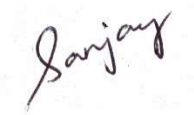
A Database for the Management of University Database

Project for the class Database Systems II
in the Summer Semester 2024

The following persons have contributed to this project:



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1. Data Model for the University Management Database

1.1 Explanation of the Data and the Application

The University Management Database[1][5] is designed to enhance and streamline the administrative processes involving students and instructors by providing a single platform to efficiently manage tasks such as adding, updating and remove student and instructor records, entering grades and viewing the results, and also viewing the free structures and handling simple fee payments.

The key entities are administrators (who are responsible for managing the database and currently overseeing the operations and transactions for instructors and students), students (aged above 16 who are enrolled at the university titled “Hochschule für Wissenschaft Europa”) and instructors (aged above 25 who are responsible for the courses and departments for the enrolled students). Additional entities are subjects, grades, courses, departments and enrolments each of which is responsible for holding the respective data concerned with the entity-relations between the primary three users.

The typical queries are to select data (retrieving specific information such as the student, instructor and course records), inserting data (adding new records for students and instructors), modifying data (modifying certain fields of existing records for students and instructors), deleting data (deregistering students and removing the instructor records), stored procedures[4] (one is responsible to run the DDL and the other is responsible to run the DML queries) and lastly, triggers[3] (automated routines handing actions against conditions like generating user_ids, passwords and emails based on the inserted records into student and instructor tables).

By incorporating these elements, the project aims to provide a simple and user-friendly solution to manage simple university operations[1][5] within a unified platform.

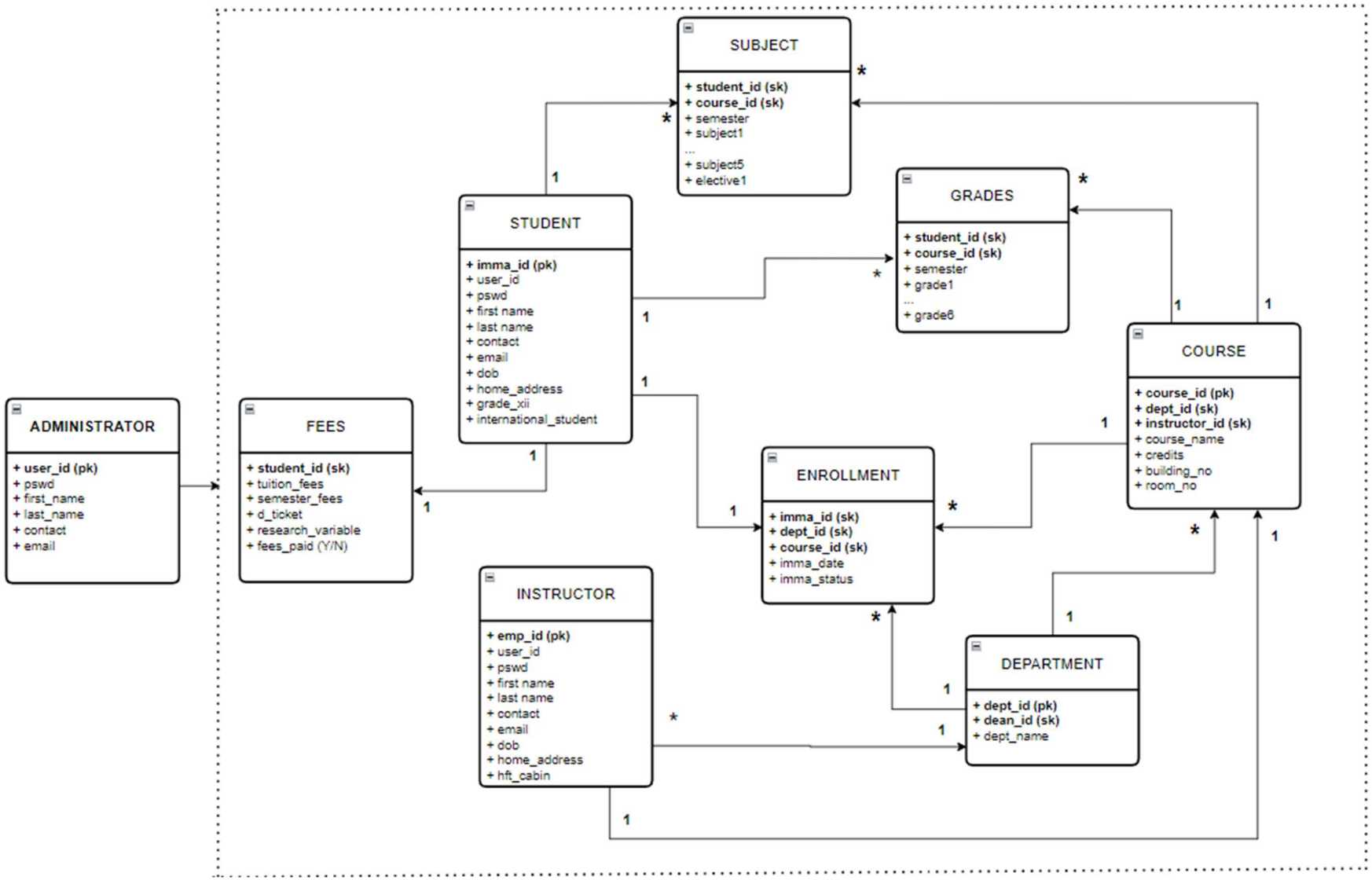
1.2 The Data Model

1.2.1 Modern ER Diagram representing Relational Schema for Operations

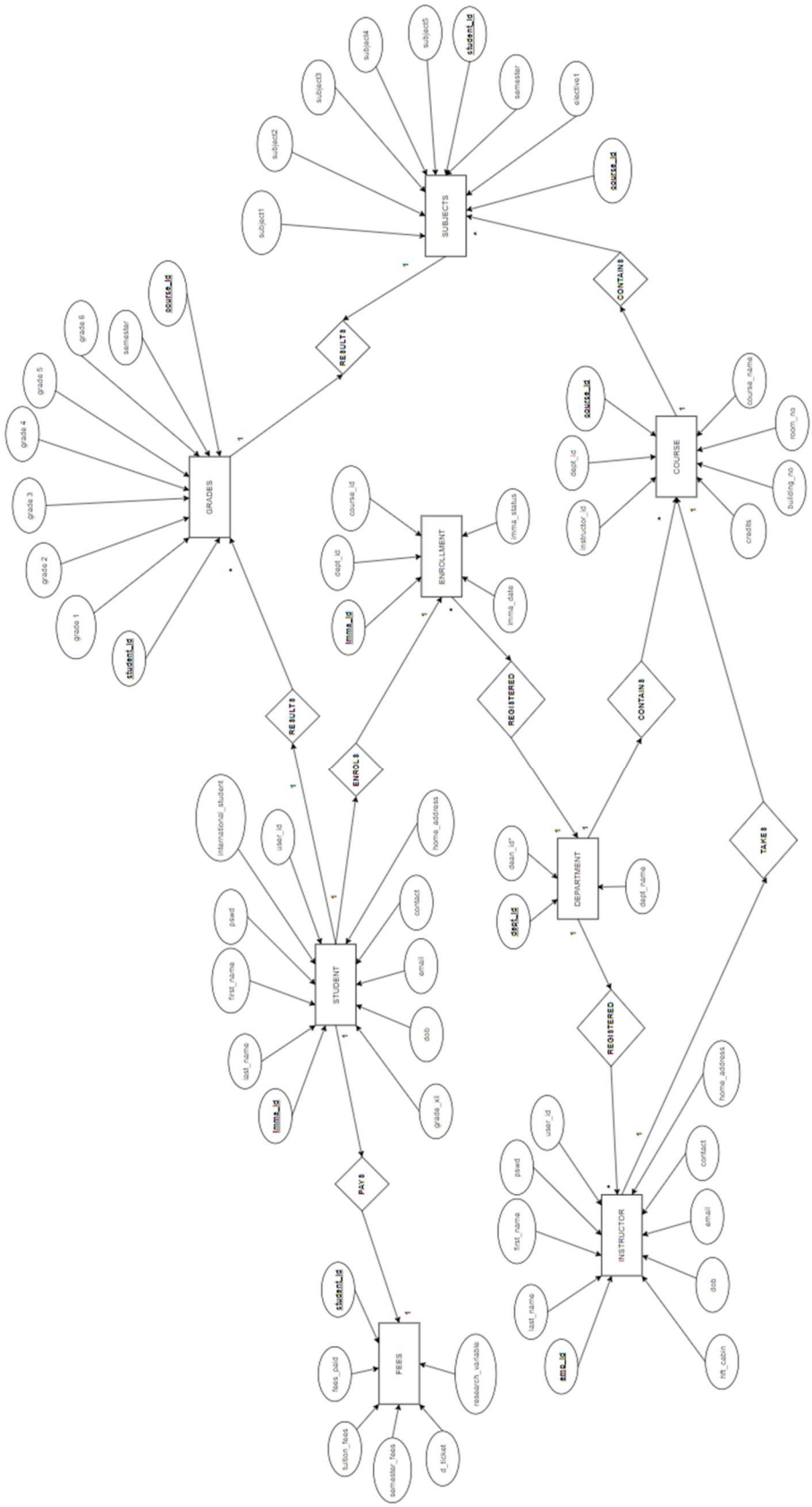
The Entity-Relational Diagram showcased below[5] provides a clear representation of the relational schema governing the operations within the University Management System[1][5]. Each table, including those about administrators, is interconnected via integrity constraints, marked as Primary Keys (pk) and Secondary/Foreign Keys (sk). The ER Diagram is designed with the following objectives in mind:

1. The **administrator** table houses individuals with privileged access to the database, enabling them to manage **student** and **instructor** parent records, as well as associated child records such as **enrolment**, **grades**, and **courses**.
2. Robust data integrity constraints are implemented to ensure accurate relationships between tables, facilitating the automatic removal of orphaned records, and thereby maintaining data consistency and reliability.

RELATIONAL SCHEMA: OPERATIONAL



1.2.2 Actual ER Diagram (Please Zoom as this was difficult to format inside Word)



2. System Requirements

The project was designed and operated on a Windows 11 operating system with a 64-bit architecture, running on a laptop equipped with 16 GB of RAM and 500 GB SSD storage. Below is a summary of the hardware, software, and project management requirements necessary for the seamless operation of the project:

2.1 Hardware Requirements

Hardware Components	Requirements
Operating System	Windows 10 / 11 / 11 pro
Architecture	x64-bit
Processor	Intel i5 10th gen or higher
RAM	Recommended: at least 8GB
Storage	SSD with at least 500 GB capacity
Network	High Speed internet connection for accessing LIDA server
Database Servers	HFT LIDA Server

2.2 Software Requirements

Software Requirement	Tool	Purpose
Integrated Development Environment	Recommended: IntelliJ IDEA Community Edition 2021.1.1 Alternative: Apache Netbeans IDE 21	IDE for implementing GUI and connecting the GUI to the MySQL database on the LIDA server
Version Control	Optional: GitHub (be aware of the GDPR regulations)	Committing, pushing, pulling or rolling back the changes to the code
Database Management Tools	Recommended: SQL Workbench/J Alternative: PuTTy release 0.81 (x64 bit) (for Windows only)	GUI for handling MySQL database queries and transactions
Database	MySQL	SQL Database used for the project
JDBC Connectivity	mysql-connector-java-8.0.23.jar	MySQL JDBC driver required to connect to the MySQL database via the IDE or Thin Client
Database Scripts	Recommended: Notepad++ (64-bit x64) Alternative: Sublime Text 3	Additional Text based IDEs to write SQL scripts and perform regex quality testing
Java Development Kit	Recommended: JDK 21 or higher	Required for JAVA as the main programming language
Graphical User Interface	Java Swings	Frontend development of the GUI
Virtual Network	Cisco Secure Client - AnyConnect VPN 5.1.3.62	to access HFT LIDA server

Plugins	jcalendar-1.4.zip rs2xml.jar	These are external plugins to be placed inside the code/library repository to add the additional functionalities of date/time and JTable respectively.

2.3 Project Management Requirements

Project Management Task	Tool
Agile Methodology	O365 Planner Optional: Atlassian JIRA
Communication Management	O365 Teams accessible using university user ids (data integrity)
Project Documentations	O365 Microsoft Word
Code Snippets	https://carbon.now.sh/
UML and Use Case Diagrams	https://draw.io https://excalidraw.com/

3. Relational Design

3.1 Table Schemas

The following are the snippets of the SQL code to create tables for our project. These statements are also a part of our stored procedure illustrated in the later chapter. The schemas are well equipped with data integrity constraints defined by the primary and foreign keys deemed as necessary as per the ER Diagram. Referential integrities have been carefully implemented to avoid having orphaned nodes when parent table records are removed.

```
/* DDL STATEMENTS */

/* 1. DROP TABLES */

/*1.1*/
DROP TABLE IF EXISTS GRADES;
DROP TABLE IF EXISTS SUBJECT;

/*1.2*/
DROP TABLE IF EXISTS FEES;
DROP TABLE IF EXISTS ENROLLMENT;

/*1.3*/
DROP TABLE IF EXISTS COURSE;
DROP table IF EXISTS DEPARTMENT;

/*1.4*/
DROP TABLE IF EXISTS INSTRUCTOR;
DROP TABLE IF EXISTS STUDENT;

/*1.5*/
```

```sql
DROP TABLE IF EXISTS ADMINISTRATOR;

/* 2. SCHEMA CREATION */

/*2.1 ADMINISTRATOR TABLE */
CREATE TABLE ADMINISTRATOR(
    USER_ID VARCHAR(16) PRIMARY KEY,
    PSWD VARCHAR(16),
    FIRST_NAME VARCHAR(255),
    LAST_NAME VARCHAR(255),
    CONTACT VARCHAR(17),
    EMAIL VARCHAR(255) /* Trigger to generate regex email ->
firstname.lastname@hft-europa.com*/
);

/*2.2 INSTRUCTOR TABLE */
CREATE TABLE INSTRUCTOR(
    USER_ID VARCHAR(16),
    PSWD VARCHAR(16),
    FIRST_NAME VARCHAR(255),
    LAST_NAME VARCHAR(255),
    CONTACT VARCHAR(15),
    EMAIL VARCHAR(50), /* Trigger to generate regex email ->
firstname.lastname@hft-europa.com*/
    DOB VARCHAR(255),
    HOME_ADDRESS VARCHAR(255),
    HFT_CABIN VARCHAR(255),
    EMP_ID VARCHAR(16) PRIMARY KEY
);

/*2.3 STUDENT TABLE */
CREATE TABLE STUDENT(
    USER_ID VARCHAR(16),
    PSWD VARCHAR(16),
    FIRST_NAME VARCHAR(255),
    LAST_NAME VARCHAR(255),
    CONTACT VARCHAR(15),
    EMAIL VARCHAR(50),
    DOB VARCHAR(255),
    HOME_ADDRESS VARCHAR(255),
    GRADE_XII VARCHAR(16),
    INTERNATIONAL_STUDENT VARCHAR(16),
    IMMA_ID VARCHAR(16) PRIMARY KEY
);

/*2.4 DEPARTMENT TABLE */
CREATE TABLE DEPARTMENT(
    DEPT_ID INT PRIMARY KEY,
    DEAN_ID VARCHAR(16),
    DEPT_NAME VARCHAR(255),
    FOREIGN KEY (DEAN_ID) REFERENCES INSTRUCTOR(EMP_ID)
       ON DELETE SET NULL ON UPDATE CASCADE
);

/*2.5 COURSE TABLE */
CREATE TABLE COURSE(
    COURSE_ID INT PRIMARY KEY,
    DEPT_ID INT,
    INSTRUCTOR_ID VARCHAR(16),
    COURSE_NAME VARCHAR(255),
    COURSE_CODE VARCHAR(10), /* Master Software Technology -> mst */
```

```
    CREDITS INT,
    BUILDING_NO INT,
    ROOM_NO INT,
    FOREIGN KEY (DEPT_ID) REFERENCES DEPARTMENT(DEPT_ID)
    ON DELETE SET NULL ON UPDATE CASCADE,
    FOREIGN KEY (INSTRUCTOR_ID) REFERENCES INSTRUCTOR(EMP_ID)
    ON DELETE SET NULL ON UPDATE CASCADE
);

/*2.6 FEES */
CREATE TABLE FEES(
    STUDENT_ID VARCHAR(16),
    TUITION_FEES VARCHAR(16), /* 1500 Euros for International Students */
    SEMESTER_FEES VARCHAR(16), /* 200 Euros for all */
    D_TICKET VARCHAR(16), /* Optional: 360 Euros for all */
    RESEARCH_VARIABLE VARCHAR(16), /* Optional: Variable */
    FEES_PAID VARCHAR(3),
    FOREIGN KEY (STUDENT_ID) REFERENCES STUDENT(IMMA_ID)
    ON DELETE SET NULL ON UPDATE CASCADE
);

/*2.7 ENROLLMENT */
CREATE TABLE ENROLLMENT(
    IMMA_ID VARCHAR(16),
    DEPT_ID INT,
    COURSE_ID INT,
    IMMA_DATE VARCHAR(255),
    IMMA_STATUS VARCHAR(100),
    FOREIGN KEY (IMMA_ID) REFERENCES STUDENT(IMMA_ID)
    ON DELETE SET NULL ON UPDATE CASCADE,
    FOREIGN KEY (DEPT_ID) REFERENCES DEPARTMENT(DEPT_ID)
    ON DELETE SET NULL ON UPDATE CASCADE,
    FOREIGN KEY (COURSE_ID) REFERENCES COURSE(COURSE_ID)
    ON DELETE SET NULL ON UPDATE CASCADE
);

/*2.8 SUBJECT TABLE */
CREATE TABLE SUBJECT(
    STUDENT_ID VARCHAR(16),
    COURSE_ID INT,
    SEMESTER INT,
    SUBJECT1 VARCHAR(255),
    SUBJECT2 VARCHAR(255),
    SUBJECT3 VARCHAR(255),
    SUBJECT4 VARCHAR(255),
    SUBJECT5 VARCHAR(255),
    ELECTIVE1 VARCHAR(255),
    FOREIGN KEY (STUDENT_ID) REFERENCES STUDENT(IMMA_ID)
    ON DELETE SET NULL ON UPDATE CASCADE,
    FOREIGN KEY (COURSE_ID) REFERENCES COURSE(COURSE_ID)
    ON DELETE SET NULL ON UPDATE CASCADE
);

/*2.9 GRADES TABLE */
CREATE TABLE GRADES(
    STUDENT_ID VARCHAR(16),
    COURSE_ID INT,
    SEMESTER INT,
    GRADE1 VARCHAR(8),
    GRADE2 VARCHAR(8),
    GRADE3 VARCHAR(8),
```

```
    GRADE4 VARCHAR(8),
    GRADE5 VARCHAR(8),
    GRADE6 VARCHAR(8),
    FOREIGN KEY (STUDENT_ID) REFERENCES STUDENT(IMMA_ID)
    ON DELETE SET NULL ON UPDATE CASCADE,
    FOREIGN KEY (COURSE_ID) REFERENCES COURSE(COURSE_ID)
    ON DELETE SET NULL ON UPDATE CASCADE
);
```

3.2 Database Tables with Data

There are 9 tables defined in our ER-Diagram. Below are the snippets of all the tables. The values for all the tables except ADMINSTRATOR, COURSE and DEPARTMENT are dynamically added during transactions, while the former are added during the stored procedure runs. An exception to the COURSE table is the column ***instructor_id*** where the fields are populated during transactions.

