Information Management and Data Engineering

CSU 34041

7. Mapping to Logical Design

Today’s Lecture

- Introduction to Relational Schema Mapping
- Mapping Entity Types
- Mapping Multivalued Attributes
- Mapping Relationships
- Cinema Example

Relational Schema Mapping

Relational Schema Mapping

- How to move from a conceptual database design
  - Entity Relationship Model
- …to a logical database design
  - Relational Database Schema
- We follow a series of steps to map entity types, relationships and attributes into relations

Relational Schema Mapping

- We will use the examples from the previous lectures to illustrate these mapping steps
- The mapping will create:
  - Relations
    - with simple, single-valued attributes
  - Constraints
    - primary keys
    - unique keys
    - referential integrity constraints

Mapping Entity Types

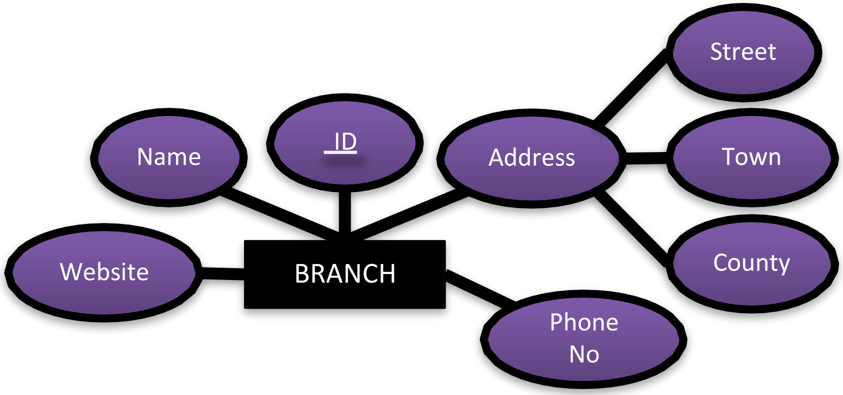
Mapping of Entity Types

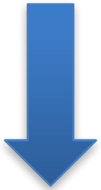
- For each entity type E in the ER diagram, create a relation R that includes all the simple attributes of E
- Composite attributes
  - when mapping composite attributes include only the simple component attributes in the new relation R

Mapping of Entity Types

- Key attributes
  - choose one of the key attributes of E as the primary key of R
  - composite key attributes are included as a *composite primary key*
- Additional key attributes should be included as secondary unique keys of the relation

