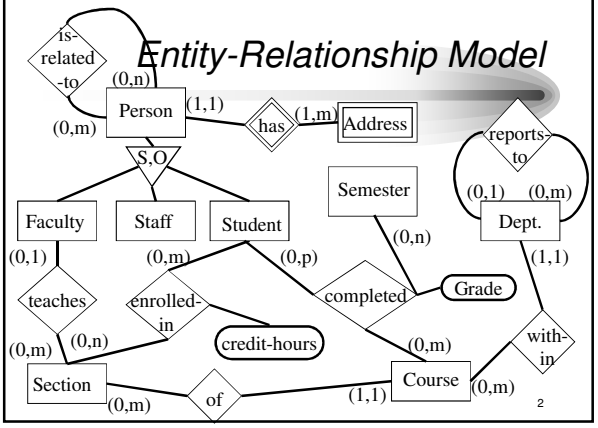
ER to Relational Conversion

© Department of Computer Science
Northern Illinois University
September 2000

1

Entity-Relationship Model



2

Entity-Relationship Model

ENTITIES

- Person
  - SSN (Identifier)
  - Name
  - Birth-Date
  - Beginning Date
- Address
  - Type (discriminator)
  - Street
  - City
  - State
  - Zip
- Faculty
  - SSN (Identifier)
  - Contact hours
  - Tenure status
- Staff
  - SSN (Identifier)
  - Position
- Student
  - SSN (Identifier)
  - Overall GPA
  - Major

3

Entity-Relationship Model

ENTITIES

- Dept.
  - Dept-Code (ID)
  - Dept-Name
  - Dept-Address
  - Dept-Chair
- Course
  - Crse-Code (ID)
  - Crse-Title
  - Crse-Max-Credit-Hours
  - Crse-Var-Hours-Code
  - Crse-Fee
- Section
  - Sect-Code (ID)
  - Sect-Credit-Hours
  - Sect-Meet-Time
  - Sect-Meet-Day
- Semester
  - Sem-Yr (ID)
  - Sem-Session (ID)

4

Entity-Relationship Model

RELATIONSHIPS with attributes

- Student enrolled-in Section
  - Credit-hours
    - In a variable credit section this attribute would be used to hold the credit hours for which a specific student is enrolled.
- Completed
  - Grade
    - A student is allowed to take a course more than once.

5

ER to Relational Conversion

1 Consider all strong entities not subtypes (do not consider “date” entities here)

2 Consider sub-type entities

- two methods

3 Consider weak entities

4 Consider One-to-many binary relationships

6

ER to Relational Conversion

5 Consider many-to-many binary relationships
6 Consider relationships greater than binary (other than those involving "date" entities)
7 Consider relationships greater than binary involving a "date" entity
8 Consider recursive relationships

7

Consider All Strong Entities not Subtypes

- create a new relation
- name of the relation is the name of the entity
- attributes of entity become attributes of relation
- primary key of relation is entity identifier

8

Consider All Strong Entities not Subtypes

Person

SSN	Name	….		
PK				

9

Consider Sub-type Entities (First Method)

- treat as a strong entity
- primary key is the entity identifier
- primary key is also a foreign key referencing the relation created from the supertype entity

10

Consider Sub-type Entities (First Method)

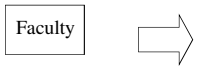
Faculty

SSN	Tenure	…		
PK				
FK				

11

Consider Sub-type Entities (Second Method)

- combine into the relation created from the supertype entity as a composite attribute



Person

SSN	Name	….	…	Faculty		
PK				Tenure		

Consider Sub-type Entities

- may combine the two methods within the conversion of the sub-types of a single ISA

13

Consider Weak Entities

- create a new relation
- name of the relation is the name of the weak entity
- attributes of entity become attributes of relation

