Data 604: Data Management

Lecture 3 – Topics:

- Data Modeling – Relational
- Hands on Class exercise
- Homework1

Keys - Summary

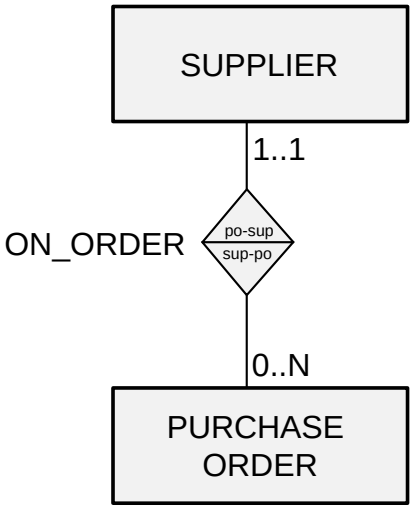
Key Type	Description
Super Key	An attribute(s) that uniquely identifies each row in a table
Candidate Key	An attribute that meets all of the requirements of a primary key. In other words, it has the potential to be a primary key.
Primary Key	The selected candidate that uniquely identifies all other attribute values in a row.
Foreign Key	An attribute(s) in one table whose values must match the primary key in another table or whose value must be null.

Functional Dependencies and Prime Attribute Type

In the following Relation, what are the Functional Dependencies?
Customer (CustNumber, CustomerName, City, State, Zip)

CustNumber -> CustomerName
CustNumber -> City
CustNumber -> State
CustNumber -> Zip

Foreign Keys



SUPPLIER

SUPNR	SUPNAME	SUPADDRESS	SUPCITY	SUPSTATUS
…				
37	Ad Fundum	82, Wacker Drive	Chicago	95
94	The Wine Crate	330, McKinney Avenue	Dallas	75
…				

PURCHASE_ORDER

PONR	PODATE	*SUPNR*
1511	2015-03-24	37
1512	2015-04-10	94
…		

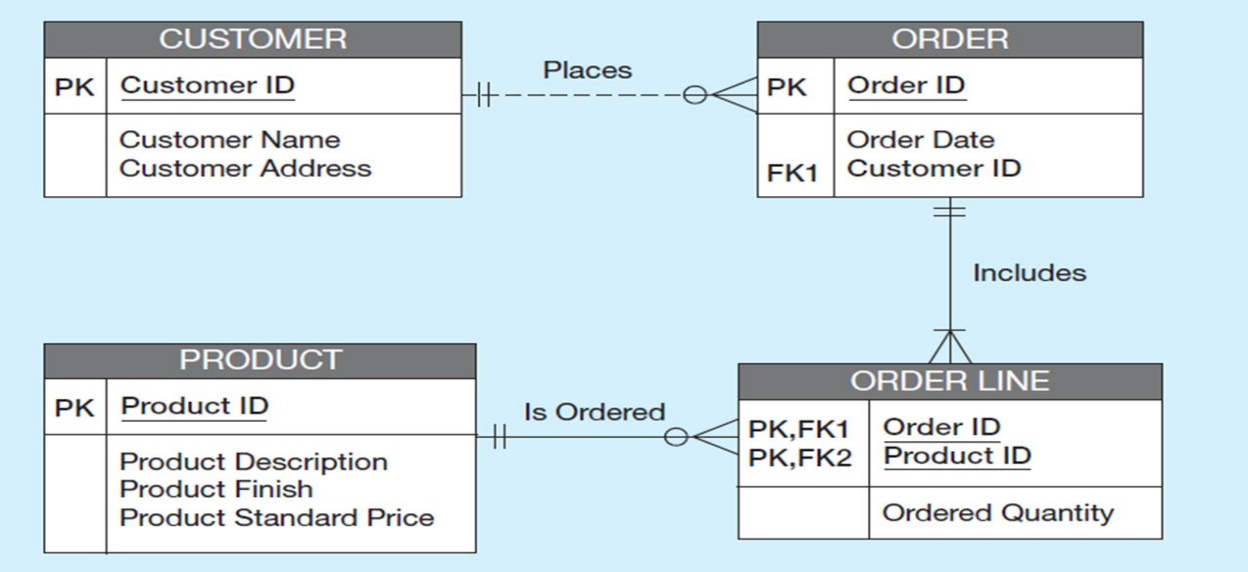
Relational Constraints or integrity constraints

