SQL Learning Quick Approach

DBMS LAB
CSE- 304

LECTURE -03

Motivation

- You’ve just been hired by Brac Bank as their DBA for their online banking web site.
- You are asked to create a database that monitors:
  - customers
  - accounts
  - loans
  - branches
  - transactions, …
- Now what??!!!

Database Design Steps

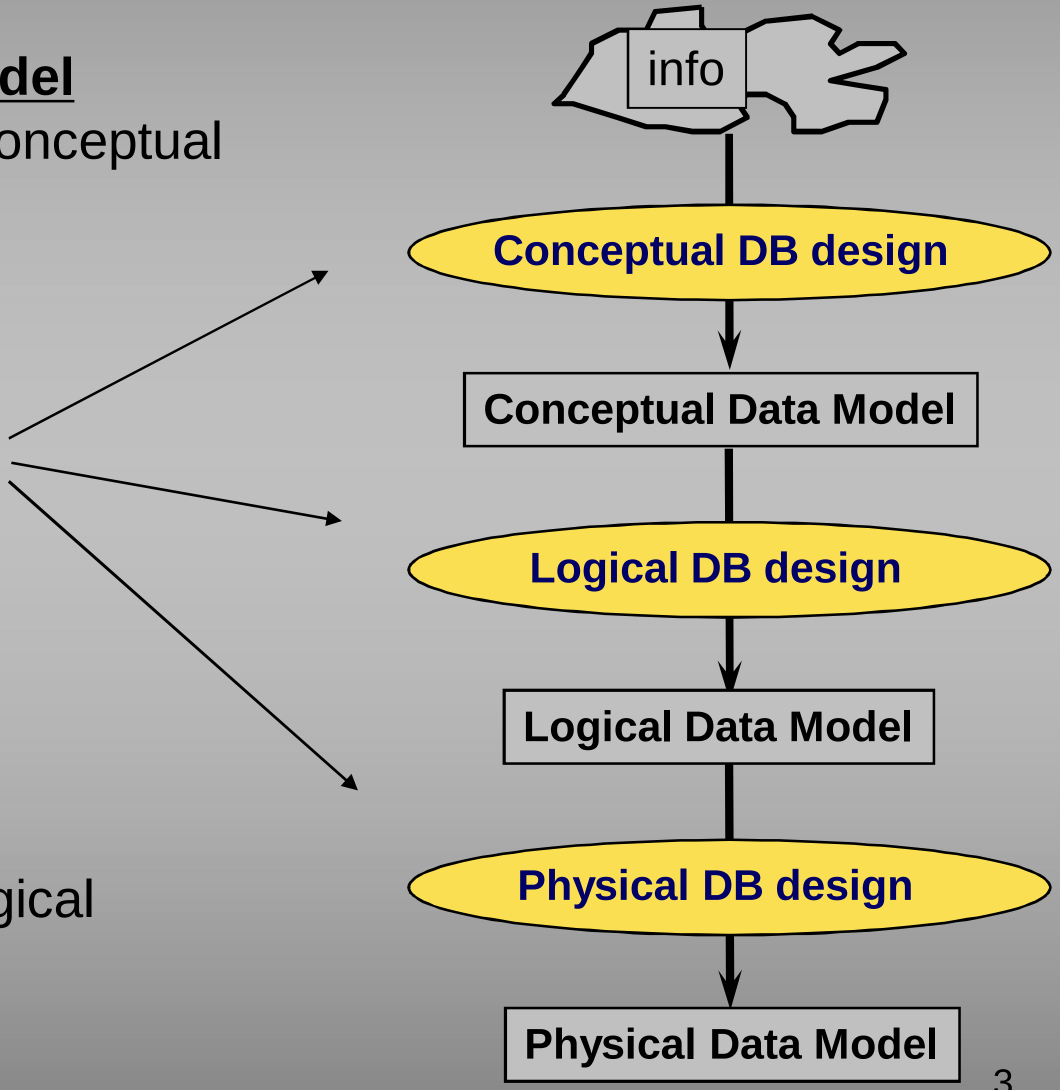
<u>Entity-relationship Model</u>

Typically used for conceptual database design

Three Levels of Modeling

<u>Relational Model</u>

Typically used for logical database design



info

Conceptual DB design

Conceptual Data Model

Logical DB design

Logical Data Model

Physical DB design

Physical Data Model

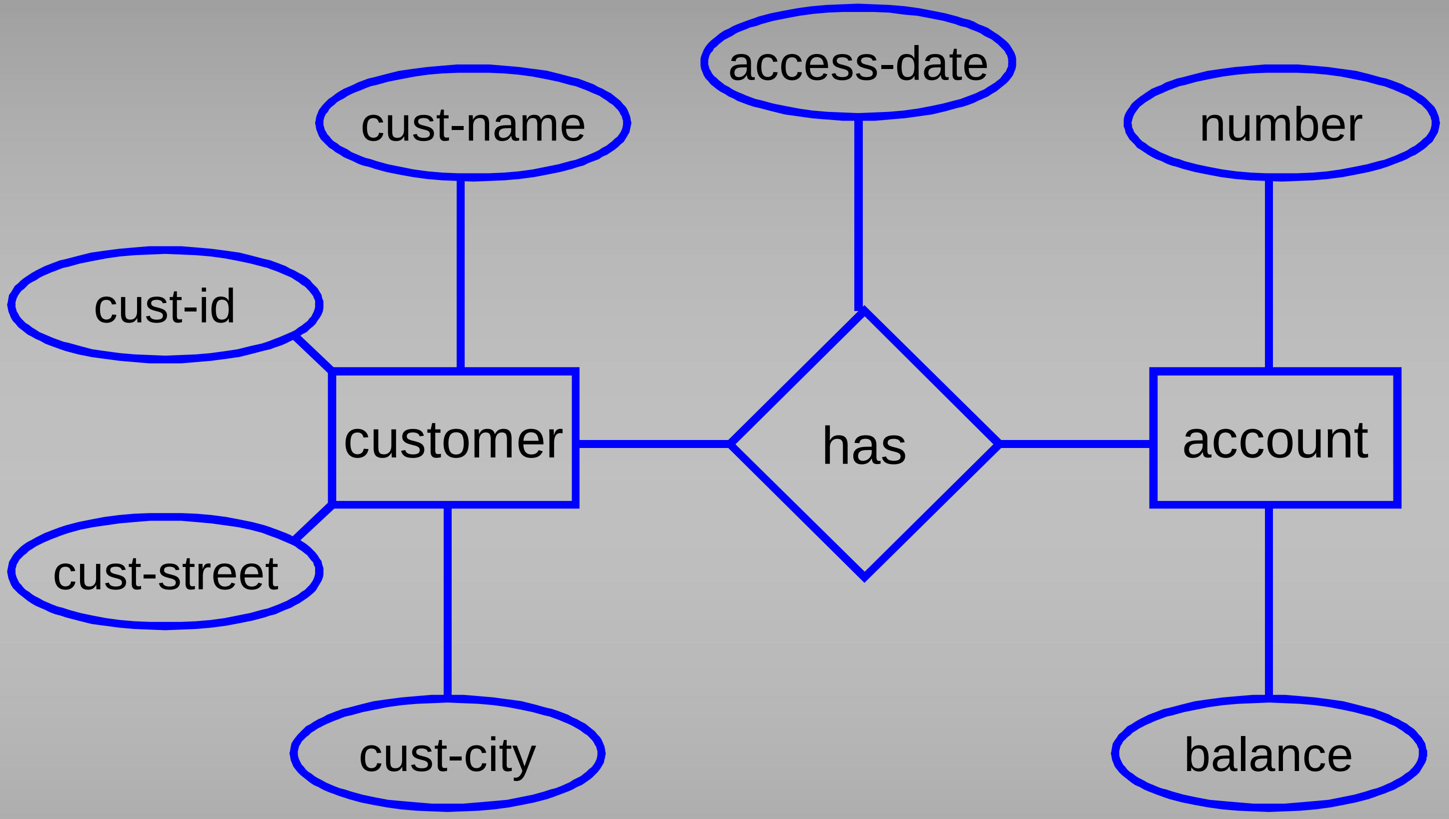
Entity-Relationship Model

- Two key concepts
  - Entities:
    - An object that exists and is distinguishable from other objects
      - Examples: Bob Smith, BofA, CMSC424
    - Have attributes (*people* have *names* and *addresses*)
    - Form entity sets with other entities of the same type that share the same properties
      - Set of all people, set of all classes
    - Entity sets may overlap
      - *Customers* and *Employees*

Entity-Relationship Model

- Two key concepts
  - Relationships:
    - Relate 2 or more entities
      - E.g. Bob Smith *has account at* College Park Branch
    - Form relationship sets with other relationships of the same type that share the same properties
      - Customers *have accounts at* Branches
    - Can have attributes:
      - has account at may have an attribute start-date
    - Can involve more than 2 entities
      - Employee works at Branch at Job

ER Diagram: Starting Example



- Rectangles: entity sets
- Diamonds: relationship sets
- Ellipses: attributes

Next: Relationship Cardinalities

- We may know:

  One customer can only open one account

  OR

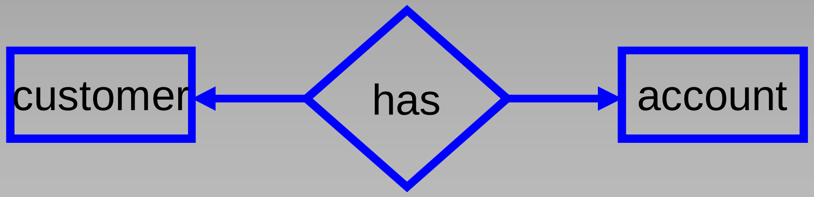
  One customer can open multiple accounts
- Representing this is important
- Why ?
  - Better manipulation of data
  - Can enforce such a constraint
  - Remember: If not represented in conceptual model, the domain knowledge may be lost

Mapping Cardinalities

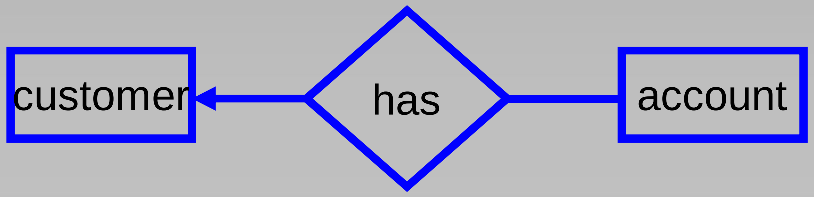
- Express the number of entities to which another entity can be associated via a relationship set
- Most useful in describing binary relationship sets

