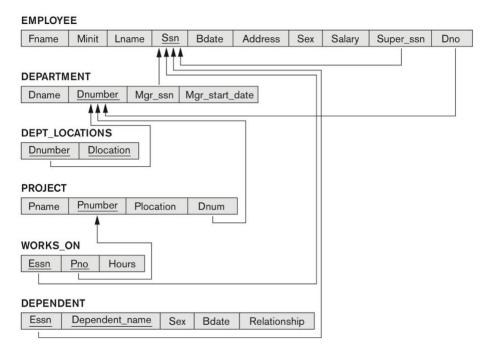SE | Software
Engineering
The University of Auckland

SOFTENG 351 S1 C – Lab 06

Due Date: Sunday 10 May 2020 at 11:59pm

10 marks in total = 1% of the final grade

THE RELATIONAL ALGEBRA

1. Specify the following queries on the COMPANY relational database schema and its data state shown below in the form of relational algebra expressions (i.e. using relational algebra operations, such as 'σ', 'π', 'ρ', set operations, 'X', '⋈', '*', 'ℑ' of aggregate functions, etc.). And show the result of each query as it would apply to the following sample database state.

EMPLOYEE

| Fname | Minit | Lname | Ssn | Bdate | Address | Sex | Salary | Super_ssn | Dno |

DEPARTMENT

| Dname | Dnumber | Mgr_ssn | Mgr_start_date |

DEPT_LOCATIONS

| Dnumber | Dlocation |

PROJECT

| Pname | Pnumber | Plocation | Dnum |

WORKS_ON

| Essn | Pno | Hours |

DEPENDENT

| Essn | Dependent_name | Sex | Bdate | Relationship |

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

DEPT_LOCATIONS

Dnumber	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

WORKS_ON

Essn	Pno	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	NULL

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship
333445555	Alice	F	1986-04-05	Daughter
333445555	Theodore	M	1983-10-25	Son
333445555	Joy	F	1958-05-03	Spouse
987654321	Abner	M	1942-02-28	Spouse
123456789	Michael	M	1988-01-04	Son
123456789	Alice	F	1988-12-30	Daughter
123456789	Elizabeth	F	1967-05-05	Spouse

(a) Retrieve the names of employees in department 5 who work more than 10 hours per week on the 'ProductX' project.

[2 mark]

(b) For each project, list the project name and the total hours per week (by all employees) spent on that project.

[2 mark]

(c) For each department, retrieve the department name, and the average salary of employees working in that department.

[2 mark]

(d) List the last names of department managers who have no dependents.

[2 mark]

FUNCTIONAL DEPENDENCIES AND NORMALIZATION

2. Consider the following relations for an order-processing application database at ABC, Inc.

ORDER (Order_no, Odate, Cust_no, Total_amount)
ORDER-ITEM (Order_no, Item_no, Qty_ordered, Total_price, Discount)

Assume that each item has a different discount. The Total_price refers to one item, Odate is the date on which the order was placed, and the Total_amount is the amount of the order. If we apply a natural join on the relations Order-Item and Order in this database, what does the resulting relation schema look like? What will be its key? Show the FDs in this resulting relation. Is it in 2NF? Is it in 3NF? Why or why not? (State any assumptions you make.)

[2 mark]