# Homework 2

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## 1 WHAT IS A SANDWICH?

### 1.1 A list of whether I consider sandwiches or not

***Table 1*** — What is a sandwich?

| Name | Is sandwhich? | Description |
|---|---|---|
| BLT on white bread | TRUE | Square; bread+bacon+lettuce+mayonnaise+bread |
| Hamburger | FALSE | Fillings placed in **one bun sliced by two** |
| Turkey and swiss on potato roll | TRUE | Uncertain shape; bread+turkey+potato+cheese |
| Meatball sub | FALSE | Rounded-rectangle; bread+3 meatballs+bread |
| Tuna salad on brioche | TRUE | Undefined shape for brioche |
| Chicken wrap | FALSE | Thin flour wrapping chicken in a cylinder |
| Chip butty | TRUE | Bread+chips+sauce+bread |
| Burrito | FALSE | Thin flour wrapping meat, cucumber, rice, etc. |
| Ice cream sandwich | TRUE | Bread+ice-cream+bread |
| Grilled cheese | TRUE | Bread+cheese+bread |
| Turkey hero | FALSE | French bread cut lengthwise; turkey, cheese, vege |
| Ice cream taco | FALSE | corn or wheat tortilla topped with ice cream |
| Vada pav | FALSE | Fried potato dumpling inside one bread bun |
| Toast | FALSE | Piece of bread exposed to radiant heat |
| Cheese quesadilla | FALSE | Heated tortilla (flour) with melted cheese inside |
| Toaster strudel | FALSE | Bread+layered pastry+filling inside |
| Veggie burger | FALSE | Hamburger without meat |
| Klondike bar | FALSE | Ice cream in chocolate shell |
| Egg & cheese biscuit | FALSE | |
| Buttered biscuit | FALSE | |
| Gyro | FALSE | Meat and vege in gyroscope-shaped bread roll |
| Sushi rolls | FALSE | Seaweed, rice, miscellaneous filling |

| Name | Is sandwhich? | Description |
|---|---|---|
| Patty melt | TRUE | Beef between toasted bread with cheese |
| Calzone | FALSE | Fillings pocketed (sealed) in bread |
| Sloppy joe | FALSE | Beef paste between a sliced bread bun |

### 1.2 Illustrating incremental concept learning using potential sandwiches

See Figure 1—Figure 4— for the incremental heuristic process of concept learning. From the first two positive examples, concepts about the structure and ingredients are learned. Comparatively, the two negative examples inspires the learning agent about the wrong structures of bread. In Figure 3—, plentitude features of hamburgers, including fillings and the bread structure, are exploited to address all the possibilities for something not to be a sandwich.