Mapping Cardinalities

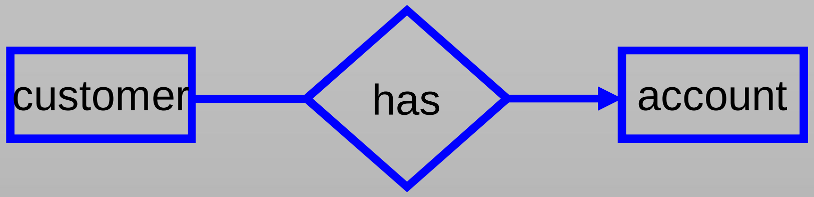
- One-to-One



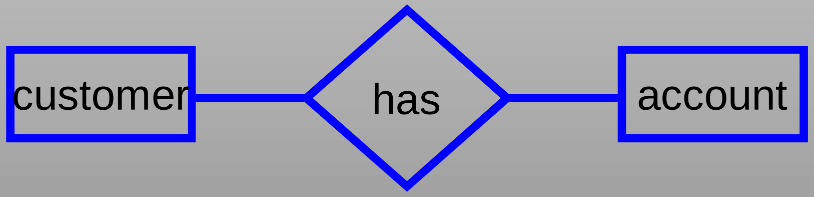
- One-to-Many



- Many-to-One



- Many-to-Many



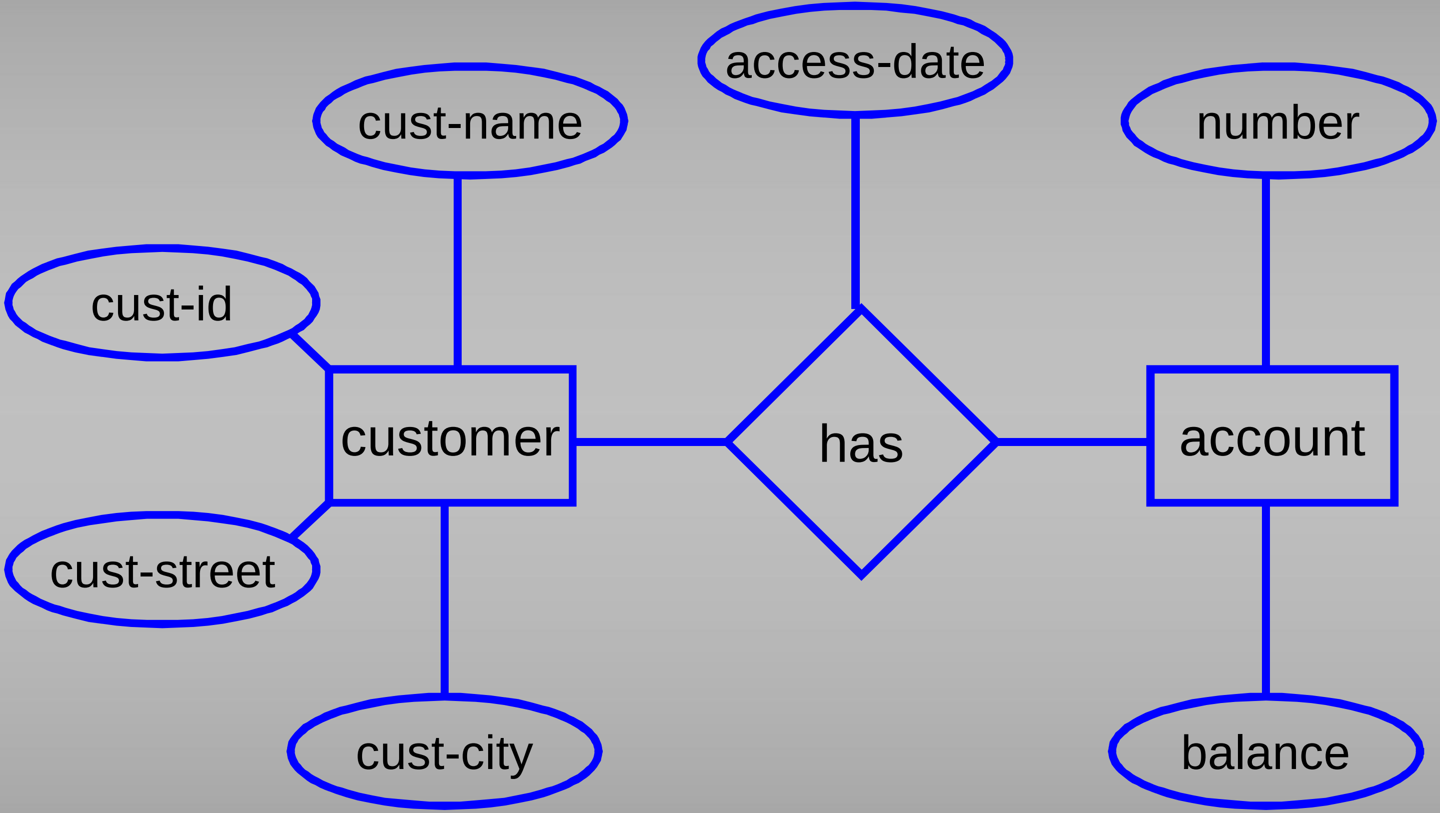
Mapping Cardinalities

- Express the number of entities to which another entity can be associated via a relationship set
- Most useful in describing binary relationship sets
- N-ary relationships ?

Next: Types of Attributes

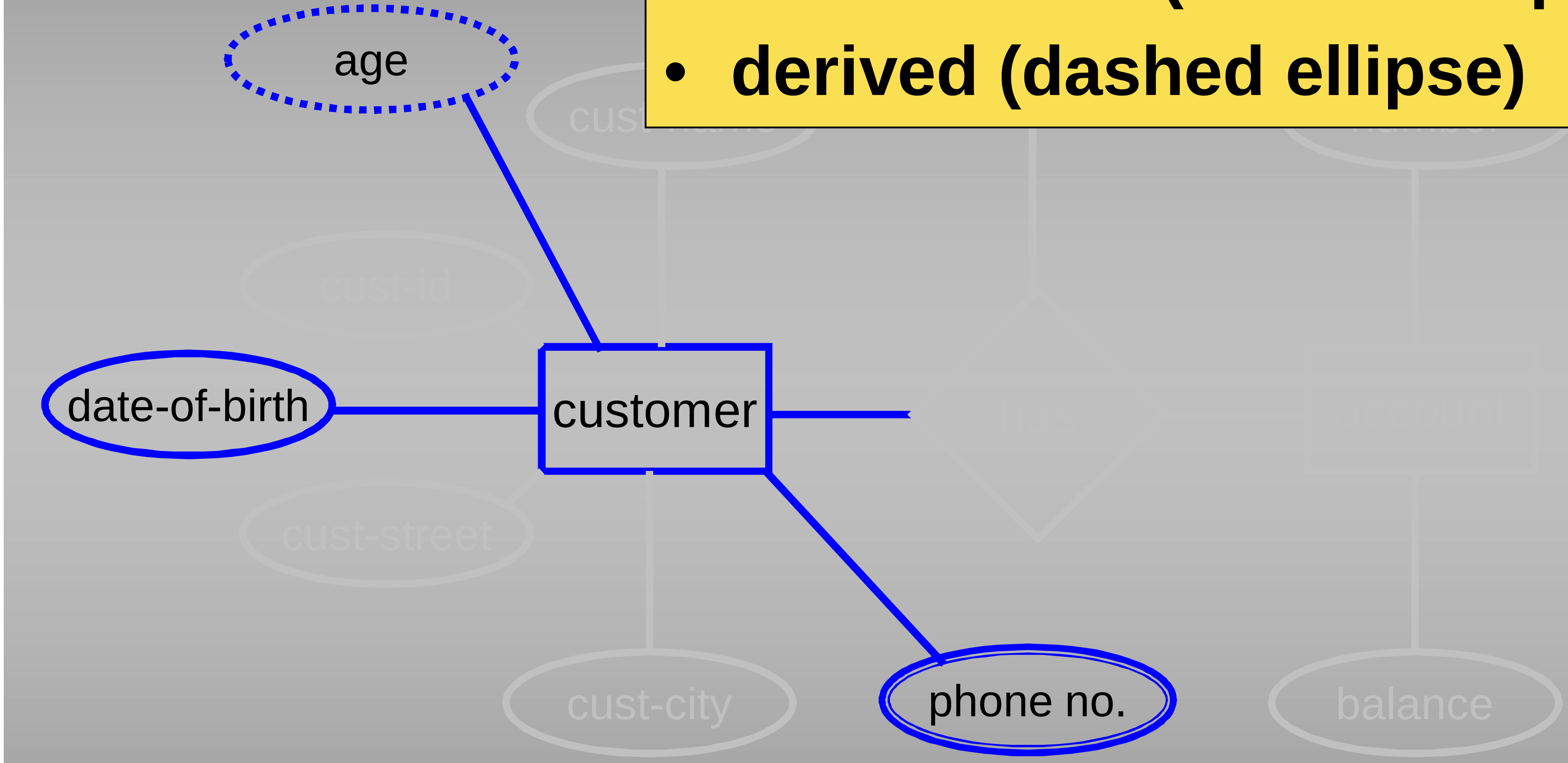
- Simple vs Composite
  - Single value per attribute ?
- Single-valued vs Multi-valued
  - E.g. Phone numbers are multi-valued
- Derived
  - If date-of-birth is present, age can be derived
  - Can help in avoiding redundancy, enforcing constraints etc…