Mapping of Entity Types



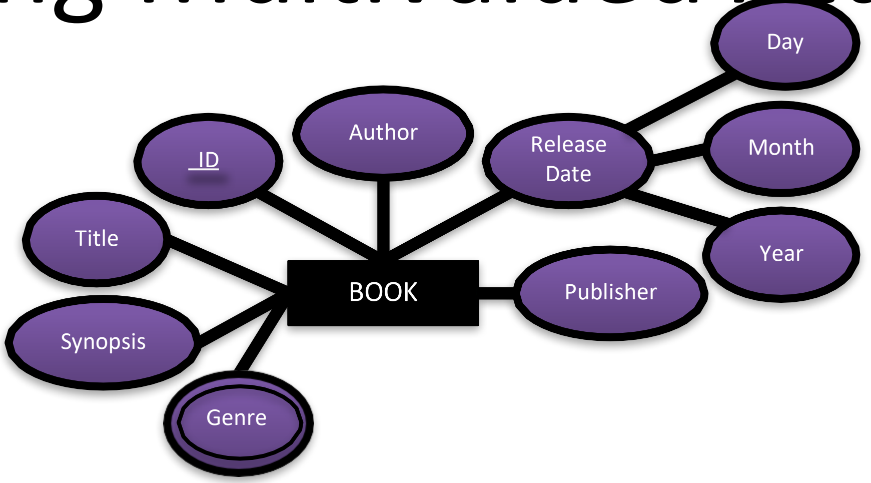


BRANCH

branch_id	name	street	town	county	phone_no	website

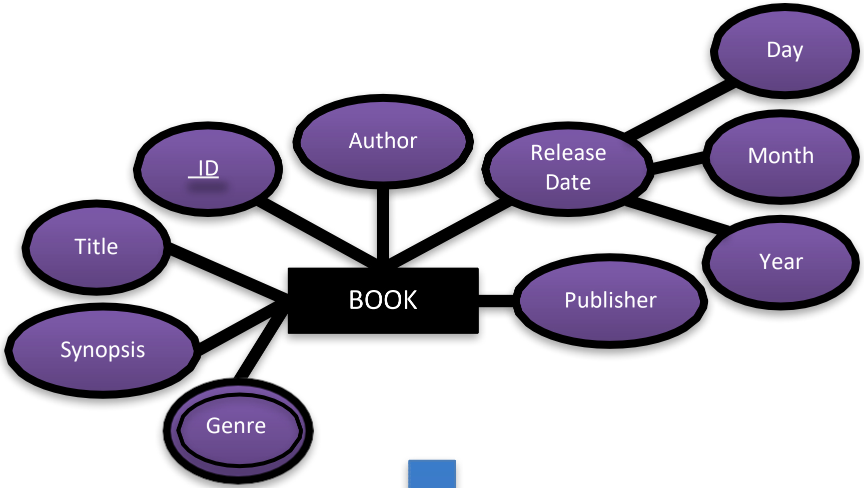
Mapping Multivalued Attributes

Mapping Multivalued Attributes



- For each multivalued attribute A, create a new relation R
- The new relation R will include:
  - An attribute corresponding to A
  - The primary key K from the relation that represents the entity type that A came from
    - This becomes a *foreign key* in R
  - The *primary key* of R is the combination of A and K

Mapping Multivalued Attributes



BOOK

book_id	title	synopsis	author	cert	publisher	release_day	release_month	release_year

GENRE

book_id	genre

Mapping Relationships

Mapping Relationships

- In addition to mapping the entity types from the ER model into the Relational Schema, we also need to map the relationship types