Domain constraint	The value of each attribute type A must be an atomic and single value from the domain dom(A).
Key constraint	Every relation has a key that allows to uniquely identify its tuples.
Entity integrity constraint	The attribute types that make up the primary key should always satisfy a NOT NULL constraint.
Referential integrity constraint	A foreign key FK has the same domain as the primary key PK attribute type(s) it refers to and either occurs as a value of PK or NULL. (e.g. Delete rule of 'parent-dependent' tables: restrict, cascade, set-to-null)

Mapping a ER Model to a Relational Model

- Mapping Entity Types
- Mapping Relationship Types
- Mapping Multivalued Attribute Types
- Mapping Weak Entity Types
- Putting it All Together

Relational Schema



Example of Mapping a Regular Entity

a) CUSTOMER entity type

b) CUSTOMER relation

CUSTOMER

CustomerID	CustomerName	CustomerAddress	CustomerPostalCode

Mapping a Composite Attribute

a) CUSTOMER entity type with composite attribute

b) CUSTOMER relation with address detail

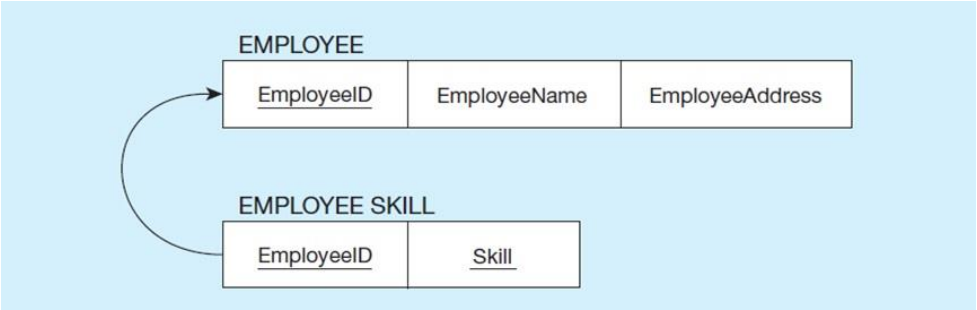
CUSTOMER

CustomerID	CustomerName	CustomerStreet	CustomerCity	CustomerState	CustomerPostalCode

Mapping an Entity with a Multivalued Attribute

a) EMPLOYEE entity type with multivalued attribute

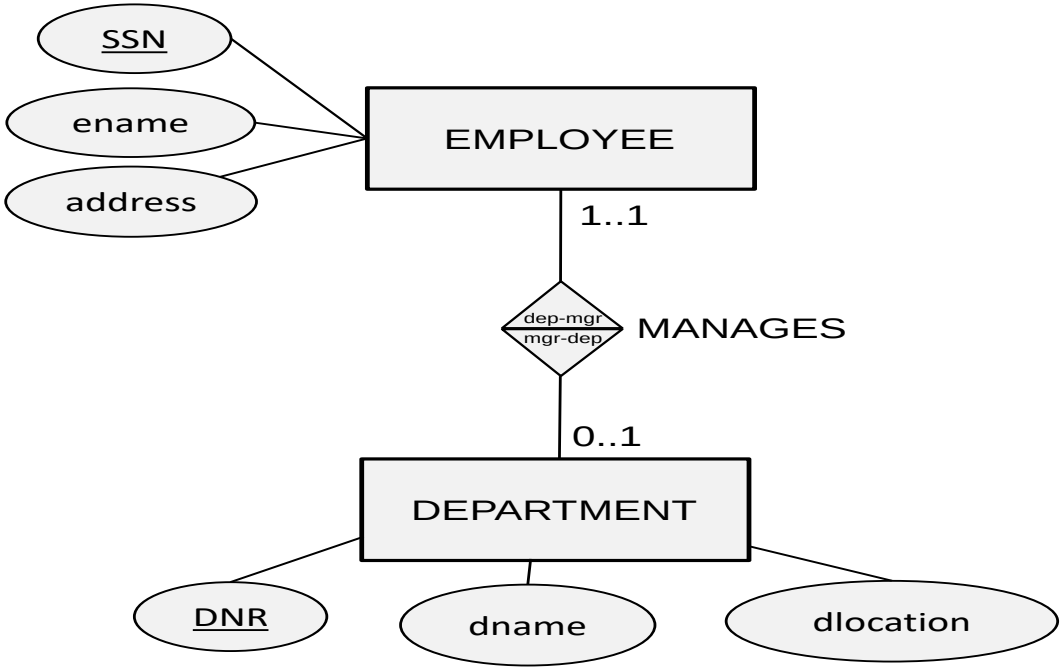
b) EMPLOYEE and EMPLOYEE SKILL relations



