



Recipe analysis

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GitHub repo: <https://github.com/ozbej/food-analysis>

RecipeNLG

- A Cooking Recipes Dataset for Semi-Structured Text Generation
- Based on Recipe1M+ dataset, but provides over 1 million new, preprocessed and deduplicated recipes on top of it
- Example data instance:

```
{'id': 0,
 'title': 'No-Bake Nut Cookies',
 'ingredients': ['1 c. firmly packed brown sugar',
 '1/2 c. evaporated milk',
 '1/2 tsp. vanilla',
 '1/2 c. broken nuts (pecans)',
 '2 Tbsp. butter or margarine',
 '3 1/2 c. bite size shredded rice biscuits'],
 'directions': ['In a heavy 2-quart saucepan, mix brown sugar, nuts, evaporated milk',
 'Stir over medium heat until mixture bubbles all over top.',
 'Boil and stir 5 minutes more. Take off heat.',
 'Stir in vanilla and cereal; mix well.',
 'Using 2 teaspoons, drop and shape into 30 clusters on wax paper.',
 'Let stand until firm, about 30 minutes.'],
 'link': 'www.cookbooks.com/Recipe-Details.aspx?id=44874',
 'source': 0,
 'ner': ['brown sugar',
 'milk',
 'vanilla',
 'nuts',
 'butter',
 'bite size shredded rice biscuits']}
```

NER Extraction

- **Goal:** Extract ingredients from recipe directions
 - **Example input:** Thoroughly cream shortening, sugar and vanilla. Beat in eggs, then chocolate. Sift together dry ingredients. Blend in with milk; add nuts. Chill 3 hours; form in 1-inch balls and roll in powdered sugar. Place on greased cookie sheet 2 to 3 inches apart. Bake at 350 for 15 minutes. Cool slightly and remove from pan. Makes 4 dozen.
 - **Example output:** shortening, sugar, vanilla, eggs, chocolate, flour, baking powder, salt, milk, nuts
- NER tagging using IOB format: [O, B-ING, I-ING]
- NER tag 30.000 data instances from RecipeNLG
- Example tagged sentence:

Thouroughly	cream	shortening	,	sugar	and	vanilla	.	Beat	in	eggs	,	then	chocolate	.
O	O	B-ING	O	B-ING	O	B-ING	O	O	O	B-ING	O	O	B-ING	O

Results

Training:

- Fine-tuned a pretrained NER model from HuggingFace (*bert-finetuned-ner*)
- 24.000 train, 3.000 validation, and 3.000 test data
- 3 epochs

Results:

Set	Precision	Recall	F1	Accuracy
Validation	0.7783	0.8306	0.8036	0.9594
Test	0.7800	0.8303	0.8043	0.9603

- [Dharawat and Doan](#) report 95.01 F1 (trained on Foodbase and Food.com with manual annotations)
- Results could be improved by:
 - Removing noise from data
 - Training on a larger dataset
 - Training on full-text recipes instead on short directions

Food.com Recipes and Interactions

- 18 years of uploads and interactions on Food.com
- 180k+ recipes and 700k+ interactions
- Recipe data:

index	name	id	minutes	contributor_id	submitted	tags	nutrition	n_steps	steps	description	ingredients	n_ingredients	user_id	recipe_id	date	rating	review
0	arriba baked winter squash mexican style	137739	55	47892	2005-09-18	['60-minutes-or-less', 'time-to-make', 'course', 'main-ingredient', 'cuisine', 'preparation', 'occasion', 'north-american', 'side-dishes', 'vegetables', 'mexican', 'easy', 'fall', 'holiday-event', 'vegetarian', 'winter', 'dietary', 'christmas', 'seasonal', 'squash']	[51.5, 0.0, 13.0, 0.0, 2.0, 0.0, 4.0]	11	['make a choice and proceed with recipe', 'depending on size of squash , cut into half or fourths', 'remove seeds', 'for spicy squash , drizzle olive oil or melted butter over each cut squash piece', 'season with mexican seasoning mix if', 'for sweet squash , drizzle melted honey , butter , grated piloncillo over each cut squash piece', 'season with sweet mexican spice mix', 'bake at 350 degrees , again depending on size , for 40 minutes up to an hour , until a fork can easily pierce the skin', 'be careful not to burn the squash especially if you opt to use sugar or butter', 'if you feel more comfortable , cover the squash with aluminum foil the first half hour , give or take , of baking', 'if desired , season with salt']	autumn is my favorite time of year to cook! this recipe can be prepared either spicy or sweet, your choice! two of my posted mexican-inspired seasoning mix recipes are offered as suggestions.	['winter squash', 'mexican seasoning', 'mixed spice', 'honey', 'butter', 'olive oil', 'salt']	7	4470	137739	2006-02-18	5	I used an acorn squash and recipe#137681 Sweet Mexican spice blend. Only used 1 tsp honey & 1 tsp butter between both halves.,, sprinkled the squash liberally with the spice mix. Baked covered for 45 minutes uncovered or 15. I basted the squash with the the butter/honey from the cavity allowing it to get a golden color. Lovely Squash recipe Thanks Cookgirl