Types of Attributes

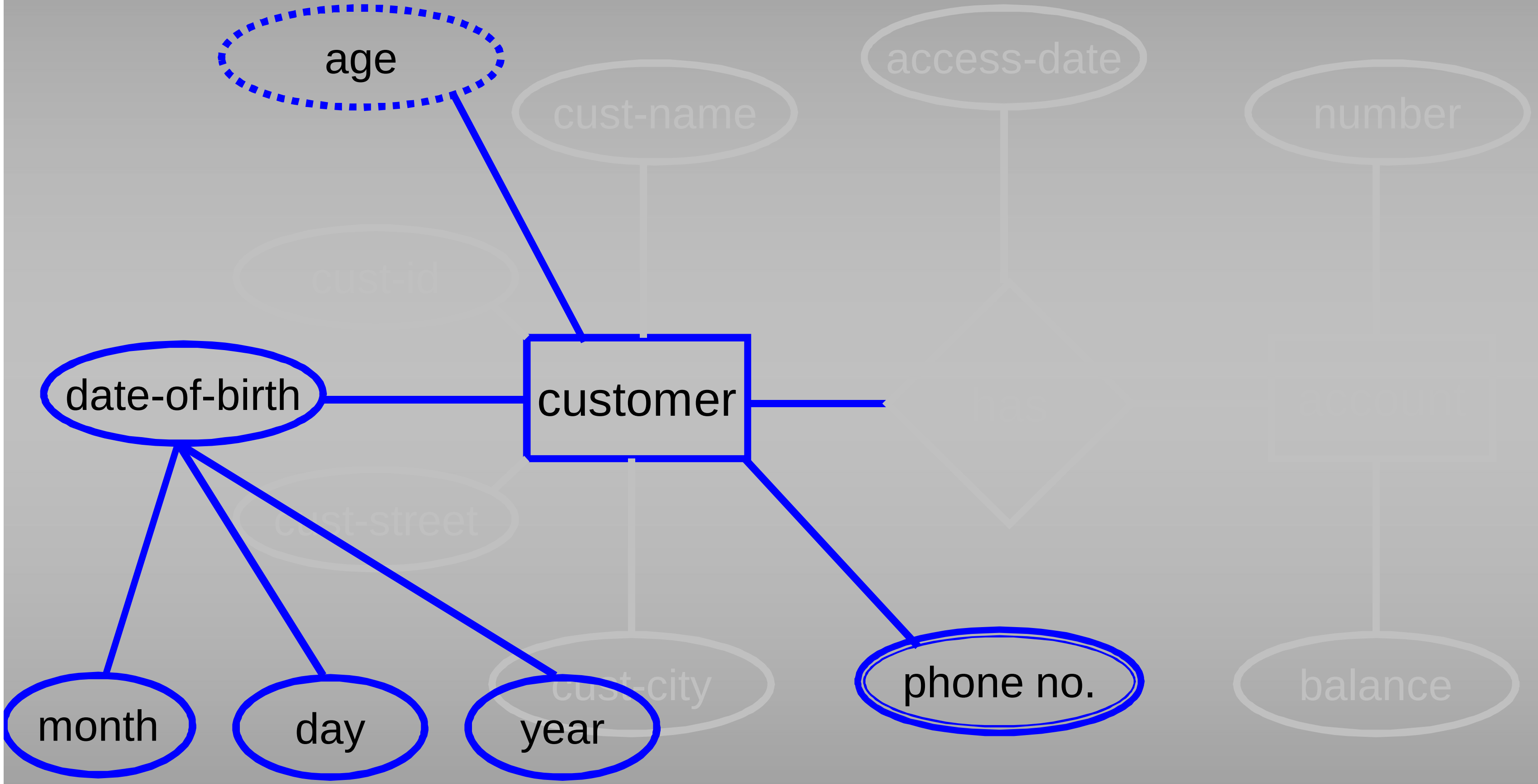


Types of Attributes

- **multi-valued (double ellipse)**
- **derived (dashed ellipse)**



Types of Attributes

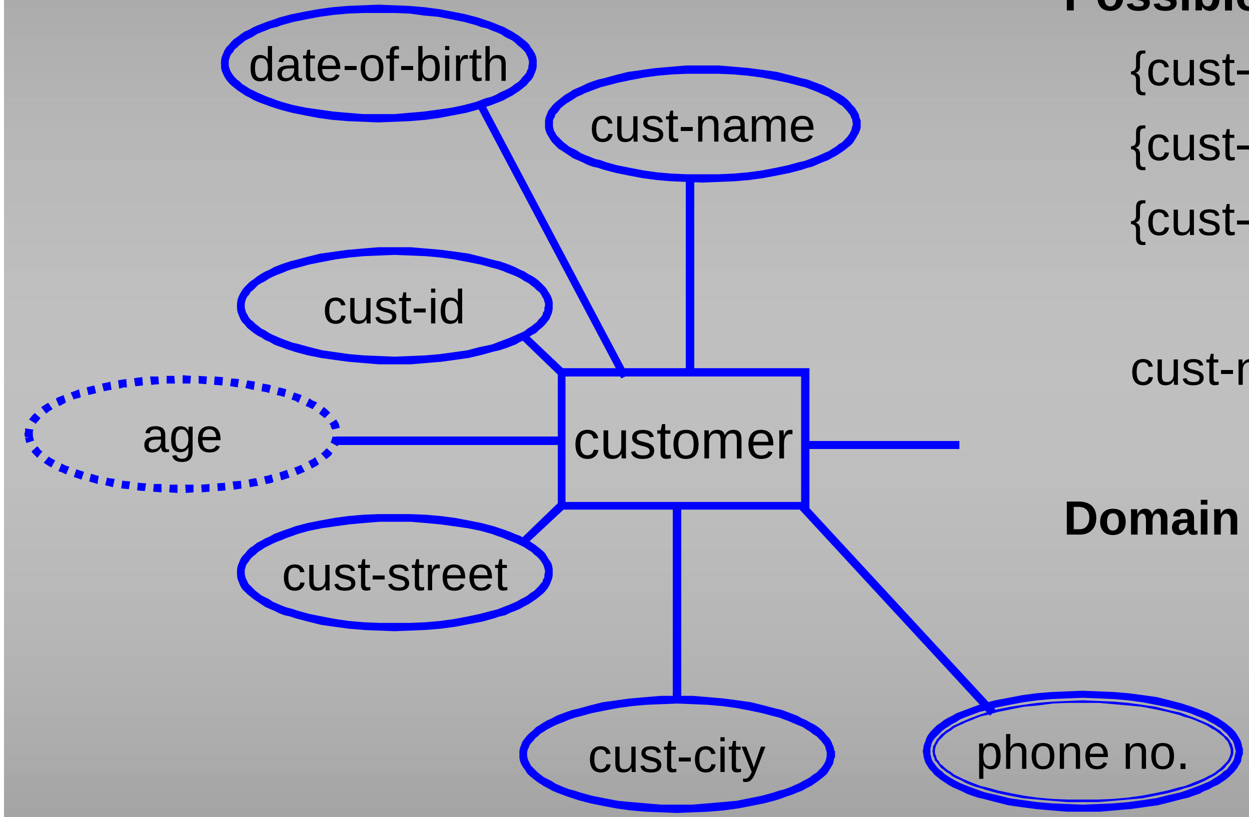


Composite Attribute

Next: Keys

- Key = set of attributes identifying individual entities or relationships

Entity Keys



Possible Keys:

{cust-id}

{cust-name, cust-city, cust-street}

{cust-id, age}

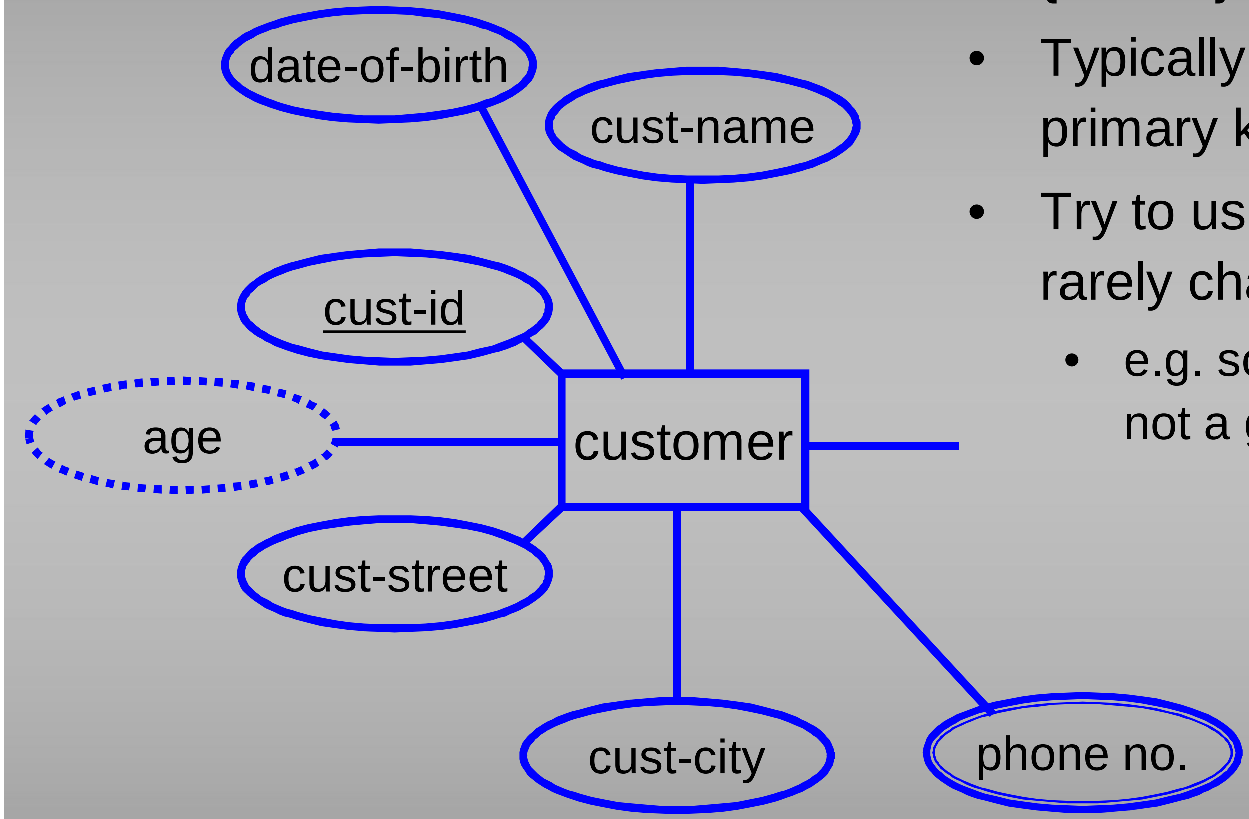
cust-name ?? Probably not.

Domain knowledge dependent !!

Entity Keys

- *Superkey*
  - any attribute set that can distinguish entities
- *Candidate key*
  - a minimal superkey
    - Can’t remove any attribute and preserve key-ness
      - {cust-id, age} not a superkey
      - {cust-name, cust-city, cust-street} is
        - assuming cust-name is not unique
- *Primary key*
  - Candidate key chosen as *the* key by DBA
  - Underlined in the ER Diagram

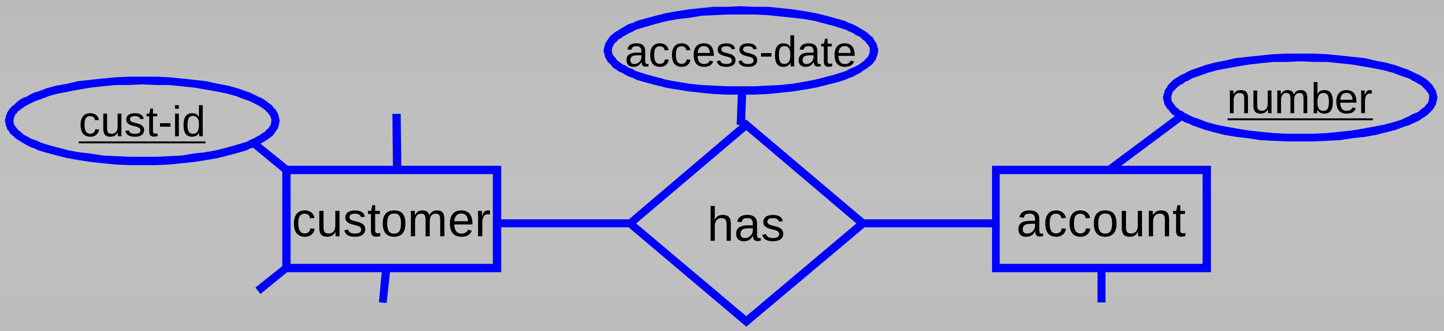
Entity Keys



- {*cust-id*} is a natural primary key
- Typically, SSN forms a good primary key
- Try to use a candidate key that rarely changes
  - e.g. something involving address not a great idea

Relationship Set Keys

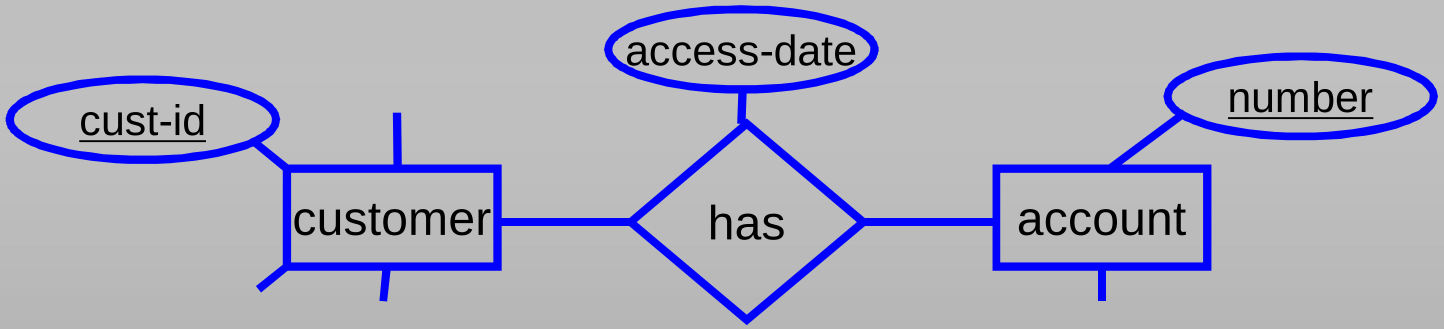
- What attributes are needed to represent a relationship completely and uniquely ?
  - Union of primary keys of the entities involved, and relationship attributes



  - *{cust-id, access-date, account number}* describes a relationship completely

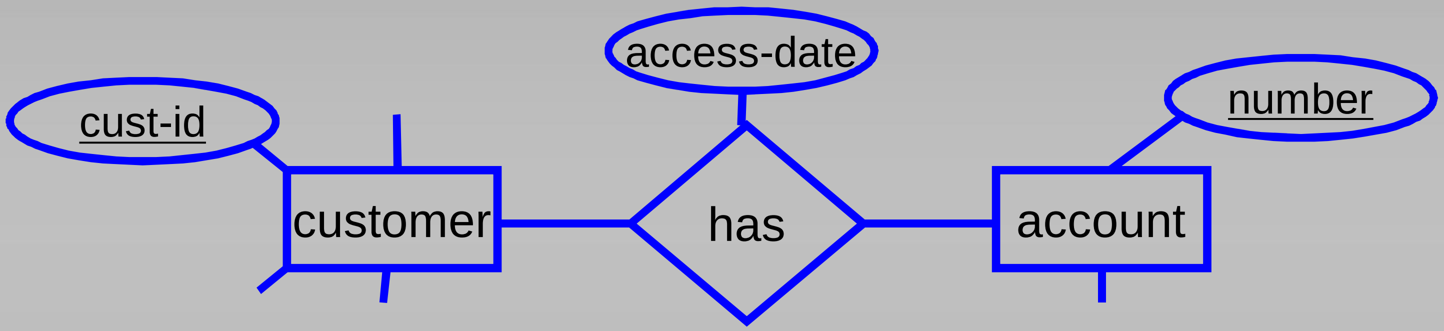
Relationship Set Keys

- Is *{cust-id, access-date, account number}* a candidate key *?*
  - No. Attribute *access-date* can be removed from this set without losing key-ness
  - In fact, union of primary keys of associated entities is always a superkey



