choices, activities happening at the same time or repeating something, but very infrequently compared to activities happening in sequence. Except for the order in which activities occurred, also other information was provided, namely about the frequency with which particular activities were included in a routine, activities at different levels of execution and conditions for certain activities to be performed. Furthermore, it was found that sensors do not necessarily observe the activities that people find interesting. It is possible that they observe small actions, such as opening a drawer, or big actions, such as movement in a room, which do not tell what a person was really doing without context information. For the presentation of text, an overview of words used to indicate order, frequencies and conditions has been made. It was found that if activities were discussed at different levels, then this was mostly done in sentences following each other, without using any special words.

The second research question was: *How is the way common behavior should be textually described to a general audience different from how the LPM algorithm, using sensor logs, describes common behavior?* Again, the question consisted of two sub-questions, one about the difference in type of information and the other about difference in presentation. An important difference in type of information was when something was seen as a pattern. People discussed only activities that followed each other directly. The LPM algorithm on the other hand also considers something a pattern if the activities in the pattern are separated by other activities in between. In addition,

the LPM algorithm does provide information about frequency of activities, but in numbers and not in qualitative words as people do. Furthermore, the LPM algorithm does not work with several layers of activities, thus does not allow an activity to have sub-activities. Also, it is only able to find conditions based on activities and not based on other data, such as the time. In terms of presentation, the process models needed to be translated to text.

The third research question was: *How can the differences between the output of the LPM algorithm and how common behavior should be textually described to a general audience be overcome?* The first sub-question was: *In what ways can the LPM algorithm be adapted to produce output closer to the requirements of a general audience?* To answer this question, several techniques are suggested to be added to the LPM algorithm, such that the models it provides include the type of information in people's descriptions. First a method placing constraints on the number of activities that is allowed to occur in between the activities of a pattern is explained and tested. Next, ways to include hierarchy of activities, frequencies and conditions in the LPM algorithm are discussed. Higher- or lower-level activity labels can for example be found using context information of the sensor log and information about activities in general. Frequency numbers can be translated to words using fuzzy methods and conditions can be found using time information or, if available, other data such as data about the weather. To include activity labels, frequency information and conditions in process trees, extra attributes for the nodes in a process tree are needed. The second sub-question was: *How can the information in the models provided by the LPM algorithm be translated to text suitable for a general audience?* To answer this question, a method for text creation is developed. It has been chosen to make the sentences as sequential as possible, without explicitly mentioning ordering constructs such as parallelism. This means that structures such as nested choices are presented without actually nesting sentences, but by referring back to the activity that they belong to. For this it is needed that operators have activity labels, which can be abstract names, but are preferably real activity descriptions. Evaluation showed that adding frequencies and conditions causes ambiguity in some cases, because it isn't always clear that they belong to only one activity. Furthermore however, the text created for trees correctly presents the information in the tree, should be understandable for a general audience and is grammatically correct.

There is much room for further research about communication of common behavior to a broad audience. In the problem description has specifically been mentioned that in this thesis the topic is researched for sensor logs and the LPM algorithm. However, many other techniques for observing behavior and interpreting observations exist, which could also be explored. Furthermore, more research can be performed about the information that people would like to have about their common behavior and the presentation that is suitable for a broad audience. The limitations and opportunities for the analysis performed for this thesis have been elaborately discussed in the respective chapter. In terms of behavior that supports a pattern, it would be interesting to test the constraints on non-pattern activities on different data sets and to also test the influence of placing constraints on time in between activities. There are a lot of opportunities for finding higher- or lower-level activity labels, communication frequency information and finding conditions. This thesis has presented some ideas and some relevant research already performed, which can be used as starting place for further research. Future work for the text creation method lies in making the text more flexible and natural and in evaluating it with people.

This thesis has made a first step in presenting behavioral patterns to a general audience. It has been analyzed how people communicate their common behavior. This information has been used to make and suggest techniques for adapting the existing Local Process Model algorithm and for developing a method that creates text, of common behavior, suitable for a general audience.

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Appendix A

Video texts

The first section of this appendix contains the corrected and marked video transcripts. The second section contains the original transcripts.

The videos can be found with the following URLs:

Winter Morning Routine, Christen Dominique:
https://www.youtube.com/watch?v=pfE-HF8A_Sc

WEEKEND MORNING ROUTINE, Billie rose White:
<https://www.youtube.com/watch?v=2rVZvWeZ2cw>

SPRING MORNING ROUTINE 2017!!, MissRemiAshten:
<https://www.youtube.com/watch?v=q4KQ9H5WGxc>

Spring Morning Routine 2017 | Olivia Jade, Olivia Jade:
<https://www.youtube.com/watch?v=UGoqeJMXhuY>

SPRING MORNING ROUTINE 2017 - Caci Twins, CACI TWINS:
<https://www.youtube.com/watch?v=fQj1436elhU>

Sierra's Morning Routine, Haschak Sisters:
<https://www.youtube.com/watch?v=w2ikvf2gqMQ>

MY MORNING ROUTINE 2017, Camilla Frederikke:
<https://www.youtube.com/watch?v=0M11z52gynY>

Healthy Morning Routine 2017, Lindsay Marie:
<https://www.youtube.com/watch?v=1U7Vzoz1AVE>

Before School Morning Routine | viviannnv, Vivian V:
<https://www.youtube.com/watch?v=-zyTZ3nG6W4>

1 Hour Realistic Morning Routine, Rachelleea:
<https://www.youtube.com/watch?v=uB3Im50TWCY>

A.1 Structure analysis

0:00
 good morning you guys welcome to my
 0:01
 winter more actually you know what let's
 0:04
 just look at have to rewind this kind of
 0:06
 embarrassing actually Christmassy vibes
 0:12
 all over the place if this intro is way
 0:14
 better **I usually go to bed really really**
 0:16
 late **so I wind up** waking up super tired
 0:19
and then I realized I woke up way too
 0:21
 early **two hours later** now after a
 0:27
hundred yawns later I get out of bed |
 0:29
can't move on without showing you my
 0:31
 Christmassy Sox can't do it **then** I just
 0:33
got my new bedding I got it in and I
 0:36
 just moved into my new apartment so I
 0:38
 wanted to show you guys **me making my bed**
 0:40
 let's just be real right now I like to
 0:42
brush my teeth in the morning **as soon as**
 0:44
I get out of bed
 brush my teeth get that
 0:46
 nasty taste out of my mouth
 and can we
 0:48
 all just give it up give a big emoji
 0:50
 hand clap to this see inspired Santa
 0:53
 Claus right now perfect for the restroom
 0:55
 I saw I'd at TJ maxx i was like i have

0:57
 to have that because my restroom needs
 0:59
 Christmas love too **and I'll wash my face**
 1:00
with a cleanser **and**
 to make sure it's
 1:02
 really rubbed in really **good i will do**
 1:04
 this face dance she's part of my
 1:06
 routine you guys do that too right it's
 1:08
 normal right **I've been using** the Tacha
 1:10
 silk cream for my face oh my god it's
 1:13
 so good will literally give your skin a
 1:15
 silky feel i love it i highly recommend
 1:18
 it to anybody with very dry skin
and for
 1:21
my hair
 i'm just leaving it down **today**
 1:22
 washed it **yesterday** just putting it
 down
 1:24
 in its natural habitat
 for foundation
 1:26
today i'm gonna be using the vanished
 1:28
 cream hourglass foundation stick **and**
 1:30
then a little bit of shape tape under
 1:32
 the eyes from Tarte benefit goof proof
 1:34
 to fill in my brows **and** i'm using this
 1:38
Maybelline contour stick which is really
 1:40
 creamy
 1:41

Figure A.1: Winter Morning Routine part 1/3

and I really like the way it blends use
1:43
that to contour today and I'm not going
1:45
into too much detail on my **makeup**
1:47
because this isn't a makeup tutorial so
1:49
giving you a quick run through of
1:51
everything **i'm using i used to bh**
1:53
cosmetics on my eyes i use their marble
1:56
palette which i think it's a really
1:57
beautiful palette and I love Bea age
1:59
because they're so affordable and
2:00
quality is really good and then oh my
2:03
god you guys I'm obsessed with the
2:05
two-faced sweet peach everything the
2:07
palette the highlight the blush the lip
2:10
gloss and love **flashes i'm using the**
2:12
flutter lashes in kelsey they're really
2:14
natural wispy just really pretty and
2:16
this is my look **for today and now that**
2:18
i'm all done it is time for breakfast
2:20
AKA coffee
2:22
[Music]
2:28
okay everything before this moment does
2:32
not count coffee before talkie actually
2:35
have a blue coffee mug that says that so
2:36

I just want to give a quick shout out to
2:38
my coffee mug for the info on this I've
2:41
said this before I will say it again
2:42
coffee is not coffee to me without
2:44
creamer my creamer is everything this
2:47
maple cinnamon pancakes candle is my
2:50
life it is so good from Bath & Body
2:53
Works you guys have to try it it smells
2:55
a delicious **I usually check my snapchat**
2:58
anyways **let's go ahead and get ready** and
3:01
today's outfit is not going to be a
3:04
Christmas sweater darn it it's just
3:07
gonna be a regular sweater and some
3:10
jeans okay time to get dressed
3:15
yes that was I was like magic right **i'm**
3:20
gonna go ahead and put on these ugly
3:22
christmas socks because why not now **it's**
3:27
time for Boba to get in the Christmas
3:30
spirit

she actually is fighting with me
3:32
not to put this thing on she did not
3:34
like it I took it right off of her but I
3:36
thought it was look cute and I wanted
3:38
her to be in the video and she's such a
3:40
cute little kitty **so I put her in and**

Figure A.2: Winter Morning Routine part 2/3

3:42
she walked around in it and honestly
 her
 3:45
 fur is just way too fluffy or outfits
 3:49
 like this because she just looks like a
 3:51
 muscle man in them so enjoy
 3:56
 [Music]
 4:01
and then last minute I put these antlers
 4:04
on here and honestly she was not
 having
 4:07
 it she was like no I am done with you I
 4:10
 cannot even deal with you and then I
 put
 4:13
 him back on her because yes i am that
 4:15
 cat mom I needed a picture for
 snapchat
 4:17
 Heller you guys seem to like it I saw a
 4:21
 lot of each screen shot her oh my
 4:23
 snapped huh she's so she looks so
 grumpy
 4:26
 I swear she's like the happiest cat ever
 4:28
 she literally just sits around all day
 4:30
 and looks out the window that is her
 4:32
 life she doesn't even know she just sits
 4:34
 there enjoys life you can cuddle with
 4:38
 her you can pet her she won't move I
 4:40
 promise she's not very active but she's
 4:43
 super lovable and I love her so much
 4:46
so after Cat-ivities I like to write
 4:49
down my video ideas for future months
 4:52
and I'll look through my schedule make
 4:54
sure i have my week down pack and that's
 4:56
pretty much what my day consists of in
 5:00
my house if it's not filming and then
 5:02
I'm going to go ahead and head out
 now
 5:04
I'm gonna put on my booties these are
 5:06
 from steve madden they're super cute
 and
 5:09
 i love this crop top sweater from Alou
 5:11
 lose my jeans are actually from hot
 5:13
 Miami styles and I've had him for about
 5:14
 a year and I love them so much irie
 wear
 5:17
them all the time way too much actually
 5:20
and I'm just gonna go about my day
 but
 5:22
before I leave I'm gonna try not to burn
 5:24
down my new apartment
 so that's pretty
 5:26
 much it I hope you enjoyed this video
 5:28
 and until the next one I love you guys
 5:30
 bye dollies

Figure A.3: Winter Morning Routine part 3/3

0:00
 hey guys welcome back to my channel in
 0:05
 today's video I am filming a weekend
 0:08
 morning routine for you all so **in the**
 0:11
morning I normally get up around 1030am
 0:13
 I know that might sound late but that's
 0:17
 pretty early for me **and** just like
 0:19
 everyone else I will go on my phone and
 0:20
check my social media and then I never
 0:36
make my bed but just for this video I
 0:38
make my bed you can tell I am awful at
 0:41
 making beds I am just literally pulling
 0:43
 apart
 0:45
 [Music]
 1:07
 so **now it's time for breakfast it's**
 1:10
normally like twelve o'clock now but
 1:13
 yeah **petting my dog here** hey Ames what's
 1:17
 up
 1:20
 [Music]
 1:23
 so I **normally** have toast with like
 peanut
 1:26
butter or Vegemite but I **felt like** Weet-
 1:29
Bix so i have two Weet-Bix or three
 1:31
and then I put a shit ton of sugar so
 1:34
then I go back to bed I literally could
 1:47
 stay here all day **and I just ate my**
 1:49
breakfast in bed because everyone's
 1:51
normally awake **now** going to do things
 1:54
 don't need to do things they're going to
 1:57
 do things so I'm just home alone
 I
 1:59
normally watch youtube **or** I go on **Netflix**
 2:03
recently I have been watching 13
 reasons
 2:06
 why
 2:08
 [Music]
 2:23
when I eventually get ouy of bed I **have to**
 2:27
put music on to get ready so here I am
 2:29
just listening to my splendor playlist
 2:32
and my little neece that wanted to say
 2:34
 hi so this is her **brushing her teeth** with me
 2:37
and we are just getting ready
 2:39
 [Music]
 2:44
so now it's time for make up
 I'm just
 2:46
 doing a quick little rundown of my
 2:49
 everyday makeup routine that video is
 2:51
 coming very soon but this is just my
 2:54
 basic makeup routine
 2:56
 [Music]
 3:14
 [Music]

Figure A.4: WEEKEND MORNING ROUTINE part 1/2

3:17	now that my makeups done I'm going to	5:12	hope you guys enjoyed this video I love
3:35	show you my outfit so my top is from Zulus	5:14	you all so much if you enjoyed it and
3:37	am I short up from princess Polly	5:17	what more videos like this please give a
3:44	then I grab my bag and I head out the	5:19	thumbs up and I'll see you guys in my
3:56	door to whatever I'm doing that day is	5:21	next one very soon
3:58	are going to you know it's friends goin	5:24	[Music]
4:00	to lunch whatever but if I'm not doing	5:34	you
4:04	anything I literally come back inside		
4:07	and I will get a snack		
	today I was		
4:10	having a banana and just chopping it		
	up		
4:14			
	[Music]		
4:16	and then I go back in my bed I'm playing		
4:30	with my dog here she's honestly it's so		
4:32	cute and she poses to the camera when we		
4:35	try have fun and now I just ate my snack		
4:39	whatch YouTube go on netflix and I		
4:50	actually had some parcels i'm going to		
4:53	show you what I got if I have some I		
4:55	glitter and some metallic tattoos and		
4:58	then in my other bag I'm struggling to		
5:01	open it up but it's a yellow dress is		
5:05	from the inner our boutique so that was		
5:10	my weekend morning routine for you all I		

Figure A.5: WEEKEND MORNING ROUTINE part 2/2

0:00	hey guys and Rafi and welcome friends to	and then I'll go
0:01	my channel today i'm doing a spring	0:45
0:03	morning routine for you guys to be	ahead and just stretch a bit and then
0:05	honest I don't really have much to say	0:47
0:06	about it other than this has been just	actually get up
0:08	my normal morning routine for the past	first thing I do in the
0:10	few weeks now if you guys liked the	0:48
0:12	video be sure to give it a big thumbs up	morning is take a shower I've actually
0:14	let's simply get 24 into a thousand	0:50
0:17	thumbs up I know you can and also	become a morning shower or is that a word
0:19	subscribe to my channel if you haven't	0:53
0:20	already we are getting so close to two	for shampoo and conditioner lately i've
0:22	million subscribers which is just crazy	0:54
0:24	yeah I think that's all I have for the	been using the Shea Moisture argan oil
0:26	intro so let's get start alright guys so	0:56
0:28	my morning routine begins with me	and almond milk smooth and same line
0:30	obviously waking up in the morning and	0:58
0:32	if you know me I am NOT a morning	which is amazing it's been helping with
0:34	person	1:00
0:37	so I'm usually woken up by Daisy	my frizz and fly way and it's awesome
0:39	licking	1:02
0:41	my face it's usually like startles me	because it protects your hair against
0:43	and then I'll wake up and play with her	1:04
0:45	a little bit I'll go in for a kiss and	thermal damage caused by heat styling
0:47	she usually rejects me	1:05
		which you guys know I'm always throwing
		1:07
		my hair and straightening it and
		1:08
		everything so it's awesome
		so first I
		1:10
		start with the shampoo this is actually
		1:11
		sulfate free and the gently cleanses
		1:13
		while controlling my screws and
		1:15
		smoothing my hair and then I'll move
		on
		1:16
		to the soft and detangle conditioner
		1:18
		which basically just helps to detangle
		1:20
		and smooth and revive my hair which
		my
		1:22

Figure A.6: SPRING MORNING ROUTINE 2017!! part 1/5

hair gets so so so tingly so this stuff
 1:25
 is amazing for it
 once i'm done washing
 1:27
 my body and shaving and doing all the
 1:29
 other fun stuff
 I will brush my teeth
 1:31
 then once all that stuff is done I will
 1:35
 head over to my closet and from there I
 1:37
 work on my makeup I pick out my outfit
 1:39
 for the day get changed and do my hair
 1:41
 now starting with my makeup
 I have a
 1:44
 pretty long routine that I do every
 1:46
 single day so if you guys want to check
 1:48
 that out I just put up a video of me
 1:50
 showing you how I do it from start to
 1:51
 finish so you guys can watch that I will
 1:53
 link it down below if you want to check
 1:54
 that out and you can watch an actual
 1:56
 in-depth tutorial
 once the makeup is
 1:58
 done I will move on to picking out my
 1:59
 outfit for the day
 and for the spring
 2:01
 time I love wearing really cute and
 2:02
 girly things I absolutely love the whole
 2:05
 off the shoulder top trends so I am
 2:06
 obsessed with that I also love
 2:08
 frightened summery dresses and on this
 2:10
 day I decided to go for the cute
 2:12
 little blue dress the denim jacket
 after
 2:14
 my outfit is picked out I move on to
 2:15
 styling my hair
 and I've been obsessed
 2:17
 with these products from shea moisture
 2:18
 and also a really great thing about them
 2:20
 is they're super accessible and you can
 2:22
 find them at Target and Walmart so
 first
 2:24
 I start out with the argan oil and
 2:26
 almond milk blowout cream this is
 2:27
 seriously amazing as you can see my
 2:30
 hair looks pretty crazy when I get out
 2:31
 of the shower and let it air dry so this
 2:33
 just helps to condition my hair as you
 2:35
 can see after brushing it out it just
 2:36
 looks so so much better and honestly
 the
 2:39
 blow-up cream makes it so much easier
 to
 2:41
 brush out and it also helps with my
 2:43
 sideways and my spray and just makes
 it

