



Database Design

3-1 Identifying Relationships



Objectives

This lesson covers the following objectives:

- Interpret and describe relationship optionality
- Interpret and describe relationship cardinality
- Relate (connect or join) entities by applying the rules of cardinality and optionality

Purpose

- Being able to identify the relationships between entities makes it easier to understand the connections between different pieces of data.
- Relationships help you see how different parts of a system affect each other.
- For example, the entities STUDENT and COURSE are related to each other.
- To accurately model the business, the relationships between entities are as important as the entities themselves.

Relationships in Families

- A relationship is the way in which two or more people or things are connected.
- Family relationships categorize relationships between people, for example mother, father, aunt and cousin.
- The name of the relationship tells us how the family members are connected.



Relationships in Data Models

Relationships:

- Represent something of significance or importance to the business
- Show how entities are related to each other
- Exist only between entities (or one entity and itself)
- Are bi-directional
- Are named at both ends
- Have optionality
- Have cardinality

What is Optionality in a Relationship?

- Relationships are either mandatory or optional.
- Consider the two entities EMPLOYEE and JOB.
- Based on what you know about instances of the entities, you can determine optionality by answering two questions:
- Must every employee have a job?
 - In other words, is this a mandatory or optional relationship for an employee?
- Must every job be assigned to an employee?
 - In other words, is this a mandatory or optional relationship for a job?

What is Cardinality in a Relationship?

- Cardinality measures the quantity of something.
- In a relationship, it determines the degree to which one entity is related to another by answering the question, “How many?”
- For example:
 - How many jobs can one employee hold? One job only? Or more than one job?
 - How many employees can hold one specific job? One employee only? Or more than one employee?
 - Note: The cardinality of a relationship only answers whether the number is singular or plural; it does not answer with a specific plural number.

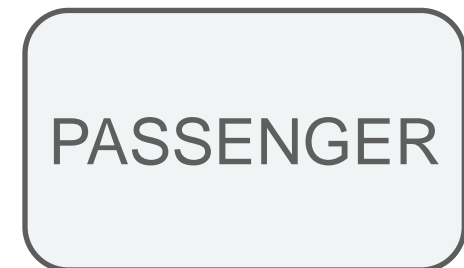
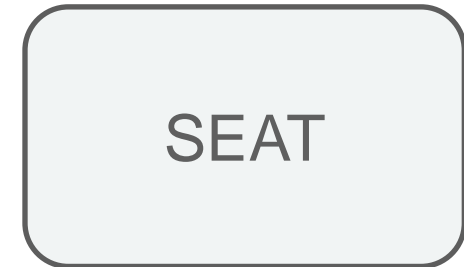
Optionality and Cardinality

Examples:

- Each EMPLOYEE must hold one and only one JOB
- Each JOB may be held by one or more EMPLOYEES
- Each PRODUCT must be classified by one and only one PRODUCT TYPE
- Each PRODUCT TYPE may classify one or more PRODUCTS

Relationships

- Each SEAT may be sold to one or more PASSENGERs
- Each PASSENGER may purchase one SEAT
- SEAT is sold to a PASSENGER (or PASSENGERs -- hence, overbooking)
- PASSENGER purchases or books a SEAT