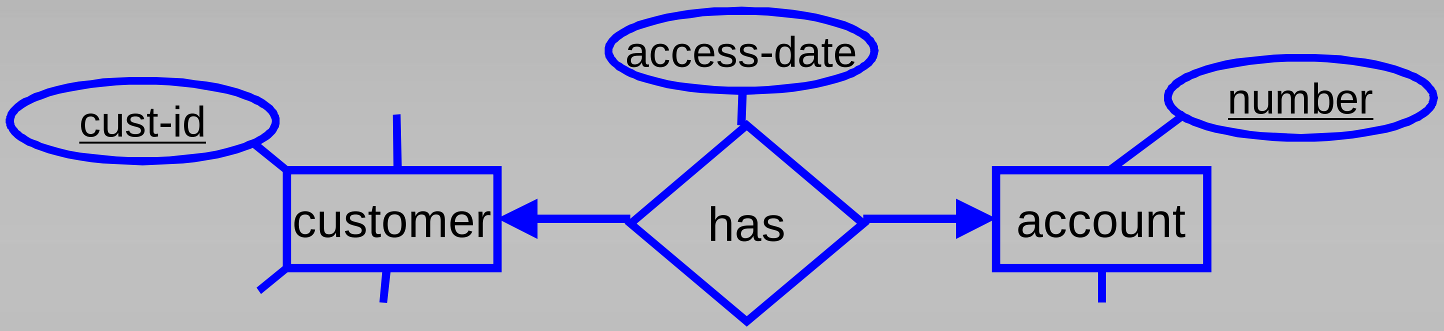
Relationship Set Keys

- Is {cust-id, account-number} a candidate key ?
    - Depends



Relationship Set Keys

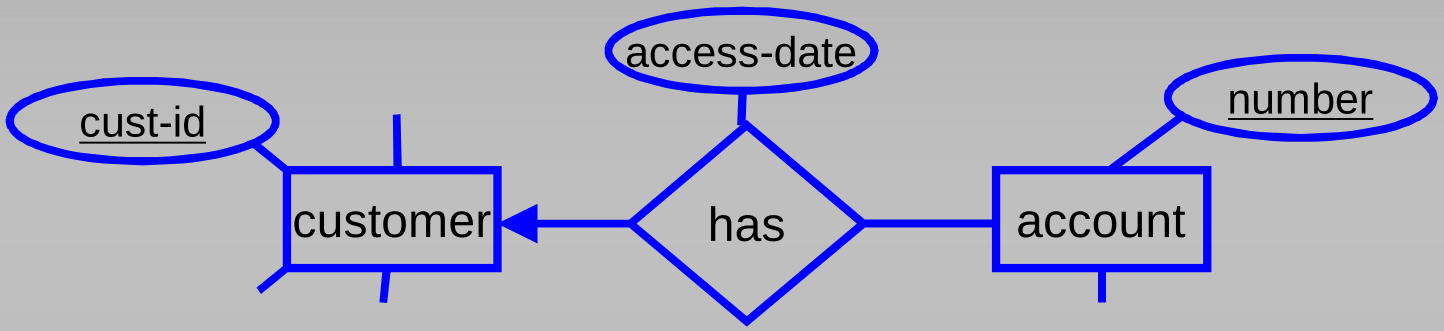
- Is {cust-id, account-number} a candidate key ?
  - Depends



- If one-to-one relationship, either *{cust-id}* or *{account-number}* sufficient
  - Since a given *customer* can only have one *account*, she can only participate in one relationship
  - Ditto *account*

Relationship Set Keys

- Is {cust-id, account-number} a candidate key ?
  - Depends



- If one-to-many relationship (as shown), *{account-number}* is a candidate key
  - A given customer can have many accounts, but at most one account holder per account allowed

Relationship Set Keys

- General rule for binary relationships
  - one-to-one: primary key of either entity set
  - one-to-many: primary key of the entity set on the many side
  - many-to-many: union of primary keys of the associate entity sets
- n-ary relationships
  - More complicated rules

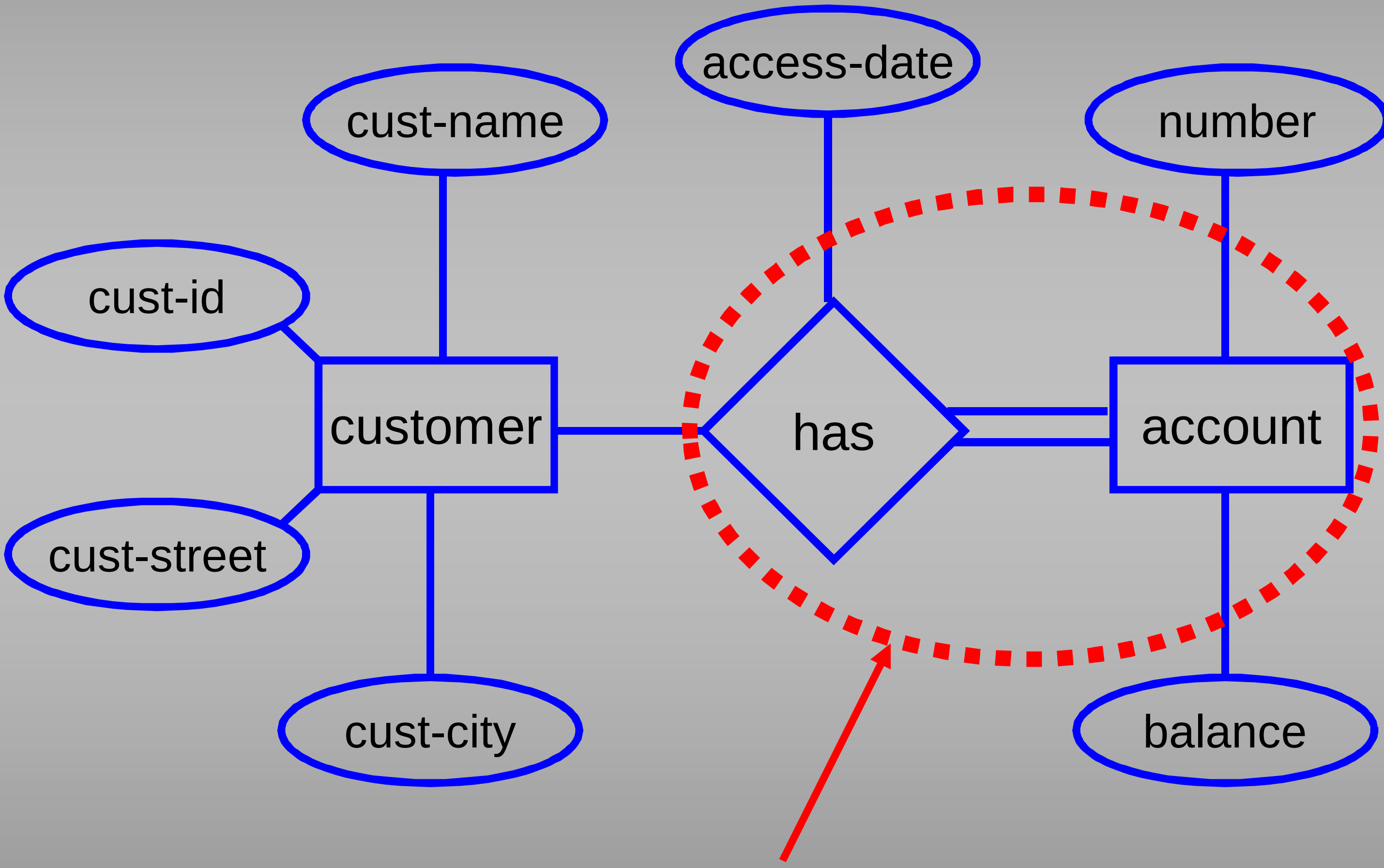
Next: Data Constraints

- Representing semantic data constraints
  - We already saw constraints on relationship cardinalities