Figure A.7: SPRING MORNING ROUTINE 2017!! part 2/5

a lot more manageable also for some
 2:47
 reason I am the worst at blow-drying
 my
 2:49
 hair but this just makes my hair looks
 2:50
 so smooth and silky and awesome after
 2:53
 which is really great and after my hair
 2:55
 is dry I move on to the flute and pain
 2:57
 thermal protection milk which I am
 2:59
 always be styling my hair whether it be
 3:01
 for photo shoots or set or just filming
 3:03
 and things like that and I also just
 3:04
 kind of prefer to have my hair curls so
 3:06
 I'm always looking for a really good
 3:08
 skate tamer spray this spray is
 awesome
 3:10
 because it controls frizz its locks
 3:12
 humidity and improves the appearance
 of
 3:13
 my split ends and makes my hair look
 3:15
 shinier and this is all while protecting
 3:17
 my hair against heat damage once my
 hair
 3:19
 is fully protected I'll take a one and a
 3:21
 half inch curling iron and throw my
 3:22
 entire head
 and then it's time to change
 3:24
 and move on to breakfast

now if you guys
 3:27
 know me you know that i absolutely
 love
 3:29
 cooking i love getting in the kitchen
 3:31
 and just making food i think it's so
 3:33
 much fun and on this morning i decided
 3:35
 to make a tomato spinach and feta
 3:37
 frittata which that is a mouthful and it
 3:39
 tastes so good now on the mornings that
 I
 3:41
 wake up and I'm feeling extra hungry
 and
 3:43
 just like I want to make something
 3:44
 special this is something really easy
 3:46
 that I whip up and I thought I'd show
 3:47
 you guys how to make it
 so you just
 3:49
 start by adding some olive oil
 to a
 3:51
 skillet and then putting in your
 dye sub
 3:53
 onion and while your onion is
 cooking up
 3:55
 on the stove you can move
 over to your
 3:56
 tomatoes I chop those up in
 half and I
 3:58
 also already took my fresh
 spinach and
 4:00

Figure A.8: SPRING MORNING ROUTINE 2017!! part 3/5

chop that up as well also side
 note
 4:02
other really awesome
breakfasts that I
 4:04
like to make in the morning are
 like
 4:05
 avocado toast I love making
 oatmeal and
 4:07
 just like hearty breakfasts like
 that
 4:09
once my onions are ready i will
add in
 4:11
my spinach and spinach cooks
 down so
 4:13
 much it's pretty crazy **and while**
we wait
 4:15
for those to cook together we
 can move
 4:17
 on to the **main base of the**
frittata
 4:18
 which are eggs some
 soy ahead and
 4:21
 cracking four eggs into
 a bowl adding
 4:23
 I sifted cup of flour **as**
well as half a
 4:25
 teaspoon of baking
 powder **and then**
 4:27
 wishing that all
 together **and then also**
 4:29
 the statistic **you can**
add a little bit
 4:31
of milk to it
 this recipe is seriously
 4:33
 so easy you guys and I promise
 it will
 4:35
 impress whoever you're
 cooking for even
 4:37
 if it's just for yourself it will suit
 4:38
 if we impress you all you're
 going to do
 4:40
then is just add in your
 vegetable mix
 4:42
 it all around **and then** pour it
 back into
 4:44
 a skillet that is oven safe **after**
that
 4:48
 you're just going to place all of
 your
 4:49
 little cherry tomatoes on top
 and I put
 4:51
 them all like facing upwards so
 it just
 4:53
 looks more aesthetically
 pleasing **once**
 4:55
your tomatoes are placed go
ahead and
 4:56
throw it into the oven will go
and
 4:58
actually throw it but put it into
the
 4:59
oven at 350 **degrees for about**
20 to 25
 5:02
minutes **and once it is out**

Figure A.9: SPRING MORNING ROUTINE 2017!! part 4/5

you can top it
 5:04
 with **whatever** you like you can
 eat it
 5:06
 plain **if you want** but I went
 ahead and
 5:07
 put some balsamic glaze
 sprinkle some
 5:10
 feta and then also took some
 basil from
 5:12
 my fresh herb garden that I
 have next to
 5:14
 my little counter and it just
 chopped it
 5:16
 up put it on top and serve
 myself up a
 5:18
 slice it was seriously delicious
 you
 5:20
 guys and **while I'm eating my breakfast I'll**
 5:21
usually just work on emails and catch up
 5:23
on like YouTube videos and things like
 5:25
 that
 and I also did want to be realistic
 5:27
 with you guys and I **didn't want you to**
 5:28
think that every morning I wake up and
 5:30
make myself a frittata a lot of times
 5:31
also I'll just walk youtube and eat
 5:33
something super easy whether it be
 5:35
 cereal or fruit or just something like
 5:37
 that because I don't feel like making an
 5:38
 entire meal just for myself **after about**
 5:41
eating breakfast I will do my dishes and
 5:42
whatever dishes I made pack up my bag
 5:44
and then head out the door **to start**
 5:46
whatever activities I have plans for the
 5:48
day on this day in particular my best
 5:49
friend leigh and i went to San Diego to
 5:51
 go visit our best friend kaylee but on
 5:53
 the way we actually pass a city called
 5:55
 coral fad and they are notorious for
 5:57
 having the most beautiful flower fields
 5:59
 during the spring time and I've never
 6:00
 been before even though I grew up in
 6:02
 California so we obviously had to stop
 6:04
 down on the way and I figured this was
 6:06
 perfect for my spring morning routine
 6:07
 because nothing says spring like allergy
 6:10
 I mean flower it's just kidding but
 6:12
 seriously we were so beautiful and the
 6:14
 flowers were amazing and i highly
 6:16
 recommend stopping by if you guys can
 6:18
 thank you guys so much for watching this
 6:20
 video I hope you enjoyed it if you did
 6:22
 be sure to give it a big thumbs up and
 6:24
 I'll be sure to do more morning routines
 6:26
 for you guys please subscribe if you
 6:27
 haven't already and I will see you next
 6:28
 time

Figure A.10: SPRING MORNING ROUTINE 2017!! part 5/5

0:00
hey guys welcome back to my channel
0:02
today's video is a very requested at
0:04
spring morning routine so this is an
0:07
actual legit burg morning routine this
0:08
was a couple days ago I set up my camera
0:11
the night before so you could really see
0:12
what happens in the morning so **i first**
0:16
wake up and go on my phone I know that's
0:18
such a bad habit it's just this
0:21
generation
but **I go through social media**
0:24
so I check Instagram I love
checking
0:27
Twitter seeing all the different
tweets
0:30
and updates and messages and
dms
and
0:32
also like all my app and I say what's up
0:36
I say hey i love my app for just
0:38
connecting with you guys kind of like a
0:39
big texting group chat just Olivia Jade
0:42
in the App Store
and after all that's
0:44
done I get up and I go to my bathroom
0:47
and I just head down into my bathroom
0:51
and I first start by taking a shower

0:54
today was a really busy work day for me
0:57
I was filming all day for my app so I
1:00
wanted to make sure I was nice and clean
1:02
I used my neutrogena cleansing oil to
1:05
break down my makeup if I had any left
1:07
over from the night before which I
1:08
usually don't but just in case use my
1:10
Lancer cleanse & polish **and then I also**
1:12
use this amazing grace shower gel and
1:15
then a little bit of this wet skin
1:16
moisturizer
and then brush my teeth I
1:19
love brushing my teeth you can really
1:24
it's very rare for me to not **straight**
1:26
like get up and brush my teeth I can't
1:28
like go eat breakfast and do my thing I
1:30
always have to brush my teeth **and then I**
1:32
go in with this net nasir I go into the
1:35
lancers a method Norrish cream and I
1:37
just apply this apply this I'm such a
1:41
beauty youtuber **I just put this all over**
1:44
my face and rub it in and then I go in
1:47
with my Lancer sunscreen because it's
1:49
going to be a hot day at the pier I went
1:52

Figure A.11: Spring Morning Routine 2017 | Olivia Jade part 1/3

to the san juan a computer that day so
1:54
let's putting some sunscreen on **and then**
1:56
it is time to freshen up so that's what
1:59
i used to smell good **and then** picking
2:02
out an outfit
this is a **daily** struggle
2:04
especially when filming but i knew it
2:06
was going to be super hot so **i went for**
2:08
one teaspoon jean shorts which I like
my
2:10
favorites **and then** **I just kind of went**
2:13
through
2:14
looking for a top in my closet which can
2:17
kind of take a little while these days I
2:19
need new clothing I'm over my clothing
2:21
which is so bad
I just take out my
2:25
makeup and got glammed for the day I
2:28
didn't show my makeup just because
2:30
everyone always says my makeup looks
2:31
like the exact same so didn't want to
2:33
bore anyone but I kind of sped through
2:35
some of the products I used real real
2:38
quick and yeah that's basically it I
2:41
went downstairs that had to my dog **went**
2:44
to make some breakfast

I had scrambled
2:47
eggs and I put them in corn tortillas
2:49
with a little bit of cheese and it's so
2:51
good so **take my pan out I**
spray it with
2:54
a little bit of like this olive oil
2:56
spray so it doesn't stick and
then I
2:59
like to crack an egg I'm going to
like
3:02
really walk you through this **and**
then I
3:04
like to crack another egg but
with the
3:07
other egg I don't put the yolk
that was
3:10
oh and i just put like the egg
white
3:13
part in if you get what I mean
and um i
3:17
stir it all up sorry if you're
vegan you
3:20
probably hate me right now **but**
then I
3:23
just put it in a pan and then
make some
3:27
scrambled eggs and I tried
filming all
3:30
this but it was a little bit hard to
get
3:32

Figure A.12: Spring Morning Routine 2017 | Olivia Jade part 2/3

all these angles obviously **and**
 so after
 3:34
 i'm done cooking my eggs |
 then just put
 3:36
 them on plate **and** got some
 corn
 3:41
 tortillas **and** cheese even
 though you
 3:42
 already knew that was coming this just
 3:44
 tastes really good i'm obsessive taco so
 3:46
 this is kind of like a breakfast version
 3:47
 of a taco I like to heat up my
 tortillas
 3:49
 usually I do this in a pan but I
 don't
 3:52
 know I was just feeling kind of
 crazy I
 3:54
 did it just on the stove almost
 burned
 3:55
 myself don't recommend this
 don't do
 3:58
 this **but I then** just heat them
 up put a
 4:00
 little bit of egg a little bit of the
 4:02
 cheese and we're good to go
 I usually
 4:05
 like to have breakfast with my sister or
 4:07
 something oh **I also** got water but no
 4:09
 one was home because it will everyone
 4:12
 was home that was just early in the
 4:13
 morning so it's eating by myself kind of
 4:15
 sad but it's okay uh-huh so I just ate
 4:18
 my breakfast
and then go through social
 4:20
 media usually when I like like to sit
 4:22
 down and have a moment to just like look
 4:24
 through social media
 I love going to my
 4:26
 tagged photos **and** looking at
 4:27
 acute fan pages **and** all the cute edits
 4:29
and everything like that so I'll just go
 4:31
 through and like some of those I'll go
 4:33
 on Twitter favorite some of your guys's
 4:35
 tweets that I like all of that
and then
 4:38
after i end up with that i like to throw
 4:41
 some sort of breakfast bar or some sort
 4:43
 of bar in my purse because as i said i
 4:45
 was working so it's going to be a long
 4:48
 day this was funny i was trying to
 4:49
 figure out a thumbnail I just thought
 4:51
 you guys could see like the struggle um
 4:54
I just grab my bags and then I head out
 4:57
the door and that's it so thank you for
 4:59
 watching and love you guys don't forget
 5:01
 to Like comment and subscribe and I'll
 5:03
 see you guys next time bye MA

Figure A.13: Spring Morning Routine 2017 | Olivia Jade part 3/3

0:00	hi guys so this is our weekend spring	1:49	making this spinach smoothie it is so
0:22	morning routine 2017 so if you guys are	1:52	bomb and yet it sounds gross but is
0:38	new to our YouTube channel we do sleep	1:54	really good
0:40	together sometimes I mean we're sisters	2:02	first things first if you grab a slip of
0:42	so it's not that big of a deal so when i	2:11	grain wheat grass then five large pieces
0:44	first wake up in the morning of course i	2:16	of pineapple ad for tangerine a cup and
0:46	always tie my hair so like everybody	2:22	a half of green grapes to cut for
0:56	else i always wake up and I check my	2:24	spinach then a piece of ginger a
0:58	social medias my sister and I can't go	2:27	teaspoon of organic coconut oil
1:00	eight hours without checking our social	followed	
1:02	media so of course right when we wake up	2:33	with a cup of ice yep is real green and
1:04	we do that	2:38	it's so good
1:07	well I'm trying to get ready for spring	2:40	[Music]
1:10	break so I have to get my skinny detox	2:44	so my sister and I have to go over our
1:12	tea ready	2:47	calendar because we have a busy month
1:13	[Music]	2:49	coming ahead of us and my sis nice to
1:23	I'm weird I always have to light candles	2:52	see every time I try to make her do this
1:25	right when I wake up so I light my	2:54	so I'm happy that she's actually falling
1:27	favorite candle smells exactly like	2:56	through
1:29	roses guys I'm telling you this t really	2:57	[Music]
1:37	fought in your stomach and if you guys	3:07	so after breakfast we're going to go
1:38	want to know more about it comment down	3:10	wash our faces I use tea tree oil she's
1:40	below we'll do a whole video on it while	3:14	a different one than I use I use
1:48	she is making this tea I'm going to be	3:15	dermalogica yes we do brush our teeth
		3:22	

Figure A.14: SPRING MORNING ROUTINE 2017 - Caci Twins part 1/2

but we are not going aboard you guys are
 3:24
 showing as a clip of glass I found these
 3:29
 sliced mass at Urban Outfitters and this
 3:32
 is our **first time** using them it's still
 3:37
 slimy
 3:39
 [Music]
 3:44
 well I have cucumbers and michela
 3:47
 tomatoes because he's a tomato fit this
 3:54
 is actually really fun pain we should do
 3:55
 like a full body mass kisses come down
 3:57
 guide comment down below if we should do
 4:00
 it **while we let this sit for 15 minutes**
 4:09
we're going to catch up with our
 4:10
Kardashians and watch TV now it's been
 4:16
15 minutes so it's time to peel them off
 4:18
because the weather is so beautiful
 4:28
outside right now we're going to shower
 4:29
and shave our legs and layout
 4:33
 [Music]
 4:41
it is still early and the sun is not out
 4:44
completely so we're going to lay here
 4:45
for about 2 hours buy hope you guys
 4:49
 enjoyed our 2017 spring morning routine
 4:53
 [Music]

Figure A.15: SPRING MORNING ROUTINE 2017 - Caci Twins part 2/2

0:00
 good morning guys normally when i wake
 0:01
 up first i get my glasses on and it's
 0:04
 usually not 1203 but that is just when I filmed
 0:07
 the video and I have to check my phone
 0:10
 and I go to the bathroom to wash my face
 0:14
 and brush my teeth
 when I splash the cold
 0:19
 water on my face it really helps me
 wake
 0:21
 up and I brush my teeth got to brush
 them
 0:27
 really good
 then I have to go wake
 0:31
 Olivia which takes a lot of effort she
 0:37
 never really wants to wake up she pretends
 0:42
 that she's waking up and then she just runs
 back in
 0:46
 it takes multiple time somedays
 0:54
 then when I finally get her out of bed she
 1:00
 still does not want to get up and go
 1:02
 into the bathroom but then she realizes
 1:04
 that she has to get in the shower first so
 1:06
 she runs in and I'm like oh come on
 1:10
 Olivia I guess I'll wait on you to take
 1:12
 a shower then we get dressed and sometimes
 1:19
 it takes a few tries to get Olivia in
 1:21
 the right outfit for school and even
 1:24
 some persuasion from Madison and Gracie but
 1:27
 while Madison and Gracie are changing her I go
 1:30
 down and make us breakfast this morning
 1:36
 I'm going to have some honey nut tree
 1:37
 they're one of my favorite cerials and by
 1:41
 the time I finish making a cereal she's
 1:44
 usually ready so then I informed on all
 1:47
 the cool stuff that I'm learning at
 1:49
 school and she loves hearing what I could
 1:51
 say
 1:54
 then we have to put our dishes away then we
 1:58
 get our backpacks on and we head out
 2:02
 the door time for school see you guys
 2:05
 later
 2:09
 you
 2:09
 [Music]

