Graph data modeling

NoSQL: Lecture 2

Piotr Fulmański

FACULTY OF MATHEMATICS AND COMPUTER SCIENCE
University of Lodz

Graph databases In Action

by Dave Bechberger and Josh Perryman

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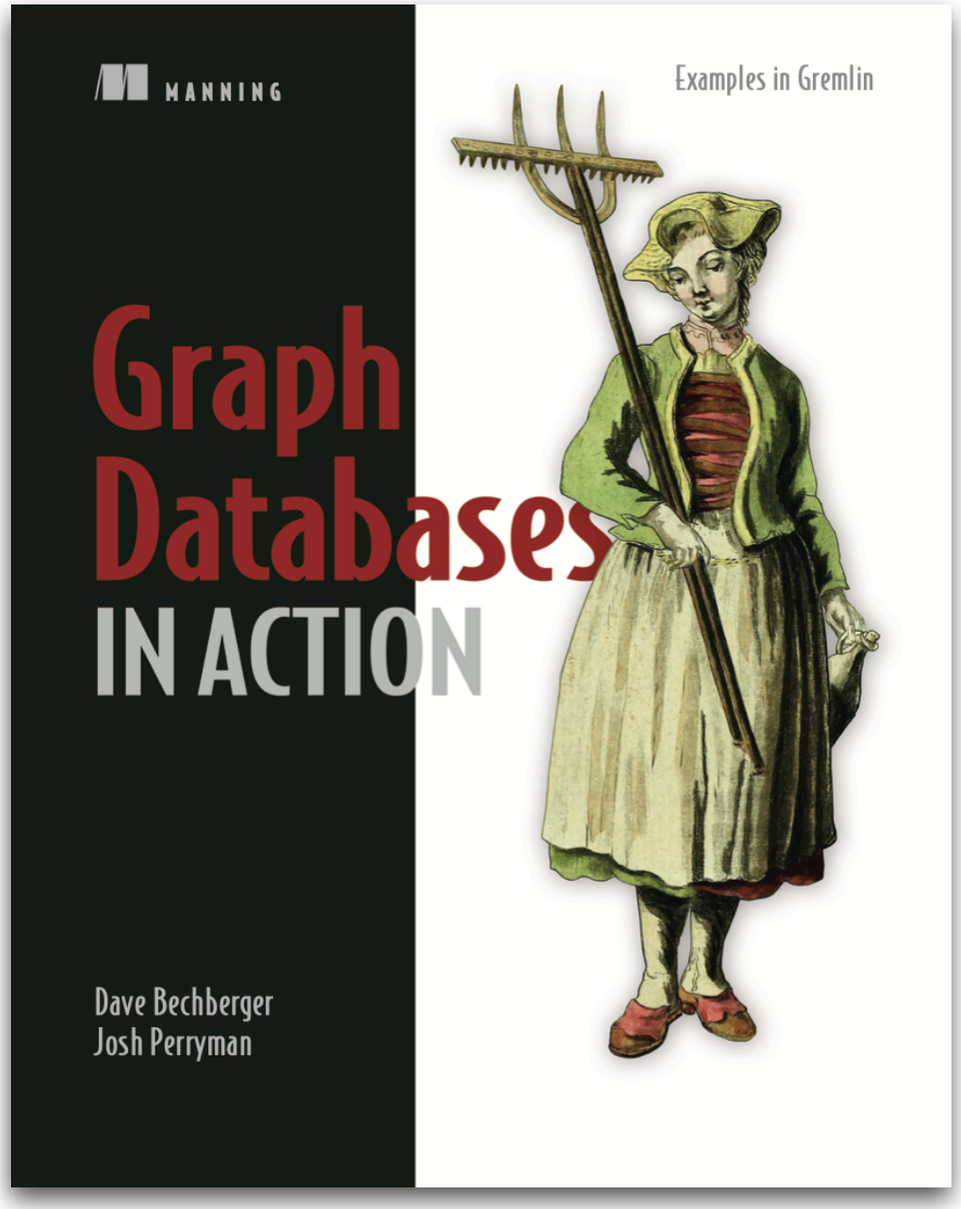

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- This picture includes the scope the solution should address and the requirements to complete the solution. The more details that this mental picture provides, the easier it’ll be to build that solution.

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    - identifying and understanding the problem,
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    - and then creating a representation of that problem in the database.
- In case of graph databases… hmmmm...
  (see *Access pattern* in next part: *Data modelling terms*)

Data modeling terms

- ***Entity*** – Describe the “things” or type of things in the domain, such as users, devices, geographic locations etc.

  As you move from problem definition and conceptual modeling, entities will often become **vertices** in the logical model and technical implementation.
  Commonly represented by *nouns*.

- ***Relationship*** – Describe how entities **interact** with one another. It could be something like “moves” as in “a vehicle moves to a location” or “friends,” in the Facebook sense of this word as a verb, as in “a person friends another person.”

  As you move from problem definition and conceptual modeling, relationships will often become **edges** in the logical model and technical implementation.
  Often represented by *verbs* (or *verbal phrases*).

- ***Attribute*** – Describes a **property** of the entity or relationship, so it always **exists in their context**.

- ***Access pattern*** – Describes either questions or methods of interaction in the domain. Examples could be things such as “Where is this vehicle going?” or “Who are this person’s friends?”

  As you move from problem definition and conceptual modeling, access patterns will often become **queries** in the logical model and technical implementation.

Use the right language

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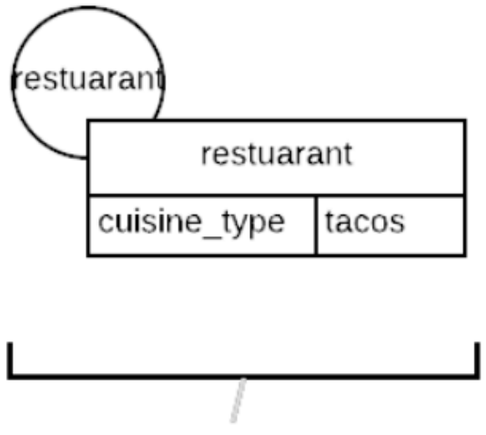
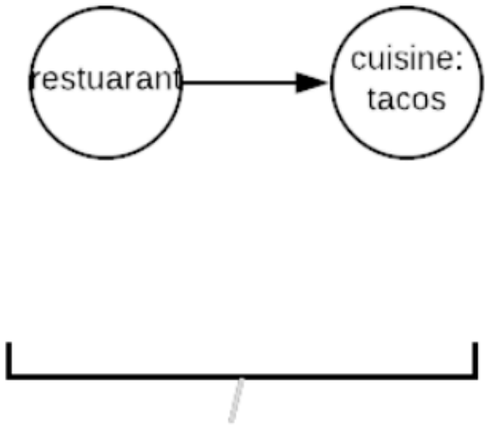


Graph implemention of cuisine as a property



Graph implemention of cuisine as another vertex

Use the right language

Vertex or node?

Note:

data modeling is about translating a real-world problem into a technical domain.

The terms *vertex* and *edge* are *technical terms* used when working with a specific type of data engine: a graph database. If you were using a relational database, the technical terms would be *table* and *column*.

But data modeling starts with engagement with the business, with users and their perspectives. The business and end users do not think in terms of vertices and edges, nor do they use these terms in their normal day to day tasks, and they shouldn't. The process uses different terms, like entity and relationship, to remind us that the conceptual model is a tool for communicating requirements between the end users and developers.

Steps of data modeling process

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1. **Understand the problem** Explore the project goals to ensure that the domain and scope of the problem is clear. Specify the common terms and the core access patterns of the users.

    1. **Who:** Business, Developers
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    3. **Result:** Textual description of problem

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    1. **Who:** Business, Developers
    2. **Tools:** Domain, Scope, Business Entities, Functionality
    3. **Result:** Textual description of problem
2. **Create a whiteboard or conceptual model** Turn text into a pictures. drawing a diagram which makes sense to the business users and will be useful to the technical developers. Create high-level picture of the problem domain from the business perspective.
    1. **Who:** Business, Developers
    2. **Tools:** Entities, Relationships, Access Patterns
    3. **Result:** Drawing with entities and their relationships

Steps of data modeling process

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3. **Create a logical data model** Combine the domain defined in the first step with the conceptual model from the second step to create the physical description of the graph data model. This includes defining the vertices, defining the edges, as well as specifying the properties on those vertices and edges. This completes the data model for your use case.

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    1. **Who:** Developers
    2. **Tools:** Vertices, edges, properties
    3. **Result:** Diagram of graph elements
4. **Test the model** Validate that our developed model satisfies the defined problem, verify its coherence.
    1. **Who:** Developers
    2. **Tools:** Results from all preceding steps
    3. **Result:** Coherence of the outputs of prior steps

Step 1: Understand the problem

DOMAIN AND SCOPE QUESTIONS

Define the boundaries of the problem.

Every problem can expand in infinite directions, so the more precisely you define the scope, the more likely you are to succeed. If you make the domain too broad, then you risk not understanding the boundaries of the problem and may never complete the application.

Questions:

- What will application do for users?
- What types of information does the application need to record to perform these tasks?
- Who are the users of our application?

Step 1: Understand the problem

BUSINESS ENTITLES QUESTIONS

Identify the fundamental building blocks of your application and how they are related to one another.

Questions:

- What sort of items or things does the application utilize?
- How do these items interact with one another?
- What are the critical pieces of data you need to know about each entity?

Step 1: Understand the problem

FUNCTIONALITY QUESTIONS

Identify how a user is going to interact with the system and/or what problems they want the system to solve for them.

Questions:

- How are people going to use the system?
- What questions does application need to answer for the user?

Step 2: Create a whiteboard model

IDENTIFYING AND GROUPING ENTITIES

Answer for the question: ***what***

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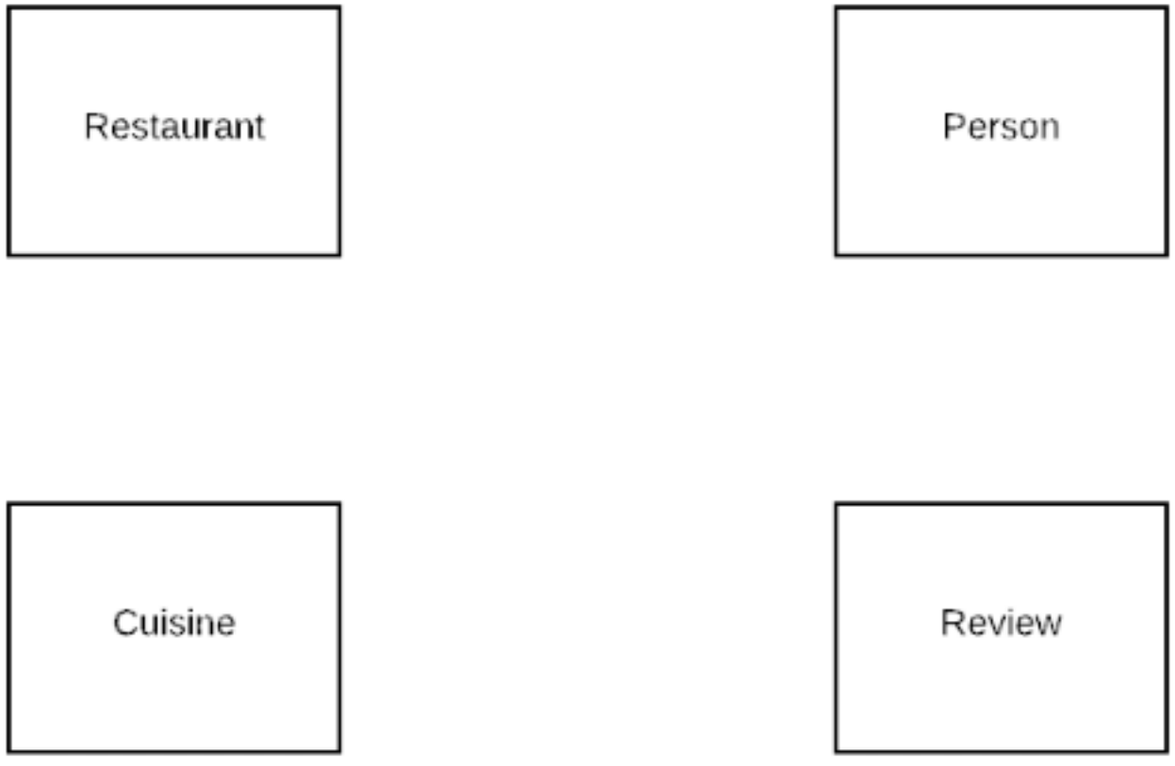

