$\pi_L R$ # projection # select L columns from R # duplicates removed

$\pi_{ID, Class} Student$

$\sigma_p R$ # selection # select rows from R that satisfy p

$\sigma_{GPA>3.0} Student$

Operators: =<>∨∧

$\rho_S R, p(A_1, A_2, ...)R$ or $\rho_{S(A_1, A_2, ...)} R$ # renaming

$\rho_{Enroll(SID1, CID1, Grade1)} Enroll$

$R \cup S$ # union of identical schemas # duplicates removed

$R - S$ # all rows of R that are not in S # identical schema

$R \cap S$ # intersection of identical schemas # $R - (R - S)$ # $S - (S - R)$ # $R * S$

$R \times S$ # cross product - pair all rows ($for\ all\ r\ and\ s,\ output\ all\ rs$)

$R \times S = S \times R$ # row order does not matter

To avoid ambiguity, attribute names can be $R.A\ and\ S.A$

$R \bowtie_p S = \sigma_p(R \times S)$

$Student \bowtie_{Student.SID=Enroll.SID} Enroll$

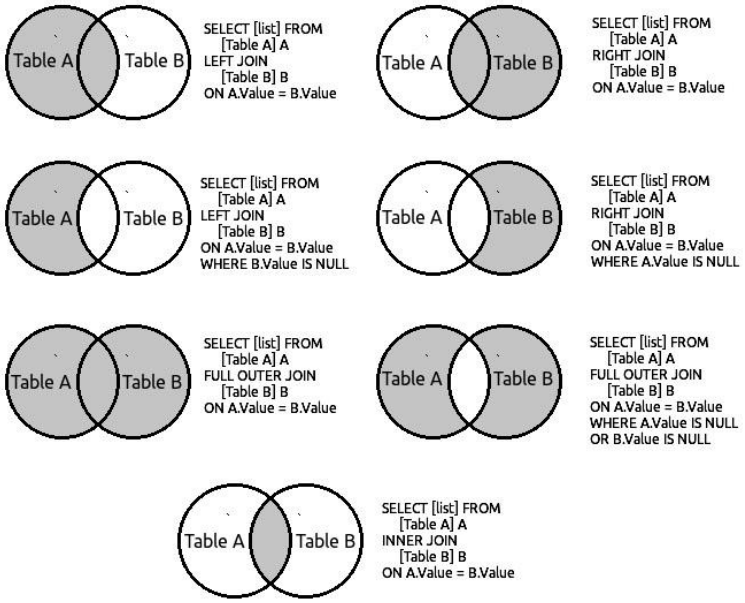
$R \bowtie S = \pi_L(R \bowtie_p S)$ # natural join # match common attrs # L is union of attrs without duplicates

$Enroll1 = \rho_{Enroll1}(SID1, CID1, Grade1)Enrolled$ # variable assignment

$\pi_{SID1}(Enroll1 \bowtie_{SID1=SID2 \wedge CID1 \neq CID2} Enroll2)$ # Students who take ≥ 2 classes

$\pi_{SID} - \pi_{Student1.SID}(\rho_{Student1} \bowtie_{Student1.GPA<Student2.GPA} \rho_{Student2})$ # highest GPA student

Bag (multiset) - set with duplicates
Bag union # sum all occurrences
Bag intersection # min number of occurrences
Bag difference # $Count = Max(0, |L| - |R|)$



SELECT … UNION SELECT … ORDER BY …
UNION ALL (like UNION, but duplicates are preserved)
SELECT … INTERSECT SELECT … (only common rows are deduplicated and selected)
SELECT … EXCEPT SELECT … (only rows from left no in right are selected)
WHERE A [NOT] IN (SELECT …)
WHERE [NOT] EXISTS(SELECT …)
WHERE x op ALL (SELECT …)
WHERE x op ANY (SELECT …)
COUNT() SUM AVG MIN MAX. NULLs excluded. WHERE GROUP BY HAVING ORDER BY
INSERT INTO (SELECT …)
CREATE [MATERIALIZED] VIEW EECS647Roster AS SELECT … [WITH CHECK OPTION]
DROP VIEW view_name;
SELECT AVG(GPA) FROM EECS647Roster;
(in sql92 no join, aggregation, subqueries)
GRANT/REVOKE SELECT,INSERT,DELETE,UPDATE(price) ON Sells TO login,PUBLIC [WITH GRANT OPTION / (CASCADE / RESTRICT)]