Figure A.16: Sierra's Morning Routine part 1/1

<p>0:00 hi yes this is the morning that I wish 0:06 that I have every single day just really 0:09 chilled waking up the right time just 0:12 ready for a new day little miss sunshine 0:15 all that good stuff unfortunately that's 0:25 never me oh well good morning guys and 0:35 welcome to my morning routine of 2017 so 0:39 I'm gonna show you I do on an everyday 0:41 morning basic routine firstly i'm 0:44 obviously waking up turning on the 0:46 lights and then just checking my 0:47 Instagram and just you know just chillin 0:50 in my bed 0:53 [Music] 0:58 I also checked my computer just my 1:08 youtube channel and then I answer some 1:10 comments watch some YouTube videos all 1:13 that good stuff and then I obviously 1:17 know it's time to get up a sad fact 1:21 about me is that I'm always freaking 1:23 cold so I've got my slippers on and then 1:25 I'm also gonna get my bathrobe or</p>	<p>1:28 whatever you want to call it because it 1:30 is so snuggly it's pretty really big and 1:32 just really really really cozy and one 1:42 of my goals for 2016 was actually to 1:44 make my bed almost every single day and 1:46 I almost made it almost so I'm all these 1:50 e until trying to keep that promise to 1:52 myself just to make my bed so there's a 1:53 bit more need and a bit more fresh from 1:55 me so yeah I'm just doing my bed as you 1:58 can see tidying up a tiny bit 2:01 [Music] 2:04 and once i'm done with that i am turning 2:10 out the lights and then moving into my 2:12 kitchen area because now it's time for 2:14 some breakfast and even though i'm not 2:16 the biggest breakfast eater I still won 2:18 my morning tea and um I just have some 2:21 kind of like green tea or some kind of 2:23 her booty whatever I feel like I want to 2:26 do some personal keeping tea which is 2:28 really good so I'm just making myself a 2:31 cup of tea and then also some breakfast</p>
--	---

Figure A.17: MY MORNING ROUTINE 2017 part 1/4

2:33
 and once again a sad fact about me is
 2:39
 that I don't usually eat that much
 2:42
 breakfast but I made a promise to
 myself
 2:44
 that I have to get better at that so I'm
 2:47
 gonna have some sort of babe at whole
 2:50
 almonds snacky breakfast kind of thing
 2:53
 with some yogurt as well since I yoga'd
 2:56
 which is really really good from alpro
 2:58
so I'm just chopping up an apple which
 3:01
 is one of my favorite apples being a
 3:03
 limb of the apples if you haven't tried
 3:05
 them they are yummy as L so I'm just
 3:08
 gonna be chopping that up in some
 small
 3:10
 pieces
 3:11
 [Music]
 3:20
and then afterwards I'm also gonna use
 3:32
some yogurt obviously in the bottom
of
 3:35
the bowl and then open some almonds
 3:38
which I'm also going to chop up into
 3:40
small pieces and i don't use any
 3:42
 measurements for this just a cut like a
 3:45
 small handful of almonds is fine **and**
3:51
then the secret ingredient is some
 3:55
vanilla powder just on top that is so
 3:58
 friggin yummy **and then** **my tea is ready**
 4:01
 and that is basically just my breakfast
 4:04
 really really quick simple easy but very
 4:07
 yummy I'm so freaking Instagram cool I
 4:10
 mean come on that is beauty in a bowl
 4:12
and then we're moving into my living
 4:21
room because I usually sit and watch
 4:23
some TV a TV show or something like
 that
 4:26
or sometimes I also edit videos but
 4:28
today i was watching scam voices saying
 4:30
 Norwegian I'm TV show which is about
 4:32
 teenagers falling in love and then I'm
 4:35
 watching season 3 i'm actually done
 with
 4:36
 it already there I just burned my tongue
 4:38
 as I **always** do a lot freaking tea and
 4:41
 them is **eating my breakfast** watching
 4:44
scam if you haven't watched scam you
 4:46
 have to is so freaking good I love
 4:50
 season 3 because it's all about the gay
 4:52
 community and how it is to be gay and
 4:54
 ehm have a gay relationship and just
 4:56

Figure A.18: MY MORNING ROUTINE 2017 part 2/4

coming out as well I just really love
 4:58
 that I left the world gets so much more
 5:02
 open-minded about those things
 honestly
 5:04
 just be yourself and then
 once i'm done
 5:09
 with my breakfast I always take it out
 5:12
 I never finish my tea unfortunately even
 5:14
 though it's really really good and then
 5:16
 I just wash it off so it's not as sturdy
 5:18
 and then moving on into my bathroom
 5:21
 because now I have to brush my teeth and
 5:23
 have a shower as well and just wake up
 5:25
 for real and I just found out the pimple
 5:28
 that I had was almost gone that was
 5:30
 really like yeah a moment for me
 but i'm
 5:34
 just gonna be brushing my teeth and
 5:35
 honestly I'm always having a bit of a
 5:38
 dance off when I'm brushing my teeth
 and
 5:40
 if anybody tells you that you're too old
 5:42
 to dance around and this is an
 awesome
 5:44
 music while you're brushing your hair or
 5:47
 just brushing your teeth get them out of
 5:50
 your life you never get too old to have
 5:52
 fun
 5:53
 [Music]
 5:58
 by the way am I the only one who kind
 of
 6:01
 wiped off my toothbrush after done
 using
 6:03
 it weird thing and then I'm just
 6:06
 brushing my hair because I'm gonna
 put
 6:07
 it up in a ponytail like a really messy
 6:10
 ponytail because I don't want to wash
 my
 6:11
 hair that day because it wasn't dirty so
 6:14
 I'm putting on my amazingly beautiful
 6:17
 and really really sexy shower cap
 6:19
 looking fancy right not and then I'll
 6:24
 put the clothes and into the shower
 hey
 6:29
 get out no oh cuz it and i'm just using
 6:33
 somebody products just to cleanse my
 6:36
 body obviously and then i'm just using
 6:38
 some different skin care products
 6:56
 and once i'm done with that it is time
 7:02
 to find some clothes for the day
 and i
 7:05
 just found a pair of jeans and a t-shirt
 7:07
 and then it's time for the make up and

Figure A.19: MY MORNING ROUTINE 2017 part 3/4

7:10
then I was finding some different
 7:12
 products to use **for that day** and I know
 7:14
 which will be messy that **then** I'm just
 7:17
sitting on my bed watching some TV
show
 7:20
 I think it was the great day nice play
 7:22
 golf **or something like that** **and then** I'm
 7:24
just applying my makeup and if you
 want
 7:26
 to do a new everyday makeup tutorial
 and
 7:28
 we know because i have changed a tiny
 7:30
 bit what I do but let me know
 7:34
 [Music]
 7:41
 [Music]
 8:05
and once the makeup is done I'm just
 8:14
putting my hair up in a ponytail because
 8:16
I just felt like that really quick
 8:19
 simple easy nothing too fancy fancy **and**
 8:22
then applying a tiny bit of lip gloss
 8:24
and then moving on to get some clothes
 8:27
on so I just wanted to wear a belt as
 8:31
well for those jeans because there were
 8:33
 tiny bit too big **and then** putting on
 8:36
some boots and then that is the outfit
 8:39
 of the day really basic simple easy very
 8:42
 minimalistic but that is me in a
 8:44
 nutshell **and then it's time to** **head out**
 8:48
the door
 I'm just grabbing an apple **and**
 8:50
my keys and then putting on a blazer
 8:53
 precise with the times and cold because
 8:54
 it's winter time **and then** I'm also
 8:56
putting on my jacket and a scarf and
 8:58
 that was all this video guys who really
 9:00
 hope that you enjoyed it like and
 9:01
 subscribe and thank you so much watching
 9:03
 love you all

Figure A.20: MY MORNING ROUTINE 2017 part 4/4

0:03	typically no always wake up first	it and I asked myself the question that
0:05	because he has an internship a few days	1:00 repeat the mantras and then I will do a
0:07	of the week so with LA traffic and how	1:02 meditation you look like a video all
0:09	it really his internship is he usually	1:04 about meditation I could do that but I
0:11	is up pretty early gives me a nice	1:06 can also link a few videos down below
0:13	little juice one cheek it is off for the	1:08 giving me - let me know in the
0:15	day now I usually wake up from Rooster	1:10 comments
0:19	give me kisses he is super cute and the	1:12 what you want - what you want but
0:21	mornings always giving me lots of love	1:13 when
0:22	ins and basically telling me hey it's	1:15 occasion is great if you deal with
0:25	time to get out and can't use dating but	1:13 anxiety stress or just just to do in
0:29	honestly with a cute puppy you miss how	1:15 general really calms my mind focuses
0:31	could anyone complain or ever wake up in	1:18 me
0:33	a bad mood now I stretch and wake up	1:19 on my goals for the day and between
0:40	first thing I always do is reach over	any
0:42	for my water that way I make sure I've	1:19 great mood
0:43	already drink a good bit of water for	1:22
0:45	the day I chug chug chug chug chug as	[Music]
0:47	much as possible or sometimes just sip	1:23
0:50	sip when I'm on camera and then I will	1:23 now this why it is a cute picture a
0:52	pull out my find your happy daily mantra	1:26 wrister because by the time I was done
0:54	book and this is when I do my morning	1:27 he was already ready to go back to bed
0:56	meditation	1:29 he was just so awake like two seconds
0:58	I read one page a day I read	1:31 ago and then since I don't know him I
		1:34 honestly spend like every moment
		1:35 together so when he does go to his
		1:36 internship I usually send him a really
		1:38 nice good-morning text just because I
		1:40

Figure A.21: Healthy Morning Routine 2017 part 1/4

already miss him
 1:40
 um yeah cheesy but it's a day and I'll
 1:47
time to get up and brush my teeth
 1:49
 because nobody wants to smell my breath
 1:51
 in the morning I promise **and now it's**
 1:55
time to grab jackets and shoes and
 1:56
definitely some sun glasses because
 1:58
 nobody wants to see my face in the
 1:59
 morning either **and take Rooster out for**
 2:02
his morning walk which by the way is
 2:07
 very new at his leash so **it still takes**
 2:09
a few tries of getting out the door and
 2:10
 everything but he's doing pretty well
 2:12
and then I always come back in with my
 2:14
coffee well not always depending on if I
 2:15
want to splurge for myself there is a
 2:17
 coffee and tea room just below my
 2:19
 apartment **so this morning** I got myself a
 2:20
 London Fog I had become super obsessed
 2:22
 with some rice recently there's some
 2:24
 yummy like Suzy so yummy **and then after**
 2:30
I feed Rooster his breakfast it is
 2:32
time to set the mood with a candle no
 2:34
 I'm just kidding I'm pretty much **only lit**
 2:35
this because I was filming but it's time
 2:38
to feed myself my own breakfast
this
 2:40
morning I decided to do a snowy Bowl
 2:42
 just because while I look good on
 camera
 2:43
 and they're pretty delicious so I just
 2:45
add some yogurt some frozen
fruit some
 2:48
peanut butter and a whole
banana and
 2:50
then I blended that up super
 super yummy
 2:52
sometimes I just like to use a
 frozen
 2:53
 banana and it makes it a little
 bit more
 2:54
 like açai Bowl texture but this
 2:56
 morning I didn't have a frozen
 banana so
 2:58
 this will work **and then after I**
blend it
 3:00
all up I will top it with granola
and
 3:02
coconut seriously so yummy
 3:05
 [Music]
 3:13
now time for me to hit the gym so
 3:16
 usually I will go to the gym **3 to 4**
 3:17
mornings out of the week let me know in
 3:19

Figure A.22: Healthy Morning Routine 2017 part 2/4

the comments if you'd like to see my
 3:20
 fitness routine I could do that really
 3:21
 soon and one thing I've been loving to
 3:23
 do as a gym is using the bike I feel
 3:25
 like it's actually really fun okay **and**
 3:32
then I get home and immediately hop in
 3:35
the shower this girl is thank you
 3:36
 nobody wants to be around that **and then**
 3:39
when I'm done it is time going to get
 3:40
ready for the day funky glad to meet me
 3:44
 I think you should happy back to me tell
 3:48
 you all you got to meet me I think you
 3:51
 should how do you package now here's
 4:02
 just a **quick overview of my outfit and**
 4:04
my makeup I'm obviously not going to
 4:05
 spend all the time telling you
 4:06
 everything because I'm dropping out a
 4:07
 makeup artist however if you look like
 4:09
 if you make an updated makeup routine
 4:11
 maybe I do that I don't know I'm not
 4:12
 like good at it but here's just
 4:13
 everything I've pretty much used every
 4:15
 morning **sometimes I'll change it up** like
 4:17
 with my eye shadow that's pretty much
 4:18
 all I really change up but this is
 4:20
 pretty much all **do every single**
 4:21
morning or when I'm going somewhere
 4:23
obviously if I'm not leaving the house
 4:24
girls not putting any makeup on but
 4:26
 today I did have a few things to do some
 4:28
 meetings and stuff so yeah
 4:33
 [Music]
 4:41
then I'll finish off any of my emails or
 4:44
anything I need to do on the computer real
 4:45
 quick and then it's time for you get
 4:47
 going throughout the day **sometimes I**
 4:49
 have meetings **sometimes** I don't leave
 4:50
 the house it really depends but today I
 4:52
 have some errands to run so I hope you
 4:54
 guys enjoyed this video and I'll see you
 4:56
 later alright guys that is it for my
 4:59
 morning your team did you like it let me
 5:01
 know in the comments give a thumbs up
 5:03
 also there's giveaway in this video I am
 5:06
 giving away an iPad Mini as well as a
 5:08
 Fujifilm Polaroid camera all you have to
 5:10
 enter isn't want to be a subscriber into
 5:12
 following on Instagram to turn on my
 5:13

Figure A.23: Healthy Morning Routine 2017 part 3/4

YouTube notifications is the bell symbol
5:15
down below that way you know every time
5:17
I upload and also you don't miss when I
5:19
announce to giveaway winner so that's
5:21
anyone wanting your team for the days
5:22
that Noah goes to work or like his
5:24
internship so if you'd like to see a
5:25
morning routine with both of us together
5:27
like an engaged living together morning
5:29
routine let me on the comments we can do
5:31
that very soon check out all my social
5:33
media linked down below subscribed if
5:34
you haven't already and that would be
5:36
guys you know see you next time bye

Figure A.24: Healthy Morning Routine 2017 part 4/4

0:00
 hey guys so this is my before class or
 0:13
 school morning routine basically just a
 0:16
 run-through of my everyday um kind of
 0:20
 step-by-step morning ritual or whatever
 0:24
 so I set my alarm **or** wake up by myself
 0:27
 around nine **or** nine-thirty **and then** I
 0:30
 like to just lay around **and** get on my
 0:33
 phone for a couple minutes **while** I'm
 0:35
 waking up um
 you know **checking all that**
 0:38
 Instagram snapchat **and** all that stuff
 0:42
and now i'm just getting out of bed **and**
 0:46
moving into the bathroom where of course
 0:50
got to start off by brushing your teeth
 0:52
 and also huge thing for me is not
 0:58
 wearing pants when i sleep because it
 1:00
 feels amazing so if you haven't done
 1:01
 that you should try it and no socks that
 1:06
 way you get the most out of your seat I
 1:09
 feel like **and then** moving to the shower
 1:14
 and I like to **wash my hair** in the
 1:18
 mornings so that way it can **air dry**
 1:20
while I'm **doing my makeup** and **making**
 1:22
breakfast and **eating** and all that so I
 1:25
 have to worry about blow drying it like
 1:27
 before we go to sleep or whatever so I
 1:29
use the Pantene pro-v moisture
renewal
 1:32
dream care shampoo and conditioner
 and
 1:35
 this actually has been **my current**
 1:38
favorite because I can use it more
 1:40
regularly on daily basis because it
 1:43
 actually doesn't strip your hair while
 1:44
 like the oils and moisture that other
 1:48
 shampoo conditioners to do so i can
 1:50
 actually wash it more often so it feels
 1:52
 clean but it doesn't make it feel dry or
 1:55
 anything like that and it leaves it
 1:57
 really smooth so i can just run my
 1:59
 fingers through it
 2:01
 a huge deal with having long hair as it
 2:03
 gets tail really easily so using this
 2:05
 more often has allowed me to prevent
 2:09
 those tangles in the first place so
 2:12
 that's awesome
next I'm moving on to a
 2:16
skincare
and all I do is I used to
 2:19
sunday riley good genes lactic acid
 2:21
treatment and actually got a little kind
 2:24
 of trial size from sephora i've been
 2:26

Figure A.25: Before School Morning Routine | viviannv.txt part 1/2

using lately and i actually am obsessed
 2:28
 with this a helped a lot with my acne
 2:30
 scarring and just like discoloration in
 2:31
 general just after the first couple
 2:33
 times I used it so so hopefully it keeps
 2:37
 working as well it is **and then I just**
 2:39
used some moisturizer but that the
 2:41
 receipt for skin care I don't like to do
 2:43
 anything too invasive just because I
 2:45
 don't want to irritate my skin before do
 2:47
 my makeup but those are two simple
 2:49
 things like to do
and then of course I
 2:51
got to take Jasper out on a little walk
 2:54
 so he's being such a good boy about
 2:57
 leash him up and walk him around the
 2:59
 neighborhood **so after our walk I like to**
 3:05
do a quick workout at home
 basically I
 3:09
like to roll up my yoga mat in front of
 3:11
the window to let some natural light
and
 3:13
play some music and do some leg
workouts
 3:17
and core workouts like crunches and
fire
 3:20
hydrants and yeah
next I'm making some

3:24
breakfast
 and she's like **my latest go to**
 3:27
 super easy and quick and it's just
 3:29
 blueberry pancakes which I actually
 3:32
 showed you guys in a my first vlog but I
 3:36
 just gotta show off this like perfect
 3:37
 pancake I made I'm pretty proud of **and**
 3:40
then add some powdered sugar and
syrup
 3:43
or honey or fruit or Nutella or
whatever
 3:47
floats your boat um but yeah
 3:53
 and **today** I just had a chai tea latte
 3:59
but other days i'll have like juice or a
 4:02
 tazo tea just **whatever** i'm gonna move
 4:07
 for **and then next** i'm just laying out a
 4:10
blanket by my mirror making sure i get
 4:12
some good natural lighting by the window
 4:14
and just do my makeup real quick this
 4:17
particular day I just for some
 4:18
 foundation but also if you guys want to
 4:20
 see it updated for everyday makeup
 4:22
 routine let me know okay I came down to
 4:27
 do that **and then** I am going to just do
 4:30
some last minute studying or homework
 4:32 before class **and then** I am off 4:37
 [Music] 4:47 [Applause]

