Designing E-R Model

CIS430/530 Database Systems

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Identifying Cardinality of a Relationship Between Two Entities

Alternative Notations
for ER Diagrams

- Specify structural constraints on Relationships

  - Replaces Cardinality ratio (1:1, 1:N, M:N) and single/double line notation for Participation constraints

  - Associate a pair of integer numbers (min, max) with each participation of an entity type E in a relationship type R, where $0 \leq min \leq max$ and $max \geq 1$
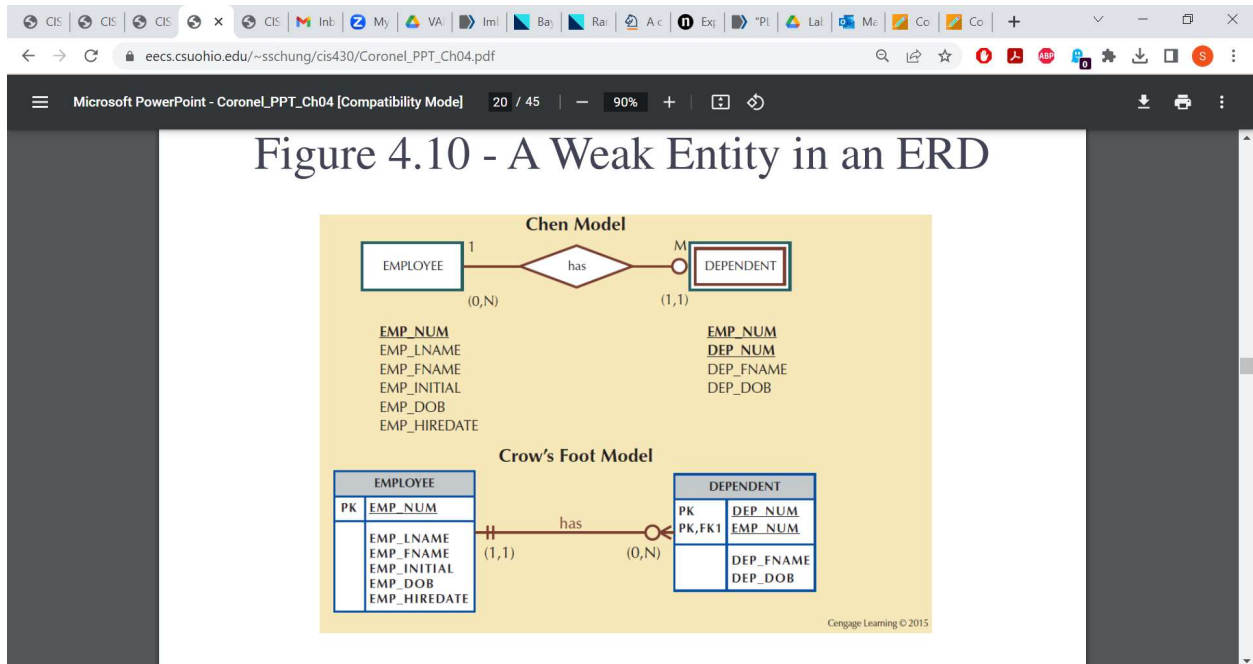
Figure 4.10 - A Weak Entity in an ERD

Chen Model

EMPLOYEE — 1 — has — M — DEPENDENT

(0,N)   (1,1)

EMP_NUM
EMP_LNAME
EMP_FNAME
EMP_INITIAL
EMP_DOB
EMP_HIREDATE

EMP_NUM
DEP_NUM
DEP_FNAME
DEP_DOB

Crow's Foot Model

EMPLOYEE	
PK	EMP_NUM
	EMP_LNAME
	EMP_FNAME
	EMP_INITIAL
	EMP_DOB
	EMP_HIREDATE

has

(1,1)   (0,N)

DEPENDENT	
PK	DEP_NUM
PK,FK1	EMP_NUM
	DEP_FNAME
	DEP_DOB

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Table 4.3 - Crow's Foot Symbols

| CROW'S FOOT SYMBOLS	CARDINALITY	COMMENT
⟩○	(0,N)	Zero or many; the "many" side is optional.
⟩│	(1,N)	One or many; the "many" side is mandatory.
‖	(1,1)	One and only one; the "1" side is mandatory.
○│	(0,1)	Zero or one; the "1" side is optional.

