

Introduction to Database Management Systems

Practice Midterm Solutions

1. a and b

2. c and e

3. Consider the following relational schema.

Emp [Eid, Name, Salary, City]

Dept [Did, Mgr, Budget, City] , Dept[Mgr] is foreign key of Emp.

WorksIn [Did, Eid] , WorksIn[Eid] is foreign key of Emp, WorksIn[Did] is foreign key of Dept

- (a) **SQL** Write an SQL query to find all departments in Toronto that have a budget that is less than the sum of all its employees salaries. Return the set of Dids for these departments.

```
select D.Did
from Dept D
where D.City = 'Toronto' and D.budget < (select sum(Salary)
                                         from Emp E, WorksIn W
                                         where E.Eid = W.Eid and W.Did = D.Did)
```

- (b) **Relational Algebra** Write a relational algebra query to find the (set of) employees who are managers of a department with at least two employees. The query should return the set of managers eids.

$$W2 = \rho_{e2 \leftarrow Eid}(WorksIn)$$

$$\Pi_{Mgr}(Dept \bowtie \sigma_{Eid \neq e2}(WorksIn \bowtie W2))$$

- (c) **Relational Algebra** Write a relational algebra query to find the (set of) names of all employees who work in exactly one department.

$$W3 = \rho_{d2 \leftarrow Did}(WorksIn)$$

$$\Pi_{Name}(Emp \bowtie (\Pi_{Eid} WorksIn - \Pi_{Eid} \sigma_{Did \neq d2}(WorksIn \bowtie W3)))$$

4. Give the result (data) returned by the following queries on the specific relations given below. (Give the **tuples** returned by each query when executed on the given relations. Do **not** describe the result in English.)

R	A	B	S	C	D
	1	1		1	2
	2	1		3	4
	3	3		3	5

- (a) $\Pi_{AD}(R \times S) - \rho_{A \leftarrow B}(\Pi_{BD}(R \bowtie_{B=C} S))$

1	4
1	5
2	2
2	4
2	5
3	2

- (b) **select** S.C, S.D, sum(R.A)
from R, S
where R.B = S.C
group by S.C, S.D

1	2	3
3	4	3
3	5	3

- (c) (**select** B
from R)
union all
(**select distinct** C
from S)

1
1
3
1
3