Figure A.26: Before School Morning Routine | viviannv.txt part 2/2

0:00
 hi everyone welcome back to my channel
 0:03
 so today I have a one-hour realistic
 0:05
 morning routine video for you because I
 0:08
 thought it would be fun to share hey how
 0:10
 to get ready in one hour so if you
 0:12
 enjoyed this video please give a thumbs
 0:13
 up and subscribe if you're new and let's
 0:15
 get started so of course you have to set
 0:17
 your alarm I found that when I was
 0:19
 working or going to school 7am was a
 0:22
 good time for me to get up I would get
 0:23
 ready from seven to eight and the key
 0:25
 thing here is to not press snooze and to
 0:27
 not try and have a little bit extra
 0:29
 sleep of it to force itself out of bed
 0:31
 exactly when your alarm goes **so get up**
 0:33
and get out of bed the first thing that
 0:35
I always like to do is I go straight to
 0:37
 cut my coffee machine and I make coffee
 0:39
 or tea but **recently I've been into** the
 0:41
 coffee it's **like every two weeks or**
 0:42
three weeks I go in and out of coffee
 0:43
and tea but I start with coffee I have
 0:45
 an espresso machine and it's the black
 0:47
 pods that are my favorite and I use a
 0:49
 little bit of soy milk as well so I
 0:56
 don't really like to have breakfast
 0:58
 straight away I know this is really
 0:59
 weird that it doesn't make me feel that
 1:00
 great **so I like to have tea or coffee**
 1:02
and kind of let it settle before i
 1:03
actually have breakfast so I always just
 1:05
take my tea on my coffee down with me to
 1:07
like my desk and that's when I do my
 1:09
makeup and I know this might be weird
 1:11
 some people but I do my makeup before I
 1:14
 eat and brush my teeth weird I know but
 1:15
 it's just what i like to do you could do
 1:17
 it whichever way that you like but for
 1:20
 my makeup **today i started with my**
 1:22
foundation i am using my astrologer to
 1:25
glow foundation in the color fawn and
 1:27
then for concealer and highlighter i'm
 1:28
using my IT cosmetics like duo I keep
 1:32
 forgetting what this is called but i'll
 1:33
 have it listed in the description and it
 1:35
 has a concealer on one end and a liquid
 1:37
 highlight on the other **and then i go**

Figure A.27: 1 Hour Realistic Morning Routine part 1/4

1:39
ahead and just powder off my face to
 set
 1:42
 everything i do a little bit of bronzing
 1:44
 using my anastacio kit **and then** i pop
 on
 1:47
 a little bit of blush for the day **and**
 1:48
then i go ahead and put on some
 1:50
highlight basically just all the basics
 1:52
 i do the full face I will have a link to
 1:54
 my everyday makeup routine in the
 1:56
 description but i think i need to do an
 1:58
 updated one because I swear my
 everyday
 1:59
routine changes like every month so I
 2:02
 feel like it's gonna have to become like
 2:03
 a monthly ritual **but I just go ahead and**
 2:05
fill my brows oh can I point out this
 2:07
 Sigma brow pencil is amazing and it is
 2:09
 perfect for daytime it's the
 2:11
 best brow product for every day **so for**
 2:17
my eyeshadow I'm going with my
 favorite
 2:19
e orange e-type colors **so I'm starting**
 2:22
with the color camel all over
 my lid
 2:25
 from the lorac mega Pro palette
and then
 2:28
 I'm going to go into the outer
 crease in
 2:30
the other corner with sepia
 which is my
 2:32
 absolute favorite color because
 it's
 2:34
 pretty much the only one that
 have hit
 2:35
 pan on **and then** I'm just going
 to go
 2:36
ahead and use cream as a
highlight to
 2:38
blend that all out and soften
up all the
 2:40
 edges
then I'm going to take some
 2:42
eyeliner and do a little bit of a wing
 2:44
and then I'm going to pop a coat of
 2:46
mascara on both the top and bottom
 2:47
lashes also on this particular day I
 2:52
 decided to type myself and see how
 long
 2:54
 it actually took me to do this
 2:55
 particular makeup look and I forgot to
 2:57
 start recording when doing my
 foundation
 2:59
 like the Australis foundation but once I
 3:01
 had finished it I set my timer and the
 3:03
 rest of my face actually only took 17

Figure A.28: 1 Hour Realistic Morning Routine part 2/4

3:05 minutes so it is totally doable to do
 3:07 all of your makeup in 25 minutes each
 3:09 day **so then it's time to** head to the
 3:14 kitchen **and** make some breakfast so at
 3:17 seven-thirty i like to juice all of my
 3:20 goodies from the night before so if you
 3:22 remember watching at my
 organizational
 3:23 night routine well this is the morning
 3:25 routine that follows that so i'll have
 3:27 that listed in the description if you've
 3:29 not seen that organizational night
 3:30 routine but I had all my Froot prepared
 3:33 the night before so that I can totally
 3:34 just chuck it in the juicer and make
 3:36 some fresh green juice because I'm a
 3:38 juice person and not so much a
 smoothie
 3:39 person **and then I'm going to go ahead**
 3:41 **and** make breakfast my favorite
 breakfast
 3:44 I think **right now at the moment** that I
 3:46 have been obsessed with ya are these
 3:48 like bread stick thingies that you get
 3:49 from kohls I've made them many times
 3:51 before in my water ate today videos
 and
 3:53 I put fresh tomato and avocado and red
 3:56 onions on them and once i toast them a
 3:58 little bit with some salt and pepper it
 3:59 is so good it really doesn't take that
 4:01 long to make if you were really well
 4:03 behaved you could cuddle the
 ingredients
 4:05 off the night before **so I just went**
 4:07 **ahead and** made these **and then** I go
 and
 4:09 take them **and sit down on my computer**
 4:10 **and** I go through emails go through my
 4:12 youtube subscription **and** just kind of
 4:14 check up on **everything** that I'd missed
 4:15 while I was leaving
 4:17 **then it's time to** get dressed and
 4:21 everything should be laid out from the
 4:23 night before so that your are nice and
 4:24 organized and all you have to do is put
 4:25 your clothes on so i have this adorable
 4:27 little Eiffel Tower shirt that we got
 4:30 from valley girl I think one time and
 4:32 I'm just wearing some black jeans and
 4:34 black boots just made my outfit super

Figure A.29: 1 Hour Realistic Morning Routine part 3/4

4:36 simple and yeah like I said if
 4:38 everything is just light out but not
 4:40 before then all you got to do is just
 4:41 put it on then I head over to the
 4:46 **bathroom and I brush my teeth** I don't
 4:48 know what my toothbrushes colgate I
 4:50 think who knows there's a bunch of
 4:52 toothbrushes at the toothbrush store and
 4:53 I just like toothbrushes when I need
 4:55 them **and then once I've brushed my teeth I**
 4:57 **go ahead and brush through my hair**
 4:58 definitely need some dry shampoo **on this**
 5:01 **particular day** but I may have run out
 5:03 and I really need to buy some more but I
 5:04 just go ahead and give my hair a brush
 5:06 whether I'm gonna put it up or leave it
 5:07 out like it is **whatever** is just
 5:09 happening that day **it's just when I work**
 5:10 **my hair in and then I go ahead and put**
 5:12 **on at my lip product** because I had
 5:13 brushed my teeth and I'm using my becky
 5:16 steeler liquid lipstick **and then it's**
 5:19 **time to quickly pack all your bags**
 5:21 everything should be laid out from the
 5:22 night before again books bag handbag
 5:24 everything everything should be sorted
 5:25 from the night before so all you got to
 5:27 do is pick it up and walk straight out
 5:29 the front door so I hope you guys have
 5:30 enjoyed this video if you have make sure
 5:32 you give it a thumbs up and you can
 5:33 check out my last video at the top and
 5:35 another routine video down the bottom
 5:37 and i'll see you in my next video bye

Figure A.30: 1 Hour Realistic Morning Routine part 4/4

A.2 Video transcripts

Winter Morning Routine

0:00 good morning you guys welcome to my 0:01 winter more actually you know what let's 0:04 just look at have to rewind this kind of 0:06 embarrassing actually Christmassy vibes 0:12 all over the place if this intro is way 0:14 better I usually go to bed really really 0:16 late so I wind up waking up super tired 0:19 and then I realized I woke up way too 0:21 early two hours later now after a 0:27 hundred yawns later I get out of bed I 0:29 can't move on without showing you my 0:31 Christmassy Sox can't do it then I just 0:33 got my new bedding I got it in and I 0:36 just moved into my new apartment so I 0:38 wanted to show you guys be making my bed 0:40 let's just be real right now I like to 0:42 brush my teeth in the morning as soon as 0:44 I get out of bed brush my teeth get that 0:46 nasty taste out of my mouth and can we 0:48 all just give it up give a big emoji 0:50 hand clap to this see inspired Santa 0:53 Claus right now perfect for the restroom 0:55 I saw I'd at TJ maxx i was like i have 0:57 to have that because my restroom needs 0:59 Christmas loved to and I'll wash my face 1:00 with a cleanser and to make sure it's 1:02 really rubbed in really good i will do 1:04 with this face dance she's part of my 1:06 routine you guys do that too right it's 1:08 normal right I've been using the touch 1:10 assault claim for my face oh my god it's 1:13 so good will literally give your skin a 1:15 silky feel i love it i highly recommend 1:18 it to anybody with very dry skin and for 1:21 my hair i'm just leaving it down today 1:22 washed it yesterday just putting it down 1:24 in its natural habitat we're foundation 1:26 today i'm gonna be using the vanished 1:28 cream hourglass foundation stick and 1:30 then a little bit of shape tape under 1:32 the eyes from Tarte benefit goof proof 1:34 to fill in my brows and i'm using this 1:38 Maybelline contour stick which is really 1:40 creamy 1:41 and I really like the way it blends use 1:43 that to contour today and I'm not going 1:45 into too much detail on my makeup 1:47 because this isn't a makeup tutorial so 1:49 giving you a quick run through of 1:51 everything i'm using i used to bh 1:53 cosmetics on my eyes i use their marble 1:56 palette which i think it's a really 1:57 beautiful palette and I love Bea age 1:59 because they're so affordable and 2:00 quality is really good and then oh my 2:03 god you guys I'm obsessed with the 2:05 two-faced sweet peach everything the 2:07 palette the highlight the blush the lip 2:10 gloss and love flashes i'm using the 2:12 flutter lashes in kelsey they're really 2:14 natural wispy just really pretty and 2:16 this is my look for today and now that 2:18 i'm all done it is time for breakfast 2:20 AKA coffee 2:22 [Music] 2:28 okay everything before this moment does 2:32 not count coffee before talkie actually 2:35 have a blue coffee mug that says that so 2:36 I just want to give a quick shout out to 2:38 my coffee mug for the info on this I've 2:41 said this before I will say it again 2:42 coffee is not coffee to me without 2:44 creamer my creamer is everything this 2:47 maple cinnamon pancakes candle is my 2:50 life it is so good from Bath & Body 2:53 Works you guys have to try it it smells 2:55 a delicious I usually check my snapchat 2:58 anyways let's go ahead and get ready and 3:01 today's outfit is not going to be a 3:04 Christmas sweater darn it it's just 3:07 gonna be a regular sweater and some 3:10 jeans okay times again change 3:15 yes that was I was like magic right I'm 3:20 gonna go ahead and put on these ugly 3:22 christmas socks because why not now it's 3:27 time for boba to get in the Christmas 3:30 spirit she actually is fighting with me 3:32 not to put this thing on she did not 3:34 like it I took it right off of her but I 3:36 thought it was look cute and I wanted 3:38 her to be in the video and she's such a 3:40 cute little kitty so I put her in and 3:42 she walked around in it and honestly her 3:45 fur is just way too fluffy or outfits 3:49 like this because she just looks like a 3:51 muscle man in them so enjoy 3:56 [Music] 4:01 and then last minute I put these antlers 4:04 on here and honestly she was not having 4:07 it she was like no I am done with you I 4:10 cannot even deal with you and then I put 4:13 him back on her because yes i am that 4:15 cat mom I needed a picture for snapchat 4:17 Heller you guys seem to like it I saw

a 4:21 lot of each screen shot her oh my 4:23 snapped huh she's so she looks so grumpy 4:26 I swear she's like the happiest cat ever 4:28 she literally just sits around all day 4:30 and looks out the window that is her 4:32 life she doesn't even know she just sits 4:34 there enjoys life you can cuddle with 4:38 her you can pet her she won't move I 4:40 promise she's not very active but she's 4:43 super lovable and I love her so much 4:46 so after Mike activities I like to write 4:49 down my video ideas for future months 4:52 and I'll look through my schedule make 4:54 sure i have my week down pack and that's 4:56 pretty much what my day consists of in 5:00 my house if it's not filming and then 5:02 I'm going to go ahead and head out now 5:04 I'm gonna put on my booties these are 5:06 from steve madden they're super cute and 5:09 i love this crop top sweater from Alou 5:11 lose my jeans are actually from hot 5:13 Miami styles and I've had him for about 5:14 a year and I love them so much irie wear 5:17 them all the time way too much actually 5:20 and I'm just gonna go about my day but 5:22 before I leave I'm gonna try not to burn 5:24 down my new apartment so that's pretty 5:26 much it I hope you enjoyed this video 5:28 and until the next one I love you guys 5:30 bye dollies

WEEKEND MORNING ROUTINE

0:00 hey guys welcome back to my channel in 0:05 today's video I am filming a weekend 0:08 morning routine for you all so in the 0:11 morning I normally get off around 1030am 0:13 I know that might sound late but that's 0:17 pretty early for me and just like 0:19 everyone else I will go on my phone and 0:20 check my social media and then I never 0:36 make my bed but just for this video I 0:38 make my bed you can tell I am awful at 0:41 making beds I am just literally pulling 0:43 apart 0:45 [Music] 1:07 so now it's time for breakfast it's 1:10 normally like twelve o'clock now but 1:13 yeah petting my dog here hey Ames what's 1:17 up 1:20 [Music] 1:23 so I normally have toes with like peanut 1:26 butter or Vegemite but I felt like we 1:29 pick so i have to let me be four three 1:31 and then I put a shit ton of sugar so 1:34 then I go back to bed I literally could 1:47 stay here all day and I just ate my 1:49 breakfast in bed because everyone's 1:51 normally awake now going to do things 1:54 don't need to do things they're going to 1:57 do things so I'm just gonna loan I 1:59 normally watch youtube or I go on Nestle 2:03 recently I have been watching 13 reasons 2:06 why 2:08 [Music] 2:23 when I eventually get a bad I have to 2:27 put music on to get ready so here I am 2:29 just listening to my splendor playlist 2:32 and my little needs that wanted to say 2:34 hi so his her brushing her teeth with me 2:37 and we are just getting ready 2:39 [Music] 2:44 so now it's time to make up I'm just 2:46 doing a quick little rundown of my 2:49 everyday makeup routine that video is 2:51 coming very soon but this is just my 2:54 basic makeup routine 2:56 [Music] 3:14 [Music] 3:17 now that my makeups done I'm going to 3:35 turn my outfit to my top is from Zulus 3:37 am I short up from princess Polly 3:44 then I grab my bag and I head out the 3:56 door to whatever I'm doing that day is 3:58 are going to you know it's friends goin 4:00 to lunch whatever but if I'm not doing 4:04 anything I literally come back inside 4:07 and I will get a snack today I was 4:10 having a banana and just chopping it art 4:14 [Music] 4:16 and then I go back in my bed I'm playing 4:30 with my dog here she's honestly it's so 4:32 cute and he poses to the camera when we 4:35 try have fun and always ate my snack 4:39 what's YouTube go on netflix and I 4:50 actually had some parcels i'm going to 4:53 show you what I got if I have some I 4:55 glitter and some metallic tattoos and 4:58 then in my other bag I'm struggling to 5:01 open it up but it's a yellow dress is 5:05 from the inner our boutique so that was 5:10 my weekend morning routine for you all I 5:12 hope you guys enjoyed this video I love 5:14 you all so much if you enjoyed it and 5:17 what more videos like this please give a 5:19 thumbs up and I'll see you guys in my 5:21 next one very soon 5:24 [Music] 5:34 you

SPRING MORNING ROUTINE 2017!!

