Appendix: Generating Personalized Recipes from Historical User Preferences

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1 Food.com: Dataset Details

Our raw data consists of 270K recipes and 1.4M user-recipe interactions (reviews) scraped from Food.com, covering a period of 18 years (January 2000 to December 2018). See Table 1 for dataset summary statistics, and Table 2 for sample information about one user-recipe interaction and the recipe involved.

	# Recipes	# Users	# Reviews	Sparsity (%)
Raw	231,637	226,570	1,132,367	99.998
Processed	178,265	25,076	749,053	99.983

Table 1: Interaction statistics for Food.com dataset before and after data processing.

2 Generated Examples

See Table 3 for a sample recipe for chicken chili and Table 4 for a sample recipe for sweet waffles.

3 Human Evaluation

We prepared a set of 15 pairwise comparisons per evaluation session, and collected 930 pairwise evaluations (310 per personalized model) over 62 sessions. For each pair, users were given a partial recipe specification (name and 3-5 key ingredients), as well as two generated recipes labeled 'A' and 'B'. One recipe is generated from our baseline encoder-decoder model and one recipe is generated by one of our three personalized models (Prior Tech, Prior Name, Prior Recipe). The order of recipe presentation (A/B) is randomly selected for each question. A screenshot of the user evaluation interface is given in Figure 1. We ask the user to indicate which recipe they find more coherent, and which recipe best accomplishes the goal indicated by the recipe name. A screenshot of this survey interface is given in Figure 2.

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* denotes equal contribution

Field	Value
date	2002-03-30
user_id	27395
recipe_id	23933
name	chinese candy
n_steps	4
steps	['melt butterscotch chips in heavy saucepan over low heat', 'fold in peanuts and chinese noodles until coated', 'drop by tablespoon onto waxed paper', 'let stand in cool place until firm']
n_ingredients	3
ingredients	['butterscotch chips', 'chinese noodles', 'salted peanuts']
calorie_level	0 (Low)

Table 2: Sample data from GeniusKitchen with recipe and user interaction details.

```
Recipe name: "strawberry pop cake "

Some ingredients:
--cake mix
--egg white
--oil
--water


Recipe A:
1) preheat oven to 375
2) grease and flour two 8 - inch round cake pans
3) in a small bowl , combine sugar and egg
4) beat with electric mixer until well blended
5) pour into prepared pan
6) bake for 30 - 35 minutes , or until toothpick comes out clean
7) remove from oven and allow to cool
8) store cake in refrigerator
9) this recipe may be stored for up to 2 days in refrigerator
10) to serve : thaw for 30 minutes before cutting .


Recipe B:
1) bake cake according to directions
2) cool
3) cut cake horizontally to 1 / 2 - inch pieces and place in buttered pan
4) combine eggs and milk and pour over top
5) bake at 350 f for 25 - 30 minutes or until cake springs back when touched lightly
6) cool completely
7) frost cake
8) sprinkle with pecans
9) serve immediately
10) enjoy !
11) makes 6 servings .


Do you prefer recipe A or recipe B? (A/B): ▮
```

Figure 1: A sample question for pairwise evaluation survey.

