

## School of Computing and Information Technology

**Student to complete:**

Family name

Other names

Student number

Table number


### **CSIT815 Data Management and Security Wollongong Campus**

## **Examination Paper Spring Session 2019**

Exam duration	3 hours
Weighting	60%
Items permitted by examiner	None
Aids supplied	None
Directions to students	8 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 EMPLOYEE(
ENUM          DECIMAL(12)          NOT NULL,/* Employee number          */
FNAME         VARCHAR(50)          NOT NULL,/* First name                    */
LNAME         VARCHAR(50)          NOT NULL,/* Last name                     */
DOB           DATE                  NULL,/* Date of birth                 */
CONSTRAINT EMPLOYEE_PKEY PRIMARY KEY(ENUM) );
```

```
CREATE TABLE DRIVER(
ENUM          DECIMAL(12)          NOT NULL,/* Employee number          */
LNUM          DECIMAL(8)           NOT NULL,/* Driving license number    */
STATUS        VARCHAR(10)         NOT NULL,/* Driver status             */
CONSTRAINT DRIVER_PKEY PRIMARY KEY(ENUM),
CONSTRAINT DRIVER_UNIQUE UNIQUE(LNUM),
CONSTRAINT DRIVER_FKEY FOREIGN KEY(ENUM) REFERENCES EMPLOYEE(ENUM),
CONSTRAINT DRIVER_STATUS CHECK (
STATUS IN ('AVAILABLE', 'BUSY', 'ON LEAVE')) );
```

```
CREATE TABLE TRUCK(
REGNUM        VARCHAR(10)         NOT NULL,/* Registration number       */
CAPACITY      DECIMAL(7)          NOT NULL,/* Capacity                  */
WEIGHT        DECIMAL(7)          NOT NULL,/* Weight                    */
STATUS        VARCHAR(10)         NOT NULL,/* Present status            */
CONSTRAINT TRUCK_PKEY PRIMARY KEY(REGNUM),
CONSTRAINT TRUCK_STATUS CHECK
( STATUS IN ('AVAILABLE', 'USED', 'MAINTAINED')),
CONSTRAINT TRUCK_WEIGHT CHECK
( WEIGHT > 0.0 AND WEIGHT < 500 ),
CONSTRAINT TRUCK_CAPACITY CHECK
( CAPACITY > 0.0 AND CAPACITY < 100 ) );
```

```
CREATE TABLE TRIP(
TNUM          DECIMAL(10)         NOT NULL,/* Trip number              */
LNUM          DECIMAL(8)          NOT NULL,/* Driving license number    */
REGNUM        VARCHAR(10)         NOT NULL,/* Truck registration number */
TDATE         DATE                NOT NULL,/* Trip date                 */
CONSTRAINT TRIP_PKEY PRIMARY KEY (TNUM),
CONSTRAINT TRIP_CKEY UNIQUE (LNUM, REGNUM, TDATE),
CONSTRAINT TRIP_FKEY1 FOREIGN KEY (LNUM) REFERENCES DRIVER(LNUM),
CONSTRAINT TRIP_FKEY2 FOREIGN KEY (REGNUM) REFERENCES TRUCK(REGNUM) );
```