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Example: Department Store   1/2

- ▶ A department store operates in several cities
- ▶ In a city there is one headquarter coordinating the local operations
- ▶ A city may have several stores
- ▶ Stores hold any amount of items
- ▶ Customers place their orders for any number of items to a given store

GOAL: Optimize shopping in each city
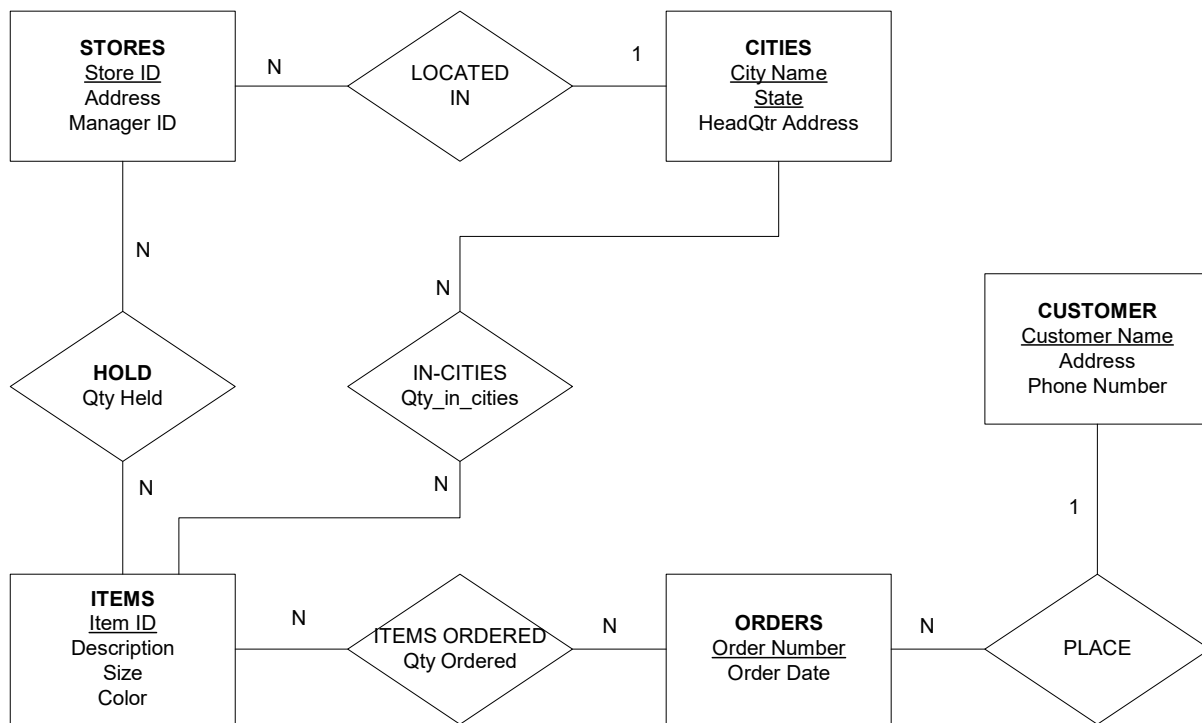
Entity Sets to Tables

