Database Course

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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

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Assignments (1)

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

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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!

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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

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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

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Entity-Relationship Diagrams

Database Course, Fall 2003

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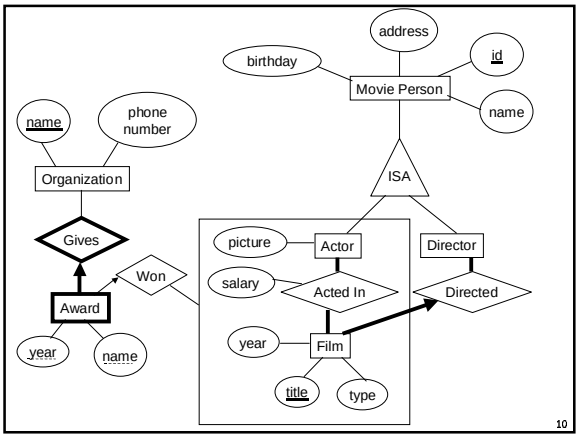

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Scenario

- 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)

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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

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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 wi th the same name. A single organization does not give more than one award with a particular name per year.

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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)

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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

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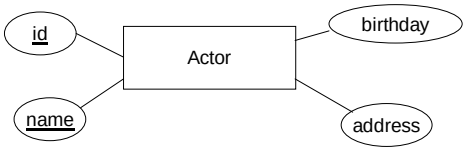
Another Option for a Key?



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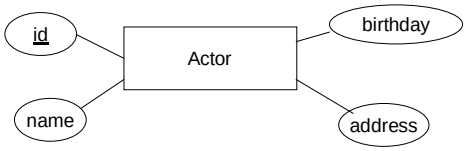
Example



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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

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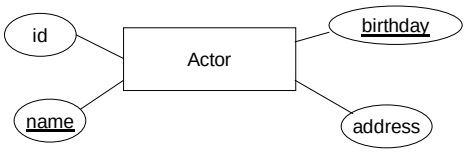
Another Option for a Key?



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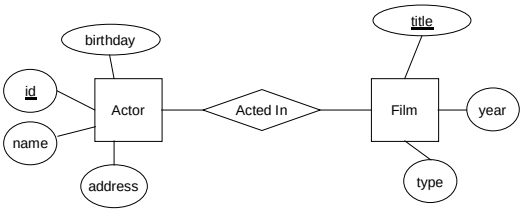
Example



Where does the salary attribute belong?

salary

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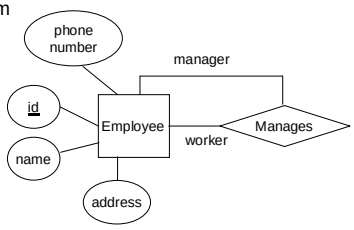
Recursive Relationships

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



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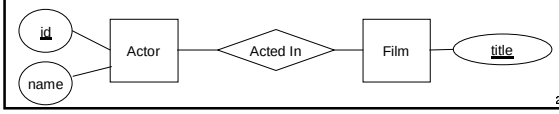
Important Note

- 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?



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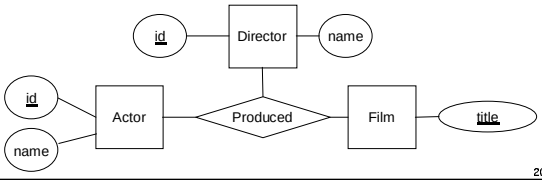
n-ary Relationship

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



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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

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Another Option: Remember Recursive Relationships

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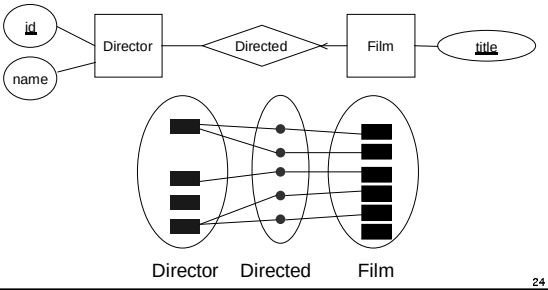
One-to-Many

- ✓ A film is directed at most one director
- ✓ A director can direct any number of films



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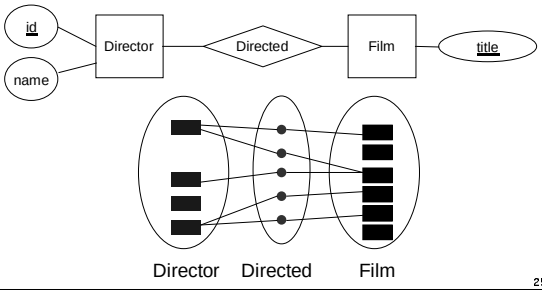
Many-to-Many