Participation Constraint

- Given an entity set E, and a relationship R it participates in:
  - If every entity in E participates in at least one relationship in R, it is total participation
  - partial otherwise

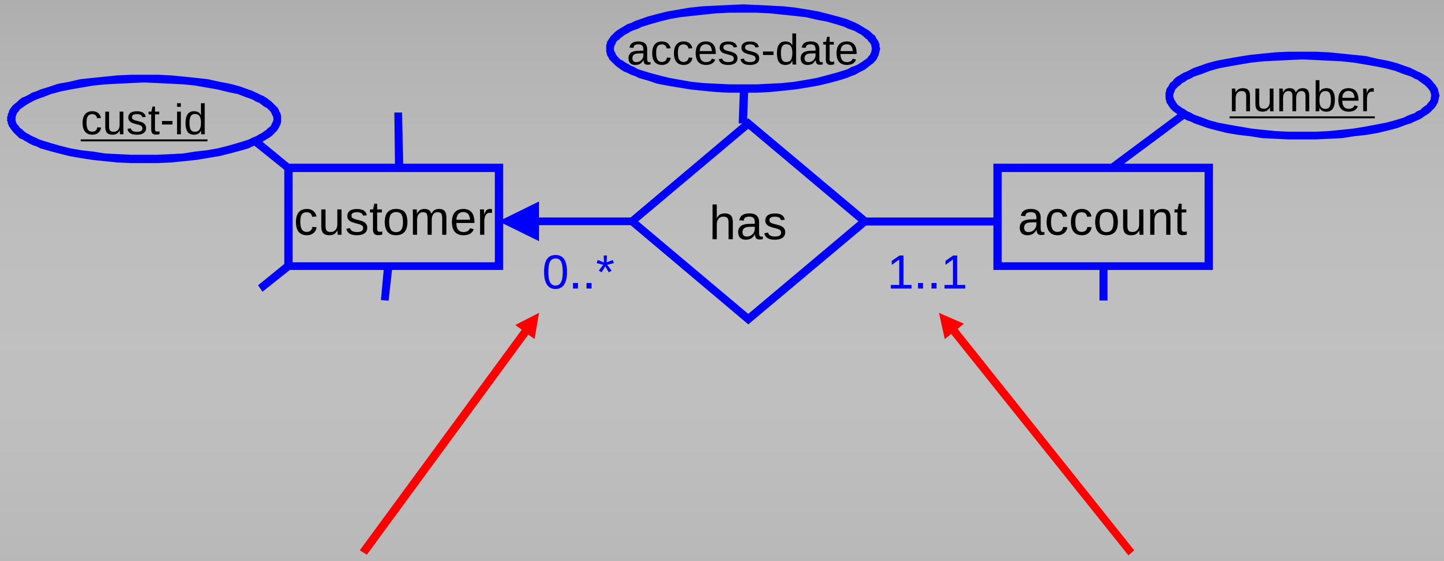
Participation Constraint



Total participation

Cardinality Constraints

How many relationships can an entity participate in ?



