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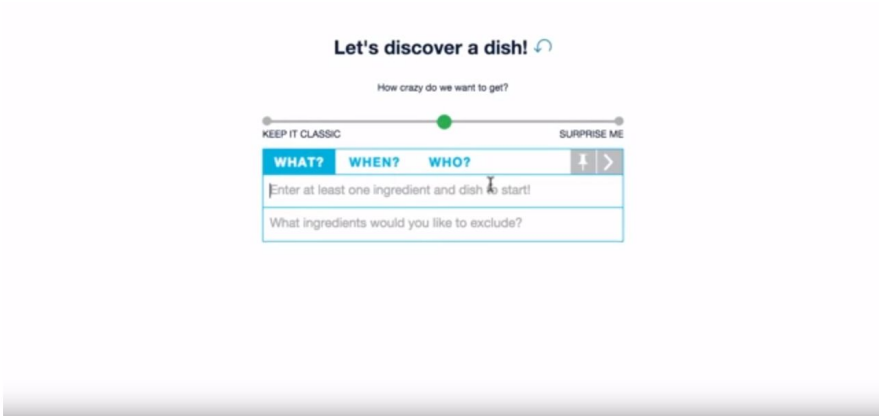
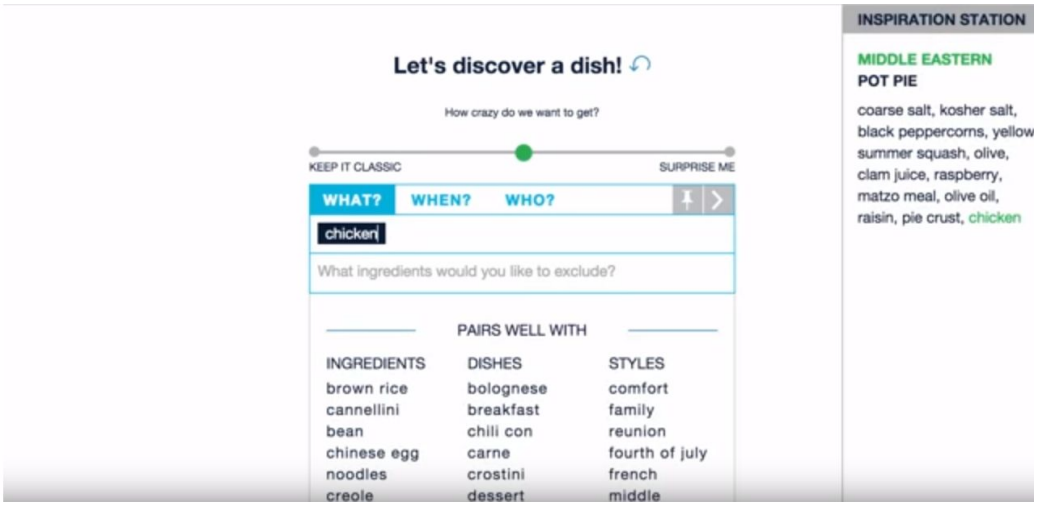
From the first moment on this earth, humans embark on an amazing journey. A journey that allows us to learn and grow into adulthood where we continue to form into unique human beings. Such journey would not be possible without the fundamental skill of learning. This skill which is not only adaptable by humans can also be applied to machines as well. The question is, can machines experience this journey, are they able to learn and adjust to new problems never seen before?

In order to try to answer such a question, we will examine a system that was developed by IBM called Cognitive Cooking. Cognitive Cooking allows for dynamic creation of new recipes based on various parameters such as flavor, taste, seasonality, textures and form. The system contains a knowledge database to handle all of the information regarding ingredients, ingredient information on a molecular level, recipes, nutritional information, and information regarding the general populations likes and dislikes. Such knowledge base helped create a system for building new recipes.





The most intriguing aspect of the Cognitive Cooking system is the ability to generate new recipes that it has never seen before. This introduces many problems on different levels which makes finding solutions very difficult. The system has to put together a dish based on variances from previous dishes that it has seen. Once a new dish is created it has to be unique and tested for overall efficiency. Each created dish must be stored back into the knowledge base (Learning by Recording Cases) and whenever new recipe is requested, the system must be smart enough to find a previous dish similar and create a new recipe off of that previous recipe.

After describing in much detail how IBM's Cognitive Cooking system works, let's pretend that the system does not exist so that we can begin to build one ourselves. The first step in building would be to develop a deep knowledge base so that we can apply case-based reasoning. Frames can also be used as specific data structures to divide the knowledge by representing "stereotyped situations". Frames will help to capture text from recipe books or text being submitted through user input. When gathering input, we can analyze the text for verbs and associate a frame. For example:

1. **Classic Sandwich:** 2 slices cheddar, monterey jack or Swiss cheese between 2 slices country white bread; cook, flipping once, until golden.