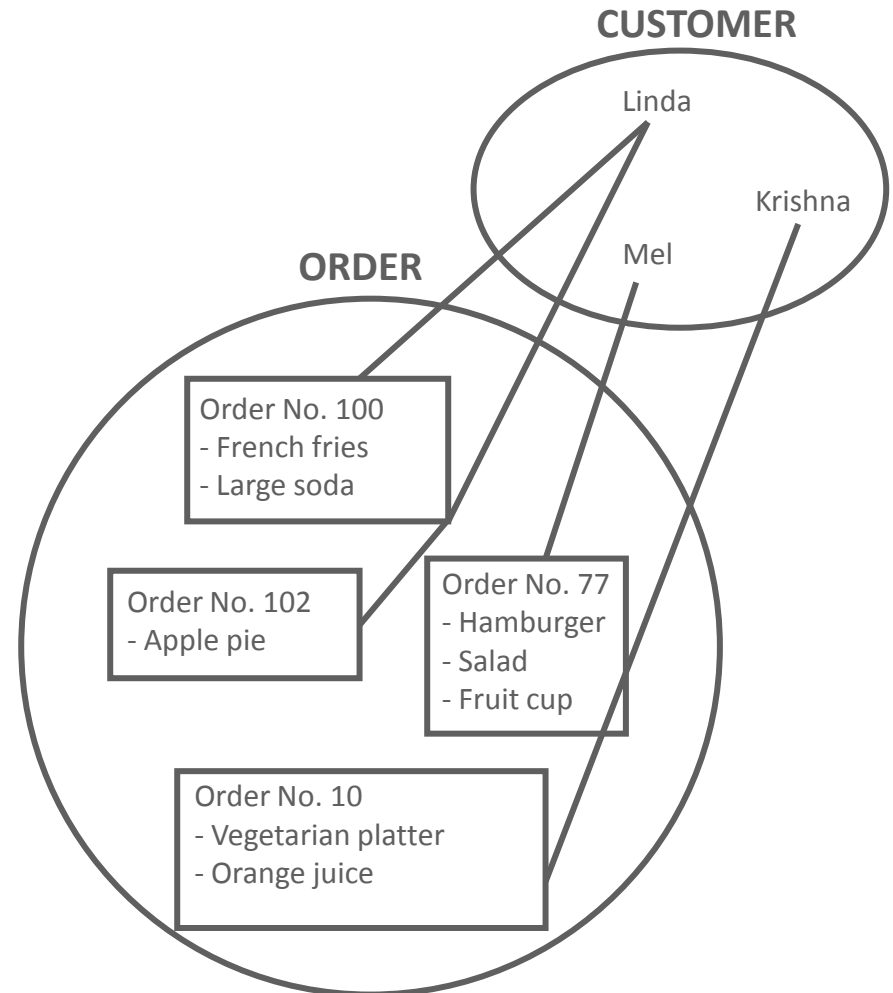
Business Scenario 1

What are the relationships in the following business scenario?

- “In our restaurant, a customer walks up to the counter and places their order. A customer can order for him or herself only, or for him/herself and others. For example, a mother orders for herself and her children.
- We consider the mother to be the customer who owns the order and is responsible for payment. Over a period of time, a customer can place as many orders as he wants.”