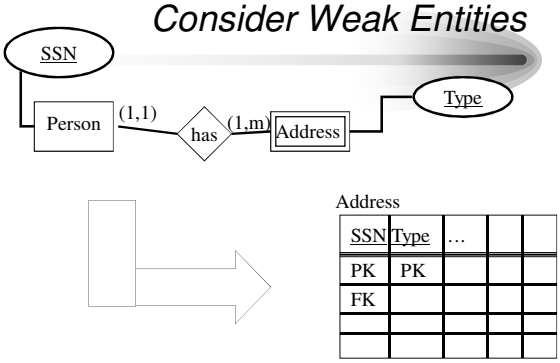
14

Consider Weak Entities

- primary key of the relation is the concatenation of the primary key of the relation created from the strong entity and the discriminator of the weak entity
- the attribute which is the primary key of the relation created from the strong entity is also a foreign key

15

Consider Weak Entities



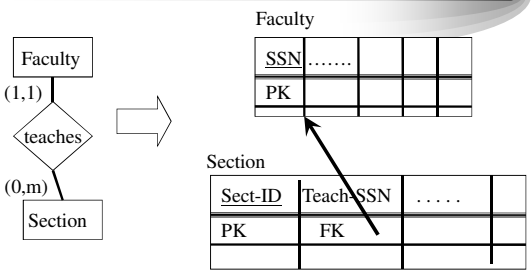
16

Consider One-to-many Binary Relationships

- The primary key of the relation created from the "one" entity becomes a foreign key in the relation created from the "many" entity.

17

Consider One-to-many Binary Relationships



18

Consider Many-to-many Binary Relationships

- Create a new relation for the relationship whose primary key is the concatenation of the entity-ids of the related entities.
- The primary key attributes are also foreign keys into the relations created from the related entities.

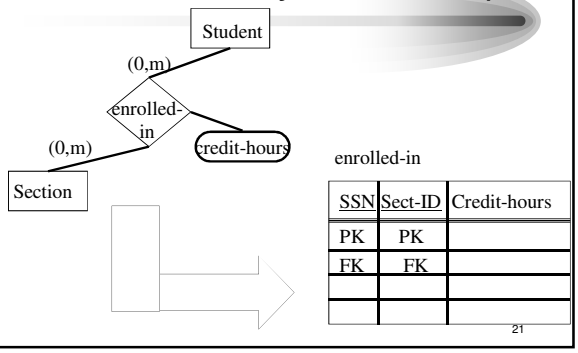
19

Consider Many-to-many Binary Relationships

- The name of the new relation should reflect the relationship name.
- The intersection data of the relationship become non prime attributes of the relation.

20

Consider Many-to-many Binary Relationships



enrolled-in

SSN	Sect-ID	Credit-hours
PK	PK	
FK	FK	

21

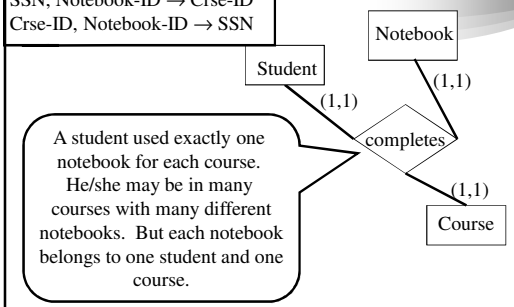
Consider Relationships Greater than Binary

- Create a new relation for the relationship.
- The primary key of the new relation depends upon the cardinalities of the relating entities.

22

Consider Relationships Greater than Binary

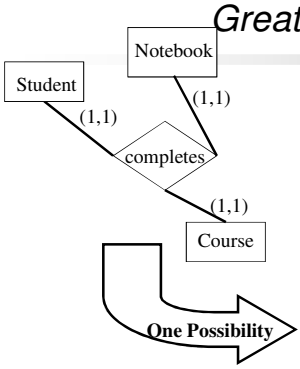
SSN, Crse-ID → Notebook-ID
SSN, Notebook-ID → Crse-ID
Crse-ID, Notebook-ID → SSN



A student used exactly one notebook for each course. He/she may be in many courses with many different notebooks. But each notebook belongs to one student and one course.