The following snippets illustrate the backend data present in our tables:

3.2.1 ADMINISTRATOR table

```
SELECT * FROM ADMINISTRATOR;
```

Statement 1 | Database Explorer 2

```
1 SELECT *
2 FROM ADMINISTRATOR;
```

Result 1 | Messages

USER_ID	PSWD	FIRST_NAME	LAST_NAME	CONTACT	EMAIL
41BaPa	4e3556b34e3556cf	Patrick	Bateman	+49 15512345671	Patrick.Bateman@hft-europa.de
41BlLo	4e36f07b4e36f096	Lou	Bloom	+49 15513456712	Lou.Bloom@hft-europa.de
41GoRy	4e34cb214e34cb3e	Ryan	Gosling	+49 15511234567	Ryan.Gosling@hft-europa.de

3.2.2 COURSE table

Note: The ***instructor_id*** value was updated during a transaction of inserting a new instructor record as illustrated in the coming chapters.

```
SELECT * FROM COURSE;
```

Statement 1 Database Explorer 2

```
SELECT *
FROM COURSE;
```

Result 1 Messages

COURSE_ID	DEPT_ID	INSTRUCTOR_ID	COURSE_NAME	COURSE_CODE	CREDITS	BUILDING_NO	ROOM_NO
11	1		Bachelor of Computer Science	bcs	210		
12	1		Bachelor of Augmented Reality	bar	210		
13	1		Bachelor's degree in digitalization and information management	bdi	210		
14	1		Bachelor Surveying and Geoinformatics	bsg	210		
15	1		Master Photogrammetry and Geoinformatics	mpg	90		
16	1	564203	Master Software Technology	mst	90		
17	1		Master Digital Processes and Technologies	mdp	90		
21	2		Bachelor Applied Mathematics and AI	bam	210		
22	2		Master Mathematics	mam	90		
31	3		Bachelor of Business Administration	bba	210		
32	3		Business Administration International Business course	bai	210		
33	3		Bachelor of Infrastructure Management	bim	210		
34	3		Bachelor of Business Informatics	bbi	210		
35	3		Master General Management	mgm	90		
36	3		Master Environmentally Oriented Logistics	meo	90		
37	3		Master of Business Psychology	mdb	90		
41	4		Bachelor of Building Physics	bbp	210		
42	4		Bachelor of Climate Engineering	bce	210		
43	4		Master Building Physics	mbp	90		
44	4		Master in Sustainable Energy Competence	mse	90		

3.2.3 DEPARTMENT table

Note: The ***dean_id*** field is for **future scope**. The goal is to add innovative triggers[3] in our database system and code to automatically or manually assigned deans.

```
SELECT * FROM DEPARTMENT;
```

```
SELECT *
FROM DEPARTMENT;
```

Result 1 Messages

DEPT_ID	DEAN_ID	DEPT_NAME
1		Computer Science
2		Mathematics
3		Business
4		Building Physics

3.2.4 INSTRUCTOR table

Note: Values displayed here **after the transactions have been committed**, illustrated in the later sections.

```
SELECT * FROM INSTRUCTOR;
```

Statement 1 Database Explorer 2

```
SELECT *
FROM INSTRUCTOR;
```

Result 1 Messages

USER_ID	PSWD	FIRST_NAME	LAST_NAME	CONTACT	EMAIL	DOB	HOME_ADDRESS	HFT_CABIN	EMP_ID
41HaKa	85f40b0585f40b0d	Kakashi	Hatake	01551045712122	Kakashi.Hatake@hft-europa.de	01-Aug-1990	14A, In der Au, 70327, Stuttgart	2/314	564203

3.2.5 STUDENT table

Note: Values displayed here **after the transactions have been committed**, illustrated in the later sections.

```
SELECT * FROM STUDENT;
```

Statement 1 | Database Explorer 2

```
1 SELECT *
2 FROM STUDENT;
```

Result 1 | Messages

USER_ID	PSWD	FIRST_NAME	LAST_NAME	CONTACT	EMAIL	DOB	HOME_ADDRESS	GRADE_XII	INTERNATIONAL_STUDENT	IMMA_ID
41UzNa	d837dfecd837dff6	Naruto	Uzumaki	015510523699	Naruto.Uzumaki@hft-europa.de	01-Jan-1998		99.0	Yes	657535

3.2.6 FEES table

Note: Values displayed here **after the transactions have been committed**, illustrated in the later sections.

```
SELECT * FROM FEES;
```

Statement 1 | Database Explorer 2

```
1 SELECT *
2 FROM FEES;
```

Result 1 | Messages

STUDENT_ID	TUITION_FEES	SEMESTER_FEES	D_TICKET	RESEARCH_VARIABLE	FEES_PAID
657535	1500	200	360.0	2.0	YES

3.2.7 ENROLLMENT table

Note: Values displayed here **after the transactions have been committed**, illustrated in the later sections. The working is as follows –

1. The Administrator adds a new record for a student, and the status is ***admitted***.
2. After the student has paid the fees, the matriculation status is updated as ***enrolled.***
3. The matriculation date is the date when the student was admitted into the university.
4. Every enrolment of a student record is tagged against a course and the corresponding department (here, course refers to the main branch / programme, not to be confused with the subjects and the grades).

```
SELECT * FROM ENROLLMENT;
```

Statement 1 Database Explorer 2

```
1 SELECT *
2 FROM ENROLLMENT;
```

Result 1 Messages

IMMA_ID	DEPT_ID	COURSE_ID	IMMA_DATE	IMMA_STATUS
657535	1	16	2024-06-01	ENROLLED

3.2.8 SUBJECT table

Note: Values displayed here **after the transactions have been committed**, illustrated in the later sections.

```
SELECT * FROM SUBJECT;
```

Statement 1 Database Explorer 2

```
1 SELECT *
2 FROM SUBJECT;
```

Result 1 Messages

STUDENT_ID	COURSE_ID	SEMESTER	SUBJECT1	SUBJECT2	SUBJECT3	SUBJECT4	SUBJECT5	ELECTIVE1
657535	16	1	DBS II	SPM 2	CPL	SWA	CV	IT Security

3.2.9 GRADES table

Note: Values displayed here **after the transactions have been committed**, illustrated in the later sections.

```
SELECT * FROM GRADES;
```

Statement 1 Database Explorer 2

```
1 SELECT *
2 FROM GRADES;
```

Result 1 Messages

STUDENT_ID	COURSE_ID	SEMESTER	GRADE1	GRADE2	GRADE3	GRADE4	GRADE5	GRADE6
657535	16	1	1.5	1.5	1.5	1.5	1.5	1.5

3.3 Normalization

Overall, all the schemas are in 2NF, with some tables also achieving 3NF forms as summarized in the table below -

Table Name	Normalization	Description	Justification
ADMINISTRATOR, INSTRUCTOR, STUDENT,	3NF	1. 3NF - There are no transitive dependencies	Most of these tables are dimensional tables (except for department and

DEPARTMENT, FEES		2. 2NF – All non key attributes are fully functionally dependent on the primary key 3. 1NF - All fields are atomic values.	fees which are connected to instructor and student but without a transitive dependency). Such tables maintain 3NF as they only contain additional information with a primary key serving as the prime purpose of relational integration.
COURSE, ENROLLMENT, SUBJECT, GRADES	2NF	1. 2NF – All non key attributes are fully functionally dependent on the primary key 2. 1NF - All fields are atomic values.	These tables have a relational transitive dependency on the other 3NF tables as they contain the main summarized fields, gradually turning into fact tables.

Future Scope: To enhance the efficiency and normalization of the database, the tables currently in 2NF can be further decomposed into 3NF, provided additional fact tables are introduced. In practice, maintaining a large database effectively requires a greater number of dimension tables and fewer fact tables. This approach helps optimize database performance and manageability.

3.4 Integrity Constraints

Referential integrity constraints have been established to ensure data integrity and consistency, thereby maintaining appropriate relationships between tables and fields. The table below summarizes all the referential integrity constraints:

Table	Referential Integrity	Comments
ADMINISTRATOR	No referential integrity constraints defined	1. Dimension table which maintains admin user data and is standalone.
INSTRUCTOR	No referential integrity constraints defined	1. Dimension table which maintains instructor user data and is standalone.
STUDENT	No referential integrity constraints defined	1. Dimension table which maintains student user data and is standalone.
DEPARTMENT	FOREIGN KEY (DEAN_ID) REFERENCES INSTRUCTOR(EMP_ID) ON DELETE SET NULL ON UPDATE CASCADE	1. Referential integrity between the *dean_id* of the **department** table and the primary key *instructor_id* of the **instructor** table.

		2. Changes in the **instructor** table are reflected in the **department** table 3. **Designed as a future scope** to explore how universities assign deans on a rotational / round robin basis
COURSE	FOREIGN KEY (DEPT_ID) REFERENCES DEPARTMENT(DEPT_ID) ON DELETE SET NULL ON UPDATE CASCADE	1. Referential integrity between the *dept_id* of the **course** table and the primary key *dept_id* of the parent table **department**. 2. Changes in the department table are reflected in the child course table. 3. Prevents the case of orphaned course records who have no linkage to any of the parent departments.
	FOREIGN KEY (INSTRUCTOR_ID) REFERENCES INSTRUCTOR(EMP_ID) ON DELETE SET NULL ON UPDATE CASCADE	1. Referential integrity between the *instructor_id* of the **course** table and the primary key *emp_id* of the **instructor** table. 2. Changes in the instructor table are reflected in the course table. 3. Ensures every instructor is associated with a course being taught.
FEES	FOREIGN KEY (STUDENT_ID) REFERENCES STUDENT(IMMA_ID) ON DELETE SET NULL ON UPDATE CASCADE	1. Referential integrity between the *student_id* of the **fees** table and the primary key *imma_id* of the parent **student** table. 2. Changes in the student table are reflected in the child fees table. 3. Prevents the case of orphaned fees records who have no linkage to any of the parent student matriculations.
ENROLLMENT	FOREIGN KEY (IMMA_ID) REFERENCES STUDENT(IMMA_ID) ON DELETE SET	1. Referential integrity between the *imma_id* of the **enrollment** table and the primary key *imma_id* of the **student** parent table.

	NULL ON UPDATE CASCADE	2. Changes in the student table are reflected in the child fees table. 3. Prevents the case of orphaned enrollment records who have no linkage to any of the parent student matriculations.
	FOREIGN KEY (DEPT_ID) REFERENCES DEPARTMENT(DEPT_ID) ON DELETE SET NULL ON UPDATE CASCADE	1. Referential integrity between the *dept_id* of the **enrollment** table and the primary key *dept_id* of the **department** table. 2. Changes in the department table are reflected in the enrollment table. 3. Ensures every enrolled student is associated with a department.
	FOREIGN KEY (COURSE_ID) REFERENCES COURSE(COURSE_ID) ON DELETE SET NULL ON UPDATE CASCADE	1. Referential integrity between the *course_id* of the **enrollment** table and the primary key *course_id* of the **course** table. 2. Changes in the course table are reflected in the enrollment table. 3. Ensures every enrolled student is associated with a course.
SUBJECT	FOREIGN KEY (STUDENT_ID) REFERENCES STUDENT(IMMA_ID) ON DELETE SET NULL ON UPDATE CASCADE	1. Referential integrity between the *student_id* of the **subject** table and the primary key *imma_id* of the **student** parent table. 2. Changes in the student table are reflected in the child subject table. 3. Prevents the case of orphaned subject records who have no linkage to any of the parent student matriculations.
	FOREIGN KEY (COURSE_ID) REFERENCES COURSE(COURSE_ID) ON DELETE SET NULL ON UPDATE CASCADE	1. Referential integrity between the *course_id* of the **subject** table and the primary key *course_id* of the **course** table. 2. Changes in the course table are reflected in the subject table.

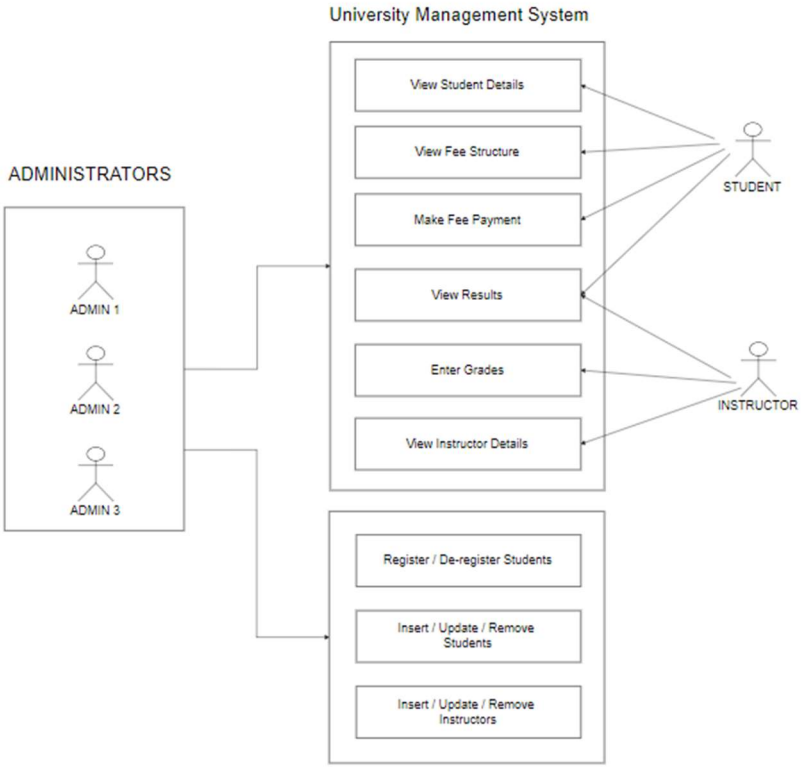
		3. Ensures every subject that is inserted against grades for an enrolled student is associated with a course.
GRADES	FOREIGN KEY (STUDENT_ID) REFERENCES STUDENT(IMMA_ID) ON DELETE SET NULL ON UPDATE CASCADE	1. Referential integrity between the *student_id* of the **grades** table and the primary key *imma_id* of the **student** parent table. 2. Changes in the student table are reflected in the child grades table. 3. Prevents the case of orphaned grade records who have no linkage to any of the parent student matriculations. 4. **Future scope** is to improve on the decomposition to make them 3NF.
	FOREIGN KEY (COURSE_ID) REFERENCES COURSE(COURSE_ID) ON DELETE SET NULL ON UPDATE CASCADE	1. Referential integrity between the *course_id* of the **grades** table and the primary key *course_id* of the **course** table. 2. Changes in the course table are reflected in the grades table. 3. Ensures every grade that is inserted against a subject for an enrolled student is associated with a course. 4. **Future scope** is to improve on the decomposition to make them 3NF.

4. Use Cases

4.1 Use Cases

The use cases below depict primarily around how administrators can manage the entire ecosystem of the UMS. These use cases form the superset of all the other use cases described above in the UML code.

4.1.1 Consolidated UML Diagram for all primary use cases

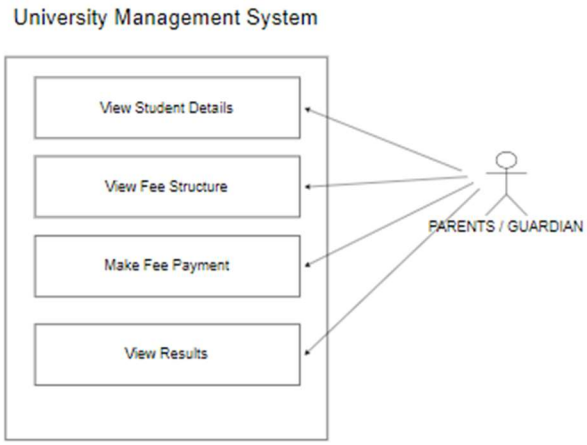


The above diagram illustrates a consolidated UML use case for the primary users: administrators, instructors, and students.

1. **Administrators:** As previously discussed, administrators have the highest level of access control. They are responsible for managing the administration and operations of the database.
2. **Students:** Students can use the GUI to view their details and results. As a future scope with the help of row level security, we will also enable the students to be able to pay the fees which pertains to their unique matriculation ids.

5. **Instructors:** Instructors can use the GUI to view their details, enter grades for students in their subjects, and view their results.

4.1.2 Future Proposal – Restricted access to Parents / Guardians



- A potential future use case could be included for guardians or parents to view restricted data, such as their ward's grades and fee status.
- **Current Access:** Currently, guardians can access the Student UMS via their ward's credentials, eliminating the need for additional database resources and overhead.
- **GDPR Compliance and Future Scope:** To comply with GDPR regulations, we propose offering guardians the option to consent to saving their data and creating a Guardian account. This would help students manage financial stability and facilitate the payment of tuition and semester fees.

