**CS 540- Database Management Systems**

**Assignment 1**

Submitted by :

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**Question**

Consider the following relational schema:

emp (eid: integer (a), ename: string (b), age: integer (c), salary: real (d))  
works (eid: integer (a), did: integer (e), pc\_time: integer (f))  
dept (did: integer (e), dname: string (g), budge: real (h), managerid: integer (i))

**Q1. Return names of every employee who works in the "Hardware", "Software", and "Research" departments.**

**a) Datalog:**

Q1(b) : emp(a,b,c,d),works(a,e,f),dept(e,“Hardware”,h,i)

Q2(b) : emp(a,b,c,d),works(a,e,f),dept(e,“Software”,h,i)

Q3(b) : emp(a,b,c,d),works(a,e,f),dept(e,“Research”,h,i)

Q(b) : Q1(b),Q2(b),Q3(b)

**b) Relational Algebra:**

**c) Relational Calculus:**

Q(b) = ∃a,∃e,∃g (dept(e,g,h,i) ∧ (g = ”Hardware” ∨ g = ”Software” ∨ g = ”Research”) ∧ works(a,e,f) ∧ emp(a,b,c,d))

e) SQL

SELECT DISTINCT e.name

FROM emp e

JOIN works w ON e.eid = w.eid

JOIN dept d ON w.did = d.did

WHERE d.dname IN (“Hardware”, “Software”, “Research”)

**Q2. Return the names of every department without any employee.**  
**a) Datalog:**  
  
Q1(e, g, h, i) :- dept(e, g, h, i), works(a, e, f)  
Q(b) :- dept(e, g, h, i), not Q1(e, g, h, i)

**b) Relational Algebra:**

**c) Relational calculus :**

Q(g) = ∃e,∃h,∃i (dept(e,g,h,i) ∧ ¬∃a,∃f (works(a,e,f)))

d) SQL

SELECT d.dname

FROM dept d

LEFT JOIN works w On d.did = w.did

WHERE w.eid IS NULL;

**Q.3 Print the managerid of managers who manage only departments with budgets greater than $1.5 million.**

**a) SQL**

**SELECT d.managerid**

**FROM dept d**

**WHERE d.budget > 1500000;**

**Q.4 Print the name of employees whose salary is less than or equal to the salary of every employee.**

**a) SQL**

**SELECT e.ename**

**FROM emp e**

**WHERE e.salary <= ALL(SELECT salary FROM emp);**

**Q.5 Print the enames of managers who manage the departments with the largest budget.**

**a) SQL**

**SELECT e.ename**

**FROM emp e, dept d**

**WHERE e.eid = d.managerid**

**AND d.budget = (SELECT MAX(budget) FROM dept);**

**Q6 Print the name of every department and the average salary of the employees of that department. The department must have a budget more than or equal to 50.**

**a) SQL**

**SELECT d.dname, AVG(e.salary) AS avg\_salary**

**FROM emp e**

**JOIN dept d ON e.eid = d.managerid**

**WHERE d.budget >= 50**

**GROUP BY d.dname;**

**Q7 Print the managerids of managers who control the largest amount of total budget. As an example, if a manager manages two departments, the amount of total budget for him/her will be the sum of the budgets of the two departments. We want to find managers that have max total budget.**

**a) SQL**

**SELECT d.managerid**

**FROM dept d**

**GROUP BY d.managerid**

**HAVING SUM(d.budget) = (**

**SELECT MAX(total\_budget)**

**FROM (**

**SELECT SUM(budget) AS total\_budget**

**FROM dept**

**GROUP BY managerid**

**) AS subquery**

**);**



**Q8 Print the name of every employee who works only in the ”Hardware” department.**

**a) SQL**

**SELECT emp.ename**

**FROM emp**

**JOIN works ON emp.eid = works.eid**

**JOIN dept ON works.did = dept.did**

**WHERE dept.dname = 'Hardware'**

**GROUP BY emp.ename**

**HAVING COUNT(distinct works.did) = 1;**



**Q9** Prove that non-recursive Datalog without negation and relational algebra with selection, projection, and Cartesian product operators express the same set of queries. In this question, we consider only the non-recursive Datalog without negation queries with a single rule. We also consider only the relational algebra queries that produce non-empty answers over at least one database instance. Theorem 4.4.8 in Alice Book provides a summary of this proof. You should complete this summary and submit your proof.