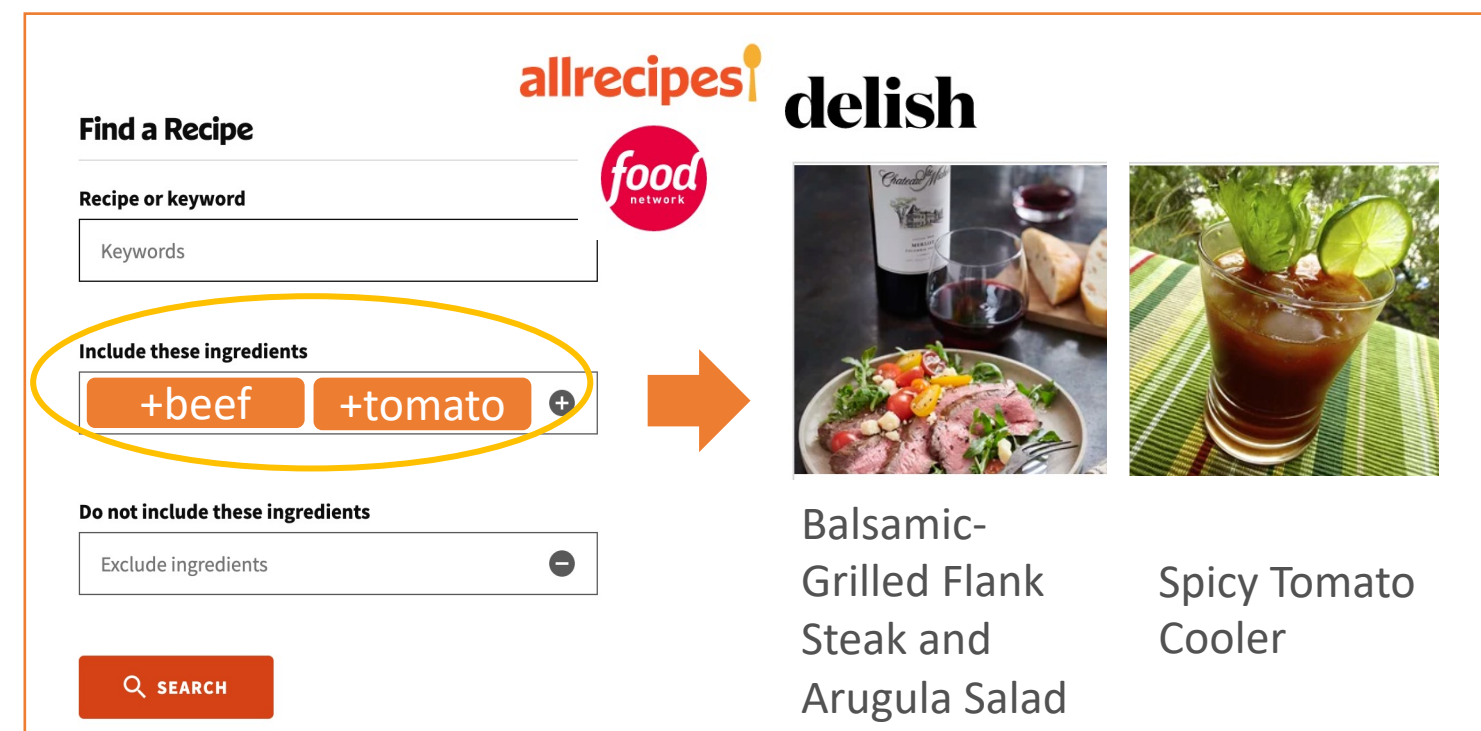# Finding your desired recipes:
using ingredients at hand & alternative ingredients

Recipe recommender

Summary

"
Cook easily with what you have. Some ingredients not available? Don't want to add? Find alternative ingredients. Don't forget to add other complementary ingredients to enhance the taste!
"

- Problem

- Non-applicable solutions: algorithm focuses on past reviews
- No alternative ingredients provided: not considering users' preferences, health concerns or food intolerances and/or allergies.

- Why should we care?

Covid quarantine forcing me to learn how to cook...

