# School of Computing and Information Technology

**Student to complete:**

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| Family name | |
| Other names | |
| Student number | |
| Table number | |

# CSIT115
# Data Management and Security
# Wollongong Campus

## Examination Paper
## Autumn Session 2017

Exam value: 60% of the subject assessment.

Marks available: 60 marks

| | |
|---|---|
| Exam duration | 3 hours |
| Items permitted by examiner | *None* |
| Aids supplied | None |
| Directions to students | 7 questions to be answered. |

**This exam paper must not be removed from the exam venue**

**THE QUESTIONS 3, 4, 5, 6 and 7 REFER TO THE RELATIONAL TABLES LISTED BELOW**

```
CREATE TABLE DEPARTMENT (
     department_name     VARCHAR(30)    NOT NULL,
     street_address      VARCHAR(40)    NOT NULL,
     postal_code         VARCHAR(12)    NOT NULL,
     city                VARCHAR(30)    NOT NULL,
     country_name        VARCHAR(40)    NOT NULL,
     manager_id          DECIMAL(6)          NULL,
     CONSTRAINT DEPARTMENT_PK PRIMARY KEY(department_name));

CREATE TABLE JOB (
     job_title           VARCHAR(35)    NOT NULL,
     min_salary          DECIMAL(6)          NULL,
     max_salary          DECIMAL(6)          NULL,
     CONSTRAINT JOB_PK PRIMARY KEY(job_title) );

CREATE TABLE EMPLOYEE (
     employee_id         DECIMAL(6)     NOT NULL,
     first_name          VARCHAR(20)    NOT NULL,
     last_name           VARCHAR(25)    NOT NULL,
     email               VARCHAR(25)    NULL,
     phone_number        VARCHAR(20)    NULL,
     hire_date           DATE           NOT NULL,
     job_title           VARCHAR(35)    NOT NULL,
     salary              DECIMAL(8,2)   NULL,
     manager_id          DECIMAL(6)     NULL,
     department_name     VARCHAR(30)    NULL,
     CONSTRAINT EMPLOYEE_PK PRIMARY KEY(employee_id),
     CONSTRAINT EMPLOYEE_CK1 UNIQUE(email),
     CONSTRAINT EMPLOYEE_CK2 UNIQUE(phone_number),
     CONSTRAINT EMPLOYEE_FK1 FOREIGN KEY(department_name)
         REFERENCES DEPARTMENT(department_name),
     CONSTRAINT EMPLOYEE_FK2 FOREIGN KEY(job_title)
         REFERENCES JOB(job_title) );

CREATE TABLE JOBHISTORY (
     employee_id         DECIMAL(6)     NOT NULL,
     start_date          DATE           NOT NULL,
     end_date            DATE           NULL,
     job_title           VARCHAR(35)    NOT NULL,
     department_name     VARCHAR(30)    NULL,
     CONSTRAINT JOBHISTORY_PK
                    PRIMARY KEY (employee_id, start_date),
     CONSTRAINT JOBHISTORY_FK1 FOREIGN KEY(job_title)
         REFERENCES JOB(job_title),
     CONSTRAINT JOBHISTORY_FK2 FOREIGN KEY(employee_id)
         REFERENCES EMPLOYEE(employee_id),
     CONSTRAINT JOBHISTORY_FK3 FOREIGN KEY(department_name)
         REFERENCES DEPARTMENT(department_name) );
```

**QUESTION 1 (10 marks)**

Read and analyse the following specification of a sample database domain.

*A network of vehicle repair services would like to create a database with information about the vehicles, owners of vehicles, repairs performed on vehicles, and staff employed at the repair service nodes.*

*A network consists of the service nodes distributed all over a country. Each service node is located at a different address. An address consists of city name, street, name and building number. Each node has a name, that is unique in a city it is located at. It is possible that two nodes located in different cities have the same names. Each node has a unique phone number and unique email address.*

*The nodes employ mechanics, administration, and management staff members. An employee is described by a unique employee#, first name, last name, date of birth, and hire date. A collection of four attributes that includes first name, last name, date of birth, and hire date is unique for each employee. Additionally, mechanics are described by a list of qualifications possessed, administration members are described by a list of IT skills possessed and management staff members are described by a position occupied. An employee can work only at one service node.*

