Entity Relationship Diagrams ERDs

Lecture 08

DBS201

What is an ERD?

- This conceptual data model represents the data used in an organization and the relationships between the data
- It is a graphical representation of the proposed database

Why ERDs?

- Documentation used to represent the database in an abstract way
- The data model can be reviewed by the end user and the person responsible for the physical database design
- Useful tool for the person creating the data model.

Entities and Events

- Entities - People, places, things or concepts about which information must be recorded
- Entities as Events – Placing an order or approving a loan
- Attributes for entities, events and relationships would be things like customer names or dates on which orders were placed
- Attribute – one single valued fact about an entity that we may want to record

E (Relationship)Ds

- Relationships are found between entities
- An employee is in a department
- A department has many employees
- Business rules must be taken into account
- Every employee must be in a single department

E (Relationship)Ds

- Relationships are found between entities and events
- A customer (entity) places an order (event)
- A loan officer (entity) approves a loan (event)
- Business rules must be taken into account
- Loan example - a rule that the borrower must have an adjusted gross income of at least half of his or her outstanding debt may be enforced

An ERD should…

- capture all required information
- make sure data appears only once in the database design
- not include in the data model any data that is derived from other data that is already in the data model
- arrange data in the data model in a logical manner

Equivalent Terms:

Relational Model	Table-Oriented DBMS	Conventional File Systems	Conceptionally Represents
Relation	Table	File	Entity Type
Tuple	Row	Record	Entity Instance
Attribute	Column	Field	Property
Domain	Column Type	Data Type	Allowable Values
Element	Column Value	Field Value	Property Value

Customer

- Customer Relation
- Customer Table
- Customer File
- Customer Entity

Last Name

- Last name attribute in Customer Relation
- Last name column in Customer Table
- Last name field in Customer File
- Last name property of Customer Entity

Phone Number

- Customer Relation phone number domain is numeric or character
- Customer Table phone number column type is numeric or character
- Customer File phone number data type is numeric or character
- Customer Entity phone number allowable values are numeric or character

Phone Number is 4164915050

- Customer Relation phone number ***element*** is 4164915050 or (416) 491-5050
- Customer Table phone number ***column value*** is 4164915050 or (416) 491-5050
- Customer Table phone number ***field value*** is 4164915050 or (416) 491-5050
- Customer Table phone number ***property value*** is 4164915050 or (416) 491-5050
- A numeric field can use an edit code to get the special characters included "() – "

Last Name, First Name, Phone

- Smith, Bill, 9056668888 as a tuple in the Customer Relation
- Smith, Bill, 9056668888 as a row in the Customer Table
- Smith, Bill, 9056668888 as a record in the Customer File
- Smith, Bill, 9056668888 as an entity instance of the Customer Entity

Steps in Designing an ERD

- Create Entities by identifying the people, places or events about which the end user wants to store data

- Define Attributes by determining the attributes that are essential to the system under development. For each attribute, match it with exactly one entity that it describes

Steps in Designing an ERD

- **Select Unique Identifier** Identify the data attribute(s) that uniquely identify one and only one occurrence of each entity. Eliminate many to many relationships, and include a unique identifier (UID) and foreign keys in each entity

- **Define Relationships** Find the natural associations between pairs of entities using a relationship matrix. Arrange entities in rectangles and join those entities with a line

Steps in Designing an ERD

- **Determine Optionality and Cardinality** Determine the number of occurrences of one entity for a single occurrence of the related entity.

- **Name Relationships** Name each relationship between entities

- **Eliminate Many-to-Many Relationships** Many-to-many relationships cannot be implemented into database tables because each row will need an indefinite number of attributes to maintain the many-to-many relationship. Many-to-many relationships must be converted to one-to-many relationships using associative entities

- **Determine Data Types** Identify the data types and sizes of each attribute

Case Study

- Each employee may be assigned to one and only one department. Some employees may not be assigned to any department. The employee data is stored in the employee entity.

- Each department could have many employees assigned to it. Some departments may not have any employees assigned to them. The department data is stored in the department entity.

- Each employee may have one and only one job title. Under certain circumstances, some employees may not be assigned a job title.

Case Study

- Each job title may be assigned to many employees. Some job titles may not be assigned to any employees. The job data is stored in the job entity.

