OSU Oregon State	Relational Algebra

An Intro to Relational Algebra

- Relational algebra is a mathematical abstraction of database operations
- · Works procedurally
 - That is steps happen in order to get to the result
 - Contrast with relational calculus where conditions are just specified
- Probably wont use this in your day to day life unless you go into database theory
 - May be a question or two on the exam and will be an assignment



Basics

- A query is made from a collection of operators
- An operator takes as input one or two instances of a relation and returns a single relation
- Operators can be nested and combined to achieve the desired query

Core Set of Operators

- Selection
- Projection
- Union
- Intersection
- Differnece
- Cross-product

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Selection

- Selection
 - $-\sigma_{GPA>3.5}(Students)$
 - Returns the student instance containing only rows that have a GPA > 3.5
 - Same as SELECT * FROM STUDENTS WHERE GPA >3

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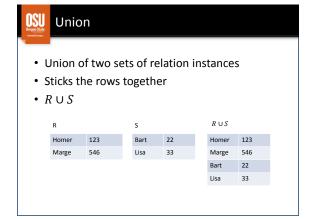
Projection

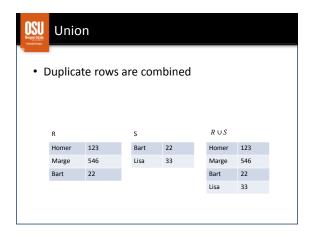
- Projection
 - $-\pi_{SID,SName,GPA}(Students)$
 - Returns just the SID, Sname, GPA columns from students
 - Similar to SELECT SID, SNAME, GPA FROM Students
- Projection can filter out columns, Selection and filter out rows

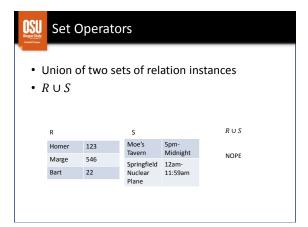
A Simple Query

- Display the ID and Name of students with a GPA > 3.5
- $\pi_{SID,SName}(\sigma_{GPA>3.5}(Students))$
- · Order is important here
 - If we did projection first we would no longer have GPA to select from

Union of two sets of relation instances Sticks the rows together R S Homer 123 Bart 22 Marge 546 Lisa 33

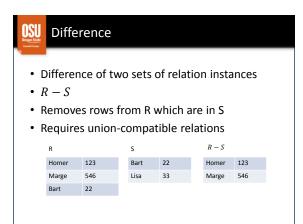


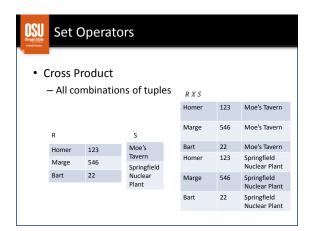




Must have the same number of attributes Corresponding attributes must have identical domains

Intersection • Intersection of two sets of relation instances • $R \cap S$ • Requires union-compatible relations $R \cap S$ Homer 123 Bart 22 Bart 22 Marge 546 Lisa 33 22 Bart





Joins

- Can be created from just cross-products, projections and selections
- More often used than cross product
- Wont blow your stack as often

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Joins

• Conditional Join

$$R \rhd \lhd cS = \sigma_C(R \times S)$$

- Example
- S1 Sailors(<u>sid:integer</u>, sname:string, rating:integer, age:real)
- S2 Boats(bid:integer, bname:string, color:string)
- R1 Reserves(sid:integer, bid:integer, day: date)

$$S_1 \rhd \lhd_{S1.sid=R1.sid} R_1$$



Joins

- Example
- S1 Sailors(sid:integer, sname:string, rating:integer, age:real)
- S2 Boats(bid:integer, bname:string, color:string)
- R1 Reserves(sid:integer, bid:integer, day: date)

$$S_1 \rhd \lhd_{S1.sid=R1.sid} R_1$$

 Returns a new table with all attributes of S1 and R1 with rows from S1 joined together with rows from R1 where the sid are the same

Joins

• Natural join

$$S_1 \triangleright \triangleleft R_1$$

- Special case in which we look at all common fields between two relations and select rows based on equality in those fields
- · Just more shorthand



Wrapping Up

- These are the basic operations on relational algebra
- There are more complex operations
- You probably won't encounter this other than in the context of planning and building a DBMS or academic papers

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