RELATIONS

CS 200 RECITATION 12

Relations

A relation aggregates members of a set into tuples according to some relationship (any one will do!) between those members.

- $\{0, 1, 2, 3\}$ is a set. Set is a list of elements in no particular order with no duplicates.
- $(0, 2)\,(1, 3)$ are two tuples drawn from that set
- $\{(0, 2), (1, 3), (1, 1)\}$ is a relation on that set (relationship = one I made up). Note that this is also a set, a set of tuples.

Properties of Relations

- Reflexive
  - $(a, a) \in R$ for every element $a \in R$. That means that for every member X in the set, the relation must have an (X,X) tuple
- Symmetric
  - $(b, a) \in R$ whenever $(a, b) \in R$. If my relation contains (1,2) it must also contain (2,1) to be symmetric.
- Anti-symmetric
  - if $(b, a) \in R$ then (a, b) is not in R. $a = b$ is a special case, (1,1) is a tuple which is both symmetric and anti-symmetric
- Transitive
  - if $(a, b) \in R$ and $(b, c) \in R$, then $(a, c) \in R$. If I have (1,2) and (2,3) I must also have (1,3) for it to be transitive.

These properties are pretty much all-or-nothing. Either the entire relation is reflexive or it isn't. A single counter example is all that is necessary to remove one of these properties from a relation.

Combining Relations

- Union
  - $R1 \cup R2$. Both sets concatenated, duplicates removed
- Intersection

- $R1 \cap R2$. Set of elements in both relations

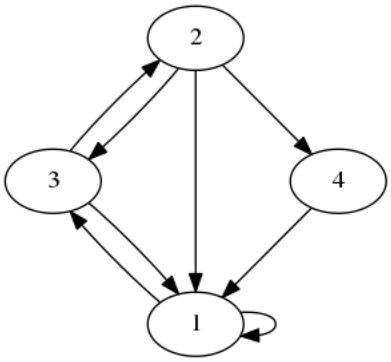
- Subtraction
  - $R1 - R2$. Removes elements common to both relations from R1.

- Composite
  - $R2 \circ R1$. Find tuples in R1 with second elements which are the same as first elements in tuples from R2. Make a new tuple from the unused elements in this process. This new tuple may not be present in R1 or R2, it can be completely new.
  - $\{(1,1),(1,4),(2,3),(3,1),(3,4)\}$= R1
  - $\{(1,0),(2,0),(3,1),(3,2),(4,1)\}$= R2
  - $\{(1,0),(1,1),(2,1),(2,2),(3,0),(3,1)\}= R2 \circ R1$

Representing Relations

- As a Matrix
  - $\{(2,1),(3,1),(3,2)\} = \begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 1 & 1 \end{bmatrix}$

- As a Digraph, this is graph of $\{(1,1),(1,3),(2,1),(2,3),(2,4),(3,1),(3,2),(4,1)\}$, though it looks different than the book's version (sorry)



What are they used for?

Probably the largest industrial use for relations is the **Relational Database.** Which is a technique for storing large amounts of data, and is built directly upon this math. Notable:

- Oracle
- Microsoft Access
- PostgreSQL
- MySQL
  - In fact, any SQL is probably a relational database

Grading

1. Complete the worksheet
2. Show it to me for attendance