Homework 2

Kevin Hung
khung34@gatech.edu

1 QUESTION 1

1.1 Sandwiches

From the list of dishes provided in the assignment, the following are what I consider to be sandwiches: BLT on white bread, hamburger, turkey and swiss on potato roll, meatball sub, tuna salad on brioche, chip butty, grilled cheese, turkey hero, vada pav, toast (with a topping), veggie burger, egg & cheese biscuit, patty melt, sloppy joe.

1.2 Illustration of Incremental Concept Learning

To illustrate how incremental concept learning works, I will go through two positive examples and two negative examples of sandwiches. For all the examples, the sandwich will contain the minimum number of ingredients that would constitute such a sandwich to avoid complexity.

The first positive example of a sandwich is a turkey and swiss on potato roll, leading to the concept model in Figure 1. Variabilization is already done, with only one of each object.

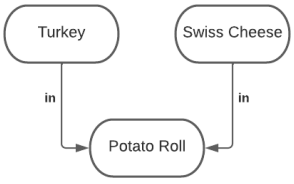


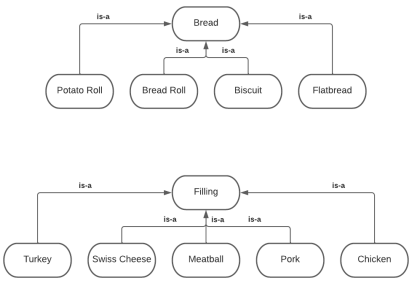
Figure 1—Initial concept of a sandwich.

The next example is also a positive one: a meatball sub. As it does not fit the current model, we must generalize using the "enlarge-set" heuristic to add elements to the sets. As the *in* link appears twice, we also use the "require-link" heuristic to turn it into *must-in*. This is shown in Figure 2.

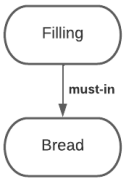
To generalize this model, we use the "climb-tree" heuristic to include background knowledge. This results in Figure 3, where specific fillings and bread types are generalized into abstract objects.

(a) Meatball sub as a positive example ***(b)*** Updated concept

Figure 2—Concept of a sandwich after another positive example.



(a) Background knowledge of fillings and bread types



(b) Updated concept of a sandwich

Figure 3—Using background knowledge to update concepts.

Next, a negative example of a sandwich is used: a chicken wrap. As the example includes a *wraps* link, we use the "forbid-link" heuristic to specialize the model as seen in Figure 4.

(a) Chicken wrap as a negative example ***(b)*** Updated concept

Figure 4—Concept of a sandwich after a negative example.

Finally, we use a (pork-stuffed) gyro as a negative example. Similar to the previous negative example, there is a *stuffs* link not present in the existing model. Using the "forbid-link" heuristic, we get the specialized model in Figure 5.

1.3 Would Other Sandwiches Change the Model?

The only sandwiches that would change the model are grilled cheese and toast. For these, the *in* link does not exist. Instead, they use an *on* link as the fillings are

(a) Gyro as a negative example ***(b)*** Updated concept

Figure 5—Concept of a sandwich after another negative example.

now toppings to be put on top of the bread. To update the model, the *must-in* link must be reverted to an *in* link and the *on* link added as an alternative.

1.4 Classification Parameters

To classify a sandwich from the list in the assignment, the following parameters would be useful:

- Has bread?
- Has filling?
- Filling between slices of bread?
- Filling on top of bread?
- Has meat?
- Has cheese?
- Has vegetables?
- Has bacon?
- Has turkey?
- Has ground beef?
- Has beef patty?
- Has tuna?
- Has eggs?
- Has potatoes?

In this case, filling is a generic descriptor for any ingredient of the dish that is not bread.

1.5 Abstracted Classification of Sandwiches

In Table 1, the parameter values for six selected sandwiches are shown. Some of the more specific parameters are omitted for brevity as they apply to none of the sandwiches.

Based on these values, the table in Figure 2 below shows an abstracted classifica-

Table 1—Parameter values for sandwiches

Parameter	Hamburger	Tuna salad on brioche	Grilled cheese
Has bread?	**Yes**	**Yes**	**Yes**
Has filling?	**Yes**	**Yes**	**Yes**
Filling between slices of bread?	**Yes**	**Yes**	No
Filling on top of bread?	No	No	**Yes**
Has meat?	**Yes**	**Yes**	No
Has cheese?	No	No	**Yes**
Has vegetables?	No	No	No
Has beef patty?	**Yes**	No	No
Has tuna?	No	**Yes**	No
Has eggs?	No	**Yes**	No

Parameter	Vada pav	Veggie burger	Egg & cheese biscuit
Has bread?	**Yes**	**Yes**	**Yes**
Has filling?	**Yes**	**Yes**	**Yes**
Filling between slices of bread?	**Yes**	**Yes**	**Yes**
Filling on top of bread?	No	No	No
Has meat?	No	No	No
Has cheese?	No	No	**Yes**
Has vegetables?	**Yes**	**Yes**	No
Has eggs?	No	No	**Yes**
Has potatoes?	**Yes**	No	No

tion of what a sandwich is. A sandwich must have bread and filling. The filling must be either between slices of bread (fully or partially sliced) or on top of the bread. All other ingredients are maybe present, and would determine the type of sandwich.