```
CREATE TABLE TRIPLEG(
TNUM          DECIMAL(10)         NOT NULL,/* Trip number              */
LEGNUM        DECIMAL(2)          NOT NULL,/* Leg number                */
DEPARTURE     VARCHAR(30)         NOT NULL,/* Departure city            */
DESTINATION   VARCHAR(30)         NOT NULL,/* Destination city          */
CONSTRAINT TRIPLEG_PKEY PRIMARY KEY (TNUM, LEGNUM),
CONSTRAINT TRIPLEG_UNIQUE UNIQUE(TNUM, DEPARTURE, DESTINATION),
CONSTRAINT TRIPLEG_FKEY1 FOREIGN KEY (TNUM) REFERENCES TRIP(TNUM) );
```

### QUESTION 1 (10 marks)

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

*A University would like to create a database to record information about some of its activities.*

*The university offers a number of degrees to students. A degree is described by a unique name, total number of credit points required to complete a degree, and several requirements that must be satisfied by the future students. The university offers three types of degrees: undergraduate degrees, postgraduate degrees, and graduate certificate. Postgraduate degrees are available only for the students who already got an undergraduate degree. A description of a postgraduate degree includes a list of acceptable undergraduate degrees. A description of a graduate certificate includes a requirement on the total number of years of professional experience.*

*Each degree consists of an ordered sequence of subjects. A description of a subject consists of its number in a sequence and unique code, unique title, total number of credits points a subject is worth, and a list of learning objectives.*

*The university employs academic staff members, tutors and support staff members. A common description of a university employee consists of a unique employee number, first name last name and date of birth. First name, last name and date of birth uniquely identified each employee. Additionally, academic staff members and tutors are described by an academic degree achieved. Support staff members are described by a list of qualifications acquired in the past together with a date when each qualification has been acquired.*

*The university assigns the academic staff members and tutors to the subjects. A subject has one or two academic members assigned and a number of tutors. An academic staff member and tutor can be assigned to many subjects. Support staff members are assigned to the degrees. Each support staff member is assigned to one degree and a degree has one or more support staff members assigned.*

*The university is divided into faculties and faculties are divided into schools. Academic staff members and tutors belong to one school and each school consists of many academic staff members and tutors. The faculties and schools are described by the unique names. The university keeps information when the academic staff members and tutors joined the schools. The university also keeps information about the former employees who worked at the university in the past. A description of a former employee is the same as current employee and additionally it includes a hire date and end of employment date.*

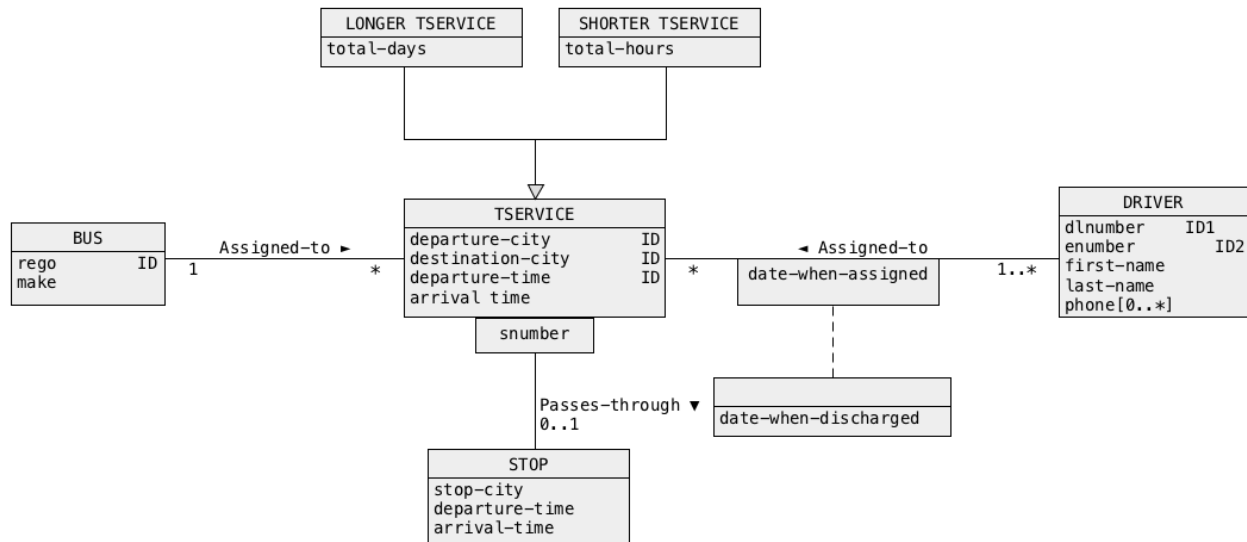
Draw a conceptual schema for the specification of a database domain listed above. Use a notation of UML simplified class diagrams explained to you during the lecture classes in the subject.

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.

It is not allowed to use any artificial identifiers and any attributes that are not mentioned in a specification above.

## QUESTION 2 (10 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 an **association 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) Modify a consistency constraint of the sample database such that after a modification it is possible to record in the database information about the trucks that have capacity up to and including 200.  
(2 marks)
- (2) Modify a structure and consistency constraint of the sample database such that after a modification it is possible to store in the database information about the total number of legs a trip consists of. Assume, that a trip cannot consists of more than 10 legs.  
(2 marks)
- (3) Modify a structure and consistency constraints of a sample database such it is possible to store in a database information about the mechanics employed by a transportation company. Assume, that a description of mechanic consists of an employee number, first name, last name, date of birth and qualification level. A qualification level is a positive integer number 1 or 2 or 3 or 4 or 5. Remember that a mechanic is an employee.  
(2 marks)