- Each employee may be assigned to many projects. Sometimes an employee may be off work and is not assigned to any projects.

- Each project must be assigned to at least one employee. Some projects may have several employees assigned to them. The project data is stored in the project entity

Case Study

- Entities:
  - Employee
  - Department
  - Job
  - Project

Identify Attributes

- Employee's Attributes:
  - employee_id, first_name, last_name, soc_ins_no, hire_date
- **Volatile** attributes: their values constantly change.
  - age (instead, you can use the date of birth)
- **Required** and **Optional** Attributes
- **Time dependant** attributes
- **Domains**

Select Unique Identifier (UID)

- Every entity must have unique identifying attribute(s) called a unique identifier

- This is a single attribute or a collection of attributes that uniquely identifies one and only one instance of an entity.

- When two or more attributes are used as the unique identifier it is called a **concatenated key.**

Candidate Key

- Sometimes there are several attributes that could be the unique identifier

- For an EMPLOYEE entity we could use
  - *employee_id*
  - *social_ins_no*
  - *email_address*
  - *telephone_no*

- These are all called **candidate keys**

Candidate Keys Must:

- Be unique for each instance within an entity
- Never be missing, incomplete or NULL for an instance
- Use no attributes other than those necessary to uniquely identify an instance of an entity

Unique Identifier

- Should be meaningless other than as an identifier
- Should never change
- Should not have a limited number of values available
- Only one (UID) should be specified for each table

EMPLOYEE EXAMPLE

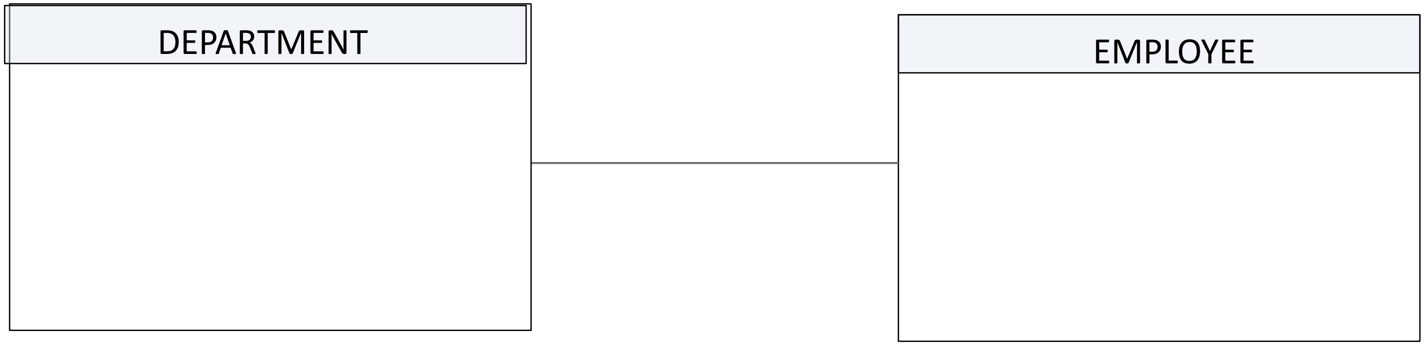
- Soc_ins_no is not meaningless
  - Do you want people knowing your personal number in the company?

- A telephone number may change

- The best choice is an arbitrarily generated employee number assigned when the employee is hired

