Generating Personalized Recipes from Historical User Preferences

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Images of food made from personalized versions of online recipes

Motivation

- Rarely does ‘one recipe fit all’
- Recipe retrieval systems cannot include all variants of a recipe
- Existing generative methods cannot handle personal preferences

Problem Statement

Personalized recipe generation: expand a name and incomplete ingredient details into complete instructions aligned with the user’s historical preferences.

Recipe Dataset

	# User interactions	# Recipes	# Unique Ingredients	Avg # Steps	Avg # Tokens
Food.com	1M	231,637	13,000	9.77	117

Common Ingredients

Salt	Butter	White sugar
Eggs	Water	Vanilla Extract
Onion	Cinnamon	Black Pepper
Garlic	Milk	Brown Sugar
Flour	Olive Oil	Lemon Juice

Diverse User Profiles:

50% of users consumed ≤ 6 recipes 10% of users consumed >45 recipes

How do we personalize?

- **Prior Recipe** - Recipe embedding by ID
- **Prior Name** - Names of previous consumed recipes
- **Prior Technique** - Previously encountered cooking techniques

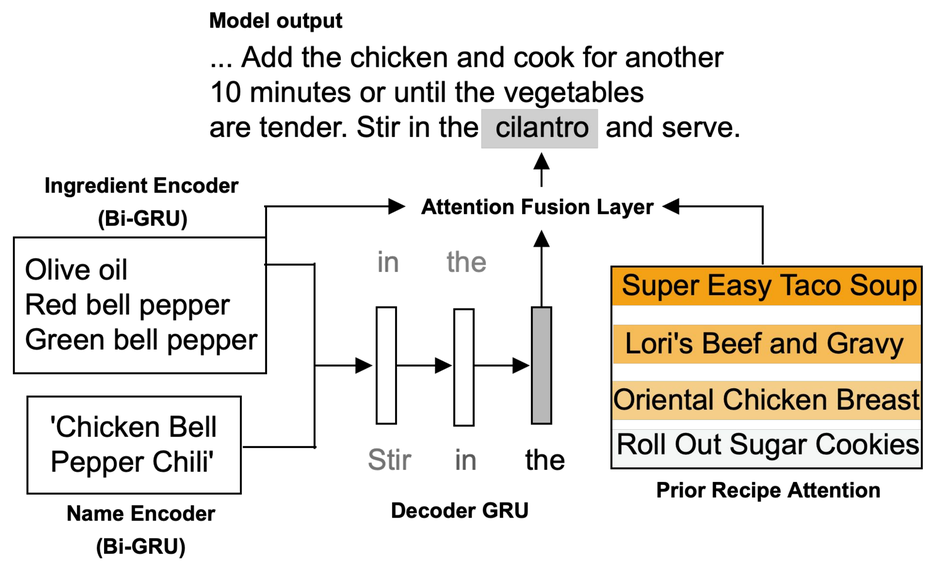
Contributions

New Task: personalized recipe generation

New dataset: 180K+ recipes & 700K+ user interactions for this task

New evaluation strategies for instructional texts addressing coherence and new metric for personalization in generation

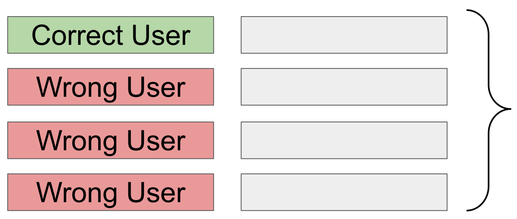
Personalized Recipe Generation Model



The model outputs the steps of a recipe, decoded via **top-k** sampling.

Measure of Personalization

We propose a **ranking metric** to measure personalization:.

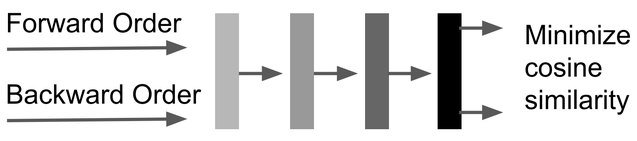


Rank generated recipe conditioned on user profile based on likelihood

We then calculate accuracy and MRR.

Measure of Recipe Coherence

Recipe Level Coherence



Teacher Model, trained on gold recipes

Coherence Score (∈ [0, 2]):

$$\text{Cosine}(\text{Forward}(Gold), \text{Forward}(Gen)) - \text{Cosine}(\text{Backward}(Gold), \text{Backward}(Gen))$$

Higher score, the better coherence

Recipe Step Entailment

Positive pairs: consecutive recipe steps.

Negative pairs: all other combinations

Teacher Model: Finetuned BERT on these pairs, 85% accuracy

Results

Model	Pers. Accuracy	Pers. MRR	Recipe level Coherence	Recipe Step Entailment	Perplexity
Enc-Dec	0.100	0.293	1.77	0.72	9.611
Prior Tech	0.128	0.319	1.78	0.73	9.572
Prior Recipe	0.302	0.412	1.80	0.76	9.511
Prior Name	**0.505**	**0.628**	**1.82**	**0.78**	**9.516**

Pomberrytini

Ingredients: pomegranate-blueberry juice, cranberry juice, vodka

Gold	Place everything except the orange slices in a cocktail shaker. Shake until well mixed and well chilled. Pour into martini glasses and float an orange slice in each glass.
Enc-Dec	Combine all ingredients. Cover and refrigerate. Serve with whipped topping.
Prior Recipe	Pour the ice into a cocktail shaker. Pour in the vodka and vodka. Add a little water and shake to mix. Pour into the glass and garnish with a slice of orange slices. Enjoy!
Prior Name	Combine all ingredients except for the ice in a blender or food processor. Process to make a smooth paste and then add the remaining vodka and blend until smooth. Pour into a chilled glass and garnish with a little lemon and fresh mint.