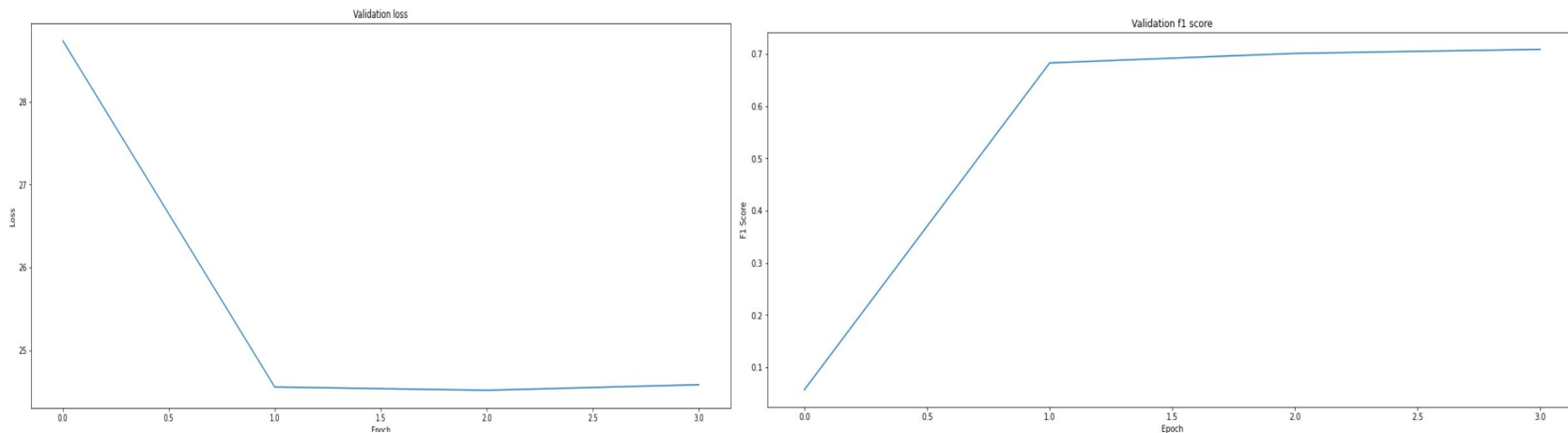
Inferring Tags from recipe description



- **Goal:** Predict tags from given natural language recipe description
 - **Example input:** thickened with a mix of cooked oats and veggies, this soup has all the flavor of the original with a fraction of the fat stuff. low in cholesterol too!
 - **Example output:** ['60-minutes-or-less', 'time-to-make', 'course', 'main-ingredient', 'preparation', 'occasion', 'bisques-cream-soups', 'main-dish', 'soups-stews', 'vegetables', 'vegan', 'vegetarian', 'stove-top', 'dietary', 'one-dish-meal', 'low-cholesterol', 'low-saturated-fat', 'low-calorie', 'comfort-food', 'low-in-something', 'taste-mood', 'equipment']
- Preprocessing: Limit description text to 300 words
- Approach: Fine-Tune pre-trained BertModel ("bert-base-cased")
- -> add Classifier on Top of Bert Model,
- -> gets output from last bert layer as input, output = number of tags
- -> to speed up training time we trained the model only on the top 20 most common tags

Results

Validation Epoch: 3, Loss: 24.580522537231445, F1-Score: 0.7086989879608154 Train Epoch: 3, Loss: 24.34857177734375, F1-Score: 0.7197327017784119



-> F1-Score of 0.72 for predicting the top 20 labels for any recipe given its description

Infer Tags from Description + Nutrition

- Goal: Increase the precision/f1 score of predicting tags
- Certain tag group (nutritional values):
 - High-fibre, low calories, healthy, low-sodium

are correlated to nutrition features

calories (#), total fat (PDV), sugar (PDV) , sodium (PDV) , protein (PDV) , saturated fat, carbohydrates

- Approach: Add an additional layer which takes the Output of the classifier from the previous layer and additionally the nutrition values of the recipe as input
- Sample Nutrition: [64.8, 3.0, 13.0, 54.0, 4.0, 2.0, 3.0]
- For modelling non-linear features the nutrition values are feed into a fully connected network with 2 layers and a ReLU function in between, before getting concatenated with the output from the previous network