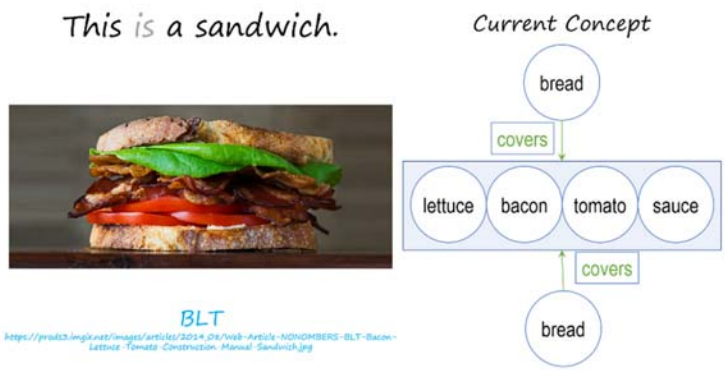


*Figure 1*— BLT is sandwich

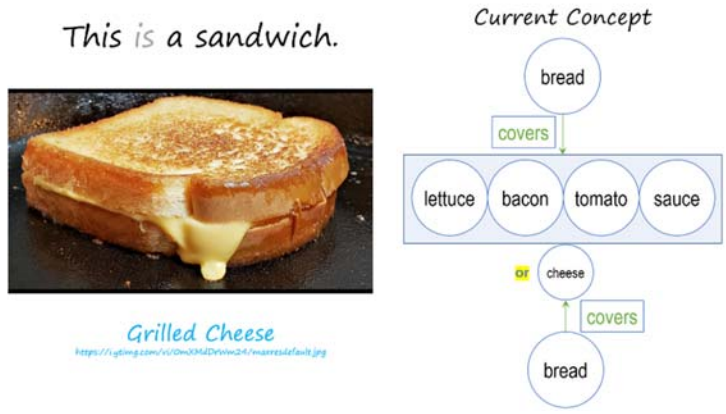


*Figure 2*— Grilled cheese is sandwich

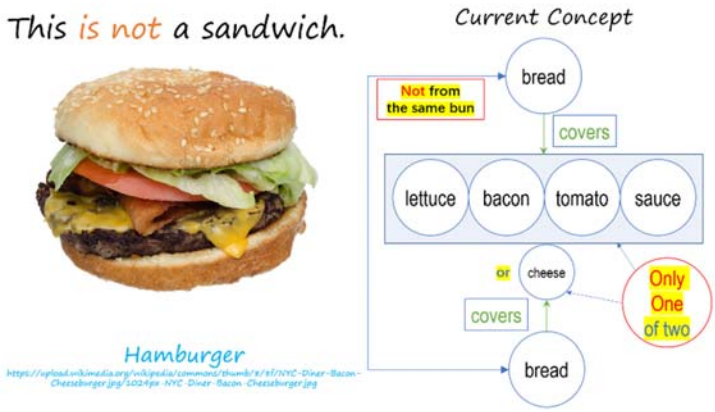


*Figure 3* — Hamburger is NOT sandwich

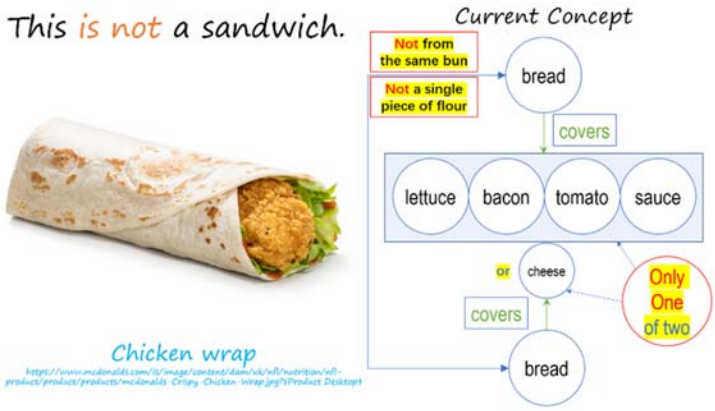


*Figure 4* — Chicken wrap is NOT sandwich

### 1.3 The potential sandwich that could make a significant difference

If the next input to the model is an **ice cream sandwich**, the learning agent would make major revises on the ingredients. More varieties of ingredients would be accepted for a sandwich.

### 1.4 Parameters that may help differentiating sandwiches

*Table 2* — Parameters for sandwiches

| Parameter | Description |
|---|---|
| How many pieces of flour? | Usually 2 pieces of flour for a sandwich |
| Flour pieces not from a single dough? | The bread of a hamburger is from a single bun |
| All pieces of flour are high-protein flour? | Biscuits are made of low-protein flour |

| Parameter | Description |
|---|---|
| Has ingredients besides flour? | Must be TRUE for sandwiches |
| Has structure flour + non-flour + flour? | Structures like rolls do not account for a sandwich |

*Table 3* — Values of parameters for six sandwiches (part 1)

| Parameter | BLT | Turkey & swiss | Tuna salad on brioche |
|---|---|---|---|
| How many pieces of flour? | 2 | 2 | 2 |
| Flour pieces from a single dough? | FALSE | FALSE | FALSE |
| All pieces of flour are high-protein flour? | TRUE | TRUE | TRUE |
| Has ingredients besides flour? | TRUE | TRUE | TRUE |
| Has structure flour + non-flour + flour? | TRUE | TRUE | TRUE |

*Table 4* — Values of parameters for six sandwiches (part 2)

| Parameter | Chip butty | Ice cream sandwich | Grilled cheese |
|---|---|---|---|
| How many pieces of flour? | 2 | 2 | 2 |
| Flour pieces from a single dough? | FALSE | FALSE | FALSE |
| All pieces of flour are high-protein flour? | TRUE | TRUE | TRUE |
| Has ingredients besides flour? | TRUE | TRUE | TRUE |
| Has structure flour + non-flour + flour? | TRUE | TRUE | TRUE |

## 1.5 Classification rules for a sandwich

has 2 pieces of flour ∧ all high-protein flour

∧ ¬ flour from the same dough

∧ has ingredients besides flour

∧ 2 pieces of flour cover all the other ingredients

## 1.6 Is a hotdog a sandwich?

### 1.6.1 *Through increment concept learning*

Referring to Figure 4—, hotdog is not sandwich, in that the bread for a hotdog is from a single flour bun.