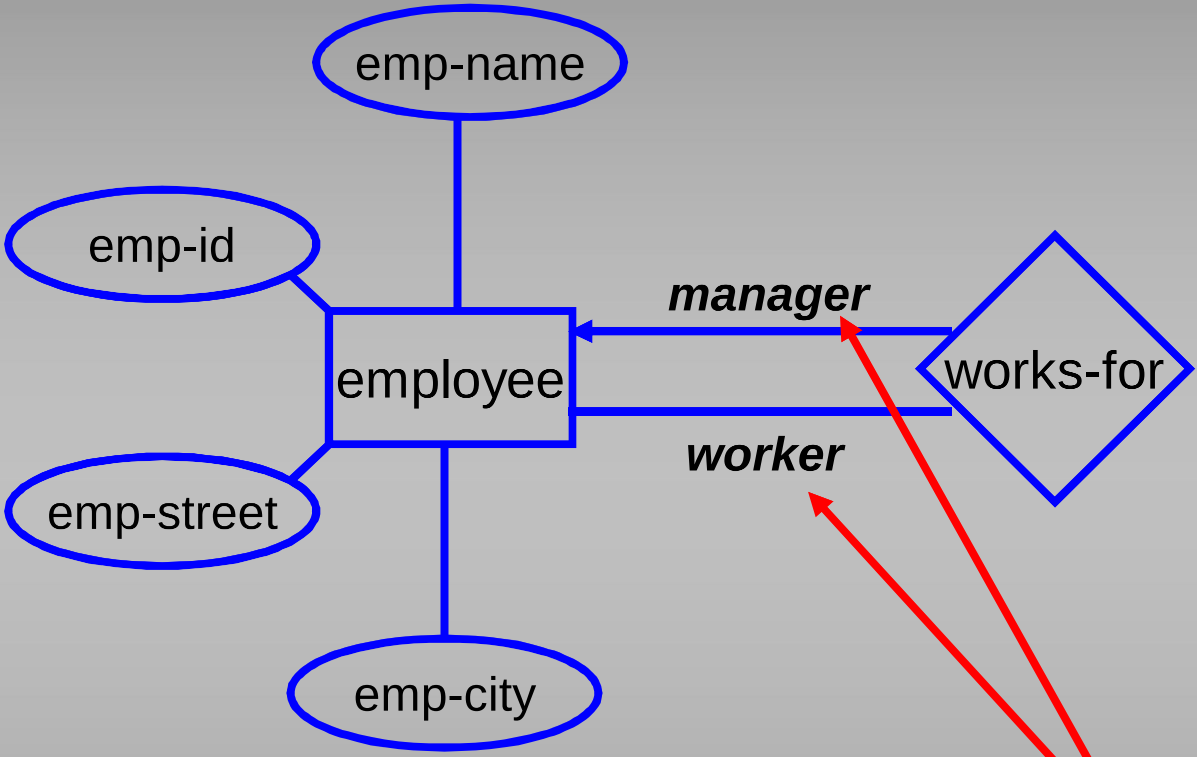
Minimum - 0
Maximum – no limit

Minimum - 1
Maximum - 1

Next: Recursive Relationships

- Sometimes a relationship associates an entity set to itself

Recursive Relationships



Must be declared with roles

Next: Weak Entity Sets

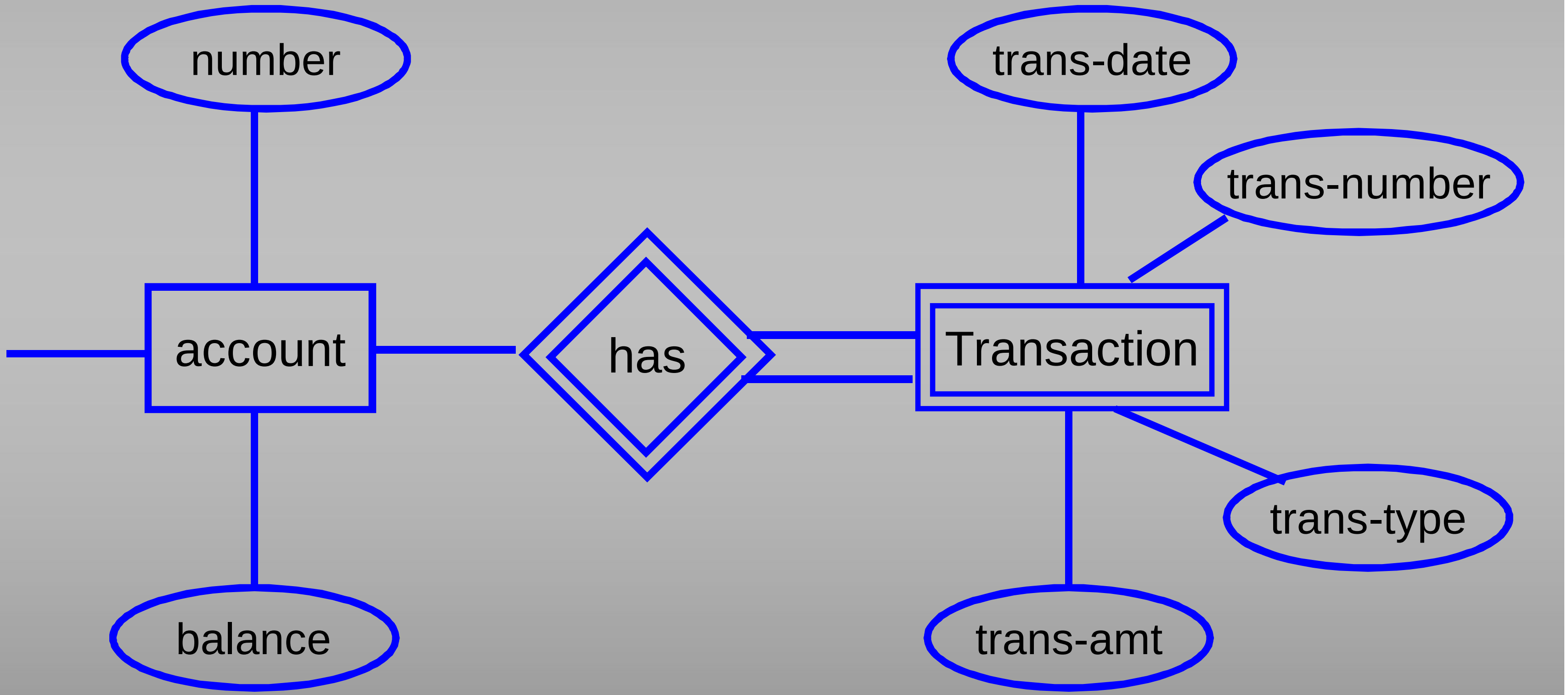
- An entity set without enough attributes to have a primary key
- E.g. Transaction Entity
  - Attributes:
    - transaction-number, transaction-date, transaction-amount, transaction-type
    - transaction-number: may not be unique across accounts