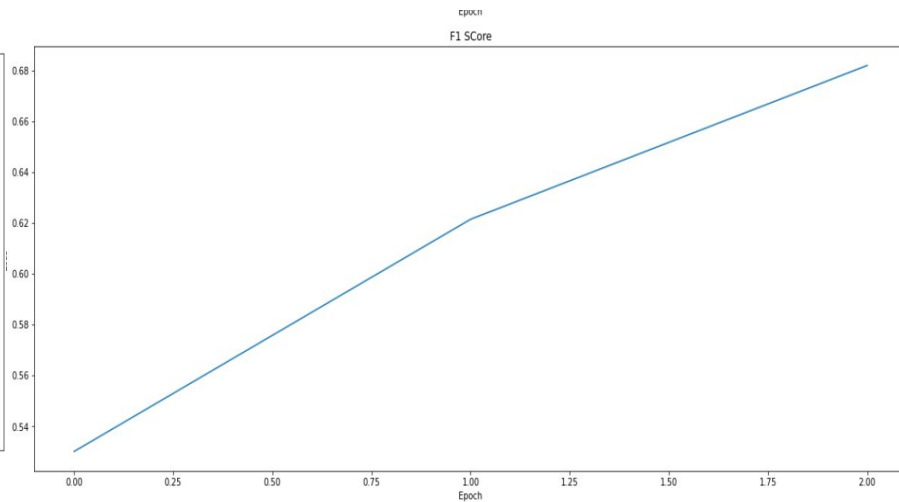
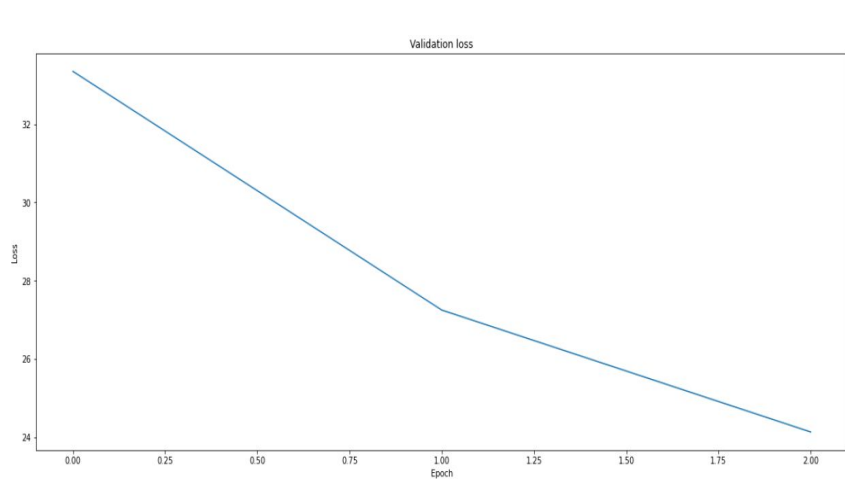
Results



After Epoch 2:

Loss: 24.5365

F1-Score: 0.68207

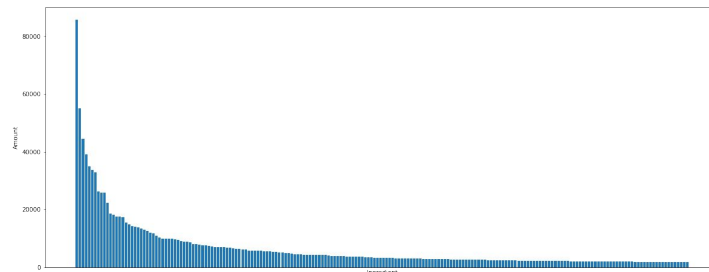


Recipe recommendation based on recipe similarity

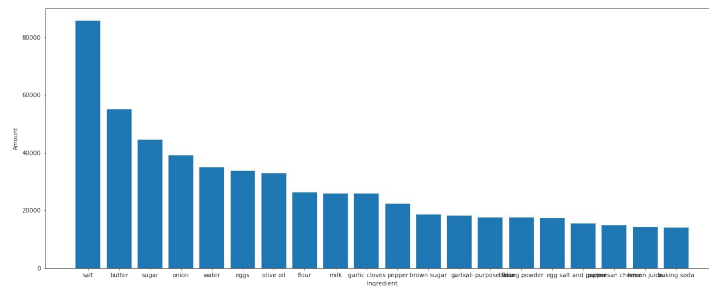
Goal: Model recipes, such that recipes which are similar in dish type, ingredients and preparation are close together