For those who lack of cooking experience, our recipe recommender will ease the burden of cooking by giving:
- Recipes based on ingredients at hand
- Alternative ingredients to substitute
- Complementary ingredients to add

Data and DBMS

- Data: "Food.com Recipes and Interactions"
  - Downloaded from Kaggle
  - Originally scraped from Food.com for 18 years (January 2000 ~ December 2018)
  - # User-recipe interactions: 1.4M reviews
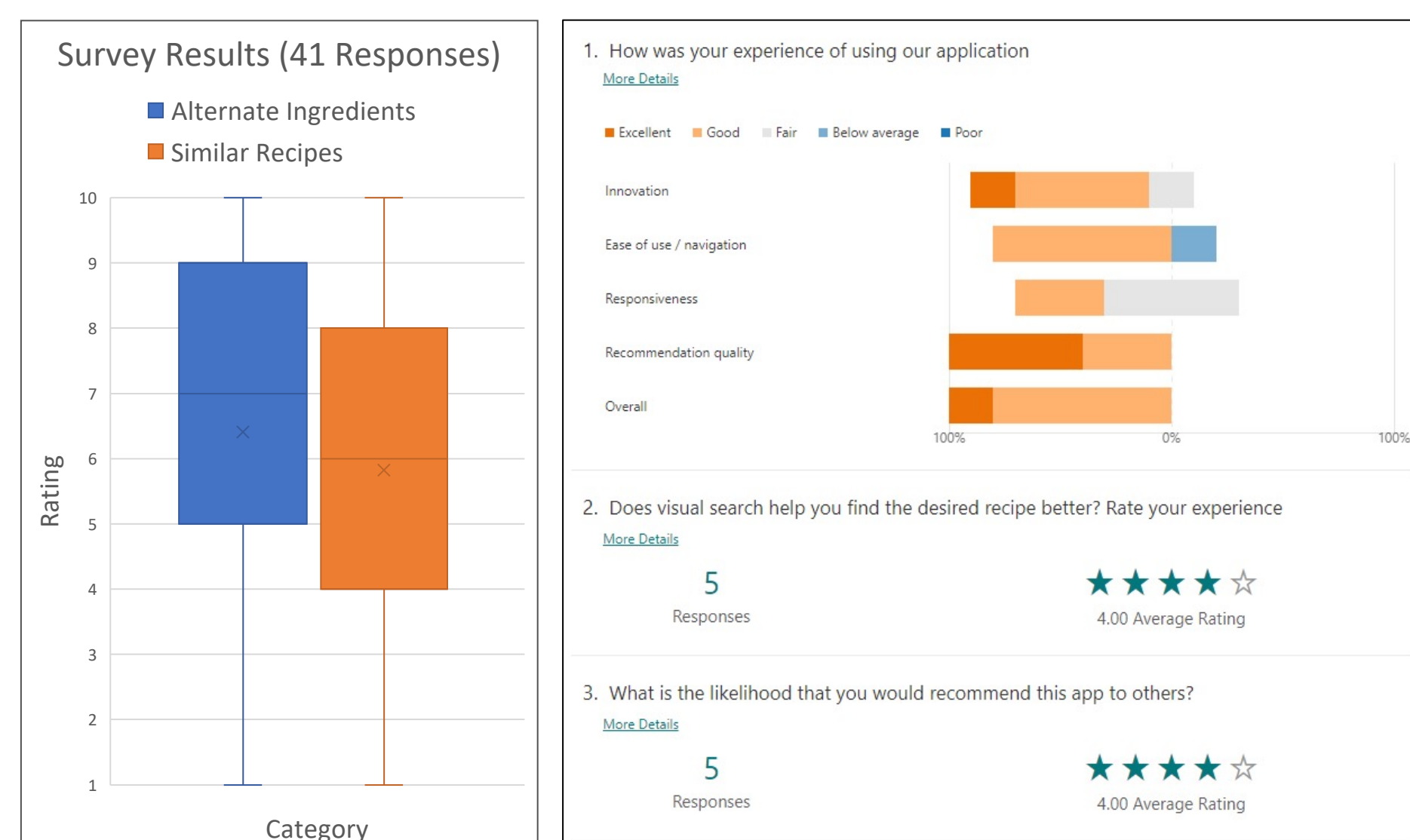
- Graph DBMS: neo4j
  - Easy to visualize graphs of User to User, Recipe to Recipe, and Recipe to Ingredient relationships, and between all three types of nodes.
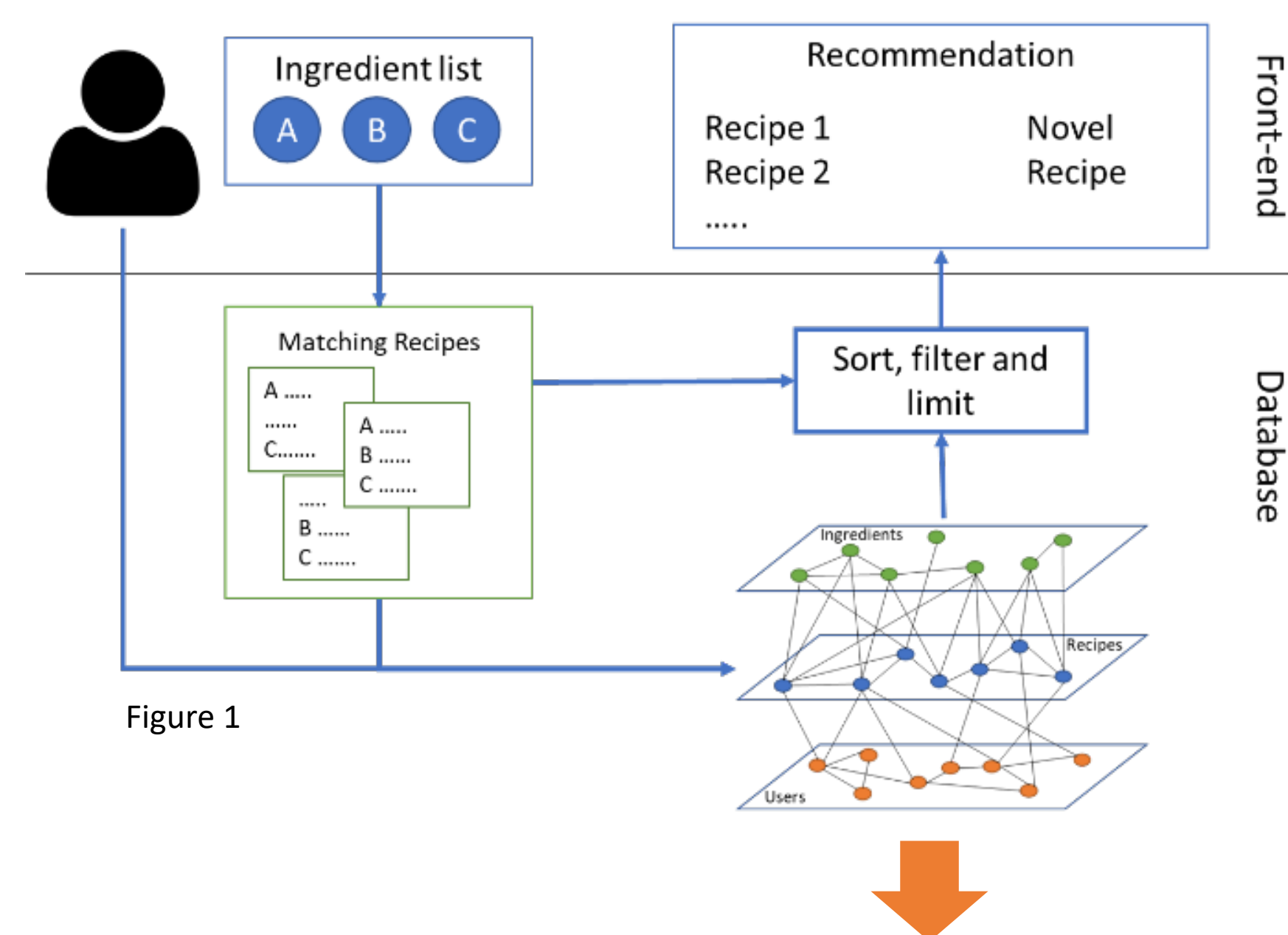
Evaluation

