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Using event spaces, setting and theme to assist the interpretation and development of museum stories

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Abstract. Stories are used to provide a context for museum objects, for example linking those objects to what they depict or the historical context in which they were created. Many explicit and implicit relationships exist between the people, places and things mentioned in a story and the museum objects with which they are associated. We describe an interface for authoring stories about museum objects in which textual stories can be associated with semantic annotations and media elements. A recommender component provides additional context as to how the story annotations are related directly or via other concepts not mentioned in the story.

The approach involves generating a concept space for different types of story annotation such as artists and museum objects. The concept space is predominantly made up of a set of events, forming an event space. The concept spaces of all story annotations can be combined into a single view. Narrative notions of setting and theme are used to reason over the concept space, identifying key concepts and time-location pairs, and their relationship to the rest of the story. Story setting and theme can then be used by the reader or author to assist in interpretation or further evolution of the story.

Keywords: Storytelling, museums, concept space, event space, theme, setting.

1 Introduction

Stories are often used in the presentation of museum objects. The story describes a context of the object, describing for example, how the object was created, or how the artwork can be seen as a response to conditions of the time. A story may relate multiple museum objects, describing how the creation of one was in reaction to, or in some way influenced, by another. Stories therefore provide a valuable mechanism for interpreting museum objects and understanding them within a wider context.

Museum storytelling is not the preserve of the museum professional. Museum organizations understand and expect stories to be told by their visitors. Rowe et al. [1] distinguish between the large, overall story of the exhibition and the small, personal stories associated with it. These small stories may originate from the visitor, triggered by something in the exhibition. For example, the visitor may recall a personal experience related to a museum object in the exhibition. Museums may also use small

stories themselves to help visitors to relate to the overall story, for example, presenting the (possibly fictional) story of a character that lived at a certain time in order to bring it to life. O'Neil [2] describes how Kelvingrove Art Gallery and Museum in Glasgow selected a set of 100 stories through a process of public consultation to assist visitor interpretation of the exhibits. The use of storytelling in museums can be seen as part of a more general trend away from the presentation of museum works according to classification schemes (such as time periods and art schools). For example, Dion suggests that the paintings of Manet are better understood if exhibited with the paintings he was reacting against, rather than other impressionist paintings from 30 years later [3].

Many relationships can exist between the concepts (people, places, museum objects) mentioned in museum stories. Some of these relationships may be articulated in the story, while others may remain implicit. For example, the story may mention two artists but only touch on the connections between them. The story author may assume or be unaware of these connections. The reader may fail to establish these connections for themselves.

As well as implicit or explicit relationships between the concepts of the story, much more could potentially be said about how each story concept connects to further concepts currently lying outside the scope of the story. For example, participants in the story will be involved in many more activities, and mentioned locations will be the site of other events. Art objects mentioned in the story, may feature in many more events concerning, for example, their creation, acquisition and display. Unmentioned national or international events may have influenced what happened in the story. Some of these external links may assist the reader or author. Many more may be a distraction or irrelevance from the perspective of the story. We propose to employ the narrative concepts of setting and theme to provide a focus and abstraction for how the potentially large knowledge space around the story is explored, in which themes are key concepts of the story and settings are times and places at which events in the story occurred. This approach was inspired by our earlier work on the analysis of museum stories, manually annotated according to their constituent events, to understand what the story reader saw as important [4].

Stories are generally understood as comprising events, which are emplotted into structures that express relationships across those events, and are then narrated for an audience [5]. Many semantic and knowledge-based research applications developed for the museum sector adopt an event-based approach. This can be explained in terms of the richness of event-based representations for reasoning and their use in aligning heterogeneous knowledge sources [6] as well as their affordance for story representation. A number of event ontologies have been developed including LODE [7] and SEM [8]. The CIDOC CRM ontology [9] facilitates an event-based approach to the representation of heritage and cultural knowledge. Heritage applications that utilize an event-based approach include the work of Hyvönen et al. [10] in the development of an event-based gazetteer of the First World War using Linked Data sources. Similarly, van den Akker et al. [11] utilize an event-based representation of heritage in which events are used as points of connection between historical concepts.