- Each relationship type is modeled differently

  - 1:1 One to One
  - 1:N One to Many
  - M:N Many to Many

Mapping 1:1 Relationships

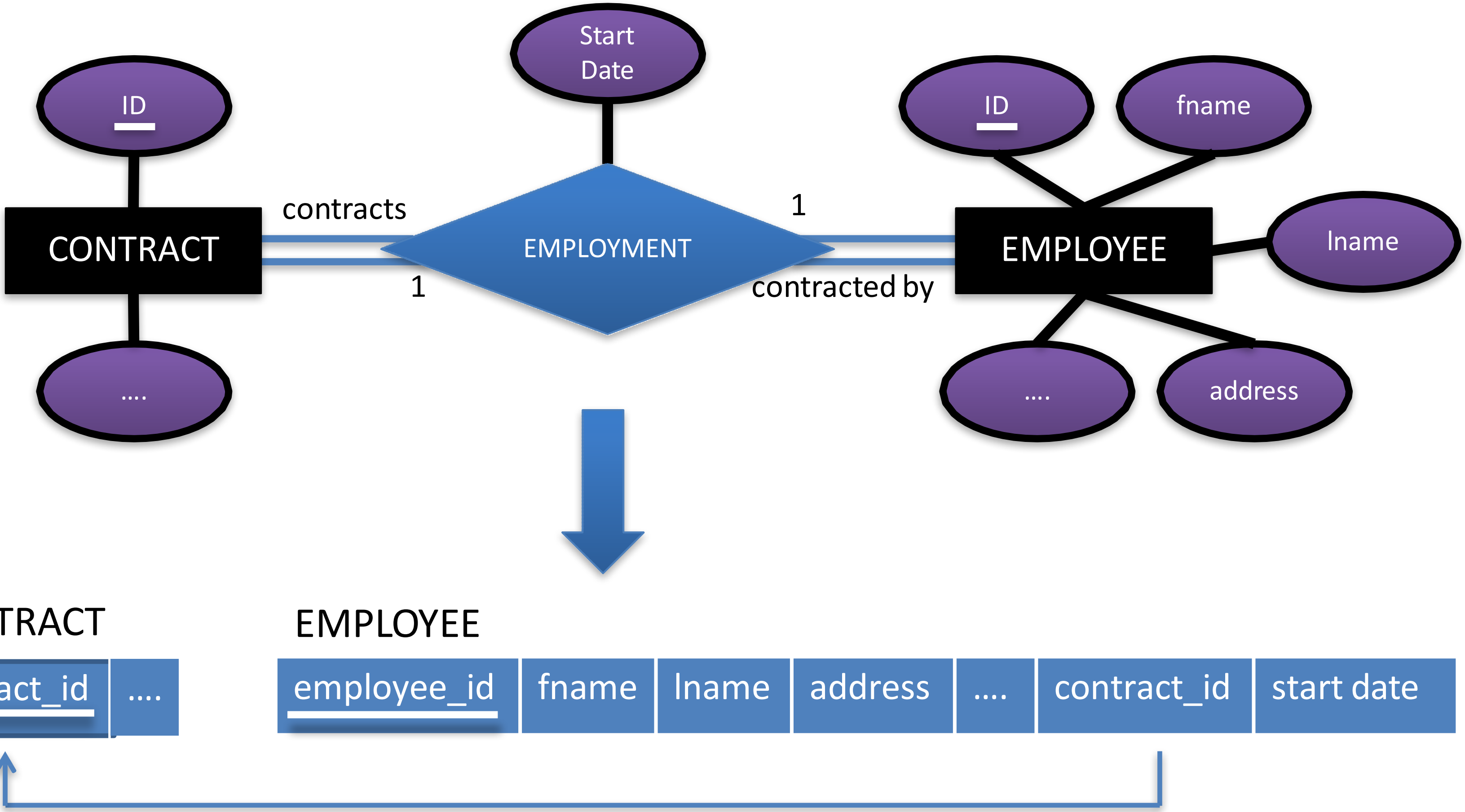
Mapping 1:1 Relationships

- There are two main approaches to mapping binary 1:1 relationships
  - Foreign Key Approach
    - Most useful and most commonly used
  - Merged-Relation Approach
    - Used in cases of *total participation*
- For each binary 1:1 relationship type R
  - identify the relations S and T that correspond to the entity types participating in R

Mapping 1:1 Relationships

- Foreign Key Approach
  - choose one of the participating relations, say S
  - include as a foreign key in S the primary key of T
  - if possible, choose an entity type with *total participation* in R for the role of S
  - include all the simple attributes of the relationship type R as attributes of S

Mapping 1:1 Relationships



CONTRACT

contract_id	....

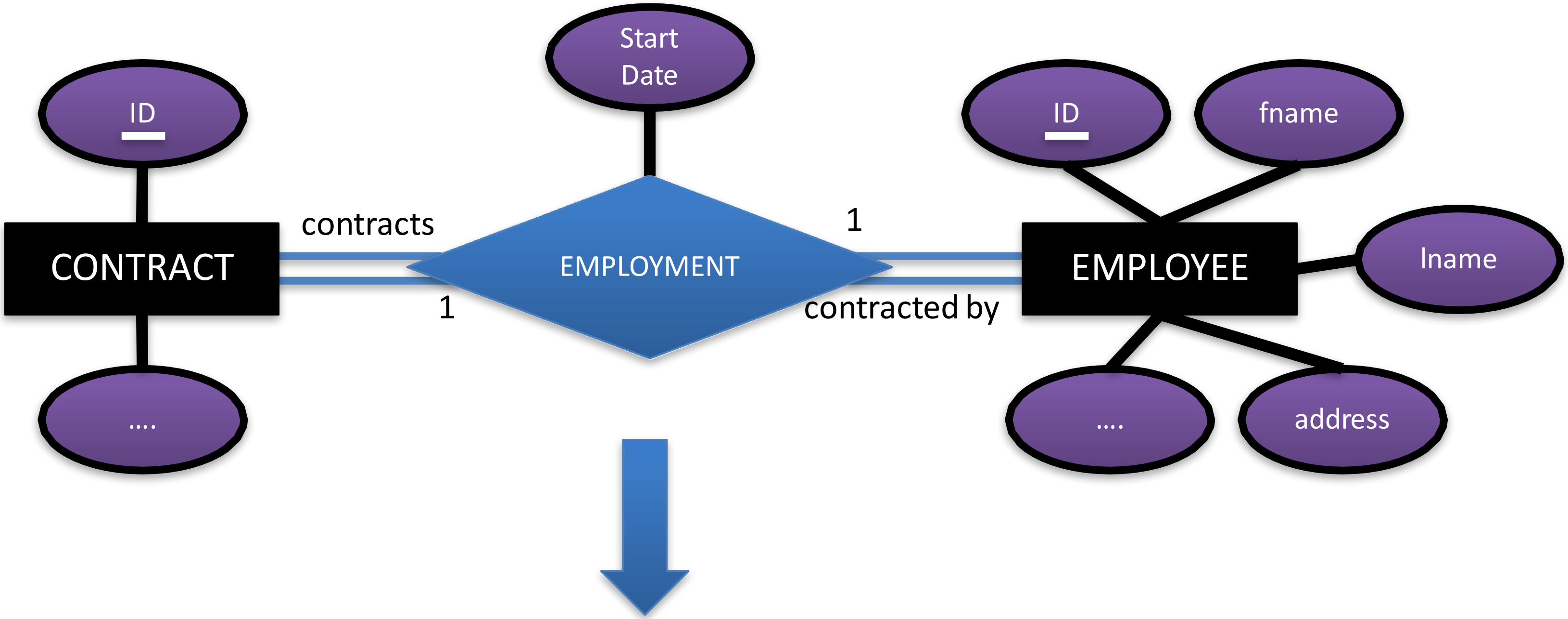
EMPLOYEE

employee_id	fname	lname	address	....	contract_id	start date

Mapping 1:1 Relationships

- Merged Relation Approach
  - This can only be used when both S and T have *total participation* in the relationship type R
  - Merge the two entity types S and T and the relationship type R into one single relation V
  - V should include all the simple component attributes of S, T and R
  - This is possible as the joint total participation indicates that the two tables will have an identical number of tuples at all time

