



SCSSE
School of Computer Science and Software Engineering

Student to complete:

Family name	
Other names	
Student number	
Table number	

CSCI235

Databases

Wollongong Campus

Examination Paper

Autumn Session 2015

Exam duration	3 hours
Items permitted by examiner	Nil
Aids supplied	Nil
Directions to students	8 questions to be answered This paper is worth 60% of the total marks for the subject

This exam paper must not be removed from the exam venue

Question 1

(Total 5 marks)

Read the description of a sample database domain given below.

A management of large international airport would like to implement a database system to store information about the employees and airplanes stationed and maintained at the airport. The relevant information is as follows.

Every airplane has a registration number, and each airplane is of a specific model. The airport accommodates a number of airplane models and each model is identified by a model number (e.g. Boeing 737-200) and has a capacity and weight. A registration number uniquely identifies each airplane.

The database should store information about two groups of employees: technicians and traffic controllers. All employees are described by a full name (first, middle, and last name), employee number, hire date, and salary.

Each technician is an expert in one or more plane model(s), and his/her expertise may overlap with that of other technicians.

Traffic controllers must have an annual medical examination. For each traffic controller, we must store the date and result of the most recent medical examinations. The results of medical examinations are either "satisfactory" or "not satisfactory".

The technicians periodically perform number of tests to ensure that airplanes are still airworthy. Each test is identified by a unique FAA test number and has a name, and maximum possible score. The aviation authorities require the airport to keep track of each time a given airplane is tested using a given test. For each testing event, the information needed is date, the number of hours spent on the test, and the score the airplane received on the test.

Analysis the requirements given above and construct the UML diagrams for the database.
No additional attribute allowed.

Your diagrams of conceptual schema **must** be consistent with a graphical notation of simplified UML class diagrams explained to you during the lecture classes in a subject CSCI235/MCS9235/CSCI835 Databases. **Application of another conceptual modeling notation will result in no marks awarded for this question!**

THE QUESTIONS 2, 3, 4, 7 REFER TO THE RELATIONAL TABLES LISTED BELOW

The schemas of relational tables, specifications of primary, candidate, foreign keys and check constraints are given below.

```

CREATE TABLE APPLICANT (
    anumber    NUMBER(6)          NOT NULL, /* Applicants          */
    fname      VARCHAR(20)        NOT NULL, /* Applicant number    */
    lname      VARCHAR(30)        NOT NULL, /* First name          */
    dob        DATE               NOT NULL, /* Last name           */
    city       VARCHAR(30)        NOT NULL, /* Date of birth       */
    state      VARCHAR(20)        NOT NULL, /* City                */
    phone      NUMBER(10)         NOT NULL, /* State               */
    email      VARCHAR(50),       /* Phone number        */
    CONSTRAINT APPLICANT_pkey PRIMARY KEY (anumber)); /* E-mail address      */

CREATE TABLE EMPLOYER (
    ename      VARCHAR(100)       NOT NULL, /* Employers           */
    city       VARCHAR(30)        NOT NULL, /* Employer name       */
    state      VARCHAR(20)        NOT NULL, /* City                */
    phone      NUMBER(10)         NOT NULL, /* State               */
    fax        NUMBER(10),        /* Phone number        */
    email      VARCHAR(50),       /* Fax number          */
    web        VARCHAR(50),       /* E-mail address      */
    CONSTRAINT EMPLOYER_pkey PRIMARY KEY (ename)); /* Web site address    */

CREATE TABLE EMPLBY (
    anumber    NUMBER(6)          NOT NULL, /* Employed by         */
    ename      VARCHAR(100)       NOT NULL, /* Applicant number    */
    fromdate   DATE               NOT NULL, /* Employer name       */
    todate     DATE,              /* Employed from       */
    CONSTRAINT EMPLBY_pkey PRIMARY KEY (anumber, ename, fromdate)); /* Employed to         */

CREATE TABLE POSITION (
    pnumber    NUMBER(8)          NOT NULL, /* Positions           */
    title      VARCHAR(30)        NOT NULL, /* Position number     */
    salary     NUMBER(9,2)        NOT NULL, /* Position title      */
    extras     VARCHAR(50),       /* Salary              */
    bonus      NUMBER(9,2),       /* Extras              */
    specification VARCHAR(2000) NOT NULL, /* End of year bonus   */
    ename      VARCHAR(100)       NOT NULL, /* Specification       */
    CONSTRAINT POSITION_pkey PRIMARY KEY (pnumber), /* Employer name      */
    CONSTRAINT POSITION_fkey FOREIGN KEY (ename) REFERENCES EMPLOYER(ename)
);

CREATE TABLE APPLIES (
    anumber    NUMBER(6)          NOT NULL, /* Applicant number    */
    pnumber    NUMBER(8)          NOT NULL, /* Position number     */
    appdate    DATE               NOT NULL, /* Application date     */
    CONSTRAINT APPLIES_pkey PRIMARY KEY (anumber, pnumber),
    CONSTRAINT APPLIES_fkey1 FOREIGN KEY (anumber) REFERENCES APPLICANT
(anumber),
    CONSTRAINT APPLIES_fkey2 FOREIGN KEY (pnumber) REFERENCES POSITION
(pnumber));