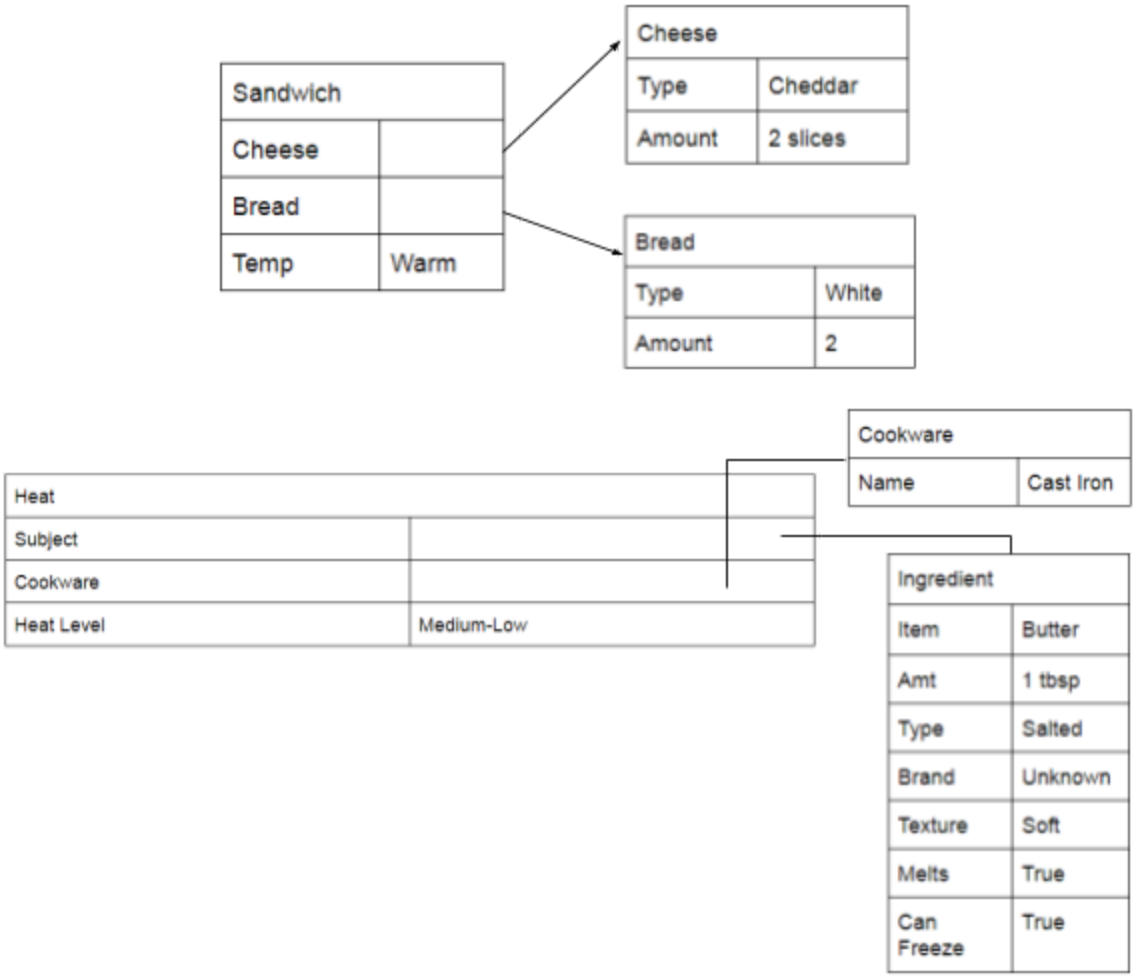
How to make grilled cheese:

1. Heat 1 tablespoon salted butter in a cast-iron or nonstick skillet over medium-low heat.

2. Press the sandwich slightly and place it in the skillet. Cook until golden on the bottom, 3 to 5 minutes.

3. Flip, adding more butter to the pan if needed, and cook until the other side is golden and the cheese melts, 3 to 5 more minutes.

