Homework 2

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# 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 |  |

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 |

1. Dishes not classified as soup

# A diagram of a food system Description automatically generated with medium confidenceincremental concept learning

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.

# 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 |

1. 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 |

1. 10 dishes classified as soup or not using 5 parameters.

# 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.

## 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.

## 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."

## 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.