Mapping 1:1 Relationships



EMPLOYEE_RECORD

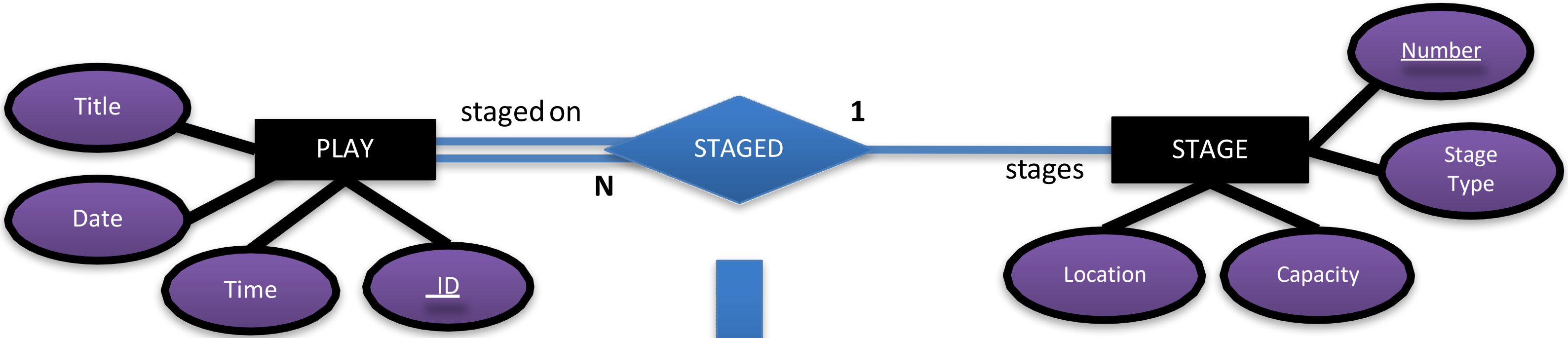
contract_id	....	start_date	employee_id	fname	lname	address	....

Mapping 1:N Relationships

Mapping 1:N Relationships

- For each binary 1:N relationship type R
  - identify the relation S that corresponds to the entity types on the N-side of R
- Include as a foreign key in S, the primary key of T, which is the relation representing the entity type at the other side of R
- Include any simple attributes of the relationship type R as attributes of S
  - or simple component attributes of a composite attribute