Input	**Name:** Chicken Bell Pepper Chili Weight Watchers **Ingredients:** olive oil, red bell pepper, green bell pepper, yellow bell pepper **Calorie:** Medium
Gold	In a large nonstick dutch oven or saucepan, heat the oil. Saute the bell peppers and onion until softened, about 5 minutes. Add the chicken. Cook, breaking apart with a wooden spoon, until no longer pink, 5 - 7 minutes. Sprinkle with the flour, chili powder, cumin, cocoa powder, and cayenne. Cook, stirring briskly and constantly, 1 minute. Stir in the tomatoes and vinegar. Bring to a boil. Reduce the heat and simmer, stirring frequently, until thick, 30 - 40 minutes. Stir in the chickpeas. Simmer until heated through, about 5 minutes.
Enc-Dec	Heat oil in a large, heavy pot over medium heat. Add chicken and cook until browned on both sides, about 10 minutes, or until browned; drain. Add onion and garlic and saute for 2 minutes. Add chicken broth, chicken broth, and corn starch. Bring to a slow boil, reduce heat, cover and simmer for 30 minutes. Remove from heat and add the tomatoes and corn. Simmer until chicken is cooked through, about 10 minutes. Serve over rice or noodles.
Prior Tech	Heat oil in large saucepan over medium - high heat. Add chicken and cook until browned. Add bell pepper and onions, cook 2 minutes, stirring frequently. Add chicken broth. Cover, simmer, stirring occasionally, for 10 minutes or until vegetables are tender, stirring occasionally. Add chicken, cover, and cook 10 more minutes or until chicken is cooked through. Remove from heat. Stir in remaining ingredients. Season with salt and pepper to taste. Serve over rice and top with additional shredded cheese and cilantro.
Prior Recipe	Heat oil in large dutch oven over medium - high. Add chicken, bell peppers, bell peppers and onion. Saute 2 - 3 minutes. Add broth and tomato paste; stir. Bring to a boil. Reduce heat and simmer, covered, for 10 minutes or until rice is tender, stirring often. Stir in chicken. Cover and simmer for 10 minutes. Stir in parsley. Serve over rice. Garnish with cilantro.
Prior Name	Heat the oil in a large skillet over medium - high heat. Add the peppers and onions. Cook, stirring, until the vegetables are soft and beginning to soften, about 5 minutes. Stir in the tomatoes, corn, corn, and corn. Bring to a boil. Reduce heat to low, cover, and simmer for 10 minutes. Add the chicken and cook for another 10 minutes or until the vegetables are tender. Stir in the cilantro and serve.

Table 3: Sample generated recipe "Chicken Bell Pepper Chili Weight Watchers" for all models.

Input	**Name:** Cinna Nilla Waffles **Ingredients:** flour, egg, milk, vegetable oil, sugar **Calorie:** Medium
Gold	Heat waffle iron. Beat eggs in large bowl with hand beater until fluffy. Beat in remaining ingredients until smooth. Pour batter into waffle iron and cook for approximately 5 minutes. Serve immediately or cool to pack into freezer bags and freeze.
Enc-Dec	Mix the flour, baking soda, and salt in a bowl. In a separate bowl, whisk together the milk, oil, eggs and sugar. Stir the flour mixture into the egg mixture, and continue to mix well. Add the flour to the egg mixture. Mix well and pour into a greased waffle iron. Cook for 2 minutes, remove from heat and serve.
Prior Tech	In a medium bowl mix flour, eggs, and milk until combined. Add the dry ingredients and stir until just combined and do not mix. Heat griddle over medium heat, add the oil, oil, and cook the pancakes until golden brown and cooked through. Serve with a little milk or cream. Enjoy
Prior Recipe	In a mixing bowl, whisk together the eggs, milk, oil, sugar, vanilla, salt and vanilla. Cover and let the mixture stand in the fridge for about 1 hour. Spoon batter into waffle iron and close the grill.
Prior Name	Preheat waffle iron. Beat together the eggs, milk and oil until well blended, add the vanilla and mix well with a mixer. Fold in flour, baking powder, and cinnamon. Spread 1 / 2 the mixture in a greased waffle iron. Bake until golden brown, about 15 minutes per side. Sprinkle with powdered sugar and serve warm.

Table 4: Sample generated waffle recipe for all models.

```
NOTE: Recipes may use more than just the provided ingredients!


Recipe name: "old settler s beans "

Some ingredients:
--ground beef
--bacon
--onion
--kidney bean
--pork & bean


Recipe A:
1) cook beef , onion , and onion in large pot of boiling water
2) cook for 5 minutes or until beans are tender
3) add beans , corn , and worcestershire sauce
4) cook until beans and beans are tender , stirring occasionally
5) add remaining ingredients
6) cook over low heat for 5 - 10 minutes .


Recipe B:
1) brown beef , onions , green onions , garlic , and onion
2) add beans , water and water
3) bring to a boil , reduce heat to simmer , and cook for 10 minutes
4) add beans and cook for 5 - 7 hours .


Which is more coherent (grammatical), recipe A or recipe B? (A/B):

GOAL: `old settler s beans`
Which recipe better accomplishes the goal (above), recipe A or recipe B? (A/B):
```

Figure 2: A sample question for coherence evaluation survey.