- Each attribute of the E. S. becomes an attribute of the table
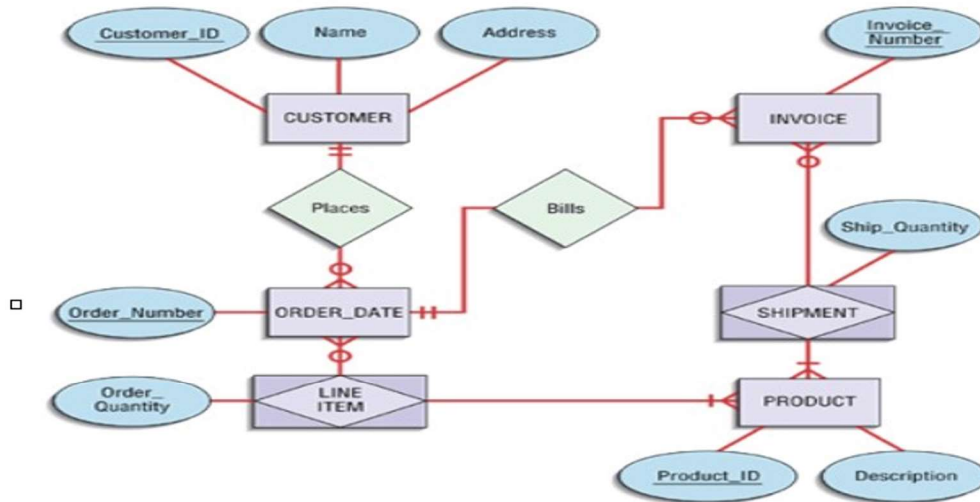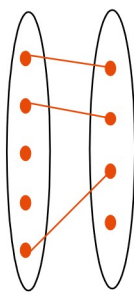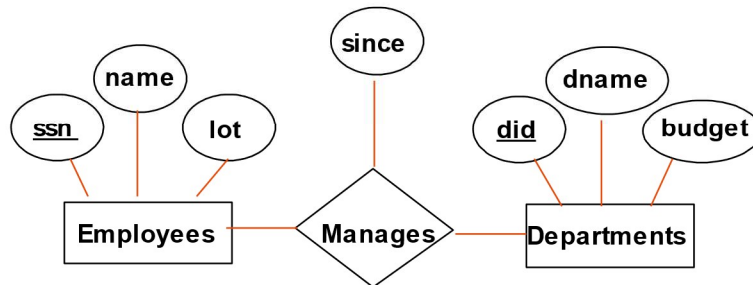

Relations:
```
CUSTOMER(Customer_ID,Name,Address)
PRODUCT(Product_ID,Description)
ORDER(Order_Number,Customer_ID,Order_Date)
LINE ITEM(Order_Number,Product_ID,Order_Quantity)
INVOICE(Invoice_Number,Order_Number)
SHIPMENT(Invoice_Number,Product_ID,Ship_Quantity)
```
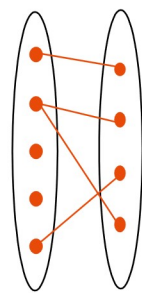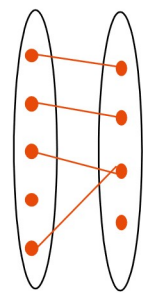
9.7

Cardinality Ratio
(1:1, 1:N, M:N)

- Each dept has at most one manager, according to the cardinality rule on Manages.
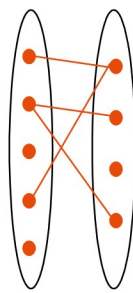

Translation to relational model?

1-to-1   1-to Many   Many-to-1   Many-to-Many

Steps to Identify a Cardinality either 1-1, 1-N, or M-N for a Relationship between Two Entities

1. Pick an object in the left Entity, check whether, for a given object in the left side Entity, it is allowed to have a relationship with one or more objects from the right-side Entity

2. Pick an object in the right-side Entity, check whether for a given object in right Entity, it is allowed to have a relationship with one or more objects from the left side of Entity

If Both Step 1 and Step 2 is NO => 1-1

If Yes in Step 1 but No in Step2 => 1-N

Or

If No in Step 1 but Yes in Step2 => N-1

(Note that N-1 is equivalent to 1-N if you switch the left entity with the right entity)

If Yes in Both Step 1 And Step 2   => M-N

Examples of Cardinality 1-1, 1-N, M-N

- **1 – 1 relationship**

Examples:

A Manager manages a Dept and at the same time, a Dept can only have One Manager.

A Country has One President and a President represents Only One Country, not more than one country.

- **1-N: relationship**

Example1: A Customer ORDERs a Basket (Order or Invoice or Purchase info) in the Amazon website where a Basket represent an Order Record for One Transaction.

A Customer (Any given Customer) can have multiple Order Invoices (multiple Orders, multiple Baskets) on the Amazon website, but any given one Basket (Order) should have One (One and Only) Customer that the basket is Ordered by.

Example2:

An Employee can have Multiple (Many) Dependents but a given dependent should have only one employee that the dependent is depending on.

- **M-N relationship**

Example 1: A Customer ORDERs Products

a Customer can ORDER multiple (one or more instances of) Products.

And at the same time, a Product can be ordered by N (one or more) different Customers

Example 2: A Basket (Invoice) Contains Items (Products)

a Basket (Order Invoice) can Contain N (one or more different instances of) Items (Products).

And at the same time, an item (a product) can be Contained by N (1 or more different) Baskets

Example 3: A Student Registers a Course

a Student can Register N (one or more different) Courses

at the same time, A Course can be registered by M (one or more) different Students