Mapping 1:N Relationships



PLAY

play_id	title	time	date

STAGE

number	stage_type	capacity	location

PLAY

play_id	time	date	stage_number

STAGE

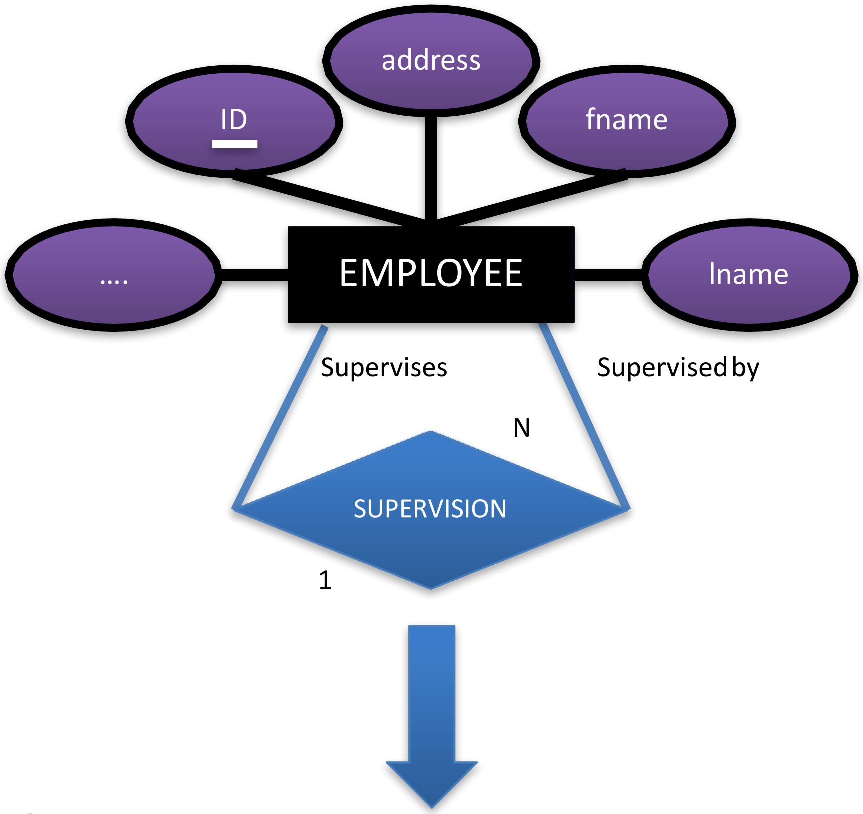
number	stage_type	capacity	location

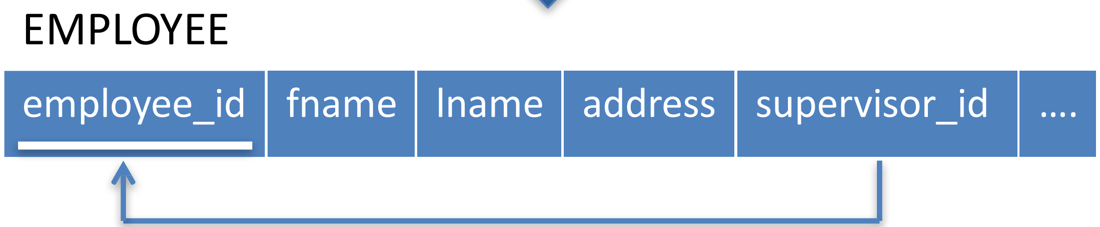
Mapping Recursive Relationships

Mapping Recursive Relationships

- Recursive relationships
  - where an entity instance can refer to another instance of the same entity type
- For each recursive relationship type R
  - Include the primary key of T, which is the relation representing the entity type involved, as a foreign key in the same relation, T
  - Include any simple attributes of the relationship type R as attributes of T
    - or simple component attributes of a composite attribute

Mapping Recursive Relationships





EMPLOYEE

employee_id	fname	lname	address	supervisor_id	....