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IDENTIFYING RELATIONSHIPS BETWEEN ENTITIES

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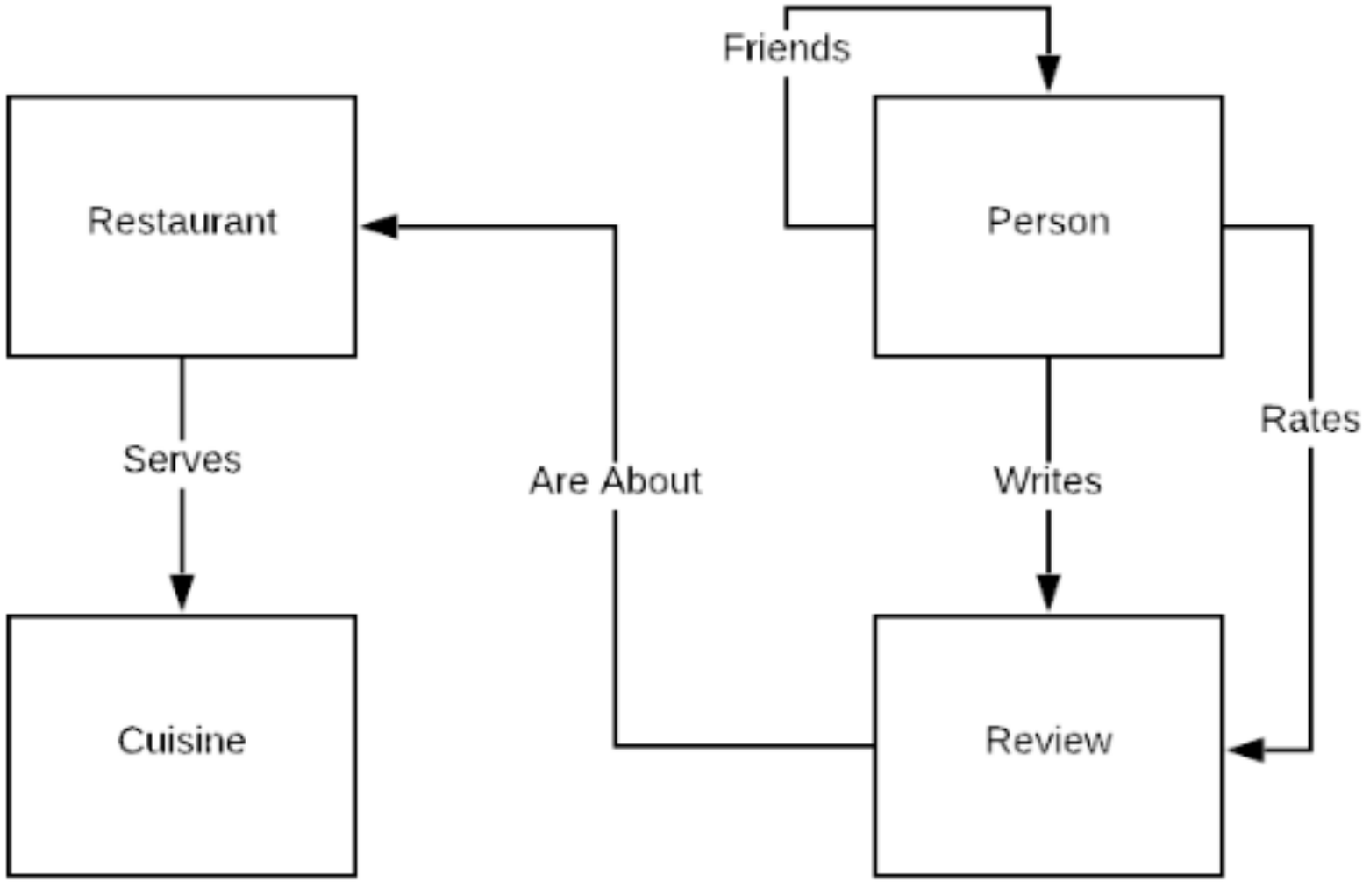
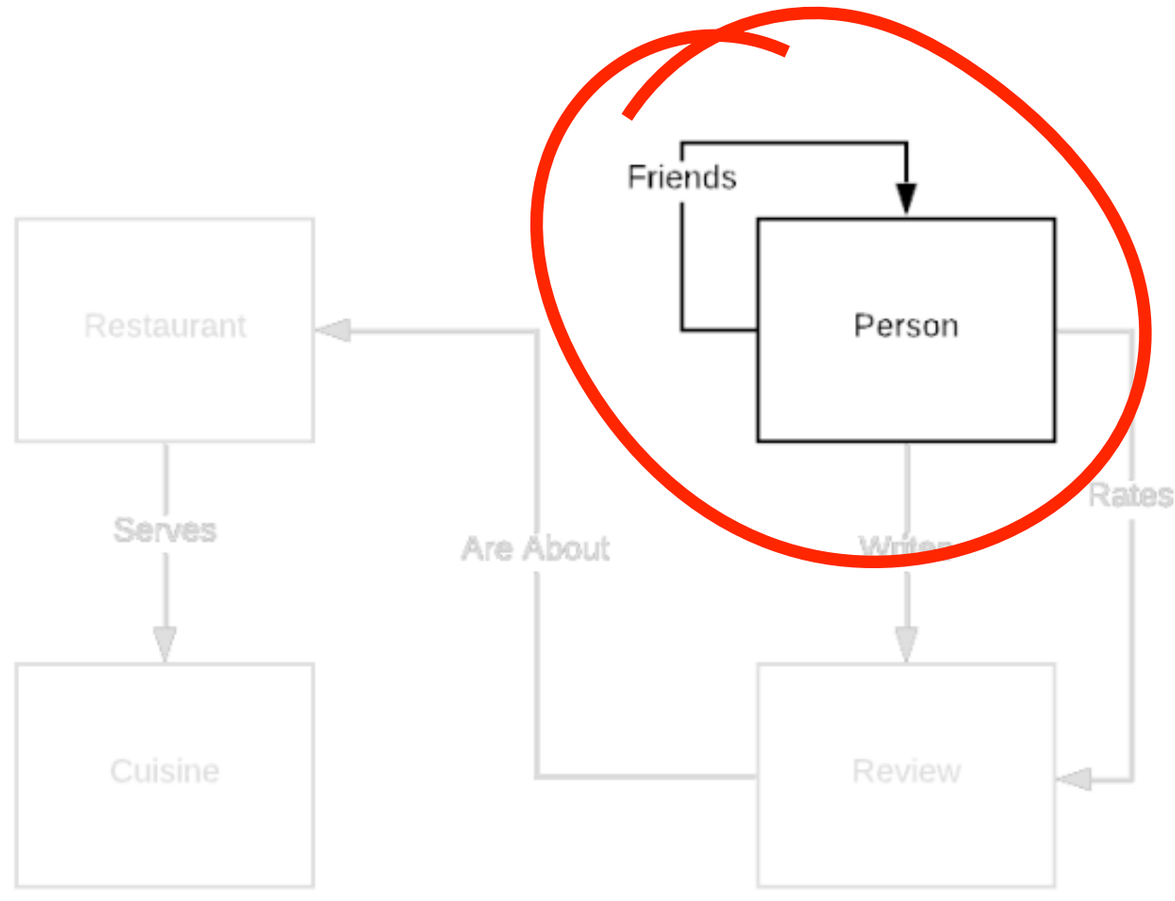


Step 3: Create a logical data model

TRANSLATE ENTITIES TO VERTICES

- Finding the conceptual entities
- Naming the vertex labels



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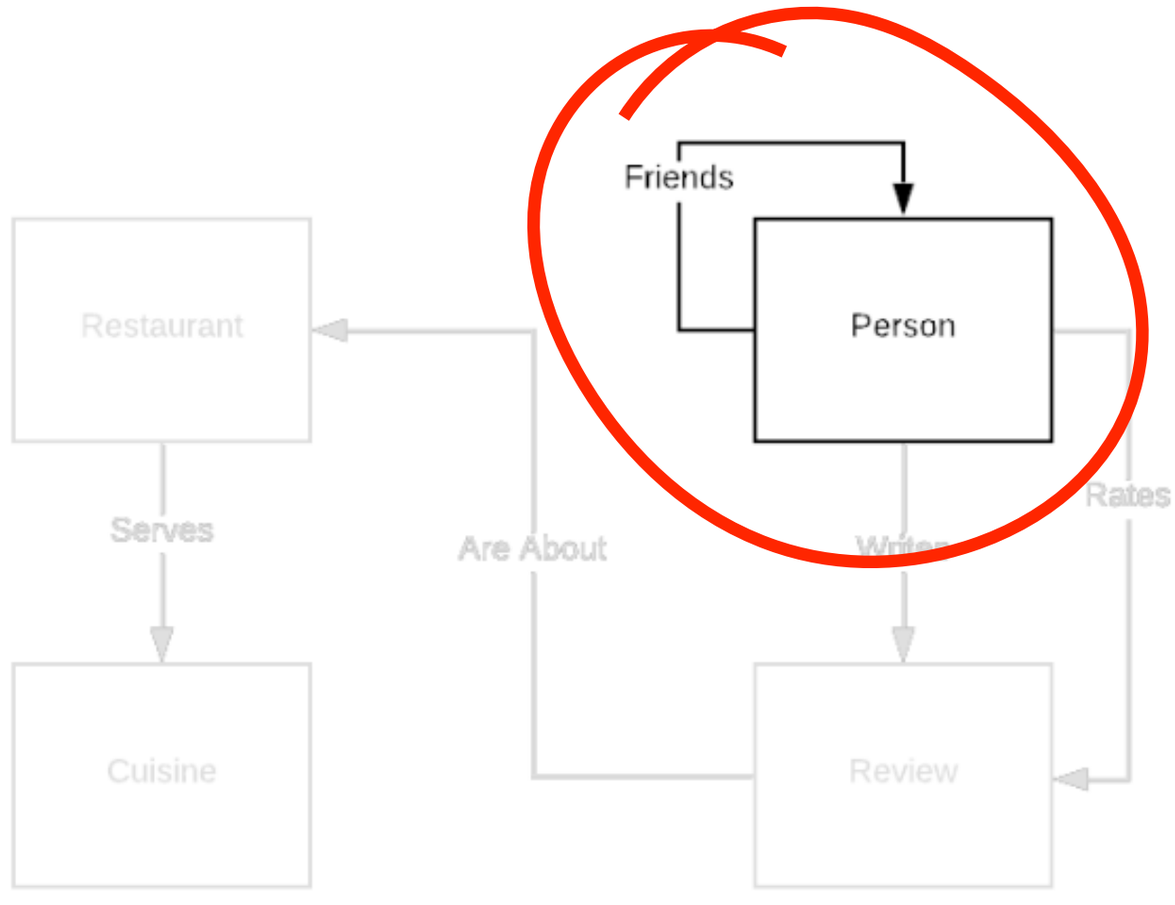

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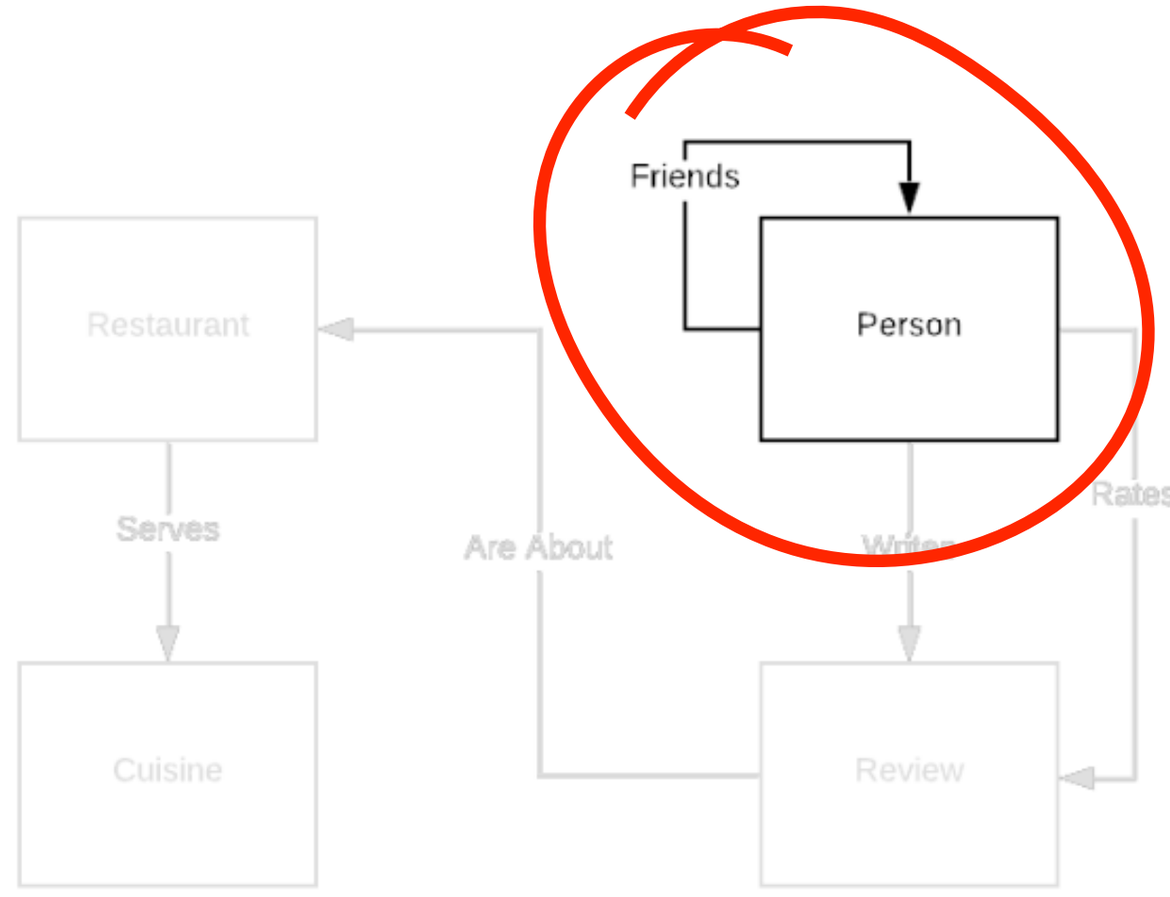