4.2 Description of the Graphical User Interface

The Graphical User Interface (GUI) is built using **Java Swing[2]**, a powerful toolkit for creating user-friendly interfaces. A ***Person*** interface is defined to include basic data requirements like first name, last name, contact details, and address. This interface is implemented by two classes, ***Student*** and ***Instructor***, each with additional fields relevant to their roles, such as room numbers, cabins, courses, and departments.

Java Swing was chosen for its ease of use in creating forms[2], which makes collecting and managing user information straightforward. The design ensures that all classes are neatly organized into packages, promoting clean and maintainable code.
User input collected via the Swing forms is stored in the HFT LIDA server database. This process uses the MySQL driver provided in Moodle to connect, store and retrieve the data for the project.

5. Transactions / Triggers

5.1 Transactions

5.1.1 DML Statements part of the stored procedure call

These SQL queries are part of the second stored procedure which is called right before the GUI is started[2]. These update the database with static values for the administrator, department and course to cover the prerequisites for the use cases illustrated above. The administrator queries insert three admin users for the main database system to work, the department and the course queries pre-fill the database with static values of the departments and their respective courses which are then updated or aligned against instructors or students depending on their enrolment or registration. There are also cases of **complex multiple joins** in Transactions 3,6, and 9 respectively.

5.1.1.1 Inserting values into the ADMINISTRATOR table

```
/*3.1 ADMINISTRATOR */

INSERT INTO ADMINISTRATOR (FIRST_NAME, LAST_NAME, CONTACT) VALUES ('Ryan',
'Gosling', '+49 15511234567');
INSERT INTO ADMINISTRATOR (FIRST_NAME, LAST_NAME, CONTACT) VALUES
('Patrick', 'Bateman', '+49 15512345671');
INSERT INTO ADMINISTRATOR (FIRST_NAME, LAST_NAME, CONTACT) VALUES ('Lou',
'Bloom', '+49 15513456712');
```

5.1.1.2 Inserting values into the DEPARTMENT table

```
/* 3.2 DEPARTMENT */

INSERT INTO DEPARTMENT (DEPT_ID, DEPT_NAME, DEAN_ID) VALUES (1,'Computer
Science', NULL);
INSERT INTO DEPARTMENT (DEPT_ID, DEPT_NAME, DEAN_ID) VALUES
(2,'Mathematics', NULL);
INSERT INTO DEPARTMENT (DEPT_ID, DEPT_NAME, DEAN_ID) VALUES (3,'Business',
NULL);
INSERT INTO DEPARTMENT (DEPT_ID, DEPT_NAME, DEAN_ID) VALUES (4,'Building
Physics', NULL);
```

5.1.1.3 Inserting values into the COURSE table

The ***course*** table is the child table for the ***department*** table as every course is linked to a parent department. The data integrity constraints do not allow orphaned courses to exist, hence, these values have been added to the initial call to pre-fill the database with specific courses to which students or instructors can be aligned with. The goal is to have every instructor and student linked to a department and its corresponding course (or programme).

```
/* 3.3 COURSE */

/* Computer Science */
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (11, 1, NULL, 'Bachelor
of Computer Science', 'bcs', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (12, 1, NULL, 'Bachelor
of Augmented Reality', 'bar', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (13, 1, NULL,
"Bachelor's degree in digitalization and information management", 'bdi',
210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (14, 1, NULL, 'Bachelor
Surveying and Geoinformatics', 'bsg', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (15, 1, NULL, 'Master
Photogrammetry and Geoinformatics', 'mpg', 90, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (16, 1, NULL, 'Master
Software Technology', 'mst', 90, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (17, 1, NULL, 'Master
Digital Processes and Technologies', 'mdp', 90, NULL, NULL);

/* Mathematics */
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (21, 2, NULL, 'Bachelor
Applied Mathematics and AI', 'bam', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (22, 2, NULL, 'Master
Mathematics', 'mam', 90, NULL, NULL);
```

```
/* Business */
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (31, 3, NULL, 'Bachelor
of Business Administration', 'bba', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (32, 3, NULL, 'Business
Administration International Business course', 'bai', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (33, 3, NULL, 'Bachelor
of Infrastructure Management', 'bim', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (34, 3, NULL, 'Bachelor
of Business Informatics', 'bbi', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (35, 3, NULL, 'Master
General Management', 'mgm', 90, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (36, 3, NULL, 'Master
Environmentally Oriented Logistics', 'meo', 90, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (37, 3, NULL, "Master of
Business Psychology", 'mdb', 90, NULL, NULL);

/* Building Physics */
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (41, 4, NULL, 'Bachelor
of Building Physics', 'bbp', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (42, 4, NULL, 'Bachelor
of Climate Engineering', 'bce', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (43, 4, NULL, 'Master
Building Physics', 'mbp', 90, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (44, 4, NULL, 'Master in
Sustainable Energy Competence', 'mse', 90, NULL, NULL);
```

5.1.2 Transactions as per the use cases

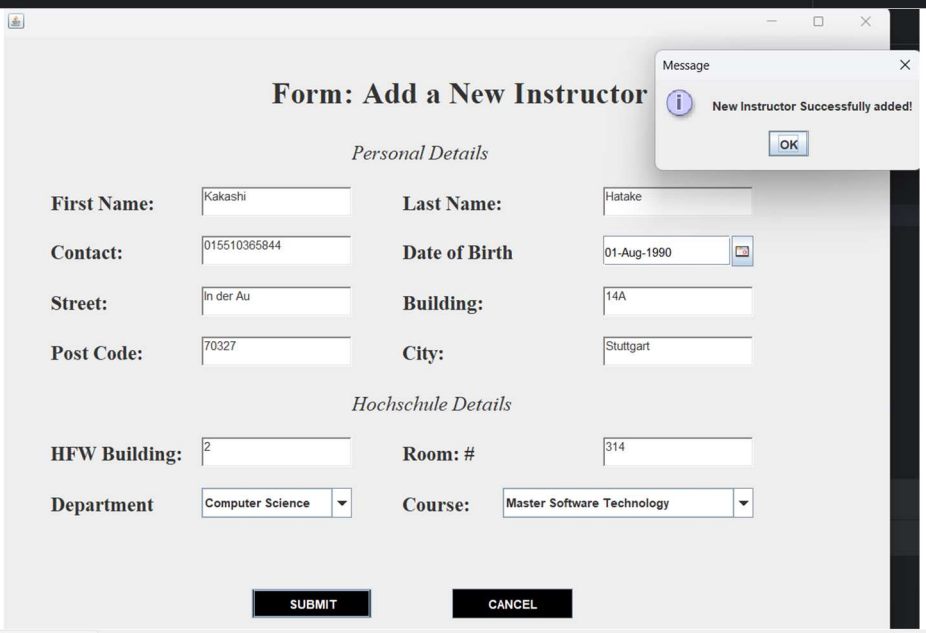
Administrators have the highest privileges to add/modify/delete student and instructor records, while also maintaining the basic student and instructor privileges to add/view grades against subjects and/or pay fees that automatically update the registration fields in the enrolment as “fees paid” because of the integrity constraints applied in the DDL statements of the initial stored procedure call. Commit and Rollback scenarios are also included in the following snippets[6][7][8][9] to take care of the transactions:

Transaction #1: Adding Instructor Records

The Administrators can add new instructors to the DBMS provided the contact follows the German Phone notation (used Regex) and the age is above 25 years.
The queries are committed only if they follow both the preliminary conditions, else the transactions are rolled back to avoid saving the incorrect query results. Necessary joins have also been taken care inside the SQL queries with appropriate data integrity constraints for the table COURSE which has a relationship with the table INSTRUCTOR via *instructor_id* field.

```
INSERT INTO INSTRUCTOR (FIRST_NAME, LAST_NAME, CONTACT, DOB, HOME_ADDRESS, HFT_CABIN, EMP_ID) VALUES ('"""
+ firstName + "','"
+ lastName + "','"
+ contact + "','"
+ dob + "','"
+ address + "','"
+ hftCabin + "','"
+ empID + "')";
```

```
int result = newInstructor.insertIntoDB(c, threshold: 25);
if(result==1) {
    // COMMIT
    c.conn.commit();

    String query = """
            update COURSE
            set instructor_id=
            (
                select emp_id from INSTRUCTOR where first_name='"""
            + firstName +
            """
                    ' and last_name='"""
            + lastName + "')" + "where upper(course_name) = upper('" + course + "');";

    c.stmt.executeUpdate(query);
    c.conn.commit();

    JOptionPane.showMessageDialog( parentComponent: null, message: "New Instructor Successfully added!");
    this.setVisible(false);
}
else if (result == 0) {
    JOptionPane.showMessageDialog( parentComponent: null, message: "ERROR: All values must be entered!");
}
else{
    // ROLLBACK
    // Instructor is less than or equal to 25 years and is NOT eligible
    c.conn.rollback();
    JOptionPane.showMessageDialog( parentComponent: null, message: "ERROR: Age>=25 and/or Contact must follow german phone standards!");
}
```



Statement 1 | Database Explorer 2

```
1 select * from INSTRUCTOR;
```

Result 1 | Messages

USER_ID	PSWD	FIRST_NAME	LAST_NAME	CONTACT	EMAIL	DOB	HOME_ADDRESS	HFT_CABIN	EMP_ID
41HaKa	85f40b0585f40b0d	Kakashi	Hatake	015510365844	Kakashi.Hatake@hft-europa.de	01-Aug-1990	14A, In der Au, 70327, Stuttgart	2/314	564203

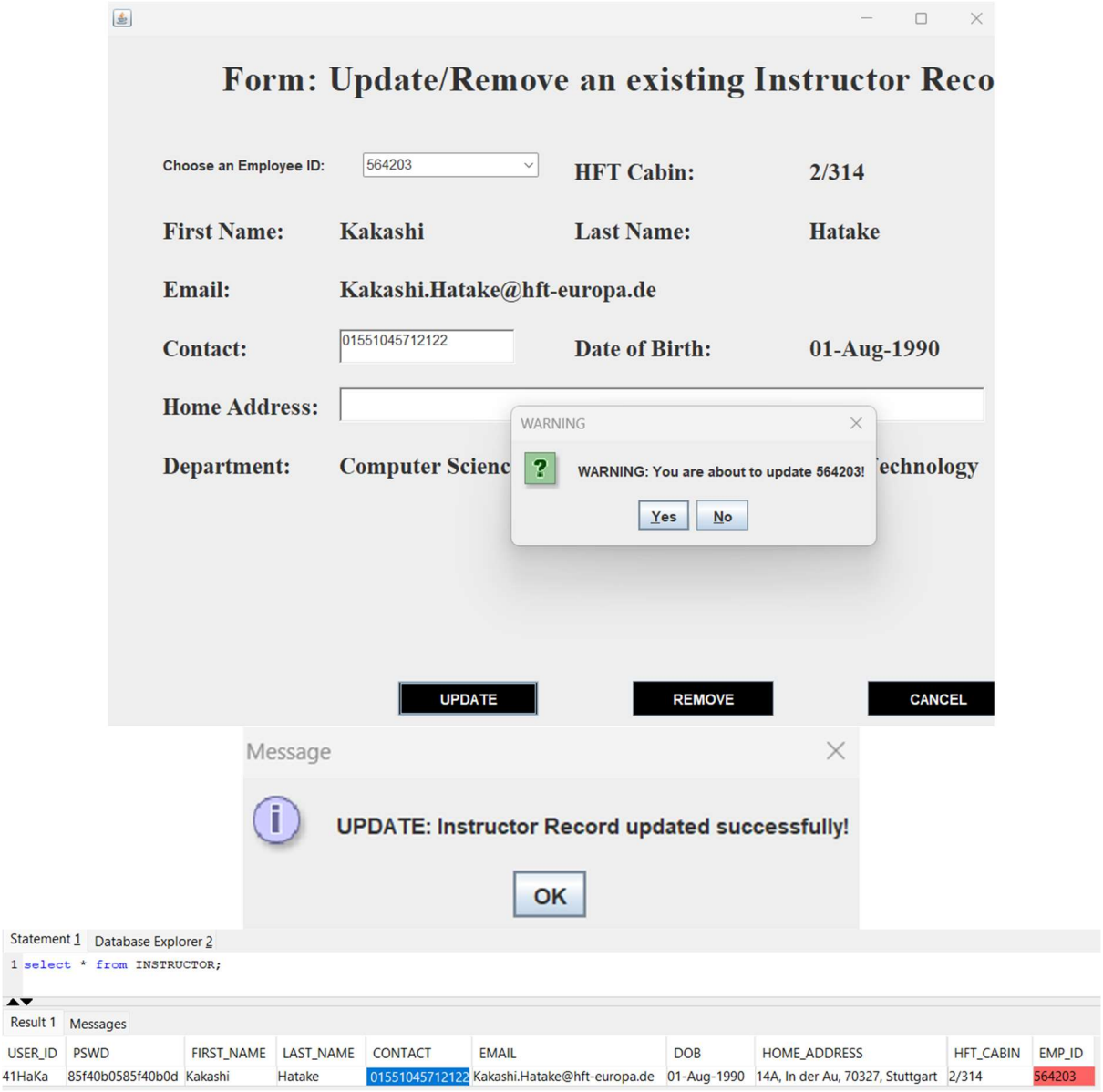
Transaction #2: Updating / Removing Instructor Records

The Administrators can add update instructors to the DBMS but only the contact (which again follows the German Phone notation) and the address. The queries are committed only if they follow the preliminary conditions, else the transactions are rolled back to avoid saving the incorrect query results. The Administrators can also remove the instructors but this transaction is permanent and it cannot be rolled back. However, the UI has been designed to give a warning dialogue before every transaction so that the transaction can be cancelled before it can begin.

```
String query = """
               UPDATE INSTRUCTOR
               SET CONTACT = '
               """ + newContact + "'"
       +
       """
               WHERE EMP_ID =
               """
       + empID + ";";
c.stmt.executeUpdate(query);

if(!checkContact(newContact)){
    return -1; // rollback in the outside function
}
else{
    c.conn.commit();
}
```

```
String query = """
               UPDATE INSTRUCTOR
               SET HOME_ADDRESS = '
               """ + newAddress + "'"
       +
       """
               WHERE EMP_ID =
               """
       + empID + ";";
c.stmt.executeUpdate(query);

if(!checkContact(newContact)){
    return -1; // rollback in the outside function
}
else{
    c.conn.commit();
}
```

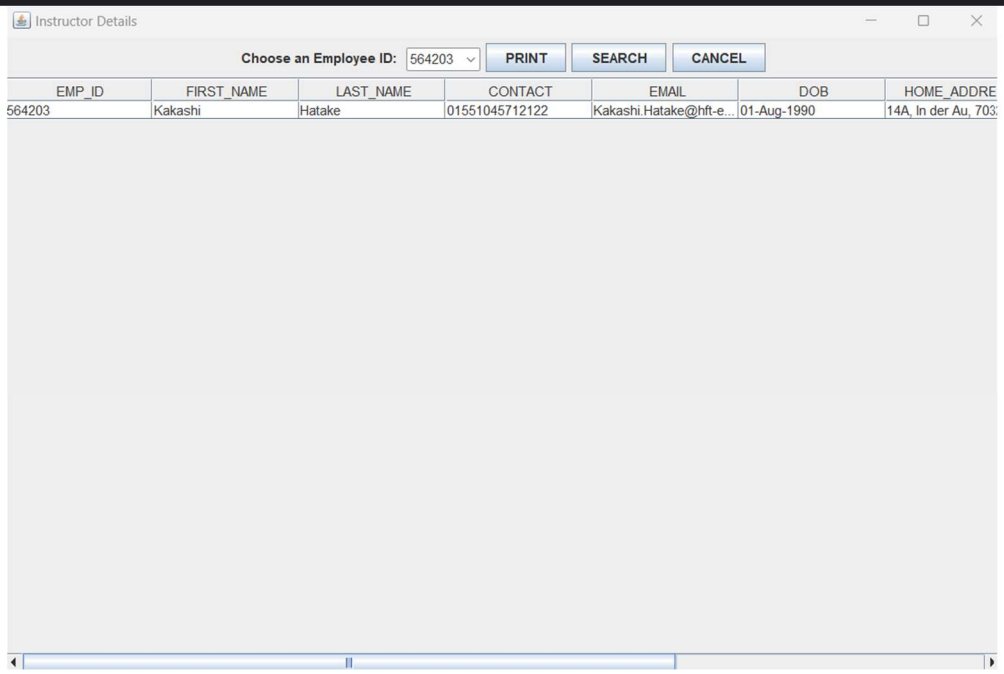
```
try {
    c.conn.setAutoCommit(false);

    String query = """
           DELETE FROM INSTRUCTOR
           WHERE EMP_ID =
           """
           + choiceItem + ";";

    c.stmt.executeUpdate(query);
    c.conn.commit();

    JOptionPane.showMessageDialog( parentComponent: null,  message: "UPDATE: Instructor Record deleted successfully!")
    setVisible(false);
} catch (Exception e) {
    e.printStackTrace();
}
```



Transaction #3: Viewing Instructor Records

This is feature shared by the ADMINISTRATOR and INSTRUCTOR where instructor records can be viewed by both the parties. As a future scope, we are working on developing the row level security for the instructor access so that they can only view the data revolving around their *employee_id*. We are also building on improving the UI of the table to improve readability[11][12]. Currently, the admins and the instructors have the option of either viewing or printing the required data to their desktop which can be useful for analysis. As there are no insertions or updations, there are no COMMIT or ROLLBACK scenarios applicable here. These queries **use multiple joins** and each join maintains data referential integrity as they have been predefined in the DDL statements.

```
String query = """
SELECT DISTINCT
I.EMP_ID, I.FIRST_NAME, I.LAST_NAME, I.CONTACT, I.EMAIL, I.DOB, I.HOME_ADDRESS, I.HFT_CABIN,
C.COURSE_NAME, D.DEPT_NAME
FROM
INSTRUCTOR I
LEFT JOIN COURSE C
ON I.EMP_ID = C.INSTRUCTOR_ID
LEFT JOIN DEPARTMENT D
ON C.DEPT_ID = D.DEPT_ID
WHERE I.EMP_ID =
""" + choiceItem + ";";
```

