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Published in:
Proceedings of the 31st Benelux Conference on Artificial Intelligence (demos)

Publication date:
2019

Document Version:
Accepted author manuscript

ZebraTutor: Explaining How to Solve Logic Grid Puzzles (Demo)*

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1 Introduction

In this demonstration, we present ZebraTutor, an end-to-end solution for solving logic grid puzzles (also known as Zebra puzzles) and for explaining, in a human-understandable way, how this solution can be obtained from the clues.

ZebraTutor[3] starts from a plain English language representation of the clues and a list of all the entities present in the puzzle. It then applies NLP techniques to build a puzzle-specific *lexicon*. This lexicon is fed into a type-aware variant of the semantical framework of Blackburn and Bos ([1, 2]), which translates the clues into discourse representation theory. This logic is further transformed to a specification in the IDP language [4], an extension of first-order logic.

It then uses this formal representation of the clues both to solve the puzzle and to explain how to a user can find this solution. The focus of our explanation is on simplicity: in generating explanations and choosing the *order* in which the reasoning steps are explained, we chose to order by an estimate of mental effort required to follow the reasoning step. Each reasoning step is visualised as the clue(s) involved and the resulting changes on the grid.

When solving such puzzles, it can either be used for explaining how to obtain an entire solution, or for providing help to users who are stuck during the solving process. Indeed, our explanation method will, given a partial solution, find the easiest next derivation to make.

2 System Overview

The **input** to ZebraTutor is a set of natural language sentences (from hereon referred to as "clues"), and the names of the *entities* that make up the puzzle, e.g. Englishman, red house, Zebra, etc.

3 ZebraTutor is an extension of software originally developed in the context of a Master's thesis [3]. It was first presented at the 2019 workshop on progress towards the holy grail in an informal publication entitled "User-Oriented Solving and Explaining of Natural Language Logic Grid Puzzles".

In typical logic grid puzzles, the entity names are present in the grid that is supplied with the puzzle. For some puzzles, not all entities are named or required to know in advance; a prototypical example is Einstein's Zebra puzzle, which ends with the question "Who owns the zebra?", while the clues do not name the Zebra entity, and the puzzle can be solved without knowledge of the fact that there is a zebra in the first place.

Steps Our framework consists of the following steps, starting from the input:

1. Part-Of-Speech tagging: with each word a part-of-speech tag is associated.
2. Chunking and lexicon building: a problem-specific lexicon is developed.
3. From chunked sentences to logic: using a custom grammar and semantics a logical representation of the clues is constructed.
4. From logic to a complete IDP specification: the logical representation is translated into the IDP language and augmented with logic-grid-specific information.
5. Explanation-generating search in IDP: we exploit the IDP representation of the clues to search for simple explanations as to how the puzzle can be solved.
6. Visualisation of the explanation: the step-by-step explanation is visualized.

2.1 Demonstration

The working of our system is demonstrated on http://bartbog.github.io/zebra. This webpage contains for some puzzles:

- All the the clues, and which (minor) modifications to the natural language formulation we implemented.
- The lexicon that is required to parse the puzzles (semi-automatically generated).
- The resulting idp theory associated to each of the clues.
- Runnable IDP files to either solve the puzzle, or generate the explanations.
- The visualization of the explanation by derivation steps.

The website is still under construction and will be updated with more puzzles in the near future.

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