Optimizing Cookie Recipes for Ratings Using Machine Learning and Deep Vector-to-Sequence Recurrent Neural Models

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Abstract

This project employed machine learning concepts and processes in an attempt to teach a computer an algorithm that outputs a cookie recipe that is comparable to human-made recipes. The process involved feeding the algorithms a data set of cookie recipes that included details such as ingredients, ratings, and calories. A second algorithm was used to construct instructions for a recipe once ingredients were selected based off of instructions from the dataset of recipes. The recipes were gathered by scraping the website allrecipes.com for chocolate chip cookie recipes that were compiled in order to teach the computer to recognize tasty cookies by looking at things such as reviews, ingredients, and calories.

1 Introduction: Making a Highly Rate Chocolate Chip Cookie

The objective of these experiments was to generate a cookie recipe that was optimized for critic ratings by using multiple types of neural and non-neural networks to predict and create chocolate chip cookie recipes based on the input of over 250 human-made recipes and instructions. There were 138 different parameters inputted, including Rating, Calories, and 136 different ingredients such as sugar, flour, and egg.

To get the instructions, we created a vector-to-sequence algorithm that takes the input of a recipe ingredient vector and uses the instructions from the 250 man-made recipes to make predictions about the sequence of instructions in the output.

Related Work

The use of machine learning for baking/cooking is relatively unexplored, but there are some articles, such as *Bayesian Optimization for a Better Dessert*[1] and *Cuisine Classification and Recipe Generation*[2].When conducting exploratory research, we were unable to find another study that employed vector-to-sequence algorithms.

2 Methods and Experiments

2.1 Algorithms

This experiment involved testing 9 different algorithms: Deep Learning Neural Networks, Gradient Boosting, Extreme Trees, Random Forest, Normalized Neural Networks, Wide Neural Networks, Neural Networks SVM, and Linear Regression. Based on the resulting vectors from each, we narrowed our focus to the following three algorithms: Deep Learning, Gradient Boosting, and Extreme Trees.

[1]Kochanski, Greg et al. Bayesian Optimization for a Better Dessert. (2017).
[2]Naik, JitendraB.. Cuisine Classification and Recipe Generation. (2015).

2.1.1 Deep Learning

2.1.2 Gradient Boosting

2.1.3 Extreme Trees

2.2 Baking and Serving

2.3 Surveys

Survey questions included:

- Appearance on a scale of 1 (unfit for consumption) to 5 (Excellent)
- Aroma on a scale of 1 (unfit for consumption) to 5 (Excellent)
- Taste on a scale of 1 (unfit for consumption) to 5 (Excellent)
- Texture:
  - Crunchy
  - Chewy
  - Gooey
  - Juicy
  - Soggy
  - Creamy
  - Other
- Overall Sastification on a scale of 1 (Hated It) to 10 (Loved It)

3 Analysis

3.1 Ingredients

3.2 Instructions

As the vector-to-sequence algorithm is previously untested in other research, the end results leave something to desire in terms of ability to finesse and actual usability. However, it is an accomplishment to have gotten a working algorithm that takes in an ingredient vector and outputs a semi-usable recipe. Improvements include ensuring that the instructions contain all ingredients in the vector that contain non-zero values and eliminating repeating loops that the algorithm gets stuck on.

4 Lessons Learned

Acknowledgments

References

5 Ideas for Further Work

6 Supplemental Material

6.1 Final Recipes with Unedited Instruction Sequences

Cookie 1: Deep Learning

Ingredients:

- 1 tsp baking soda
- 1.75 c butter
- 2 eggs
- 1.25 c flour
- .33 c sugar
- .25 tsp vanilla
- .66 c cocoa powder
- 5.28 oz creamy pb
- 2 egg yolk
- 5.28 tbsp espresso powder
- 5 tsp salt
- 8 oz semisweet

