Data Modeling for SQL

by

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Models

- Models attempt to represent the real world in a formal system which can be manipulated to control or predict the behavior of the real world
- In a computer system, we have some limitations in the tools, so we have to fit the problem to the tools

Entity

- **Entity: A thing that acts or is acted upon -- look for a simple noun.**
- **The entity in the model is not always one thing in the reality - same person can play the role of “stockholder”, “employee”, “customer“, etc.**
- **Multiple things in reality can be one entity - a sports team buys a product as a customer in the model, even tho the team is made of many people**
  - **The concept of a “lawful person” – church, company, team, organization, etc.**

Attributes

- **Attributes are the properties we wish to model about an entity.**
- **“An entity is the sum of all its attributes” -- Leibnitz**
- **.. but we cannot record them all, so we have to pick the important ones**
- **Here is where we worry about scales, encodings, measurements, constraints, etc.**

Values & Domains -1

- Domains: Where the values for the attributes come from.
- We usually encode them -- i.e. we use a color code and not an actual color in the database.
  - One attribute can have many scales
  - Color= Land Color number, Pantone number, etc
  - Temperature= Celsius, Fahrenheit, Kelvin, etc.
- This is a set of values and can be defined by intention (list) or by extension (rules).

Values & Domains -2

- It is sometimes hard to tell an attribute from a value
- If I have a table of Sales, is the month of the sale a value or an attribute?
- It often depends on your model ...
- Quick heuristic: does this thing have to belong to something or is it physically separate?

Relations -1

- **Relations put the entities into a system**
- **Some relationships are important because we use them in the model to create actions in the real world -- i.e. orders and inventory**
- **Some relationships are real but not important because we take no actions in the model and/or real world -- i.e. employee golf score and his salary**

Relations -2

- You will see other terms for these concepts in the literature, but a relationship has
- Degree
- Rank
- Membership

Rank

- Rank = number of participants in the relationship
  - Rank can be unary, binary or n-ary
- We like binary relationships
  - Write them as infixed operators in math
  - ER diagrams and graphs lead you to them
- A marriage is binary (husband, wife)
- A sale is ternary (buyer, seller, item)
  - The most important leg on a three-legged stool is the one that is missing

Degree

- Degree = number of elements from each entity class that take part in the relationship
- one to one = 1:1 = Conventional marriage
- one to many = 1:n = A harem
- many to many = m:n = Corporate marriage
- Some writers also include “non-relations”
  - zero to zero = prohibition; bestiality
  - zero to one = no relationship; Dilbert’s love life

Membership -1

- Membership = How the entity can participate in the relationship
- Mandatory = no entity, no relationship
- Optional = entity is not required
- Combinations are sometimes trickier than you would think - there can be conditional memberships
  - A prayer circle requires 13 Jews
  - A customer buys one or more items

Membership -2

- **Employee must have a department; Department needs one or more employees to exist.**
- **Employee must have a department; Department can be empty**
- **Employee can be unassigned; Department needs one or more employees to exist**
- **Employee can be unassigned; Departments can be empty**

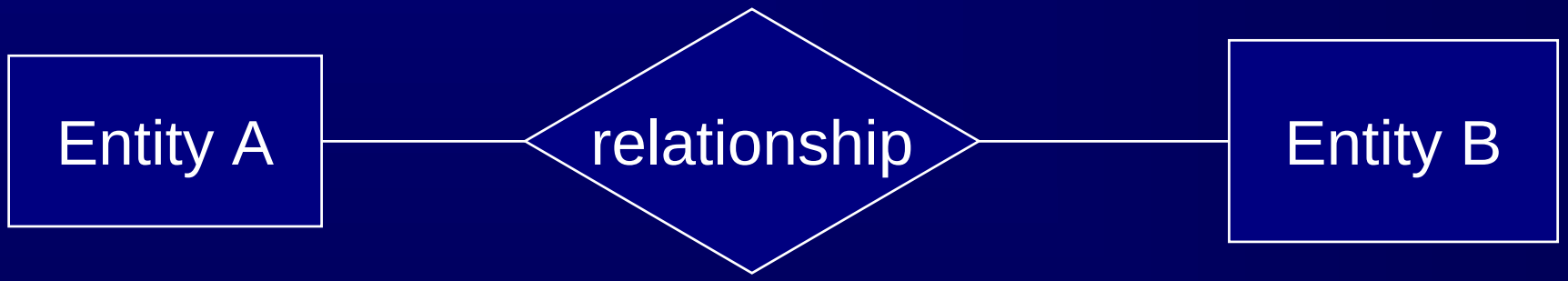
Relationships & Entities

- It is hard to decide if something is an entity, a relationship or both.
- A marriage license is relationship
  - If you destroy the license, you are still married
  - You must divorce or kill your wife!
- A bearer bond is a relationship
  - If you destroy the bond, you are out of luck - the token *is* the relationship
- A relationship can have attributes of its own
  - A home loan related buyer-seller-lender, but it has an amount of its own