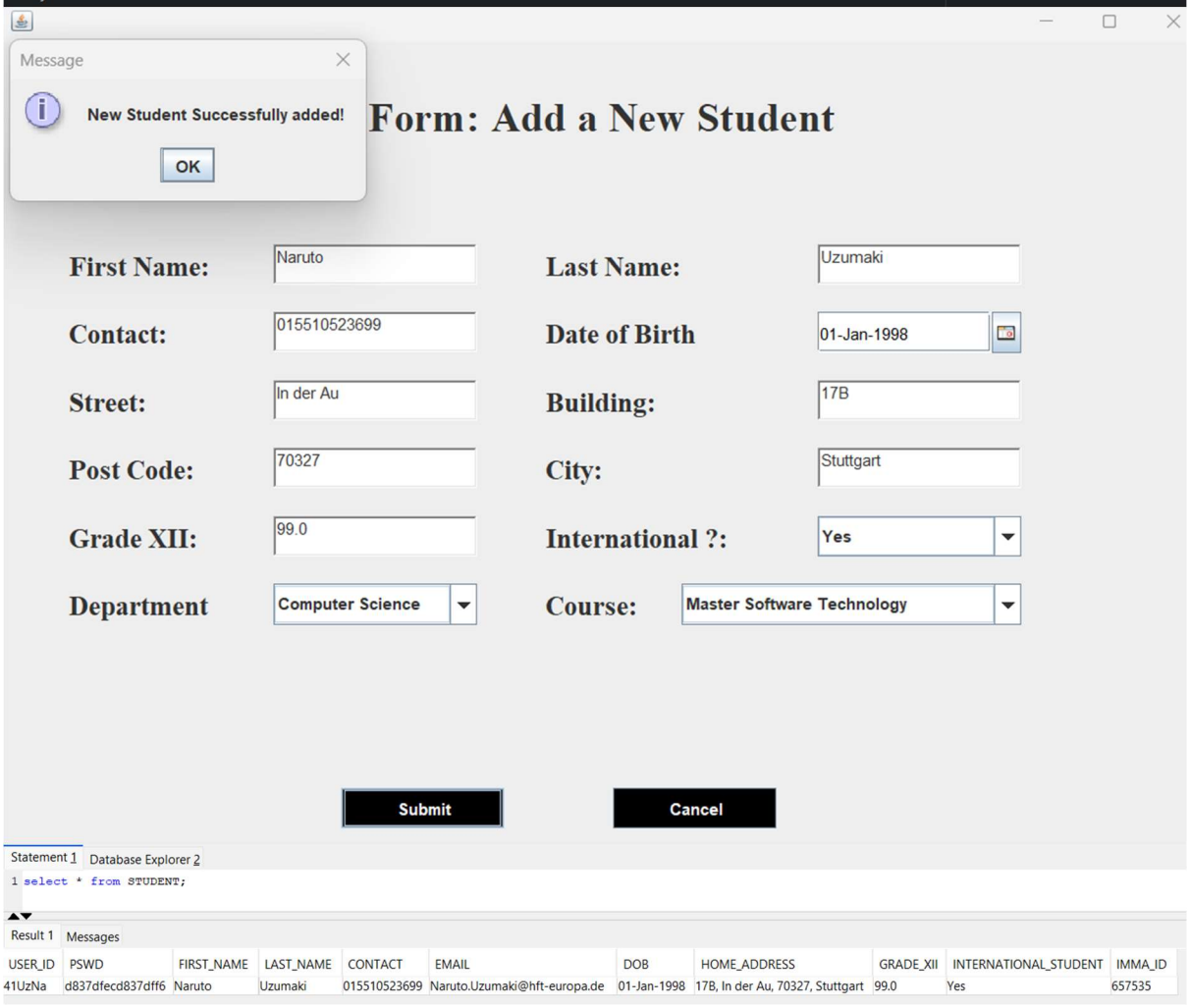


Transaction #4: Inserting Student and Enrolment Records

The Administrators can add new students to the DBMS provided the contact follows the German Phone notation (used Regex) and the age is above 16 years.
The queries are committed only if they follow both the preliminary conditions, else the transactions are rolled back to avoid saving the incorrect query results. Necessary joins have also been taken care inside the SQL queries with appropriate data integrity constraints for the table COURSE which has a relationship with the table STUDENT via *imma_id* field (for matriculation).

```
String query = """
        INSERT INTO STUDENT (FIRST_NAME, LAST_NAME, CONTACT, DOB, HOME_ADDRESS, GRADE_XII, INTERNATIONAL_STUDENT, IMMA_ID) VALUES ('"""
        + firstName + "','"
        + lastName + "','"
        + contact + "','"
        + dob + "','"
        + address + "','"
        + gradeXII + "','"
        + internationalStudent + "','"
        + matID + "')";

c.stmt.executeUpdate(query);
```

```
try{
    c.conn.setAutoCommit(false);

    // Check if the new student is more than 16 years old
    int result = newStudent.insertIntoDB(c, threshold: 16);
    if(result == 1){
        // COMMIT
        c.conn.commit();
        // Todays date
        String today = String.valueOf(LocalDate.now());

        query = "INSERT INTO ENROLLMENT (IMMA_ID, DEPT_ID, COURSE_ID, IMMA_DATE, IMMA_STATUS) VALUES ('"
                + matID + "','"
                + deptID + "','"
                + courseID + "','"
                + today + "','ADMITTED');";
        c.stmt.executeUpdate(query);
        c.conn.commit();

        JOptionPane.showMessageDialog( parentComponent: null, message: "New Student Successfully added!");
        this.setVisible(false);
    }
    else if (result == 0) {
        JOptionPane.showMessageDialog( parentComponent: null, message: "ERROR: All values must be entered!");
    }
    else{
        // ROLLBACK
        // Student is less than or equal to 16 years and is NOT eligible for enrollment
        c.conn.rollback();
        JOptionPane.showMessageDialog( parentComponent: null, message: "ERROR: Age>=16 and/or Contact must follow german phone standards!");
    }
```



Statement 1 | Database Explorer 2

```
1 select * from STUDENT;
```

Result 1 | Messages

USER_ID	PSWD	FIRST_NAME	LAST_NAME	CONTACT	EMAIL	DOB	HOME_ADDRESS	GRADE_XII	INTERNATIONAL_STUDENT	IMMA_ID
41UzNa	d837dfecd837dff6	Naruto	Uzumaki	015510523699	Naruto.Uzumaki@hft-europa.de	01-Jan-1998	17B, In der Au, 70327, Stuttgart	99.0	Yes	657535

Transaction #5: Updating / Deregistering Student Records

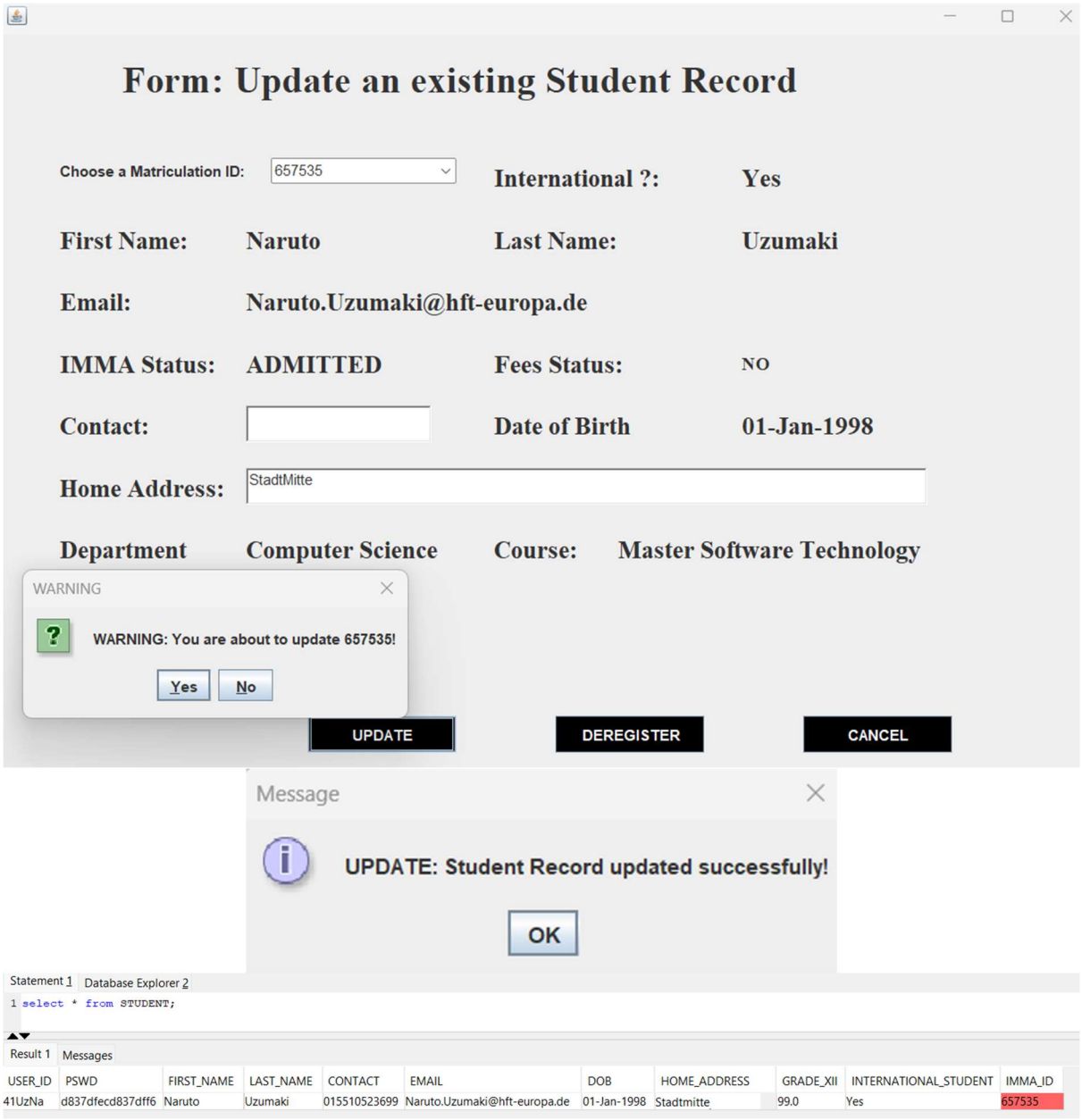
The Administrators can add update student records to the DBMS but only the contact (which again follows the German Phone notation) and the address. The queries are committed only if they follow the preliminary conditions, else the transactions are rolled back to avoid saving the incorrect query results. The Administrators can also remove the students (called as deregistration) but this transaction is permanent and it cannot be rolled back. However, the UI has been designed to give a warning dialogue before every transaction so that the transaction can be cancelled before it can begin.

```
String query = """
               UPDATE STUDENT
               SET CONTACT = '
               """ + newContact + "'"
        +
        """
               WHERE IMMA_ID =
               """
        + stuID + ";";
c.stmt.executeUpdate(query);
```

```
String query = """
               UPDATE STUDENT
               SET HOME_ADDRESS = '
               """ + newAddress + "'"
        +
        """
               WHERE IMMA_ID =
               """
        + stuID + ";";
c.stmt.executeUpdate(query);
```

```
try {
    int dialogButton = JOptionPane.YES_NO_OPTION;
    int dialogResult = JOptionPane.showConfirmDialog( parentComponent: null, message: "WARNING: You are about to update " + choiceItem + "!", title: "WARNING",dialogButton);

    if(dialogResult == 0) {
        // YES
        String contact = tfContact.getText();
        String address = tfAddress.getText();

        Student existingStudent = new Student();

        c.conn.setAutoCommit(false);

        if(existingStudent.updateContactDB(c, choiceItem, contact, address)==1){
            // COMMIT
            c.conn.commit();
            JOptionPane.showMessageDialog( parentComponent: null, message: "UPDATE: Student Record updated successfully!");
            setVisible(false);
        }
        else{
            // ROLLBACK
            // Contact mistake
            c.conn.rollback();
            JOptionPane.showMessageDialog( parentComponent: null, message: "ERROR: Contact must follow german phone standards!");
        };
```

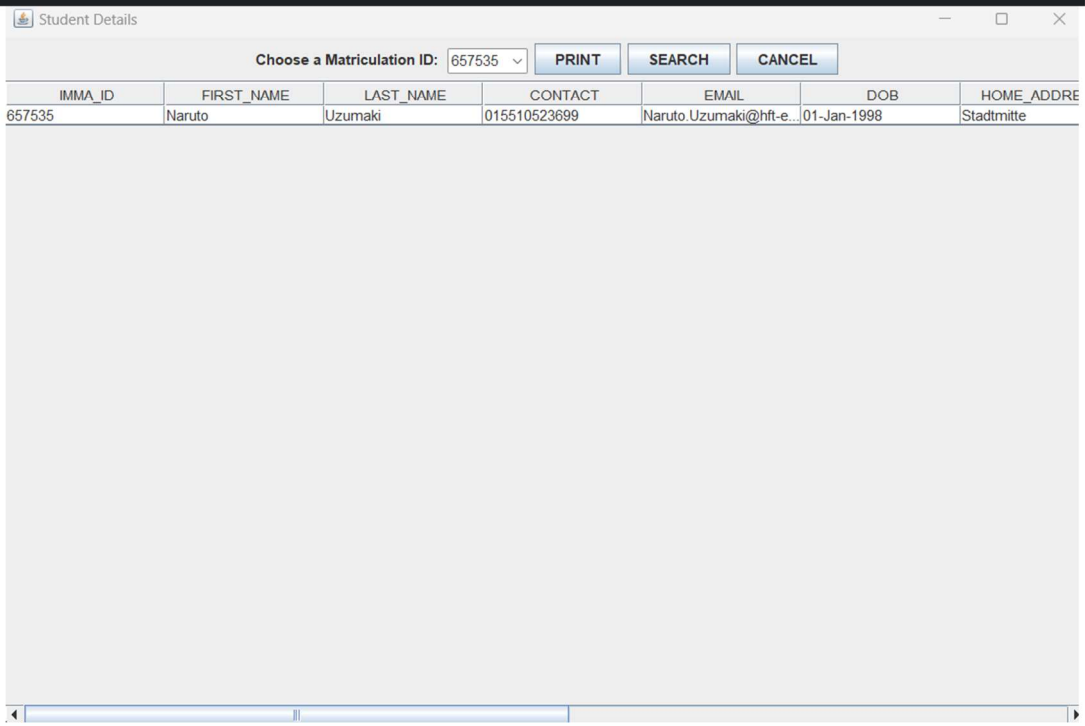
```
try {

    c.conn.setAutoCommit(false);

    String query = """
        DELETE FROM STUDENT
        WHERE IMMA_ID =
        """
            + choiceItem + ";";

    c.stmt.executeUpdate(query);
    c.conn.commit();

    JOptionPane.showMessageDialog( parentComponent: null, message: "UPDATE: Student Record deleted successfully!");
    setVisible(false);
}
```



Transaction #6: Viewing Student Records

This is feature shared by the ADMINISTRATOR and STUDENTs where student records can be viewed by both the parties. As a future scope, we are working on developing the row level security for the student access so that they can only view the data revolving around their *imma_id*. We are also building on improving the UI of the table to improve readability[11][12]. Currently, the admins and the students have the option of either viewing or printing the required data to their desktop which can be useful for analysis. As there are no insertions or updations, there are **NO COMMIT or ROLLBACK scenarios applicable here**. These queries **use multiple joins** and each join maintains data referential integrity as they have been predefined in the DDL statements.

```
String query = """
SELECT DISTINCT
S.IMMA_ID, S.FIRST_NAME, S.LAST_NAME, S.CONTACT, S.EMAIL, S.DOB, S.HOME_ADDRESS, S.INTERNATIONAL_STUDENT,
C.COURSE_NAME, D.DEPT_NAME,
E.IMMA_DATE, E.IMMA_STATUS, F.FEES_PAID
FROM
STUDENT S
LEFT JOIN ENROLLMENT E
ON S.IMMA_ID = E.IMMA_ID
LEFT JOIN FEES F
ON S.IMMA_ID = F.STUDENT_ID
LEFT JOIN COURSE C
ON E.COURSE_ID = C.COURSE_ID
LEFT JOIN DEPARTMENT D
ON C.DEPT_ID = D.DEPT_ID
WHERE S.IMMA_ID =
""" + choiceItem + ";";
```