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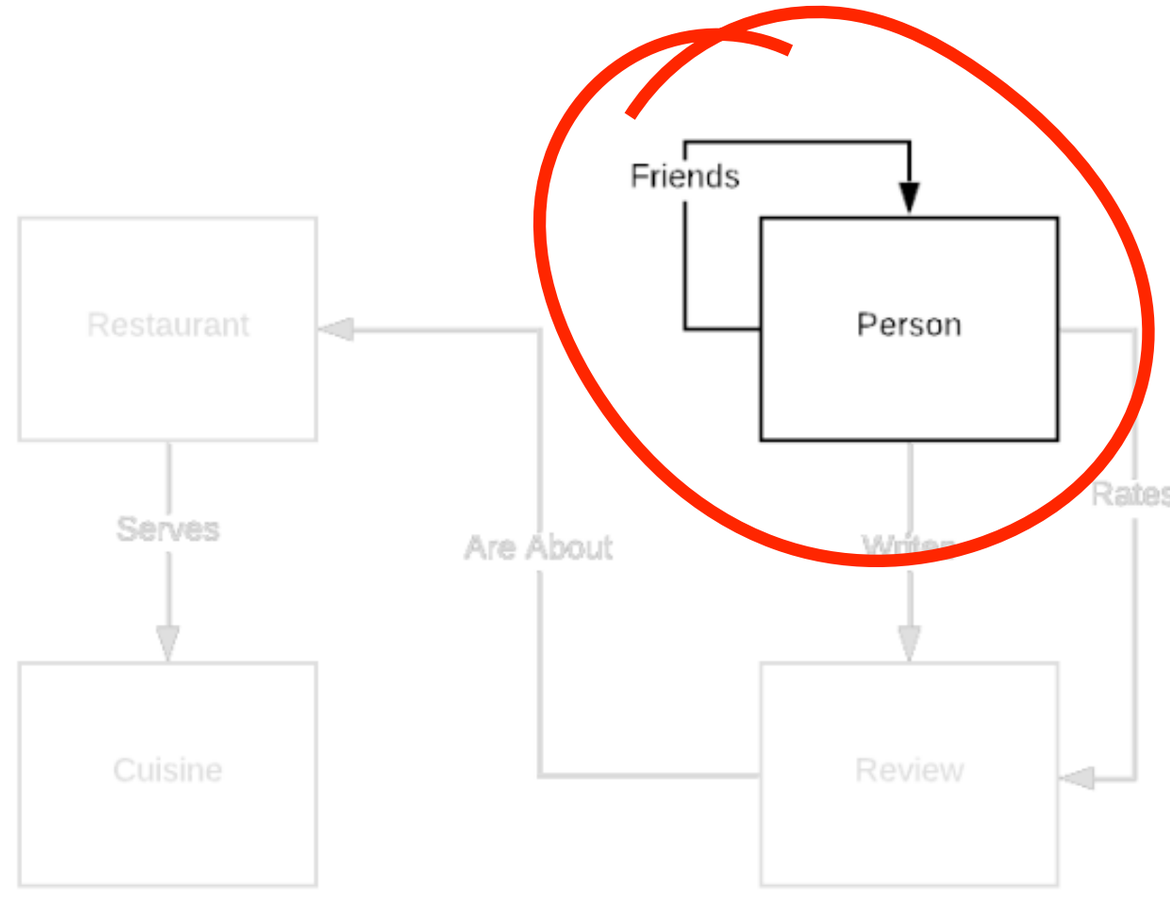

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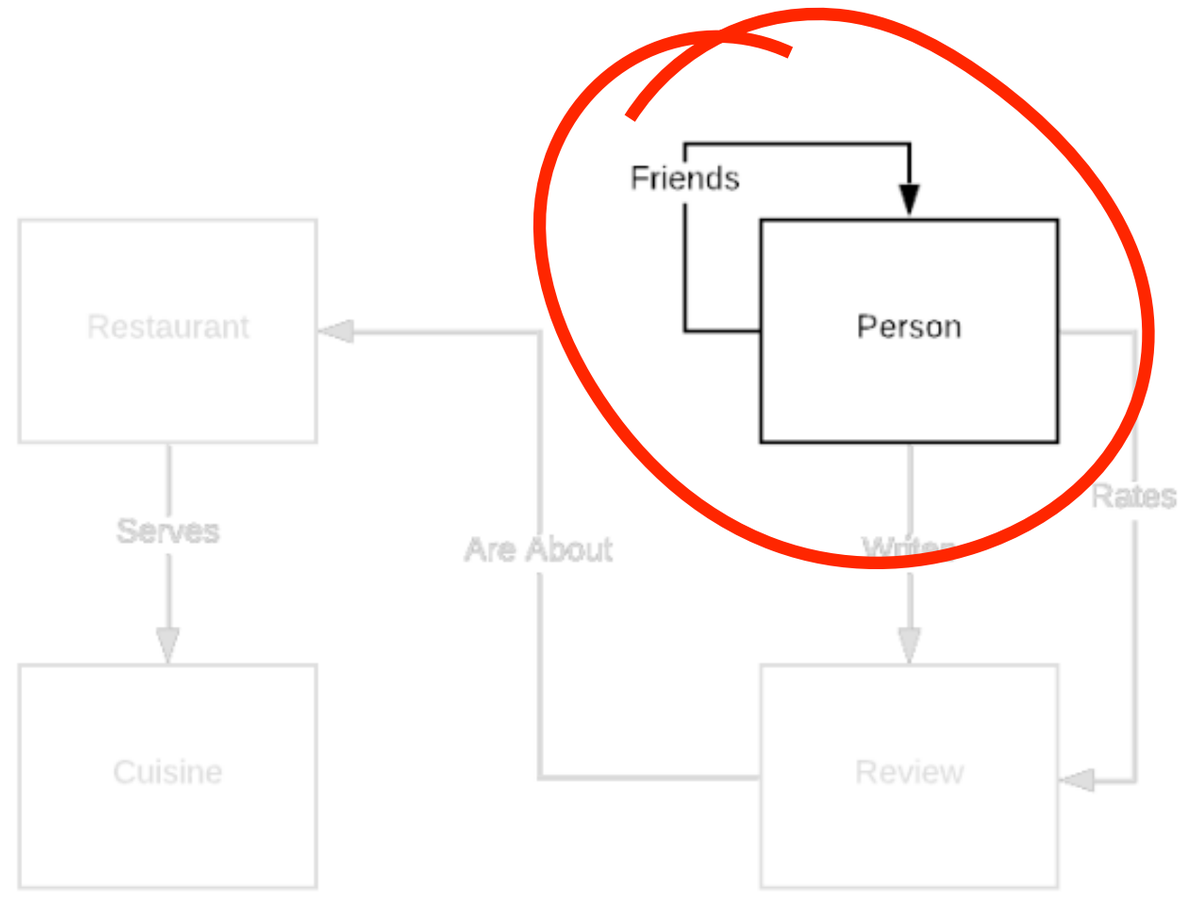

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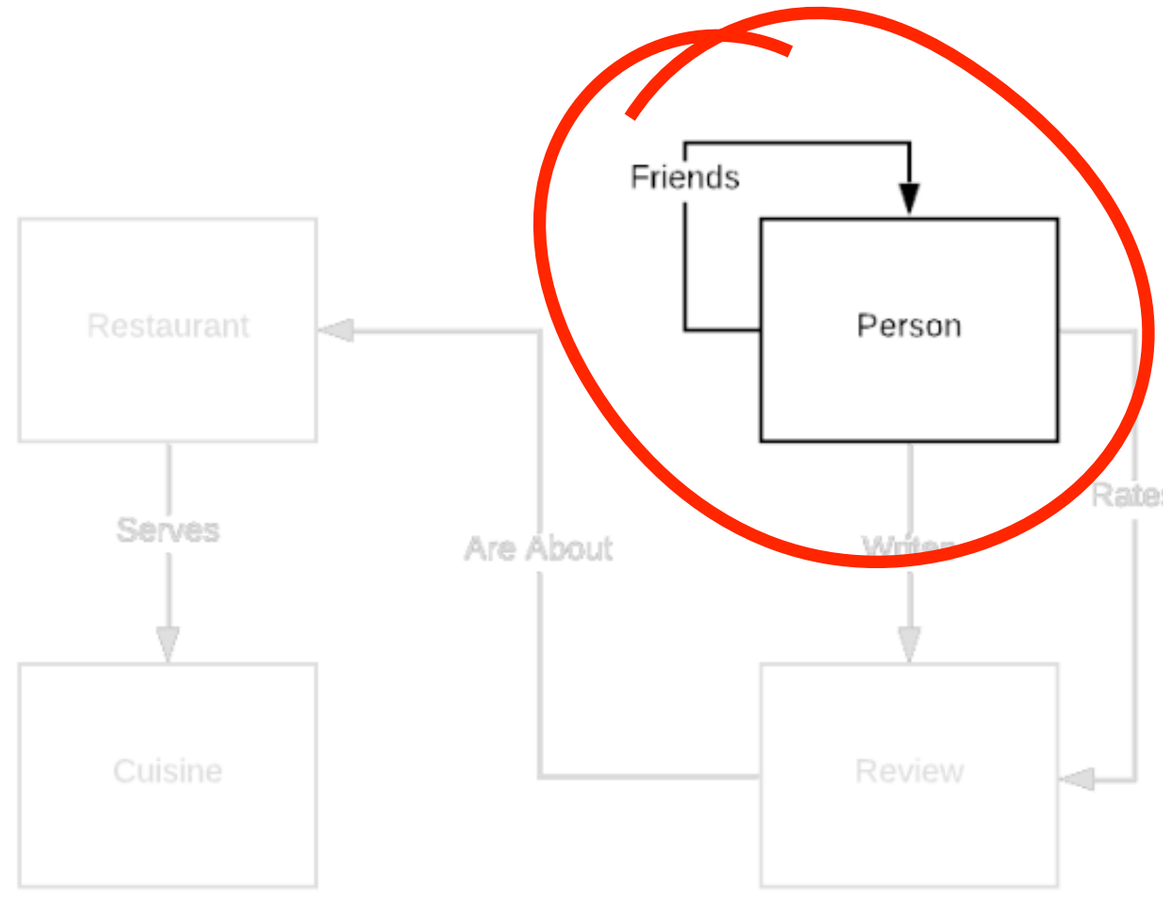

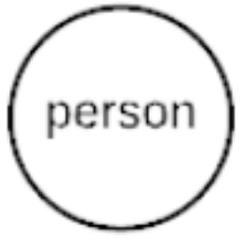

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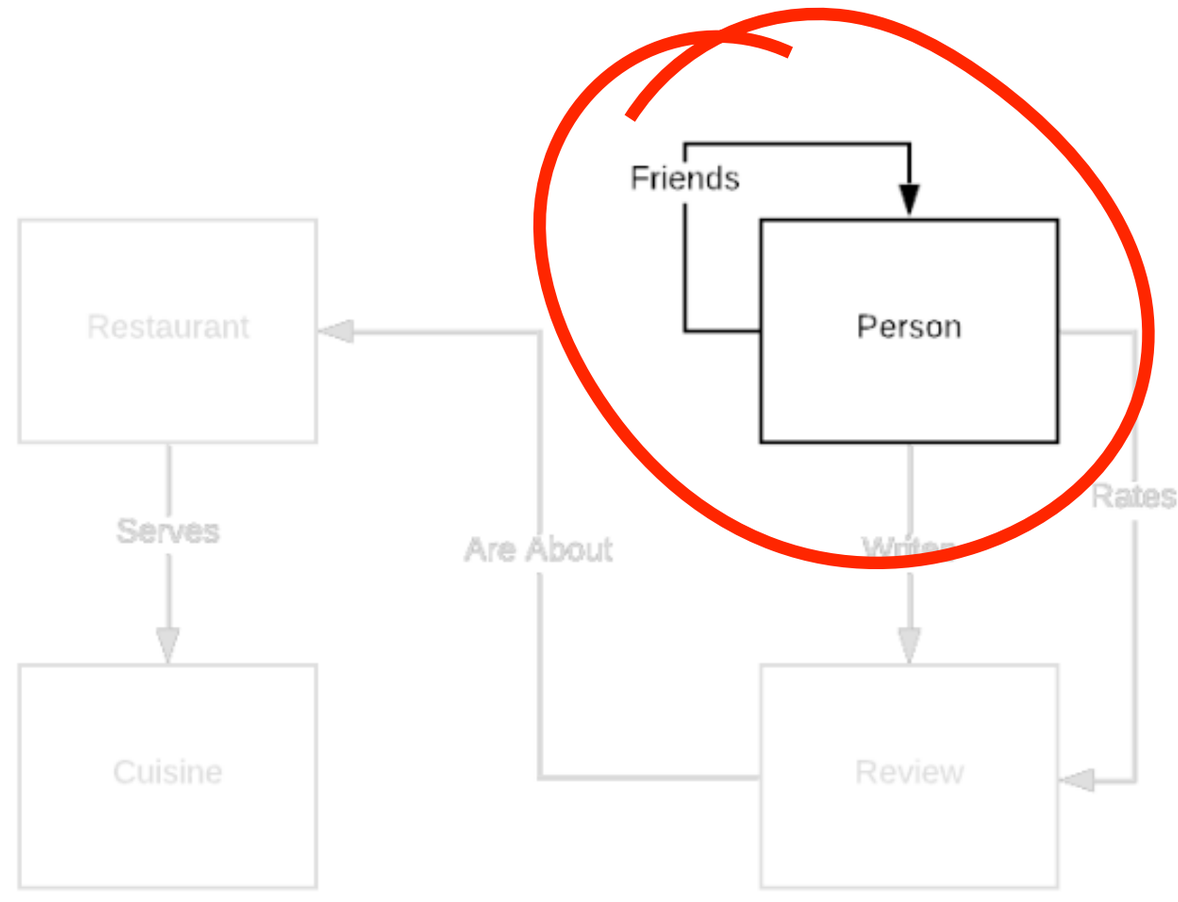

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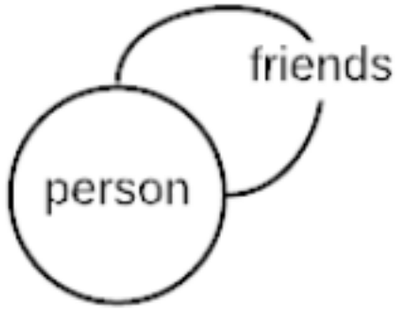

