Homework 2

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1 BINARY CLASSIFICATION

Soups:

Borscht	Chicken Broth	Chicken noodle soup	Clam chowder	Consommé	Corn chowder	French onion soup in a bread bowl
Gazpacho	Gumbo	Miso soup	Pho	Tomato bisque	Vichyssoise	

Table 1 — Dishes classified as soup

Not Soup:

Baked beans	Cereal with milk	Chicken pot pie	Chili	Chocolate pudding	Coconut milk	Crème brûlée
Fruit salad in syrup	Guacamole	Hot chocolate with marshmallows	Hot tea with tea leaves	Ice cream sundae	Iced tea	Jambalaya
Macaroni and cheese	Massaman curry	Mashed potatoes	Melted ice cream	Menudo	Milkshake	Oatmeal
Pasta bolognese	Rice pudding	Risotto	Spaghetti with marinara sauce		Yogurt with granola	Stew

Table 2 — Dishes not classified as soup

2 INCREMENTAL CONCEPT LEARNING

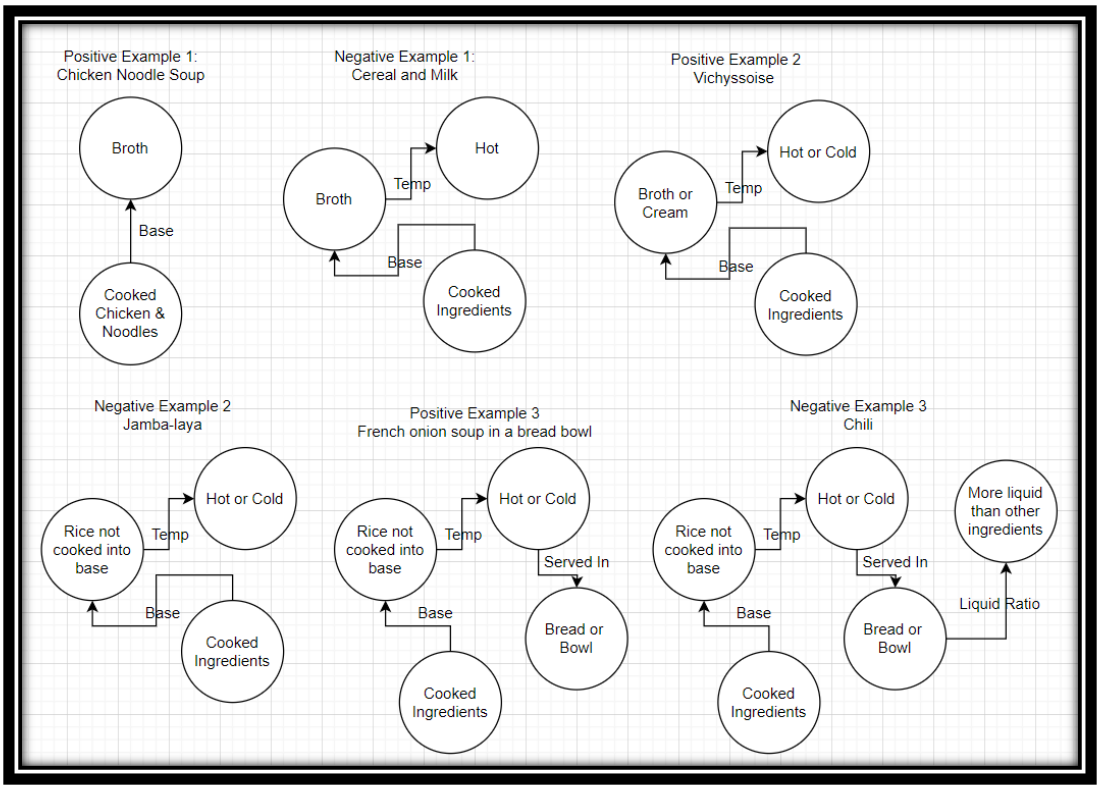

Figure 1 — Incremental Concept Learning using possible soups.

As seen in figure 1 above, the model for defining soup evolves through incremental concept learning, starting with an initial positive example, *Chicken Noodle Soup*, which establishes the base heuristic that soup is a broth-based dish with cooked chicken and noodles. The first negative example, *Cereal and Milk*, specializes the definition by excluding dishes that use milk as well as dished that contain uncooked ingredients. The second positive example, *Vichyssoise*, generalizes the definition to include soups served hot or cold, with the base of the soup now being either broth or cream based. The second negative example, *Jambalaya*, further specializes the model by excluding dishes where the solid ingredients (such as rice) are not cooked into the liquid base. The third positive example, *French Onion Soup in a Bread Bowl*, expands the model by allowing soups to be served in vessels such as bread bowls. Finally, the third negative example, *Chili*, specializes the definition further, excluding dishes where the liquid component is not dominant over the solids.

