

CS258

THE UNIVERSITY OF WARWICK

Second Year Winter Examinations 2014/15

Database Systems

Time allowed: 2 hours

Answer **FOUR** questions out of six.

Read carefully the instructions on the answer book and make sure that the particulars required are entered on **each** answer book.

Calculators are not required and not permitted.

1. Consider the **COMPANY** schema diagram in Figure 1 overleaf.

(a) Explain why certain attributes have been underlined. [4]

(b) Explain the meaning of the following phrase.

Pno is a foreign key of WORKS_ON that references PROJECT.

[6]

(c) Write SQL code to create the following views.

i. View named **VFA** that lists the first names of all employees from the 'Administration' department. [5]

ii. View named **VDNMA** that provides the following details for every department: department number, manager's last name, average departmental salary. [5]

(d) Is it possible to define a view that will report the following details for each employee: Ssn and the number of employees who work on exactly the same set of projects? Explain why not or provide an SQL query. [5]

Total mark for this question: 25

EMPLOYEE

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
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DEPARTMENT

Dname	<u>Dnumber</u>	Mgr_ssn	Mgr_start_date
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DEPT_LOCATIONS

<u>Dnumber</u>	<u>Dlocation</u>
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PROJECT

Pname	<u>Pnumber</u>	Plocation	Dnum
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WORKS_ON

<u>Essn</u>	<u>Pno</u>	Hours
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DEPENDENT

<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
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Figure 1: COMPANY schema diagram

2. Write the following queries in SQL for the **COMPANY** database of Figure 1.

- (a) Retrieve the birth date of the manager of Department No. 6. [5]
- (b) List all first names of company employees without any repetitions. [5]
- (c) Retrieve the first and last names of all employees whose salary is greater than that of the manager of Department No. 5. [5]
- (d) Retrieve all distinct numbers of projects such that everybody working on them has 'A.' as the middle initial. [5]
- (e) For all departments with a male employee but without any female employees, list the department number followed by the number of male employees. [5]

Total mark for this question: 25

3. Specify the following queries in relational algebra for the **COMPANY** database (Figure 1).

- (a) Retrieve Social Security Numbers of all employees whose first name is 'Graham'. [6]
- (b) Retrieve names of Alan J. Baker's dependents. [6]
- (c) Retrieve the last names of all employees supervised by the manager of Department No. 3. [6]
- (d) Find the last names of employees who work on all the projects controlled by Department No. 1. [7]

Total mark for this question: 25

4. (a) Give the definition of a key. [4]
- (b) Consider the relation schema $\text{PERSON}(\text{age}, \text{first name}, \text{surname}, \text{postcode})$ and the relation state given below. Identify potential keys of PERSON. [6]

<i>age</i>	<i>first name</i>	<i>surname</i>	<i>postcode</i>
40	Barbara	Taylor	CV4 7AL
40	Bernard	Jones	CV3 8AK
41	Brenda	Taylor	CV4 7AM
42	Boris	Smith	CV5 2XY
43	Barbara	Taylor	CV4 7XX
44	Boris	Smith	CV1 5GH

- (c) Which of the following dependencies may hold in the above relation? If a dependency cannot hold, specify the tuples that cause the violation.
- i. $\text{age} \rightarrow \text{first name}$ [3]
 - ii. $\text{first name} \rightarrow \text{surname}$ [3]
 - iii. $\text{surname} \rightarrow \text{first name}$ [3]
- (d) Is it true that $X \rightarrow Y$ and $Y \rightarrow Z$ imply $X \rightarrow Z$? Justify your answer. [6]

Total mark for this question: 25

5. Consider the following relation schema:

$\text{CAR_SALE}(\text{Car}\#, \text{Date_Sold}, \text{SalesPerson}\#, \text{Commission}\%, \text{Discount_Amt}),$

where $\{\text{Car}\#, \text{SalesPerson}\#\}$ is the primary key (we assume that a car may be sold by multiple salespeople). Assume the following additional dependencies:

$\text{Date_Sold} \rightarrow \text{Discount_Amt},$
 $\text{SalesPerson}\# \rightarrow \text{Commission}\%.$

- (a) Based on the primary key, determine whether this relation is in 1NF, 2NF, 3NF. [9]
- (b) Perform any normalisation steps required to bring it into 3NF. [16]

Total mark for this question: 25

6. (a) One of the main heuristic rules for query optimisation is to apply SELECT and PROJECT before JOIN. Explain why. [4]
- (b) What is the difference between pipelining and materialisation? [4]
- (c) A file of 4096 blocks is to be sorted with an available buffer space of 64 blocks. How many passes will be needed in the merge phase of the external sort-merge algorithm? [5]
- (d) Outline the six steps of the heuristic algebraic optimisation algorithm. [12]

Total mark for this question: 25