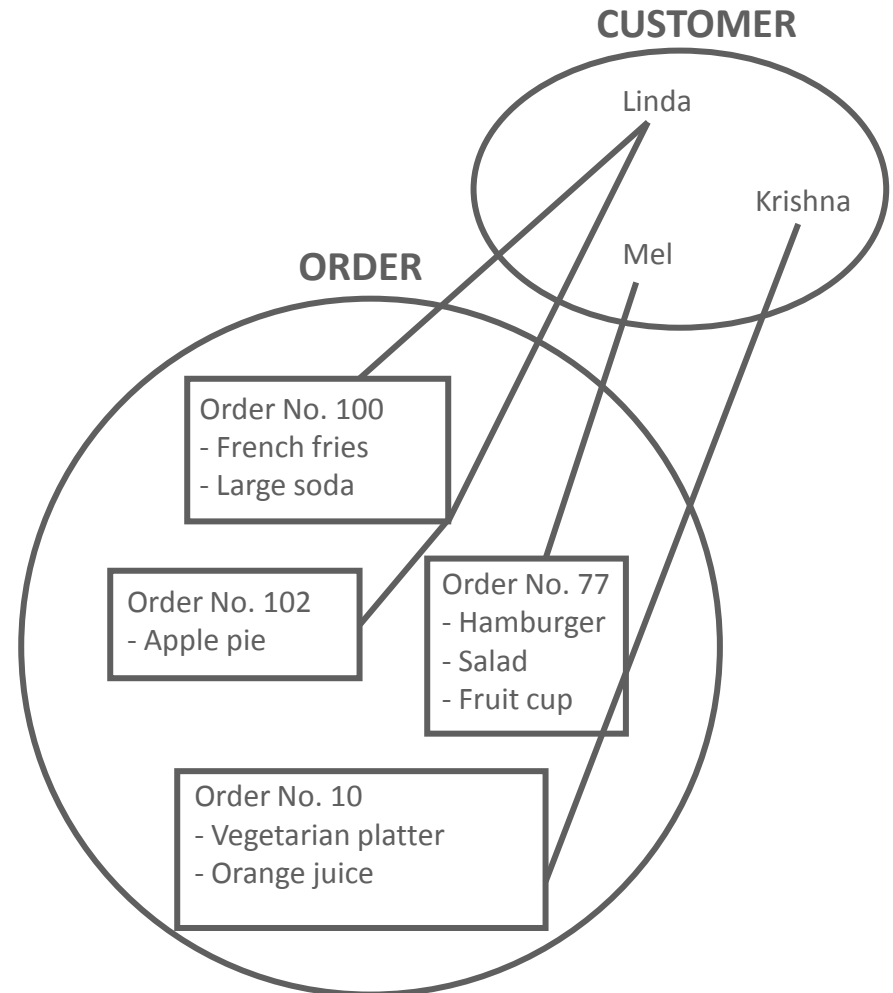
Business Scenario 1

- CUSTOMER places ORDERS: optionality and cardinality
- Optionality = **Must** or **may**?
- Each ORDER **must** be placed by one (and only one) CUSTOMER.
- Each CUSTOMER **must** place one or more ORDERS.



Business Scenario 1

- Cardinality = **How many?**
- Each ORDER must be placed by **one and only one** CUSTOMER.
- Each CUSTOMER must place **one or more** ORDERS.



Business Scenario 2

- A relationship can join one entity to itself.
- Examine the following scenario:
 - “We need to keep track of our employees and their managers. Every employee has one manager, including the managing director who manages him/herself. Each manager can manage several employees.”



Business Scenario 2

- Since managers are also employees, both are listed in the same entity: EMPLOYEE.

RELATIONSHIP

Each **EMPLOYEE** **may** be managed by **one and only one**
EMPLOYEE

Each **EMPLOYEE** **may** manage **one or more** **EMPLOYEEs**

Terminology

Key terms used in this lesson included:

- Cardinality
- Optionality
- Relationship

Summary

In this lesson, you should have learned how to:

- Interpret and describe relationship optionality
- Interpret and describe relationship cardinality
- Relate (connect or join) entities by applying the rules of cardinality and optionality

