



COS 221 Practical Assignment 3

- Date Issued: **23rd March 2022**
- Date Due: **6th April 2022** before **11:00 (in the morning)**
- Submission Procedure: **Upload to ClickUP**
- This assignment consists of **7 tasks** for a total of **90 marks**.

1 Introduction

This practical assignment utilises the scenario provided in Practical Assignment 1. The scenario is given below for your convenience.

*The University of Pretoria executive committee has decided to deliver better value to its students, staff and alumni. They will be opening and operating the UPBank through the Enterprises@UP initiative. The University of Pretoria has requested that you, as a young Computer Science undergraduate student to **design the conceptual data model for UPBank**. You have requested more information from them and were provided with the information below.*

The UPBank will operate only within the South African borders, and as such will need to comply with all regulatory and legal requirements. As part of the global fight against money laundering, the South African government has introduced the Financial Intelligence Center Act, 38 of 2001, often referred to as “FICA”. FICA provides a legal framework to prevent criminals from introducing their illicit gains into our bank system. Section 21 and 22 of FICA requires that all banks ensure they have correct details of their customers, by way of a process known as Know-Your-Customer, abbreviated KYC. As part of its vision to offer enhanced value to its students, staff and members, all clients of UPBank will be identified by their u-number. Even though the University of Pretoria has your details, they are prohibited under the new POPIA law to share your personal details with the bank. Thus, the bank would require each new member to provide their name, a postal and physical address, in addition to various contact methods, such as SMS, Email and telephone numbers. However for compliance reasons UPBank would require their customers yearly to resubmit KYC information which would include proof of their ID number and physical address. It is critical for compliance to ensure a full history of KYC validations are kept. However unlike KYC, validation of UP membership will only be conducted once, of which record must be kept.

Initially the bank will only offer three banking products, namely a cheque account, savings account and 32-day notice deposit account. For a member to open an account they would be required to visit a UPBank branch which will remain the owner of that account on the banking platform. Each branch will be identified by a unique branch code. To allow users of the UPBank easy access to locate and phone a branch, UPBank would like to store additional information on each branch such as address, operating hours and contact details. Each branch will be responsible for administering various ATM’s across Pretoria. The bank would like to know at all times how much cash is available at each ATM as well as the date and time of the last filling of the ATM. UPBank has contracts with multiple Cash-In-Transit (CIT) companies responsible for filling up the ATM. For each of these contracts it is required to store the start and end date of the contract. To ensure cash is always available, an ATM is allowed to be filled up by various CIT contracts.

After successful completion of this assignment you should be able to:

- convert E(E)R-diagrams to relational models;
- draw relational models;
- implement derived relational models in a RDBMS;

- query the relational extension using Structured Query Language (SQL); and
- construct and execute relational algebra expressions against a relational model.

2 Constraints

1. You must complete this assignment individually or in pairs.
2. The database dump will be marked. The SQL scripts from the database dump:
 - (a) which run and perform what they are supposed to do get full marks
 - (b) which run but do not perform as required, will receive partial marks
 - (c) which do not run will be allocated partial marks based on the functionality they would have exhibited.
3. You need to use your MariaDB, MySQL Workbench and Duke University radb (Relational Algebra Interpreter) installations to complete the practical assignment.

3 Submission Instructions

You are required to upload a single archive that includes the following files:

- A pdf containing the answers to the tasks.
- A file or files containing the SQL statements from your database dump to:
 - create your database,
 - create the tables in your database, and
 - populate the tables with the data you populated the tables with.
- A file or files containing the relational algebra expressions to:
 - query the relational extension
- a **readme.txt** file informing the marker what they should do to restore the database onto another machine.

Upload your archive to ClickUP. No late submissions will be accepted, so make sure you upload in good time.

4 Online resources

The following resources will help with creating a E(E)R model using Chen's Notation.

