THE RELATIONAL ALGEBRA

- SELECT: $\sigma_{<condition>}(R)$, e.g. STUDENT

Name	SSN	Phone	Address	Major
Ben	190897222	876-6723	12 David Dr, Brea	CPSC
Ed	239026517	789-2579	58 Deerpark Ave, Fullerton	MATH
Jack	163899991	132-2311	90 College Blvd, Fullerton	CPSC
Karl	179113131	708-7821	111 State Street, Riverside	ACCT

$\sigma_{Major='CPSC'}$
(STUDENT)

Name	SSN	Phone	Address	Major
Ben	190897222	876-6723	12 David Dr, Brea	CPSC
Jack	163899991	132-2311	90 College Blvd, Fullerton	CPSC

THE RELATIONAL ALGEBRA

- PROJECT: $\pi_{<attribute\ list>}(R)$, e.g. STUDENT

Name	SSN	Phone	Address	Major
Ben	190897222	876-6723	12 David Dr, Brea	CPSC
Ed	239026517	789-2579	58 Deerpark Ave, Fullerton	MATH
Jack	163899991	132-2311	90 College Blvd, Fullerton	CPSC
Karl	179113131	708-7821	111 State Street, Riverside	ACCT

$\pi_{Name,\ SSN,\ Major}$
(STUDENT)

Name	SSN	Major
Ben	190897222	CPSC
Ed	239026517	MATH
Jack	163899991	CPSC
Karl	179113131	ACCT

THE RELATIONAL ALGEBRA

- RENAME: $\rho_{S(B1, B2, B3, ..., Bn)}(R)$, e.g. STUDENT(SSN, Name, BDate) $\rho_{STUDENT\_RECORD(Social\_Security\_Number, Student\_Name, Date\_of\_Birth)}(STUDENT)$.

SET operations:
- UNION (UNION): $R \cup S$
- INTERSECTION (INTERSECT): $R \cap S$
- SET DIFFERENCE (MINUS): R - S
- CARTESIAN PRODUCT: $R \times S$

THE RELATIONAL ALGEBRA

- UNION: $R \cup S$, example

STAFF

Name	Phone	Office
Sandra	278-3700	CS522
Liz	278-4999	CS522B
Phyllis	278-3119	CS522A

FACULTY

Name	Phone	Office
Barbara	278-2041	CS548
James	278-7257	CS544
Darin	278-7255	CS511A
Xiong	278-7258	CS538

STAFF∪FACULTY

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Phyllis	278-3119	CS522A

THE RELATIONAL ALGEBRA

- CARTESIAN PRODUCT: R×S, example STUDENT×ENROLL

Name	SSN	Major
Ben	190897222	CPSC
Jack	163899991	CPSC
Karl	179113131	ACCT

SSN	Class	Grade
190897222	CPSC431	A
163899991	CPSC440	B

Name	SSN	Major	SSN	Class	Grade
Ben	190897222	CPSC	190897222	CPSC431	A
Jack	163899991	CPSC	190897222	CPSC431	A
Karl	179113131	ACCT	190897222	CPSC431	A
Ben	190897222	CPSC	163899991	CPSC440	B
Jack	163899991	CPSC	163899991	CPSC440	B
Karl	179113131	ACCT	163899991	CPSC440	B

THE RELATIONAL ALGEBRA

- JOIN: $R \bowtie_{<condition>} S = \sigma_{<condition>}(R \times S)$

STUDENT

Name	SSN	Major
Ben	190897222	CPSC
Jack	163899991	CPSC
Karl	179113131	ACCT

ENROLL

SSN	Class	Grade
190897222	CPSC431	A
163899991	CPSC440	B

$STUDENT \bowtie_{STUDENT.SSN=ENROLL.SSN} ENROLL = STUDENT * ENROLL$

Name	SSN	Major	SSN	Class	Grade
Ben	190897222	CPSC	190897222	CPSC431	A
Jack	163899991	CPSC	163899991	CPSC440	B

THE RELATIONAL ALGEBRA

- DIVISION: R ÷ S

ENROLL

SSN	Class
190897222	CPSC431
190897222	CPSC440
163899991	CPSC431
120982765	CPSC440
179113131	CPSC440
179113131	CPSC431
149239812	CPSC431

ClassList

Class
CPSC431
CPSC440

ENROLL ÷ ClassList

SSN
190897222
179113131

THE RELATIONAL ALGEBRA

Aggregate functions and grouping (French Script MT $\mathscr{F}$):

$$_{<grouping\ attribute>}\mathscr{F}_{<function\ list>}(R)$$

Functions:

- COUNT (COUNT): e.g. $_{MAJOR}\mathscr{F}_{COUNT(*)}(STUDENT)$
- SUM (SUM): e.g. $_{DEPTNO}\mathscr{F}_{SUM(SALARY)}(EMPLOYEE)$
- AVERAGE (AVG): e.g. $_{CNO,YEAR,SEMESTER,SEC\#}\mathscr{F}_{AVG(GRADE)}(ENROLL)$
- MAXIMUM (MAX): e.g. $_{CNO,YEAR,SEMESTER}\mathscr{F}_{MAX(GRADE)}(ENROLL)$
- MINIMUM (MIN): e.g. $\mathscr{F}_{MIN(SALARY)}(EMPLOYEE)$