Database Course

1

General Information

- **TAs**:
  - Sara Cohen
  - Jonathan Mamou
- **Course Email:** db@cs.huji.ac.il
- **Moderated Newsgroup:** local.course.db.ta
- **Students Newsgroup:** local.course.db.stud
- **Course Homepage:** http://www.cs.huji.ac.il/~db

2

Assignments (1)

- **About** 10 assignments
- Weight is between 15-30 percent of final grade
- **All assignments must be handed in!**
- **Assignments are done alone!**

3

Assignments (2)

- Submission of Assignments:
  - Theoretical assignments - in the box in Ross -2
  - Programming assignments - electronic submission
- Assignments are returned in Ross -2, grades available via the internet
- Make sure that you have a grade when the exercise is returned!

4

Appeals and Extensions

- Appeals are submitted in the box in Ross -2
- Appeal form available via the internet
- Appeals should be submitted **not later** than 1 week after assignments are returned
- Extensions are possible in special cases (I.e., miluim, childbirth, etc.).
- Ask for the extension **before** the due date

5

Notes

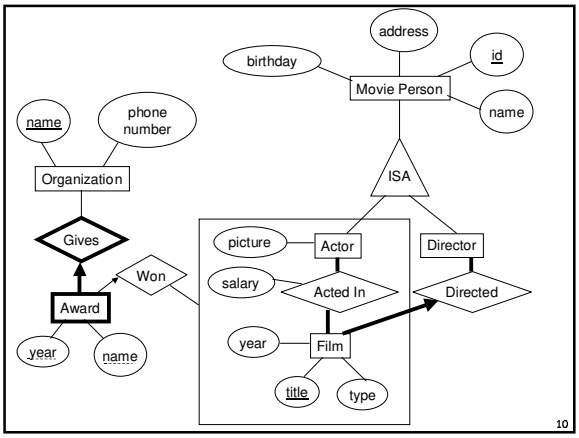
- **Jonathan Mamou** will deal with most problems that are related to the assignments
- **Sara Cohen** will deal with most problems that are related to the tirgul material
- Tirgulim will usually be taught without slides. However, ***incomplete*** lecture notes (in slide format) will usually be available via the internet

6

Entity-Relationship Diagrams

Database Course, Fall 2003

7



10

Scenario

- http://www.imdb.com wants to store information about movies
- Three steps:
  - Requirements Analysis: Discover what information needs to be stored, how the stored information will be used, etc. Taught in "System Analysis and Design" (Offer Drori)
  - Conceptual Database Design: High level description of data to be stored (ER model)
  - Logical Database Design: Translation of ER diagram to a relational database schema (description of tables)

8

Entities, Entity Sets

- **Entity** (ישות): An object in the world that can be distinguished from other objects
  - Examples of entities:
  - Examples of things that are not entities:
- **Entity set** (קבוצת ישויות): A set of similar entities
  - Examples of entity sets:

  ✐ Entity sets are drawn as rectangles

11

Example Requirements

- http://www.imdb.com wants to store information about films
- For actors and directors, we want to store their name, a unique identification number, address and birthday (why not age?)
- For actors, we also want to store a photograph
- For films, we want to store the title, year of production and type (thriller, comedy, etc.)
- We want to know who directed and who acted in each film. Every film has one director. We store the salary of each actor for each film
- An actor can receive an award for his part in a film. We store information about who got which award for which film, along with the name of the award and year.
- We also store the name and telephone number of the organization who gave the award. Two different organizations can give an award with the same name. A single organization does not give more than one award with a particular name per year.

9

Attributes

- **Attributes** (תכונות): Used to describe entities
  - All entities in the set have the same attributes
  - A minimal set of attributes that uniquely identify an entity is called a **key**
  - An attribute contains a single piece of information (and not a list of data)

12

Attributes (2)

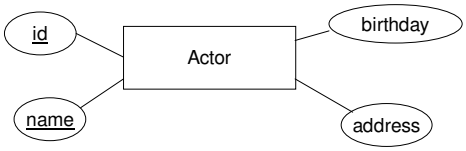
- Examples of attributes:
- Examples of things that cannot be attributes:

✎ Attributes are drawn using ovals

✎ The names of the attributes which make up a key are underlined

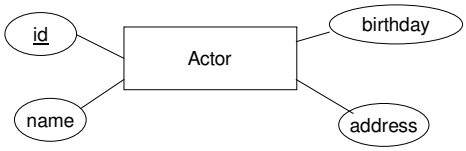
13

Another Option for a Key?



16

Example



14

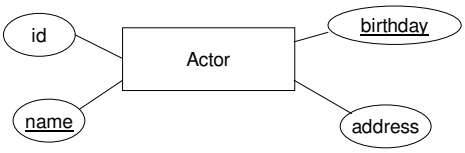
Relationships, Relationship Sets

- **Relationship** (קשר): Association among two or more entities
  - Relationships may have attributes
  - Examples of Relationships:
- **Relationship Set** (קבוצת קשרים): Set of similar relationships
  - Examples of Relationship sets:

✎ Relationship sets are drawn using diamonds

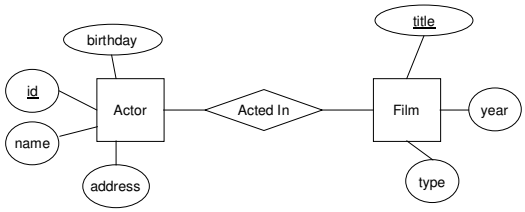
17

Another Option for a Key?