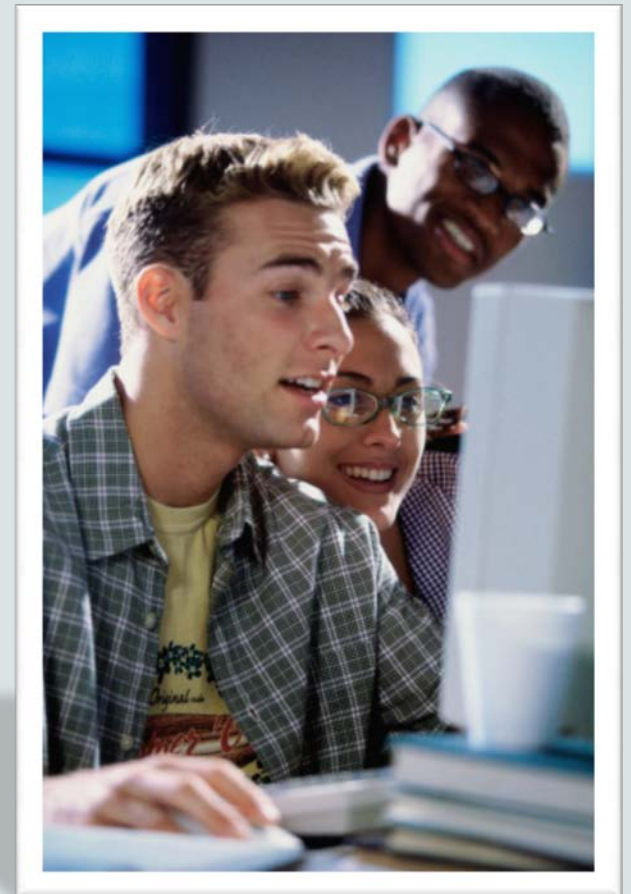




Database Design

3-2

ER Diagramming Conventions



Objectives

This lesson covers the following objectives:

- Construct ER diagram components that represent entities, attributes and relationships according to diagramming conventions

Purpose

- People speak different languages throughout the world, but some signs are understood globally.
- Guess the meaning of these signs.

International Signs



1



2



3



4



5



6



7

Purpose

- How well did you do?
- Did you guess the meaning of most signs?

International Signs



1



2



3



4



5



6



7

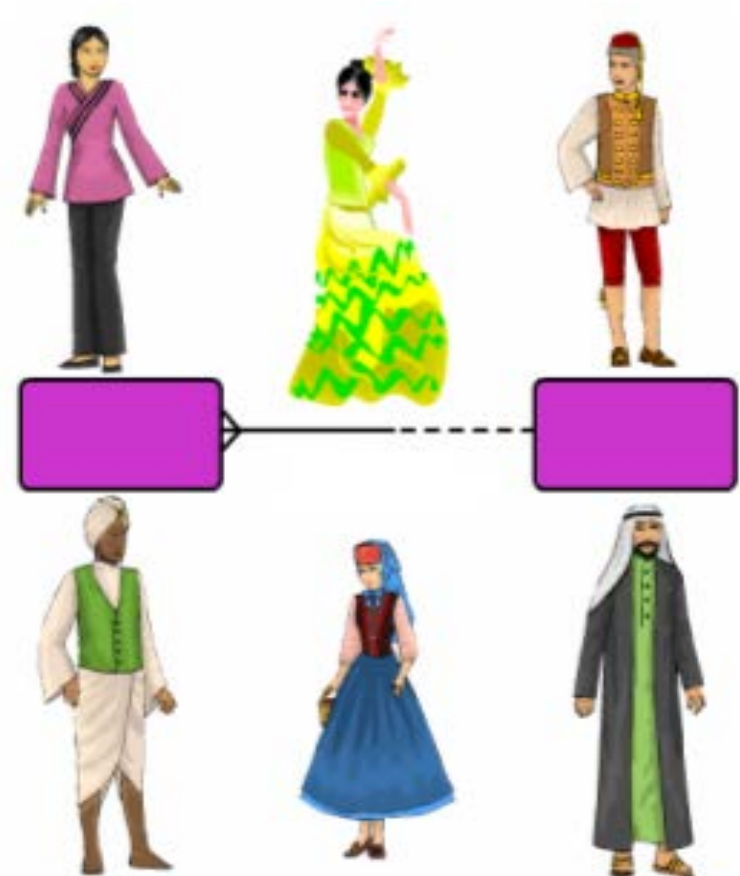
Key:

1. Crosswind
2. Roundabout
3. No entry for vehicles carrying more than a certain quantity of explosives or readily inflammable substances
4. Lane for slow vehicles
5. Stop in Brazil
6. Low clearance
7. Mr. Yuk

Shared Convention

- It is efficient to communicate information in a way that can be easily understood by many people.
- ER diagramming is like that -- you may say or write things differently because of the way you speak, your accent, and so on, but everyone draws ER diagrams according to the same conventions.