Mapping Relationship Types

- Mapping a binary 1:1 relationship type
- Mapping a binary 1:N relationship type
- Mapping a binary M:N relationship type
- Mapping unary relationship types
- Mapping n-ary relationship types

Mapping a Binary 1:1 Relationship Type



Mapping a Binary 1:1 Relationship Type

EMPLOYEE(SSN, ename, address, *DNR*)

DEPARTMENT(DNR, dname, dlocation)

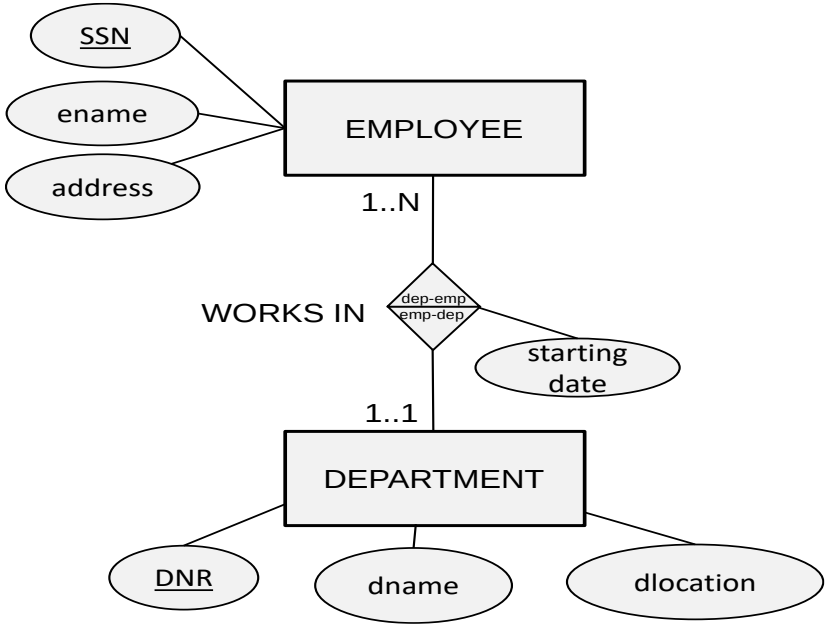
EMPLOYEE(SSN, ename, address, *DNR*)

511	John Smith	14 Avenue of the Americas, New York	001
289	Paul Barker	208 Market Street, San Francisco	003
356	Emma Lucas	432 Wacker Drive, Chicago	NULL
412	Michael Johnson	1134 Pennsylvania Avenue, Washington	NULL

DEPARTMENT(DNR, dname, dlocation)

001	Marketing	3th floor
002	Call center	2nd floor
003	Finance	basement
004	ICT	1st floor

Mapping a Binary 1:N Relationship Type



EMPLOYEE(SSN, ename, address, starting date, *DNR*)

DEPARTMENT(DNR, dname, dlocation)

