Ingredients to Recipes: CSP Generated Instructions

Kaylee Bement, Henry Lin, Nikki Taylor

Introduction

Problem
- provide set of ingredients → get ordered set of instructions for a recipe

Instruction Format
- <action> <ingredient> <action qualifier>
- Example: cook pasta for 10 minutes

Dataset and Methods

Dataset
- Epicurious Recipes from Kaggle, containing 20,050 recipes

CSP

Variables	Domain
Requested ingredient	1 to number of ingredients
Possible action	0 to number of ingredients
Where to put ingredient	bowl, skillet, pot, kettle, saucepan, pan, ""
Cook time (in minutes)	0 to 60
Bowl size	small, medium, large, ""

- We refer to the last 3 variables as "qualifiers"
- **Constraints**
  - Each ingredient assigned to a unique instruction number
  - Each ingredient has an action
- **Weighted factors**
  - Ingredient-verb pairs
  - Verb order
 - Ingredient order
  - Qualifier-action pairs

Methods and Results

Backtracking vs Beam Search
- On 2 ingredients
  - Backtracking: ~3 mill operations
  - Beam Search: 27 operations

Evaluation of Instructions
- Features are tuples of verb, ingredient, qualifiers
- Weights are created using dataset & determined by frequency
- Evaluation function = sum of relevant weights ÷ number of ingredients

Evaluation of Generated Instructions
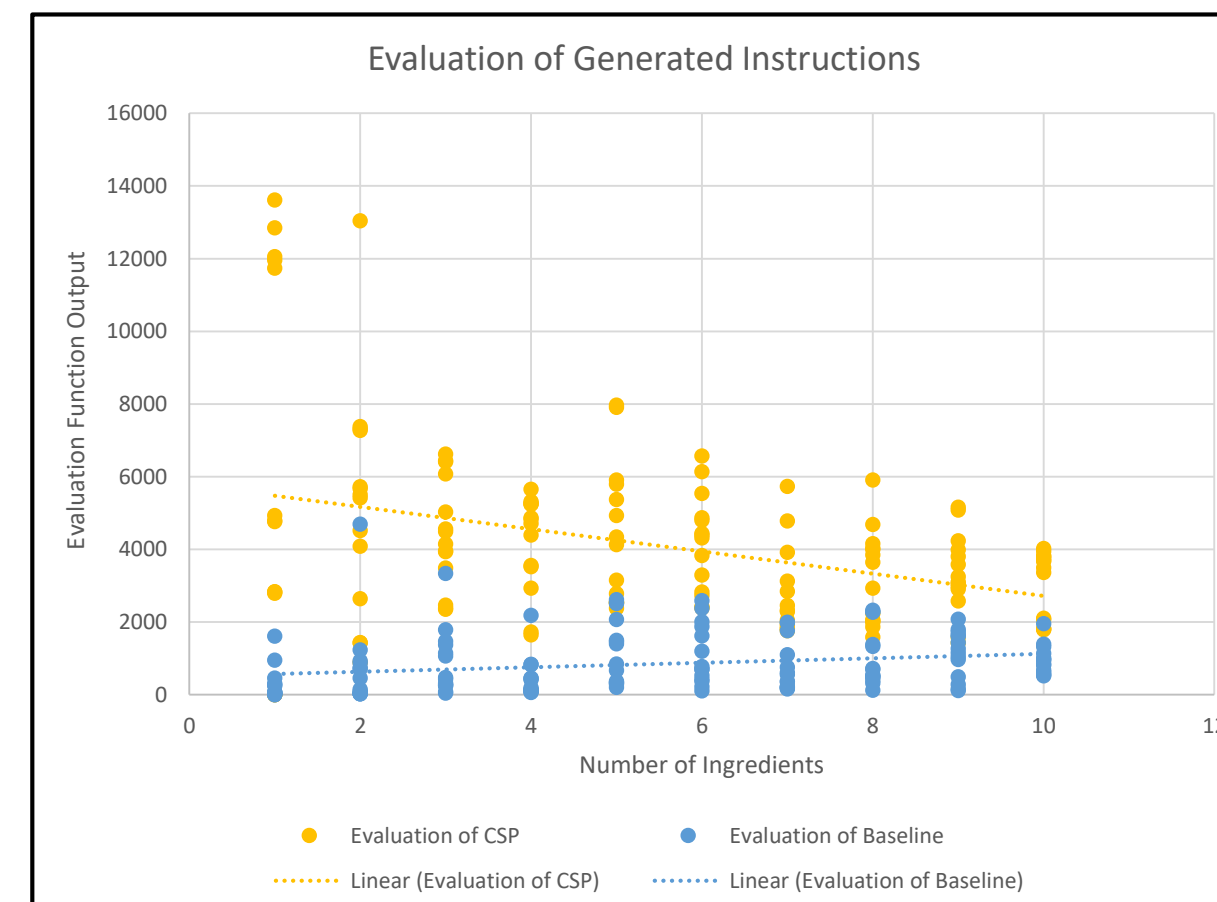
Example
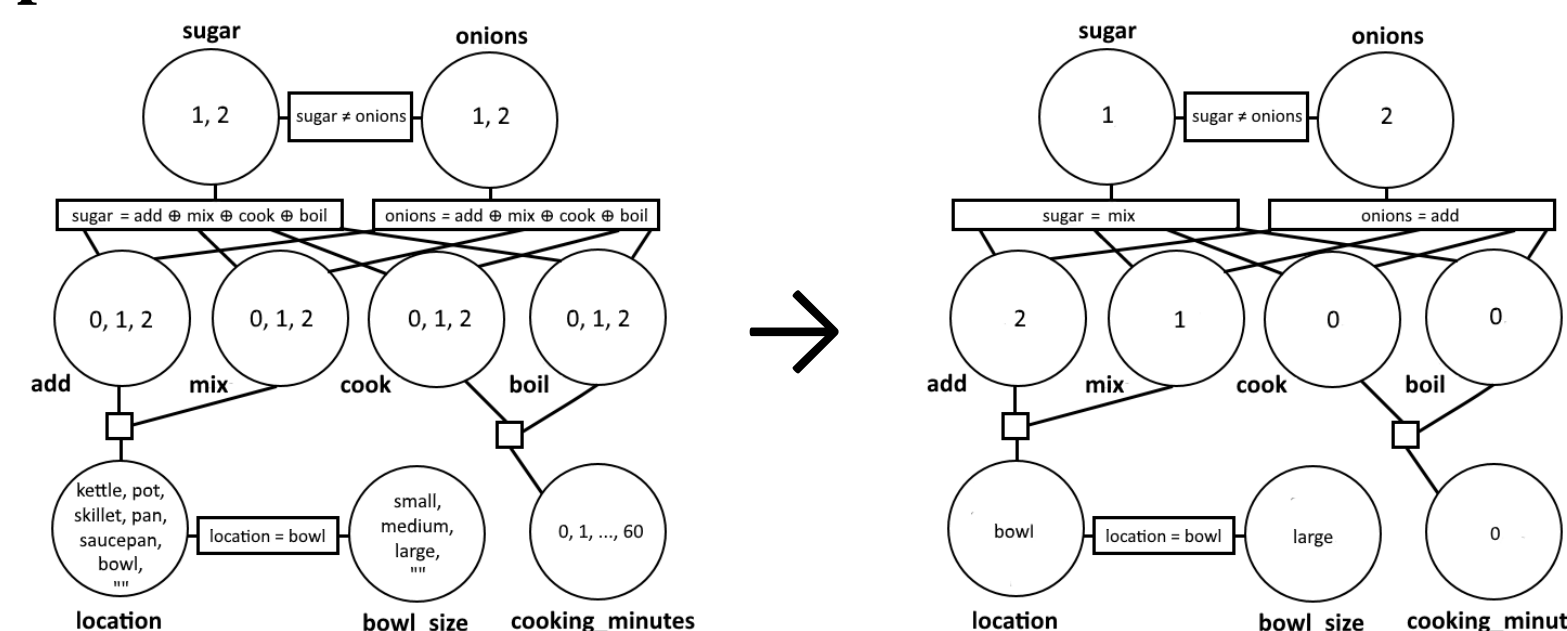
- Recipe: stir sugar in large bowl. add onions in large bowl.
- Evaluation Score: 13,085.5