0:00 hey guys and Rafi and welcome friends to 0:01 my channel today i'm doing a spring 0:03

morning routine for you guys to be 0:05 honest I don't really have much to say 0:06 about it other than this has been just 0:08 my normal morning routine for the past 0:10 few weeks now if you guys liked the 0:12 video be sure to give it a big thumbs up 0:14 let's simply get 24 into a thousand 0:17 thumbs up I know you can and also 0:19 subscribe to my channel if you haven't 0:20 already we are getting so close to two 0:22 million subscribers which is just crazy 0:24 yeah I think that's all I have for the 0:26 intro so let's get start alright guys so 0:28 my morning routine begins with me 0:30 obviously waking up in the morning and 0:32 if you know me I am NOT a morning person 0:34 so I'm usually woken up by Daisy licking 0:37 my face it's usually like startles me 0:39 and then I'll wake up and play with her 0:41 a little bit I'll go in for a kiss and 0:43 she usually rejects me and then I'll go 0:45 ahead and just stretch of it and then 0:47 actually get it first thing I do in the 0:48 morning is take a shower I've actually 0:50 become a morning shower or about a word 0:53 or shampoo and conditioner lately i've 0:54 been using the Shea Moisture argan oil 0:56 and almond milk smooth and same line 0:58 which is amazing it's been helping with 1:00 my frizz and fly way and it's awesome 1:02 because it protects your hair against 1:04 thermal damage caused by heat styling 1:05 which you guys know I'm always throwing 1:07 my hair and straightening it and 1:08 everything so it's awesome so first big 1:10 start with the shampoo this is actually 1:11 sulfate free and the gently cleanses 1:13 while controlling my screws and 1:15 smoothing my hair and then I'll move on 1:16 to the soft and detangle conditioner 1:18 which basically just helps to detangle 1:20 and smooth and revive my hair which my 1:22 hair gets so so so tingly so this stuff 1:25 is amazing for it once i'm done washing 1:27 my body and shaping and doing all the 1:29 other fun stuff I will brush my teeth 1:31 then once all that stuff is done I will 1:35 head over to my closet and from there I 1:37 work on my makeup I pick out my outfit 1:39 for the day get changed and do my hair 1:41 now starting with my makeup I have a 1:44 pretty long routine that I do every 1:46 single day so if you guys want to check 1:48 that out I just put up a video of me 1:50 showing you how I do it from start to 1:51 finish so you guys can watch that I will 1:53 link it down below if you want to check 1:54 that out and you can watch an actual 1:56 in-depth tutorial once the makeup is 1:58 done I will move on to picking out my 1:59 outfit for the day and for the spring 2:01 time I love wearing really cute and 2:02 girly things I absolutely love the whole 2:05 off the shoulder top trends so I am 2:06 obsessed with that I also love 2:08 frightened summery dresses and on this 2:10 day I decided to go for the cute 2:12 little blue dress the denim jacket after 2:14 my officers picked out I move on to 2:15 styling my hair and I've been obsessed 2:17 with these products from shea moisture 2:18 and also a really great thing about them 2:20 is they're super accessible and you can 2:22 find them at Target and Walmart so first 2:24 I start out with the argan oil and 2:26 almond milk blowout cream this is 2:27 seriously amazing as you can see my 2:30 chair looks pretty crazy when I get out 2:31 of the shower and let it air dry so this 2:33 just helps to condition my hair as you 2:35 can see after brushing it out it just 2:36 looks so so much better and honestly the 2:39 blow-up cream makes it so much easier to 2:41 brush out and it also helps with my 2:43 sideways and my spray and just makes it 2:45 a lot more manageable also for some 2:47 reason I am the worst at blow-drying my 2:49 hair but this just makes my hair looks 2:50 so smooth and silky and awesome after 2:53 which is really great and after my hair 2:55 is dry I move on to the flute and pain 2:57 thermal protection milk which I am 2:59 always be styling my hair whether it be 3:01 for photo shoots are sad or just filming 3:03 and things like that and I also just 3:04 kind of prefer to have my hair curls so 3:06 I'm always looking for a really good 3:08 skate tamer spray this note is awesome 3:10 because it controls frizz its locks 3:12 humidity and improves the appearance of 3:13 my split ends and makes my hair look 3:15 shinier and this is all while protecting 3:17 my hair against heat damage once my hair 3:19 is fully protected I'll take a one and a 3:21 half inch curling iron and throw my 3:22 entire head and then it's time to change 3:24 and move on to breakfast now if you guys 3:27 know me you know that i absolutely

love 3:29 cooking i love getting in the kitchen 3:31 and just making food i think it's so 3:33 much fun and on this morning i decided 3:35 to make a tomato spinach and feta 3:37 frittata which that is a mouthful and it 3:39 tastes so good now on the borings that I 3:41 wake up and I'm feeling extra hungry and 3:43 just like I want to make something 3:44 special this is something really easy 3:46 that I whip up and I thought I'd show 3:47 you guys how to make it so you just 3:49 start by adding some olive oil to a 3:51 skillet and then putting in your dye sub 3:53 onion and while your onion is cooking up 3:55 on the stove you can move over to your 3:56 tomatoes I chop those up in half and I 3:58 also already took my fresh spinach and 4:00 chop that up as well also side note 4:02 other really awesome breakfasts that I 4:04 like to make in the morning are like 4:05 avocado toast I love making oatmeal and 4:07 just like hearty breakfasts like that 4:09 once my onions are ready i will add in 4:11 my spinach and spinach cooks down so 4:13 much it's pretty crazy and while we wait 4:15 for those to cook together we can move 4:17 on to the main base of the frittata 4:18 which are eggs some soy ahead and 4:21 cracking four eggs into a bowl adding 4:23 I sifted cup of flour as well as half a 4:25 teaspoon of baking powder and then 4:27 wishing that all together and then also 4:29 the statistic you can add a little bit 4:31 of milk to it this recipe is seriously 4:33 so easy you guys and I promise it will 4:35 impress whoever you're cooking for even 4:37 if it's just for yourself it will suit 4:38 if we impress you all you're going to do 4:40 then is just add in your vegetable mix 4:42 it all around and then pour it back into 4:44 a skillet that is oven safe after that 4:48 you're just going to place all of your 4:49 little cherry tomatoes on top and I put 4:51 them all like facing upwards so it just 4:53 looks more aesthetically pleasing once 4:55 your tomatoes are place go ahead and 4:56 throw it into the oven will go and 4:58 actually throw it but put it into the 4:59 oven at 350 degrees for about 20 to 25 5:02 minutes and what's out you can pop it 5:04 with whatever you like you can eat it 5:06 plain if you want but I went ahead and 5:07 put some balsamic glaze sprinkle some 5:10 feta and then also took some basil from 5:12 my fresh herb garden that I have next to 5:14 my little counter and it just chopped it 5:16 up put it on top and serve myself up a 5:18 slice it was seriously delicious you 5:20 guys and lon eating my breakfast I'll 5:21 usually just work on emails and catch up 5:23 on like YouTube videos and things like 5:25 that and I also did want to be realistic 5:27 with you guys and I didn't want you to 5:28 think that every morning I wake up and 5:30 make myself a frittata a lot of times 5:31 also I'll just walk youtube and eat 5:33 something super easy whether it be 5:35 cereal or fruit or just something like 5:37 that because I don't feel like making an 5:38 entire meal just for myself after about 5:41 eating breakfast I will do my dishes and 5:42 whatever dishes I made pack up my bag 5:44 and then head out the door to start 5:46 whatever activities I have plans for the 5:48 day on this day in particular my best 5:49 friend leigh and i went to San Diego to 5:51 go visit our best friend kaylee but on 5:53 the way we actually pass a city called 5:55 coral fad and they are notorious for 5:57 having the most beautiful flower fields 5:59 during the spring time and I've never 6:00 been before even though I grew up in 6:02 California so we obviously had to stop 6:04 down on the way and I figured this was 6:06 perfect for my spring morning routine 6:07 because nothing says spring like allergy 6:10 I mean flower it's just kidding but 6:12 seriously we were so beautiful and the 6:14 flowers were amazing and i highly 6:16 recommend stopping by if you guys can 6:18 thank you guys so much for watching this 6:20 video I hope you enjoyed it if you did 6:22 be sure to give it a big thumbs up and 6:24 I'll be sure to do more morning routines 6:26 for you guys please subscribe if you 6:27 haven't already and I will see you next 6:28 time

Spring Morning Routine 2017 | Olivia Jade

0:00 hey guys welcome back to my channel 0:02 today's video is a very requested at 0:04 spring morning routine so this is an 0:07 actual legit burg morning routine this 0:08 was a couple days ago I set up my camera 0:11 the night before so you could really see 0:12 what happens in the

morning so i first 0:16 wake up and go on my phone I know that's 0:18 such a bad habit it's just this 0:21 generation but I go through social media 0:24 so I check Instagram I love checking 0:27 Twitter seeing all the different tweets 0:30 and updates and messages and dms and 0:32 also like all my app and I say what's up 0:36 I say hey i love my app for just 0:38 connecting with you guys kind of like a 0:39 big texting group chat just Olivia Jade 0:42 in the App Store and after all that's 0:44 done I get up and I go to my bathroom 0:47 and I just head down into my bathroom 0:51 and I first start by taking a shower 0:54 today was a really busy work day for me 0:57 I was filming all day for my app so I 1:00 wanted to make sure I was nice and clean 1:02 I used my neutrogena cleansing oil to 1:05 break down my makeup if I had any left 1:07 over from the night before which I 1:08 usually don't but just in case use my 1:10 Lancer cleanse & polish and then I also 1:12 use this amazing grace shower gel and 1:15 then a little bit of this wet skin 1:16 moisturizer and then brush my teeth I 1:19 love brushing my teeth you can really 1:24 it's very rare for me to not straight 1:26 like get up and brush my teeth I can't 1:28 like go eat breakfast and do my thing I 1:30 always have to brush my teeth and then I 1:32 go in with this net nasir I go into the 1:35 lancers a method Norrish cream and I 1:37 just apply this apply this I'm such a 1:41 beauty youtuber I just put this all over 1:44 my face and rub it in and then I go in 1:47 with my Lancer sunscreen because it's 1:49 going to be a hot day at the pier I went 1:52 to the san juan a computer that day so 1:54 let's putting some sunscreen on and then 1:56 it is time to freshen up so that's what 1:59 i used to smell good and then picking 2:02 out an outfit this is a daily struggle 2:04 especially when filming but i knew it 2:06 was going to be super hot so i went for 2:08 one teaspoon jean shorts which I like my 2:10 favorites and then I just kind of went 2:13 through 2:14 looking for a top in my closet which can 2:17 kind of take a little while these days I 2:19 need new clothing I'm over my clothing 2:21 which is so bad I just take out my 2:25 makeup and got glammed for the day I 2:28 didn't show my makeup just because 2:30 everyone always says my makeup looks 2:31 like the exact same so didn't want to 2:33 bore anyone but I kind of sped through 2:35 some of the products I used real real 2:38 quick and yeah that's basically it I 2:41 went downstairs that had to my dog went 2:44 to make some breakfast I had scrambled 2:47 eggs and I put them in corn tortillas 2:49 with a little bit of cheese and it's so 2:51 good so take my pan out I spray it with 2:54 a little bit of like this olive oil 2:56 spray so it doesn't stick and then I 2:59 like to crack an egg I'm going to like 3:02 really walk you through this and then I 3:04 like to crack another egg but with the 3:07 other egg I don't put the yolk that was 3:10 oh and i just put like the egg white 3:13 part in if you want to mean and um i 3:17 stir it all up sorry if you're vegan you 3:20 probably hate me right now but then I 3:23 just put it in a pan and then make some 3:27 scrambled eggs and I tried filming all 3:30 this but it was a little bit hard to get 3:32 all these angles obviously and so after 3:34 i'm done cooking my eggs I then just put 3:36 them on plate and got some corn 3:41 tortillas and cheese even though you 3:42 already knew that was coming this just 3:44 tastes really good i'm obsessive taco so 3:46 this is kind of like a breakfast version 3:47 of a taco I like to heat up my tortillas 3:49 usually I do this in a pan but I don't 3:52 know I was just feeling kind of crazy I 3:54 did it just on the stove almost burned 3:55 myself don't recommend this don't do 3:58 this but I then just heat them up put a 4:00 little bit of egg a little bit of the 4:02 cheese and we're good to go I usually 4:05 like our breakfast was like my sister or 4:07 something oh I also go to water but no 4:09 one was home because it will everyone 4:12 was home that was just early in the 4:13 morning so it's eating by myself kind of 4:15 sad but it's okay uh-huh so I just ate 4:18 my breakfast and then go through social 4:20 media usually when I like like to sit 4:22 down and have a moment to just like look 4:24 through social media I love going to my 4:26 tagged photos and looking at 4:27 acute fan pages and all the cute edits 4:29 and everything like that so I'll just go 4:31 through and like some of those I'll go 4:33 on Twitter favorite some of your guys's 4:35 tweets that I like all of that and then 4:38 after i end up with that i like to throw 4:41 some

sort of breakfast bar or some sort 4:43 of bar in my purse because as i said i 4:45 was working so it's going to be a long 4:48 day this was funny i was trying to 4:49 figure out a thumbnail I just thought 4:51 you guys could see like the struggle um 4:54 I just grab my bags and then I head out 4:57 the door and that's it so thank you for 4:59 watching and love you guys don't forget 5:01 to Like comment and subscribe and I'll 5:03 see you guys next time bye MA

SPRING MORNING ROUTINE 2017 - Caci Twins

0:00 hi guys so this is our weekend spring 0:22 morning routine 2017 so if you guys are 0:38 new to our YouTube channel we do sleep 0:40 together sometimes I made more sisters 0:42 so it's not that big of a deal so when i 0:44 first wake up in the morning of course i 0:46 always tie my hair so like everybody 0:56 else i always wake up and I check my 0:58 social medias my sister and I can't go 1:00 eight hours without checking our social 1:02 media so of course right when we wake up 1:04 we do that 1:07 well I'm trying to get ready for spring 1:10 break so I have to get my skinny detox 1:12 tea ready 1:13 [Music] 1:23 I'm weird I always have to like panels 1:25 right when I wake up so I like my 1:27 favorite candle smells exactly like 1:29 roses guys I'm telling you this t really 1:37 fought in your stomach and if you guys 1:38 want to know more about it comment down 1:40 below we'll do a whole video on it while 1:48 she is making this tea I'm going to be 1:49 making this spinach smoothie it is so 1:52 bomb and yet it sounds gross but is 1:54 really good 2:02 first things first if you grab a slip of 2:11 grain wheat grass then five large pieces 2:16 of pineapple ad for tangerine a cup and 2:22 a half of green grapes to cut for 2:24 spinach then a piece of ginger a 2:27 teaspoon of organic coconut oil followed 2:33 with a cup of ice yep is real green and 2:38 it's so good 2:40 [Music] 2:44 so my sister and I have to know her 2:47 calendar because we have a busy month 2:49 coming ahead of us and my sis nice to 2:52 see every time I try to make her do this 2:54 so I'm happy that she's actually falling 2:56 through 2:57 [Music] 3:07 so after breakfast we're going to go 3:10 wash our faces I use tea tree oil she's 3:14 a different one than I use I use 3:15 dermalogica yes we do brush your teeth 3:22 but we are not going aboard you guys are 3:24 showing as a clip of glass I found these 3:29 sliced mass at Urban Outfitters and this 3:32 is our first time using them it's still 3:37 slimy 3:39 [Music] 3:44 well I have cucumbers and michela 3:47 tomatoes because he's a tomato fit this 3:54 is actually really fun pain we should do 3:55 like a full body mass kisses come down 3:57 guide comment down below if we should do 4:00 it while we let this sit for 15 minutes 4:09 we're going to catch up with our 4:10 Kardashians and watch TV now it's been 4:16 15 minutes so it's fun peel them off 4:18 because the weather is so beautiful 4:28 outside right now we're going to shower 4:29 and shave our legs and layout 4:33 [Music] 4:41 it is still early in the sun is not out 4:44 completely so we're going to lighten it 4:45 for about 2 hours 50 hope you guys 4:49 enjoyed our 2017 spring morning routine 4:53 [Music]

Sierra's Morning Routine

0:00 good morning guys normally when i wake 0:01 up first i get my glasses on and it's 0:04 usually not 1203 but next time I from 0:07 the video and I have to check my phone 0:10 and I go to the bathroom to wash my face 0:14 and brush my teeth when I / the cold 0:19 water on my face it really helps me wake 0:21 up and I brush my teeth got a Russian 0:27 really good then I have to go with 0:31 Olivia which takes a lot of effort he 0:37 never really wants to wake up Kendrick 0:42 speaking on and then gets runs back in 0:46 it takes multiple time sunday 0:54 dannemora finally get her out of bed can 1:00 you still does not want to get up and go 1:02 into the bathroom but then she realizes 1:04 refused to get in the shower first so 1:06 she runs in and I'm like oh come on 1:10 Olivia I guess I'll wait on you to take 1:12 a shower then get dressed and sometimes 1:19 it takes a few tries to get Olivia and 1:21 the right outfit for school and given 1:24 some persuasion from Madison Gracie but 1:27 while my fingers are changing her I go 1:30 down and make us breakfast this morning 1:36 I'm going to have some honey nut tree 1:37

they're one of my favorite series and by 1:41 the time I finish making a cereal she's 1:44 usually right so then I informed on all 1:47 the cool stuff that I'm learning at 1:49 school and she was hearing what I could 1:51 say 1:54 Daniel is put our victims away can we 1:58 get our backpacks on and we shout out 2:02 the door time for school see you guys 2:05 later 2:09 you 2:09 [Music]