Mapping M:N Relationships

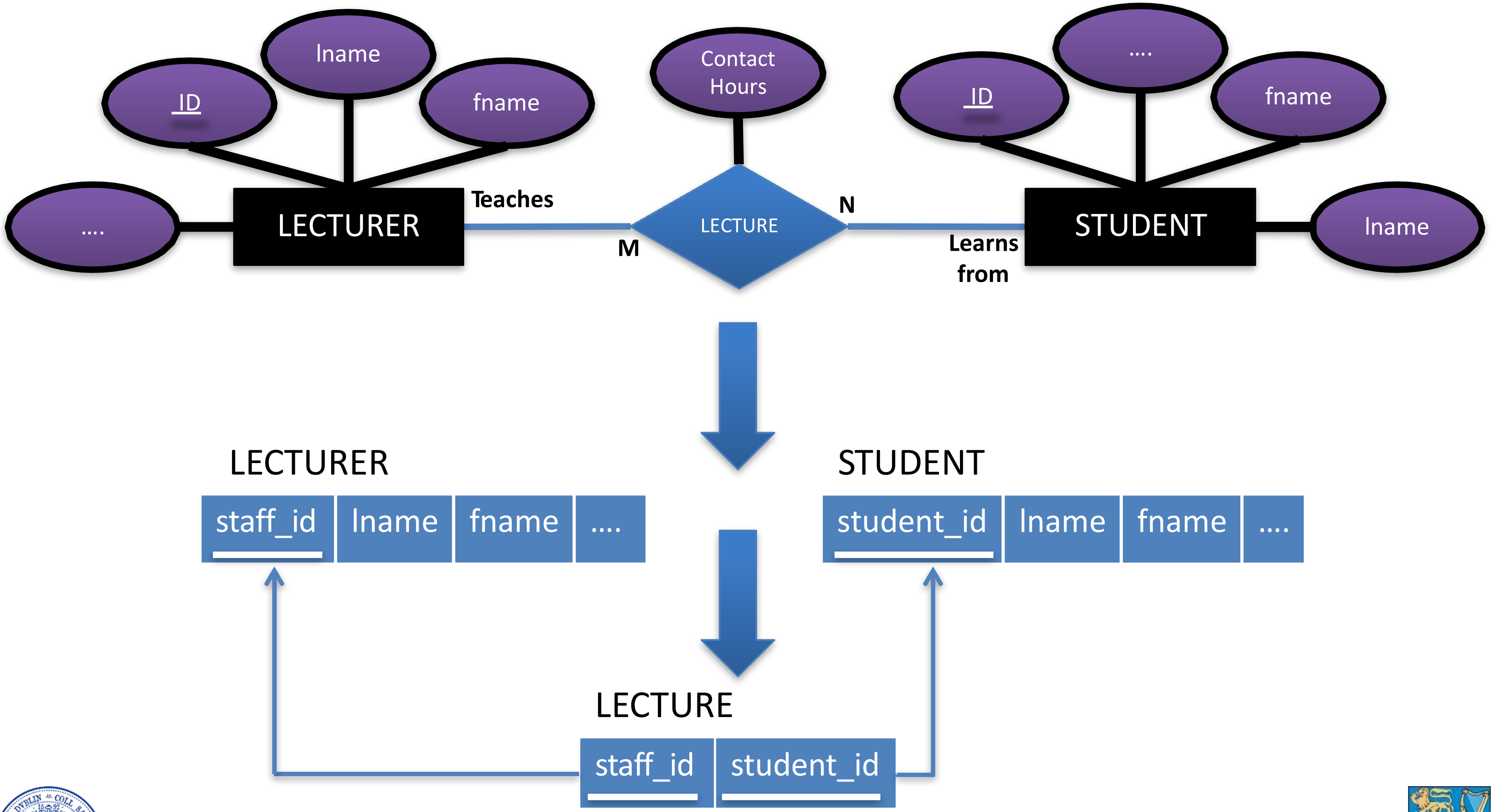
Mapping M:N Relationships

- Many to Many relationship types are more complex to map that 1:1 or 1:N
- As each entity instance may reference many entity instances in the other participating entity type
  - You cannot use a foreign key attribute in either participating entity
  - You must create a new relation to represent the relationship type

Mapping M:N Relationships

- For each binary M:N relationship type R
  - create a new relation S to represent R
- Include as foreign key attributes in S the primary keys of the relations that represent the participating entity types
  - The combination of these foreign keys is the composite primary key of S
- Include any simple attributes of the relationship type R as attributes of S
  - or simple component attributes of a composite attribute

Mapping M:N Relationships



LECTURER

staff_id	lname	fname	....