The rest of the paper is structured as follows. Section 2 describes a model of museum story authoring in which a story can be authored and semantically annotated alongside a recommender component that provides additional context. Section 3

shows how an event-based concept space can be generated and aggregated across story annotations. Section 4 describes how themes can be identified from the concept space and made available to the user for navigation. Section 5, describes how settings can be derived from the events of a concept space. Section 6, shows how settings themselves can be used to produce a concept space bringing in national and international perspectives on the events of the story. Section 7 describes a preliminary evaluation of the approach.

2 A model of museum story authoring

Museum objects are often presented alongside stories that supply a context. For example, the story might recount a mythological tale depicted in the object or describe how the life of the artist influenced the work. The story itself provides a branching-off point to explore other people, places, events as well as other stories and museum objects. In this work, we present a lightweight approach to authoring museum stories. The museum authoring component is paired with a recommender component that provides access to the surrounding context of the story. The link between the two components is the set of annotations associated with the story.

The screenshot shows a web-based interface for creating a story. At the top, it says 'DOSSIERS >' and 'Create Story'. Below this is a form with the following sections:

- Title ***: A text input field containing 'Michael Warren'.
- Description (Edit summary)**: A text area containing a paragraph about Michael Warren, including his birth year (1950), location (Gorey, County Wexford, Ireland), education (Bath Academy of Art, Trinity College, Dublin), and a reference to a 1998 article.
- Select a file**: A section with a text input field for a file path and a 'Select' button.
- Suggested providers**: A list of providers with radio buttons: 'None', 'None', and 'None'.
- Tags**: A dropdown menu with 'Hirst' selected.
- Select an item from the list:**: A list of items with their roles: 'Damen Hirst' (Painting Artist), 'Michael Hirst' (TV Producer), 'David Hirst' (Professional Association Ft.), 'Tory Hirst' (Actor), and 'Rob Hirst' (Alternative Artist).

Fig. 1. The authoring environment for writing stories and adding media and annotations.

The story authoring environment (see figure 1) and recommender component were implemented as modules in the Drupal Content Management System [12]. The annotations of the story are associated with Freebase topics, using a variant of Freebase Suggest customized for the Drupal environment. The story text can also be associated with media elements (images, videos). The story text and associated media objects are themed for presentation according to a pre-defined template.

The recommender component produces a concept space from the Freebase annotations associated with the story. The recommender component can be used both by the author to assist in story development and by the reader to explore beyond the story. Annotations are used to generate a concept space comprising associated attributes (e.g. name and description of an artwork) and events (e.g. creation, ownership and exhibition events of an artwork) of the annotation. Narrative notions of setting and theme are then used to extract elements from the concept space of potential greater relevance to the author or reader.

In the narratology literature, themes are defined as the most central concepts of a story. Tomashevsky [13] argues that stories need themes for coherence and give context that can assist interpretation. Themes derived from the concept space suggest new concepts not annotated in the story. These may be used by the author to extend the scope of the story or by the reader to understand more about the story and its context. For example, a theme could relate to a person that is connected to a number of people mentioned in the story, thereby potentially extending the story as well as uncovering connections between annotations already associated with the story.

Settings are derived from the time and location attributes of events in the concept space. The author or reader can use identified settings (such as London 1900-1905) as a starting point to find out about other events associated with the setting. Settings may also suggest relationships between times and locations mentioned in the story that may not be explicit in the text itself.

The recommender component is implemented as a Drupal module that uses the Freebase API to query and retrieve information and store it locally in the installation. The timeline.js library is used to visualize event spaces. A Drupal background process module is used to retrieve and process information from Freebase asynchronously in order not to disrupt user interaction with the system.

Although the surrounding context is not, and may never be, part of the story itself, narrative principles were adopted to represent and process story context for a number of interrelated reasons. First, events allow translation of knowledge represented using a range of different schemas into a homogenous form. This allows different types of reasoning to be applied across the events (such as theme and setting identification) and the events to be presented in accessible ways to the user, for example, using timelines. Second, theme and setting identification from the concept space allows what may potentially be the most interesting aspects brought to the attention of the reader or author. Third, navigating related sets of events in terms of setting and theme allows the concept space to be traversed using a type of abstraction different from that found in knowledge graph navigation tools (e.g. Sig.ma [14], Sindice [15]), though still maintaining a reasonable degree of domain independence. This abstraction may better fit the tasks of the author (e.g. “I need to say more about the historical context in which this happened”) or questions of the reader (“In what other ways are the people in this story connected?”). The following sections describe how the concept space of a story is generated and how theme and setting are calculated and used.