Mapping a Binary 1:N Relationship Type

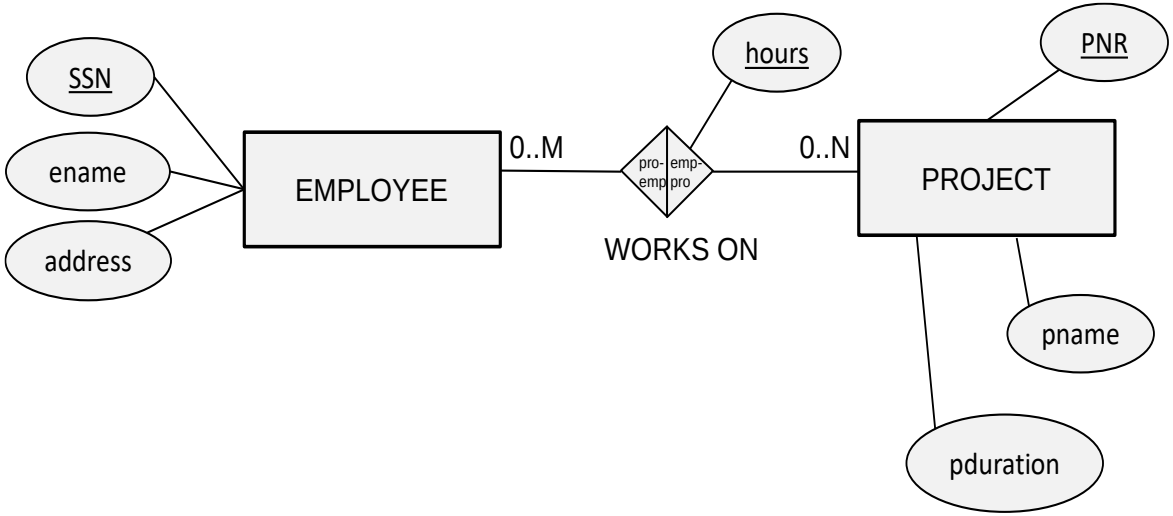
EMPLOYEE(SSN, ename, address, starting date, *DNR*)

511	John Smith	14 Avenue of the Americas, New York	01/01/2000	001
289	Paul Barker	208 Market Street, San Francisco	01/01/1998	001
356	Emma Lucas	432 Wacker Drive, Chicago	01/01/2010	002

DEPARTMENT(DNR, dname, dlocation)

001	Marketing	3th floor
002	Call center	2nd floor
003	Finance	basement
004	ICT	1st floor

Mapping a Binary M:N Relationship Type



EMPLOYEE(<u>SSN</u>, ename, address)

PROJECT(<u>PNR</u>, pname, pduration)

WORKS_ON(<u>*SSN*</u>, <u>*PNR*</u>, hours)

Mapping a Binary M:N Relationship Type

EMPLOYEE(SSN, ename, address, *DNR*)

511	John Smith	14 Avenue of the Americas, New York	001
289	Paul Barker	208 Market Street, San Francisco	001
356	Emma Lucas	432 Wacker Drive, Chicago	002

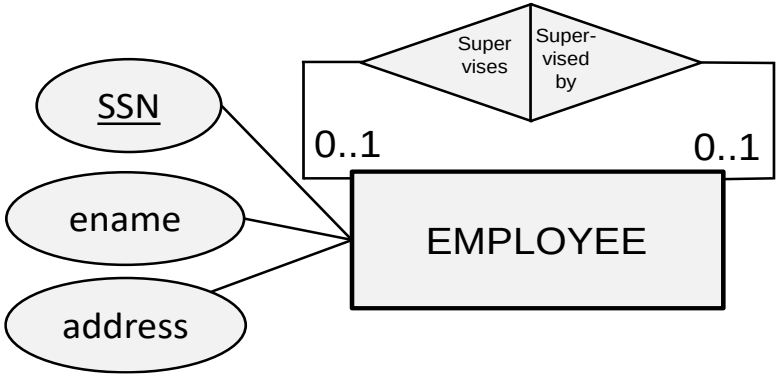
PROJECT(PNR, pname, pduration)

1001	B2B	100
1002	Analytics	660
1003	Web site	52
1004	Hadoop	826

WORKS_ON(*SSN, PNR*, hours)

