CS 1555

Lecture 8

**Formal Query Languages: Relational Algebra (continued)**

Basic set operations

- r UNION s: all values in at least one of the relations (no duplicates)

- r INTERSECT s: all values in both relations

- r DIFFERENCE s: all values in r that are not in s

- Relations need to be union compatible: same arity and the attributes must have the same type

- Both UNION and INTERSECT are commutative, but DIFFERENCE is not

Cartesian product

- r X s

- Arity of Cartesian product is arity of r + arity of s, cardinality is cardinality of r \* cardinality of s

Equi-join

- r EQUIJOINr.i = s.j s

- Basically a macro for taking Cartesian product of r and s, then passing to selection

Theta-join

- Generalized equi-join

- Use an operator from {=, <, <=, >, >=, !=}

Natural join

- Equi-join without duplicate columns

- r \*p s

- p = list of attributes: p = R INTERSECT S

- Macro for taking equijoin of r and s, where the condition is the common columns. Then passing to projection, where you are projecting the union of r and s 🡪 you get all tuples where the shared attributes have the same values

Example query: for every outreach activity located in PGH, list its project number, the responsible section name, and the name of its head

- Library DB Schema:

- LIBRARIAN(Name, SSN, SNO, BirthPlace) – SNO is a FK for SECTION.SNO

- SECTION(Sname, SNO, Head) – Head is a FK for LIBRARIAN.SSN

- OUTREACH(Pname, PNO, SNUM, Location) – SNUM is a FK for Section.SNO

- WORKSON(LSSN, PNO, Hours)

- Location and project num are in OUTREACH table, section name is in SECTION table, head is in LIBRARIAN table

- PP 🡨 Selectlocation=’PGH’ (OUTREACH);

- SPP 🡨 PP EQUIJOINSNUM=SNO SECTION;

- HSPP 🡨 SPP EQUIJOINSNO=SNO AND Head=SSN LIBRARIAN;

- RSLT 🡨 ProjectPNO, Sname, Name (HSPP);

Division

- Let r(R) and s(S) be relations such that S is a subset of R

- The division of r by s, denoted by r / s:

- is a relation whose schema is Q = R – S and

- includes all t such as tr[Q] = t and tr[S] = t

- Example (important to remember that quotient X s should be R)

R s R / s

|  |  |  |  |
| --- | --- | --- | --- |
| A | B | C | D |
| 1 | 2 | 3 | 4 |
| 2 | 4 | 6 | 8 |
| 1 | 2 | 6 | 8 |
| 2 | 4 | 3 | 4 |

|  |  |
| --- | --- |
| C | D |
| 3 | 4 |
| 6 | 8 |

|  |  |
| --- | --- |
| A | B |
| 1 | 2 |
| 2 | 4 |

|  |  |
| --- | --- |
| C | D |
| 3 | 4 |
| 6 | 8 |

Division with remainder

- Same idea, but can have rows left over

- Important to remember that quotient X s + REM should be R