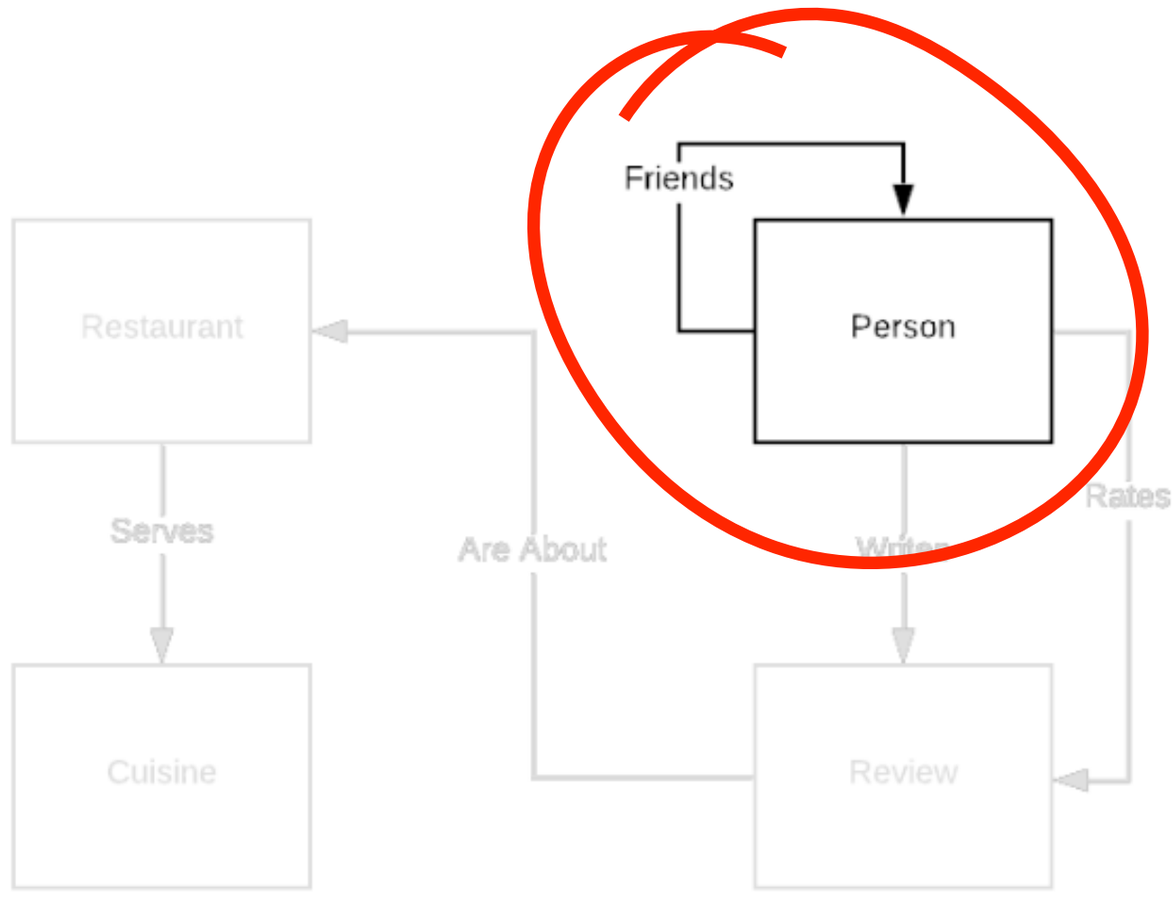

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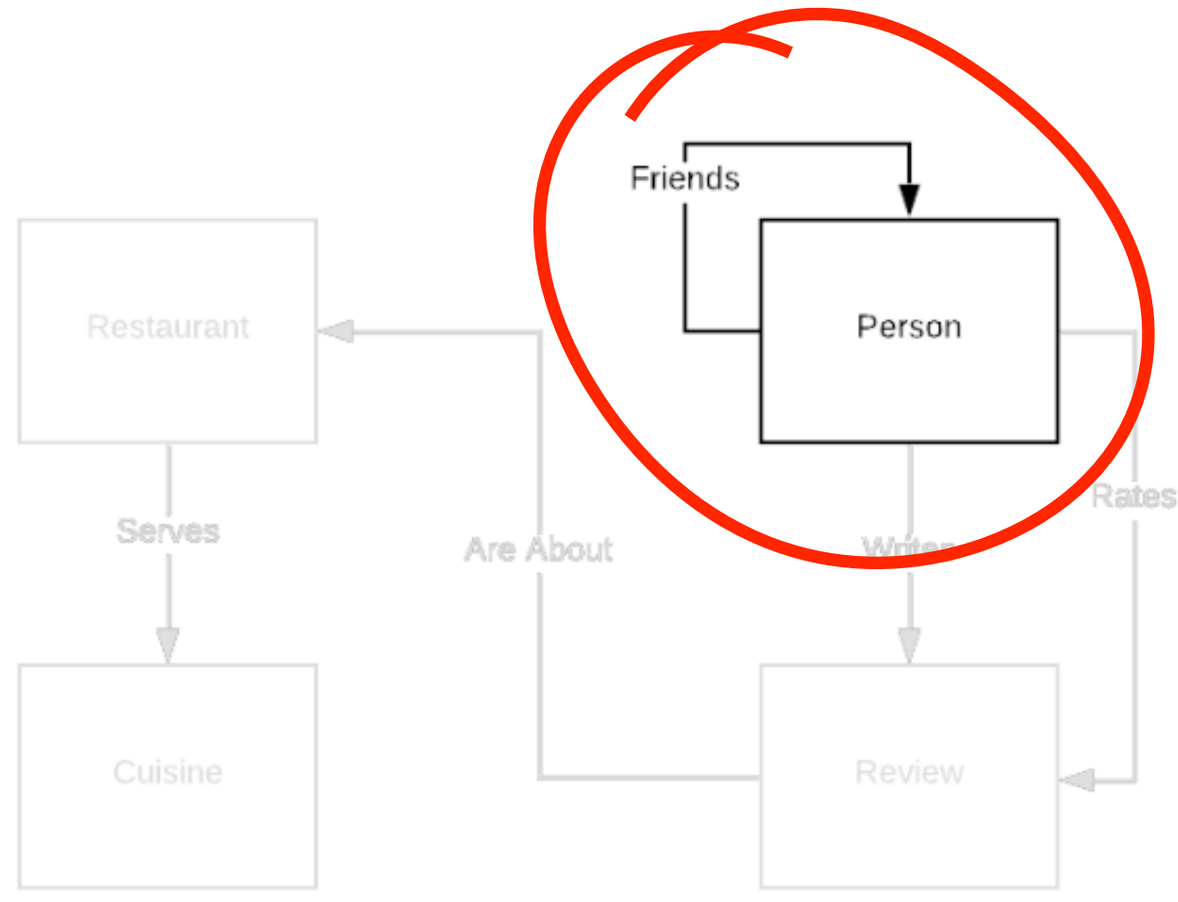

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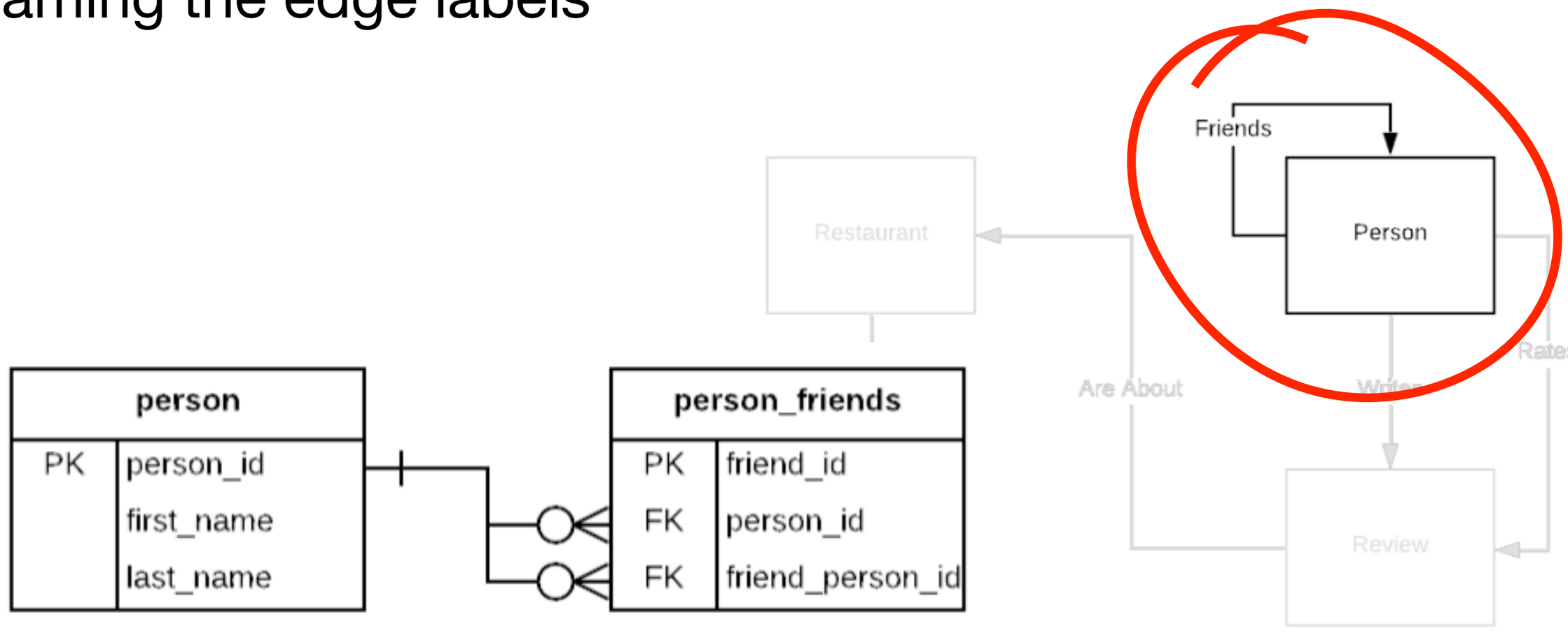

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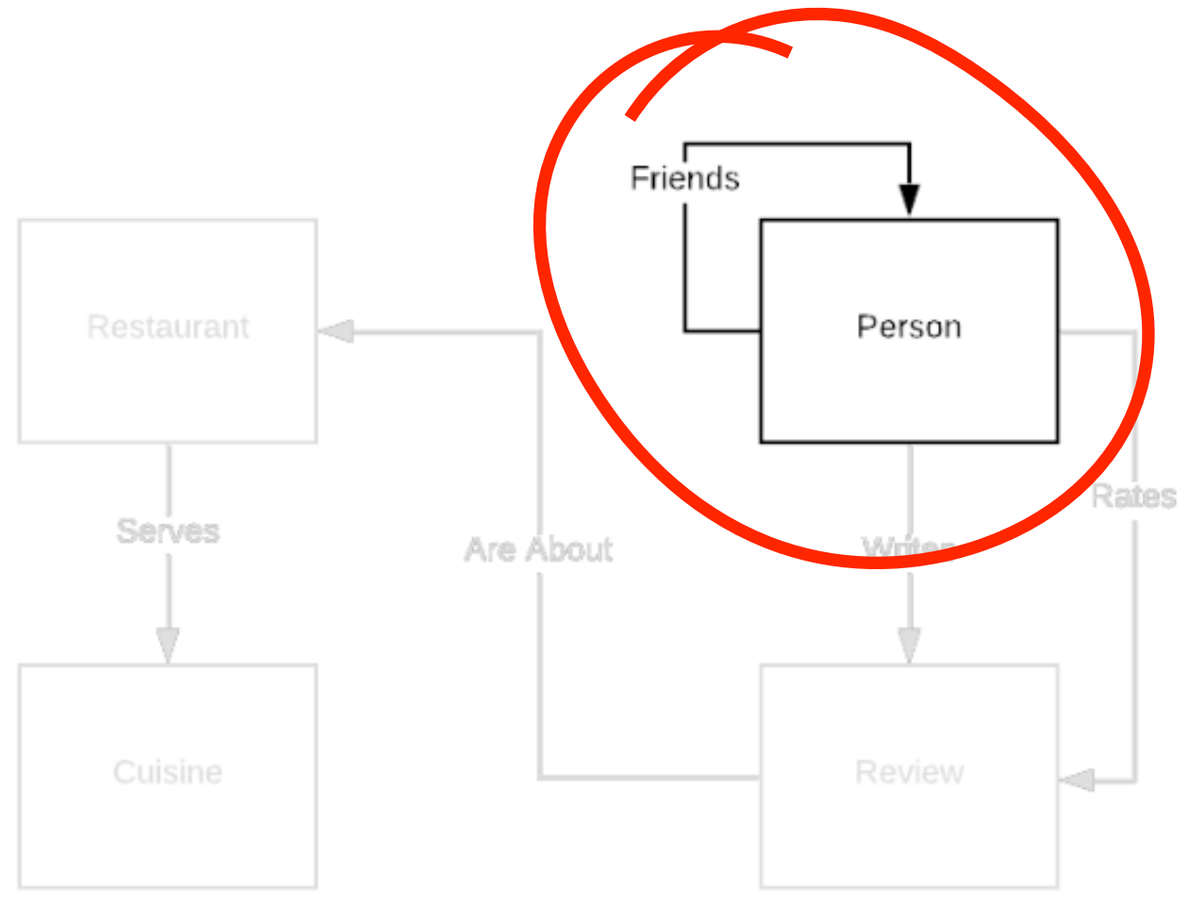