- (4) Modify a consistency constraints of a sample database such it is possible to store in a database information about the trip without providing information about a driver licence number. Such modification is required when a driver leaves a transportation company and we would like to keep information about all trips performed by the driver.  
(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) Assume, that the largest number of a trip is 1000 (the largest value in a column `TNUM` in a relational table `TRIP`). Assume, that a new trip has been completed today. The trip was from Sydney to Dubbo and then from Dubbo back to Sydney. The trip has been performed by a driver with a licence number 007 (column `LNUM` in a relational table `TRIP`) who used a truck with a registration number `AL08UK`. Insert appropriate information into a sample database.  
(2 marks)
- (2) Delete from a database information about trip number 100. Remember, that the foreign keys in all `CREATE TABLE` statements have no `ON DELETE CASCADE` clause.  
(2 marks)
- (3) Change a status of all drivers who performed more than 100 trips to a value `ON LEAVE`.  
(2 marks)
- (4) Copy information about all employees born before a year 2000 to a new table `E19CENT`. There is no need to enforce any consistency constraints on the new table.  
(2 marks)

**QUESTION 5 (10 marks)**

Write `SELECT` statements that implement the following queries.

- (1) Find the first and the last names of all drivers who are on leave. (2 marks)
- (2) Find the registration numbers of all trucks that have not been used so far. (2 marks)
- (3) Find the registration numbers of all trucks that have been used more than 100 times. (2 marks)
- (4) Find the distinct names of all cities visited during a trip number 5 or a trip number 6. A city is visited if it is either a departure city or a destination city of any leg included within a trip. (2 marks)
- (5) Find the registration numbers of all trucks that have been used by both drivers with a driving licence number 007 and with a driving license number 008. (2 marks)

**QUESTION 6 (7 marks)**

Assume that a user `root` with a password `'csit115'` created a database called `transport` and the user executed `CREATE TABLE` statements given on page 2 of the examination paper to create the relational tables in the database `transport`.

Write SQL script that performs the following operations by a user `root`. Assume that a user `root` has already connected to the database.

- (1) A user `root` nominates a database `transport` as a default database and then the user creates two roles `driver` and `admin`.
- (2) A user `root` grants the read access rights to the relational tables `EMPLOYEE` and `DRIVER` to a role `admin`. The read access rights cannot be propagated to other roles or users.
- (3) A user `root` grants the rights to insert the rows into a relational tables `TRIP` and `TRIPLEG` to a role `driver`. The access rights can be propagated to other roles or users.
- (4) A user `root` grants the update privilege on all relational tables in `csit115` database to a role `admin`. The privilege cannot be propagated to other roles or users.
- (5) A user `root` grant the read access rights to information about the total number trips performed by each driver to a role `driver`.
- (6) A user `root` creates 2 new users and grants a role `driver` to one user and a role `admin` to another user. The names and passwords to two new user accounts are up to you.
- (7) A user `root` sets the resource limits for the users created in the previous step and it allows for maximum 3 concurrent connections. Finally, a user `root` locks both user accounts created in the previous step.



**QUESTION 7 (4 marks)**

The implementation and testing of complex `SELECT` statements that operate on many relational tables and involve many sophisticated search conditions is a difficult and time consuming task.

- (1) Describe what SQL programming technique would you use to simplify the implementation and testing of complex `SELECT` statements. Note, that we expect from you a description of a technique that has been practiced in one of the Laboratory tasks in this session.

(2 marks)

- (2) Use a technique described in the previous step to implement the following query as `SELECT` statement.

*Find the first and the last names of all drivers who performed more than 3 trips in 2019.*

Note, that no marks will be granted for a solution of task (2) that does not use a technique explained in task (1).

(2 marks)

**QUESTION 8 (3 marks)**

A transformation of generalizations into the relational tables in a step of logical design can be performed in 3 generic and different ways.

Describe 3 ways how generalizations can be transformed into the relational tables and provide the simple examples for each one of the transformations.