UOW AUSTRALIA

School of Computing and Information Technology

Student to complete:

Family name	
Other names	
Student number	
Table number	

CSIT115
Data Management and Security
Wollongong Campus

Examination Paper
Autumn Session 2018

Exam duration	3 hours
Weighting	60 %
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 APPLICANT(              /* Applicants          */
anumber   DECIMAL(6)  NOT NULL,      /* Applicant number    */
fname     VARCHAR(20) NOT NULL,      /* First name          */
lname     VARCHAR(30) NOT NULL,      /* Last name           */
dob       DATE        NOT NULL,      /* Date of birth       */
     CONSTRAINT APPLICANT_pkey PRIMARY KEY ( anumber ) );

CREATE TABLE POSITIONS(              /* Advertised positions */
pnumber   DECIMAL(8)  NOT NULL,      /* Position number
title     VARCHAR(30) NOT NULL,      /* Position title      */
salary    DECIMAL(6)  NOT NULL,      /* Salary              */
ename     VARCHAR(100) NOT NULL,     /* Employer name       */
     CONSTRAINT POSITION_pkey PRIMARY KEY ( pnumber ) );

CREATE TABLE APPLIES(                /* Job applications    */
anumber   DECIMAL(6)   NOT NULL,     /* Applicant number    */
pnumber   DECIMAL(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 POSITIONS ( pnumber ) );

CREATE TABLE SPOSSESSED(
anumber   DECIMAL(6)   NOT NULL,     /* Applicant number    */
sname     VARCHAR(30)  NOT NULL,     /* Skill name          */
slevel    DECIMAL(2)   NOT NULL,     /* Skill level         */
     CONSTRAINT SPOSSESSED_pkey PRIMARY KEY ( anumber, sname ),
     CONSTRAINT SPOSSESSED_fkey1 FOREIGN KEY ( anumber )
               REFERENCES APPLICANT ( anumber ) );