*The owners bring their vehicles to services nodes for repairs. Information about an owner includes the first name, last name, and unique phone number. A vehicle is described by a unique registration number, make, model, and manufacturing year. We consider two types of vehicles: cars and trucks. A truck has the same description as a car and additionally it is described by capacity.*

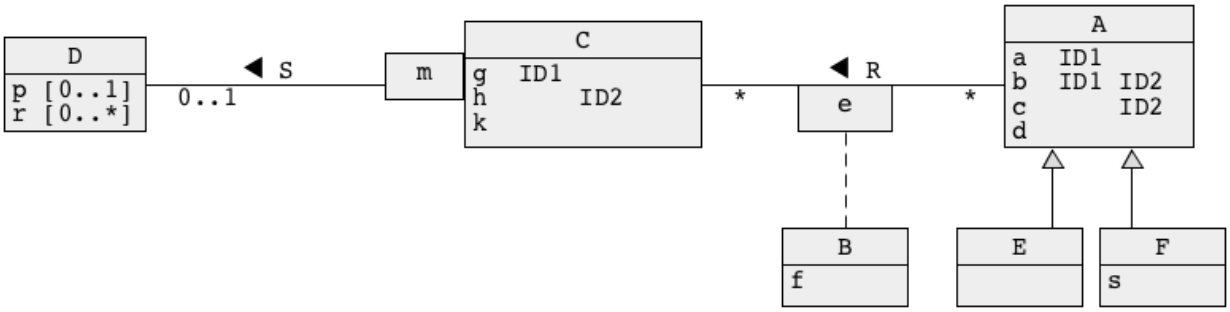
*Each time a vehicle is brought for repairs a date and time is recorded. A vehicle can be repaired at any of the service nodes included in the network and of course any node can repair any vehicle. When a repair process is completed date and time when an owner collects a vehicle is recorded. Note, that a repair process takes some time and its completion date is not know when the process is started.*

*A repair process consists of one or more steps. Each step has a number, which is unique within a process, a short description, and a list of parts used at a step. It is also recorded which mechanics were involved in each step of repair process and how much time each one of tem spent on each step. A mechanic can be involved in many repair steps and each step may require involvement of many mechanics.*

Draw a conceptual schema for the specification of a database domain listed above. Use a notation of UML simplified class diagrams explained to you during the lecture classes in the subject.

There is NO NEED to provide a detailed analysis how a conceptual schema has been created. The final conceptual schema expressed in a notation of UML simplified classes is completely sufficient.

**QUESTION 2 (8 marks)**
Consider a conceptual schema given below.




Your task is to perform a step of logical database design, i.e. to transform a conceptual schema given above into a collection of relational schemas.

For each relational schema clearly list the names of attributes, primary key, candidate keys (if any), and foreign keys (if any). Assume, that **subset method** must be used to implement a generalization.

**QUESTION 3 (8 marks)**
Write the data definition statements of SQL that modify the structures of a database listed on a page 2 of the examination paper in the way described below. Note, that some of the modification may require more than one data definition statements of SQL statement.

(1) It should be possible, after a modification, to add to the database information about commission percentage for each employee. The value of commission percentage is between 0 and 1. For example, 0.45 represents 45%.

(2 marks)

(2) It should be possible, after a modification, to add information that a department manager is an employee and a manager of an employee is an employee as well.

(2 marks)

(3) It should be possible, after a modification, to store information about the historical salaries of employees in a relational table `JOBHISTORY`. Additionally, a modification must enforce a constraint such that the end of job date must be later than the start of job date for employees in the relational table `JOBHISTORY`.

(2 marks)

(4) A modification must delete an attribute (a column) `hire_date` from a relational table `EMPLOYEE`. Additionally a modification must enforce a constraint such that all values of attribute `salary` in a relational table `EMPLOYEE` must be a positive.

