Relational Database Design: E/R-Relational Translation

Introduction to Databases

CompSci 316 Spring 2020

DUKE COMPUTER SCIENCE

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Announcements (Thu. Jan. 30)

- HW2/Lab1 due tonight (Thurs, Jan 30, 11:59 pm)
- HW3 Q1-Q3 posted
  - Q4, extra credit to be posted next week after the material is covered in class
  - Many parts, start early!
- Please form your groups by next Thursday Feb 6!
  - So that we can help you find a group if needed well before MS1 is due
  - Project formation spreadsheet shared
  - 5 members for standard projects please! (otherwise we may have to shuffling later, better if you do it yourself)
  - If you want to do an open project, let me know asap

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Announcements – contd. (Thu. Jan. 30)

- HW extension requests (See the course policy)
  - We cannot accommodate requests for "I need more time" to be fair to all
  - For unforeseen situations not in our control like medical reasons, you **must submit an incapacitation form and copy your academic dean** while requesting an extension and mention the extra time you need (typically 1-2 days).
  - Make sure that you have an email from me accepting the extension request and specifying the deadline.
  - That deadline is final for you and late submissions with penalty do not apply
  - Be careful as the next hw would be posted

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Database design steps: review

- Understand the real-world domain being modeled
- Specify it using a database design model (e.g., E/R)
- Translate specification to the data model of DBMS (e.g., relational)
- Create DBMS schema

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Today

You designed an ER digram

Translate it to a Relational Database

Train (*number*, *engineer*, *type*)
Station (*name*, *address*, *type*)
TrainStop (*train_number*, *station_name*, *time*)

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E/R model: review

- Entity sets
  - Keys
  - Weak entity sets
- Relationship sets
  - Attributes on relationships
  - Multiplicity
  - Roles
  - Binary versus n-ary relationships
    - Modeling n-ary relationships with weak entity sets and binary relationships
  - ISA relationships

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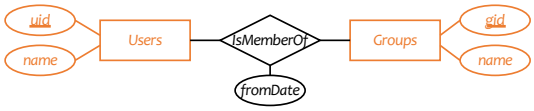
Translating entity sets

- An entity set translates directly to a table
  - Attributes → columns
  - Key attributes → key columns



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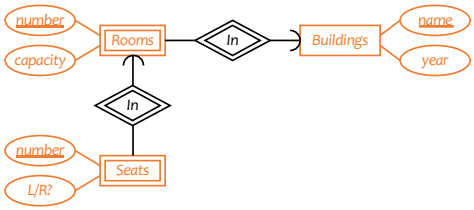
Translating weak entity sets

- Remember the "borrowed" key attributes
- Watch out for attribute name conflicts



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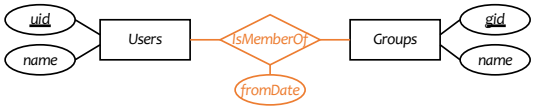
Translating relationship sets

- A relationship set translates to a table
  - Keys of connected entity sets → columns
  - Attributes of the relationship set (if any) → columns
  - Multiplicity of the relationship set determines the key of the table



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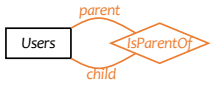
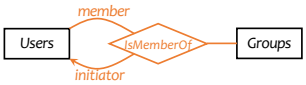
More examples



Parent (parent_uid, child_uid)



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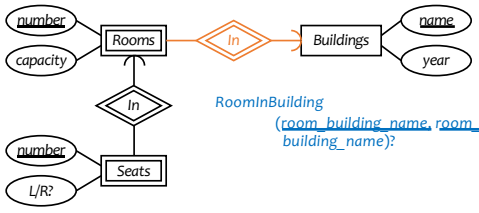
Translating double diamonds?



RoomInBuilding
(room_building_name, room_number, building_name)?