CREATE TABLE SNEEDED(
pnumber   DECIMAL(8)   NOT NULL,     /* Position number     */
sname     VARCHAR(30)  NOT NULL,     /* Skill name          */
slevel    DECIMAL(2)   NOT NULL,     /* Skill level         */
     CONSTRAINT SNEEDED_pkey PRIMARY KEY ( pnumber, sname ),
     CONSTRAINT SNEEDED_fkey1 FOREIGN KEY ( pnumber )
               REFERENCES POSITIONS ( pnumber ) );
```

QUESTION 1 (10 marks)

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

A network of hospitals would like to create a database with information about the patients, treatments of patients, doctors, and nurses.

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

The hospitals employ doctors, administration, and nursing staff members. A hospital employee is described by a unique employee number, 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, doctors are described by a specialisation, administration members are described by a list of IT skills possessed and nurses are described by list of training courses passed. An employee works only at one hospital.

The patients are admitted to the hospitals for treatments. A patient is described by the first name, last name, and unique phone number. We consider two types of patients: in-patients and out-patients. Out-patients have the same description as in-patients and they are additionally described by residence address. Residence address consists of city name, street name, building number, and optionally flat number.

Each time a patient is admitted to a hospital, admission date and time is recorded. A patient can be admitted and treated at any of the hospitals that belong to the network of hospitals and of course any hospital can treat any patient. When a treatment is completed, a patient discharge date is recorded. A treatment may take some time and its completion date is not known when the treatment is started.

A treatment consists of one or more steps. Each step has a number, which is unique within a treatment, a short description, and a list of drugs applied at a step. It must be recorded in the database which doctors and which nurses were involved in each step of treatment. A doctor and a nurse can be involved in many treatment steps and each step may require involvement of many doctors and nurses.

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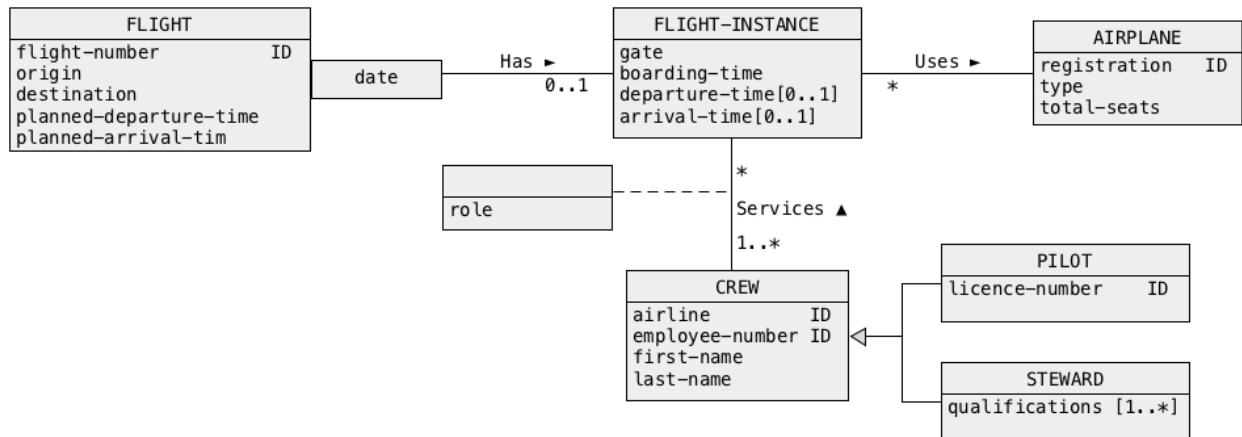
Your task is to perform a step of logical database design, i.e. to transform a conceptual schema given above into a collection of relational schemas.

For each relational schema clearly list the names of attributes, primary key, candidate keys (if any), and foreign keys (if any). Assume, that **superset 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) We would like to add to the database information about the total number of applications for each position. The total number of applications is a nonnegative integer number not greater than 99.

(2 marks)

(2) We would like to increase salary of position up to 99999.99 in any currency.

(2 marks)

(3) We would like to add information about the skills not possessed by any applicant.

(2 marks)

(4) In the future information about a date of birth of an applicant will be optional.

(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) Last night, the largest position number was `777` and the largest position number had not changed up to now. Today, a new position of `King` was advertised by a company `UnitedKingdom Pty Ltd` with a salary `999.99`. Also today, `Robin Hood`, applicant number `888`, decided to apply for the position.

(1 mark)

(2) Applicant number `105` won one million dollars in Lotto and she decided to withdraw all her applications and remove all her information from the database.

(2 marks)

(3) A position `1`, `teller` offered by `ANZ Bank` with a salary `10000` must change its number to `779`. Assume, that at the moment there is no other position with a number `779` and that `778` is the largest position number.

(2 marks)

(4) Due to a government intervention all positions that have a word `gambling` in their title must be dropped and removed from the database.

(3 marks)

QUESTION 5 (10 marks)

Write SELECT statements that implement the following queries.

(1) Find the first and last names of applicants (fname, lname) who applied for at least one position offered by an employer with a name Golden Bolts.

(2 marks)

(2) Find the first and last names of applicants (fname, lname) who did not apply for a position number 7 (pnumber).

(2 marks)

(3) Find the numbers of applicants (anumber) who in the same moment applied for both positions number 7 and number 8 (pnumber).

(2 marks)

(5) Find the numbers applicants (anumber) together with the total number of positions applied by each applicant. If an applicant has not applied about any position yet then include into an answer his/her number with the total number of positions equal to zero (0).

(2 marks)

(4) Find the numbers of positions (pnumber) that have more than 10 applicants

(2 marks)

QUESTION 6 (7 marks)

Assume that a user `root` with a password `'root'` created a database called `APPS` and the user executed `CREATE TABLE` statements given on page 2 of the examination paper to create the relational tables in the database `APPS`.

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

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

(2) The script allows the users `company` and `applicant` for no more than 2 concurrent connections to the database.

(3) The script grants the access in a read mode on all relational tables in `APPS` database to the users `company` and `applicant`. The read access rights must be granted such that both users are not allowed to grant access in read mode to all tables to the other users.

(3) The script grants access in read and write mode to all tables in `APPS` database to a user `admin`. The user `admin` must have the rights to grant the privileges to the other users.

(4) The script grants the access in the read and write modes on a relational table `APPLICANT` in `APPS` database to a user `applicant`. In this case, a user `applicant` is not allowed to grant the same privilege to the other users.

(5) The script grants the access in a read mode to the columns `anumber`, and `sname` in a relational table `SPOSSESSED` to a user `company`. A user `company` is not allowed to grant the same privilege to the other users.

(6) The script grants the access in a read mode to information about the total number of applications to a user `admin`. A user `admin` is not allowed to grant the same privilege to the other users.

(7) The script grants the rights to create the relational tables and to create the relational views in a database `APPS` to a user `admin`. The user is allowed to propagate the privilege to the other users.

QUESTION 7 (9 marks)

MySQL allows for specification of domain constraints as so called `CHECK` constraint in `CREATE TABLE` statement of SQL. However, at the moment, the latest version of MySQL does not automatically enforce such constraints in a database.

For the discreet domain constraints that restricts the values in a domain of a given attribute to a given set of values, like of example a `CHECK` constraint:

```
CONSTRAINT CHECK_CONSTRAINT CHECK sname IN ('reading', 'writing', 'thinking')
```

it is possible to enforce a domain constraint in a different way than directly through `CREATE TABLE` statement.

(1)   Explain how would you enforce the following constraint on the contents of relational table `SPOSSESED`:

The skills `reading` and `writing` can only be possessed by the applicants at the levels which are positive integer numbers not greater than `3`, while a skill `thinking` can be possessed by the applicants at a level zero (`0`) and at the levels which are positive integer numbers equal or less than 5.

(3 marks)

(2)   Implement SQL script that enforces a constraint listed above in the sample database.

(6 marks)