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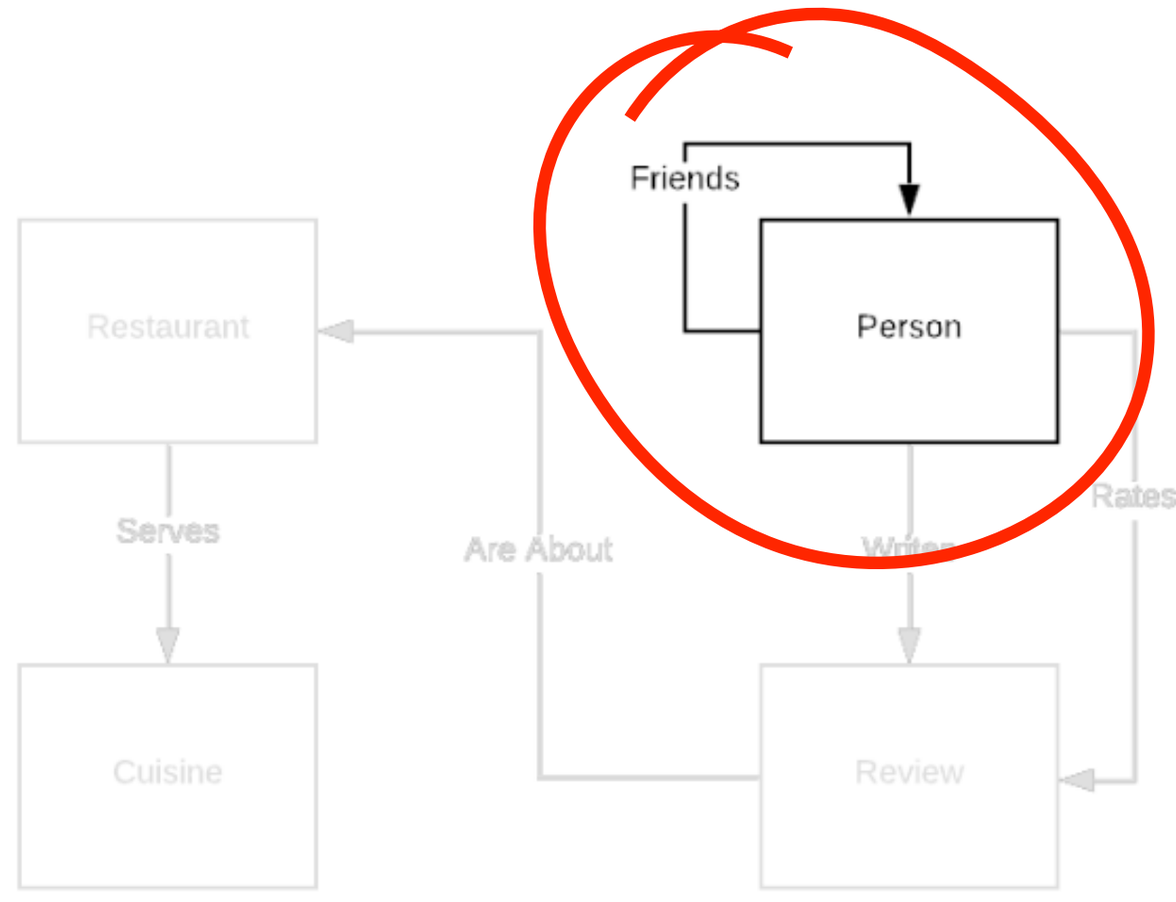
TRANSLATE RELATIONSHIPS TO EDGES

- Finding the relationships
- Naming the edge labels
- Give the edge a direction



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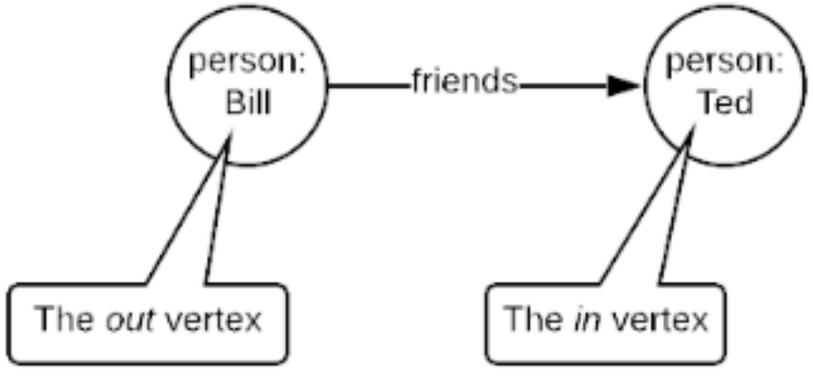

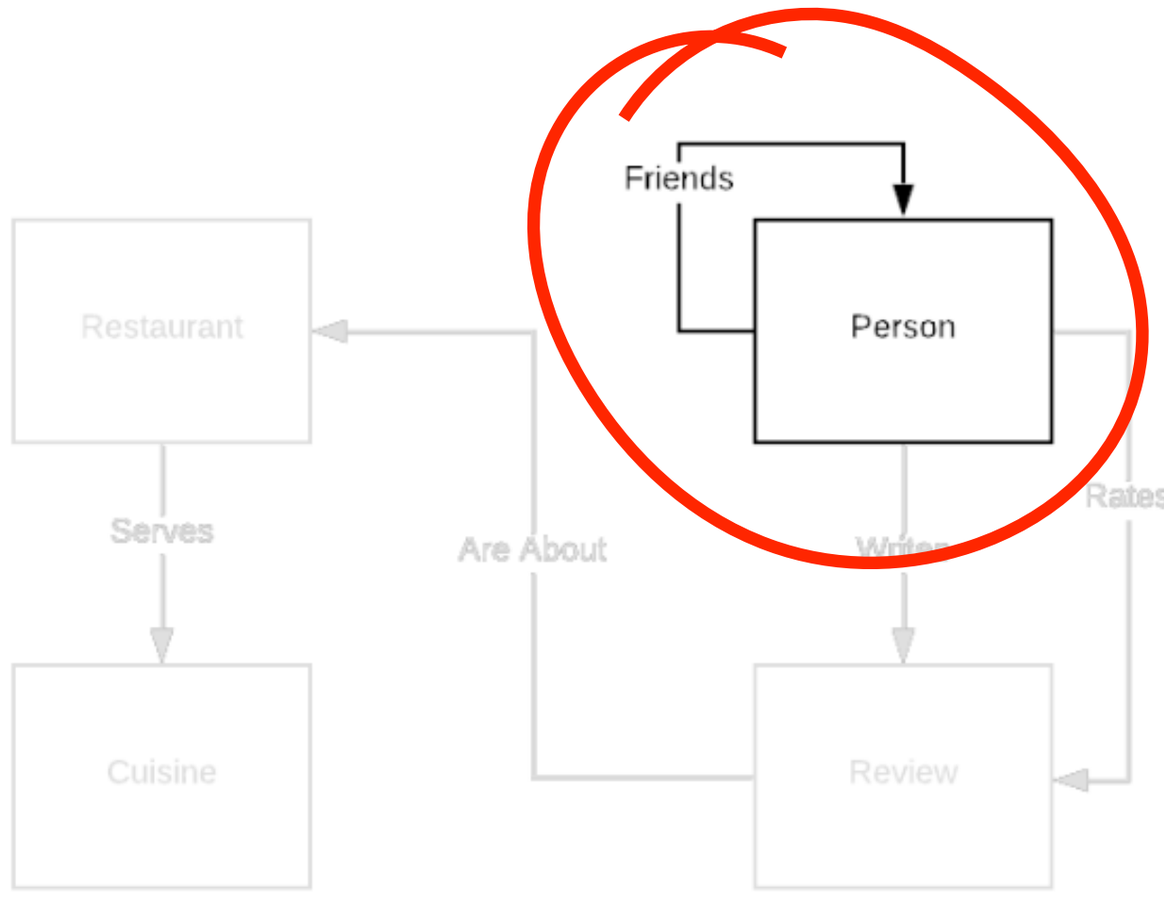

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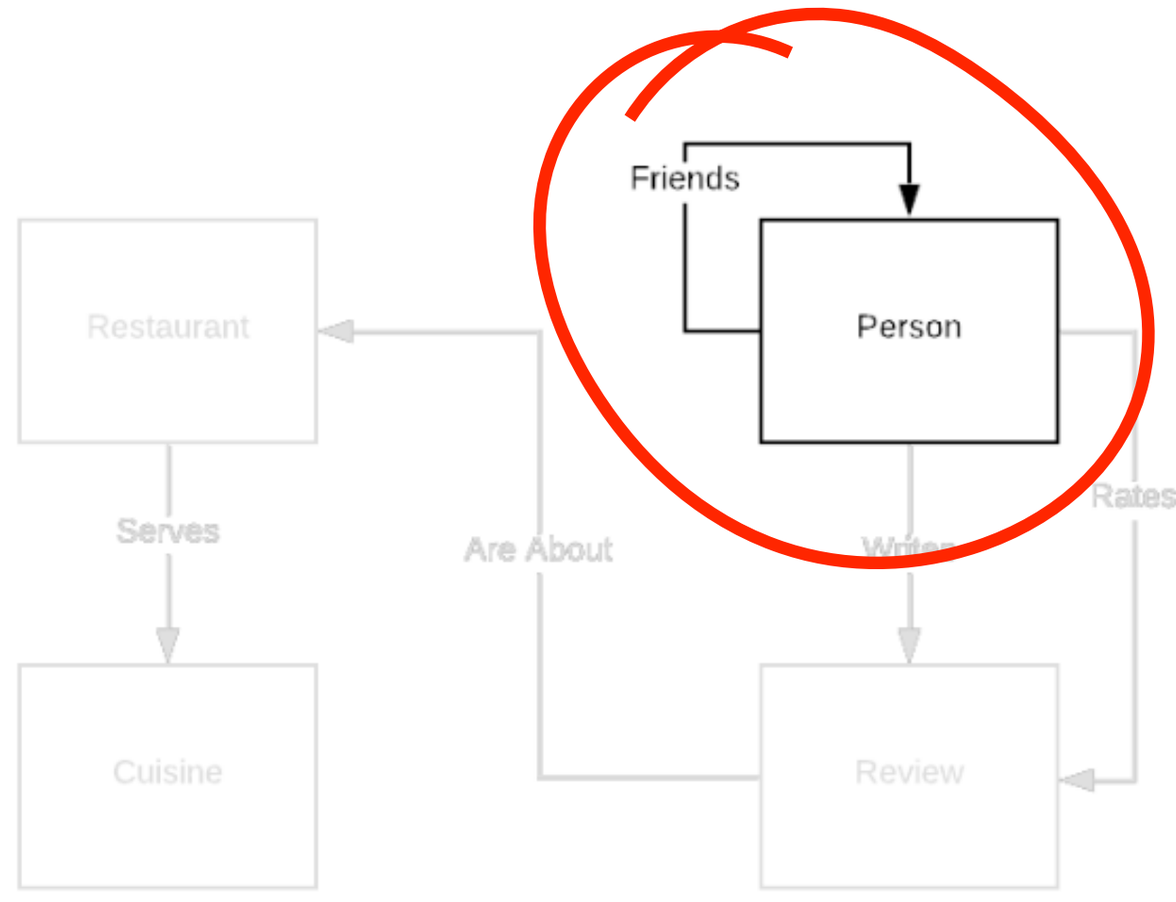

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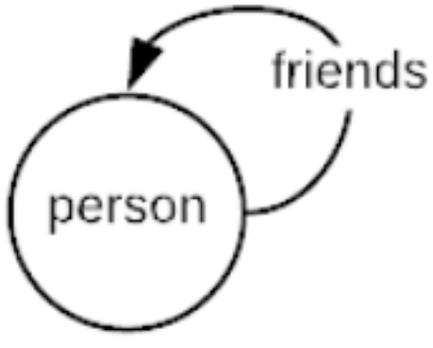
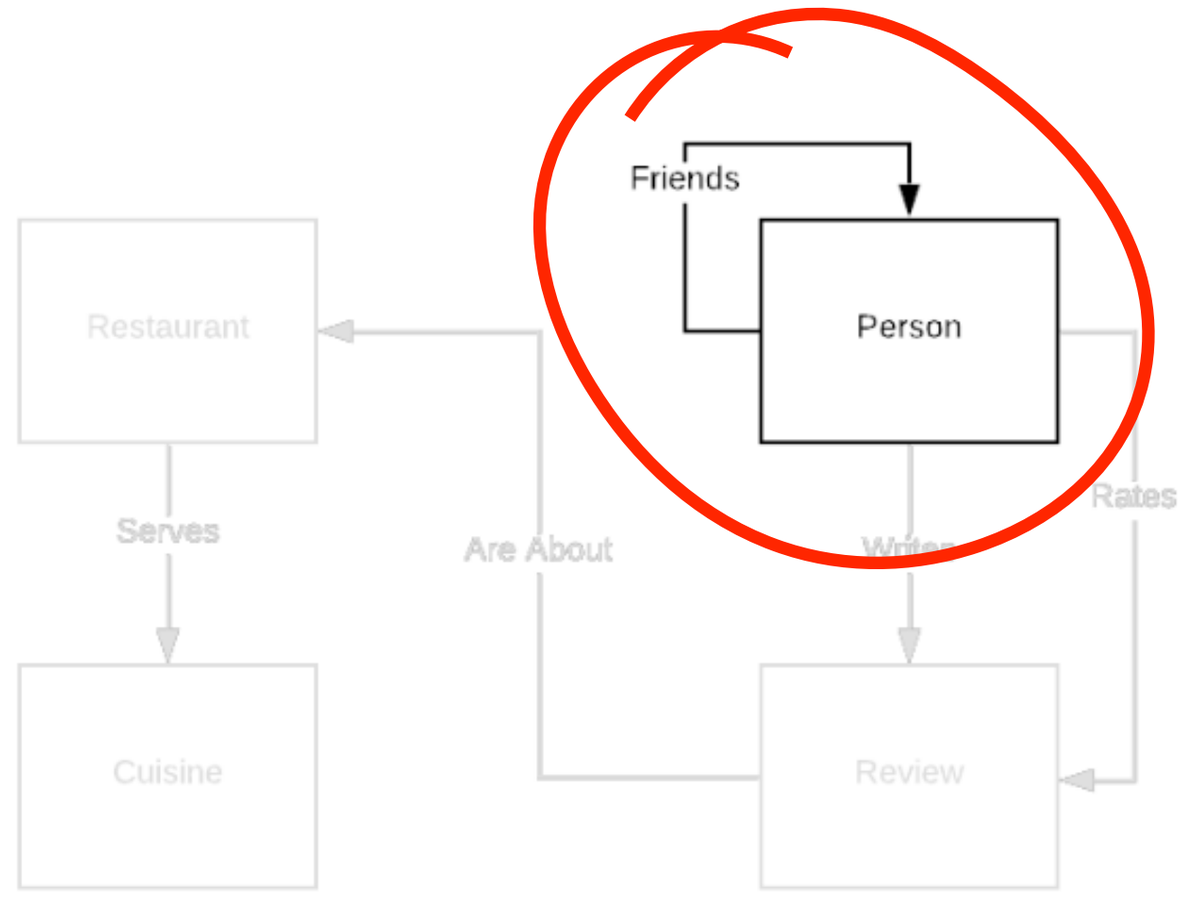
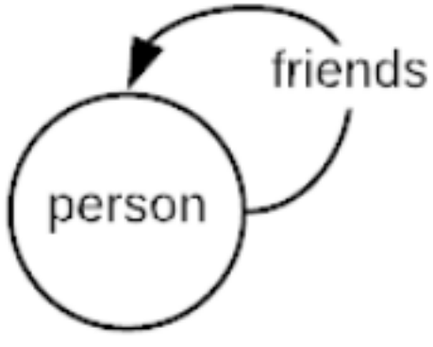