- Recommendation algorithm:
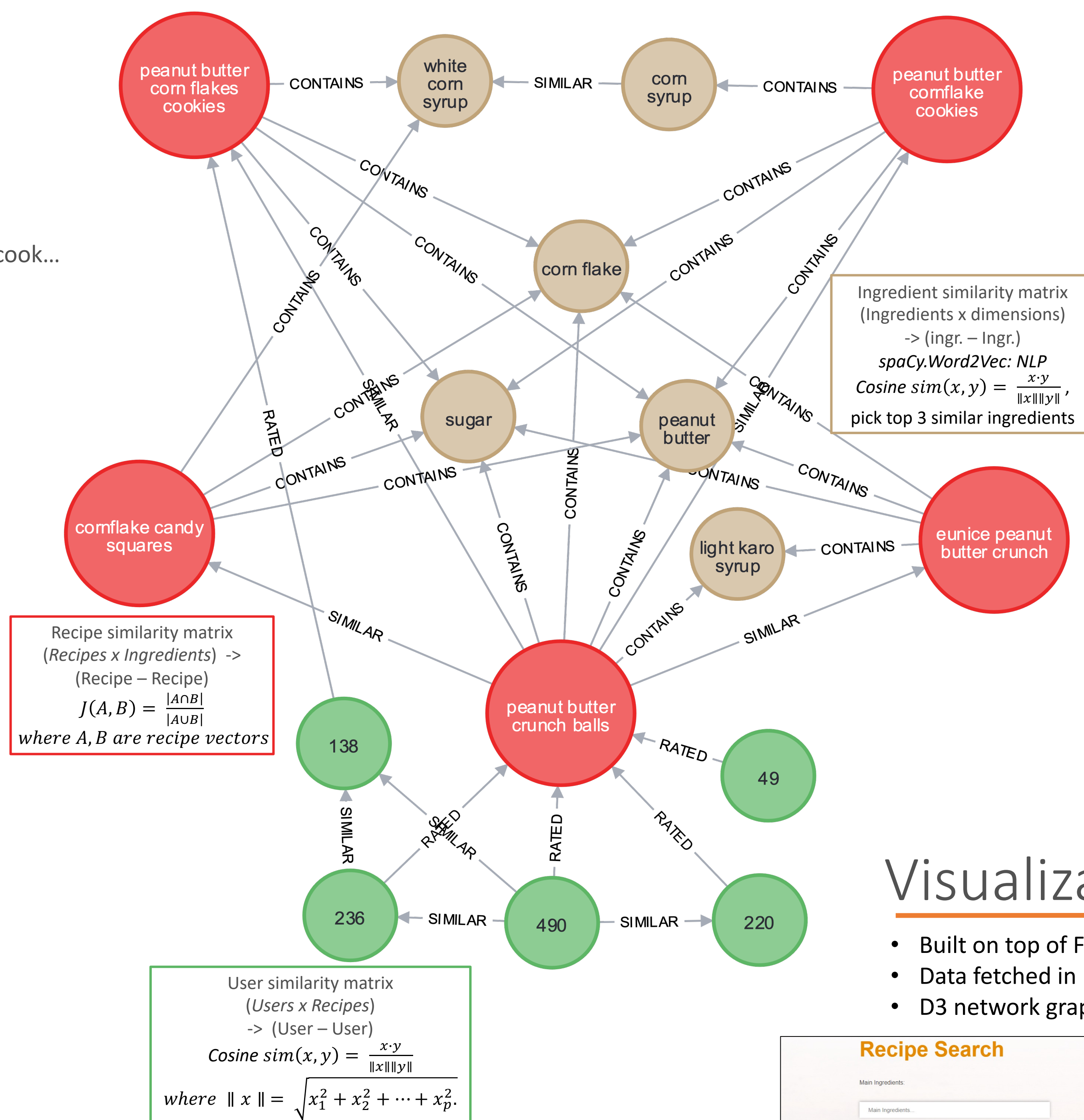
Our survey of 41 users found:

- Proposed alternative ingredients would substitute certain ingredients in a recipe (6.4/10 on average) with change in smell, taste or color of the recipe.
- Alternative ingredients substitution score varies widely: according to the usage of the ingredients, how important its role in the recipe etc.
- Recipes are not exactly similar but close to each other based on their ingredients (5.8/10 on average).


Survey Results (41 Responses)

Approach:

Figure 1

Data representation example

Ingredient similarity matrix (Ingredients x dimensions) -> (ingr. – Ingr.)
spaCy.Word2Vec: NLP
$Cosine\ sim(x,y) = \frac{x \cdot y}{\|x\| \|y\|}$,
pick top 3 similar ingredients

Recipe similarity matrix (Recipes x Ingredients) -> (Recipe – Recipe)
$J(A,B) = \frac{|A \cap B|}{|A \cup B|}$
where A, B are recipe vectors

User similarity matrix (Users x Recipes) -> (User – User)
$Cosine\ sim(x,y) = \frac{x \cdot y}{\|x\| \|y\|}$
where $\| x \| = \sqrt{x_1^2 + x_2^2 + \cdots + x_p^2}$.

Matching Recipes

Content based filtering   Collaborative filtering

The sequence of activities from user input to recipe recommendation is illustrated in Figure 1.
Step 1: We first find the matching recipes in our database purely based on ingredient match.
Step 2: We use collaborative filtering to get another set of recipes which will be ranked based on number of occurrences within the user network.
Step 3: We use content-based filtering to find recipes based on the liking of the user and its similarities which is again ranked.
Step 4: Complementary ingredient selector and alternate ingredients will be presented separately in the UI.