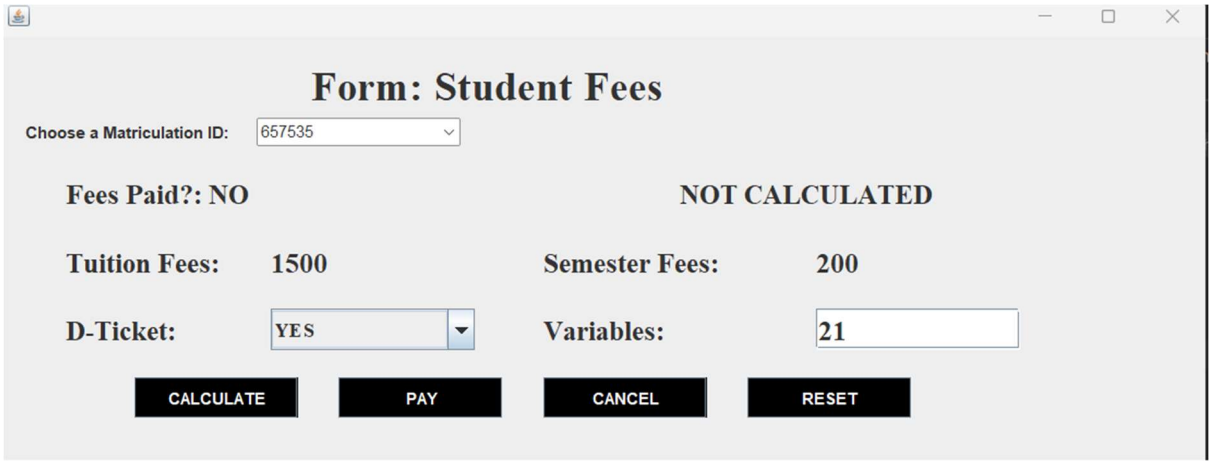


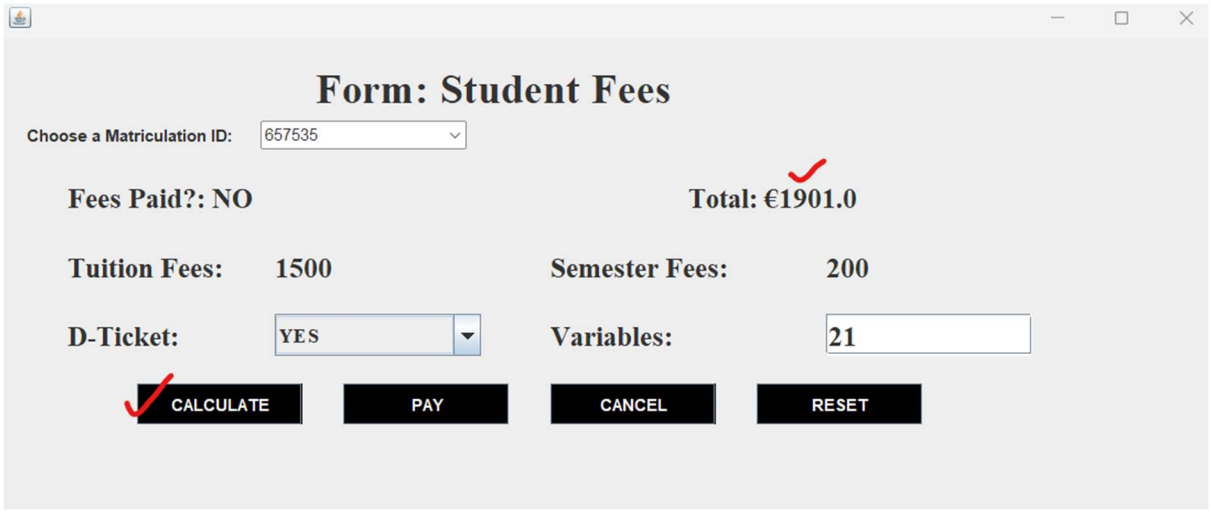
Transaction #7: Updating Student Fee Status

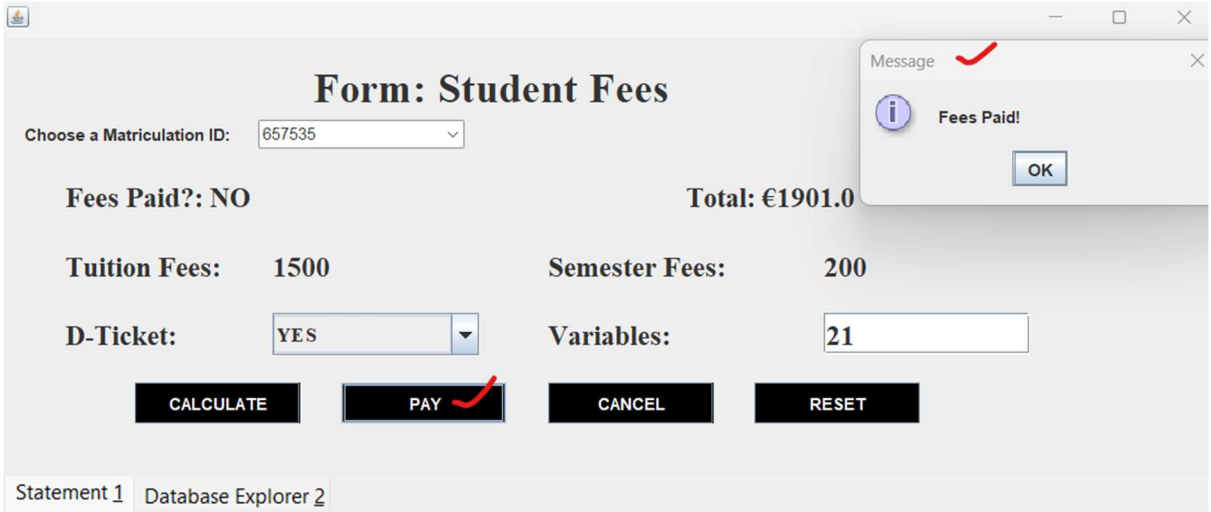
The Administrators can add update student fee status to the DBMS. The tuition fees are applicable only to the international students, while semester fees are common to all. The form also gives the option of selecting the D-ticket (Deutschland Fahrkarte) at a discounted price to the students. The total amount can then be paid by simply clicking a button. The queries **are committed only** if the fee status for the selected student shows as “NOT PAID”, **else the transactions are rolled back** to avoid saving the incorrect query results. There is also an option for the administer to manually reset the paid fees status to “NOT PAID”.

```
// TRANSACTIONS - COMMIT ROLLBACK
try{
    String query = """
    UPDATE FEES
    SET D_TICKET = '
    """ + d_ticket + "', RESEARCH_VARIABLE = '" + variables + "', FEES_PAID = 'YES' WHERE STUDENT_ID = '" + immaID + "';";

    c.stmt.executeUpdate(query);
    c.conn.commit();

    query = "UPDATE ENROLLMENT SET IMMA_STATUS = 'ENROLLED' WHERE IMMA_ID = '" + immaID + "';";
    c.stmt.executeUpdate(query);
    c.conn.commit();
}
catch (Exception ee){
    c.conn.rollback();
}

JOptionPane.showMessageDialog( parentComponent: null,  message: "Fees Paid!");
this.setVisible(false);
```

```
try{
    c.conn.setAutoCommit(false);

    String immaID = studIDChoice.getSelectedItem();

    // TRANSACTIONS - COMMIT ROLLBACK
    try{
        String query = "UPDATE FEES SET D_TICKET = '0', RESEARCH_VARIABLE = '0', FEES_PAID='NO';";
        c.stmt.executeUpdate(query);
        c.conn.commit();

        query = "UPDATE ENROLLMENT SET IMMA_STATUS = 'ADMITTED' WHERE IMMA_ID = '" + immaID + "';";
        c.stmt.executeUpdate(query);
        c.conn.commit();
    }
    catch (Exception ee){
        c.conn.rollback();
    }

    JOptionPane.showMessageDialog( parentComponent: null,  message: "Warning: Fees Status changed to NOT PAID! ");
    this.setVisible(false);
```





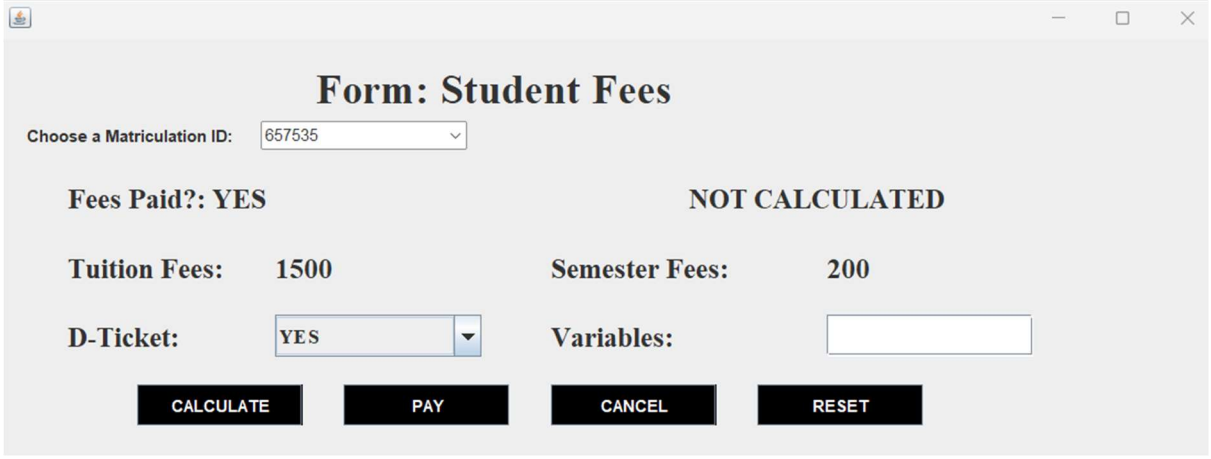


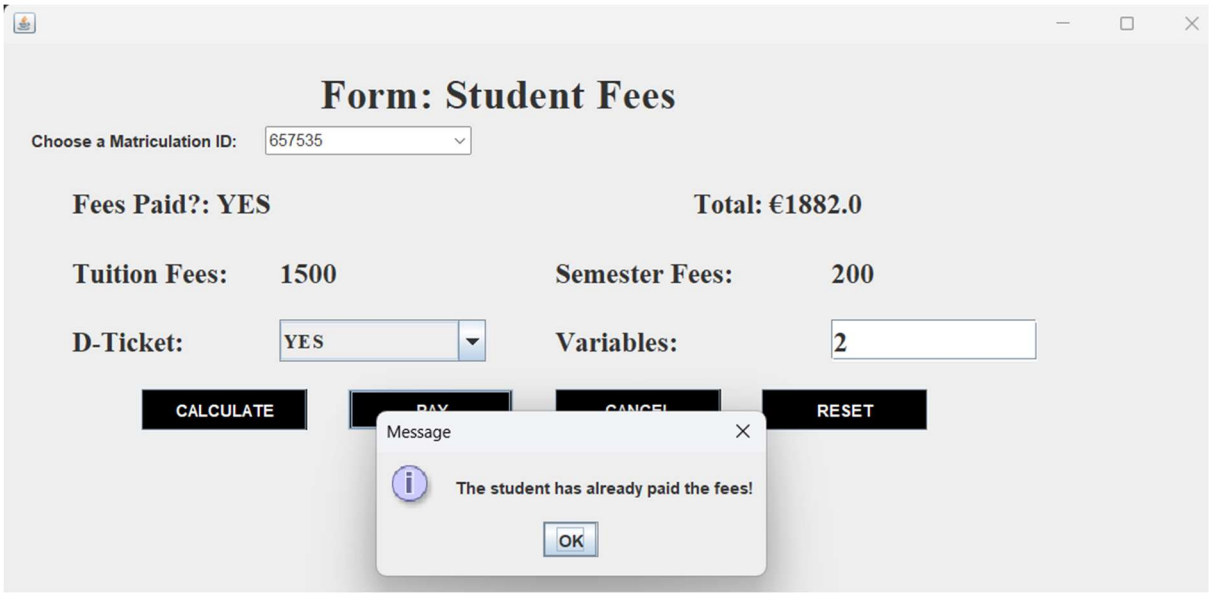
Statement 1 | Database Explorer 2

```
1 SELECT S.FIRST_NAME, S.LAST_NAME, F.*
2 FROM FEES F
3 LEFT JOIN STUDENT S
4 ON F.STUDENT_ID = S.IMMA_ID;
```

Result 1 | Messages

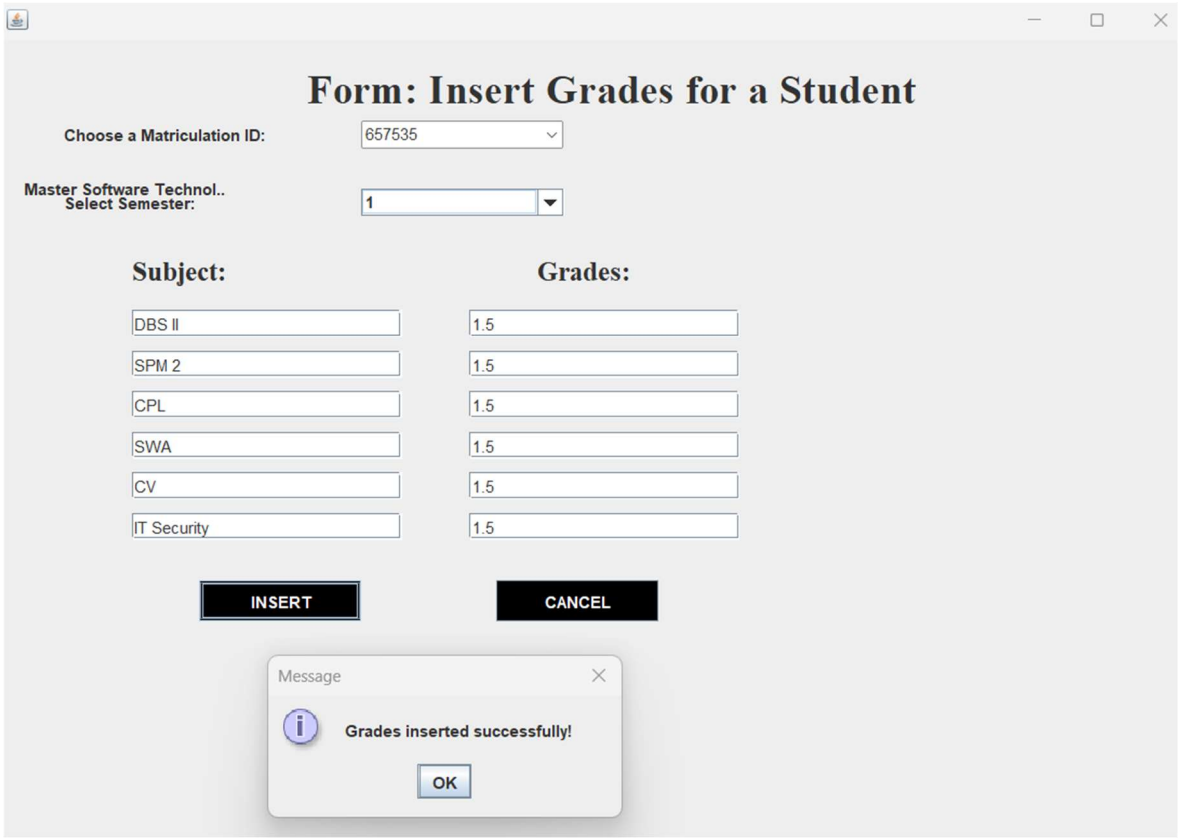
FIRST_NAME	LAST_NAME	STUDENT_ID	TUITION_FEES	SEMESTER_FEES	D_TICKET	RESEARCH_VARIABLE	FEES_PAID
Naruto	Uzumaki	657535	1500	200	360.0	21.0	YES

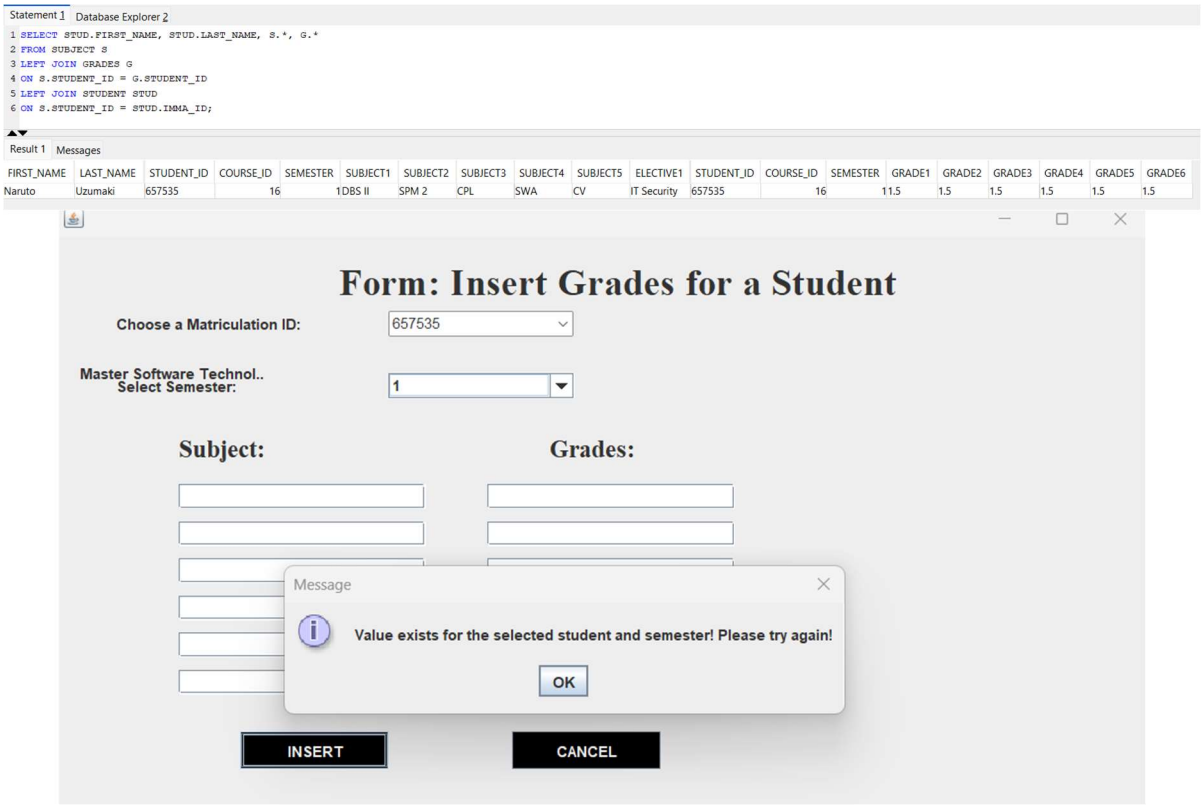




Transaction #8: Inserting Grades for a student by an instructor

The Administrators and Instructors can insert grades to the students in the DBMS but **only once (commit only once)**. Rollback happens automatically if the system detects a case of multiple grades assigned for a semester. Necessary joins have also been taken care inside the SQL queries with appropriate data integrity constraints for the tables SUBJECT and GRADES which have a relationship with the table STUDENT via *imma_id* field (for matriculation).