Discussion and Conclusion

- Based on our human evaluations and evaluation function, requesting fewer ingredients results in a recipe that makes more sense
- Requesting ingredients that are commonly used for a certain action are often paired correctly (eg. whisk eggs)
- Ingredients that are commonly used together for many recipes were more often in a correct order (eg. ingredients commonly used in baking)

Future Work

- Extend CSP model to add more information to recipe (e.g. quantity)
- Add form of exploration vs exploitation to help innovate recipes, mimicking human creativity
- Compare runtime and outputs of CSP to other methods such as MDPs or RNNs
- Modify ingredient domains to allow for multiple ingredients in each instruction

References

[1] Chloé Kiddon, Ganesa Thandavam Ponnuraj, Luke Zettlemoyer, and Yejin Choi. 2015. Mise en Place: Unsupervised Interpretation of Instructional Recipes. *Proceedings of the 2015 Conference on Empirical Methods in Natural Language Processing*(2015). DOI:http://dx.doi.org/10.18653/v1/d15-1114

[2] Jiwei Li, Will Monroe, Tianlin Shi, Sébastien Jean, Alan Ritter, and Dan Jurafsky. 2017. Adversarial Learning for Neural Dialogue Generation. (September 2017).

[3] Sosuke Amano, Kiyoharu Aizawa, and Makoto Ogawa. 2015. Food Category Representatives: Extracting Categories from Meal Names in Food Recordings and Recipe Data. *2015 IEEE International Conference on Multimedia Big Data*(2015). DOI:http://dx.doi.org/10.1109/bigmm.2015.54