Mini-Project 3: Sentence Reading (Spring 2021) CS7637

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***Abstract*—For this project we are tasked with developing a relatively intelligent agent. This agent will be given sentences and then asked questions about the sentence. The agent is expected to be able to respond appropriately.**

1 SETUP

We are given a text file with around 500 common words in the English language. I used python library 'spaCy' and its 'en_core_web_trf' model to create my agent's knowledge base. This worked by passing in the various words to the model, which produced a dictionary of information. The information that I found most useful was the 'Lemma' which was the base for the word, the 'POS' which was 'Part Of Speech.' I copied the results into an internal function within the agent. The reason I did this, was to have quick and direct access.

1.1 Call Graph

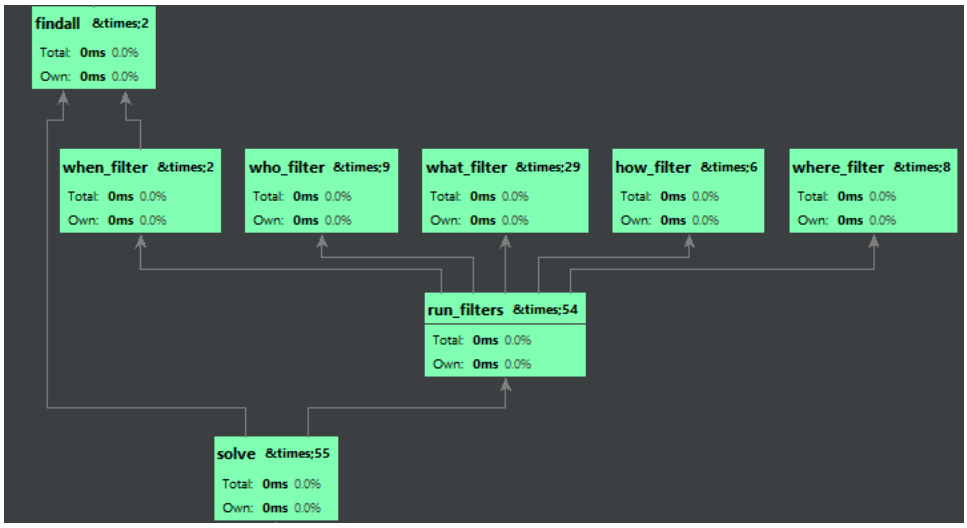

***Figure 1*—Call graph of sentence reading agent testing over fifty various question/answer combinations. Source: Josh Adams**

The call graph shows a few things, the first is my agent is relatively quick as it took less than two milliseconds to process over fifty questions and produce their corresponding correct answers.

1.2 How does your agent work?

My agent works by first processing the question and determining what kind of filtering it should use. This will be based on the first word within the question, such as "who", "what", and "where". Once that is determined the agent will then use the various filters to extract knowledge from the questions. Each filter has different rules which reduce the possible answer choices further. An example of this would be in the 'what' filter. The agent would look at the supporting word after the target, "what" in the question. This supporting word could be various things but based on that supporting word, the possible answers were limited further. For example, if the supporting word were some type of an action, the agent would try and find the corresponding action within the sentence. Then return the owner of that action if that owner was part of the possible answer choices.

1.3 How well does your agent perform?

My agent is able to consistently get almost all of the answers correct in grad-escope.

#	SUBMITTED AT (EST)	SUBMITTERS	SCORE	ACTIVE
34	Mar 12 at 2:08PM	JCA	40.0	✔
33	Mar 12 at 2:07PM	JCA	40.0	Activate
32	Mar 12 at 2:07PM	JCA	40.0	Activate
31	Mar 12 at 2:07PM	JCA	40.0	Activate
30	Mar 12 at 2:07PM	JCA	40.0	Activate
29	Mar 12 at 11:26AM	JCA	40.0	Activate
28	Mar 12 at 11:05AM	JCA	38.0	Activate