23

Consider Relationships Greater than Binary

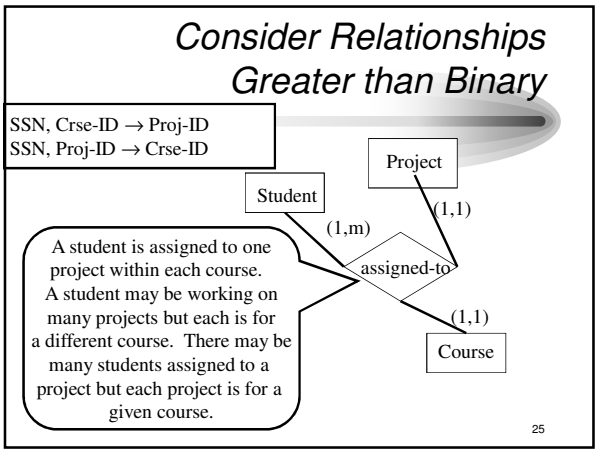


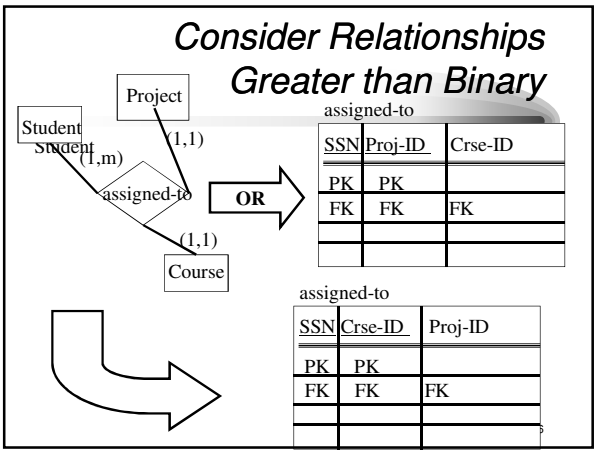
Completes

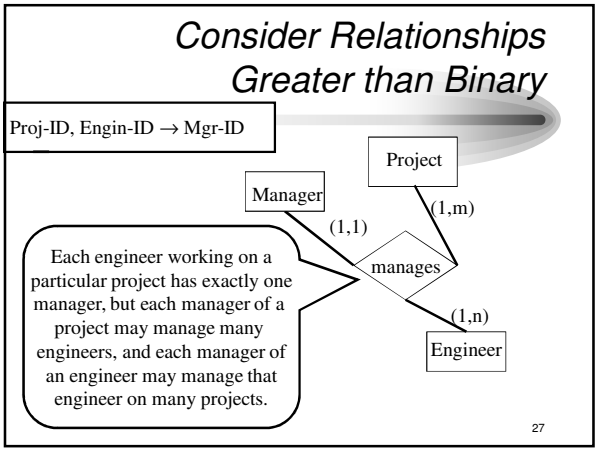
SSN	Crse-ID	Notebook-ID
PK	PK	
FK	FK	FK

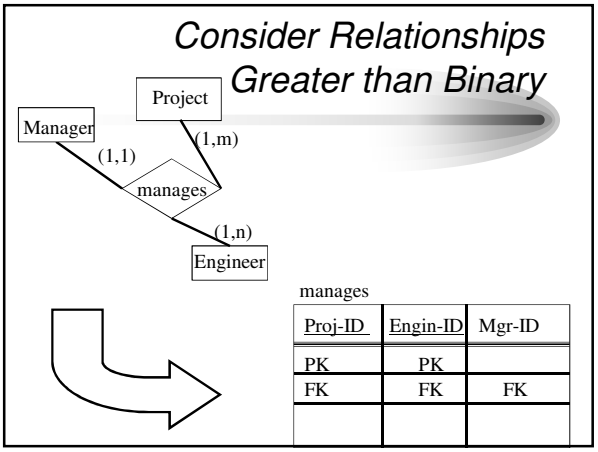
One Possibility

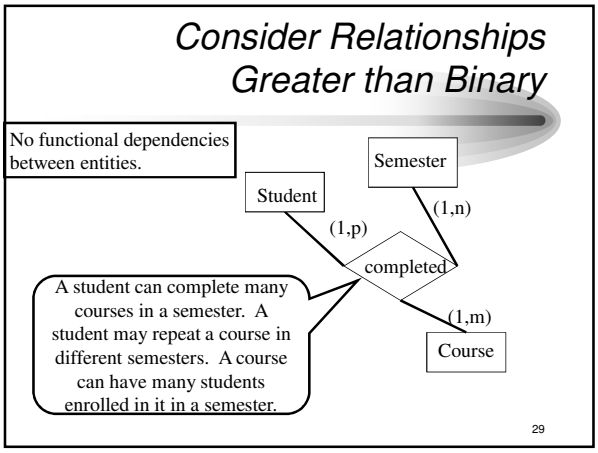
24

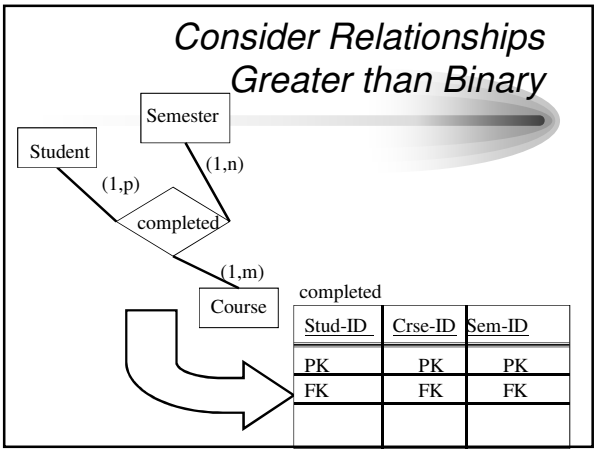

Consider Relationships Greater than Binary
SSN, Crse-ID → Proj-ID
SSN, Proj-ID → Crse-ID
Project
Student
(1,1)
(1,m)
assigned-to
(1,1)
Course
A student is assigned to one project within each course. A student may be working on many projects but each is for a different course. There may be many students assigned to a project but each project is for a given course.
25


Consider Relationships Greater than Binary
Project
Student
(1,1)
(1,m)
assigned-to
(1,1)
Course
OR
assigned-to
SSN Proj-ID Crse-ID
PK PK