### 1.6.2 *Using the classifier based on parameters*

Hotdog is not sandwich, still because the bread is from a single bun.

### 1.6.3 *Using case-based reasoning*

The nearest-neighbor of hotdog may be meatball sub, which is not a sandwich. Therefore, hotdog is not sandwich. The closest sandwich to hotdog might be turkey and swiss on potato roll.

## 2 UNDERSTADING THE SENTENCE: "MARIA DIDN'T SAY I KICKED THE CAN."

### 2.1 Explain how an AI agent might make sense of that sentence

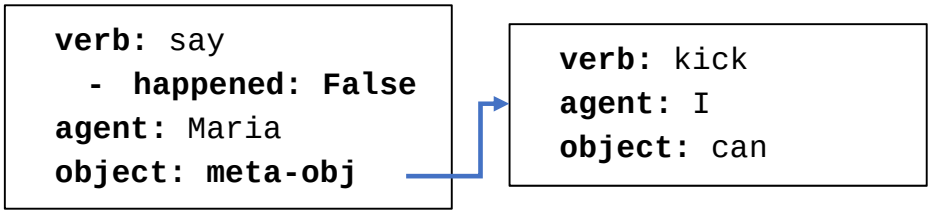


*Figure 5* — The frame representation of the sentence

The AI agent may first detect the subjects (Maria; I; can; "I kicked the can") in the sentence. To verify the can as a subject instead of a modal verb, we need the help from its context. With the word "can" serving as an object of the verb "kick", and appended after "the", the AI agent may explore its knowledge base to search for the meaning of "can" as a noun.

Besides, to verify the clause "I kicked the can" as a whole object, grammar knowledge is necessary for the AI. It should know that a sentence can be appended after a transitive verb, and identify that a single "I" is not likely to be the object of "say", according to both the semantics and the grammar.

### 2.2 Different emphasis on the sentence

In Figure 5— the emphasis is put on the verb about whether Maria did say a sentence. However, the emphasis can be also on any other agent, object or verb in the sentence.

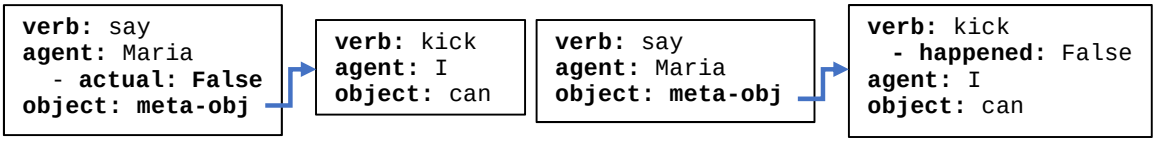


*Figure 6* — Extra 2 different emphases on the sentence

### 2.2.1 *Possible tactics for an AI to find the emphasis*

To identify what is the actual emphasized component, we shall make use of the context of the sentence by detecting the frequency of different **types** of components that has been recently mentioned. For example, if the preceding text has frequently mentioned what Mary has done, we may infer that the current sentence is emphasizing that Mary didn't "**say**", and she might had written the sentence or sent it via text message.

Following this idea, we may first list all the possible emphases, and classify these components into different equivalent classes. Then we can detect whether similar components of the same equivalent class have been mentioned in the context. If components of a specific equivalent class are intensively discussed nearby, we may infer the major topic that is being discussed in the current sentence.

### 2.2.2 *The AI's understanding about different emphases changing the meaning of the sentence*

Different emphases change the key information delivered by the sentence. When the AI has determined the emphasized component in the sentence, it can then extract new working knowledge from this whole article. By comparing the knowledge acquired by different emphases, the AI can understand the impact of different emphases altering the meaning, simply by generate & test. Inferences of different equivalent classes can be deduced from different emphases, asking the AI to pay attention to different types of information in the subsequent text.

### 2.2.3 *How an AI might be able to infer whether the sentence is literal or figurative*

This can also be achieved by matching equivalent classes. For example, if Mary is in her working office, and components related to "work" or "schedule" is frequently mentioned in the context, the AI may be likely to take the sentence as figurative. In contrast, if Mary is in a park and having fun, then she is more likely to kick a literal can.

Besides, there is a prior possibility of humans using figurative expressions. Evidently humans use less rhetoric than straightforward sentences. Based on the prior possibility, higher threshold is need to determine that the sentence is figurative. Extra knowledge is needed about human's frequency of using figurative sentences.