```

Question 2

(Total 6 marks)

Implement in SQL data definition and data manipulation statements to perform the following modifications to the sample database.

(a) It should be possible to store in the database information about total number of applications submitted by each applicant. It may happen that an applicant submits no applications and that an applicant cannot submit more than 10 applications. Update the table to setup the correct total number of applications' value for each applicant.

(1.5 marks)

(b) Add the foreign key constraints for the columns "anumber" and "ename" in the table EMPLBY without re-create the table.

(1 mark)

(c) Change the values of employer names in the database to uppercase values. Carefully consider the order of the statements.

(1.5 marks)

(d) Remove from the database the information about an applicant (anumber=8) and all related information for the applicant.

(1 mark)

(e) An applicant (anumber=6) applied a position (pnumber=3). Add this information into the database. The application date should be the current date.

(0.5 mark)

(f) There is no need to store fax number for all employers.

(0.5 mark)

Question 3

(Total 10 marks)

Implement the following queries as SELECT statements of SQL (one statement for each question). An implementation technique, like for instance join queries, nested queries, group by, having etc is up to you.

(a) Find the applicants' numbers and names (lnames, fnames) that have continuously employed by the same employer for longer than 2 years (more than 730 days).

(2 marks)

(b) Find the applicants' numbers and full names (lnames, fnames) who have not applied yet.

(2 marks)

(c) Find the applicants' numbers and full names (lname, fname) who have applied for the largest number of positions.

(2 marks)

(d) Find the names of employers and total number of positions offered by each one of them. Include the employers who have no position offered at this moment.

(2 marks)

(e) Find the applicants numbers and full names (lname, fname) that had been employed by "UNIVERSITY OF SYDNEY" and immediately employed by "UNIVERSITY OF WOLLONGONG" after that. It is not possible that the applicants were employed by some other employers between "UNIVERSITY OF SYDNEY" and "UNIVERSITY OF WOLLONGONG".

(2 marks)

Question 4

(Total 9 marks)

Implement in SQL data manipulations, access control, and PL/SQL on the sample database. You are not allowed to suspend, delete, and modify any consistency constraints in the sample database.

(a) Create a relational table **TOTALEMPLOYEES**(ename, totalEmployees) that contains the employers' names and the total number of employees working for the employer. An applicant that is not currently employed by the employer cannot be count as an employee for this employer. The relational table must have appropriate consistency constraints set up. Add the correct data into the table **TOTALEMPLOYEES**.

(2 marks)

(b) Remove all applicants that haven't applied any positions in one year (365 days).

(2 marks)

(c) Grant to a user *SCOTT* read access right on the information of all employers' names that offered the positions with the largest salary.

(1 mark)

(d) Increase the salaries by 10% of all positions that have least number of applicants applied for.

(1 mark)

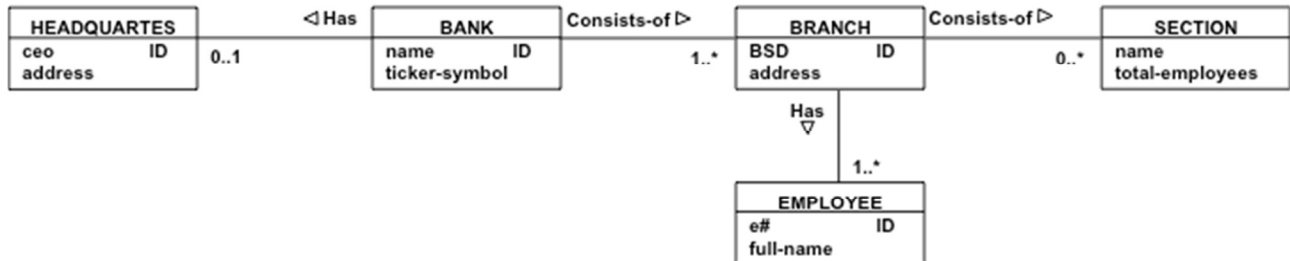
(e) Implement a PL/SQL stored function **FindApplicant** that takes an applicant's number as a parameter and returns the list of positions' titles he/she has applied. Positions' titles should be separated by commas (','),. Execute the function and display all applicants' numbers and the position titles applied by each one of them.