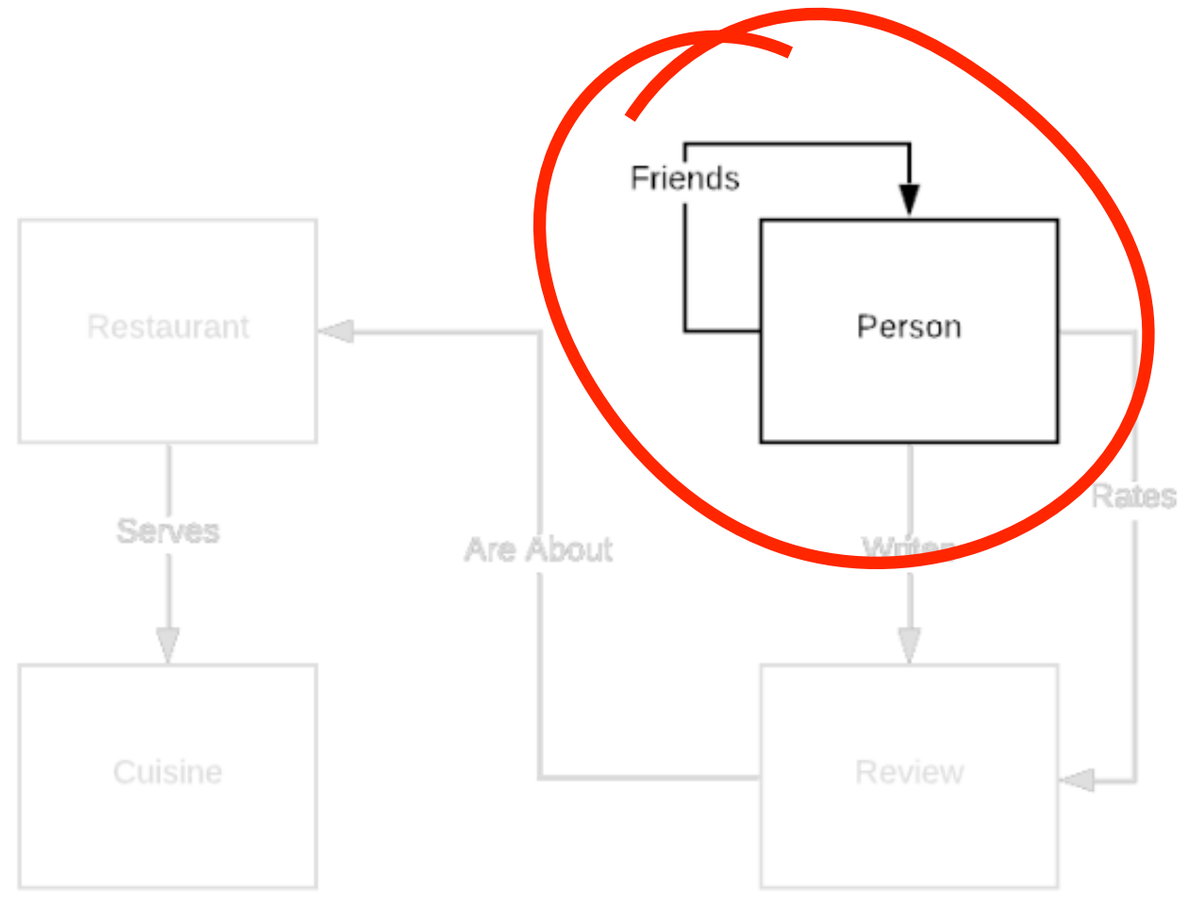


Step 3: Create a logical data model

TRANSLATE RELATIONSHIPS TO EDGES

- Finding the relationships
- Naming the edge labels
- Give the edge a direction
- Determine edge uniqueness





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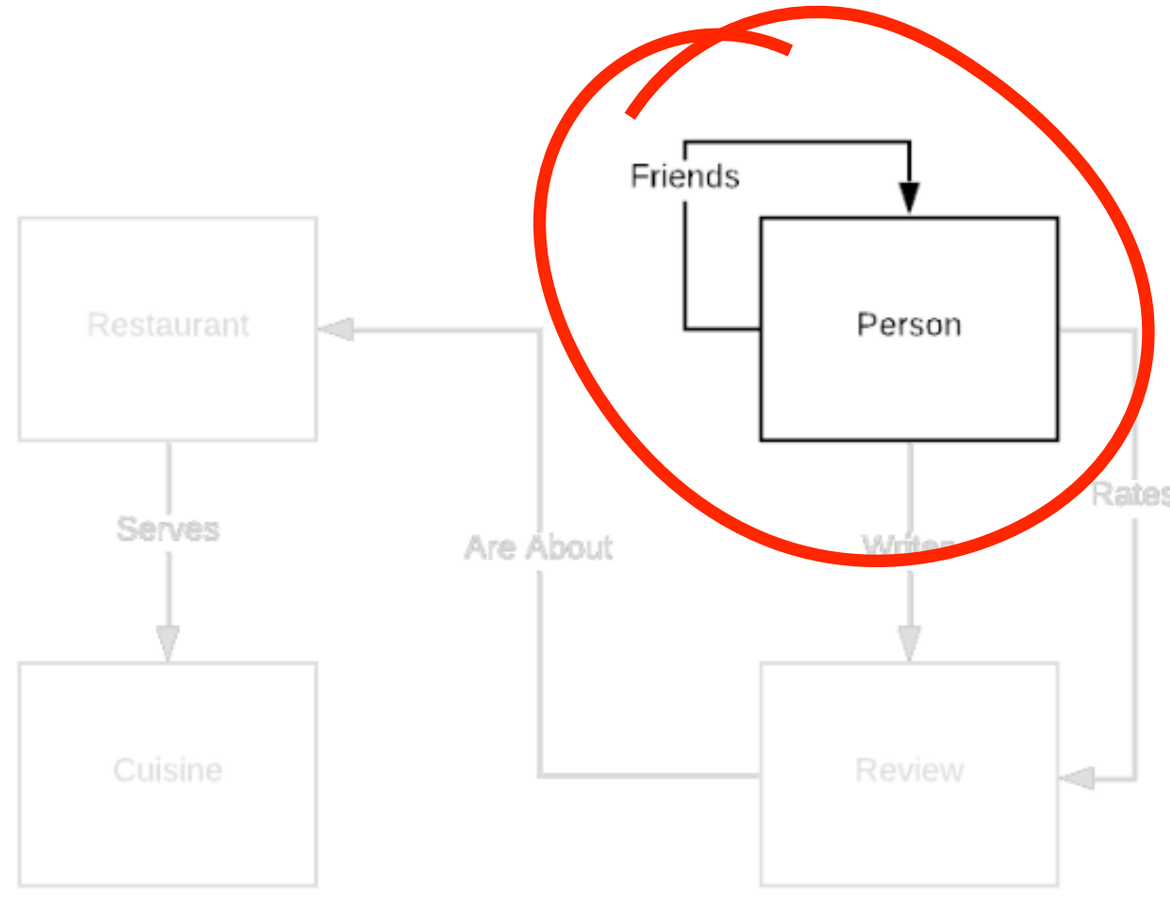
FIND AND ASSIGN PROPERTIES TO VERTICES AND EDGES



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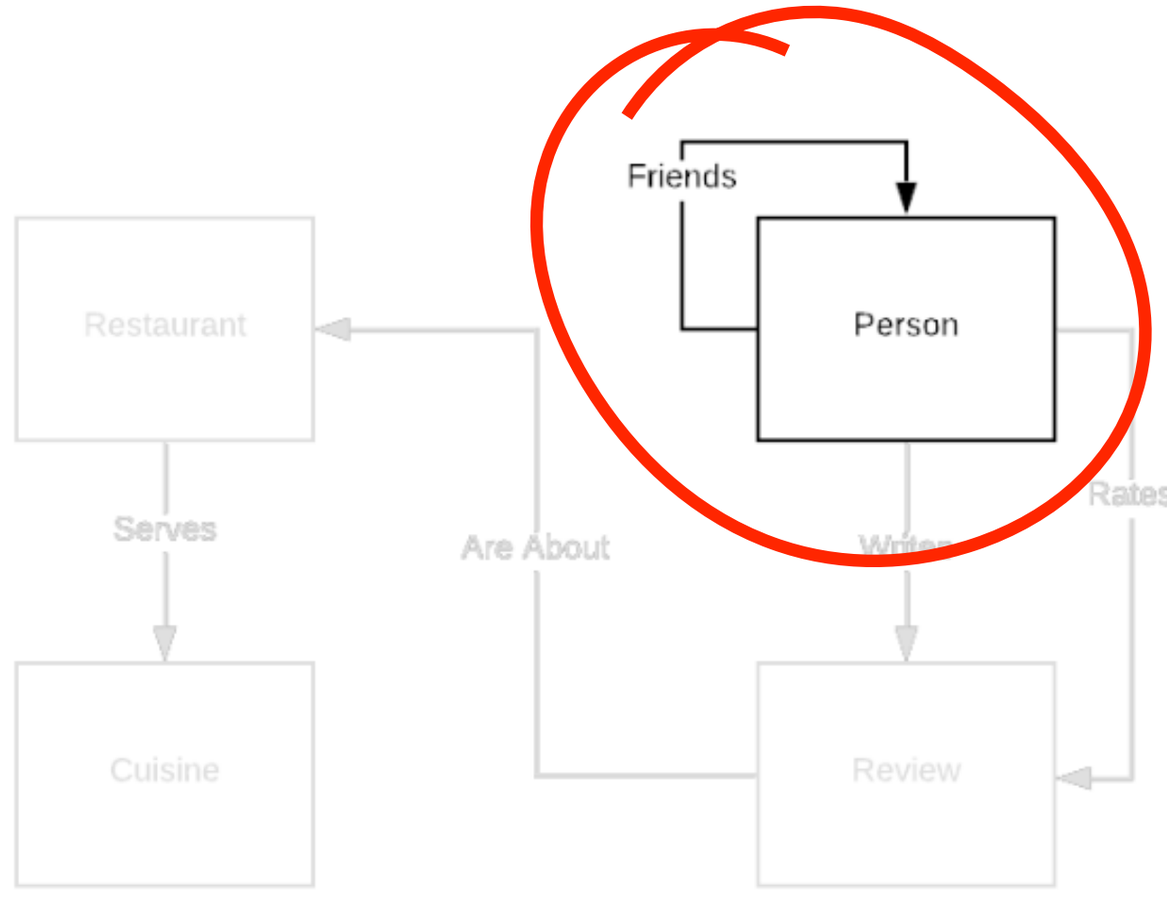
FIND AND ASSIGN PROPERTIES TO VERTICES AND EDGES

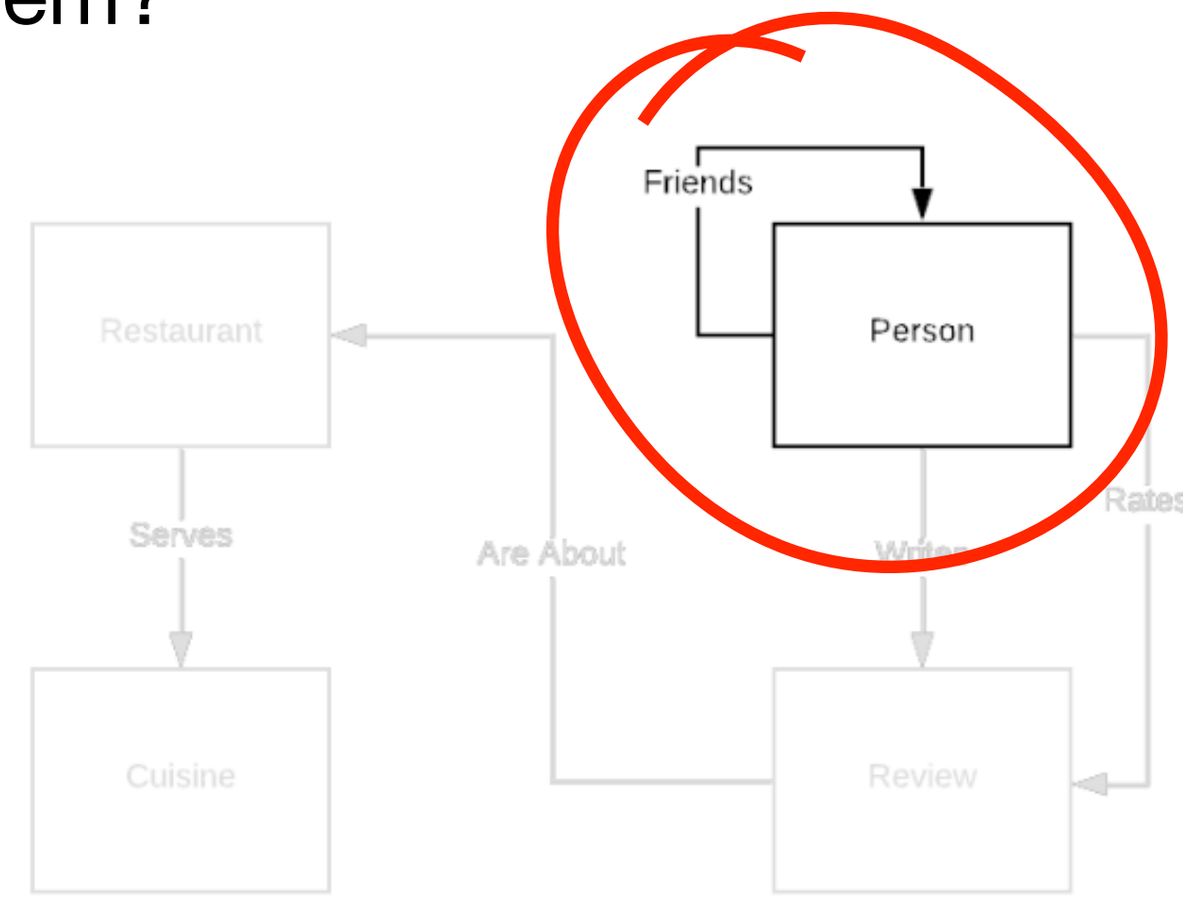
- What properties are required?



