

1. Writing queries (SQL and Relation Algebra)

For each of the following questions, provide a relational algebra expression that solves it, and its corresponding SQL statement. You can refer to Parts as P , Suppliers as S , and Catalog as C .

- (a) [4] Find the **pid** of all the parts that are color *red*.

$$\pi_{pid} \sigma_{color = 'red'} P$$

- (b) [4] Find **sid** of suppliers who supply at least one *red* and at least one *blue* part.

$$\begin{aligned} \text{Red} &= \pi_{sid} \sigma_{color = 'red'} P \bowtie C \\ \text{Blue} &= \pi_{sid} \sigma_{color = 'blue'} P \bowtie C \\ \text{Blue} \cap \text{Red} \end{aligned}$$

- (c) [4] Find the **address** of the suppliers who supply the part with **pname** *Fire Hydrant Cap*.

$$\pi_{address} \sigma_{pname = 'Fire Hydrant Cap'} (S \bowtie C \bowtie P)$$

- (d) [4] Find the **pid** of parts in the catalog that do not have a price (price is not null).

$$\pi_{pid} \sigma_{Price \text{ is NULL}} C$$

- (e) [4] ~~Find out how many tuples in the catalog have a price.~~

(f) [4] Find out the number of parts that are in the relations Parts (how many tuples are in the relation Parts).

(g) [4] For each part in the Parts relation, list its **pid**, and the number of suppliers that sell that part.

(h) [4] For each part in the Catalog relation, list its **pid**, its most expensive price, and the **sid** of the supplier which sells it at that price.

Exactly one:

Two Or More =

$\Pi_{pid} P - \text{Two Or More}$

2 or more suppliers.

(i) [4] List the **pid** of parts that are sold by ~~exactly 2~~ suppliers.

& exactly one supplier

2 or more $P_1 = P$

$\Pi_{pid} (P_1 \bowtie (P_1.pid = P.pid \wedge P_1.sid \neq P.sid))$

(j) [4] List the *pname* of the parts that are not in the catalog relation.

$\Pi_{pname} \sigma_{\text{not}(pid \in (\Pi_{pid} C))} P$

2. Normalization

- (a) [5] Consider a relation $R(A, B, C, D)$ with the following functional dependencies (FDs): $A \rightarrow B, BC \rightarrow D$. Which of the following FDs can be derived from them? Show all your work.

- $AC \rightarrow D$

Yes.

- $B \rightarrow D$

No

candidate

- (b) [5] Given the relation $R(A, B, C)$ and the set of functional dependencies $F = \{AB \rightarrow C, B \rightarrow A, C \rightarrow B\}$. Find all the keys of this relation. Show all your work.

B, C

- ~~(c) [5] Consider the relation $R(A, B, C, D)$, with the following functional dependencies: $AB \rightarrow D, B \rightarrow C, C \rightarrow B$. Its candidate keys are AB and AC . Is R in BCNF? Is R in 3NF? Show all your work.~~

- (d) [5] Let relation $R = (A, B, C)$, and assume the following set of FDs: $A \rightarrow B$, $B \rightarrow C$, $C \rightarrow A$. Compute the projection of its set of FDS into the subrelation $R_1 = (A, B)$. Show all your work.

$$A \rightarrow B$$

$$B \rightarrow A$$

- (e) [5] Consider the relation $R(A, B, C, D, E)$ with set of functional dependencies $F = \{AB \rightarrow C, AB \rightarrow E, E \rightarrow A, E \rightarrow B, C \rightarrow D\}$. F is minimal, and the keys of the relation are AB , and E . ~~This table is not 3NF. Decompose it, using synthesis, into a set of relations that are loss-less join and dependency preserving (you do not have to demonstrate that the resulting relations satisfy these last two properties).~~ Show all your work.

find projection of fds.

ABC	Projection of ABC
ACD	$AB \rightarrow C$
BCD.	
etc.	ACD
	$AC \rightarrow D$
	$C \rightarrow D.$

End of examination
Total pages: 6
Total marks: 65