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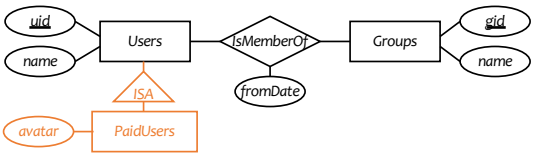
Translating subclasses & ISA



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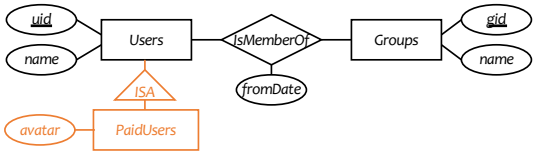
Translating subclasses & ISA: approach 1

- Entity-in-all-superclasses approach ("E/R style")



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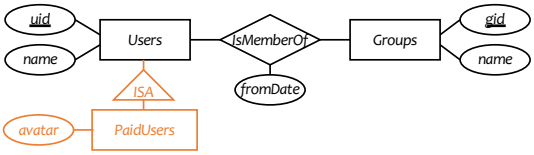
Translating subclasses & ISA: approach 2

- Entity-in-most-specific-class approach ("OO style")



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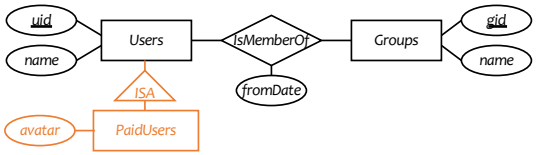
Translating subclasses & ISA: approach 3

- All-entities-in-one-table approach ("NULL style")



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Comparison of three approaches

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A complete example

- Design a database consistent with the following:
  - A station has a unique name and an address, and is either an express station or a local station
  - A train has a unique number and an engineer, and is either an express train or a local train
  - A local train can stop at any station
  - An express train only stops at express stations
  - A train can stop at a station for any number of times during a day
  - Train schedules are the same everyday
- Draw the ER diagram and translate into relational model

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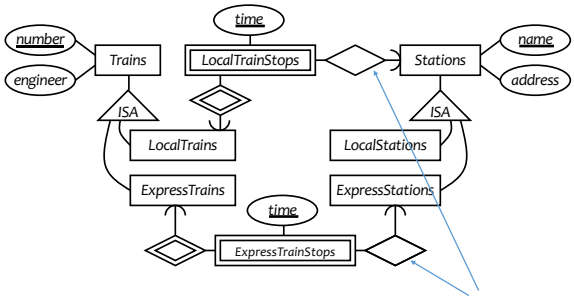
A complete example: ER diagram



Next, Relational Design!

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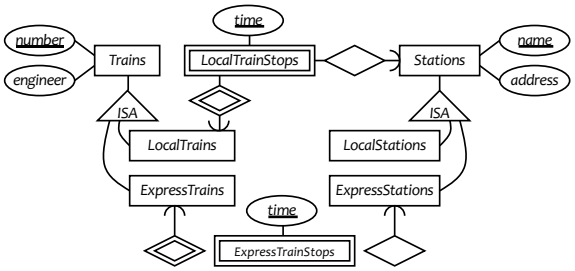
A complete example: ER diagram



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Simplifications and refinements

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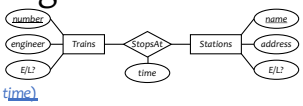
An alternative design

Train (*number*, *engineer*, *type*)
Station (*name*, *address*, *type*)
TrainStop (*train_number*, *station_name*, *time*)



- Encode the type of train/station as a column rather than creating subclasses
- What about the following constraints?
  - Type must be either "local" or "express"
  - Express trains only stop at express stations
- Arguably a better design because it is simpler!

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Warning: mechanical translation procedures given in this lecture are no substitute for your own judgment!

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Design principles

- KISS
  - Keep It Simple, Stupid
- Avoid redundancy
  - Redundancy wastes space, complicates modifications, promotes inconsistency
- Capture essential constraints, but don't introduce unnecessary restrictions
- Use your common sense

http://ungenius.files.wordpress.com/2010/03/thehomer.jpg

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Quick clarifications: RA questions

- What is "some"?
  - At least one
  - e.g., Drinkers frequent some bars that serve beer X
- What is "only"?
  - E.g., Drinkers frequent only bars that serve beer X
- What is "every"?
  - E.g., Drinkers frequent every bars that serve beer X

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