Zachary Waters

Ashok Goel

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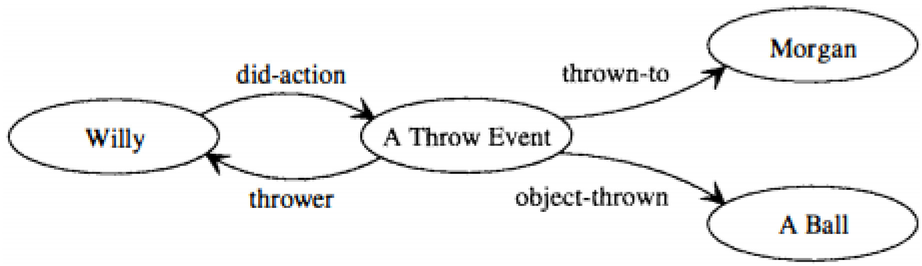
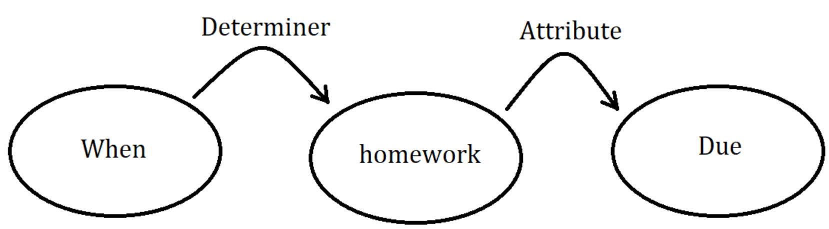
Assignment 2

The objective of this assignment is for me to explain how I would use semantic networks and rule-based production systems to design a chatbot. Many of the concepts discussed here will be use in the upcoming second programming assignment, so allow me to briefly elaborate on the project specifics. Project 2 requires us to determine the intent of various questions which are constructed from a word bank. The question's intent is determined by the unique combination of the object and category encompassed by the question. To determine the intent of the question, the project guidelines specify that we should create our own example questions, parse and determine how they map to their intent, then create an agent that can apply that information to new questions. This means that problem that is presented to us in project 2 can be broken down into two sub problems. The first part is creating mappings between sentences and their intent. And the second part is matching a new sentence with one of these mappings. As expanded upon further in this paper, Semantic networks and rule-based production systems offer a solution to each of these problems.

Semantic networks can be used to tackle the first problem, by allowing us to represent a question in a representation that makes its important objects and relations explicit. Semantic networks accomplish this by representing the various elements of a sentence as nodes, each connected to each other by links that illustrate the relationship the various elements have between each other. For example, the sentence "Willy threw a ball to Morgan" can be represented as a semantic network below.



One of the strengths that semantic networks possess is their ability to represent multiple sentences that share the same structure. They can do this by abstracting out the various lexical nodes that comprise their structure into broader more encompassing elements, where for example "Willy" and "Morgan" can be replaced by a more general "Subject 1" and "Subject 2". This would allow the previously shown semantic network to be capable of representing a nearly structurally identical sentence: "Billy threw a rock at Chace". To tie this back to our domain, we can use semantic networks to map a question like "when is the homework due" into the form shown below.



Just from looking at this semantic network, you can easily identity the "Object" and the "Category" of the sentence, allowing us to determine the question's intent. Just like before the elements of the network can be generalized in order to allow it to work with similarly structured questions like "when is the homework deadline". This question maps to the same intent value but uses slightly modified phrase, "deadline" instead of "due", when asking for its attribute. In project 1, trying to account for the many different kinds of synonymic phrases that could be used became a major hurdle, one that I wasn't able to completely overcome. Project 2 simplifies this problem by using word bank to draw from, which caps the total possible number of variations that can be used. It is important to make sure that I don't overgeneralize my system so that a sentence like "when is the test due" does not map to the same intent as something like "when is the homework due". As even though the sentence structure and category are the same, the different objects, result in a new object-category combination, mapping it to a different intent. So, a potential solution I am considering is simply creating a semantic network for each object variation of a structure. So, in summary, semantic networks can be used to create representations for the different structures of questions that could appear in project 2.

Now that we have our list of possible sentence structures, that just leaves the process of mapping a new question to the correct correspondent semantic network in order to determine its intent. This is where production systems come into play. A rule-based production system consists of three components: a working memory, a rule base, and an inference engine. The working memory contains all the elements that comprise of the domain space of the problem, in this case the elements are the various types of words and phrases that comprise the question. The Rules base contains various rules that follow the structure of a logical "IF-Then" conditional. An example a rule that might be used in my project would be "**IF** when and deadline are in the same sentence **THEN** suggest X semantic network" .The inference engine determines which of the rules in the rule base have their conditionals satisfied by the elements in the working memory, and then decides which rules to apply. This section is the final step that maps our newly seen question to a semantic network, which in turns maps our question to its intent.

With these two systems incorporated as I described, I believe I have a good jumping off point for how I should approach project 2.