(3 marks)

Question 5

(Total 8 marks)

Consider the following conceptual schema representing a database domain of a large network of banks. Each bank included in a network consists of branches and each branch consists of sections. Some branches are too small to have sections. Headquarters of a bank are located at a given address. Some banks do not have headquarters. A bank employs staff members located at each branch. Each branch has one manager.



- (1) Write XML document with the sample contents of a database consistent with a conceptual schema given above. Insert into your document information about at least one instance of an object from each class. **(3 marks)**
- (2) Write Document Type definition (DTD) that validates XML documents that contain information represented by the conceptual schema above. **(5 marks)**

Question 6

(Total 8 marks)

Consider the following XML document.

```
<ebay>
  <listing>
    <seller_info name="cubsfantony" rating="848"/>
    <payment_types>MasterCard</payment_types>
    <item>laptop</item>
    <auction_info>
      <current_bid currency="USD">620.00</current_bid>
      <time_left unit="day">4</time_left>
      <high_bidder>
        <bidder_name>gosha555@excite.com</bidder_name>
        <bidder_rating>2</bidder_rating>
      </high_bidder>
      <bid_history>
        <highest_bid_amount currency="USD">620.00</highest_bid_amount>
        <quantity>1</quantity>
      </bid_history>
    </auction_info>
  </listing>
  <listing>
    <seller_info name="jamesb" rating="256"/>
    <payment_types>Visa</payment_types>
    <item>calculator</item>
    <auction_info>
      <current_bid currency="USD">200.00</current_bid>
      <time_left unit="day">4</time_left>
      <high_bidder/>
      <bid_history/>
    </auction_info>
  </listing>
</ebay>
```

(1) Implement the following queries in XPath:

- (i) Find all items such that have price greater than 200 and price is listed in USD.
- (ii) Find all items such that their bid history is empty and all items are listed by a seller whose name is jamesb.

(4 marks)

(2) Implement the following queries in XQuery:

- (i) List the names of all sellers who have at least one listing such that time left is greater than 2 days.
- (ii) Find the names of items listed by more than one seller.

(4 marks)

Question 7

(Total 8 marks)

Consider the sample database listed after a specification of Question 1 in the examination paper.

- (1) Show a sample concurrent execution of two database transactions such that the execution reveals a **non-repeatable read phenomenon**. Thoroughly explain why the execution reveals a non-repeatable read phenomenon. Remember to set an appropriate isolation level for the transactions. **Note, that a sample execution without the detailed explanations scores no marks.**

Use a technique of presentation of concurrent execution of two database transactions explained to you during the lecture classes and such that the statements of the first transaction are listed on the left-hand side of a page and the statements of the second transaction are listed on the right-hand side of a page. Make sure that each statement starts in a different line to represent a different moment in time when its execution starts.

(4 marks)

- (2) Show a sample concurrent execution of two database transactions such that the execution ends up in a **deadlock**. Thoroughly explain why the execution ends up in deadlock. Remember to set an appropriate isolation level for the transactions. **Note, that a sample execution without the detailed explanations scores no marks.**

Use a technique of presentation of concurrent execution of two database transactions explained to you during the lecture classes and such that the statements of the first transaction are listed on the left-hand side of a page and the statements of the second transaction are listed on the right-hand side of a page. Make sure that each statement starts in a different line to represent a different moment in time when its execution starts.

(4 marks)

Question 8

(Total 6 marks)

Read and analyse the relational schemas and functional dependencies valid for each one of the relational schemas given below.

For each one of the relational schemas, determine the highest normal form, which is valid for a schema. Justify your answer.

Justification must include the derivations of minimal keys from the functional dependencies and testing the validity of normal forms against the relational schemas, minimal keys, and functional dependencies.

A correct guess without the comprehensive justifications scores no marks !

- (1) ROOM(bnum, rnum, area, type)
bnum, rnum \rightarrow area, type

(2 marks)

- (2) DRIVER(licence#, fname, lname, trip#)
licence# \rightarrow fname
licence# \rightarrow lname
trip# \rightarrow licence#

(2 marks)

- (3) WAREHOUSE(name, address item, qty)
address, item \rightarrow qty
name, item \rightarrow qty
name \rightarrow address

(2 marks)

~ End of Examination ~