Determining relationships

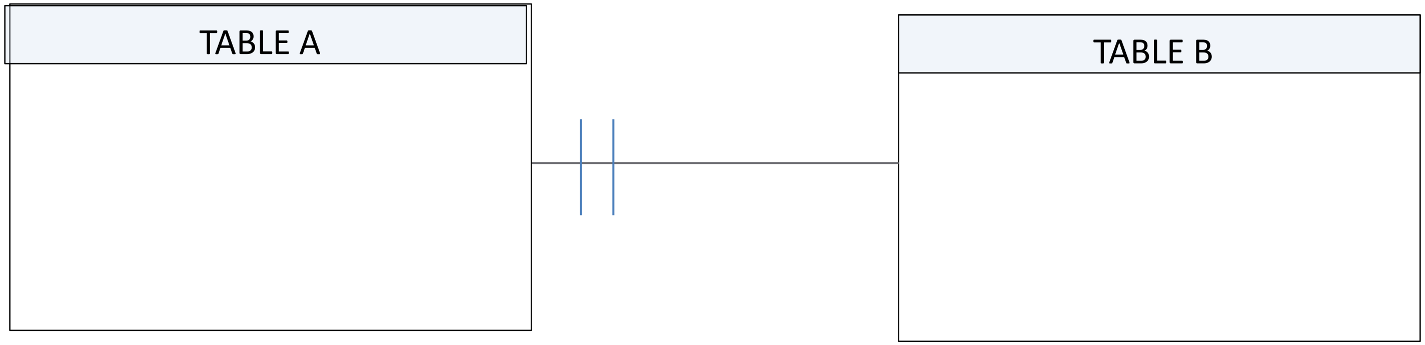
A relationship is like a verb that shows some dependency or natural association between two entities



A department contains employees
An employee is assigned to a department

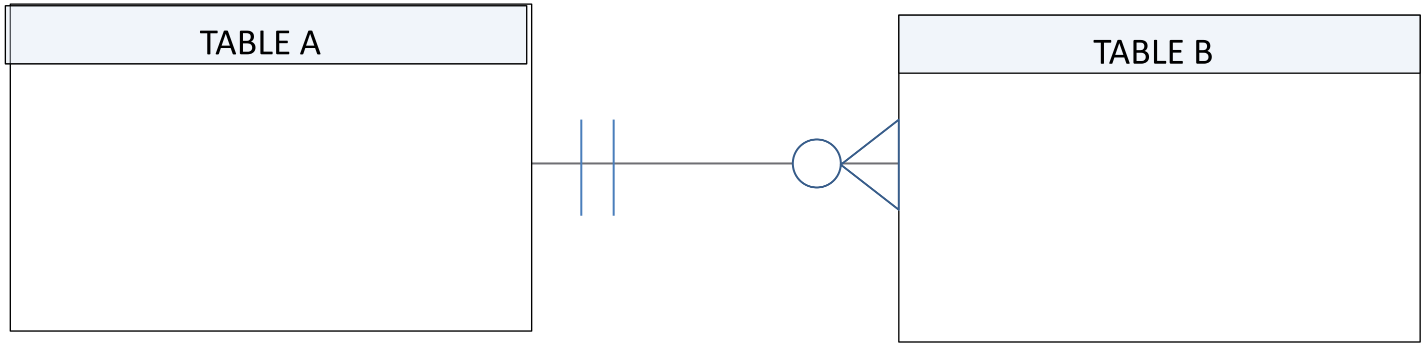
Determining optionality and cardinality

Each instance of Table B is related to a maximum of one and a minimum of one instance of Table A

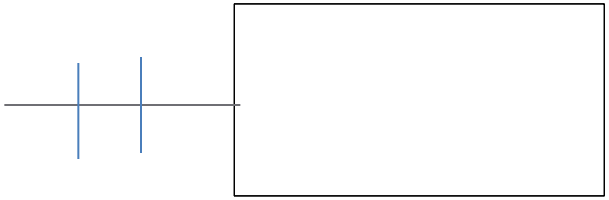


Optionality and Cardinality

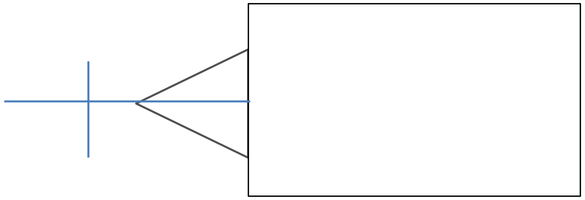
- Each instance of Table A is related to zero, one or more instances of Table B