MY MORNING ROUTINE 2017

0:00 hi yes this is the morning that I wish 0:06 that I have every single day just really 0:09 chilled waking up the right time just 0:12 ready for a new day little miss sunshine 0:15 all that good stuff unfortunately that's 0:25 never me oh well good morning guys and 0:35 welcome to my morning routine of 2017 so 0:39 I'm gonna show you I do on an everyday 0:41 morning Gracie routine firstly i'm 0:44 obviously waking up turning on the 0:46 lights and then just checking my 0:47 Instagram and just you know just chillin 0:50 in my bed 0:53 [Music] 0:58 I also checked my computer just my 1:08 youtube channel and then I answer some 1:10 comments watch some YouTube videos all 1:13 that good stuff and then I obviously 1:17 know it's time to get up a sad fact 1:21 about me is that I'm always freaking 1:23 cold so I've got my slippers on and then 1:25 I'm also gonna get my bathrobe or 1:28 whatever you want to call it because it 1:30 is so snuggly it's pretty really big and 1:32 just really really really cozy and one 1:42 of my goals for 2016 was actually to 1:44 make my bed almost every single day and 1:46 I almost made it almost so I'm all these 1:50 e until trying to keep that promise to 1:52 myself just to make my bed so there's a 1:53 bit more need and a bit more fresh from 1:55 me so yeah I'm just doing my bed as you 1:58 can see tidying up a tiny bit 2:01 [Music] 2:04 and once i'm done with that i am turning 2:10 out the lights and then moving into my 2:12 kitchen area because now it's time for 2:14 some breakfast and even though i'm not 2:16 the biggest breakfast eater I still won 2:18 my morning tea and um I just have some 2:21 kind of like green tea or some kind of 2:23 her booty whatever I feel like I want to 2:26 do some personal keeping tape which is 2:28 really good so I'm just making myself a 2:31 cup of tea and then I'll some breakfast 2:33 and once again a sad fact about me is 2:39 that I don't usually eat that much 2:42 breakfast but I made a promise to myself 2:44 that I have to get better at that so I'm 2:47 gonna have some sort of babe at whole 2:50 almonds snacky breakfast kind of thing 2:53 with some yogurt as well since I yoga'd 2:56 which is really really good from alpro 2:58 so I'm just chopping up an apple which 3:01 is one of my favorite apples being a 3:03 limb of the apples if you haven't tried 3:05 them they are yummy as L so I'm just 3:08 gonna be chopping that up in some small 3:10 pieces 3:11 [Music] 3:20 and then afterwards I'm also gonna use 3:32 some yogurt obviously in the bottom of 3:35 the bowl and then open some almonds 3:38 which I'm also going to chop up into 3:40 small pieces and i don't use any 3:42 measurements for this just a cut like a 3:45 small handful of almonds is fine and 3:51 then the secret ingredient is some 3:55 vanilla powder just on top that is so 3:58 friggin yummy and then my tea is ready 4:01 and that is basically just my breakfast 4:04 really really quick simple easy but very 4:07 yummy I'm so freaking Instagram cool I 4:10 mean come on that is beauty in a bowl 4:12 and then we're moving into my living 4:21 room because I usually sit and watch 4:23 some TV a TV show or something like that 4:26 or sometimes I also edit videos but 4:28 today i was watching scam voices saying 4:30 Norwegian I'm TV show which is about 4:32 teenagers falling in love and then I'm 4:35 watching season 3 i'm actually done with 4:36 it already there I just burned my tongue 4:38 as I always do a lot freaking tea and 4:41 them is eating my breakfast watching 4:44 scam if you haven't watched scam you 4:46 have to is so freaking good I love 4:50 season 3 because it's all about the gay 4:52 community and how it is to be gay and 4:54 dumb have a gay relationship and just 4:56 coming out as well I just really love 4:58 that I left the world gets so much more 5:02 open-minded about those things honestly 5:04 just be yourself and then once i'm done 5:09 with my Freck fish I always take it out 5:12 I never finish my tea unfortunately even 5:14 though it's really really good and then 5:16 I just

wash it off so it's not as sturdy 5:18 and then moving on into my bathroom 5:21 because now I have to brush my teeth and 5:23 have a shower as well and just wake up 5:25 for real and I just found out the pimple 5:28 that I had was almost gone that was 5:30 really like yeah a moment for me but I'm 5:34 just gonna be brushing my speed and 5:35 honestly I'm always having a bit of a 5:38 dance off when I'm crushing my teeth and 5:40 if anybody tells you that you're too old 5:42 to dance around and this is an awesome 5:44 music while you're brushing your hair or 5:47 just brushing your teeth get them out of 5:50 your life you never get too old to have 5:52 fun 5:53 [Music] 5:58 by the way am I the only one who kind of 6:01 wiped off my toothbrush after done using 6:03 it weird thing and then I'm just 6:06 brushing my hair if it doesn't gonna put 6:07 it up in a ponytail like a really messy 6:10 ponytail because I don't want to wash my 6:11 hair that day because it wasn't dirty so 6:14 I'm putting on my amazingly beautiful 6:17 and really really sexy shower cap 6:19 looking fancy right not and then I'll 6:24 put the clothes and into the shower hey 6:29 get out no oh cuz it and i'm just using 6:33 somebody products just to cleanse my 6:36 body obviously and then i'm just using 6:38 some different skin care products 6:56 and once i'm done with that it is time 7:02 to find some clothes for the day and i 7:05 just found a pair of jeans and a t-shirt 7:07 and then it's time for the very job and 7:10 then I was fighting some different 7:12 products to use for that day and I know 7:14 which will be messy that then I'm just 7:17 sitting on my bed watching some TV show 7:20 I think it was the great day nice play 7:22 golf or something like that and then i'm 7:24 just applying my makeup and if you want 7:26 to do a new everyday makeup tutorial and 7:28 we know because i have changed a tiny 7:30 bit what I do but let me know 7:34 [Music] 7:41 [Music] 8:05 and once the makeup is done I'm just 8:14 putting my hair up in a ponytail because 8:16 I just felt like that really quick 8:19 simple easy nothing too fancy fancy and 8:22 then applying a tiny bit of lip gloss 8:24 and then moving on to get some clothes 8:27 on so I just wanted to wear a belt as 8:31 well for those jeans because there were 8:33 tiny bit too big and then putting on 8:36 some boots and then that is the outfit 8:39 of the day really basic simple easy very 8:42 minimalistic but that is me in a 8:44 nutshell and then it's time to head out 8:48 the door I'm just grabbing an apple and 8:50 my keys and then putting on a blazer 8:53 precise with the times and cold because 8:54 it's winter time and then I'm also 8:56 putting on my jacket and a scarf and 8:58 that was all this video guys who really 9:00 hope that you enjoyed it like and 9:01 subscribe and thank you so much watching 9:03 love you all

Healthy Morning Routine 2017

0:03 typically no always wake up first 0:05 because he has an internship a few days 0:07 of the week so with LA traffic and how 0:09 it really his internship is he usually 0:11 is up pretty early gives me a nice 0:13 little juice one cheek it is off for the 0:15 day now I usually wake up from rooster 0:19 give me kisses he is super cute and the 0:21 mornings always giving me lots of love 0:22 ins and basically telling me hey it's 0:25 time to get out and can't use dating but 0:29 honestly with a cute puffle you miss how 0:31 could anyone complain or ever wake up in 0:33 a bad mood now I stretch and wake up 0:40 first thing I always do is reach over 0:42 for my water that way I make sure I've 0:43 already drink a good bit of water for 0:45 the day I chug chug chug chug chug as 0:47 much as possible or sometimes just sip 0:50 sip when I'm on camera and then I will 0:52 pull out my find your happy daily mantra 0:54 book and this is when I do my morning 0:56 meditation I read one page a day I read 0:58 it and I asked myself the question that 1:00 repeat the mantras and then I will do a 1:02 meditation you look like a video all 1:04 about meditation I could do that but I 1:06 can also link a few videos down below 1:08 giving me - let me know in the comments 1:10 what you want - what you want but when 1:12 occasion is great if you deal with 1:13 anxiety stress or just just to do in 1:15 general really calms my mind focuses me 1:18 on my goals for the day and between any 1:19 great mood 1:22 [Music]

1:23 now this why it is a cute picture a 1:26 wrister because by the time I was done 1:27 he was already ready to go back to bed 1:29 he was just so awake like two seconds 1:31 ago and then since I don't know him I 1:34 honestly spend like every moment 1:35 together so when he does go to his 1:36 internship I usually send him a really 1:38 nice good-morning text just because I 1:40 already miss him 1:40 um yeah cheesy but it's a day and I'll 1:47 time to get up and brush my teeth 1:49 because nobody wants to smell my breath 1:51 in the morning I promise and now it's 1:55 time to grab jackets and shoes and 1:56 definitely some plugs devices because 1:58 nobody wants to see my face in the 1:59 morning either and take rooster out for 2:02 his morning walk which by the way is 2:07 very new at his leash so it still takes 2:09 a few tries of getting out the door and 2:10 everything but he's doing pretty well 2:12 and then I always come back in with my 2:14 coffee well not always depending on if I 2:15 want to splurge for myself there is a 2:17 coffee and tea room just below my 2:19 apartment so this morning I got myself a 2:20 London Fog I had become super obsessed 2:22 with some rice recently there's some 2:24 yummy like Suzy so yummy and then after 2:30 I see speed restore his breakfast it is 2:32 time to set the mood with a candle no 2:34 miss Q thinks I'm pretty much only like 2:35 this because I was sowing but it's time 2:38 to feed myself my own breakfast this 2:40 morning I decided to do a snowy Bowl 2:42 just because while I look good on camera 2:43 and they're pretty delicious so I just 2:45 add some yogurt some frozen fruit some 2:48 peanut butter and a whole banana and 2:50 then I blended that up super super yummy 2:52 sometimes I just like to use a frozen 2:53 banana and it makes it a little bit more 2:54 like aa Bowl texture but this 2:56 morning I didn't have a frozen banana so 2:58 this will work and then after I blend it 3:00 all up I will top it with granola and 3:02 coconut seriously so yummy 3:05 [Music] 3:13 now time for me to hit the gym so 3:16 usually I will go to the gym 3 to 4 3:17 mornings out of the week let me know in 3:19 the comments if you'd like to see my 3:20 fitness routine I could do that really 3:21 soon and one thing I've been loving to 3:23 do as a gym is using the bike I feel 3:25 like it's actually really fun okay and 3:32 then I get home and immediately hop in 3:35 the shower this girl is thank you 3:36 nobody wants to be around that and then 3:39 when I'm done it is time going to get 3:40 ready for the day funky glad to meet me 3:44 I think you should happy back to me tell 3:48 you all you got to meet me I think you 3:51 should how do you package now here's 4:02 just a quick overview of my outfit and 4:04 my makeup I'm obviously not going to 4:05 spend all the time telling you 4:06 everything because I'm dropping out a 4:07 makeup artist however if you look like 4:09 if you make an updated makeup routine 4:11 maybe I do that I don't know I'm not 4:12 like good at it but here's just 4:13 everything I've pretty much used every 4:15 morning sometimes I'll change it up like 4:17 with my eye shadow that's pretty much 4:18 all I really change up but this is 4:20 pretty much all I do every single 4:21 morning or when I'm going summer 4:23 obviously if I'm not leaving the house 4:24 girls not putting any makeup on but 4:26 today I did have a few things to do some 4:28 meetings and stuff so yeah 4:33 [Music] 4:41 then I'll finish off any of my emails or 4:44 you need to do on the computer real 4:45 quick and then it's time for you get 4:47 going throughout the day sometimes I 4:49 have meetings sometimes I don't leave 4:50 the house it really depends but today I 4:52 have some errands to run so I hope you 4:54 guys enjoyed this video and I'll see you 4:56 later alright guys that is it for my 4:59 morning your team did you like it let me 5:01 know in the comments give a thumbs up 5:03 also there's giveaway in this video I am 5:06 giving away an iPad Mini as well as a 5:08 Fujifilm Polaroid camera all you have to 5:10 enter isn't want to be a subscriber into 5:12 following on Instagram to turn on my 5:13 YouTube notifications is the bell symbol 5:15 down below that way you know every time 5:17 I upload and also you don't miss when I 5:19 announce to giveaway winner so that's 5:21 anyone wanting your team for the days 5:22 that Noah goes to work or like his 5:24 internship so if you'd like to see a 5:25 morning routine with both of us together 5:27 like an engaged living together morning 5:29 routine let me on the comments we

can do 5:31 that very soon check out all my social 5:33 media linked down below subscribed if 5:34 you haven't already and that would be 5:36 guys you know see you next time bye

Before School Morning Routine | viviannnv

0:00 hey guys so this is my before class or 0:13 school morning routine basically just a 0:16 run-through of my everyday um kind of 0:20 step-by-step morning ritual or whatever 0:24 so I set my alarm or wake up by myself 0:27 around nine or nine-thirty and then I 0:30 like to just lay around and get on my 0:33 phone for a couple minutes while I'm 0:35 waking up um you know checking all that 0:38 Instagram snapchat and all that stuff 0:42 and now i'm just getting out of bed and 0:46 moving into the bathroom where of course 0:50 got to start off by brushing your teeth 0:52 and also huge thing for me is not 0:58 wearing pants when i sleep because it 1:00 feels amazing so if you haven't done 1:01 that you should try it and no socks that 1:06 way you get the most out of your seat I 1:09 feel like and then moving to the shower 1:14 and I like to wash my hair in the 1:18 mornings so that way it can air dry 1:20 while I'm doing my makeup and making 1:22 breakfast and eating and all that so I 1:25 have to worry about blow drying it like 1:27 before we go to sleep or whatever so I 1:29 use the Pantene pro-v moisture renewal 1:32 dream care shampoo and conditioner and 1:35 this actually has been my current 1:38 favorite because I can use it more 1:40 regularly on daily basis because it 1:43 actually doesn't strip your hair while 1:44 like the oils and moisture that other 1:48 shampoo conditioners to do so i can 1:50 actually wash it more often so it feels 1:52 clean but it doesn't make it feel dry or 1:55 anything like that and it leaves it 1:57 really smooth so i can just run my 1:59 fingers through it 2:01 a huge deal with having long hair as it 2:03 gets tail really easily so using this 2:05 more often has allowed me to prevent 2:09 those tingles in the first place so 2:12 that's awesome next I'm moving on to a 2:16 skincare and all I do is I used to 2:19 sunday riley good genes lactic acid 2:21 treatment and actually got a little kind 2:24 of trial size from sephora i've been 2:26 using lately and i actually am obsessed 2:28 with this a helped a lot with my acne 2:30 scarring and just like discoloration in 2:31 general just after the first couple 2:33 times I used it so so hopefully it keeps 2:37 working as well it is and then I just 2:39 used some moisturizer but that the 2:41 receipt for skin care I don't like to do 2:43 anything too invasive just because I 2:45 don't want to irritate my skin before do 2:47 my makeup but those are two simple 2:49 things like to do and then of course I 2:51 got to take Jasper out on a little walk 2:54 so he's being such a good boy about 2:57 leash him up and walk him around the 2:59 neighborhood so after our walk I like to 3:05 do a quick workout at home basically I 3:09 like to roll up my yoga mat in front of 3:11 the window to let some natural light and 3:13 place the music and do some leg workouts 3:17 and core workouts like crunches and fire 3:20 hydrants and yeah next I'm making some 3:24 breakfast and she's like my latest go to 3:27 super easy and quick and it's just 3:29 blueberry pancakes which I actually 3:32 showed you guys in a my first vlog but I 3:36 just gotta show off this like perfect 3:37 pancake I made I'm pretty proud of and 3:40 then add some powdered sugar and syrup 3:43 or honey or fruit or Nutella or whatever 3:47 floats your boat um but yeah 3:53 and today I just had a chai tea latte 3:59 but other days i'll have like juice or a 4:02 tazo tea just whatever i'm gonna move 4:07 for and then next i'm just laying out a 4:10 blanket by my mirror making sure i get 4:12 some good natural lighting by the window 4:14 and just do my makeup real quick this 4:17 particular day I just for some 4:18 foundation but also if you guys want to 4:20 see it updated for everyday makeup 4:22 routine let me know okay I came down to 4:27 do that and then I am going to just do 4:30 some last minute studying or homework 4:32 before class and then I am off 4:37 [Music] 4:47 [Applause]

1 Hour Realistic Morning Routine

0:00 hi everyone welcome back to my channel 0:03 so today I have a one-hour realistic 0:05 morning routine video for you because I 0:08 thought it would be fun to share hey how 0:10 to

get ready in one hour so if you 0:12 enjoyed this video please give a thumbs 0:13 up and subscribe if you're new and let's 0:15 get started so of course you have to set 0:17 your alarm I found that when I was 0:19 working or going to school 7am was a 0:22 good time for me to get up I would get 0:23 ready from seven to eight and the key 0:25 thing here is to not press snooze and to 0:27 not try and have a little bit extra 0:29 sleep of it to force itself out of bed 0:31 exactly when your alarm goes so get up 0:33 and get out of bed the first thing that 0:35 I always like to do is I go straight to 0:37 cut my coffee machine and I make coffee 0:39 or tea but recently I've been into the 0:41 coffee it's like every two weeks or 0:42 three weeks I go in and out of coffee 0:43 and tea but I start with coffee I have 0:45 an espresso machine and it's the black 0:47 pods that are my favorite and I use a 0:49 little bit of soy milk as well so I 0:56 don't really like to have breakfast 0:58 straight away I know this is really 0:59 weird that it doesn't make me feel that 1:00 great so I like to have tea or coffee 1:02 and kind of let it settle before i 1:03 actually have breakfast so I always just 1:05 take my tea on my coffee down with me to 1:07 like my desk and that's when I do my 1:09 makeup and I know this might be weird 1:11 some people but I do my makeup before I 1:14 eat and brush my teeth weird I know but 1:15 it's just what i like to do you could do 1:17 it whichever way that you like but for 1:20 my makeup today i started with my 1:22 foundation i am using my astrologer to 1:25 glow foundation in the color fawn and 1:27 then for concealer and highlighter i'm 1:28 using my IT cosmetics like duo I keep 1:32 forgetting what this is called but i'll 1:33 have it listed in the description and it 1:35 has a concealer on one end and a liquid 1:37 highlight on the other and then i go 1:39 ahead and just powder off my face to set 1:42 everything i do a little bit of bronzing 1:44 using my anastacio kit and then i pop on 1:47 a little bit of blush for the day and 1:48 then i go ahead and put on some 1:50 highlight basically just all the basics 1:52 i do the full face I will have a link to 1:54 my everyday makeup routine in the 1:56 description but i think i need to do an 1:58 updated one because I swear my everyday 1:59 routine changes like every month so I 2:02 feel like it's gonna have to become like 2:03 a monthly ritual but I just go ahead and 2:05 fill my brows oh can I point out this 2:07 Sigma brow pencil is amazing and it is 2:09 perfect for daytime it's the 2:11 best brow product for every day so for 2:17 my eyeshadow I'm going with my favorite 2:19 e orange e-type colors so I'm starting 2:22 with the color camel all over my lid 2:25 from the lorac mega Pro palette and then 2:28 I'm going to go into the outer crease in 2:30 the other corner with sepia which is my 2:32 absolute favorite color because it's 2:34 pretty much the only one that have hit 2:35 pan on and then I'm just going to go 2:36 ahead and use cream as a highlight to 2:38 blend that all out and soften up all the 2:40 edges then I'm going to take some 2:42 eyeliner and do a little bit of a wing 2:44 and then I'm going to pop a coat of 2:46 mascara on both the top and bottom 2:47 lashes also on this particular day I 2:52 decided to type myself and see how long 2:54 it actually took me to do this 2:55 particular makeup look and I forgot to 2:57 start recording when doing my foundation 2:59 like the Australis foundation but once I 3:01 had finished it I set my timer and the 3:03 rest of my face actually only took 17 3:05 minutes so it is totally doable to do 3:07 all of your makeup in 25 minutes each 3:09 day so then it's time to head to the 3:14 kitchen and make some breakfast so at 3:17 seven-thirty i like to juice all of my 3:20 goodies from the night before so if you 3:22 remember watching at my organizational 3:23 night routine well this is the morning 3:25 routine that follows that so I'll have 3:27 that listed in the description if you've 3:29 not seen that organizational night 3:30 routine but I had all my Froot prepared 3:33 the night before so that I can totally 3:34 just chuck it in the juicer and make 3:36 some fresh green juice because I'm a 3:38 juice person and not so much a smoothie 3:39 person and then I'm going to go ahead 3:41 and make breakfast my favorite breakfast 3:44 I think right now at the moment that I 3:46 have been obsessed with ya are these 3:48 like bread stick thingies that you get 3:49 from kohls I've made them many times 3:51 before in my water ate today videos and 3:53 I put fresh tomato and avocado and red 3:56 onions on them and once i toast them a