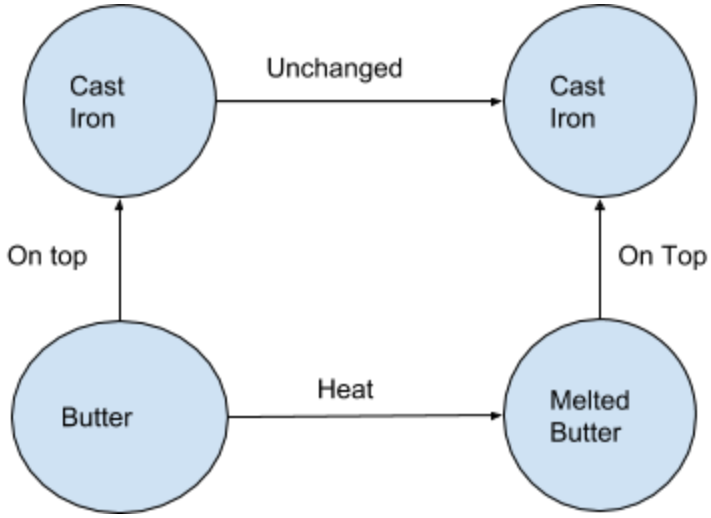
Figure 1



The example in Figure 1 shows the frames within the first sentence of the recipe. Each frame can grow or shrink according to the verb the frame is associated with. In this example, I used basic information that was not assumed, only information that was inferred from the text. Each one of these frames can be reused based on the ingredients in the text. For example, if the ingredient was ‘cheese' one might build a frame similar to the following:

Ingredient	
Item	Cheese
Amt	Unknown
Type	American
Brand	Unknown
Texture	Soft
Melts	True
Can Freeze	True

By using frames, we can expect what to do next and what to do when the expectations are not met. The example in Figure 1 can also be thought about as a semantic network where as the frame Heat is the action that is associated with the objects. This example below shows the concept of a semantic network using the first sentence of building a grilled cheese.



Having the association between frames and semantic networks is very powerful when trying to design an intelligent system that is capable of building its own recipes. As we have

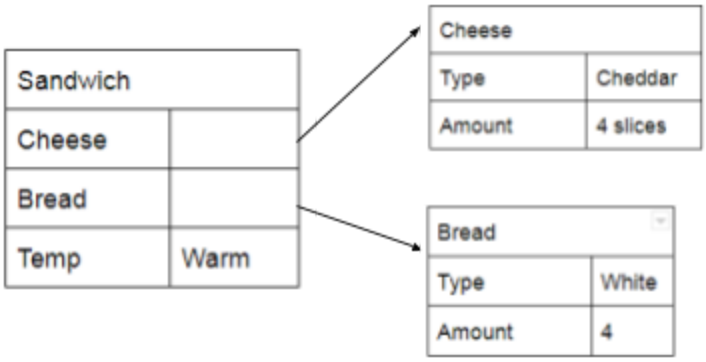
previously seen earlier in this course, the use of semantic networks along with generate and test to solve Raven's Matrices worked really well when applied together. The fundamental idea is to build a large semantic network using the deep knowledge base created from frames and case based reasoning to generate and test new recipes. Once the recipe is created, it must then store the recipe (recording cases) and must learn a new recipe from the previous one.

As in the grilled cheese recipe example, we were simply only building the frames for the knowledge base, however once we have the knowledge for the grilled cheese then the system can start to build off of itself. From Figure 1 we know that:

- Sandwich
- 1 tbsp salted butter
- cast iron skillet
- 3 to 5 minutes
- Flip
- (action)Cheese melts
- 2 slices cheddar
- Until Golden

The entire systems knowledge base would be broken down into many smaller individual knowledge bases that when put together makes up the overall recipe. This knowledge base is then recorded for the first recipe. Once the first entry is added, the system will try to learn a new recipe based on the previous case. The system will take the individual knowledge bases used to form the previous recipe and make minor alterations using generate and test. An example of these possible changes can be seen in Figure 2

Figure 2:



These new frames for Figure 2 were generated from the previous case and then tested as a new recipe. This recipe is not always going to be a "good" recipe become stored into the overall

system knowledge base. A filter can be applied to each recorded case stored whether it was a good or bad case. The generation of new recipes is all dependant on the addition of ingredients into the knowledge base. Using Figure 1 again, if we had entered a tomato into our ingredient list, new variations could then be applied and new permutations of grilled cheese can be created.

Overall the idea of creating such system comes with many difficulties in building the entire network. Such difficulty comes from parsing the text, reducing ambiguity and building each knowledge base. This concept ties in very well with basic machine learning techniques such as reinforcement learning to output a new result from a list of parameters. The system has to always be fed more and more information in order to continue to build unique recipes.

When we look forward to see the way that the world is moving, one can make the analyzation that it's only becoming more and more machine dependant. Machines will continue to grow and advance is ways that were never seemed imaginable. Cognitive Cooking by IBM is just one system for recipes, imagine the possibilities when applied to other areas.

Sources:

https://en.wikipedia.org/wiki/Case-based_reasoning
https://www.ted.com/talks/florian_pinel_how_ibm_s_watson_is_redefining_the_future_of_cooking
http://www.coursedocs.org/gatech/cs7637/index.html