If other examples like *Stew* or *Fruit Salad in Syrup* were introduced, the model would be generalized further to include heartier, chunkier soups or further refined to exclude non-savory or non-liquid-centric dishes.

3 CLASSIFICATION

To employ a classification approach, we can use the 5 parameters from above to distinguish soup from other dishes. The parameters are liquid based, cooked ingredients, temperature, liquid-to-solid ratio, and the dish's serving vessel. Table 3 below classifies 6 dishes using the 5 parameters above and indicates whether the dish was earlier labeled as soup or not soup.

Dish	**Base Liquid**	**Cooked Ingredients**	**Temperature**	**Liquid-to-Solid Ratio**	**Served In**	**Soup?**
Chicken Noodle Soup	Yes	Yes	Hot	More liquid	Bowl	Yes
Cereal with Milk	Yes	No	Cold	More liquid	Bowl	No
Gazpacho	Yes	Yes	Cold	More liquid	Bowl	Yes
Chili	Yes	Yes	Hot	More solid	Bowl	No
Macaroni and Cheese	No	Yes	Hot	More solid	Plate	No
Clam Chowder	Yes	Yes	Hot	More liquid	Bowl	Yes

Table 3 — 6 dishes, 5 parameters, and a classification of soups or not

Using the above 5 parameters to construct a classification tree would result in the following:

1. Does the dish have a liquid base? If yes check the next parameter, if not then it's not a soup.

2. Are the ingredients cooked? If yes, go to the next parameter. If not, it's not soup.
3. Is the dish served hot or cold? If yes, go to the next parameter. If not, its not a soup.
4. Does the dish have more liquid than solids? If yes, go to the next parameter. If not, it is not soup.
5. Is the dish served in a bowl or bread? If yes, it is a soup. If not, it is not soup.

Finally, we can select 10 dishes from the list and use this classification tree to classify whether the dish is a soup or not.

Dish	**Base Liquid**	**Cooked Ingredients**	**Temperature**	**Liquid-to-Solid Ratio**	**Served In**	**Soup?**
Hot Chocolate	Yes	No	Hot	More liquid	Cup	No
French Onion Soup	Yes	Yes	Hot	More liquid	Bread Bowl	Yes
Jambalaya	No	Yes	Hot	More solid	Plate	No
Pho	Yes	Yes	Hot	More liquid	Bowl	Yes
Ice Cream Sundae	No	No	Cold	More solid	Bowl	No
Menudo	Yes	Yes	Hot	More liquid	Bowl	Yes
Oatmeal	Yes	Yes	Hot	More solid	Bowl	No

Rice Pudding	Yes	Yes	Cold	More liquid	Bowl	Yes
Stew	Yes	Yes	Hot	More solid	Bowl	No
Tomato Bisque	Yes	Yes	Hot	More liquid	Bowl	Yes

Table 4 — 10 dishes classified as soup or not using 5 parameters.

4 THE TRUTH ABOUT GRITS (ITS NOT A SOUP!)

To determine whether grits are soup, we can evaluate them using three different perspectives: incremental concept learning, the classification model, and case-based reasoning.

4.1 Incremental Concept Learning

Based on the model developed through incremental concept learning, grits would not be classified as soup. The key heuristics in this model specify that a soup must have a liquid base, such as broth or cream, and grits do not meet this criterion. Additionally, the liquid-to-solid ratio for grits is typically in favor of solids, with the liquid component (often water or milk) being absorbed into the grains, further disqualifying it as a soup.

4.2 Classification Model

Using the classification approach, grits also fail to qualify as a soup. While grits do have a liquid base during preparation (water or milk), the cooked ingredients (cornmeal) absorb the liquid, resulting in a solid-like consistency. The liquid-to-solid ratio heavily favors the solids, and grits are typically served on a plate or in a bowl but not with the liquid element that would classify it as soup. Hence, the classification tree would categorize grits as "not soup."

4.3 Case-Based Reasoning

In case-based reasoning, the dish most similar to grits is *Oatmeal*. Both dishes are porridge-like, absorb much of the liquid during cooking, and have a thicker, more solid consistency rather than a liquid base. Since *Oatmeal* was not classified as soup, grits would likely be classified the same way.