511	1001	10
289	1001	80
289	1003	50

Mapping Unary Relationship Types



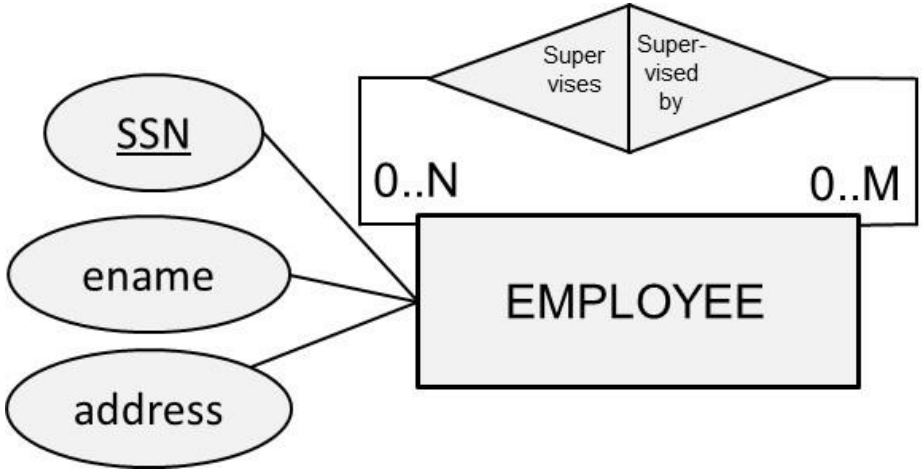
EMPLOYEE(SSN, ename, address, *supervisor*)

Mapping Unary Relationship Types

EMPLOYEE(SSN, ename, address, *supervisor*)

511	John Smith	14 Avenue of the Americas, New York	289
289	Paul Barker	208 Market Street, San Francisco	412
356	Emma Lucas	432 Wacker Drive, Chicago	289
412	Dan Kelly	668 Strip, Las Vegas	NULL

Mapping Unary Relationship Types



EMPLOYEE(SSN, ename, address)

SUPERVISION(*Supervisor*, *Supervisee*)

Mapping Unary Relationship Types

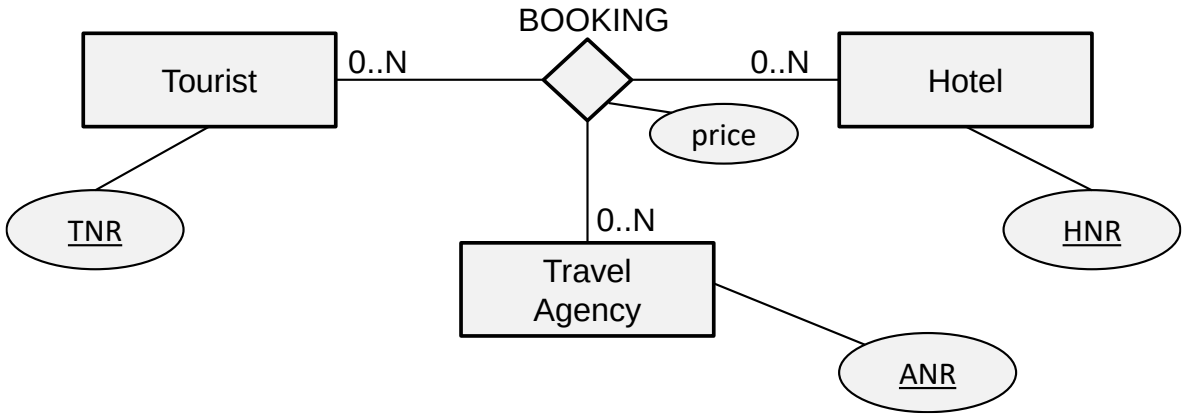
EMPLOYEE(SSN, ename, address)

511	John Smith	14 Avenue of the Americas, New York
289	Paul Barker	208 Market Street, San Francisco
356	Emma Lucas	432 Wacker Drive, Chicago
412	Dan Kelly	668 Strip, Las Vegas