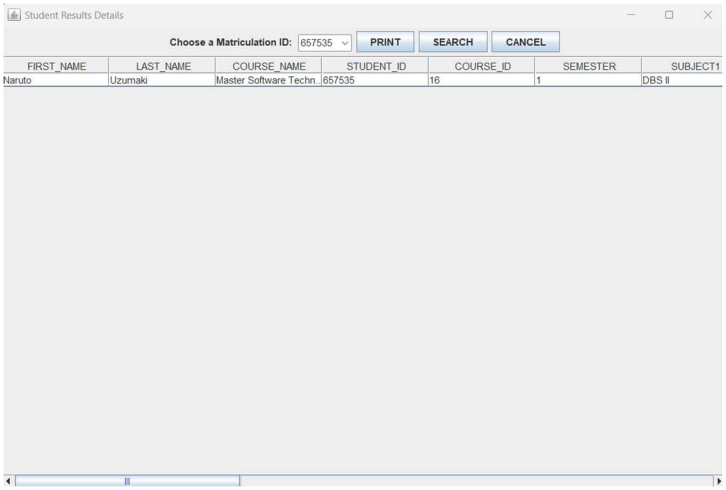




Transaction #9: Viewing Subjects and Grades Records

This is feature shared by the ADMINISTRATOR and STUDENTS where student records can be viewed by both the parties. As a future scope, we are working on developing the row level security for the student access so that they can only view the data revolving around their *imma_id*. We are also building on improving the UI of the table to improve readability[11][12]. Currently, the admins and the students have the option of either viewing or printing the required data to their desktop which can be useful for analysis. As there are no insertions or updations, there are **NO COMMIT or ROLLBACK scenarios applicable here**. These queries **use multiple joins** and each join maintains data referential integrity as they have been predefined in the DDL statements.

```
String query = """
        SELECT DISTINCT S.FIRST_NAME, S.LAST_NAME, C.COURSE_NAME, SUB.*,
G.*
        FROM
        SUBJECT SUB
        LEFT JOIN GRADES G
        ON SUB.STUDENT_ID = G.STUDENT_ID and SUB.COURSE_ID = G.COURSE_ID
and SUB.SEMESTER = G.SEMESTER
        LEFT JOIN STUDENT S
        ON S.IMMA_ID = SUB.STUDENT_ID
        LEFT JOIN ENROLLMENT E
        ON S.IMMA_ID = E.IMMA_ID
        LEFT JOIN COURSE C
        ON E.COURSE_ID = C.COURSE_ID
        """;
```



5.2 Triggers

We have successfully implemented **4 triggers** which are run between the two stored procedures[3][4][10]. The first three triggers automatically take care of creating user_ids, passwords, and email_ids based on the regex pattern and inserts them dynamically into the respective admin, instructor and student records. The last trigger updates the tuition fees based on the international status of the new student enrolled into the student database – € 1500,00 in case they are an international student, else € 0. This is useful in order to calculate the total fees and also while paying the total fees which includes the tuition fees calculated dynamically.

5.2.1 Trigger for the ADMINISTRATOR

The trigger automatically fires when a new administrator is added to create user_ids, passwords and email based on the regex (firstName.lastName@hft-europa.de).

```
/* 1. ADMINISTRATOR */
DROP TRIGGER IF EXISTS trigger_admin;

DELIMITER $$

CREATE TRIGGER trigger_admin
BEFORE INSERT ON ADMINISTRATOR
FOR EACH ROW
BEGIN
SET NEW.PSWD = CONCAT(LEFT(UUID(), 8),LEFT(UUID(), 8));
SET NEW.EMAIL = CONCAT(NEW.FIRST_NAME, '.', NEW.LAST_NAME, '@hft-
europa.de');
SET NEW.USER_ID = CONCAT(RIGHT(YEAR(CURRENT_DATE()),
1),IF(MONTH(CURRENT_DATE()) <= 6, '1', '2'),LEFT(NEW.LAST_NAME,
2),LEFT(NEW.FIRST_NAME, 2));
END;
$$

DELIMITER ;
```

5.2.2 Trigger for the INSTRUCTOR

The trigger automatically fires when a new instructor is added to create user_ids, passwords and email based on the regex (firstName.lastName@hft-europa.de).

```
/* 2. INSTRUCTOR */
DROP TRIGGER IF EXISTS trigger_instructor;

DELIMITER $$

CREATE TRIGGER trigger_instructor
BEFORE INSERT ON INSTRUCTOR
FOR EACH ROW
BEGIN
SET NEW.EMAIL = CONCAT(NEW.FIRST_NAME, '.', NEW.LAST_NAME, '@hft-
europa.de');
SET NEW.USER_ID = CONCAT(RIGHT(YEAR(CURRENT_DATE()),
1),IF(MONTH(CURRENT_DATE()) <= 6, '1', '2'),LEFT(NEW.LAST_NAME,
2),LEFT(NEW.FIRST_NAME, 2));
SET NEW.PSWD = CONCAT(LEFT(UUID(), 8),LEFT(UUID(), 8));
END;
$$

DELIMITER ;
```

5.2.3 Trigger for the STUDENT

The trigger automatically fires when a new student is added to create user_ids, passwords and email based on the regex (firstName.lastName@hft-europa.de).

```
/* 3. STUDENT */
DROP TRIGGER IF EXISTS trigger_student;

DELIMITER $$

CREATE TRIGGER trigger_student
BEFORE INSERT ON STUDENT
FOR EACH ROW
BEGIN
SET NEW.EMAIL = CONCAT(NEW.FIRST_NAME, '.', NEW.LAST_NAME, '@hft-
europa.de');
SET NEW.USER_ID = CONCAT(RIGHT(YEAR(CURRENT_DATE()),
1),IF(MONTH(CURRENT_DATE()) <= 6, '1', '2'),LEFT(NEW.LAST_NAME,
2),LEFT(NEW.FIRST_NAME, 2));
SET NEW.PSWD = CONCAT(LEFT(UUID(), 8),LEFT(UUID(), 8));
END;
$$

DELIMITER ;
```

5.2.4 Trigger for the FEES

The trigger automatically fires when a new student is added to the database. The goal is to set the tuition fees to either 0 or 1500 depending on the international status of the student whilst also preparing the fields for the other fee variables necessary for the fee payment.

```
/* 4. FEES */
DROP TRIGGER IF EXISTS trigger_fees_insert;

DELIMITER $$

CREATE TRIGGER trigger_fees_insert
AFTER INSERT ON STUDENT
FOR EACH ROW
BEGIN
INSERT INTO FEES (STUDENT_ID, TUITION_FEES, SEMESTER_FEES, D_TICKET,
RESEARCH_VARIABLE, FEES_PAID)
VALUES (NEW.IMMA_ID, CASE WHEN UPPER(NEW.INTERNATIONAL_STUDENT) = 'YES'
THEN 1500 ELSE 0 END, 200, 0, 0, 'NO');
END;
$$

DELIMITER ;
```

5.3 Stored Procedures

We have successfully created **2 stored procedures** – the first one implements all the DDL statements and the second one implements all the DML statements[4]. The order of execution is as follows:

1. Stored procedure 1 for the DDL
2. Triggers
3. Stored procedure 2 for the DML

The stored procedures can be called by simply following the format[4]:

```
call PROC_NAME();
```

5.3.1 Stored Procedure for the DDL Statements

```
/* 1. STORED PROCEDURE */

/* DDL STATEMENTS */

DROP PROCEDURE IF EXISTS UMS_Schema_Creation;

DELIMITER $$

CREATE PROCEDURE UMS_Schema_Creation()
BEGIN

/* DDL STATEMENTS */
```

```
/* 1. DROP TABLES */

/*1.1*/
DROP TABLE IF EXISTS GRADES;
DROP TABLE IF EXISTS SUBJECT;

/*1.2*/
DROP TABLE IF EXISTS FEES;
DROP TABLE IF EXISTS ENROLLMENT;

/*1.3*/
DROP TABLE IF EXISTS COURSE;
DROP table IF EXISTS DEPARTMENT;

/*1.4*/
DROP TABLE IF EXISTS INSTRUCTOR;
DROP TABLE IF EXISTS STUDENT;

/*1.5*/
DROP TABLE IF EXISTS ADMINISTRATOR;

/* 2. SCHEMA CREATION */

/*2.1 ADMINISTRATOR TABLE */
CREATE TABLE ADMINISTRATOR(
    USER_ID VARCHAR(16) PRIMARY KEY,
    PSWD VARCHAR(16),
    FIRST_NAME VARCHAR(255),
    LAST_NAME VARCHAR(255),
    CONTACT VARCHAR(17),
    EMAIL VARCHAR(255) /* Trigger to generate regex email ->
firstname.lastname@hft-europa.com*/
);

/*2.2 INSTRUCTOR TABLE */
CREATE TABLE INSTRUCTOR(
    USER_ID VARCHAR(16),
    PSWD VARCHAR(16),
    FIRST_NAME VARCHAR(255),
    LAST_NAME VARCHAR(255),
    CONTACT VARCHAR(15),
    EMAIL VARCHAR(50), /* Trigger to generate regex email ->
firstname.lastname@hft-europa.com*/
    DOB VARCHAR(255),
    HOME_ADDRESS VARCHAR(255),
    HFT_CABIN VARCHAR(255),
    EMP_ID VARCHAR(16) PRIMARY KEY
);

/*2.3 STUDENT TABLE */
CREATE TABLE STUDENT(
    USER_ID VARCHAR(16),
    PSWD VARCHAR(16),
    FIRST_NAME VARCHAR(255),
    LAST_NAME VARCHAR(255),
    CONTACT VARCHAR(15),
    EMAIL VARCHAR(50),
    DOB VARCHAR(255),
    HOME_ADDRESS VARCHAR(255),
    GRADE_XII VARCHAR(16),
```

```
    INTERNATIONAL_STUDENT VARCHAR(16),
    IMMA_ID VARCHAR(16) PRIMARY KEY
);

/*2.4 DEPARTMENT TABLE */
CREATE TABLE DEPARTMENT(
    DEPT_ID INT PRIMARY KEY,
    DEAN_ID VARCHAR(16),
    DEPT_NAME VARCHAR(255),
    FOREIGN KEY (DEAN_ID) REFERENCES INSTRUCTOR(EMP_ID)
       ON DELETE SET NULL ON UPDATE CASCADE
);

/*2.5 COURSE TABLE */
CREATE TABLE COURSE(
    COURSE_ID INT PRIMARY KEY,
    DEPT_ID INT,
    INSTRUCTOR_ID VARCHAR(16),
    COURSE_NAME VARCHAR(255),
    COURSE_CODE VARCHAR(10), /* Master Software Technology -> mst */
    CREDITS INT,
    BUILDING_NO INT,
    ROOM_NO INT,
    FOREIGN KEY (DEPT_ID) REFERENCES DEPARTMENT(DEPT_ID)
    ON DELETE SET NULL ON UPDATE CASCADE,
    FOREIGN KEY (INSTRUCTOR_ID) REFERENCES INSTRUCTOR(EMP_ID)
    ON DELETE SET NULL ON UPDATE CASCADE
);

/*2.6 FEES */
CREATE TABLE FEES(
    STUDENT_ID VARCHAR(16),
    TUITION_FEES VARCHAR(16), /* 1500 Euros for International Students */
    SEMESTER_FEES VARCHAR(16), /* 200 Euros for all */
    D_TICKET VARCHAR(16), /* Optional: 360 Euros for all */
    RESEARCH_VARIABLE VARCHAR(16), /* Optional: Variable */
    FEES_PAID VARCHAR(3),
    FOREIGN KEY (STUDENT_ID) REFERENCES STUDENT(IMMA_ID)
    ON DELETE SET NULL ON UPDATE CASCADE
);

/*2.7 ENROLLMENT */
CREATE TABLE ENROLLMENT(
    IMMA_ID VARCHAR(16),
    DEPT_ID INT,
    COURSE_ID INT,
    IMMA_DATE VARCHAR(255),
    IMMA_STATUS VARCHAR(100),
    FOREIGN KEY (IMMA_ID) REFERENCES STUDENT(IMMA_ID)
    ON DELETE SET NULL ON UPDATE CASCADE,
    FOREIGN KEY (DEPT_ID) REFERENCES DEPARTMENT(DEPT_ID)
    ON DELETE SET NULL ON UPDATE CASCADE,
    FOREIGN KEY (COURSE_ID) REFERENCES COURSE(COURSE_ID)
    ON DELETE SET NULL ON UPDATE CASCADE
);

/*2.8 SUBJECT TABLE */
CREATE TABLE SUBJECT(
    STUDENT_ID VARCHAR(16),
    COURSE_ID INT,
    SEMESTER INT,
```

```
    SUBJECT1 VARCHAR(255),
    SUBJECT2 VARCHAR(255),
    SUBJECT3 VARCHAR(255),
    SUBJECT4 VARCHAR(255),
    SUBJECT5 VARCHAR(255),
    ELECTIVE1 VARCHAR(255),
    FOREIGN KEY (STUDENT_ID) REFERENCES STUDENT(IMMA_ID)
    ON DELETE SET NULL ON UPDATE CASCADE,
    FOREIGN KEY (COURSE_ID) REFERENCES COURSE(COURSE_ID)
    ON DELETE SET NULL ON UPDATE CASCADE
);

/*2.9 GRADES TABLE */
CREATE TABLE GRADES(
    STUDENT_ID VARCHAR(16),
    COURSE_ID INT,
    SEMESTER INT,
    GRADE1 VARCHAR(8),
    GRADE2 VARCHAR(8),
    GRADE3 VARCHAR(8),
    GRADE4 VARCHAR(8),
    GRADE5 VARCHAR(8),
    GRADE6 VARCHAR(8),
    FOREIGN KEY (STUDENT_ID) REFERENCES STUDENT(IMMA_ID)
    ON DELETE SET NULL ON UPDATE CASCADE,
    FOREIGN KEY (COURSE_ID) REFERENCES COURSE(COURSE_ID)
    ON DELETE SET NULL ON UPDATE CASCADE
);

END;

$$

DELIMITER ;
```

5.3.2 Stored Procedure for the DML Statements

```
/* 3. STORED PROCEDURE */

/* DML STATEMENTS */

DROP PROCEDURE IF EXISTS UML_DML_Statements;

DELIMITER $$

CREATE PROCEDURE UML_DML_Statements()
BEGIN

/* DML STATEMENTS */

/*3.1 ADMINISTRATOR */

INSERT INTO ADMINISTRATOR (FIRST_NAME, LAST_NAME, CONTACT) VALUES ('Ryan',
'Gosling', '+49 15511234567');
INSERT INTO ADMINISTRATOR (FIRST_NAME, LAST_NAME, CONTACT) VALUES
('Patrick', 'Bateman', '+49 15512345671');
INSERT INTO ADMINISTRATOR (FIRST_NAME, LAST_NAME, CONTACT) VALUES ('Lou',
'Bloom', '+49 15513456712');
```

```
/* 3.2 DEPARTMENT */

INSERT INTO DEPARTMENT (DEPT_ID, DEPT_NAME, DEAN_ID) VALUES (1,'Computer
Science', NULL);
INSERT INTO DEPARTMENT (DEPT_ID, DEPT_NAME, DEAN_ID) VALUES
(2,'Mathematics', NULL);
INSERT INTO DEPARTMENT (DEPT_ID, DEPT_NAME, DEAN_ID) VALUES (3,'Business',
NULL);
INSERT INTO DEPARTMENT (DEPT_ID, DEPT_NAME, DEAN_ID) VALUES (4,'Building
Physics', NULL);

/* 3.3 COURSE */

/* Computer Science */
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (11, 1, NULL, 'Bachelor
of Computer Science', 'bcs', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (12, 1, NULL, 'Bachelor
of Augmented Reality', 'bar', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (13, 1, NULL,
"Bachelor's degree in digitalization and information management", 'bdi',
210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (14, 1, NULL, 'Bachelor
Surveying and Geoinformatics', 'bsg', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (15, 1, NULL, 'Master
Photogrammetry and Geoinformatics', 'mpg', 90, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (16, 1, NULL, 'Master
Software Technology', 'mst', 90, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (17, 1, NULL, 'Master
Digital Processes and Technologies', 'mdp', 90, NULL, NULL);

/* Mathematics */
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (21, 2, NULL, 'Bachelor
Applied Mathematics and AI', 'bam', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (22, 2, NULL, 'Master
Mathematics', 'mam', 90, NULL, NULL);

/* Business */
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (31, 3, NULL, 'Bachelor
of Business Administration', 'bba', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (32, 3, NULL, 'Business
Administration International Business course', 'bai', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (33, 3, NULL, 'Bachelor
of Infrastructure Management', 'bim', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (34, 3, NULL, 'Bachelor
of Business Informatics', 'bbi', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (35, 3, NULL, 'Master
General Management', 'mgm', 90, NULL, NULL);
```

```
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (36, 3, NULL, 'Master
Environmentally Oriented Logistics', 'meo', 90, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (37, 3, NULL, "Master of
Business Psychology", 'mdb', 90, NULL, NULL);

/* Building Physics */
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (41, 4, NULL, 'Bachelor
of Building Physics', 'bbp', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (42, 4, NULL, 'Bachelor
of Climate Engineering', 'bce', 210, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (43, 4, NULL, 'Master
Building Physics', 'mbp', 90, NULL, NULL);
INSERT INTO COURSE (COURSE_ID, DEPT_ID, INSTRUCTOR_ID, COURSE_NAME,
COURSE_CODE, CREDITS, BUILDING_NO, ROOM_NO) VALUES (44, 4, NULL, 'Master in
Sustainable Energy Competence', 'mse', 90, NULL, NULL);

END;

$$

DELIMITER ;
```

5.4 Declaration about used AI Tools

While we have used references and have listed them in the coming chapter with citations, we declare that we have used ChatGPT for the project for the following reasons with justifications:

Category	Use Case	Justification
Stored Procedure Delimitters	SQL Workbench/J testing	1. We used ChatGPT to understand a sample stored procedure on SQL Workbench/J as it was our primary GUI for connecting to the LIDA server. 2. No codes were copied as the tool was **only** used to understand the MySQL Syntax structure as it varies for different softwares used.
Before vs After Triggers	SQL Workbench/J testing	1. We used ChatGPT to understand the differences between ***before*** *and* ***after*** triggers. 2. No codes were copied as the tool was **only** used to understand the MySQL Snytax structure for delimitters and before triggers as it varies for different softwares used.
DDL Statement	**ON DELETE SET NULL ON UPDATE CASCADE**	1. We used ChatGPT to **understand this code** (which was alsoon the moodle). 2. We wanted to understand how this line affects our referential integrities and we **only** used the tool to understand the impact on a general DDL statement.