(2 marks)

**QUESTION 4 (8 marks)**
Write the data manipulation statements of SQL that modify the contents of a database listed on page 2 of the examination paper in the ways described below. Note, that you are not allowed to modify and/or to drop any consistency constraints. Also note, that to implement some of the modifications listed below you may need more than one data manipulation statement of SQL.

(1) `James Bound`, employee id `007`, phone number `123.456.7890` has been hired on `5 March 2012` as a `Stock Manager`. His email is `jamesbound2012@gmail.com` and his salary is `8000`. He works in ta department of `Marketing` and his manager id is `201`.

(1 mark)

(2) Information about an employee number `105` must be removed from the database together with information about the employee's job history. Note, that a foreign key `JOBHISTORY_FK2` does not have `ON DELETE CASCADE` clause. Also assume that the employee is not a manager.

(2 marks)

(3) A department `Human Resources` has been moved to a new location. The new address is `100 Century Avenue`, `Shanghai`, `China`. Post code is `200120`.

(1 mark)

(4) A department `Shareholder Service` has been renamed to `Share Service`. Update all related data in the database.

(4 marks)

**QUESTION 5 (10 marks)**
Write `SELECT` statements that implement the following queries.

(1) Find the full names of employees who are the topmost level managers, i.e. who are not managed by any other employee.

(2 marks)

(2) List the full names of all departments and full names of employees working in each department. The results should be displayed in the descending order of department names and the full names of employees from the same department must be listed in the ascending order of the last names.

(2 marks)

(3) Find the full names of employees who work in a city `Geneva` in `Switzerland`.

(2 marks)

(4) Find the names of departments, names of countries and total number of employees for each department that hires more than `5` employees.

(2 marks)

(5) Find the employee id, first name and last name for each employee who is directly managed by `Matthew Weiss`.

(2 marks)

**QUESTION 6 (7 marks)**
Assume that a user `root` with a password `'root'` created a database called `HR` and the user executed `CREATE TABLE` statements given on page 2 of the examination paper to create the relational tables in the database `HR`.

Write SQL script that performs the following operations by a user `root`.

(1) The script creates three new users: `boss`, `admin`, and `worker`. The passwords are up to you.

(2) The script grants the access in a read mode on all relational tables in `HR` database to a user `boss`. The read access rights must be granted such that a user `boss` is allowed to grant access in read mode to all tables to the other users.

(3) The script grants the access in the read and write modes on a relational table `EMPLOYEE` in `HR` database to a user `admin`. In this case a user `admin` is not allowed to grant the same privilege to the other users.

(4) The script grants the access in a read mode to the columns `employee_id`, `start_date`, and `end_date` in a relational table `JOBHISTORY` to a user `boss`. A user `boss` is not allowed to grant the same privilege to the other users.

(5) The script grants the access in a read mode to information about the total number of jobs held in the past by each employee to a user `admin`.

(6) The script grants the rights to create the relational tables and to create the relational views in a database `HR` to the users `boss` and `admin`. The users are allowed to propagate the privileges to the other users.

(7) The script grants the rights to read all relational tables in all databases created on a database server to a user `boss`. A user `boss` is not allowed to grant the same privilege to the other users.

**QUESTION 7 (9 marks)**
Some of simpler Database Management Systems, like for example MySQL 5.7 Community Edition, do not have the features like database triggers or stored procedures for automatic verification of logical database consistency. In Assignment 4 task 3 in this subject you have been asked to implement your own simple system for verification of logical database consistency.

(1) Describe a technique used in your implementation of verification of logical database consistency. Write what components of the database management system were used, what actions on a database system were necessary to verify the logical consistency.

(2 marks)

(2) Write SQL script that implements a technique described in (1) to enforce the logical consistency constraint.

A relational table `EMPLOYEE` contains in a column `job_title` information about a name of the present job of each employee. A relational table `JOBHISTORY` contains in a column `job_title` information about the present and the past jobs of each employee.

For an employee, a value of an attribute `job_title` in a relational table `EMPLOYEE` must be the same as a value of an attribute `job_title` in a relational table `JOBHISTORY` in a row that contains information about the present job of the employee.

(7 marks)

In your answers to this question you are allowed to extensively quote the sample solution of Assignment 4, task 3 published by your lecturer.