Step 3: Create a logical data model

FIND AND ASSIGN PROPERTIES TO VERTICES AND EDGES

- What properties are required?
- How we are going to name them?



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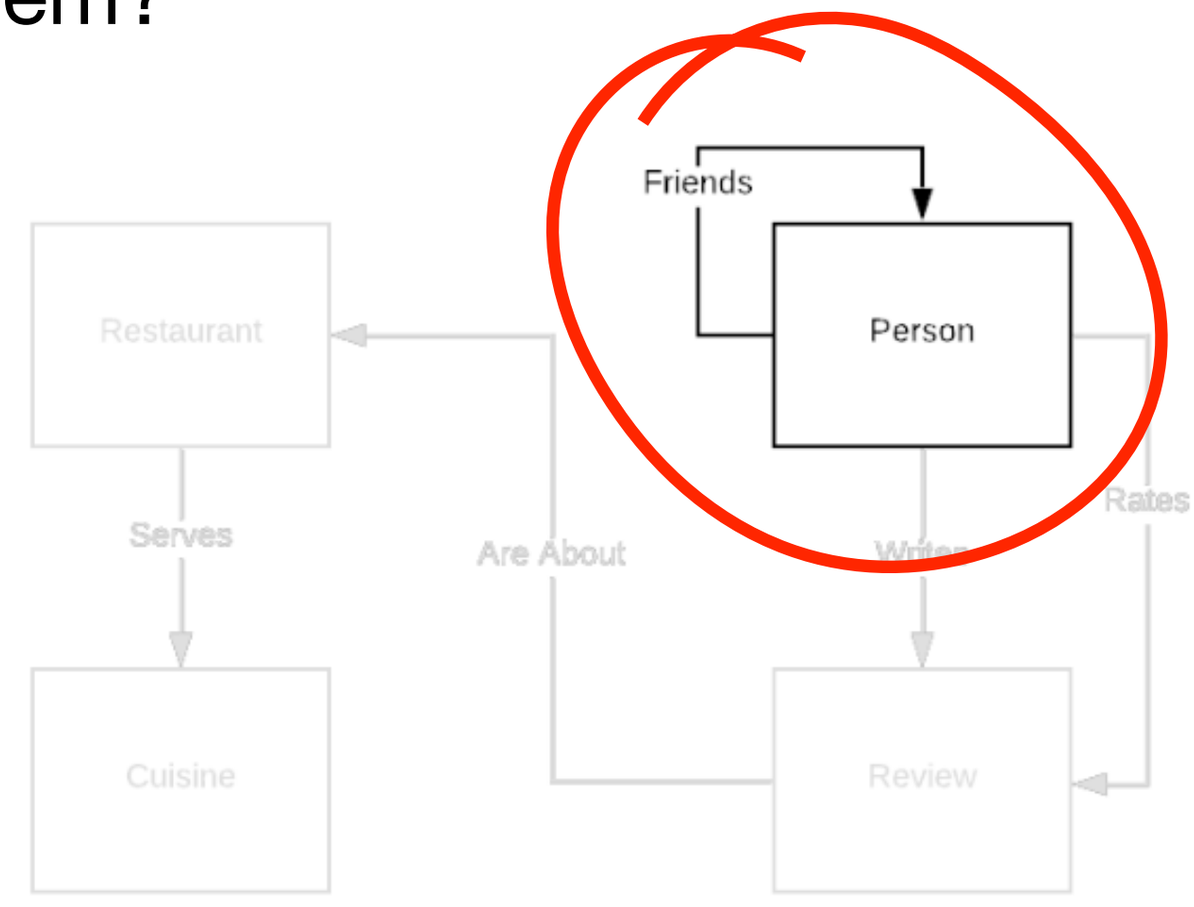
FIND AND ASSIGN PROPERTIES TO VERTICES AND EDGES

- What properties are required?
- How we are going to name them?
- What is their data type?



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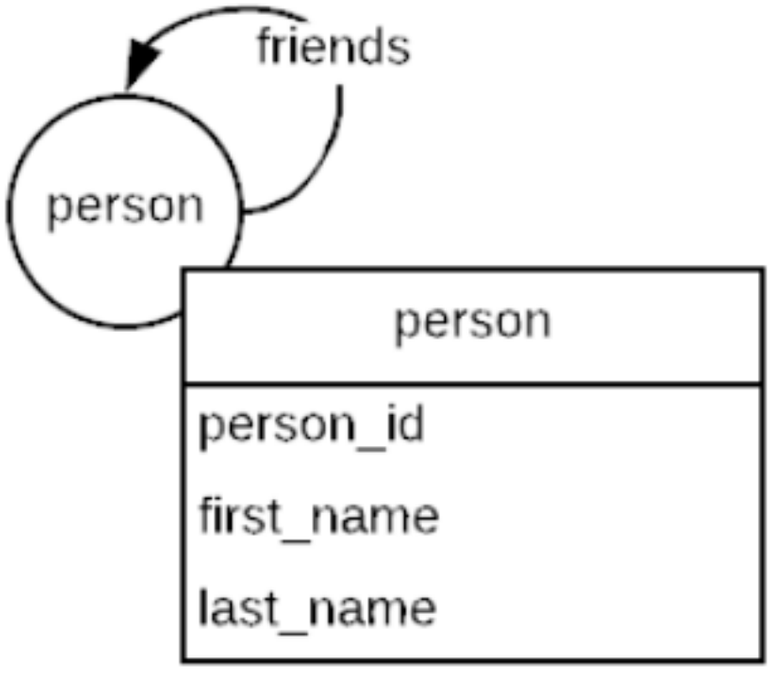
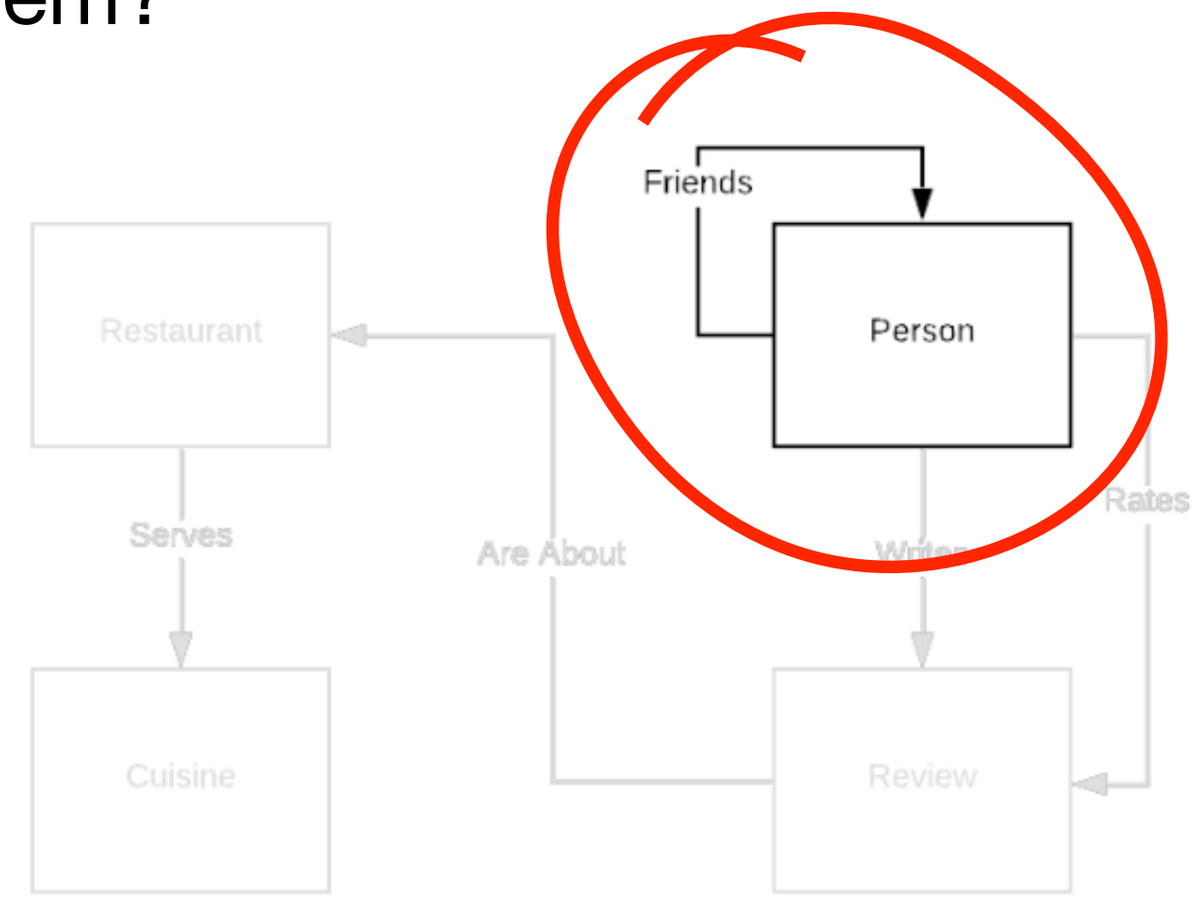
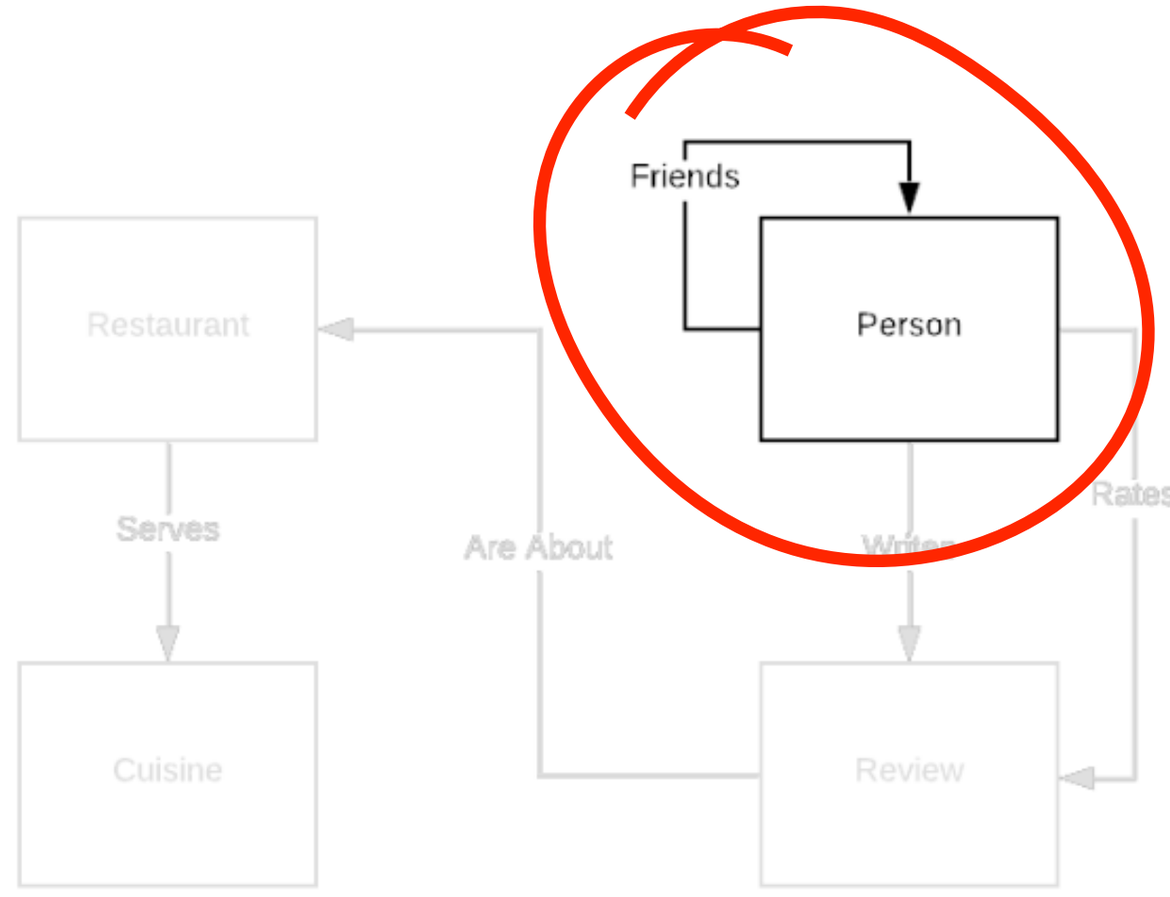




Step 4: Test the model

CAN WE ANSWER ALL OUR QUESTIONS?



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CAN WE ANSWER ALL OUR QUESTIONS?

