Recipe Recommendation Using Graph Databases:
Personalized Nutrition, Ingredient Substitution, and More

Prasanna Iyengar, Jenna Tyler, Suprio Ray

Problem: Generate personalized recipes accounting for individual preferences and dietary restrictions, which still taste good

Today, a large emphasis is placed on healthy living, including dietary restrictions. Due to common culinary practices and preferences, it is often difficult to change food habits. Previous research suggests that it is possible to generate a system that can recommend recipes with ingredient substitutions, which take into account dietary restrictions, individual preferences, and cultural culinary practices (flavor pairing).

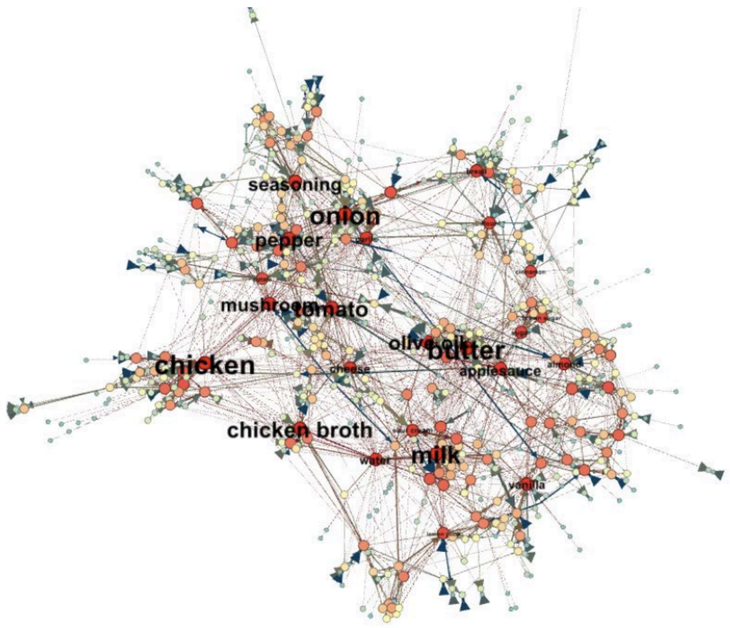

Figure 1: Ingredient substitute network (Teng et al. WebSci 2012)

Context: The Relational DBMS

Historically, database applications have centered around the relational database model. In this model, data is grouped into entities, and these entities are mapped with other entities using one or many common keys. While this is sometimes suitable, particularly for transactional workloads, for other applications the relational model requires many joins, slowing down the query process.

Graph Databases

Graph databases employ a graph model, with nodes and edges. Both nodes and edges can have properties. Connections between nodes are stored as first class citizens, allowing for rapid, constant-time operations and the traversal of millions of connections per second.

Comparing Data Models

Figure 2 shows the ER model for FooDB's dataset. Food, Flavor, Compound, and Health effect are individual entities, which all have various attributes. When implemented in a relational database, each of the many-many relationships are mapped in a separate table. Information about each item will be stored as a row in a table. Relationships between items will be stored as individual lines in a table containing both item's keys.

Figure 3 shows the model mapped in a Graph Database. Each item will be a node, and each node will have various properties. Each node has a label, helping organize the data. In this model, information about each item is stored in a node's properties. The relationships between items will be stored as an edge between the node.

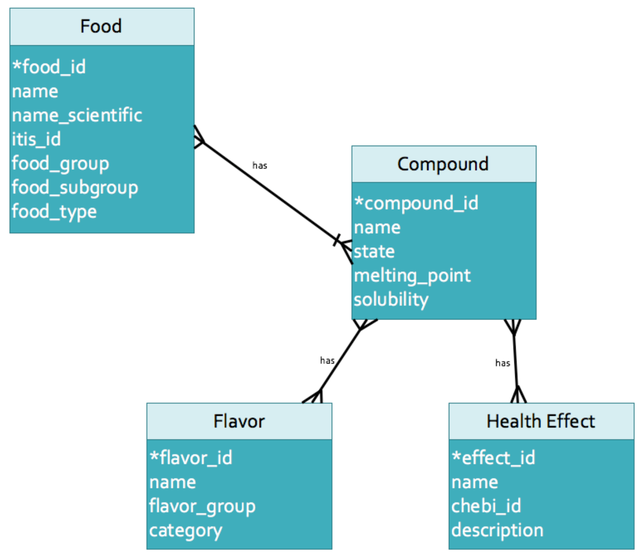

Figure 2: ER Diagram for Relational Model

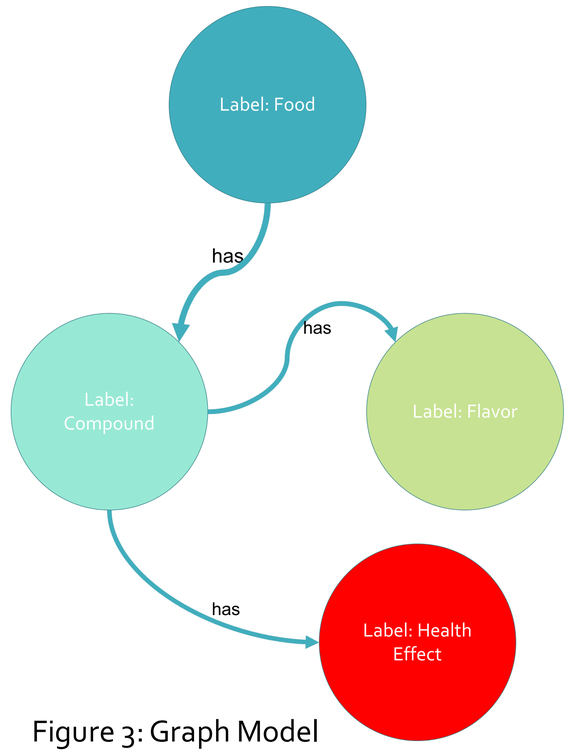

Figure 3: Graph Model

Research Problems

- Comparison of Performance between traditional RDBMS and Graph Databases
- Personalized Recipe Generation while considering:
  - Dietary Restrictions
  - Culinary Preferences
  - Culinary Practices
  - Health
- Caloric Information Calculation