6. List of References (Other than class notes on Moodle)

[1] https://www.geeksforgeeks.org/student-information-management-system/

[2] https://docs.oracle.com/javase/7/docs/api/javax/swing/package-summary.html

[3] https://www.tutorialspoint.com/mysql/mysql_create_trigger.htm

[4] https://www.tutorialspoint.com/mysql/mysql_create_procedure.htm

[5] https://www.tutorialjinni.com/university-management-system-erd.html

[6] https://stackoverflow.com/questions/65213422/is-it-necessary-to-run-rollback-in-mysql

[7] https://stackoverflow.com/questions/61534177/is-it-bad-to-call-rollback-without-any-start-transaction

[8] https://www.geeksforgeeks.org/difference-between-commit-and-rollback-in-sql/

[9] https://www.javatpoint.com/transaction-management-in-jdbc

[10] https://www.javatpoint.com/trigger-in-sql

[11] https://stackoverflow.com/questions/33981939/jtable-not-visible-when-added-to-jpanel

[12] https://stackoverflow.com/questions/14789884/make-scrollable-table

7. Appendix

7.1 Source Code of the Application and User Interface

7.1.1 Custom Connection Class – Conn.java

```
package connections;

// General Libraries
import java.sql.Connection;
import java.sql.DriverManager;
import java.sql.PreparedStatement;
import java.sql.Statement;

public class Conn {
    public Connection conn;
    public Statement stmt;

    public Conn(){
        try{
            Class.forName("com.mysql.cj.jdbc.Driver");
            conn = DriverManager.getConnection(
                    "jdbc:mysql://193.196.143.168/dk4s_41kusa1mst",
"dk4s_41kusa1mst", "bitteaendern"
            );

            stmt = conn.createStatement();
        }
        catch (Exception e){
            e.printStackTrace();
        }
    }
}
```

7.1.2 Mapping of Department to Course – DepartmentToCourseMapping.java

```
package connections;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */


// General Classes
import java.sql.ResultSet;
import java.util.ArrayList;
import java.util.HashMap;
import java.util.List;

// Importing Custom Classes
import connections.Conn;

public class DeptToCourseMapping {
    HashMap<String, List<String>> deptToCourse;

    public DeptToCourseMapping(){
```

```
        deptToCourse = new HashMap<>();

        try{
            Conn c = new Conn();
            String query = """
                    SELECT dept_name, course_name
                    FROM DEPARTMENT D
                    LEFT JOIN COURSE C
                    ON D.dept_id = C.dept_id;
                    """;

            ResultSet rs = c.stmt.executeQuery(query);
            while(rs.next()){
                String dept = rs.getString("dept_name");
                String course = rs.getString("course_name");

                // Custom JAVA method to maintain dynamic mapping of dept-
course
                insert(dept, course);
            }
        }
        catch (Exception e){
            e.printStackTrace();
        }
    }

    public void insert(String key, String value){
        // 1. Check if the key already exists
        List<String> allValues = deptToCourse.get(key);

        // 2. If the key doesn't exist, create a new mapping
        if(allValues == null){
            allValues = new ArrayList<>();
            deptToCourse.put(key, allValues);
        }

        // 3. Add the values to the new/existing list
        allValues.add(value);
    }

    public HashMap getDeptToCourseMapping(){
        return this.deptToCourse;
    }

    public String[] getDeptList(){
        return this.deptToCourse.keySet().toArray(new String[0]);
    }
}
```

7.1.3 Initial Pop Up Screen – Splash.java

```
package de.stuttgart.europa;

// Splash Screen is the initial screen that appears for 10 miliseconds
// It gives the system time to load the configurations and U.I.

/**
 @author Sanjay Prabhu Kunjibettu
```

```java
 @author Tanay Khilare
 */

// General Libraries
import javax.swing.*;
import java.awt.*;

// Importing Custom Classes
import admin.AdminLogin;

public class SplashScreen extends JFrame implements Runnable {
    Thread t;

    SplashScreen(){
        ImageIcon imageIcon1 = new
ImageIcon(ClassLoader.getSystemResource("images/splash_screen_university.jp
g"));
        Image image1 = imageIcon1.getImage().getScaledInstance(1000, 500,
Image.SCALE_DEFAULT);
        ImageIcon imageIcon2 = new ImageIcon(image1);

        JLabel lblImage = new JLabel(imageIcon2);
        this.add(lblImage);

        // Start Thread
        t = new Thread(this);
        t.start();

        try {
            Thread.sleep(10);
        }
        catch (Exception e){
            e.printStackTrace();
        }

        // JFrame Configurations
        this.setTitle("Hochschule für Wissenschaft Europa");
        this.setSize(1000,500);
        this.setVisible(true);
        this.setLocation(300,200);

    }

    @Override
    public void run(){
        try{
            Thread.sleep(5000);
            setVisible(false);
            new AdminLogin();
        }
        catch(Exception e){
            e.printStackTrace();
        }
    }

    public static void main(String[] args) {
        new SplashScreen();
    }
}
```

7.1.4 Login Page for Admin – AdminLogin.java

```
package admin;

// Page is followed after SplashScreen.java
// Admin Login Page

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.awt.*;
import javax.swing.*;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;
import java.sql.PreparedStatement;
import java.sql.ResultSet;

// Importing Custom Classes
import connections.Conn;

public class AdminLogin extends JFrame implements ActionListener {
    JLabel lblUserName, lblPassword, lblBG;
    JTextField tfUserName;
    JPasswordField pfPassword;
    JButton btnLogin;

    ImageIcon icon1, iconBG, icon2, iconAdmin;
    Image imgBG, imgAdmin;

    public AdminLogin(){

        /* 1. Admin User Name */

        // 1.1 Label
        lblUserName = new JLabel("Username: ");
        lblUserName.setBounds(70, 20, 100, 20);
        this.add(lblUserName);

        // 1.2 Text Field
        tfUserName = new JTextField();
        tfUserName.setBounds(180, 20, 150, 20);
        this.add(tfUserName);

        /* 2. Admin Password */

        // 2.1 Label
        lblPassword = new JLabel("Password: ");
        lblPassword.setBounds(70, 70, 100, 20);
        this.add(lblPassword);

        // 1.2 Text Field
        pfPassword = new JPasswordField();
        pfPassword.setBounds(180, 70, 150, 20);
        this.add(pfPassword);

        /* 3. Buttons */

        // 3.1 Login Button
```

```
        btnLogin = new JButton("Login");
        btnLogin.setBounds(100, 140, 120, 30);
        btnLogin.setBackground(Color.black);
        btnLogin.setForeground(Color.white);
        btnLogin.addActionListener(this);
        this.add(btnLogin);

        /* 4. Images */

        // 4.1 Background
        icon1 = new
ImageIcon(ClassLoader.getSystemResource("./images/admin_login_bg.jpg"));
        imgBG = icon1.getImage().getScaledInstance(500, 350,
Image.SCALE_DEFAULT);
        iconBG = new ImageIcon(imgBG);
        lblBG = new JLabel(iconBG);
        lblBG.setBounds(0, 0, 500, 350);
        this.add(lblBG);

        // JFrame Configurations
        this.setTitle("Admin Login");
        this.setSize(500,350);
        this.setLocation(400,300);
        this.setLayout(null);
        this.setVisible(true);
    }

    @Override
    public void actionPerformed(ActionEvent ae){
        if(ae.getSource() == btnLogin){
            String adminUserName = tfUserName.getText();
            String adminPassword = new String(pfPassword.getPassword());

            System.out.println(adminUserName + " " + adminPassword);

            String query = "SELECT * FROM ADMINISTRATOR WHERE USER_ID = ?
AND PSWD = ?";

            try{
                Conn c = new Conn();
                PreparedStatement preparedStatement =
c.conn.prepareStatement(query);
                preparedStatement.setString(1, adminUserName);
                preparedStatement.setString(2, adminPassword);

                ResultSet resultSet = preparedStatement.executeQuery();

                if(resultSet.next()){
                    JOptionPane.showMessageDialog(null, "You have
successfully logged in !");
                    setVisible(false);
                    new AdminMain();
                }
                else{
                    JOptionPane.showMessageDialog(null, "Invalid username
or password !");
                }
            }catch(Exception e){
                e.printStackTrace();
            }
        }
```

```
    }

    public static void main(String[] args) {
        new AdminLogin();
    }
}
```

7.1.5 Admin Desktop / Main Page – AdminMain.java

```
package admin;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.awt.*;
import javax.swing.*;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;

// Importing Custom Classes
import grades.*;
import instructor.*;
import student.*;

public class AdminMain extends JFrame implements ActionListener {
    ImageIcon icon1, iconBG;
    Image imgBG;
    JLabel lblBG;

    JMenuBar menuBar;
    JMenu menuNew, menuView, menuUpdate, menuRemove, menuExam, menuFees,
menuUtility, menuReset, menuExit;
    JMenuItem newInstructorInfo, newStudentInfo, viewInstructorInfo,
viewStudentInfo,
            updateInstructorInfo, updateStudentInfo, removeInstructorInfo,
removeStudentInfo,
            examResults, examEnterMarks, feesStructure, feesForm,
utilityCalculator, utilityNotepad,
            exitMenuItem;

    AdminMain(){
        /* 1. Images */

        // 1.1 Desktop Background
        icon1 = new
ImageIcon(ClassLoader.getSystemResource("images/desktop_bg.jpeg"));
        imgBG = icon1.getImage().getScaledInstance(1540,750,
Image.SCALE_DEFAULT);
        iconBG = new ImageIcon(imgBG);
        lblBG = new JLabel(iconBG);
        this.add(lblBG);

        /* 2. Menu Bar */

        menuBar = new JMenuBar();
```

```
        // 2.1 New
        menuNew = new JMenu("Add");
        menuNew.setForeground(Color.BLACK);
        menuBar.add(menuNew);

        // // 2.1.1 New Instructor Information
        newInstructorInfo = new JMenuItem("New Instructor");
        newInstructorInfo.setBackground(Color.WHITE);
        newInstructorInfo.addActionListener(this);
        menuNew.add(newInstructorInfo);

        // // 2.1.2 New Student Information
        newStudentInfo = new JMenuItem("New Student");
        newStudentInfo.setBackground(Color.WHITE);
        newStudentInfo.addActionListener(this);
        menuNew.add(newStudentInfo);

        // 2.2 View Existing
        menuView = new JMenu("View");
        menuView .setForeground(Color.BLACK);
        menuBar.add(menuView );

        // // 2.2.1 View Existing Instructor Information
        viewInstructorInfo = new JMenuItem("Instructor Details");
        viewInstructorInfo.setBackground(Color.WHITE);
        viewInstructorInfo.addActionListener(this);
        menuView .add(viewInstructorInfo);

        // // 2.2.2 View Existing Student Information
        viewStudentInfo = new JMenuItem("Student Details");
        viewStudentInfo.setBackground(Color.WHITE);
        viewStudentInfo.addActionListener(this);
        menuView .add(viewStudentInfo);

        // 2.3 Update
        menuUpdate = new JMenu("Update");
        menuUpdate.setForeground(Color.BLACK);
        menuBar.add(menuUpdate);

        // // 2.3.1 Update Instructor Information
        updateInstructorInfo = new JMenuItem("Update Instructor");
        updateInstructorInfo.setBackground(Color.WHITE);
        updateInstructorInfo.addActionListener(this);
        menuUpdate.add(updateInstructorInfo);

        // // 2.3.2 Update Student Information
        updateStudentInfo = new JMenuItem("Update Student");
        updateStudentInfo.setBackground(Color.WHITE);
        updateStudentInfo.addActionListener(this);
        menuUpdate.add(updateStudentInfo);

        // 2.4 Remove
        menuRemove= new JMenu("Remove");
        menuRemove.setForeground(Color.BLACK);
        menuBar.add(menuRemove);

        // // 2.4.1 Remove Instructor Information
        removeInstructorInfo = new JMenuItem("Remove Instructor");
        removeInstructorInfo.setBackground(Color.WHITE);
        removeInstructorInfo.addActionListener(this);
```

```
        menuRemove.add(removeInstructorInfo);

        // // 2.3.2 Deregister Student Information
        removeStudentInfo = new JMenuItem("Deregister Student");
        removeStudentInfo.setBackground(Color.WHITE);
        removeStudentInfo.addActionListener(this);
        menuRemove.add(removeStudentInfo);

        // 2.5 Examinations
        menuExam = new JMenu("Examinations");
        menuExam.setForeground(Color.BLACK);
        menuBar.add(menuExam);

        // // 2.5.1 View Results
        examResults = new JMenuItem("View Results");
        examResults.setBackground(Color.WHITE);
        examResults.addActionListener(this);
        menuExam.add(examResults);

        // // 2.5.2 Add Marks
        examEnterMarks = new JMenuItem("Enter Grades");
        examEnterMarks.setBackground(Color.WHITE);
        examEnterMarks.addActionListener(this);
        menuExam.add(examEnterMarks);

        // 2.6 Fees
        menuFees = new JMenu("Fees");
        menuFees.setForeground(Color.BLACK);
        menuBar.add(menuFees);

        // // 2.6.1 Fee Structure
        feesStructure = new JMenuItem("Fee Structure");
        feesStructure.setBackground(Color.WHITE);
        feesStructure.addActionListener(this);
        menuFees.add(feesStructure);

        // // 2.6.2 Student Fee Form
        feesForm = new JMenuItem("Student Form");
        feesForm.setBackground(Color.WHITE);
        feesForm.addActionListener(this);
        menuFees.add(feesForm);

        // 2.7 Utilities
        menuUtility = new JMenu("Utility");
        menuUtility.setForeground(Color.BLACK);
        menuBar.add(menuUtility);

        // // 2.7.1 Calculator
        utilityCalculator = new JMenuItem("Standard Calculator");
        utilityCalculator.setBackground(Color.WHITE);
        utilityCalculator.addActionListener(this);
        menuUtility.add(utilityCalculator);

        // // 2.7.2 Notepad
        utilityNotepad= new JMenuItem("Standard Notepad");
        utilityNotepad.setBackground(Color.WHITE);
        utilityNotepad.addActionListener(this);
        menuUtility.add(utilityNotepad);

        // 2.9 Exit
        menuExit = new JMenu("Exit");
```

```
        menuExit.setForeground(Color.BLACK);
        menuBar.add(menuExit);

        // // 2.9.1 Logout
        exitMenuItem = new JMenuItem("Logout");
        exitMenuItem.setBackground(Color.WHITE);
        exitMenuItem.addActionListener(this);
        menuExit.add(exitMenuItem);

        /* 3. JFrame Configurations */
        this.setJMenuBar(menuBar);
        this.setSize(1540, 850);
        this.setVisible(true);
    }

    @Override
    public void actionPerformed(ActionEvent ae){
        String selectedMenuItem = ae.getActionCommand();
        switch(selectedMenuItem){
            case "New Instructor":
                new AddInstructor();
                break;
            case "New Student":
                new AddStudent();
                break;
            case "Instructor Details":
                new ViewInstructor();
                break;
            case "Student Details":
                new ViewStudent();
                break;
            case "Update Instructor", "Remove Instructor":
                new UpdateInstructor();
                break;
            case "Update Student", "Deregister Student":
                new UpdateStudent();
                break;
            case "View Results":
                new ViewGrades();
                break;
            case "Enter Grades":
                new InsertGrades();
                break;
            case "Fee Structure":
                new FeeStructure();
            case "Student Form":
                new FeesForm();
                break;
            case "Standard Calculator":
                try{
                    Runtime.getRuntime().exec("calc.exe");
                    break;
                }
                catch(Exception e){
                    e.printStackTrace();
                }
            case "Standard Notepad":
                try{
                    Runtime.getRuntime().exec("notepad.exe");
                    break;
               }
```

```
                catch(Exception e){
                    e.printStackTrace();
                }
            case "Logout":
                System.exit(15);
        }
    }

    public static void main(String[] args) {
        new AdminMain();
    }
}
```

7.1.6 Person Interface – Person.java

```
package oop;

// Interface for a person object
// Useful to be used as a template to add more users

public interface Person {

    // Getters
    public String getFirstName();
    public String getLastName();
    public String getContact();
    public String getDOB();
    public String getAddress();

    // Setters
    public void setFirstName(String firstName);
    public void setLastName(String lastName);
    public void setContact(String contact);
    public void setDOB(String dob);
    public void setAddress(String address);

    // Custom Functions
    public boolean checkDOB(int threshold);

    public boolean checkContact(String contact);
}
```

