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Modelling Word Associations and Interactiveness for Describer Agents in Word-Guessing Games

A Case Study for the Location Taboo Game
B.Sc. Honours Thesis Abstract

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1 Introduction

In word-guessing games, one player describes a stimulus and his partner should guess what the stimulus is. Producing associations that would allow the partner to guess the target correctly requires an associative mechanism and modelling a shared context (Clark, 1970).

The Location Taboo Game[1] (LTG) is a cooperative word-guessing game, in which a *describer* provides short textual clues about a target city and the *guesser* should guess this city. The clues should not contain terms from a list of taboo words. In this thesis, an architecture for an Artificial Describer Agent (ADA) is presented and evaluated in simulation with an artificial guesser, as well as in a study with human guessers. The describer's objective is to elicit a correct guess by producing associations that are recognisable for the guesser. The ADA extracts word associations from a semantic vector space that has been created with a context-predicting distributional semantic model. To create *guess-independent* clues, several methods for extracting general associations for target cities are compared. Regarding the generation of *guess-dependent* clues, which add interactiveness to the game, a rule-based approach is proposed.

2 Approach

Guess-Independent Clues The first approach for clue generation assumes that the taboo words are strongly associated with the target city. For each taboo word the neighbour from the vector space that is closest to both the target city and the taboo word is selected as a clue (strategy 1). The second strategy builds upon this, as it uses neighbours from a vector space of Wordnet's synonym sets in addition, created with the AutoExtend algorithm (Rothe & Schütze, 2015).

The second approach uses example games to infer associations for a new target city. Clues from 100 games were clustered into 10 groups, representing 10 clue categories, such as *food* or *history*. For every word within a cluster, the corresponding city was used in an analogy with the new target city to find a candidate clue – e.g. for the target city *Prague* the analogy with *Venice* and *'pasta'* gives the candidate clue *'potato salad'*. This resulted in many candidate clues per cluster. Two metrics were used to choose one clue per cluster, resulting in two variants of this approach: the inverse document frequency (strategy 3) and the Cosine similarity (strategy 4).

For all strategies, the order of presentation is based on a clue's Cosine similarity to the target.

Guess-Dependent Clues The geographical aspect of guesses is used to create the interactive game-playing behaviour. To simplify the notion of dependency, a guess-dependent clue is only based on the last guess given. The following guess-dependent clues can be given: *'different continent'*, *'different country'*, *'close'* (within 100 kilometres of the target) and cardinal directions. Twenty percent of the describer agent's responses were made guess-dependent, to approximate the percentage of guess-dependent clues found in example games.

[1] This study is partially supported by the Marie Curie Initial Training Network (ITN) ESSENCE, grant agreement no. 607062.
The LTG has been designed by ESSENCE: https://www.essence-network.com/challenge/.

3 Experiments and Results

Artificial Guesser The Artificial Guesser Agent architecture presented by Dankers (2017) was used to evaluate the ADA in simulation. The vectors employed were the Wikipedia and Wikivoyage (Wiki*) vectors tailored for the LTG (Dankers, 2017) and the pre-trained Google News vectors,[2] created with the context-predicting distributional semantic models presented by Mikolov et al. (2013). The Wiki* vectors were retrained to include unigrams, bigrams and trigrams. ADAs employing the four game-playing strategies were evaluated according to their accuracy (Table 1).

Human Guessers To evaluate the ADA with human guessers, 36 games about European target cities were made available in an experiment. There were 9 games per strategy. Three types of questionnaires about the participants' geographical knowledge, familiarity with the target cities and ratings of the performance of the ADA were filled out by 9 participants. Overall, the ADAs could elicit a correct guess for 37.86% of all games played, and for 50.00% of the games in which the participants were familiar with the target city. On average, the use of natural language was valued with a 5.73 and the collaborative behaviour of the ADA was valued with a 5.90, on a scale from 1 to 10. For more detailed results per strategy, only the results for participants who indicated that they were familiar with the target city were taken into account (Table 1).

Table 1: The average performance per strategy. The accuracy is the percentage of games in which the target city was guessed correctly. The ratings express the usefulness of the clues according to the human guessers.

Strategy	Artificial Guesser	Human Guessers	
	Accuracy (%)	Accuracy (%)	Rating (1-10)
1	28.21	**59.52**	**6.89**
2	**30.77**	47.72	6.40
3	14.53	42.85	4.98
4	23.93	54.84	6.54

4 Conclusion and Future Work

In this thesis, methods for extracting word associations from a vector space have been applied to the creation of an ADA for the LTG. The ADA has been evaluated in simulation as well as in a study with human guessers. In the study, the proposed architectures could elicit a correct guess for 37.86% of all games, and for 50.00% of the games in which participants were familiar with the target city. A rule-based approach for modelling interactiveness has been proposed that allows the ADA to express relative geographical relations, depending on the last guess.

Regarding future work, dependent clues can be improved through modelling their helpfulness or adding different types. Secondly, the order in which the clues are presented could be improved. Thirdly, future work could include modelling individual word spaces that better capture an individual's knowledge.

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[2] The vectors are available at: `https://code.google.com/archive/p/word2vec/`.