Homework 2 (Spring 2021): CS7637

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***Abstract*—What is a sandwich? You may think this is an easy and somewhat ignorant question. I think we can agree that a BLT on white bread would be considered a sandwich. Is it having the bread or the meat or some combination of those? At what point does something cease being a sandwich and start being considered something else entirely? This homework assignment will explore incremental concept learning as well as classification, in an attempt to derive what makes something a sandwich.**

1 QUESTION 1

I started off by classifying these various edible objects into groups on whether I consider them a sandwich or not. Some of my choices may not be agreed upon but using three different perspectives, I will attempt to determine which are sandwiches or not.

Sandwich	Not Sandwich
• 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 • Veggie burger • Egg & cheese biscuit • Gyro • Patty melt • Sloppy joe	• Chicken Wrap • Burrito • Ice cream sandwich • Ice cream taco • Toast • Cheese quesadilla • Toaster strudel • Klondike bar • Buttered biscuit • Sushi rolls • Calzone

***Figure 1*—Various edible objects categorized as a sandwich or not. Source: DRAW.IO.**

Each of the next two perspectives will start off with the basic idea of what a sandwich is. This basic idea consists of two slices of bread with a slice of meat in the

middle. From there the different perspectives will process two positive examples and 2 negative examples. As the positive examples will be a 'Hamburger' and 'Chip butty', the two negative examples will be 'Ice cream sandwich' and 'Sushi rolls.'

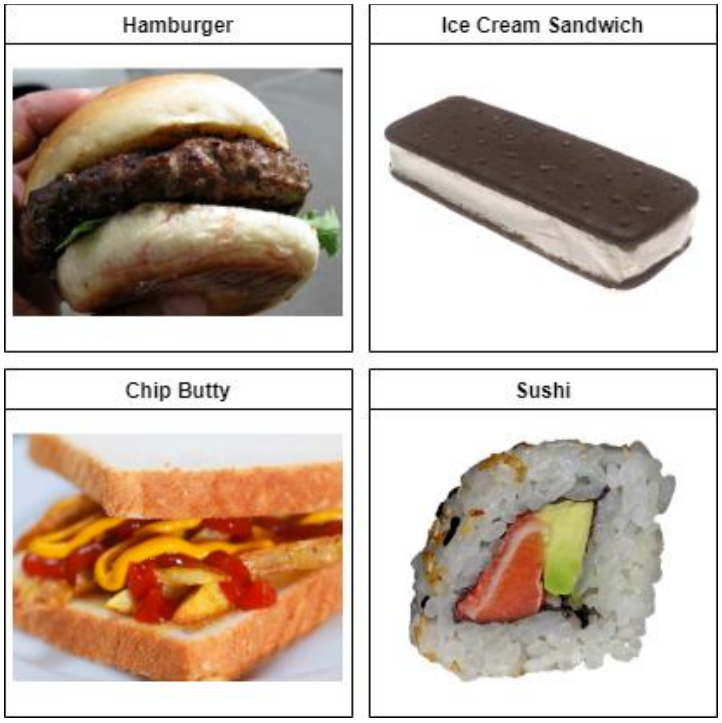

Figure 2 — The positive examples of a sandwich on the left side and negative examples on the right side. Source: DRAW.IO.

1.1 Incremental Concept Learning

Incremental concept learning takes problems and modifies its learned concept only as needed when identifying objects. It uses generalization and specialization heuristics to make progress when learning. The typical pipeline for incremental concept learning is first check if the current problem is a positive or negative example. If it is positive, does it fit the current concept? If No, we generalize. If the item is a negative example, check if the item fits the current concept. If it does fit, then we specialize.

We already have the basic idea of what is considered a sandwich, listed above. Starting with the hamburger which is a positive example we see that the hamburger has two buns which are very similar to the bread but not exactly. We also have instead of a slice of meat, a patty of meat. Since the hamburger does not fit

the current concept, we must generalize the concept. Our new concept will say that a sandwich will have meat is some form between some form of bread. Next, we will look at a negative example, the ice cream sandwich. We will not specialize our concept because the ice cream sandwich does not fit. The bread aspect does but not having meat in between.

Next positive example is a chip butty. Since this is a positive example but does not fit our current model we must generalize. Having some sort of bread will stay but the requirement of having some form of meat between will change to having something which is edible be between the bread. If we encountered the chip butty before the ice cream sandwich, I believe we would have ended up learning more by this point. The last example is sushi roll, and this is a negative example. This does not fit our current concept, so we do not generalize. If I had chosen a cheese quesadilla or the calzone, it would have made a significant difference in the model as it fits the current concept but is a negative example.

1.2 Classification Learning

Classification learning takes many features of the various items and based on different combinations, determine if an example a positive example or not.

Sandwich Features	Hamburger	Vada Pav	Grilled Cheese	Tuna Salad on Brioche	Chip Butty	Meatball Sub
• Has bread-like parts	• True	• True	• True	• True	• True	• True
• Is Cold	• False	• False	• False	• True	• False	• False
• Has meat	• True	• False	• False	• True	• False	• True
• Has natural vegetables	• ~	• False	• False	• ~	• False	• False
• Top and bottom parts touch	• False	• ~	• True	• ~	• False	• ~
• Is sweet	• False	• False	• False	• ~	• False	• False
• Typically eaten using hands	• True	• True	• True	• True	• True	• True

Figure 3 — Parameters for various examples of sandwich type items. Source: DRAW.IO.