3 Generating the concept space of story annotations

The concept space of a story is the aggregation of the concept spaces of the story annotations. First, we describe how a concept space is generated for one annotation, then how it is combined to provide a concept space for the story. The concept space of a single annotation is modeled as a mixture of direct attributes and events associated with the annotation. The same knowledge can often be modeled as either events or as direct properties of an entity [16]. For example, the birth and death of an artist can be modeled as a single life event with start and end dates, a pair of birth and death events, or as “date of birth” and “date of death” attributes of the person.

Some things are difficult to model as events such as the art movement associated with an artist. Their membership generally has no time or location data and is often a post-hoc interpretation of the artist's work. This can be contrasted with membership of an educational or learned institution, which is often an objectively recorded event with time and location information. For other types of data there can be significant information loss if an event-based or similar approach is not used. For example, the owners of an artwork and the durations of their ownership are more effectively represented in an event-based form rather than as an "owned by" property of the museum object.

The decision on whether to model knowledge as events or attributes can also be influenced by professional practice and the intended purpose to which the knowledge will be put. Through our own work, we found a preference among museum professionals to model birth and death as attributes, and to use these as part of the identifier for a person. Reasoning over the events of an artist's life (e.g. objects created, education history, membership of professional bodies) could throw up interesting connections to other artists. However, relationships based on birth and death events were not found to be interesting to the user [17]. This aligns with the observation made by Mäkelä et al [18] who found library indexers preferred to model birth and death as direct properties of a person rather than events.

Issues of knowledge representation, museum professional practice and intended uses of the knowledge were therefore used to determine appropriate events and attributes of key types of annotation. For artists, activities such as artwork creation, education, exhibition production, authoring, organization membership, awards and nominations were modeled as events. Associated artistic movements, birth and death were modeled as direct attributes.

The events and attributes of a story annotation are retrieved from Freebase using the topic and MQL APIs. The topic API is used to retrieve the name, description and associated image of the annotation. The topic API is also used to retrieve the notable types of a Freebase topic (e.g. whether a person is primarily known as an artist, author, actor, etc.). The Freebase MQL API is used first to retrieve additional knowledge based on the type of the annotation. For example, if a topic is of type "people/person" then date of birth, date of death and education history can be retrieved. Birth and death are then represented as attributes of the annotation. Education history is represented as events associated with the person. If a topic had the type "/visual_art/art_subject" (i.e. had been a subject of one or more artworks), then the associated artworks are represented as artwork creation events associated with the subject.

All event-based knowledge is stored using both the original Freebase properties as well as a mapping to a simple event schema. The schema, which grew out of our previous work with museum professionals modeling events, closely aligns with the LODE [7] and CIDOC CRM [9] ontologies. The event properties used are agent, location, start_time, end_time, activity and tag, in which the tag property is used to associate any other entities with the event. The agent, location and tag properties are equivalent to respectively the involvedAgent, involvedObject and atPlace properties of the LODE ontology. The CIDOC CRM properties had_participant, took_place_at, starts and finishes are equivalent to the agent, location, start_time and end_time properties. Activity denotes event type such as artwork creation.

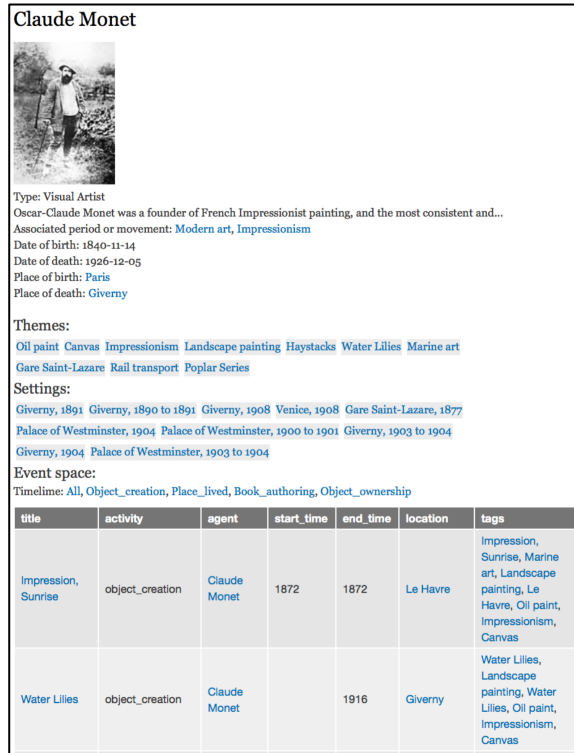


Fig. 2. Part of the concept space for the Claude Monet annotation.