- Intention & uniqueness of the approaches
  - Use of collaborative and content-based filtering rather than just text-based search.
  - Our interactive UI allows the users to select the most relevant ingredients based on its relevance to the main ingredient.
  - It proposes alternative ingredients to consider users' preferences, health concerns or food intolerances and/or allergies.

Visualization:

- Built on top of Flask framework
- Data fetched in real-time from Neo4j
- D3 network graph for visualisation
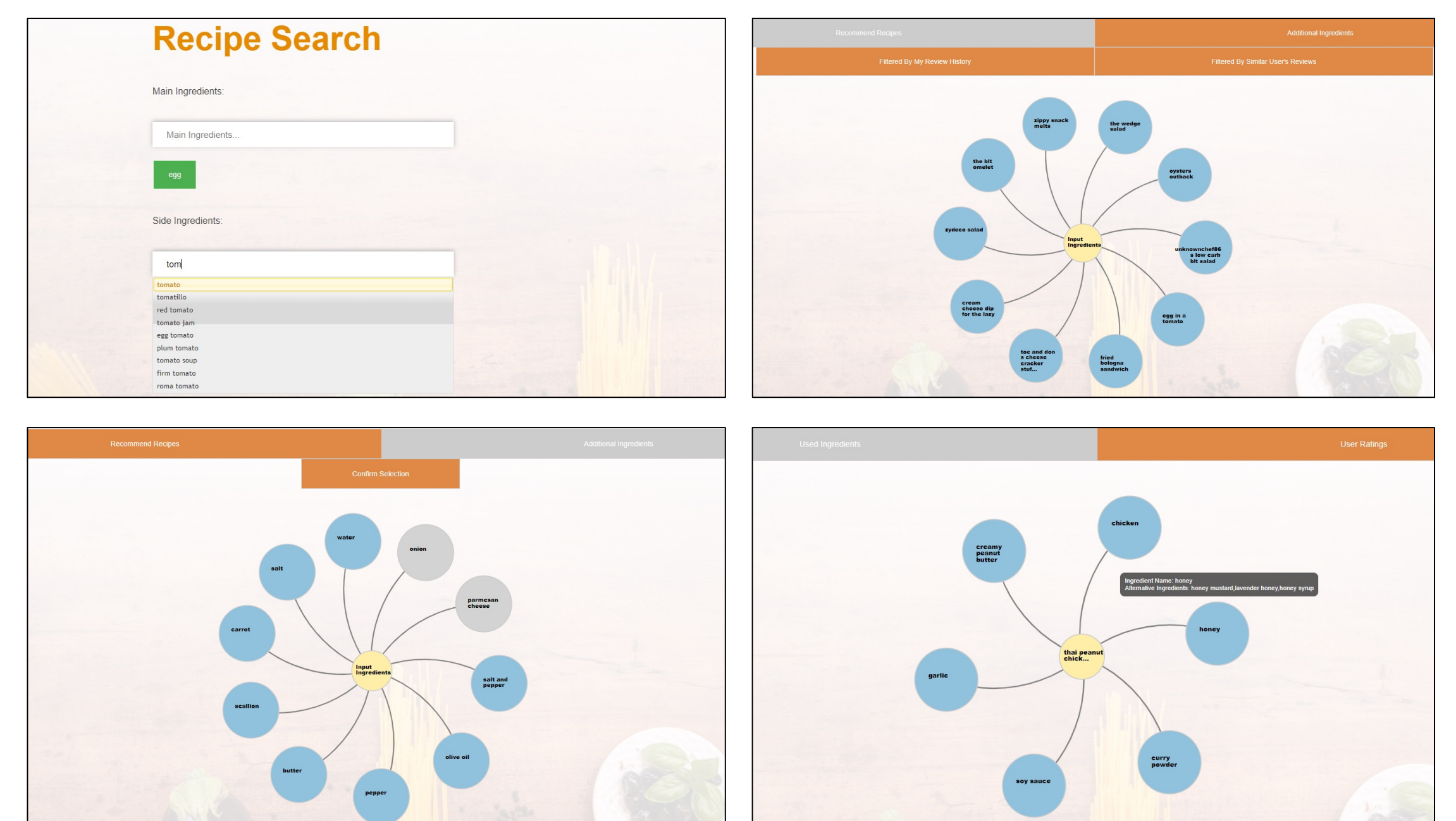
Top 10 recommended recipes according to the relevance. Additional ingredients based on the similarities of the inputs. New graphs will be calculated based on the newly added inputs. Users can filter out the recipes, either by user's review history or by similar users' reviews. When select a desired recipe, related ingredients will be represented. Tooltip will show 3 alternatives in each ingredient node.

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