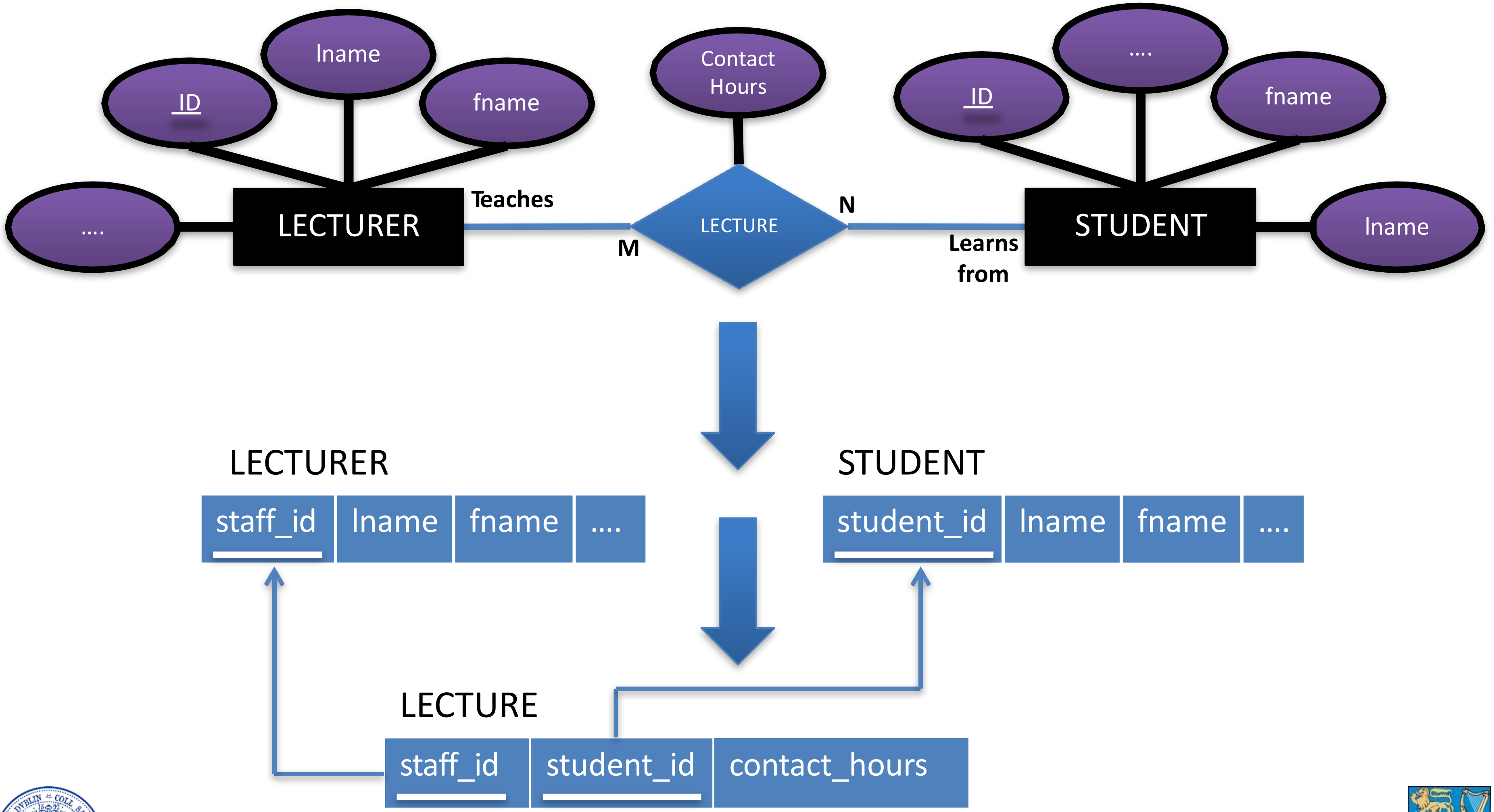
STUDENT

student_id	lname	fname	....

LECTURE

staff_id	student_id

Mapping M:N Relationships



LECTURER

staff_id	lname	fname	....

STUDENT

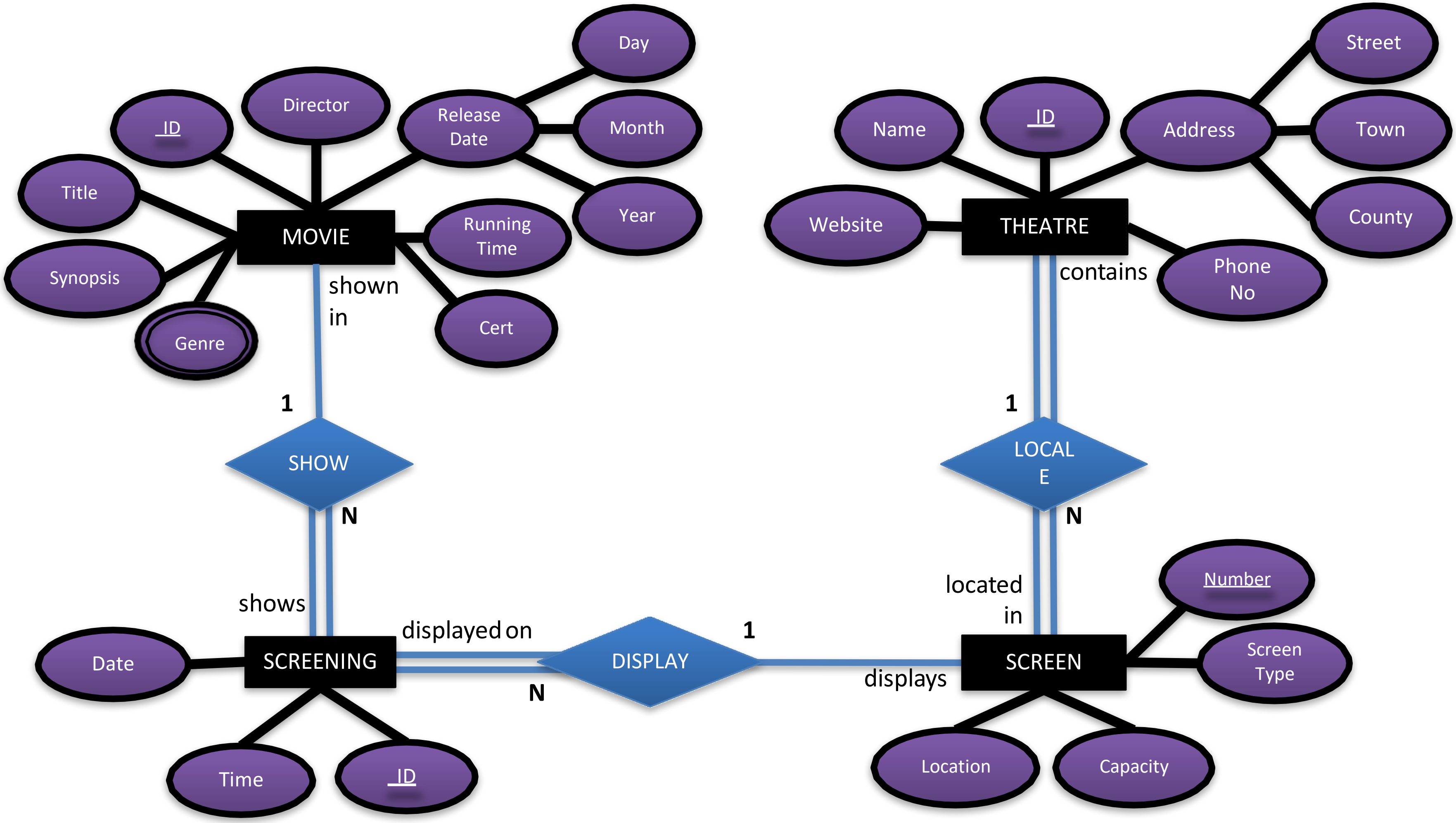
student_id	lname	fname	....

