

# 1 Relational Algebra

## 1.1 Queries in relational algebra

*Problem 1:* Find the last name and first name for the students that obtained a 10.

*Problem 2:* Find the courses where no student was graded yet.

*Problem 3:* Find the names for all the persons that are connected to the faculty (students and instructors).

*More:*

- Find the names for the students who do not earn scholarships.
- Find the names for the students who received 10 at BD.
- Find the first names for the instructors that have the same first name with at least one of the students.
- Find pairs of students that are in the same group of the same year.

*Problem 5:* Consider the following relations:

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>		<u>C</u>	<u>D</u>	<u>E</u>
	0	0	1	1		1	1	0
$r :$	0	1	1	0	$r' :$	1	1	1
	1	0	0	1		0	0	0
	1	0	1	1		0	1	1
						0	1	0

Compute:

- $\pi_{(B,C)}[r]$ ,
- $\pi_{(C,D)}[r'] - \pi_{(C,D)}[r]$
- $\pi_{(A,C)}[r] \times \pi_{(C,D)}[r']$
- $r \bowtie r'$  (natural join),
- $\pi_{(A,C)}[r] \bowtie r'$
- $r \bowtie_{\theta} r'$ , where  $\theta = (A = C) \wedge (B < D)$ .

*Problem 6:* Consider  $r$  over attribute set  $U$  and  $r'$  over attributes  $U'$  two relations. Write an expression that returns a relation consisting of those tuples in  $r$  that are not used in the relation  $r \bowtie r'$ .

## 2 Functional dependencies

*Problem 1:* Consider the relation below:

	A	B	C	D	E
	0	0	1	1	1
$r :$	0	1	1	0	1
	1	0	0	1	0
	1	0	1	1	0

Find at least two non-trivial functional dependencies satisfied by relation  $r$ .

*Problem 2:* Consider  $\Sigma = \{AB \rightarrow C, AB \rightarrow D, CD \rightarrow E\}$ . Find at least two functional dependencies that can be obtained from  $\Sigma$  using as inference system the set  $\mathcal{R}_1$ .

*Problem 3:* Show that  $FD2f$  from  $\mathcal{R}_1$  can be obtained from  $R_A$ .

*Problem 4:* Show that rule  $FD4f$  can be obtained from rules  $FD1f - FD3f$  (see slide 43 for ideas).

## 3 Multivalued dependencies

*Problem 1:* Consider the relation below:

	A	B	C	D	E
	1	0	1	7	2
$r :$	1	0	4	3	5
	1	0	1	7	5
	1	0	4	3	2

Find at least two multivalued dependencies satisfied by  $r$ . Applying inference rules, discover two new multivalued dependencies.

*Problem 2:* Prove semantically  $MVD0$  (shown at the course).

*Problem 3:* Consider  $\Sigma = \{X \twoheadrightarrow Y, Y \twoheadrightarrow Z, Z \twoheadrightarrow V\}$ . Show that  $\Sigma \vdash_{\mathcal{R}_{FM}} X \twoheadrightarrow ((V - Z) - Y)$ .

*Problem 4:* Knowing that  $Y \subseteq X$  and that  $Z \subseteq W$  show that  $XW \twoheadrightarrow YZ$ .