15

Example



Where does the salary attribute belong?

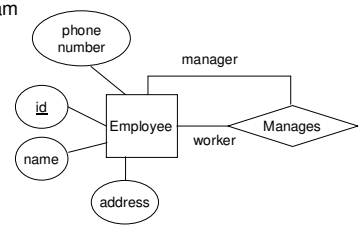
salary

18

Recursive Relationships

An entity set can participate more than once in a relationship

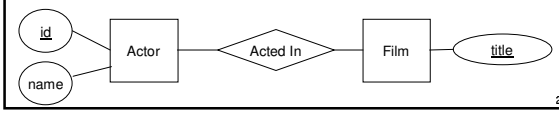
In this case, we add a description of the role to the ER - diagram



19

Important Note

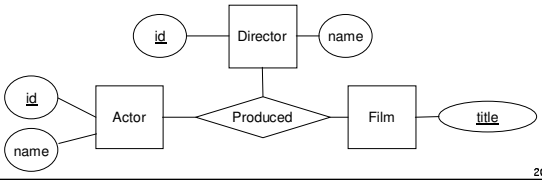
- The entities in a relationship set must identify the relationship
- Attributes of the relationship set cannot be used for identification!
- Suppose we wanted to store the role of an actor in a film.
- How would we store information about a person who acted in one film in several roles?



22

n-ary Relationship

- An *n*-ary relationship *R* set involves exactly *n* entity sets: E_1, …, E_n.
- Each relationship in *R* involves exactly *n* entities: $e_1 \varepsilon E_1$, …, $e_n \varepsilon E_n$
- Formally, $R \subseteq E_1 x \ldots x E_n$



20

Key Constraints (אילוצי מפתח)

- Key constraints specify whether an entity can participate in one, or more than one, relationships in a relationship set
- When there is no key constraint an entity can participate any number of times
- When there is a key constraint, the entity can participate **at most one time**

➢ Key constraints are drawn using an arrow from the entity set to the relationship set

23

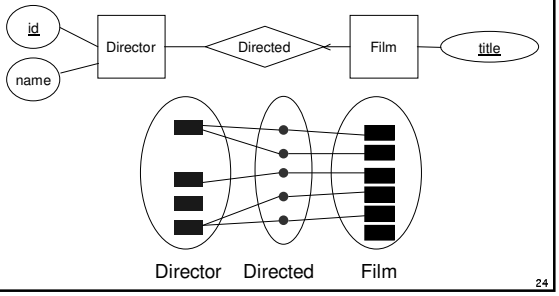
Another Option: Remember Recursive Relationships

21

One-to-Many

✓ A film is directed at most one director

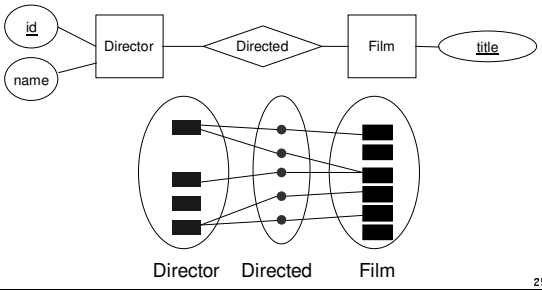
✓ A director can direct any number of films



24

Many-to-Many

- ✓ A film is directed by any number of directors
- ✓ A director can direct any number of films

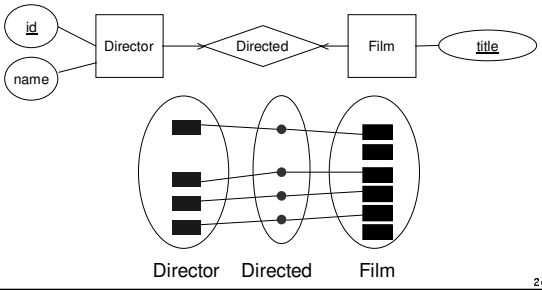


Director Directed Film

25

One-to-One

- ✓ A film is directed by at most one director
- ✓ A director can direct at most one film

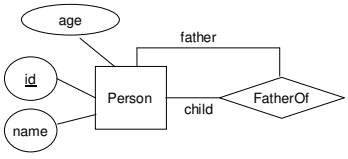


Director Directed Film

26

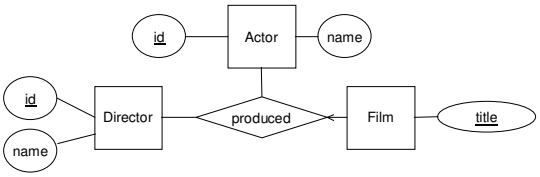
Another Example

Where would you put the arrow?



27

Key Constraints in Ternary Relationships



What does this mean?