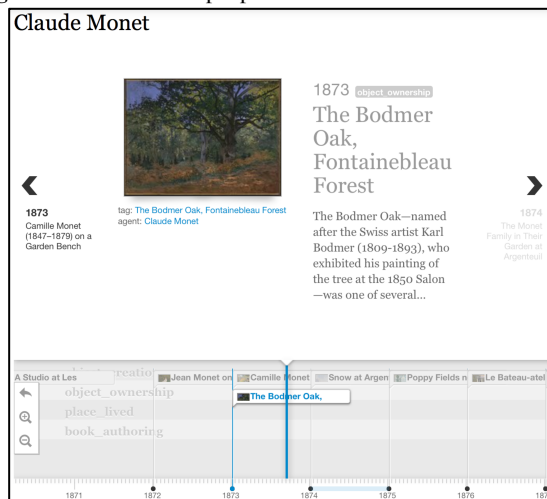


Fig. 3. Timeline of the event space of Claude Monet.

A story annotation for the Impressionist painter Claude Monet (see figure 2), has a concept space that first includes the name, associated image, notable type and description field. This is followed by any retrieved direct attributes such as date of birth. Below the derived themes and settings is the associated event space. The direct

attributes of the annotation and the attributes of the included events are all shown as navigation links. These links generate a new concept space around that associated concept. The entire event space or events of one activity (e.g. object creation) can be visualized on a timeline (excluding events for which there is no time information) (see figure 3). In a similar way, a concept space is generated for all annotations of a story, in which the events associated with each annotation are aggregated into a single event space.

4 Identifying themes from a concept space

The event space created by the annotations of a story can be relatively large to navigate, easily containing over 100 events. Themes identified from the event space can assist the author or reader in making sense of the event space and understanding what is potentially of greatest interest from the perspective of the current story. As described earlier, themes are central concepts that bind together the other elements of the story. The story already has a candidate set of themes in the form of its annotations. The additional concepts (people, places, objects, etc.) contained in the concept space of the story are evaluated as candidate themes, in terms of how they bind together the annotations of the story.

Themes can be generated for any single or multi-annotation event space. The concepts contained in the event space are scored in terms of:

Coverage - How many story annotations they are associated with either as direct attributes of the annotation (such as art movement) or through co-occurring in an event with the annotation.

Frequency - How many times the concept appears in the event space as either an attribute of a story annotation or attribute of an event.

The candidate themes of the event space are then sorted primarily in terms of coverage and secondarily in terms of frequency. Coverage is used as the primary measure as the story annotations can be seen as indicating the intended meaning of the story (if added by an author) or interpretation of the story (if added by a reader). The measure of coverage gives an indication of the extent to which each candidate theme from the concept space binds together these annotations of the story. For example, a person that worked with each person annotated in the story could be of potential interest to the author or reader.

Frequency is used as a secondary measure to order themes that are associated with the same number of annotations. Frequency on its own would be a poor indicator of theme for a concept space aggregated across a set of annotations. For example, a person may be frequently associated with one of the annotations but have no connection to the others. This person would though be a potentially strong theme when exploring that single annotation. In this case, as each candidate theme has an association to the sole annotation of interest, only frequency can be used to determine theme. Frequency alone would therefore reveal for example a regular collaborator.