Preprocessing:

- 1) Create baseline recommendations with TfidfVectorizer
 - a) Recommend similar recipes from recipe ingredients
 - b) Recommend recipes from a string of ingredients
- 2) Reduce dictionary size (from >14k to 200)
 - a) Find top 200 ingredients used
 - b) Delete ingredients from recipes not in the top 200
 - c) Filter recipes with #ingredients < 5
- 3) Tag grouping
 - a) Create tag groups by hand from the top used tags
 - i) Diet group: e.g. low-sodium
 - ii) Occasion group: e.g. holiday
 - iii) Time group: e.g. 60-minutes-or-less
 - iv) Country group: e.g. north-american




Top 200 ingredients



Top 20 ingredients

Recipe recommendation based on recipe similarity



Goal: Model recipes, such that recipes which are similar in dish type, ingredients and preparation are close together

-> Capture features which compose the recipe

Approach:

1) Train ingredient embeddings (skip-o-gram) to represent ingredients as vectors with 16 dimensions

2) Generate a recipe embedding based on the ingredient embeddings.

-> Should capture desired features, for that we split tags in 4 groups: diet, occasion, time, country

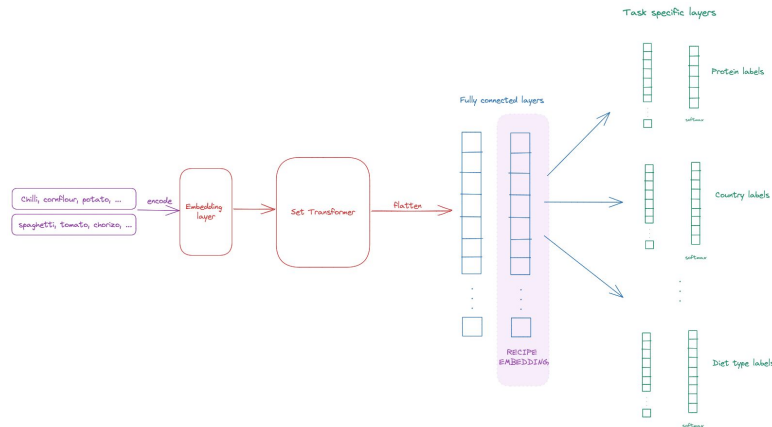
Recipe recommendation based on recipe similarity

Goal 2): Combine ingredient embeddings to a single recipe embedding

Approach: Feed Embeddings into a Set Transformer Layer (Encoding + Decoding), which adds several self-attention layers such that the network learns how to weight the ingredients

After Transformer Layer: Fully connected layer, which feeds forward into multiple fully connected layers which aim to predict diet, occasion, time, country labels.

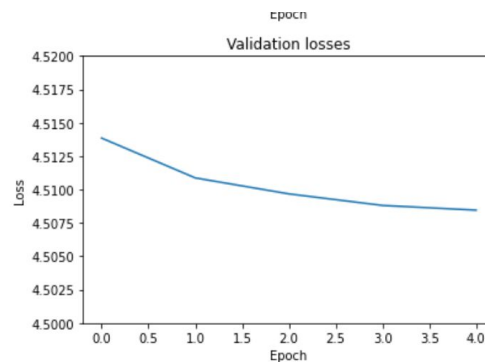
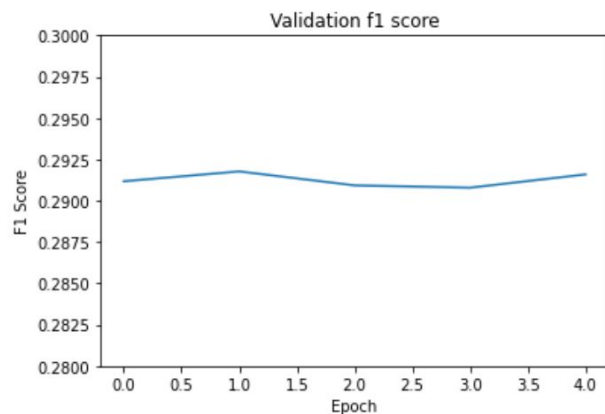
-> Learning by back-propagation of the combined loss trains the weights in the recipe embedding to minimise the loss of all targets at the same time.



Source:

<https://medium.com/gousto-engineering-techbrunch/teaching-computers-to-learn-what-recipes-are-20b91161d4da> , 09.01.2023

Results



- > After Training, set transformers can be extracted to produce embeddings for recipes (initial goal)
- > Further steps: adapt weights of targets (e.g. cuisine type higher weight than region, ...)
- > Recipe recommendation by cosine similarity of recipe embeddings

Thanks for your attention