3:58 little bit with some salt and pepper it 3:59 is so good it really doesn't take that 4:01 long to make if you were really well 4:03 behaved you could cuddle the ingredients 4:05 off the night before so I just went 4:07 ahead and made these and then I go and 4:09 take them and sit down on my computer 4:10 and I go through emails go through my 4:12 youtube subscription and just kind of 4:14 check up on everything that I'd missed 4:15 while I was leaving 4:17 then it's time to get dressed and 4:21 everything should be laid out from the 4:23 night before so that your are nice and 4:24 organized and all you have to do is put 4:25 your clothes on so i have this adorable 4:27 little Eiffel Tower shirt that we got 4:30 from valley girl I think one time and 4:32 I'm just wearing some black jeans and 4:34 black boots just made my outfit super 4:36 simple and yeah like I said if 4:38 everything is just light out but not 4:40 before then all you got to do is just 4:41 put it on then I head over to the 4:46 bathroom and I brush my teeth I don't 4:48 know what my toothbrushes colgate I 4:50 think who knows there's a bunch of 4:52 toothbrushes at the toothbrush store and 4:53 I just like toothbrushes when I need 4:55 them and then once I've brush my teeth I 4:57 go ahead and brush through my hair 4:58 definitely need some dry shampoo on this 5:01 particular day but I may have run out 5:03 and I really need to buy some more but I 5:04 just go ahead and give my hairbrush 5:06 whether I'm gonna put it up or leave it 5:07 out like it is whatever is just 5:09 happening that day it's just when I work 5:10 my hair in and then I go ahead and put 5:12 on at my lip product because I had 5:13 brushed my teeth and I'm using my becky 5:16 steeler liquid lipstick and then it's 5:19 time to quickly pack all your bags 5:21 everything should be laid out from the 5:22 night before again books bag handbag 5:24 everything everything should be sorted 5:25 from the night before so all you got to 5:27 do is pick it up and walk straight out 5:29 the front door so I hope you guys have 5:30 enjoyed this video if you have make sure 5:32 you give it a thumbs up and you can 5:33 check out my last video at the top and 5:35 another routine video down the bottom 5:37 and i'll see you in my next video bye

Appendix B

Video analysis

The first section of this appendix contains a figure for section 3.1 and the second section supports sections 3.2 and 3.3.

B.1 Information about the analyzed videos

title	vlogger	estimation age	duration video	# words	up-loaded	# views (at 19-Jul-17)
Winter Morning Routine	Christen Dominique	18-25	05:31	1021	14-Dec-16	926,294
WEEKEND MORNING ROUTINE	Billie rose White	14-20	05:35	516	13-Apr-17	321,608
SPRING MORNING ROUTINE 2017!!	Miss-Remi-Ashten	22-30	06:30	1586	7-Apr-17	450,022
Spring Morning Routine 2017 Olivia Jade	Olivia Jade	14-20	05:09	1019	5-Apr-2017	531,533
SPRING MORNING ROUTINE 2017 - Caci Twins	CACI TWINS	14-20	04:54	482	17-Mar-17	1,093,709
Sierra's Morning Routine	Haschak Sisters	10-13	02:17	276	3-Feb-17	6,631,115
MY MORNING ROUTINE 2017	Camilla Frederikke	16-22	09:08	1234	8-Jan-17	683,056
Healthy Morning Routine 2017	Lindsay Marie	18-25	05:45	1135	23-Feb-17	179,773
Before School Morning Routine — viviannv	Vivian V	14-20	04:48	698	25-Mar-17	1,456,160
1 Hour Realistic Morning Routine	Rachelleea	18-25	05:40	1302	5-Jun-16	1,879,792

Table B.1: Information about the analyzed videos

B.2 Selected sentences and words

- I have to put music on to get ready so here I am just listening to my splendor playlist and ... we are just getting ready (figure A.5)
- and while your onion is cooking up on the stove you can move over to your tomatoes and I chop those up in half and I also already took my fresh spinach and chop that up as well (figure A.8)
- and while we wait for those to cook together we can move on to the main base of the frittata (figure A.9)
- while I'm eating my breakfast I'll usually just work on emails (figure A.10)
- while she is making this tea I'm going to be making this spinach smoothie (figure A.14)
- while we let this sit for 15 minutes we're going to catch up with our Kardashians and watch TV (figure A.15)
- while Madison and Gracie are changing her I go down and make us breakfast (figure A.16)
- I'm always having a bit of a dance off when I'm brushing my teeth (figure A.19)
- I like to just lay around and get on my phone for a couple of minutes while I'm waking up (figure A.25)
- I like to wash my hair in the mornings so that way it can air dry while I'm doing my makeup (figure A.25)

Figure B.1: Sentences in the videos expressing parallelism

- "I like to brush my teeth in the morning as soon as I get out of bed. Brush my teeth, get that nasty taste out of my mouth." (figure A.1)
- "Now that I'm all done it is time for breakfast AKA coffee. ... Okay everything before this moment does not count. Coffee before talkie actually." (figure A.2)
- "So now it's time for breakfast. It's normally like twelve O'clock now, but yeah." (figure A.4)
- "Once I'm done washing my body and shaving and doing all the other fun stuff I will brush my teeth." (figure A.7)
- "And then it's time to change and move on to breakfast." (figure A.8)
- ".. and then brush my teeth. I love brushing my teeth ... It's very rare for me to not straight like get up and brush my teeth. I can't like go eat breakfast and do my thing. I always have to brush my teeth." (figure A.11)
- "I went downstairs ... went to make some breakfast." (figure A.12)

Figure B.2: Some examples of activities that always occur

- “... today’s outfit is not going to be a Christmas sweater, darn, it’s just gonna be a regular sweater and some jeans.” (figure A.2)
- “I normally have toast with like peanut butter of Vegemite but I felt like Weet-Bix, so I have two Weet-Bix or three...” (figure A.4)
- “I’m going to show you my outfit. So my top is from BooHoo and my shorts are from Princess Polly.” (figure A.5)
- “Once the makeup is done I will move on to picking out my outfit ... and on this day I decided to go for the cute little blue dress with a denim jacket.” (figure A.7)
- “I love getting in the kitchen and just making food. I think it’s so much fun and no this morning I decided to make a tomato spinach and feta frittata...” (figure A.8)
- “... and then picking out an outfit. This is a daily struggle ...” (figure A.12)
- “... went to make some breakfast. I had scrambled eggs and I put them in corn tortillas with a little bit of cheese and it’s so good.” (figure A.12)

Figure B.3: Some examples of activities that occur in different ways

cooking/eating breakfast (2), making breakfast, eating, get a snack, tomato spinach and feta frittata, main base of the frittata, scrambled eggs and I put them in corn tortillas with a little bit of cheese, a snowy Bowl, making this spinach smoothie

makeup makeup (7)

hygiene brush my teeth, take a shower, I’ll wash my face with a cleanser, wash my face, skincare

hair for my hair, do my hair, styling my hair, wash my hair, air dry

social media catch up, go on my phone, I go through social media, go through social media, checked my computer, sit down on my computer

clothing I pick out my outfit for the day, get changed, find some clothes

get ready get ready, to get ready, we are just getting ready

head out head out, head out the door

other waking up, a quick workout, Cat-ivities, time for Boba to get in the Christmas spirit, Netflix, morning mediation

Figure B.4: Activities in the videos of which sub-activities were mentioned

<ul style="list-style-type: none"> • and that's pretty much what my day consists of in my house if it's not filming (figure A.3) • if I'm not doing anything (figure A.5) • which I am always be styling my hair whether it be for photo shoots or set or just filming (figure A.8) • on the mornings that I wake up and I'm feeling extra hungry and just like want to make something special this is something really easy that I whip up (figure A.8) • because the weather is so beautiful outside right now we're going to shower and shave our legs and layout (figure A.15) • it is still early and the sun is not out completely so we're going to lay here for about 2 hours (figure A.15) • when he does go to his internship (figure A.21) • depending on if I want to splurge for myself (figure A.22) • I do every single morning or when I'm going somewhere obviously if I'm not leaving the house girls not putting any makeup on (figure A.23)
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Figure B.5: Sentences in the videos expressing a condition

Sensor (guess)	Video	Voice-over
Bedroom movement	Sitting up in bed	I usually go to bed really really late so I wind up waking up super tired
Bedroom movement	Stretching arms	
	Grabbing phone	and then I realized I woke up way too early
No bedroom movement	Laying down again	
Bedroom movement	Getting out of bed	2 hours later, now after a hundred yawns later I get out of bed
		I can't move on without showing you my Christmassy Sox
Bedroom movement	Making the bed	I just got my new bedding I got it in and I just moved into my new apartment so I wanted to show you guys me making my bed
Hallway movement	Walking to the bathroom door	
Opening bathroom door	Opening the bathroom door	
Bathroom movement	Entering the bathroom	
Bathroom light on	Switching on the light	
Bathroom movement	Putting hair in ponytail	
	Brushing teeth	I like to brush my teeth in the morning as soon as I get out of bed brush my teeth get that nasty taste out of my mouth
	Using face cream	and I'll wash my face with a cleanser, to make sure it's really rubbed in really good i will do this face dance

	Using another face cream	I've been using the Tacha silk cream for my face
	Undoing pony tail	for my hair i'm just leaving it down today washed it yesterday just putting it down
	Using foundation stick	for foundation today i'm gonna be using the vanished cream hourglass foundation stick
	Spreading foundation over face	
	Using another foundation stick	and then a little bit of shape tape under the eyes from Tarte
	Spreading foundation over face	
	Using stick to draw in eyebrows	benefit goof proof to fill in my brows
	Using another foundation stick	and i'm using this Maybelline contour stick which is really creamy
	Spreading foundation over face	
	Applying eyeshadow	i'm using i used to bh cosmetics on my eyes
	Applying mascara	
	Applying blush	
	Curling eye lashes	i'm using the flutter lashes in kelsey
	Applying lipgloss	
Bathroom movement	Putting hair right	this is my look for today and now that i'm all done it is time for breakfast AKA coffee
Hallway movement	Walking to the kitchen	
Opening fridge	Opening the fridge	
Opening cupboard	Opening a cupboard	
	Grabbing a mug	coffee before talkie actually have a blue coffee mug that says that so I just want to give a quick shout out to my coffee mug
Closing cupboard	Closing the cupboard	
	Changing settings of coffee machine	
Coffee machine power usage	Waiting while coffee is being made	
Kitchen movement	Grabbing mug from coffee machine	
	Adding creamer to mug with coffee	coffee is not coffee to me without creamer my creamer
	Stirring coffee	

	Lighting a candle	this maple cinnamon pancakes candle is my life it is so good from Bath & Body Works you guys have to try it it smells a delicious
Livingroom and/or kitchen movement	Sitting down	
	Drinking coffee	
	Looking on smartphone	I usually check my snapchat
Closet movement	Entering walk-in closet	
	Look at some jumpers	today's outfit is not going to be a Christmas sweater
	Taking a jumper	it it's just gonna be a regular sweater
	Taking some trousers	and some jeans
Closing closet door	Closing the door	okay time to get dressed
Closet movement	Walking out the door in chosen clothes	yes that was I was like magic right
Bedroom movement	Entering bedroom	
Bedroom movement	Putting on socks	I'm gonna go ahead and put on these ugly christmas socks
Hallway movement	Sitting in the hallway playing with cat	it's time for Boba to get in the Christmas spirit, she actually is fighting with me not to put this thing on, so I put her in and she walked around in it a, I put these antlers on here
	Making picture with phone	
Livingroom movement	Sitting on couch	
	Writing in notebook	so after Cat-ivities I like to write down my video ideas for future months and I'll look through my schedule make sure i have my week down pack
Livingroom movement	Getting up from couch	and then I'm going to go ahead and head out now
Hallway movement	Putting on shoes	I'm gonna put on my booties
	Making selfie in the mirror	i love this crop top sweater from Alou lose my jeans are actually from hot Miami styles
Hallway movement	Blowing out candle	and I'm just gonna go about my day but before I leave I'm gonna try not to burn down my new apartment
Hallway movement	Grabbing keys	
Opening front door	Opening the front door	
	Walking through front door	
Closing front door	Closing front door	

Table B.2: Comparison of text and video from 'Winter Morning Routine'

Appendix C

Data and algorithm for constraint-based LPMs

C.1 Information about the data

Class	Occurrences (absolute)	Occurrences (relative)
Livingroom - Motion(3)	1948	26.053%
Kitchen - Motion(23)	1769	23.659%
Bedroom - Motion(22))	935	12.505%
Cubicle Room - Motion (1)	709	9.482%
Bedroom - TV - Power(6))	461	6.166%
Bathroom - Motion (10)	439	5.871%
Kitchen - Koelkast - OC(21)	305	4.079%
Toilet - Motion (11)	230	3.076%
Outside - Backdoor - OC(4)	212	2.835%
Outside - Proximity(7)	173	2.314%
Kitchen - Porcelain Cabinet - OC (13)	144	1.926%
Kitchen - Microwave - Power(20)	95	1.271%
Kitchen - Kettle - Power(19)	29	0.388%
Outside - Frontdoor - Motion(2)	21	0.281%
Kitchen - Cutlery tray - OC (12)	7	0.094%

Figure C.1: Overview of the sensors and the amount of observations in the test sensor log

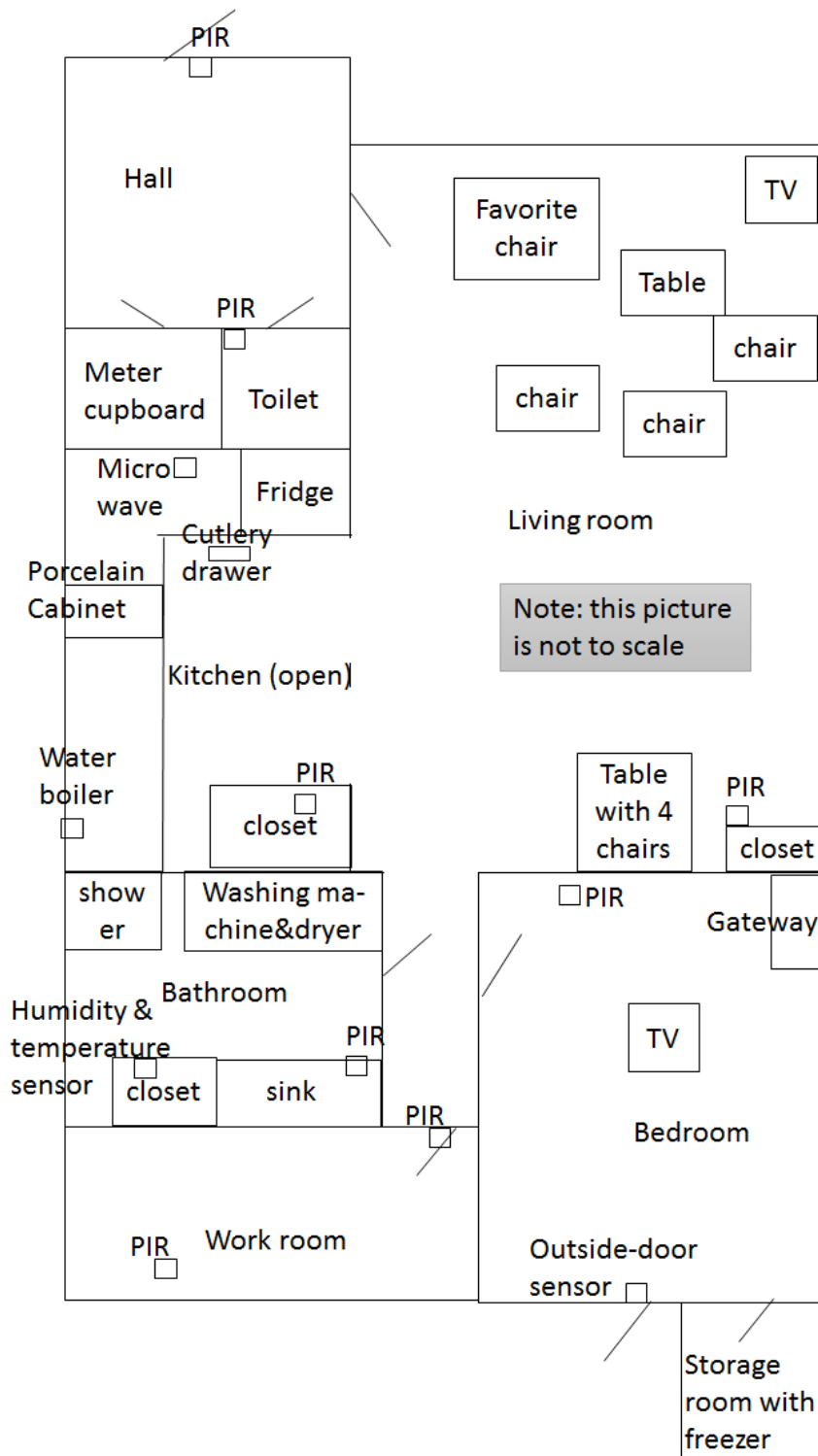


Figure C.2: Floorplan of smarthome

C.2 Model evaluation algorithm using constraints

Pseudo-code for the counting process can be found on the next page. For each trace, the algorithm loops over two different collections of events. One is the original trace of the log and the other one is the alignment made for the model with a trace from which all non-model activities have been removed. Line 5 to 13 go over the events in the original log trace and check if they represent an activity that is present in the model or not. If the activity is not in the model and if the model is already being executed (if a synchronous move has been made in the alignment since the last backloop was seen), then costs are charged. Then, the next event in the trace is checked. If the event in the trace *does* represent an activity that is present in the model, then it is time to look at the current alignment element.