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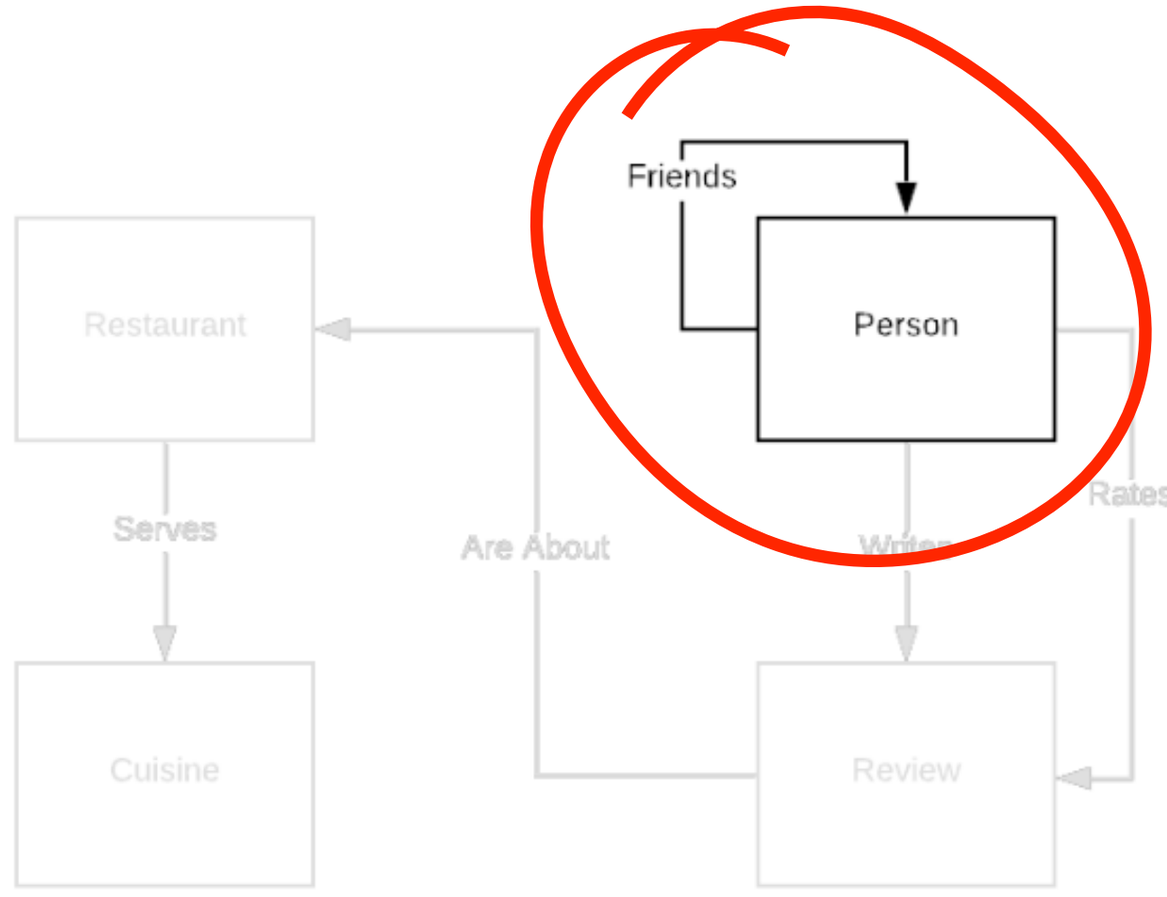
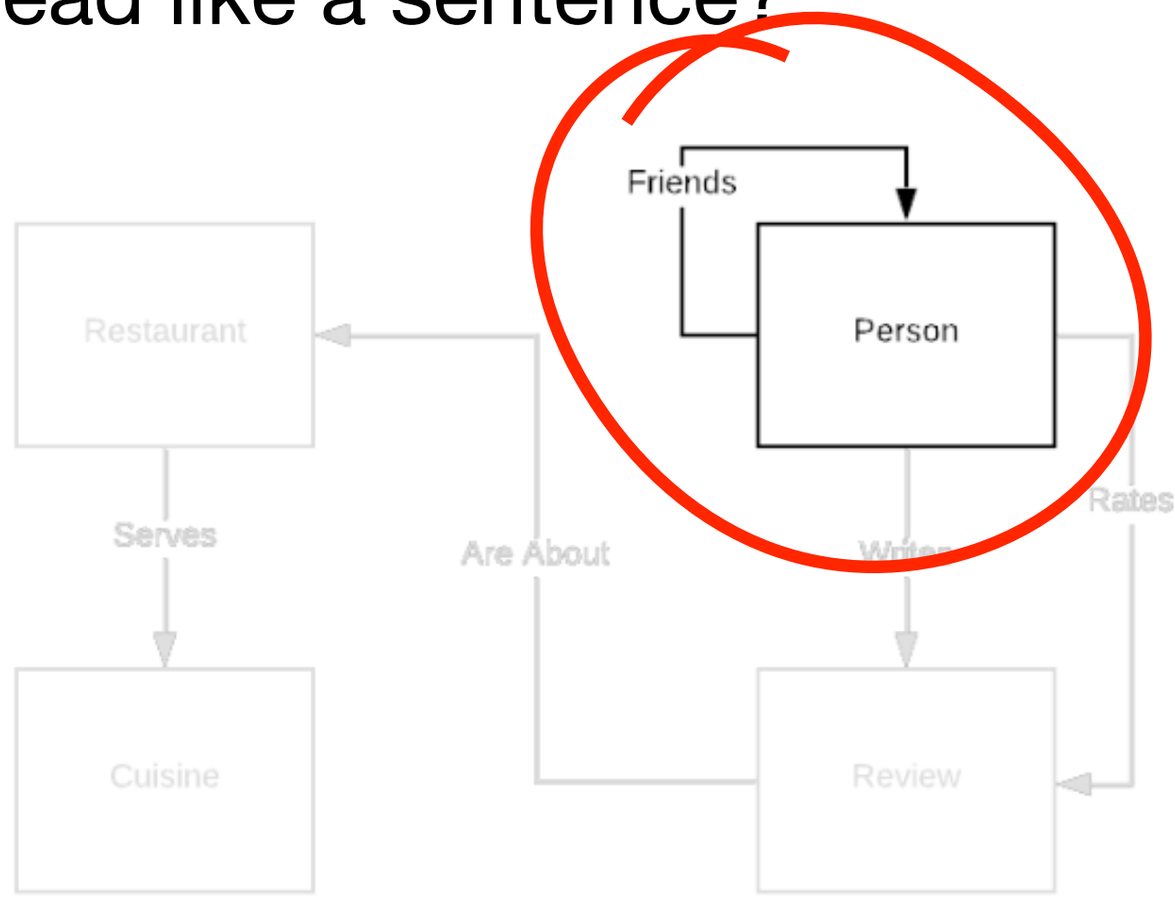


Step 4: Test the model

CAN WE ANSWER ALL OUR QUESTIONS?

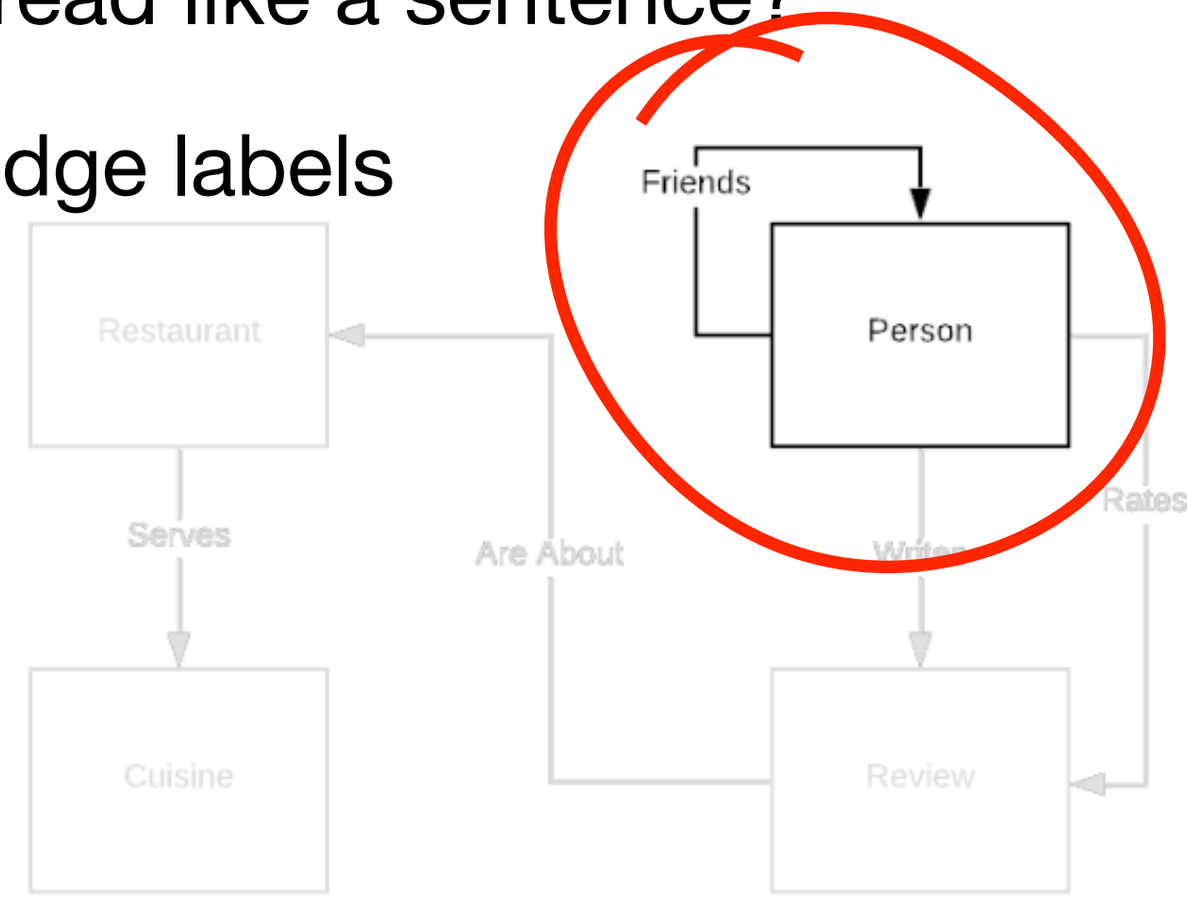
- Can we answer all our questions?
- Do the vertices and relations read like a sentence?



Step 4: Test the model

CAN WE ANSWER ALL OUR QUESTIONS?

- Can we answer all our questions?
- Do the vertices and relations read like a sentence?
- Do I have different vertex or edge labels with the same properties?



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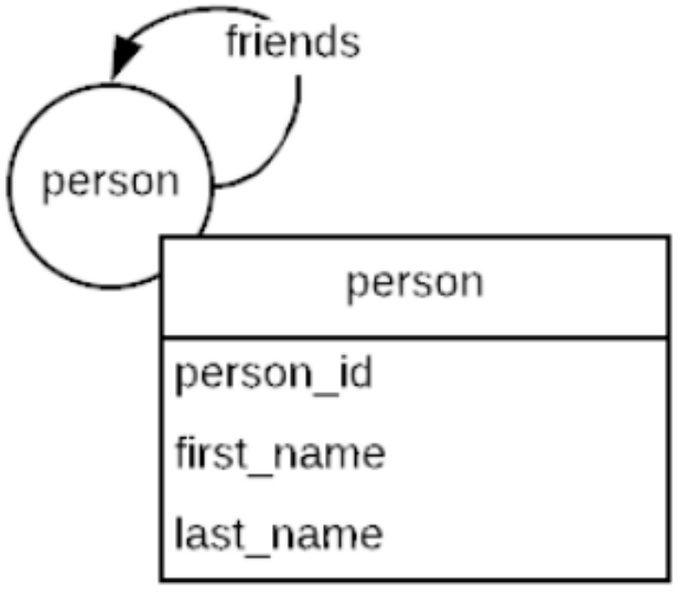

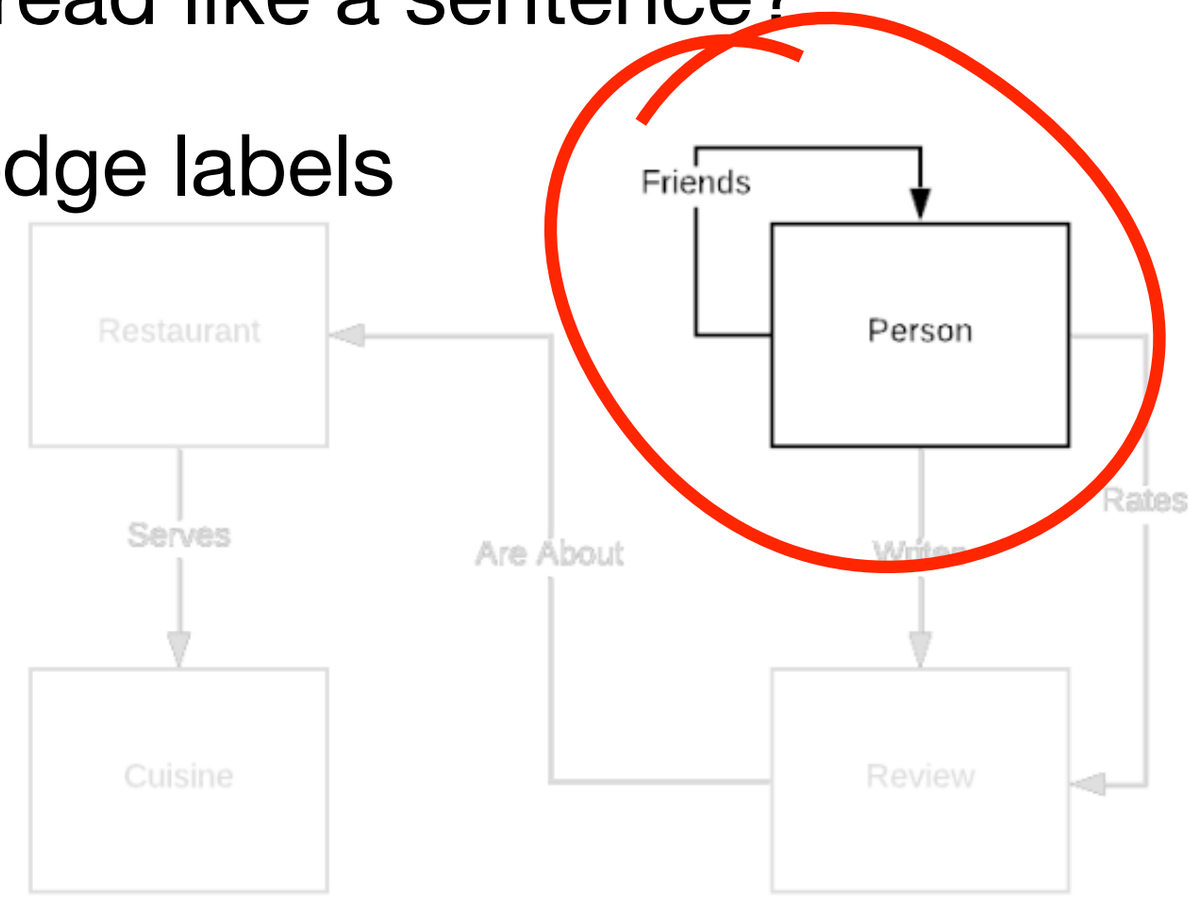

Bibliography

- [Bec] Dave Bechberger, Josh Perryman, *Graph Databases in Action*, Manning Publications, 2020