

School of Computing and Information Technology

Student to complete:

Family name

Other names

Student number

Table number

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CSIT115 Data Management and Security Wollongong Campus

Examination Paper Autumn 2016

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|-----------------------------|-----------------------------|
| Exam duration | 3 hours |
| Items permitted by examiner | <i>None</i> |
| 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 EMPLOYEE (                                /* Descriptions of employees */
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              */
BLDG          DECIMAL(3)        NOT NULL,                /* Address: building number   */
STREET        VARCHAR(30)      NOT NULL,                /* Address: street name       */
SUBURB        VARCHAR(30)      NOT NULL,                /* Address: suburb            */
STATE         VARCHAR(5)        NOT NULL,                /* Address: state              */
ZIPCODE       DECIMAL(4)        NOT NULL,                /* Address: zip code          */
SALARY        REAL              NOT NULL,                /* Salary                     */
CONSTRAINT EMPLOYEE_PKEY PRIMARY KEY(ENUM) );

CREATE TABLE DRIVER (                                    /* Description of drivers    */
ENUM          DECIMAL(12)      NOT NULL,                /* Employee number           */
LNUM          DECIMAL(8)        NOT NULL,                /* Driver license number     */
STATUS        VARCHAR(10)      NOT NULL,                /* Present status of a driver */
CONSTRAINT DRIVER_PKEY PRIMARY KEY(ENUM),
CONSTRAINT DRIVER_UNIQUE UNIQUE(LNUM),
CONSTRAINT DRIVER_FKEY FOREIGN KEY(ENUM) REFERENCES EMPLOYEE(ENUM) );

CREATE TABLE TRUCK (                                     /* Descriptions of trucks   */
REGNUM        VARCHAR(10)      NOT NULL,                /* Registration number       */
CAPACITY      DECIMAL(7)        NOT NULL,                /* Capacity of a truck       */
WEIGHT        DECIMAL(5)        NOT NULL,                /* Weight of a truck         */
DISTANCE      DECIMAL(9)        NOT NULL,                /* Distance travelled so far  */
CONSTRAINT TRUCK_PKEY PRIMARY KEY(REGNUM) );