An element in the alignment can either be a synchronous move, a backloop (which both are transitions) or a log move. If the element is a synchronous move, then the count of the activity belonging to the current event is locally increased. Furthermore, if in order to come to this element too high costs have been made, then a high cost flag is raised. If the element is a backloop and the high cost flag has not been raised, then the local counts for the activities are permanently updated and also the pattern gets a count. If the element is a log move and if the model is already being executed, then costs are charged. At this point the current alignment element has been dealt with. If the element was a synchronous or log move, then the current event of the original trace has also been dealt with and the next event can be taken. In case the element was a backloop, the current event still needs to be checked.

The process then goes back to line 2, where the next alignment element is taken and where the process starts (in line 5) with checking events of the original trace again. At the end of the trace, it is necessary to separately update the counts (if the high cost flag was not raised), because the trace does not end with a backloop (where the counts are normally updated).

The pseudo-code for evaluation of the models is as follows:

```

for each trace in the log: //each original trace
1  eventIndex = 0 //start with looking at the first event in the trace
2  synchronousSeenSinceLastBackloop == false //the model is not being executed
3  for each alignmentComponent in alignment: //alignment of trace with only in-model activities
4    goThrough = true
5    while goThrough == true:
6      event = get(eventIndex) //event from the original trace
7      if event is not in the model:
8        if synchronousSeenSinceLastBackloop == true: //the model is being executed
9          logmovecost++ //add costs for event not in model during execution
10         if there is a next event:
11           eventIndex++ //go check if next event is in the model, starting from line 5
12       else:
13         goThrough = false //if event is in the model, progress to code below
14
15     if alignmentComponent is a transition:
16       transition = alignmentComponent
17
18     if transition is a synchronous move:
19       synchronousSeenSinceLastBackloop = true //the model is being executed
20       update(localcounts) //count that this activity fits in the model
21       if logmovecosts > maxlogmovecosts:
22         highlogmovecosts = true //too much non-model transitions during execution
23         logmovecosts = 0 //start the count for in-between activities again
24       if there is a next event:
25         eventIndex++ //go to next event and alignmentComponent, starting from line 2
26
27     elseif transition is a backloop: //if the model has been executed completely
28       synchronousSeenSinceLastBackloop = false //model is not being executed
29       if highlogmovecosts == true:
30         highlogmovecosts = false //reset flag for too much non-model activities
31       else:
32         update(counts) //this model was executed without too much non-model activities
33         in between, so count can now be updated permanently (using localcounts)
34         logmovecosts = 0 //reset costs
35         clear(localcounts) //reset localcounts and go to line 2
36
37     elseif alignmentComponent is a log move: //if the activity is in the model, but does not fit
38         in the execution of the model
39       if synchronousSeenSinceLastBackloop == true //the model is being executed
40         logmovecost++
41       if there is a next event:
42         eventIndex++ //go to next event and alignmentComponent, starting from line 2
43
44 if highlogmovecosts == false: //at the end of the trace
45   update(counts)
46   logmovecosts = 0
47   clear(localcounts)

```

Appendix D

Context information of a sensor log

Figure D.1 gives an overview of context information that can be expected to be known for each observation, but that is not all traditionally included in the sensor log. An observation is made by a particular sensor at a certain date and time and has a value. A sensor is identified by an ID number and has a type and an optional label. The label can in a few words describe the sensor and what it measures, but this could also be determined from the rest of the context information. A sensor is attached to an object. This can either be a real object, such as a microwave, or in case of a movement sensor the part of the room that the sensor covers. An object has one or more types and one location. A location also has one or more types and is next to at least one other location. The model could be extended with annotations by adding a block with zero or more notations to the ‘sensor observation #’ block.

Figure D.2 gives two examples of sensor observations and their context information. One such sensor observation represents one row in a sensor log. Figure D.2a represents an observation made by a sensor with ID 5. The sensor label and type inform that this sensor measures pressure on a couch in the master bedroom. This couch, the object to which the sensor belongs, is labeled as couch number three, which suggests that there are also other couches in the house. Looking at the information about the object type shows that the couch is not only a couch, but also a bed, so this could be a couch which can be unfolded to be a bed. The location type shows us that a master bedroom is an instance of a bedroom. The house might contain other bedrooms, such as a guest bedroom. Figure D.2b represents an observation made by sensor with ID 2. The sensor label and type inform that this sensor detects movement in the west side of the living room. The object that the sensor is connected to is therefore noted to be the west side of the living room. The object ‘living room west’ is located in the living room, which is of location type ‘living room’. The object locations say that the west side of the living room is next to the hall, the kitchen and the hallway.

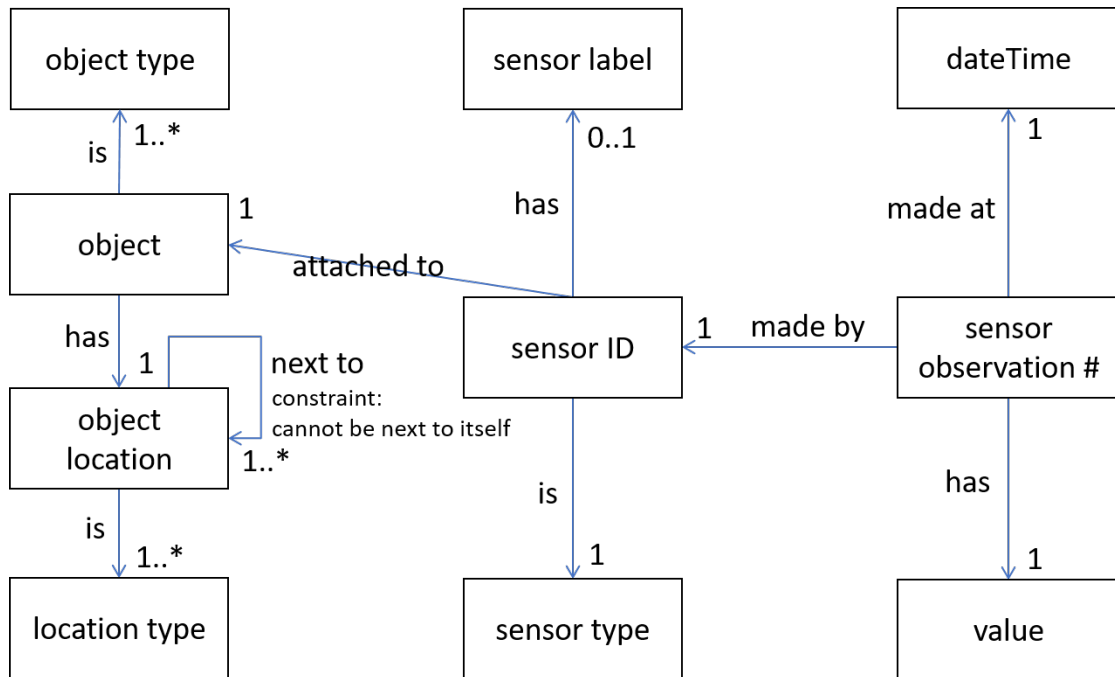


Figure D.1: Context information expected to be known about sensor observations

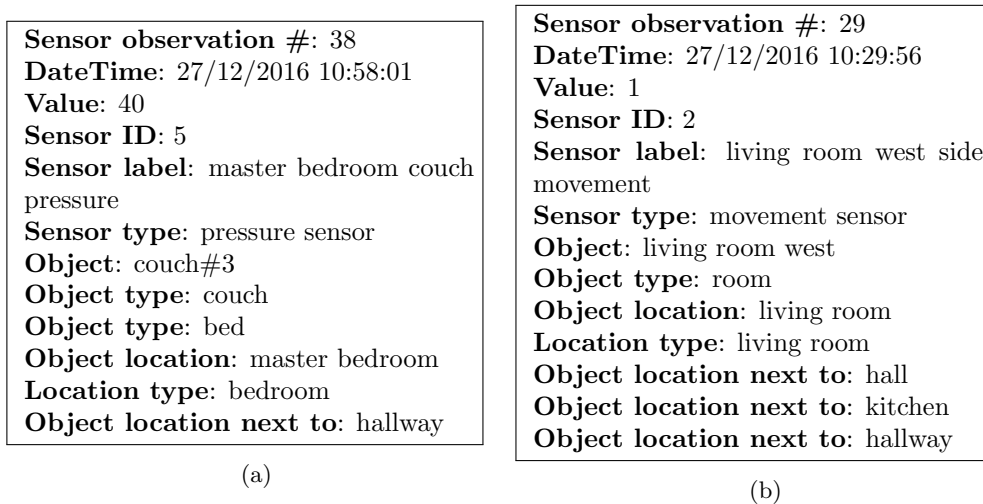


Figure D.2: Examples of a sensor observation with context information

Appendix E

Code for text creation

The following Python code is the complete code for translating a tree to text. The tree of figure 8.5 is included in the code:

```
class Tree:
    def __init__(self, id):
        self.id = id
        self.activity = None
        self.operatorType = None
        self.children = []
        self.freqText = None
        self.condition = None
        self.parent = None
        self.done = False

    def set_activity(self, activity):
        self.activity = activity
        return self

    def set_operator(self, operator):
        if operator in ("seq", "par", "excl", "incl", "loop"):
            self.operatorType = operator
        else:
            raise ValueError("This operator is not allowed.")
        return self

    def append_children(self, children):
        for c in children:
            self.children.append(c)
            c.parent = self
        return self

    def set_freq(self, freq):
        self.freqText = freq
        return self

    def set_cond(self, cond):
        self.condition = cond
        return self

    def set_done(self, done):
        self.done = done
```



```

        return self

def mergeTree(tree):
    i = 0
    while i < len(tree.children):
        child = tree.children[i]
        mergeTree(child)
        if child.operatorType == tree.operatorType and not child.activity:
            tree.children = tree.children[:i] + child.children + tree.children[i+1:]
            i += len(child.children)
        else:
            i += 1

def activityText(node, details=True):
    text = ""
    if node.condition and details == True:
        text += node.condition + ", "
    if node.freqText and details == True:
        text += node.freqText + " "
    if node.activity:
        text += "you " + node.activity
    else:
        text += giveName(node)
    return text

def generateActivityNumber():
    num = 1
    while num < 100:
        yield num
        num += 1

def giveName(node):
    if node.operatorType == "loop" and len(removeSilentsFromLoop(node,node.children)) == 1:
        text = twoLevelTree(node, node.children)
        node.set_done(True)
    else:
        j = next(abstractName)
        text = "you perform activity " + str(j)
        node.set_activity("perform activity " + str(j))
    return text

def operatorText(node):
    if node.operatorType == "seq":
        text = " and then "
    elif node.operatorType == "par":
        text = " while "
    elif node.operatorType == "excl":
        text = " or "
    elif node.operatorType == "incl":
        text = " and/or "
    elif node.operatorType == "loop":
        text = " multiple times"
    else:
        raise ValueError("No operator defined.")
    return text

def removeSilentsFromLoop(root,children):
    realChildren = []
    for child in children:
        if child.activity is not "silent":
            realChildren.append(child)
    return realChildren

```

```

def seqTree(root,children):
    text = ""
    flag = False
    for child in children:
        if not child.activity:
            flag = True
    if flag == True:
        for i, child in enumerate(children):
            if i > 0:
                text += "Then "
            if child.activity:
                text += activityText(child) + ". "
            else:
                text += twoLevelTree(child,child.children) + ". "
                child.set_done(True)
    else:
        text = twoLevelTree(root, children) + ". "
    return text

def twoLevelTree(root,children):
    text = ""
    if root.operatorType == "loop":
        children = removeSilentsFromLoop(root,children)
    if root.activity:
        text += "when " + activityText(root, False) + ", "
    if len(children) > 2:
        for child in children[:-2]:
            text += activityText(child) + ", "
    if root.operatorType == "loop":
        if len(children) >= 2:
            text += activityText(children[-2]) + " and "
            text += activityText(children[-1]) + operatorText(root)
    elif len(children) > 2 and root.operatorType == "par":
        text += activityText(children[-2]) + " and " + activityText(children[-1]) +
            " all at the same time"
    else:
        text += activityText(children[-2]) + operatorText(root) + activityText(children[-1])
    return text

def createText(currentOperator):
    sentence = ""
    if currentOperator.done == True:
        pass
    elif currentOperator.operatorType == "seq" and not currentOperator.parent:
        sentence = seqTree(currentOperator, currentOperator.children)
    else:
        sentence = twoLevelTree(currentOperator, currentOperator.children) + ". "
    if sentence is not "":
        first = sentence[0].capitalize()
        sentence = first + sentence[1:]
        print(sentence)
    for child in currentOperator.children:
        if child.children:
            createText(child)

root = Tree("bpmn-test")
root.set_operator("seq").append_children([
    Tree("node1").set_activity("take down the order"),
    Tree("node2").set_operator("par").set_activity("prepare the order").append_children([
        Tree("node3").set_operator("seq").set_activity("manage the delivery").append_children([
            Tree("node4").set_activity("assign the order to the waiter"),

```

```

        Tree("node5").set_activity("ready the cart")
    ]),
    Tree("node6").set_operator("seq").set_activity("manage the kitchen").append_children([
        Tree("node7").set_activity("submit the order ticket to the kitchen"),
        Tree("node8").set_activity("prepare the meal")
    ]),
    Tree("node9").set_operator("excl").set_activity("check if alcohol is ordered").append_
children([
    Tree("node10").set_activity("do nothing"),
    Tree("node11").set_operator("seq").set_activity("manage the sommelier").set_cond("if
alcohol is ordered").append_children([
        Tree("node12").set_activity("give the order to the sommelier"),
        Tree("node13").set_operator("incl").set_activity("take care of the alcoholic
beverages").append_children([
            Tree("node14").set_activity("fetch the wine from the cellar"),
            Tree("node15").set_activity("prepare alcoholic beverages")
        ])
    ])
])
])
]),
    Tree("node16").set_activity("deliver to the guest's room"),
    Tree("node17").set_activity("return to room-service"),
    Tree("node18").set_activity("debit the guest's account"),
])

abstractName = generateActivityNumber()
mergeTree(root)
createText(root)

```

Appendix F

Evaluation models

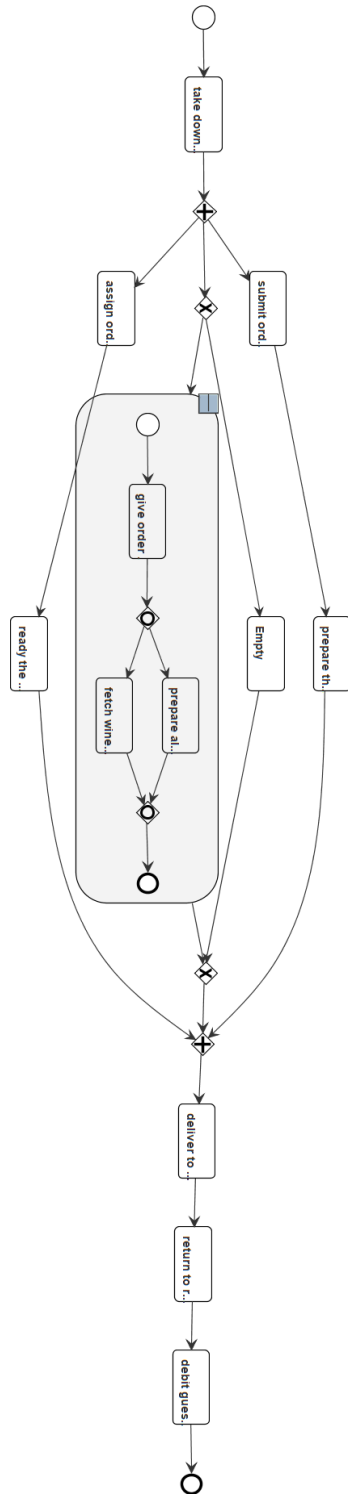


Figure F.2: BPMN model made from figure F.1 using ProM