Instructions: startseq preheat oven to three hundred and fifty degrees one hundred and seventy five degrees in medium bowl whisk together the butter brown sugar and white sugar until smooth beat in the eggs one at time then stir in the vanilla combine the flour baking soda and salt stir in the chocolate chips and walnuts roll dough into balls and place two inches apart on ungreased baking sheet bake for eight to ten minutes in the preheated oven allow cookies to cool on baking sheet for five minutes before removing to wire rack to cool completely endseq

Cookie 2: Deep Learning

Ingredients

- 4 tsp Baking Soda
- 1 c brown sugar
- 4 c flour
- .25 c sugar
- 1 tsp vanilla
- 3 c confectioners sugar
- 16 oz semisweet choc chips
- 5 c walnuts

Instructions: startseq preheat oven to three hundred and seventy five degrees one hundred and ninety degrees in medium bowl whisk together the butter brown sugar and white sugar with an electric mixer in large bowl until smooth add one whisk in the eggs one whisk in separate bowl whisk together the flour mixture and add chocolate and chocolate and not not not combine place balls place one inch balls place one inch balls place two inches balls place two inches balls place one inch balls place one inch balls place one inch balls place balls place one inch balls place one inch balls place balls ball ball ball bake in the preheated oven until set about ten minutes endseq

Cookie 3- Extreme Tree

Ingredients

- 1 tsp baking soda
- .75 c brown sugar
- .5 c butter
- 4 eggs
- 4 c flour
- 4 oz creamy PB
- 2 tsp ground cinnamon
- .5 c mashed avocado
- .66 c milk chocolate chips
- 0.5 tsp salt
- 12 oz semi sweet choc chips

Instructions: startseq preheat oven to three hundred and seventy five degrees one hundred and ninety degrees in medium bowl whisk together the butter brown sugar and brown sugar with an electric mixer in large bowl until smooth add eggs one at medium speed beat in the eggs one at time beating each addition beat in the flour mixture stir in the chocolate chips and walnuts roll balls and place two inches apart on ungreased cookie sheet bake for eight to ten minutes in the preheated oven allow cookies to cool on baking sheet for five minutes before removing to wire rack to cool completely endseq

Cookie 4- Gradient Boosting

Ingredients

- 1.5 c butter
- 2 egg
- .25 c sugar
- 1 tsp vanilla
- 2 c flaked coconut
- 12 tsp hot water
- 0.5 mashed avocado
- 0.75 c matzo cake meal
- 0.25 plain yogurt
- 1 tsp salt

- 16 oz semisweet choc chips

Instructions: startseq whisk together the flour and butter add confectioners sugar and vanilla extract with an an electric add whisk flour and stir until dough is distributed and enough to least least least least least thirty minutes or until not break up the not not break up the not half add chocolate and not not half add chocolate and not not half add chocolate and not not half add chocolate and not not half enough to least least least minutes or until not not not not not not not not not not not not not not not not not not not not not not not half add chocolate and not not half add chocolate enough to separate

Cookie 5- Extreme Tree

Ingredients

- 1 tsp baking soda
- 1 c brown sugar
- 1 c butter
- 2 egg
- 1.75 c flour
- 1.5 c mint filled morsels
- 0.25 c sugar
- 1 tsp vanilla
- 1 tsp baking powder
- 1 egg yolk
- 1 tsp ground cinnamon
- 0.5 tsp salt
- 0.5 c shortening

Instructions: startseq preheat oven to three hundred and fifty degrees one hundred and seventy five degrees in medium bowl cream together the butter brown sugar and white sugar until smooth beat in the eggs one at time then stir in the vanilla and vanilla combine the flour baking soda and salt stir into the creamed mixture until just blended fold in the chocolate chips drop by rounded spoonfuls onto the prepared cookie sheets bake for eight to ten minutes in the preheated oven allow cookies to cool on baking sheet for five minutes before removing to wire rack to cool completely endseq

Survey Questions