Some of the values in 'Figure 3' have ~ and this suggests a maybe response. For example, a hamburger has a ~ for 'Has natural vegetables.' The reason is that sometimes there are vegetables like tomatoes or onions on a hamburger.

Abstract Sandwich
• Typically eaten using hands - True

Figure 4 — Abstract class for a sandwich. Source: DRAW.IO.

Since this is just the abstract class for what is a sandwich, all sub categorial sandwiches must still hold these values. Typically eaten by hand must be true for all things to be considered a sandwich.

1.3 Is a hot dog a sandwich?

In case-based reasoning the concept of what a sandwich is learned by retrieving previously encountered similar problems and tweaking those solutions to meet the new problem. Each time storing those new results which allow for an agent to over time, learn what is and what is not a sandwich. When the example is a hot dog, I would think the meatball sub would be drawn as the most similar sandwich. I think it is more similar to the calzone which I have labeled as not a sandwich. For classification it meets the abstract of typically eaten by hand. It would still match many of the more specific features, like has bread-like parts, has meat or not being sweet. Using the incremental concept found previously, the hot dog would be considered a sandwich. With further exploring of the state space, I would expect a hot dog to not be considered a sandwich.

2 QUESTION 2

'Maria didn't say I kicked the can' can be interpreted using common sense reasoning. Starting left to right, "Maria" is not a verb, so it is placed off to the side for later use. Next is the word "didn't" which is considered an auxiliary verb so this may be processed but we must look at the next word to determine "didn't" usage and purpose. "Say" is the next word which is a verb so we can construct an action frame.

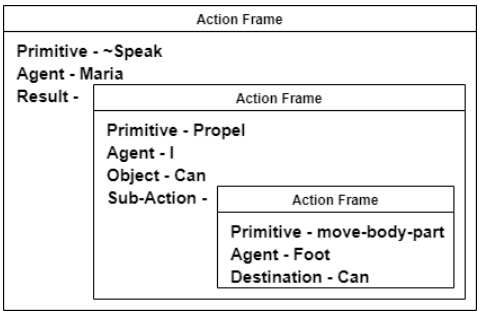

Figure 5 — Action frame. Source: DRAW.IO.

The ~ in front of the primitive is there because of the auxiliary verb " didn't ", which suggests a negation of the primitive, thus means "didn't speak". Different emphasis on the various words can make dramatic differences in the frames

needed to represent the sentence. Other examples of this sentence "Maria didn't say I kicked the *can*" and "*Maria* didn't say I kicked the can." These two sentences could mean very different things because the emphasis on "*can*" and "*Maria*".

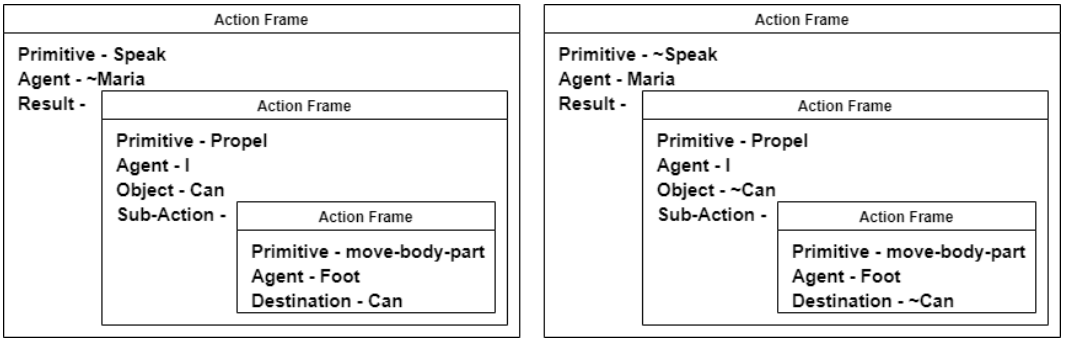

Figure 6 — Action frame for different emphasis. Source: DRAW.IO.

There could be many more levels to the action frames, but I choose to only show the most significant. The left image in figure 6 shows the sentence "*Maria* didn't say I kicked the can." The right image in figure 6 shows the sentence "Maria didn't say I kicked the *can*." The agent will gain knowledge about the environment in many ways. Looking at the frame on the right, the negation of speak was removed and the negation of Maria means that the action did occur just Maria was not the one who did it. The frame on the right is the same as the original frame except for the can being negated. This would suggest everything happened just not to the can. The same agents were involved, with the same actions but the object has changed.

An AI agent may be able to infer whether sentences are to be taken literally or figuratively by using background knowledge and emphasis coupled with relationships built in the commonsense reasoning and context. This still is a fairly difficult task, but I do believe the agent can make an informed decision. Such as in the example above if "I" or "kicked" was emphasized the agent would be able to know not to take the sentence literally.

3 REFERENCES

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