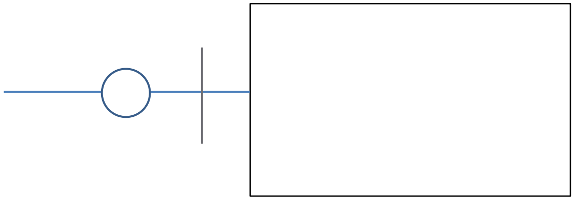
Optionality and Cardinality



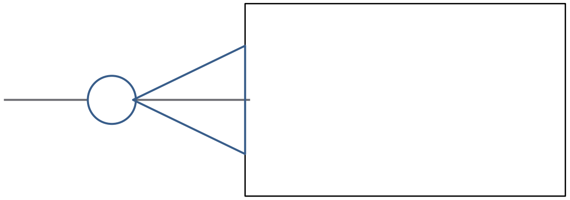
One and only one



One or more



Zero or one



Zero or many

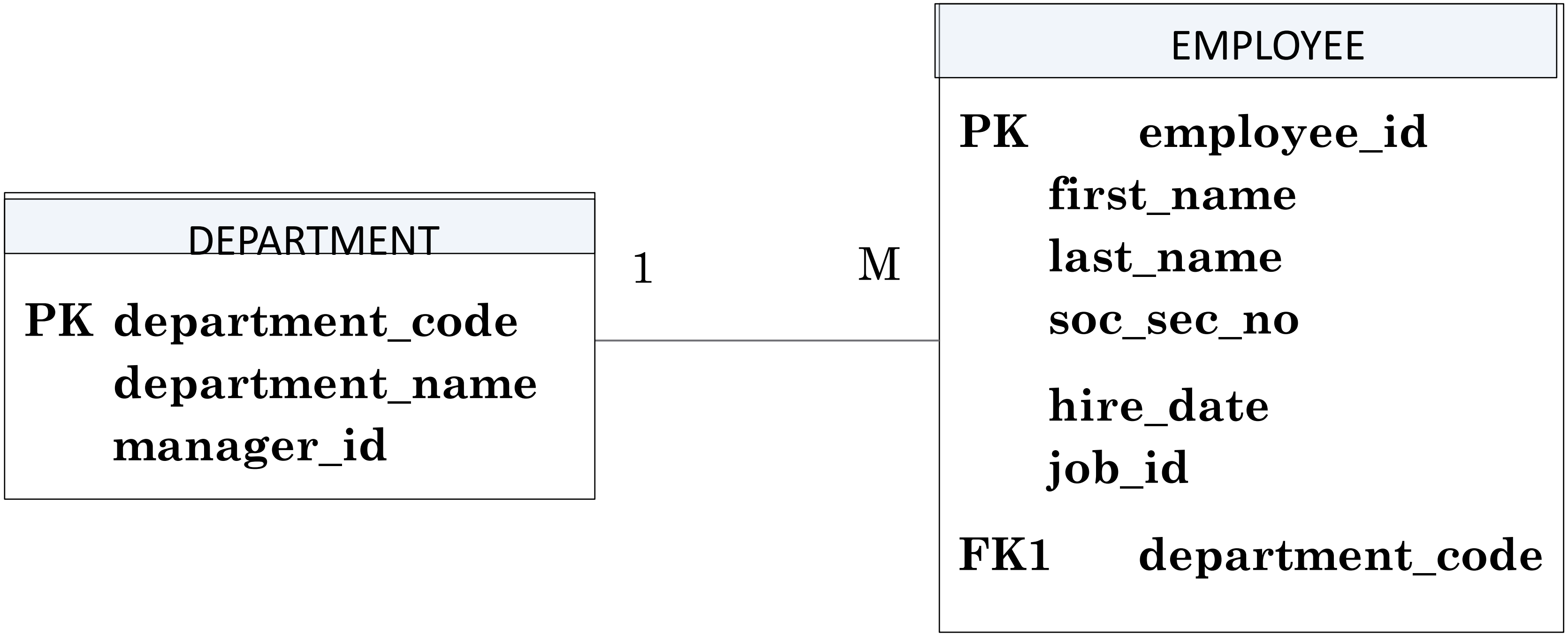
Cardinality Notations

- Different notations are used to represent the cardinality of relationships

  - 1:1
  - 1:M
  - M:N

1:M

- No information on optionality is given with this 1:M example



DEPARTMENT

PK department_code
department_name
manager_id

1

M

EMPLOYEE

PK employee_id
first_name
last_name
soc_sec_no
hire_date
job_id
FK1 department_code

Summary

- Entity or Event
- Relationship
- Optionality
- Cardinality
- Attributes
- UID
- ERD Diagrams