E-R Diagrams -1

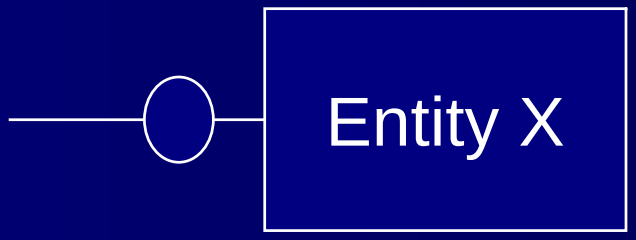
- Lots of notations for the diagram; Erwin, Chen, Howe et al
- Several popular software packages to draw them.
- Bad news about E-R tools
  - Planar graph problem
  - Only one solution generated
  - No constraints created
  - You get one model that might not be in 3NF
  - Lots of different versions of E-R
- This is why we teach ORM, but you need to be able to read E-R

E-R Diagrams -2
Chen's notation

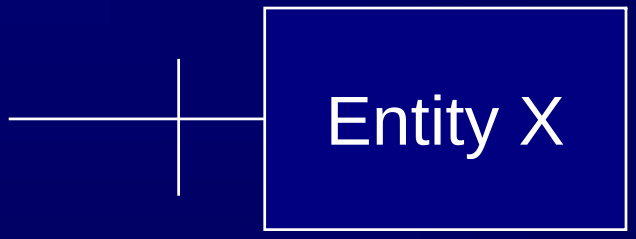


E-R Diagrams -3
Chen's notation

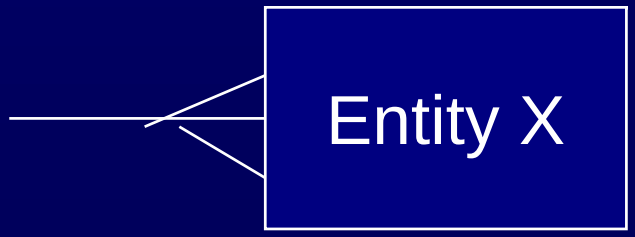
zero



One

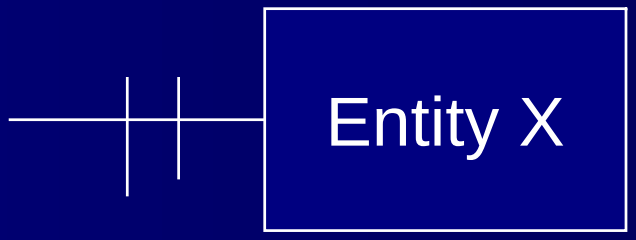


Many

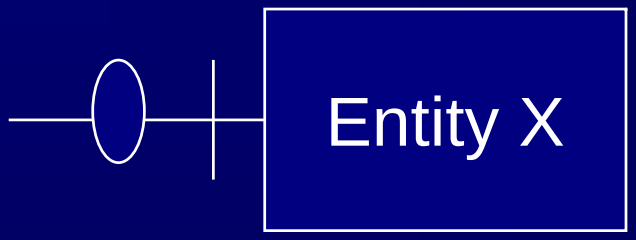


E-R Diagrams -4
Chen's notation

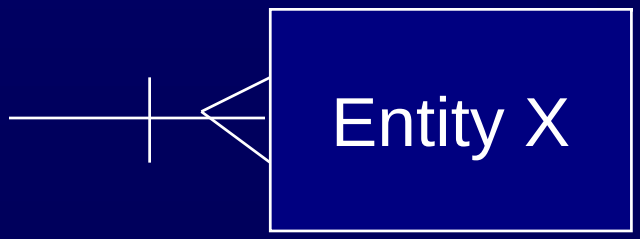
one and only one



Zero or one



One or more



ORM Models - 1

- **Semantic modeling**
  - **NIAM**
  - **Object Role Modeling**

- **Basic idea:**
  - **Describe your system in simple, formal, declarative sentences to generate a database.**
  - **This captures a high level model of the system**
  - **ORM can generate SQL directly**

ORM Models - 2

- Visio supports InfoModeler, an FORM tool designed by Terry Halpin.
- There are diagrams, but nobody uses them after the first month -- they just get in the way.
- You get more than one schema from the model
- The models are 3NF to 5NF