Table 2—Abstracted classification of sandwiches

Parameter	Value		
Has bread?	**YES**	NO	MAYBE
Has filling?	**YES**	NO	MAYBE
Filling between slices of bread?	YES	NO	**MAYBE**
Filling on top of bread?	YES	NO	**MAYBE**
Has meat?	YES	NO	**MAYBE**
Has cheese?	YES	NO	**MAYBE**
Has vegetables?	YES	NO	**MAYBE**
Has bacon?	YES	NO	**MAYBE**
Has turkey?	YES	NO	**MAYBE**
Has ground beef?	YES	NO	**MAYBE**
Has beef patty?	YES	NO	**MAYBE**
Has tuna?	YES	NO	**MAYBE**
Has eggs?	YES	NO	**MAYBE**
Has potatoes?	YES	NO	**MAYBE**

1.6 Is a Hot Dog a Sandwich?

There is an age-old question: is a hot dog a sandwich? Let's look at this question from three different perspectives. The first is using the model developed through

incremental concept learning. As seen in Figure 5, the concept of a sandwich is that it must have filling that is in the bread. The bread must not fully wrap around the filling, and the filling must not be considered to be stuffed into the bread. Based on this concept, a hot dog is considered a sandwich.

The second perspective to consider is using the classifier developed here. Something is considered a sandwich if it has bread, has filling, and the filling is either between slices of bread (fully or partially sliced) or on top of the bread. From this perspective, a hot dog is a sandwich as well.

The last perspective is through a case-based reasoning approach. What is a sandwich that is most similar to a hot dog? A hamburger is a good choice. It has a bun with meat between the two halves. We can adapt the hamburger to a hot dog by saying that a hot dog has an elongated shape and the halves are not completely separated. As these are small tweaks, a hot dog is a sandwich from this perspective.

2 QUESTION 2

2.1 Making Sense of the Sentence Using Principles of Understanding

An AI agent could use the principles of Understanding, specifically thematic role systems, to make sense of the sentence "She wasn't there." In a thematic role system, frames are based on verbs, with the slots being known based on the expectations of the verb. In this sentence, the verb is *was*. There are many definitions for *was* but the one that matches is "to have been at a place." A frame representation of this sentence is shown in Table 3.

Table 3—Frame representation of the sentence.

Thematic Role	
verb:	was
agent:	she
location:	not there

2.2 Different Emphases of the Sentence

Emphasizing different parts of the sentence alters the meaning of the sentence. As there are three words in the sentence, there are three different emphases to explore.

The first possible emphasis is "*She* wasn't there." In this case, the meaning has changed into "the other women were there". For the AI agent to come up with this meaning, it would have to know there were three candidates for an agent and that *she* refers to one of them. The frame representation in Table 4 shows this meaning.

Table 4—Frame representation of the first meaning.

Thematic Role	
verb:	was
agents:	two women
location:	there

The second possible emphasis is "She *wasn't* there." The meaning of this sentence is that it emphasizes the speaker's certainty that the woman was not there. An AI agent would have to incorporate the probability of a sentence into its knowledge in order to come up with this meaning.

The last possible emphasis is "She wasn't *there*." The sentence now means that the speaker knows where the absent woman was. For an AI agent to analyze the sentence in this way, it would have to have the concept of different locations and know that *there* refers to the drawing room. A frame representation of this meaning is shown in Table 5.

Table 5—Frame representation of the third meaning.

Thematic Role	
verb:	was
agent:	she
location:	location that's not the drawing room

2.3 Designing Agent to Avoid Tunnel Vision

An AI agent can avoid the tunnel vision that comes with assuming one interpretation by keeping all three frame representations in memory as it reasons. It can discard an interpretation if additional information comes in that contradicts or invalidates that interpretation. Alternatively, the information can reinforce an interpretation. For example, if the agent gets the information that there are more than three suspects, then the frame representation for "*She* wasn't there" would be more likely. That way, the agent would still keep the benefits of top-down reasoning.