FK FK FK
assigned-to
SSN Crse-ID Proj-ID
PK PK
FK FK FK

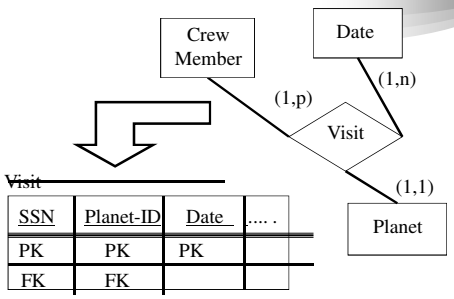

Consider Relationships Greater than Binary
Proj-ID, Engin-ID → Mgr-ID
Project
Manager
(1,m)
(1,1)
manages
(1,n)
Engineer
Each engineer working on a particular project has exactly one manager, but each manager of a project may manage many engineers, and each manager of an engineer may manage that engineer on many projects.
27


Consider Relationships Greater than Binary
Project
Manager
(1,m)
(1,1)
manages
(1,n)
Engineer
manages
Proj-ID Engin-ID Mgr-ID
PK PK
FK FK FK


Consider Relationships Greater than Binary
No functional dependencies between entities.
Semester
Student
(1,n)
(1,p)
completed
(1,m)
Course
A student can complete many courses in a semester. A student may repeat a course in different semesters. A course can have many students enrolled in it in a semester.
29