Weak Entity Sets

- A weak entity set must be associated with an identifying or owner entity set
- Account is the owner entity set for Transaction

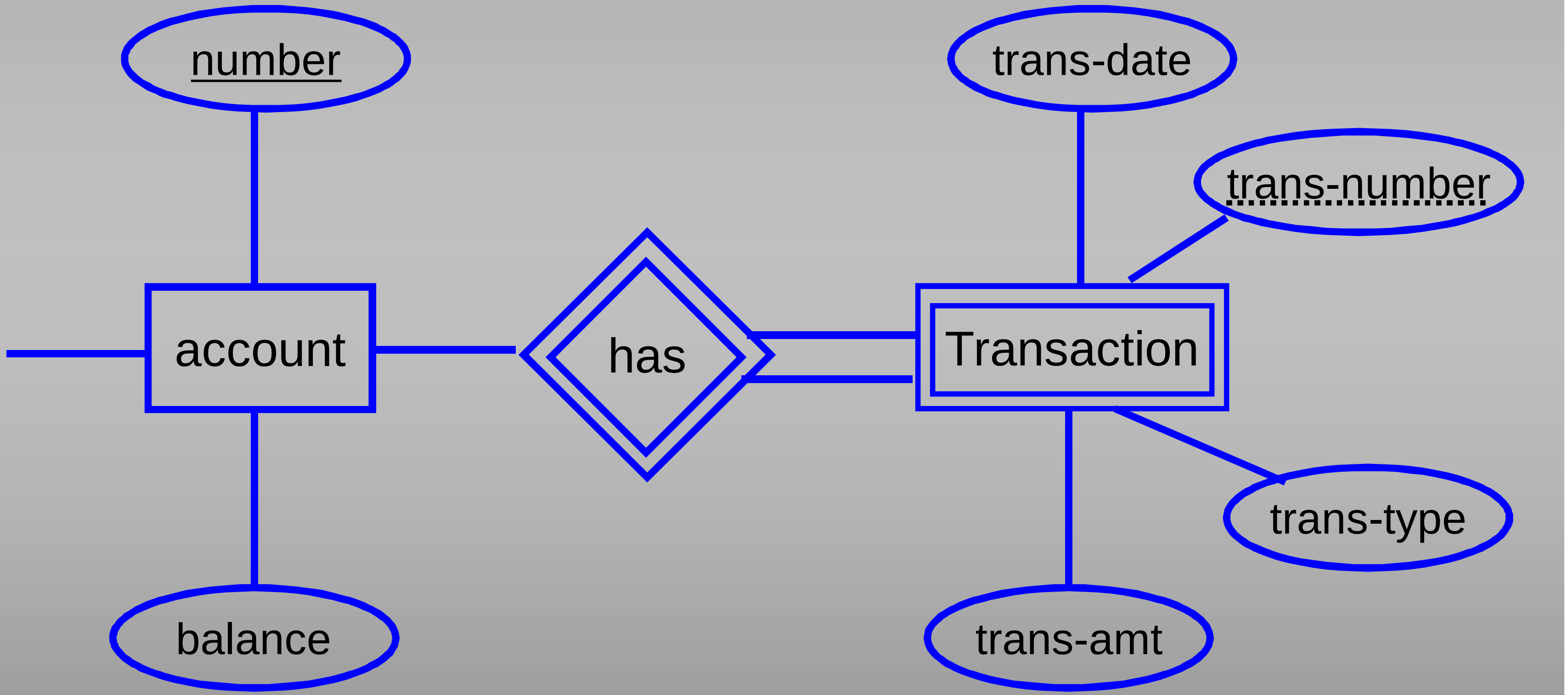
Weak Entity Sets

Still need to be able to distinguish between different weak entities associated with the same strong entity



Weak Entity Sets

Discriminator: A set of attributes that can be used for that



Weak Entity Sets

- Primary key:
  - Primary key of the associated strong entity + discriminator attribute set
  - For Transaction:
    - *{account-number, transaction-number}*