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



Director Directed Film

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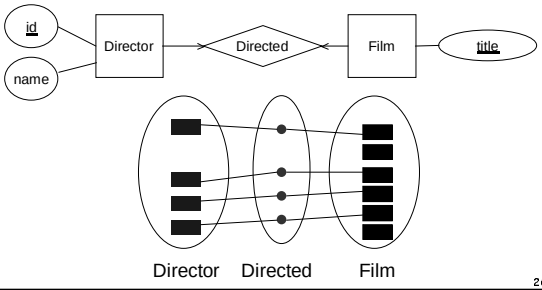
One-to-One

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



Director Directed Film

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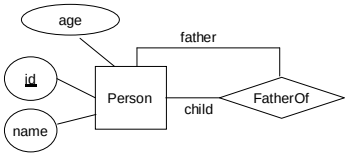
Another Example

Where would you put the arrow?



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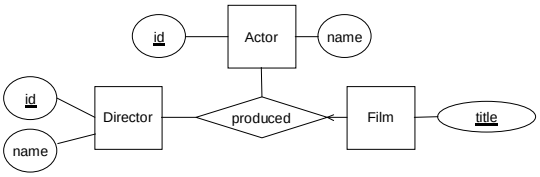
Key Constraints in Ternary Relationships



What does this mean?

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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

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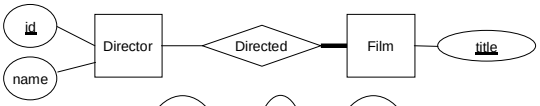
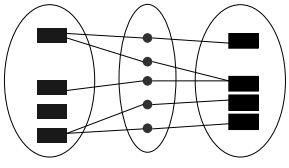
Example (1)

- 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

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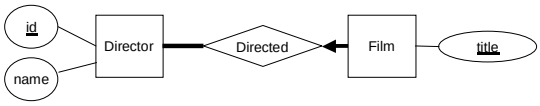
Example (2)

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



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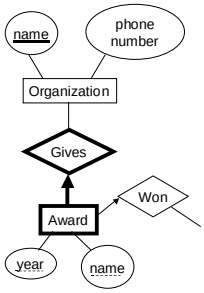
Example (1)



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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

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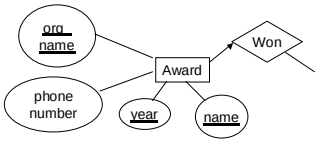
2 Reasons Why Not:



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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

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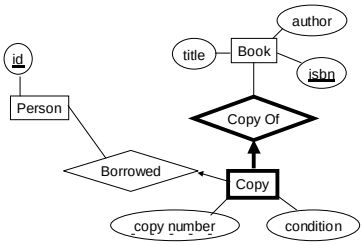
Example



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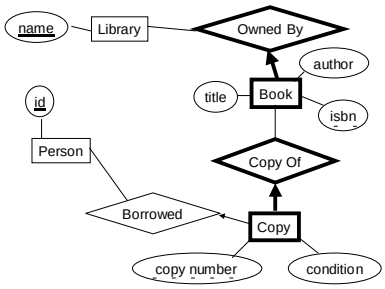
What if We Store Information About Many Libraries?



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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

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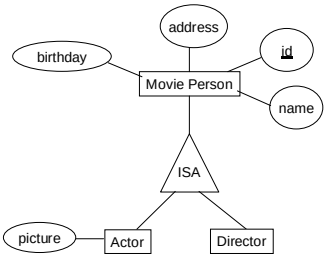
Example



What are the keys of:

1. Movie Person
2. Actor
3. Director

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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

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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

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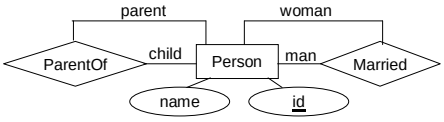
Example



Is this good?

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Aggregation

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

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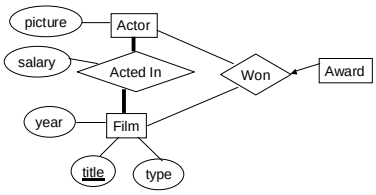
1 Reason Why Not:



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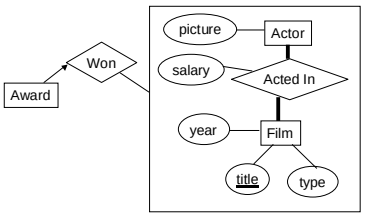
Example



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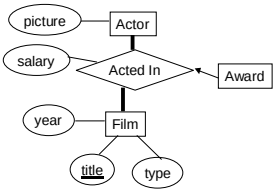
1 Reason Why Not:



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