Figure 2 — Example of performance of my agent. Source: Me

Towards the beginning of this assignment my agent would struggle with questions which were similar, and the sentence had multiple subjects. I was able to quickly solve this by using the supporting words around extracted targets. For

example, if the sentence was 'Stacy put the blue rock on the street while Lucy ran to school' and the question 'Who put the rock on the street?'. My agent would originally know this is a 'Who' question and look for things which it could be talking about. It would narrow the possible answers to 'Stacy' and 'Lucy'. Previously my agent would select the possible answer which was closest to the topic by index. Now my agent will extract the 'Who' objects as well as their supporting action, such as 'put'. This would allow my agent now to narrow the possible answer to just "Stacy" because only 'Stacy', 'put' something in the sentence.

1.4 How efficient is your agent?

My agent is very efficient and in worst case scenario would run O($N \times M$) where N is the number of words in the sentence and M is the number of words in the question. The only way the agent would experience this is if the question contained no words found within the sentence. It would have to process each word in the question and each word within the sentence. As the complexity of a sentence increases the performance of my agent stays relatively the same. Being that a sentence and question can be only a finite length before they are no longer valid. While efficiency does not degrade with size and complexity, the accuracy of my agent does.

1.5 Does your agent do anything clever?

My agent does use some clever tricks to produce correct answers for given questions. One of those clever tricks was provided in a comment on Ed-Discussion. This trick boils down to comparison of the words in the sentence and the question. It filters out words which appear in both the sentence and the question. This dramatically improves my agent's ability to process questions quickly. For example, if my sentence is "The boy walked to school" and the question is "Where did the boy walk?". My agent first processes questions differently based on the type of questions. Since this is a 'Where' question, my agent will look more towards locations or objects. The agent starts by processing setting all possible answer choices to be a copy of the sentence. Then it will filter out the possible answers which appear in the question. An example of this in figure 5.

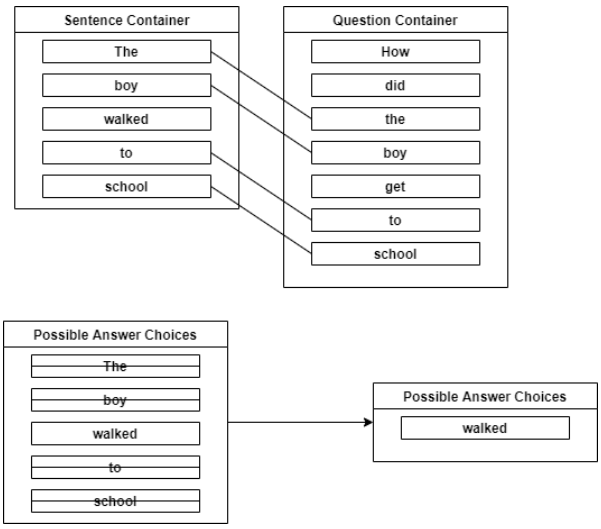

Figure 3 — Clever example. Source: Draw.io.

1.6 How does your agent compare to a human?

My agent uses similar techniques that humans do but is no where near as sophisticated. For example, when the question has 'who' in it, the agent will look to see if there is supporting words around the 'who'. Then the agent will filter out all parts of the sentence which would not be categorized as a 'who'. If there are multiple options, it will further reduce those words which appear in both sentence and question. It will continually filter the possible answers using the supporting words. An example of a supporting word would be a verb which would then be used in conjunction with the possible answers to narrow down the results. Eventually the agent is able to produce a correct answer 97.5% of the time given then common word list. My agent would fail dramatically if you asked it questions using words it has never seen before. This is one area which humans process sentences differently. My agent is not able to reason and determine the associated meaning of unseen words, while a human, generally is able to deduce a relatively accurate meaning or unseen words.

2 REFERENCES

1. https://spacy.io/
2. https://spacy.io/models/en#en_core_web_trf
3. Draw.io