Figure 4 shows the themes associated with a story that has three annotations: the Impressionist painters Camille Pissarro, Claude Monet and Paul Cézanne. The top n themes are shown (n is specified in a configuration parameter). The top themes are

those concepts in the concept space that connect to the most annotations, ordered by frequency. As all three participated in events involving the creation of Impressionist artworks, themes concerned with the art materials used, associated art movement and style of artwork predominate in the theme list. The art school Académie Suisse features higher in the theme list than Post-Impressionism even though it has a far lower frequency in the event space. This is because all three artists attended the school but all three are not associated with Post-Impressionism. If we contrast the themes with those associated solely with Claude Monet (figure 2) Académie Suisse does not feature as it has a lower frequency in that single annotation event space than themes such as Water Lillies.



Fig. 4. Themes of a concept space for Camille Pissarro, Claude Monet and Paul Cézanne.

The annotations (termed “Tags” in the interface), shown above the themes, are also ordered using the same thematic principles, primarily by the number of other annotations with which they are associated and secondarily by frequency. This gives an indication of how central each of the annotations are to the story. For example, if the annotations comprised an art teacher or pioneer and a number of other artists with which they worked (who did not necessarily work with each other), then the teacher or pioneer would head the list.

5 Identifying settings from the events of a concept space

Settings indicate both when and where something happened in a story. Setting is important as it identifies a point in time and space where characters or other objects in the story intersected. The candidate settings of an event space are all the times and locations associated in an event. A setting may include a time point (for events that have only a start or end time) or a time span (for events that have both a start and end time). Candidate settings are ranked using a similar approach to theme ordering. Settings are primarily ordered according to coverage, defined as the number of annotations associated with events featuring that particular setting.

Frequency is again used as the secondary ordering principle. Frequency is defined as the number of times the setting features in the event space. Figure 5 shows the settings derived from the event space of three story annotations: The Bodmer Oak, Fontainebleau Forest (an artwork by Monet), Chicago and 1900. These annotations could be associated with a story about the artwork being owned by Chauncey J. Blair in Chicago 1990. The highest ranked setting of the aggregated event space is Chicago 1990 as there is an event of Blair’s ownership of the artwork that contains all three of the annotations. The next setting is New York 1873-1900. This refers to a single event

about the artwork whose timespan (1873-1900) covers the annotation 1900, but is located in New York rather than Chicago.

Suggested settings may identify relationships between location and time annotations that are not made explicit in the story itself. For example, the story may mention, at various points, a year and an artist but not make the connection that the artist created an artwork in that particular year.



Fig. 5. Settings derived from the event space of three story annotations.

Similarly to themes, settings can be derived from the event space of a single annotation. In this case, as all events will have an association with the annotation, the settings can only ordered by frequency. When calculating the frequency of each setting within the event space only exact matches of time and location are considered. Temporal or spatial containment is not used. For example, an event with a setting of Paris 1880 would not be treated as an additional instance of the setting France 1880-1890. Using location and temporal containment to calculate smaller scale settings as contributing to the larger scale settings would imply some causal or other relationship between their associated events, which might not be the case. Events associated with the setting France 1880-1890 may have had no influence upon the events associated with the setting Paris 1880, and vice versa. Temporal and spatial containment is though used when presenting the event space of a setting to the author or reader. This is covered in the next section.

6 Generating the event space and themes of a setting

A setting can be used to generate a further space of events related to that setting. Events are retrieved that match as well as contain the setting in terms of location and time. This gives the user a view of larger scale events that may, but not necessarily, have had an influence on the events directly associated with the setting. So for example, if a setting was derived from the creation of an artwork and that setting fell during a national or global conflict then details of that conflict would be included in the event space of the setting. However, it is left to the reader or author to consider whether that could be relevant to the current story.

A set of themes can also be generated for the event space of the setting. However, as a setting rather than an annotation list is used to identify the events, only frequency is used to rank candidate themes. Figure 6 shows some of the events presented for the setting Paris 1865-1873, which was one of the settings suggested for the story in the previous section. In this case the local art events have been supplemented with

national and international events such as the Paris Commune, which may help contextualize the local events more closely related to the story.