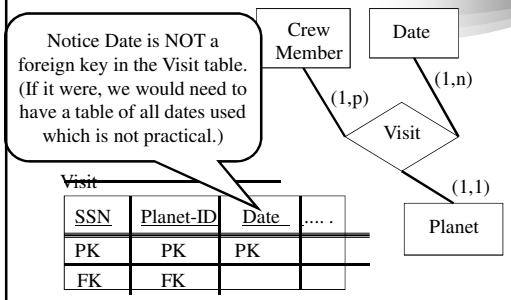

Consider Relationships Greater than Binary
Semester
Student
(1,n)
(1,p)
completed
(1,m)
Course
completed
Stud-ID Crse-ID Sem-ID
PK PK PK
FK FK FK

Consider Relationships Greater than Binary Including a Date Entity



31

Consider Relationships Greater than Binary Including a Date Entity



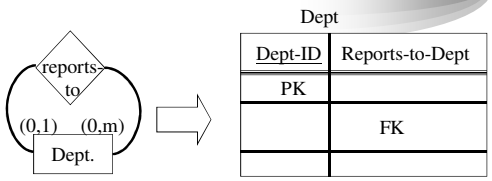
32

Consider Recursive Relationships

- Treat as the comparable type of relationship
  - one-to-many
    - use a foreign key
  - many-to-many
    - create a new relation for the relationship

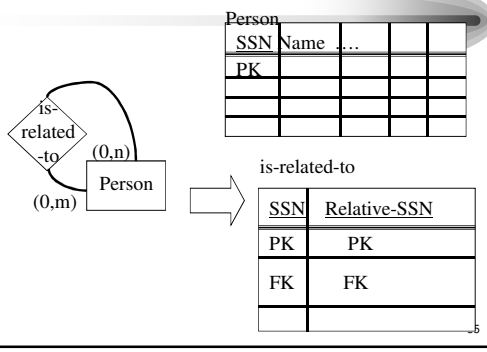
33

Consider Recursive Relationships



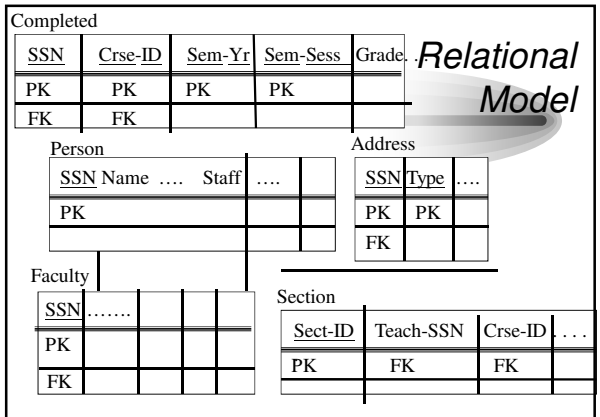
34

Consider Recursive Relationships

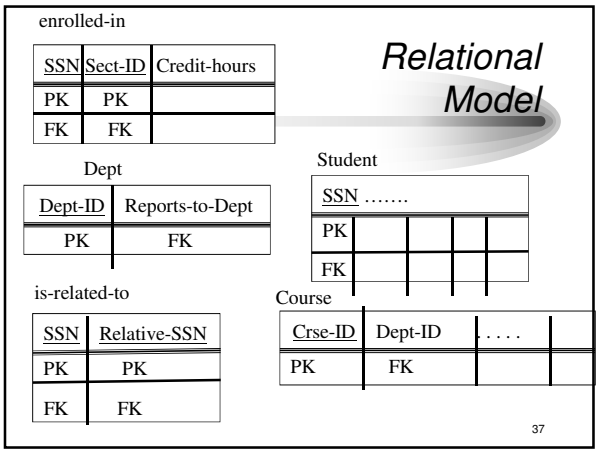


35

Relational Model



36


enrolled-in
SSN
Sect-ID
Credit-hours
PK
PK
FK
FK
Relational Model
Dept
Dept-ID
Reports-to-Dept
PK
FK
Student
SSN …….
PK
FK
is-related-to
SSN
Relative-SSN
PK
PK
FK
FK
Course
Crse-ID
Dept-ID
. . . . .
PK
FK
37