SUPERVISION(*Supervisor, Supervisee*)

289	511
289	356
412	289
412	511

Mapping n-ary Relationship Types



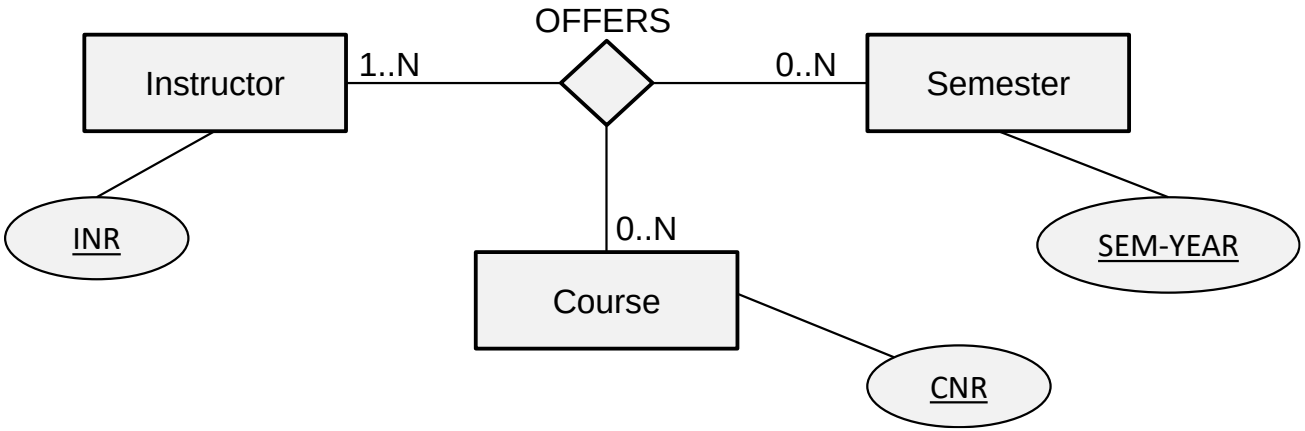
TOURIST(TNR, …)

TRAV_AGENCY(ANR, …)

HOTEL(HNR, …)

BOOKING(*TNR*, *ANR*, *HNR*, price)

Mapping n-ary Relationship Types



INSTRUCTOR(INR, …)

COURSE(CNR, …)

SEMESTER(SEM-YEAR, …)

OFFERS(*INR*, *CNR*, *SEM-YEAR*)

Mapping n-ary Relationship Types

INSTRUCTOR(INR, iname, ….)

10	Bart
12	Wilfried
14	Seppe

COURSE(CNR, cname, ….)

100	Database Management
110	Analytics
120	Java Programming

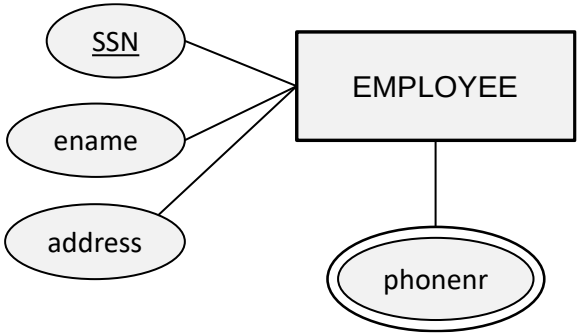
SEMESTER(SEM-YEAR, ….)

1-2015
2-2015
1-2016

OFFERS(*INR, CNR, SEM-YEAR*)

10	100	1-2015
12	100	1-2016
10	120	1-2015
14	120	1-2015

Mapping Multivalued Attribute Types



EMPLOYEE(SSN, ename, address)

EMP-PHONE(PhoneNr, *SSN*)

