

COS 425:
Database and Information
Management Systems

Relational model:
Relational algebra

Modeling access

- Have looked at **modeling information** as **data + structure**
- Now: **how model access to data** in relational model?
- Formal specification of access provides:
 - **Unambiguous** queries
 - **Correctness** of results
 - **Expressiveness** of query languages

Queries

- A query is a **mapping** from a set of relations to a relation
Query: relations → relation
- Can **derive schema of result** from schemas of input relations
- Can deduce constraints on resulting relation that must hold for any input relations
- Can identify properties of result relation

Relational query languages

- Two formal relational languages to describe mapping
 - Relational algebra
 - Procedural – lists operations to form query result
 - Relational calculus
 - Declarative – describes results of query
- Equivalent expressiveness
- Each has strong points for usefulness
 - DB system query languages (e.g. SQL)
take best of both

begin with Relational Algebra

Basic operations of relational algebra:

1. Selection σ :select a subset of tuples from a relation according to a condition
2. Projection π :delete unwanted attributes (columns) from tuples of a relation
3. cross product \times : combine all pairs of tuples of two relations by making tuples with all attributes of both
4. Set difference – : * tuples in first relation and not in second
5. union \cup : * tuples in first relation or second relation
6. Renaming ρ : to deal with name conflicts

* Set operations: $D_1 \times D_2 \dots \times D_k$ of two relations must agree

Board examples

Formal definition

- A relational expression is
 - A relation R in the database
 - A constant relation
 - For any relational expressions E_1 and E_2
 - $E_1 \cup E_2$
 - $E_1 - E_2$
 - $E_1 \times E_2$
 - $\sigma_P(E_1)$ for predicate P on attributes of E_1
 - $\pi_S(E_1)$ where S is a subset of attributes of E_1
 - $\rho(Q(L), E_1)$ where Q is a new relation name and L is a list of (old name \rightarrow new name) mappings of attributes of E_1
- A query in the relational algebra is a relational expression