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

CREATE TABLE TRIPLEG (                                   /* Descriptions of legs of trips */
TNUM          DECIMAL(10)      NOT NULL,                /* Trip number               */
LEGNUM        DECIMAL(2)        NOT NULL,                /* Leg number                */
DEPARTURE     VARCHAR(30)      NOT NULL,                /* City of departure         */
DESTINATION    VARCHAR(30)      NOT NULL,                /* City of destination       */
CONSTRAINT TRIPLEG_PKEY PRIMARY KEY (TNUM, LEGNUM),
CONSTRAINT TRIPLEG_FKEY1 FOREIGN KEY (TNUM) REFERENCES TRIP(TNUM) );

```

QUESTION 1 (9 marks)

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

A large bank would like to create a database to record some its operations.

The bank is divided into several branches and each branch is described by a unique branch number, unique branch name, and unique address.

The bank employs a number of tellers. Every teller has a unique employee number and he/she is described by full name, address, date of birth, status, and salary. The tellers are assigned to the branches such that each teller is assigned to only one branch and a branch has one or more tellers.

The bank employs a number of IT specialists. Every IT specialist is described by a unique employee number and he/she is described by full name, address, date of birth, list of skills, and salary.

Apart from the tellers, and IT specialists the bank employs other employees described by a unique employee number, full name, address, date of birth, and salary.

The bank opens accounts for the customers. To open an account a customer provides his/her personal data, i.e. first and last name, date of birth, address, and optional email. Each customer obtains from the bank a unique identification number.

A customer is allowed to own many bank accounts. Each bank account is owned by precisely one customer. An account is described by a number, which is unique at a branch, balance, and type. There are three types of accounts: either saving accounts, or checking accounts, or loan accounts. When account is opened the bank records information about date and time when it was opened and which teller was involved in the operation. Customers are allowed to open many accounts at many different branches.

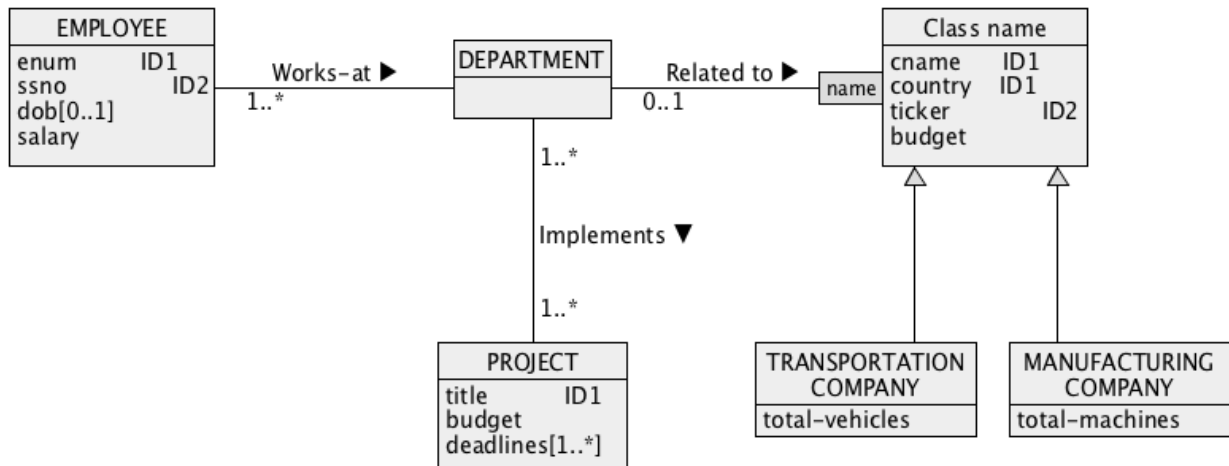
The customers perform operations on the bank accounts. A type of operation (either deposit, or withdrawal), amount of money involved, and date and time when an operation has been performed is recorded for each operation.

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 class 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 such that:

- (1) It should be possible to add to the database information about a length of entire trip. A length of a trip is an integer number greater than 0 and less than 10000,
- (2) It should be possible to store in the database information about the training courses passed by the drivers. A description of a course consists of course title and date when it has been conducted. A course title together with a course date uniquely identifies each course,
- (3) It should be possible to store information about the skills possessed by the drivers. A name of skill is a variable size string no longer than 30 characters. Note, that a driver has many skills and a skill is possessed by many drivers. Therefore, a solution which adds a column `skill_name` to a table `DRIVER` is definitely incorrect !
- (4) Information about the distance travelled so far by each truck is no longer needed. Instead we would like to store information about the present status of a truck. A status of a truck can be either "available" or "used" or "maintained".

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.

- (1) A driver with a license number 101 used a truck with a registration PKR856 to perform a trip on 15 April 2016. A driver first travelled from Sydney to Goulburn. Then, the driver travelled from Goulbourn to Waga Waga and then, finally to Melbourne. Assume that information about the driver and the truck used is already recorded in the database and that the largest number of a trip is 500.
- (2) Information about a trip number 200 must be removed from the database together with information about all legs of the trip. Note, that a foreign key `TRIPLEG_FKEY1` does not have `ON DELETE CASCADE` clause !
- (3) Information about all registration numbers and capacities of all trucks that performed at least one trip in 2015 must be copied to a new relational table `TRUCK2015`. There is no need to enforce any consistency constraints on the new table and there is no need to delete such information from a relational table `TRUCK`.
- (4) A driver that has a driver license number 102 decided to leave the company. Information about the driver must be removed from the database. Information about the trips performed by the driver must be left in the database without a driver license number.

QUESTION 5 (10 marks)

Write `SELECT` statements that implement the following queries.

- (1) Find the first and the last names of all drivers who used a truck with a registration number `PKR856` at least one time.
- (2) Find the first and the last names of all drivers who never used a truck with a registration number `PKR856`.
- (3) Find the first and the last names of all drivers who used a truck with a registration number `PKR856` at least three times.
- (4) Find the first and the last names of all drivers who used a truck with a registration `PKR856` and who used a truck with a registration `AL08UK` on two different trips.
- (5) Find the driver license number for all drivers together with the total number of trips performed by each driver. If a driver performed no trips so far then list his driver license number with 0 (zero).

QUESTION 6 (10 marks)

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

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

- (1) The script creates three new users: `jamesb`, `harryp`, and `robinh`. The passwords are up to you.
- (2) The script grants the access in a read mode on all relational tables in `transportation` database to a user `jamesb`. The read access rights must be granted such that a user `jamesb` is allowed to grant access in read mode to all tables to the other users.
- (3) The script grants the access in a write mode on the relational tables `EMPLOYEE` and `DRIVER` in `transportation` database to a user `jamesb`. In this case a user `jamesb` 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 `ENUM`, `FNAME`, `LNAME` in a relational table `EMPLOYEE` to a user `harryp`. A user `harryp` is not allowed to grant the same privilege to the other users.
- (5) The script grants the rights to reference a column `ENUM` in a relational table `EMPLOYEE` to a user `robinh`. A user `robinh` must be allowed to propagate the privilege to the other users.
- (6) The script grants the rights to create the relational tables and to create the relational views to the users `jamesb` and `harryp`. The users are not allowed to propagate the privileges to the other users.
- (7) The script grants the rights to read all information about the trucks with a capacity (attribute `CAPACITY` in a relational table `TRUCK`) greater than 1000 to the users `jamesb` and `harryp`. The users are not allowed to propagate the privileges to the other users.

QUESTION 7 (7 marks)

Some of simpler Database Management Systems, like for example MySQL 5.7 Community Edition, do not have the features for auditing the database activities. In Assignment 4, Task 4 you have been asked to implement your own simple auditing of database activities.

- (1) Describe a technique used in your implementation of simple auditing, write what components of the database management system were used, what actions on a database system were necessary to initiate the collection of audit information, and how the audit outcomes were processed.
- (2) Write SQL script that implements a technique described in (1) to discover a suspicious activity of database users, like for example an update to `SALARY` column in `EMPLOYEE` table performed on Sunday.

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