- Visual Paradigm Online: <http://online.visual-paradigm.com>
- draw.io: <http://diagrams.net>

You can access free SQL Tutorial at: https://www.w3schools.com/sql/sql_create_table.asp

Getting Started with MariaDB at: <https://mariadb.com/get-started-with-mariadb/>

To download MariaDB and access the documentation on your computer. Use the official MariaDB site – <https://www.mariadb.com/>

There are many other resources online for example Stack overflow – <https://stackoverflow.com/> a platform for developers to learn, share knowledge and build career.

Refer to the Practical Tutorial 4 for more information on obtaining, installing, setting up and using the radb tool from Duke University.

5 Rubric for marking

Creating a database	2
E(E)R Diagram	
Entities	4
Relationships	4
Cardinality	4
Specialisations/Generalisations/Unions	2
E(E)R-diagram to Relational Mapping	
Mapping of regular entities	4
Mapping of binary 1:1 relationships	2
Mapping of binary 1:N relationships	2
Mapping of binary M:N relationships	2
Mapping of multivalued attributed	1
Mapping of N-ary relationships	2
Mapping of specialisation and generalisation	2
Mapping unions	2
Creating tables and entities	
Table names	2
Column names	2
Use of datatypes	2
Inclusion of primary keys	2
Inclusion of referential integrity constraints	2
Inclusion of other constraints	2
Extensions	2
Sensible data entry	2
Innovative use of SQL	2
Structured Query Language	
Query	13
Results of query	5
Relational Algebra	
Query	10
Results of query	6
Database dump	5
Total	90

6 Assignment Instructions

Task 1: Creating a database (2 marks)

Create the database and name it `uXXXXXXXX_upbank` where `XXXXXXXX` is your student number.

Task 2: E(E)R-diagram (14 marks)

After all the additional knowledge you have obtained during the past few weeks, revise your submitted ER-diagram in Practical Assignment 1 and provide an updated E(E)R-diagram for **UPBank** as part of your uploaded PDF.

Task 3: E(E)R-diagram to Relational Mapping (17 marks)

Using the steps for conversion from ER-diagram to the Relational model as was discussed in detail in Lecture 14, provide a relational mapping of your E(E)R-diagram in your uploaded PDF.

Task 4: Creating tables and entities (18 marks)

Using your derived relational model to create all the appropriate relational intentions. Ensure to create your own relational extensions with **at least 7** entities for each relation. (Note: Make sure you have branches in **Randurg**, **Hatfield** and **Groenkloof** in your extension data.)

Task 5: Structured Query Language (18 marks)

For all of the below questions, ensure to provide the statements and a screenshot of the results in your uploaded PDF.

- 5.1 Provide a SQL statement to select sufficient attributes to identify a client (**Note:** For this question the primary key may not be selected.) (2)
- 5.2 Given that the **Randburg** branch has been closed, provide an appropriate SQL statement to update the relational extension. (**Hint:** UPBank is a financial institution) (4)
- 5.3 Provide a SQL statement to return all clients that have no KYC validations. (4)
- 5.4 Given that all ATM's belonging to the **Randburg** branch, needs to be moved to the **Hatfield** branch for administration, provide the appropriate SQL clauses. (4)
- 5.5 Provide a summary of all accounts in the UPBank system for the amount of transactions in which an account was involved. (4)

Task 6: Relational Algebra (16 marks)

For this question, you are required to use the radb tool from Duke University to query your relational database.

- 6.1 Select all attributes of ATMs whose serial number start with 'ABC123'. (4)
- 6.2 Provide the radb relational expression to return the contact information of all the Cash-In-Transit companies that fill ATM's operated by the **Groenkloof** branch. (6)
- 6.3 Select the naming and contact information of clients who has done more than 24 transactions in the past 9 months. (6)

Task 7: Database dump (5 marks)

Export your database from MariaDB to a text file that you will upload to ClickUP before the deadline. Ensure that your database intension and extension can be recreated on another machine.

IMPORTANT NOTE: Please refer to the rubric for the detailed allocation of marks.