A Shared Convention

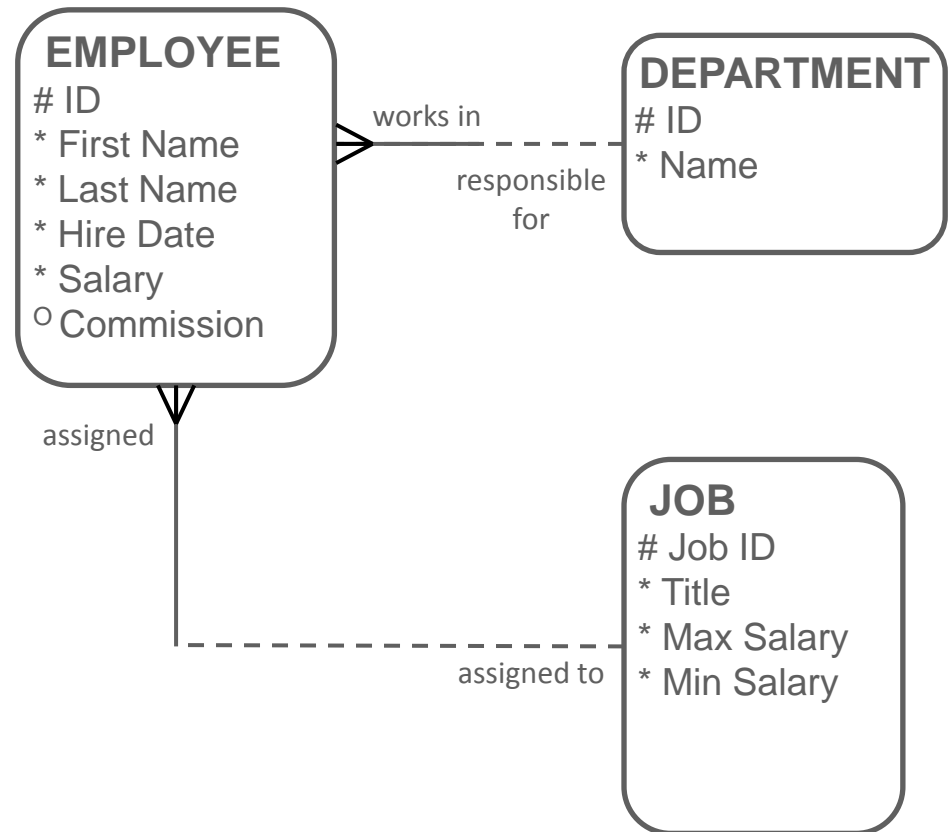


HR System: EMPLOYEEs, JOBs, and DEPARTMENTs

- “We need to store data about each of our company’s employees. We need to track each employee's first name, last name, hire date and salary. For each employee on commission, we also need to track his/her potential commission.”
- “Each employee is allocated a unique employee number.”
- “Our company is divided into departments. Each employee reports to a department - for example, accounting, sales, or development.”

HR System: EMPLOYEEs, JOBs, and DEPARTMENTs

- “We need to know the department responsible for each employee. Each department has a unique number.”
- “All employees hold a job, and we keep track of the job title, max and min salary for each job. Every job has a unique job id.”



ER Drawing Conventions

- Entities are represented by softboxes.
- Entity names go in the softboxes.
- Entity names are always singular and written with all capital letters.