Paris, 1865 to 1873

Location: [Paris](#)

Themes:
[The Bodmer Oak, Fontainebleau Forest](#)

Event space:
 Timeline: [All](#), [Military_conflict](#), [Event](#), [Object_creation](#), [Object_location](#)

title	activity	agent	start_time	end_time	location	tags
The Bodmer Oak, Fontainebleau Forest in Paris	object_location		1873	1900	Paris	The Bodmer Oak, Fontainebleau Forest
The Bodmer Oak, Fontainebleau Forest in Paris	object_location		1865	1873	Paris	The Bodmer Oak, Fontainebleau Forest
The Bodmer Oak, Fontainebleau Forest	object_creation	Claude Monet		1865-10	Paris	The Bodmer Oak, Fontainebleau Forest, Oil paint, Impressionism, Canvas
Paris Commune	event		1871-03-18	1871-05-28	Paris	
Second Battle of Orléans	military_conflict		1870-12-03	1870-12-04	France, Orléans	

Fig. 6. Themes and events of the setting Paris 1865-1873.

7 Navigating between the story, concepts and settings

The story authoring environment and associated recommender component provide a number of ways of navigating the knowledge space surrounding a story. Starting from the story itself, the reader or author can explore either the concept space of an individual story annotation or the aggregated concept space of all annotations. A single or set of annotations can have an associated set of themes. Each theme links to the concept space for that theme concept. The direct attributes of the annotation (such as art movement) or the attributes of the event space (e.g. people, objects) can also be used to navigate to their associated concept space. Single or aggregated concept spaces can also have associated settings that each link to a further event space that can draw in larger scale national and international events that give further context to the setting. The possible pathways are illustrated in figure 7.

8 Preliminary evaluation

A small observational study was conducted to gain insight into how the recommender component would support searching for different types of information in comparison to other information sources, namely web pages and Freebase. A task was devised around two artists, Dante Gabriel Rossetti and William Holman Hunt, who were both founders of the Pre-Raphaelite Brotherhood. The first question asked ‘what artistic movement were they linked to?’ in which participants should find that

they were both founders of the Pre-Raphaelite Brotherhood. The second required participants to make a value judgement and asked ‘what important artworks did they create?’ The final question asked ‘what relationships can you find between them and other artists?’

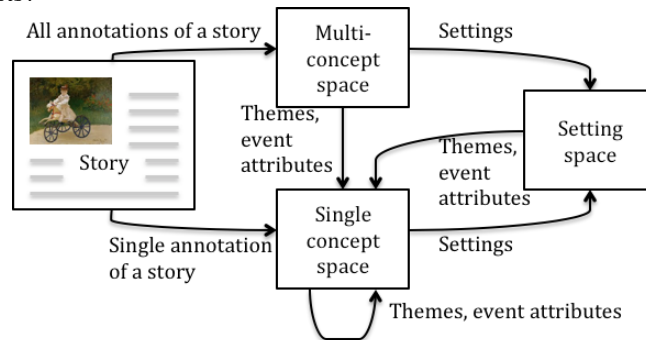


Fig. 7. Navigation paths between the story, its concepts and associated settings.

Participants were either given access to i) Freebase pages about the two artists ii) the recommender page generated for each artist, plus the multi-annotation page that merged both artists, or iii) an artist biography for each taken from www.tate.org.uk. There were two participants for each version (six in total).

Preliminary findings suggest that the recommender facilitates finding information that links artists. For example, participants were significantly faster in linking both artists to the Pre-Raphaelite Brotherhood than in the other conditions. For question two, participants relied heavily on written text for making value judgements about important artworks. For the third question, when describing the relationship between artists, without fail the participants used the terms available to describe the nature of the relationship, rather than discovering or choosing their own.

In summary, the recommender appeared to facilitate discovering information that linked more than one artist, whereas a web-type resource made it easier to answer a question which required a value judgement to be made, so that participants could rely on the judgement of others who had written the text (participants did not appear to naturally want to dig further and decide importance for themselves). Similarly when describing relationships, the information available heavily influenced what was selected and the terms used to describe the relationship, even though further searching of the resources could have provided further information that could have been used.

9 Conclusions and future work

This paper has described an approach to assisting the authors and readers of museum stories to better understand and explore the surrounding context. The approach draws on the narrative notions of setting and theme to traverse the surrounding knowledge space according to concepts that help to tie together the elements of the story and the times and places associated with the events of the story. In a future evaluation we wish to investigate the types of pathways that users take through the knowledge space when guided by setting and theme, and look at how that

is affected by features of the story and user characteristics. In terms of event reasoning, we intend to look at whether graph-based approaches and the weighting of event properties could be used to improve the ranking of settings and themes.

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