Mapping Multivalued Attribute Types

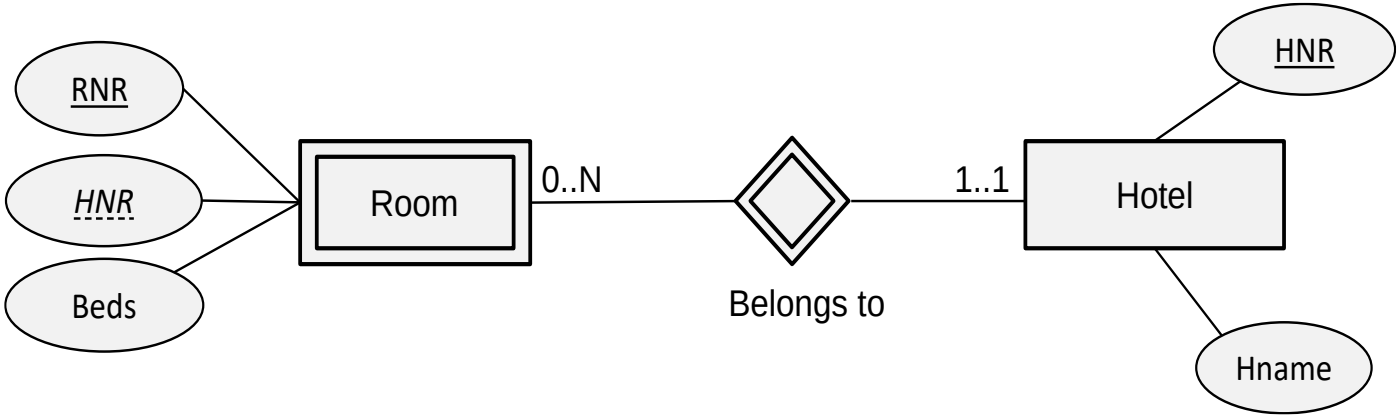
EMPLOYEE(SSN, ename, address, *DNR*)

511	John Smith	14 Avenue of the Americas, New York	001
289	Paul Barker	208 Market Street, San Francisco	001
356	Emma Lucas	432 Wacker Drive, Chicago	002

EMP-PHONE(PhoneNR, *SSN*)

900-244-8000	511
900-244-8000	289
900-244-8002	289
900-246-6006	356

Mapping Weak Entity Types



Hotel (HNR, Hname)

Room (RNR, *HNR*, beds)

Mapping Weak Entity Types

ROOM (RNR, *HNR*, Beds)

2	101	2
6	101	4
8	102	2

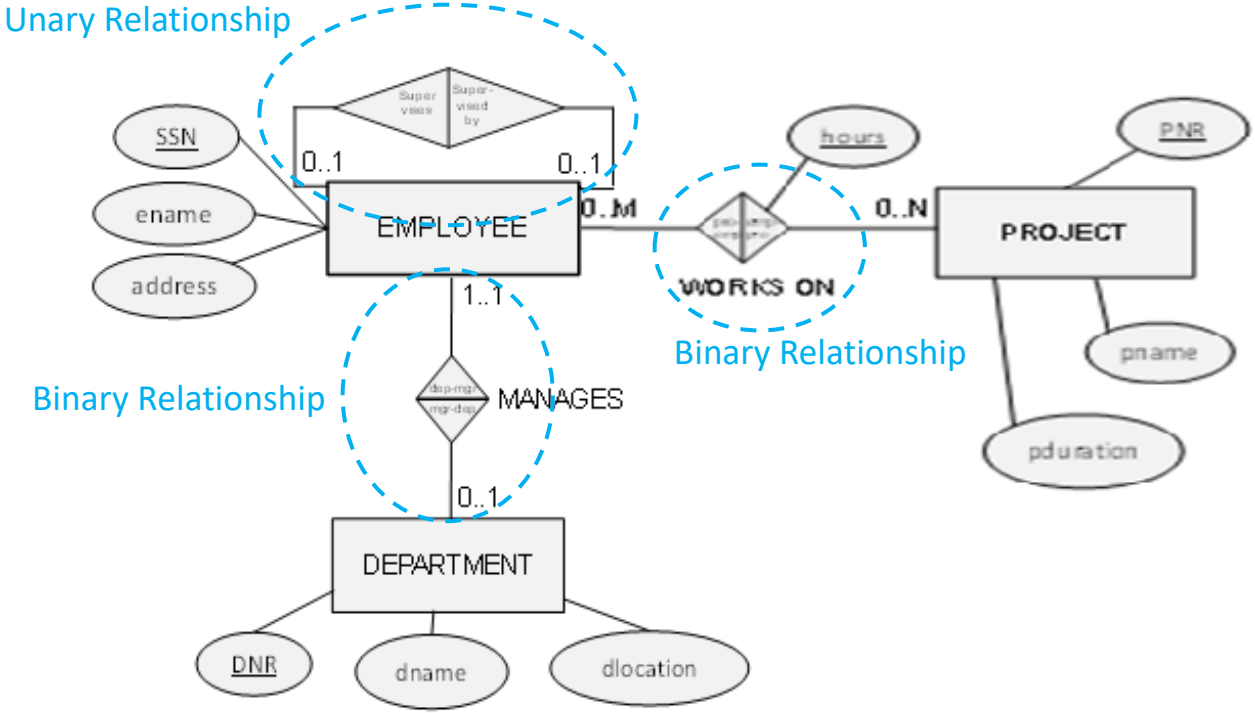
HOTEL(HNR, Hname)