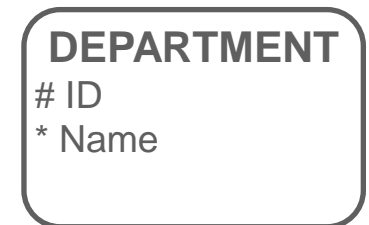
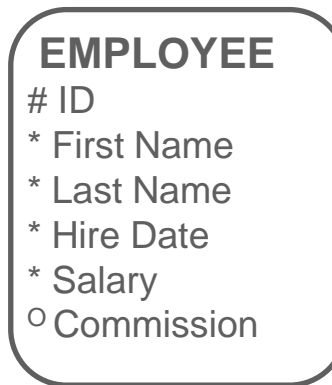
EMPLOYEE

JOB

DEPARTMENT

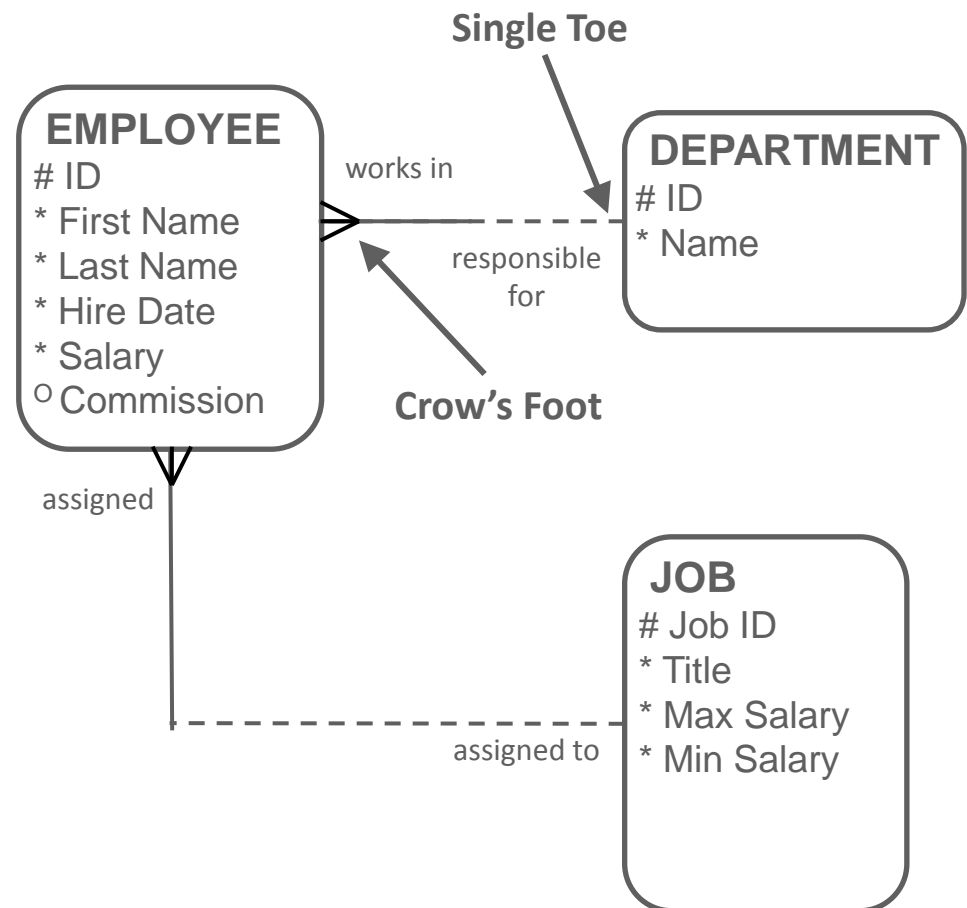
Drawing Conventions

- Attributes are listed under the entity names.
- Mandatory attributes are marked with an asterisk: “*”
- Optional attributes are marked with a circle: “o”
- Unique identifiers are marked with a hash sign: “#”



Drawing Conventions

- Relationships are lines that connect entities.
- These lines are either solid or dashed.
- These lines terminate in either a “single toe” or a “crow’s foot” at the end of each entity.
- You will learn the specific details about relationship lines in the next lesson.