28

Participation Constraints (אילוצי השתתפות)

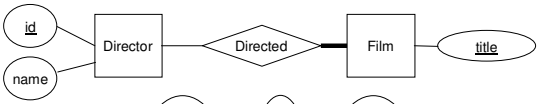
- Participation constraints specify whether or not an entity must participate in a relationship set
- When there is no participation constraint, it is possible that an entity will not participate in a relationship set
- When there is a participation constraint, the entity must participate **at least once**

✍ Participation constraints are drawn using a thick line from the entity set to the relationship set

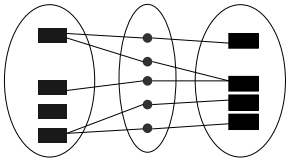
29

Example (1)

- A film has at lease one director
- A director can direct any number of films



Do you think that there should be a participation constraint from Director to Directed?

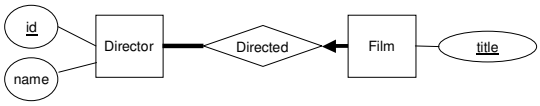


Director Directed Film

30

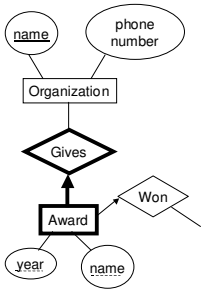
Example (2)

- We can combine key and participation constraints.
- What does this diagram mean?



31

Example (1)



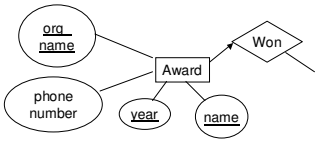
34

Weak Entity Sets

- Weak entity sets are entity sets that are not uniquely identified by their attributes
- A weak entity set has an "identifying relationship" with an entity set that is the "identifying owner" of the weak entity set

32

2 Reasons Why Not:



35

Weak Entity Sets

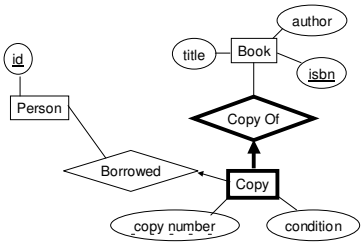
A weak entity set must:

- participate fully in the identifying relationship (✎ a thick line)
- participate in a one to many relationship with the identifying owner (✎ an arrow)

✎ Weak entity sets have a thick rectangle, their keys are underlined with a broken line, and the identifying relationship has a thick diamond

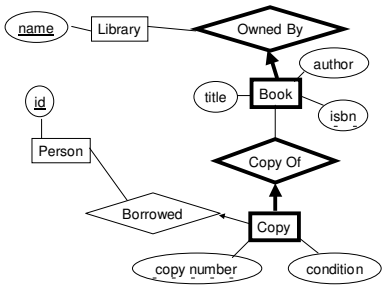
33

Example



36

What if We Store Information About Many Libraries?



37

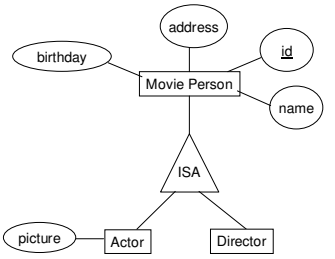
ISA Hierarchies

ISA Relationships: Define a hierarchy between entity sets

- ISA is similar to inheritance
- ISA relationships are drawn as a triangle with the word ISA inside it. The "super entity-set" is above the triangle and the "sub entity-sets" are below

38

Example



What are the keys of:

1. Movie Person
2. Actor
3. Director

39

Overlap Constraints

- **Overlap constraints:** Determine whether two sub-entity sets can contain the same entity
  - Example: Can an Actor be a Director?
  - Write "Actor OVERLAPS Director". If not written, assume no overlap

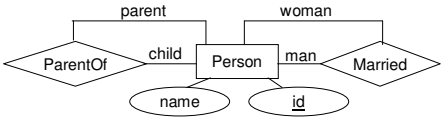
40

Covering Constraints

- **Covering constraints:** Determine whether every entity in the super-entity set is also in at least one of the sub-entity sets
  - Example: Is every movie person either an Actor or a Director?
  - Write "Actor AND Director COVER Movie Person". If not written, assume no covering

41

Example



Is this good?

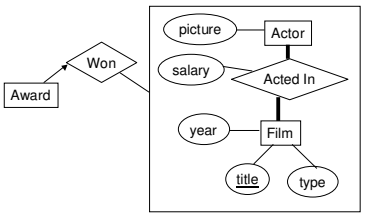
42

Aggregation

- **Aggregation:** Allows us to indicate that a relationship set participates in a relationship set

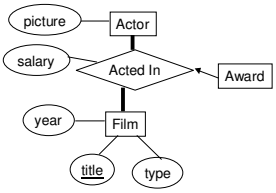
43

Example



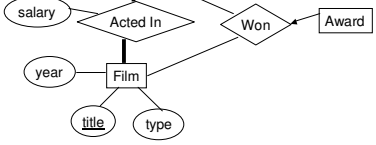
44

1 Reason Why Not:



45

1 Reason Why Not:



46