100	Holiday Inn New York
101	Holiday Inn Chicago
102	Holiday Inn San Francisco

Putting it All Together

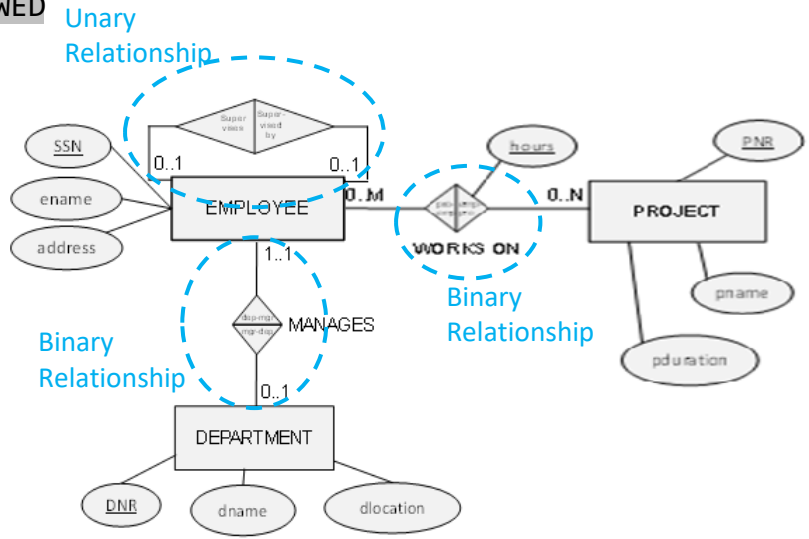
ER Model	Relational model
Entity type	Relation
Weak entity type	Foreign key
1:1 or 1:N relationship type	Foreign key
M:N relationship type	New relation with two foreign keys
N-ary relationship type	New relation with N foreign keys
Simple attribute type	Attribute type
Composite attribute type	Component attribute type
Multivalued attribute type	Relation and foreign key
Key attribute type	Primary or alternative key

Example: Putting it All Together



Example: Putting it All Together

- EMPLOYEE(SSN, ename, streetaddress, city, sex, dateofbirth, *MNR*, *DNR*)
  - SSN Primary Key, NOT NULL
  - MNR foreign key refers to SSN in EMPLOYEE, NULL ALLOWED
  - DNR foreign key refers to DNR in DEPARTMENT, NULL ALLOWED
- DEPARTMENT (DNR, dname, dlocation, *MGNR*)
  - DNR Primary Key, NOT NULL
  - MGNR: foreign key refers to SSN in EMPLOYEE, NOT NULL
- PROJECT (PNR, pname, pduration)
  - PNR Primary Key, NOT NULL
- WORKS-ON (*SSN*, *PNR*, HOURS)
  - SSN foreign key refers to SSN in EMPLOYEE, NOT NULL
  - PNR foreign key refers to PNR in PROJECT, NOT NULL



Phases of Database Design