LECTURE

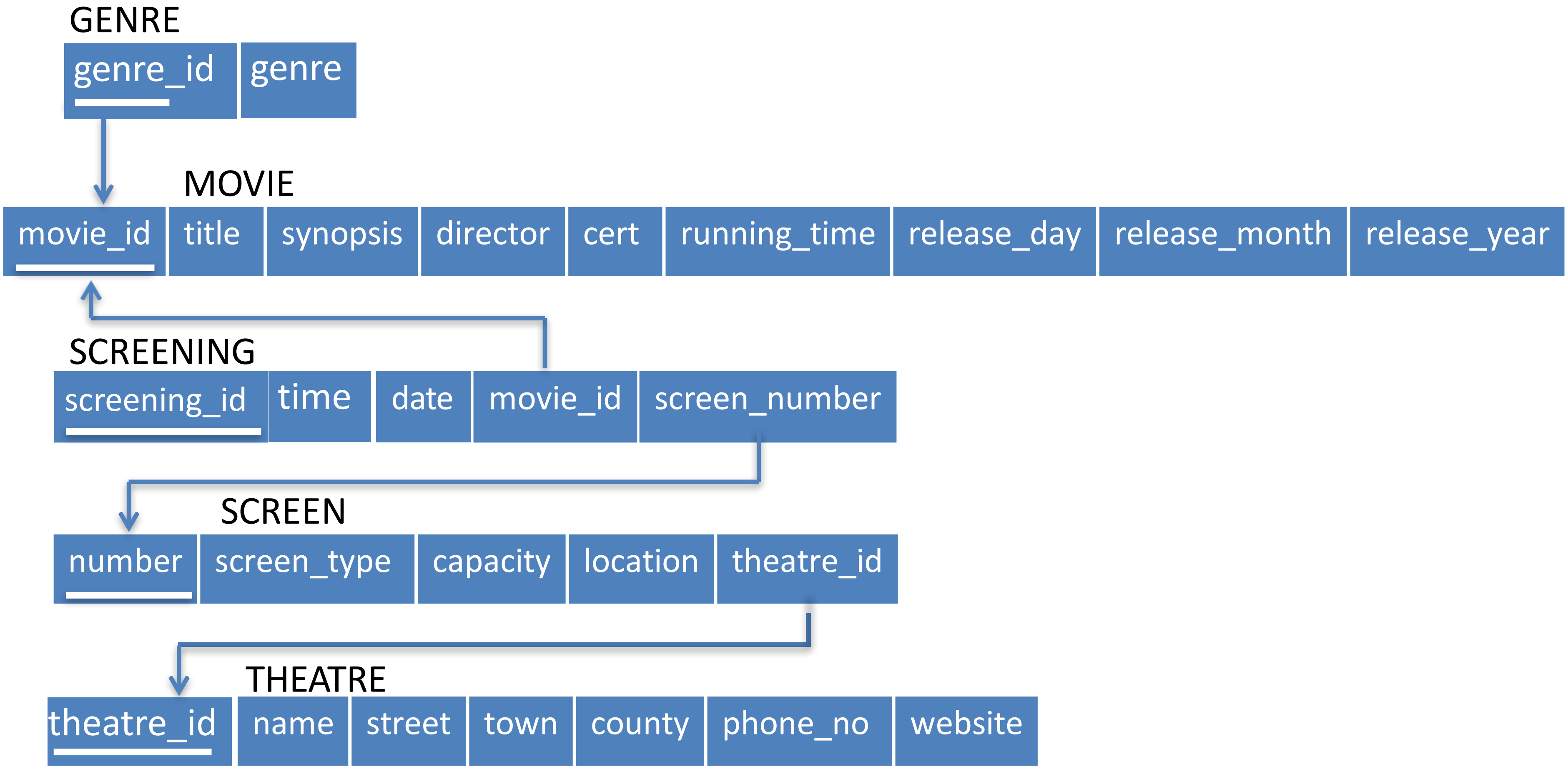
staff_id	student_id	contact_hours

Cinema Example

Cinema Example



Cinema Example



GENRE

genre_id	genre

MOVIE

movie_id	title	synopsis	director	cert	running_time	release_day	release_month	release_year

SCREENING

screening_id	time	date	movie_id	screen_number

SCREEN

number	screen_type	capacity	location	theatre_id

THEATRE

theatre_id	name	street	town	county	phone_no	website