Terminology

Key terms used in this lesson included:

- Softbox
- ER Diagramming
- Crow's Foot
- Single Toe

Summary

In this lesson, you should have learned how to:

- Construct ER diagram components that represent entities and attributes according to diagramming conventions





Database Design

3-3

Speaking ERDish & Drawing Relationships



Objectives

This lesson covers the following objectives:

- State relationships between entities in precise words (ERDish)
- Draw and label relationships correctly on an ERD

Purpose

- Most businesses use industry-specific terminology (words which have a special meaning within that business) in order to communicate information.
- Data modeling uses industry-specific terminology as well, which we will call ERDish for the purposes of this class.
- ERDish—the vocabulary used to clearly communicate the business rules that are captured on an ERD—will give you a common language both when collecting the business rules from your client and communicating them to the Database Administrators who will implement your design.

ERD Language

- ERDish is the language we use to state relationships between entities in an ERD.
- You have already been speaking and writing it, when you identified relationships and specified optionality and cardinality.
- We are simply breaking down each ERDish sentence into its components.

Breaking Down ERDish



The Components of ERDish

- EACH
- Entity A
- OPTIONALITY (must be/may be)
- RELATIONSHIP NAME
- CARDINALITY (one and only one/one or more)
- Entity B

The Components of ERDish

- Since each relationship has two sides, we read the first relationship from left to right (or top to bottom, depending on the ERD layout).

Breaking Down ERDish

1. EACH
2. Entity A
3. OPTIONALITY (must be/may be)
4. RELATIONSHIP NAME
5. CARDINALITY (one and only one/one or more)
6. Entity B



1. EACH
2. **EMPLOYEE** (entity A)
3. **MUST** (optionality, solid line)
4. **WORK IN** (relationship name)
5. **ONE (AND ONLY ONE)** (cardinality, single toe)
6. **DEPARTMENT** (entity B)

The Components of ERDish

- Now we read the relationship from right to left.

1. EACH
2. Entity B
3. OPTIONALITY (must be/may be)
4. RELATIONSHIP NAME
5. CARDINALITY (one and only one/one or more)
6. Entity A

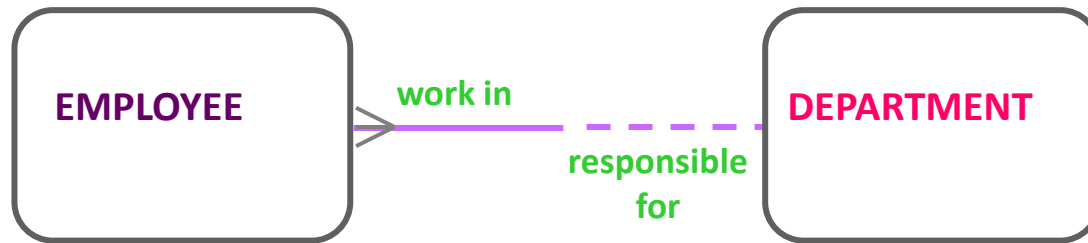
Breaking Down ERDish



1. EACH
2. **DEPARTMENT** (entity B)
3. **MAY BE** (optionality, dotted line)
4. **RESPONSIBLE FOR** (relationship name)
5. **ONE OR MORE** (cardinality, crow's foot)
6. **EMPLOYEE** (entity A)

The Components of ERDish

- Now bring it all together.



1. EACH
2. **EMPLOYEE** (entity A)
3. **MUST** (optionality, solid line)
4. **WORK IN** (relationship name)
5. **ONE AND ONLY ONE** (cardinality, single toe)
6. **DEPARTMENT** (entity B)

1. EACH
2. **DEPARTMENT** (entity B)
3. **MAY BE** (optionality, dotted line)
4. **RESPONSIBLE FOR** (relationship name)
5. **ONE OR MORE** (cardinality, crow's foot)
6. **EMPLOYEE** (entity B)

Terminology

Key terms used in this lesson included:

- ERDish

Summary

In this lesson, you should have learned how to:

- State relationships between entities in precise words (ERDish)
- Draw and label relationships correctly on an ERD