7.1.7 Instructor Class implementing Person Interface – Instructor.java

```
package oop;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.time.LocalDate;
import java.time.Period;
import java.time.format.DateTimeFormatter;
import java.time.format.DateTimeParseException;
import java.util.Random;
```

```java
import java.util.regex.Pattern;

// Custom Libraries
import connections.Conn;

public class Instructor implements Person{

    // Instance Variables
    private String firstName;
    private String lastName;
    private String contact;
    private String dob;
    private String address;
    private String hftCabin;
    private String empID;
    private String courseName;
    private String deptName;

    // Non-param constructor
    public Instructor(){}

    // Parameterized constructor
    public Instructor(String firstName, String lastName, String contact,
String dateOfBirth, String address,
                      String hftCabin, String courseName, String deptName) {
        this.firstName = firstName;
        this.lastName = lastName;
        this.contact = contact;
        this.dob = dateOfBirth;
        this.address = address;
        this.hftCabin = hftCabin;
        this.empID = getRandomEmpID();
        this.courseName = courseName;
        this.deptName = deptName;
    }

    // Getters

    @Override
    public String getFirstName() { return this.firstName; }

    @Override
    public String getLastName() { return this.lastName; }

    @Override
    public String getContact() { return this.contact; }

    @Override
    public String getDOB() { return this.dob; }

    @Override
    public String getAddress() { return this.address; }

    public String getEmpID() { return this.empID; }

    public String getHftCabin() { return this.hftCabin; }

    public String getCourseName() { return this.courseName; }

    public String getDeptName() { return this.deptName; }
```

```
    // Setters

    @Override
    public void setFirstName(String firstName) {
        this.firstName = firstName;
    }

    @Override
    public void setLastName(String lastName) {
        this.lastName = lastName;
    }

    @Override
    public void setContact(String contact) {
        this.contact = contact;
    }

    @Override
    public void setDOB(String dob) {
        this.dob = dob;
    }

    @Override
    public void setAddress(String address) {
        this.address = address;
    }

    public void setHftCabin(String hftCabin){
        this.hftCabin = hftCabin;
    }

    public void setCourseName(String courseName){
        this.courseName = courseName;
    }

    public void setDeptName(String deptName){
        this.deptName = deptName;
    }

    // Custom Functions

    public String getRandomEmpID(){
        Random rnd = new Random();
        int n = 100000 + rnd.nextInt(900000);
        return String.valueOf(n);
    }

    @Override
    public boolean checkDOB(int threshold){

        // Check if the instructor is more than 25 years to be able to
enroll

        try {
            DateTimeFormatter formatter = DateTimeFormatter.ofPattern("dd-
MMM-yyyy");
            LocalDate birthDate = LocalDate.parse(this.dob, formatter);
            LocalDate currentDate = LocalDate.now();
            Period age = Period.between(birthDate, currentDate);
            return age.getYears() > threshold;
        } catch (DateTimeParseException e) {
```

```
            e.printStackTrace();
            return false;
        }
    }

    @Override
    public boolean checkContact(String contact){
        // German Phone Number Regex
        String regex = "^(\\+49|0)[1-9][0-9]{1,14}$";

        // Compile
        Pattern pattern = Pattern.compile(regex);

        // Match
        return pattern.matcher(contact).matches();
    }

    public int insertIntoDB(Conn c, int threshold){
        if(!firstName.isEmpty() && !lastName.isEmpty() &&
!contact.isEmpty() && !dob.isEmpty() && !address.isEmpty() &&
!hftCabin.isEmpty() && !empID.isEmpty()) {
            try {
                String query = """
                        INSERT INTO INSTRUCTOR (FIRST_NAME, LAST_NAME,
CONTACT, DOB, HOME_ADDRESS, HFT_CABIN, EMP_ID) VALUES ('"""
                        + firstName + "','"
                        + lastName + "','"
                        + contact + "','"
                        + dob + "','"
                        + address + "','"
                        + hftCabin + "','"
                        + empID + "')";

                c.stmt.executeUpdate(query);

                if (!checkDOB(threshold) || !checkContact(contact)) {
                    return -1; // values failed error
                }
            }
            catch (Exception e) {
                e.printStackTrace();
                return -1;
            }

            return 1; // Insertion successful
        }

        return 0; // Values are missing
    }

    public int updateContactDB(Conn c, String empID, String newContact,
String newAddress){
        try{
            if(!newContact.isEmpty()){
                String query = """
                                UPDATE INSTRUCTOR
                                SET CONTACT = '
                                """ + newContact + "'"
                        +
                        """
                                WHERE EMP_ID =
```

```
                                """
                        + empID + ";";
                c.stmt.executeUpdate(query);

                if(!checkContact(newContact)){
                    return -1; // rollback in the outside function
                }
                else{
                    c.conn.commit();
                }
            }

            if(!newAddress.isEmpty()){
                String query = """
                                UPDATE INSTRUCTOR
                                SET HOME_ADDRESS = '
                                """ + newAddress + "'"
                        +
                        """
                                WHERE EMP_ID =
                                """
                        + empID + ";";
                c.stmt.executeUpdate(query);

                c.conn.commit();
            }
        }
        catch (Exception e){
            e.printStackTrace();
            return -1;
        }

        return 1; // worked successfully
    }
}
```

7.1.8 Student Class implementing Person Interface – Student.java

```
package oop;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.sql.ResultSet;
import java.time.LocalDate;
import java.time.Period;
import java.time.format.DateTimeFormatter;
import java.time.format.DateTimeParseException;
import java.util.Random;
import java.util.regex.Pattern;

// Custom Libraries
import connections.Conn;

public class Student implements Person{

    // Instance Variables
```

```
    private String firstName;
    private String lastName;
    private String contact;
    private String dob;
    private String address;
    private String gradeXII;
    private String internationalStudent;
    private String matID;
    private String courseName;
    private String deptName;

    // Non-param Constructor
    public Student(){}

    // Parameterized constructor
    public Student(String firstName, String lastName, String contact,
String dateOfBirth, String address,
                   String gradeXII, String internationalStudent, String
courseName, String deptName) {
        this.firstName = firstName;
        this.lastName = lastName;
        this.contact = contact;
        this.dob = dateOfBirth;
        this.address = address;
        this.gradeXII = gradeXII;
        this.internationalStudent = internationalStudent;
        this.matID = getRandomMatID();
        this.courseName = courseName;
        this.deptName = deptName;
    }

    // Getters

    @Override
    public String getFirstName() {
        return this.firstName;
    }

    @Override
    public String getLastName() {
        return this.lastName;
    }

    @Override
    public String getContact() {
        return this.contact;
    }

    @Override
    public String getDOB() {
        return this.dob;
    }

    @Override
    public String getAddress() {
        return this.address;
    }

    public String getMatID() { return this.matID; }

    public String getCourseName() { return this.courseName; }
```

```
    public String getDeptName() { return this.deptName; }

    // Setters

    @Override
    public void setFirstName(String firstName) {
        this.firstName = firstName;
    }

    @Override
    public void setLastName(String lastName) {
        this.lastName = lastName;
    }

    @Override
    public void setContact(String contact) {
        this.contact = contact;
    }

    @Override
    public void setDOB(String dob) {
        this.dob = dob;
    }

    @Override
    public void setAddress(String address) {
        this.address = address;
    }

    public void setCourseName(String courseName){
        this.courseName = courseName;
    }

    public void setDeptName(String deptName){
        this.deptName = deptName;
    }

    // Custom Functions

    public String getRandomMatID(){
        Random rnd = new Random();
        int n = 100000 + rnd.nextInt(900000);
        return String.valueOf(n);
    }

    @Override
    public boolean checkDOB(int threshold){

        // Check if the student is more than 16 years to be able to enroll

        try {
            DateTimeFormatter formatter = DateTimeFormatter.ofPattern("dd-
MMM-yyyy");
            LocalDate birthDate = LocalDate.parse(this.dob, formatter);
            LocalDate currentDate = LocalDate.now();
            Period age = Period.between(birthDate, currentDate);
            return age.getYears() > threshold;
        } catch (DateTimeParseException e) {
            e.printStackTrace();
            return false;
```

```
        }
    }

    @Override
    public boolean checkContact(String contact){
        // German Phone Number Regex
        String regex = "^(\\+49|0)[1-9][0-9]{1,14}$";

        // Compile
        Pattern pattern = Pattern.compile(regex);

        // Match
        return pattern.matcher(contact).matches();
    }

    public boolean checkIfFeesPaid(String immaID){
        Conn c = new Conn();
        System.out.println("Checking for student: " + immaID);

        try{
            String query = """
                    SELECT FEES_PAID
                    FROM FEES F
                    WHERE F.STUDENT_ID =
                    """ + immaID + ";";

            ResultSet rs = c.stmt.executeQuery(query);
            String result = "";

            while (rs.next()) {
                 result = rs.getString("FEES_PAID");
            }

            System.out.println("Did the student pay the fees: " + result +
" ?");
            return result.equals("YES");
        }
        catch (Exception e){
            e.printStackTrace();
        }

        return false;
    }

    public int insertIntoDB(Conn c, int threshold){
        if(!firstName.isEmpty() && !lastName.isEmpty() &&
!contact.isEmpty() && !dob.isEmpty() && !address.isEmpty() &&
!gradeXII.isEmpty() && !internationalStudent.isEmpty() &&
!matID.isEmpty()){
            try{
                String query = """
                        INSERT INTO STUDENT (FIRST_NAME, LAST_NAME,
CONTACT, DOB, HOME_ADDRESS, GRADE_XII, INTERNATIONAL_STUDENT, IMMA_ID)
VALUES ('"""
                        + firstName + "','"
                        + lastName + "','"
                        + contact + "','"
                        + dob + "','"
                        + address + "','"
                        + gradeXII + "','"
                        + internationalStudent + "','"
```

```
                        + matID + "')";

                c.stmt.executeUpdate(query);

                if(!checkDOB(threshold) || !checkContact(contact)){
                    return -1;
                }
            }
            catch (Exception e){
                e.printStackTrace();
                return -1;
            }

            return 1; // Insertion successful
        }

        return 0; // Values are missing
    }

    public int updateContactDB(Conn c, String stuID, String newContact,
String newAddress){
        try{
            if(!newContact.isEmpty()){
                System.out.println("Empty?" + newContact);
                String query = """
                                UPDATE STUDENT
                                SET CONTACT = '
                                """ + newContact + "'"
                        +
                        """
                                WHERE IMMA_ID =
                                """
                        + stuID + ";";
                c.stmt.executeUpdate(query);

                if(!checkContact(newContact)){
                    return -1; // rollback in the outside function
                }
                else{
                    c.conn.commit();
                }
            }

            if(!newAddress.isEmpty()){
                System.out.println("Empty for " + stuID + " ?" +
newAddress);
                String query = """
                                UPDATE STUDENT
                                SET HOME_ADDRESS = '
                                """ + newAddress + "'"
                        +
                        """
                                WHERE IMMA_ID =
                                """
                        + stuID + ";";
                c.stmt.executeUpdate(query);

                c.conn.commit();
            }
        }
        catch (Exception e){
```

```
            e.printStackTrace();
            return -1;
        }

        return 1;
    }

    public int updateFeesDB(Conn c, String immaID, String d_ticket, String
variables){
        try{
            c.conn.setAutoCommit(false);

            if(!d_ticket.isEmpty()){

                String query = """
                            UPDATE FEES
                            SET D_TICKET = '
                            """ + d_ticket + "', FEES_PAID = 'YES' WHERE
STUDENT_ID = '" + immaID + "';";
                c.stmt.executeUpdate(query);

                if(checkIfFeesPaid(immaID)){
                    return -1; // rollback in the outside function
                }
                else{
                    c.conn.commit();
                }
            }

            if(!variables.isEmpty()){

                String query = """
                            UPDATE FEES
                            SET RESEARCH_VARIABLE = '
                            """ + variables + "', FEES_PAID = 'YES' WHERE
STUDENT_ID = '" + immaID + "';";
                c.stmt.executeUpdate(query);

                if(checkIfFeesPaid(immaID)){
                    return -1; // rollback in the outside function
                }
                else{
                    c.conn.commit();
                }
            }
        }
        catch (Exception e){
            e.printStackTrace();
            return -1;
        }

        return 1;
    }
}
```

7.1.9 Java Swings Class to add a new instructor record – AddInstructor.java

```
package instructor;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.awt.*;
import javax.swing.*;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;
import java.util.HashMap;
import java.util.List;
import java.util.Random;

// Plugins
import com.toedter.calendar.JDateChooser;

// Importing Custom Classes
import connections.Conn;
import connections.DeptToCourseMapping;
import oop.Instructor;

public class AddInstructor extends JFrame implements ActionListener{
    JLabel lblHeading, lblDepartment, lblCourse,
            lblFirstName, lblLastName, lblContact,
            lblDOB, lblAddressStreet, lblAddressBuilding,
lblAddressPostCode, lblAddressCity, lblBuilding, lblRoomNumber;
    TextField tfFirstName, tfLastName, tfContact,
            tfAddressBuilding, tfAddressStreet, tfAddressPostCode,
tfAddressCity, tfBuilding, tfRoomNumber;
    JDateChooser dateChooserDOB;
    JComboBox cbDepartment;
    JComboBox<String> cbCourse;
    JButton btnSubmit, btnCancel;

    DeptToCourseMapping dcm;

    public AddInstructor(){

        /* 1. Form Heading */

        // 1. Heading
        lblHeading = new JLabel("Form: Add a New Instructor");
        lblHeading.setBounds(270, 30, 500, 50);
        lblHeading.setFont(new Font("serif",Font.BOLD,30));
        this.add(lblHeading);

        /* 2. Personal Details */

        JLabel lblPersonalDetails = new JLabel("Personal Details ");
        lblPersonalDetails.setBounds(350, 100, 250, 30);
        lblPersonalDetails.setFont(new Font("serif", Font.ITALIC, 20));
        this.add(lblPersonalDetails);

        // 2.1 First Name
        lblFirstName = new JLabel("First Name: ");
        lblFirstName.setBounds(50, 150, 150, 30);
```

```
        lblFirstName.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblFirstName);

        tfFirstName = new TextField();
        tfFirstName.setBounds(200, 150, 150, 30);
        this.add(tfFirstName);

        // 2.2 Last Name
        lblLastName = new JLabel("Last Name: ");
        lblLastName.setBounds(400, 150, 150, 30);
        lblLastName.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblLastName);

        tfLastName = new TextField();
        tfLastName.setBounds(600, 150, 150, 30);
        this.add(tfLastName);

        // 2.3 Contact
        lblContact = new JLabel("Contact: ");
        lblContact.setBounds(50, 200, 150, 30);
        lblContact.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblContact);

        tfContact = new TextField();
        tfContact.setBounds(200, 200, 150, 30);
        this.add(tfContact);

        // 2.4 Date of Birth
        lblDOB = new JLabel("Date of Birth");
        lblDOB.setBounds(400, 200, 150, 30);
        lblDOB.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblDOB);

        dateChooserDOB = new JDateChooser();
        dateChooserDOB.setBounds(600, 200, 150, 30);
        this.add(dateChooserDOB);

        // 2.5 Address

        // // 2.5.1 Street
        lblAddressStreet = new JLabel("Street: ");
        lblAddressStreet.setBounds(50, 250, 150, 30);
        lblAddressStreet.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblAddressStreet);

        tfAddressStreet = new TextField();
        tfAddressStreet.setBounds(200, 250, 150, 30);
        this.add(tfAddressStreet);

        // // 2.5.2 Building Number
        lblAddressBuilding = new JLabel("Building: ");
        lblAddressBuilding.setBounds(400, 250, 150, 30);
        lblAddressBuilding.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblAddressBuilding);

        tfAddressBuilding = new TextField();
        tfAddressBuilding.setBounds(600, 250, 150, 30);
        this.add(tfAddressBuilding);

        // // 2.5.3 Post Code
        lblAddressPostCode = new JLabel("Post Code: ");
```

```
        lblAddressPostCode.setBounds(50, 300, 150, 30);
        lblAddressPostCode.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblAddressPostCode);

        tfAddressPostCode = new TextField();
        tfAddressPostCode.setBounds(200, 300, 150, 30);
        this.add(tfAddressPostCode);

        // // 2.5.4 City
        lblAddressCity = new JLabel("City: ");
        lblAddressCity.setBounds(400, 300, 150, 30);
        lblAddressCity.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblAddressCity);

        tfAddressCity = new TextField();
        tfAddressCity.setBounds(600, 300, 150, 30);
        this.add(tfAddressCity);

        /* 3. Hochschule Details */

        JLabel lblHFWDetails = new JLabel("Hochschule Details");
        lblHFWDetails.setBounds(350, 350, 250, 30);
        lblHFWDetails.setFont(new Font("serif", Font.ITALIC, 20));
        this.add(lblHFWDetails);

        // 3.1 Hochschule Cabin
        lblBuilding = new JLabel("HFW Building: ");
        lblBuilding.setBounds(50, 400, 150, 30);
        lblBuilding.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblBuilding);

        tfBuilding = new TextField();
        tfBuilding.setBounds(200, 400, 150, 30);
        this.add(tfBuilding);

        // 3.2 Room Number
        lblRoomNumber = new JLabel("Room: #");
        lblRoomNumber.setBounds(400, 400, 150, 30);
        lblRoomNumber.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblRoomNumber);

        tfRoomNumber = new TextField();
        tfRoomNumber.setBounds(600, 400, 150, 30);
        this.add(tfRoomNumber);

        // 3.3 Department
        lblDepartment = new JLabel("Department");
        lblDepartment.setBounds(50,450,150,30);
        lblDepartment.setFont(new Font("serif",Font.BOLD,20));
        this.add(lblDepartment);

        dcm = new DeptToCourseMapping(); // Dynamic Department to Course
Mapping
        String[] dept = dcm.getDeptList();
        cbDepartment = new JComboBox(dept);
        cbDepartment.setBounds(200,450,150,30);
        cbDepartment.setBackground(Color.WHITE);
        this.add(cbDepartment);

        // 3.3 Course
        lblCourse = new JLabel("Course: ");
```

```
        lblCourse.setBounds(400,450,150,30);
        lblCourse.setFont(new Font("serif",Font.BOLD,20));
        this.add(lblCourse);

        cbCourse = new JComboBox<>();
        cbCourse.setBounds(500,450,250,30);
        cbCourse.setBackground(Color.WHITE);
        this.add(cbCourse);

        // Dynamic Mapping of Departments to Courses
        HashMap<String, List<String>> deptToCourse =
dcm.getDeptToCourseMapping();

        cbDepartment.addActionListener(new ActionListener() {
            @Override
            public void actionPerformed(ActionEvent e) {
                String deptStr = (String) cbDepartment.getSelectedItem();
                cbCourse.removeAllItems();
                for (String course : deptToCourse.get(deptStr)) {
                    cbCourse.addItem(course);
                }
            }
        });

        cbDepartment.setSelectedIndex(0); // Default Selection to 1st
Option

        /* 4. Buttons */

        // 4.1 Submit
        btnSubmit = new JButton("SUBMIT");
        btnSubmit.setBounds(250,550,120,30);
        btnSubmit.setBackground(Color.BLACK);
        btnSubmit.setForeground(Color.WHITE);
        btnSubmit.addActionListener(this);
        this.add(btnSubmit);

        // 4.2 Cancel
        btnCancel = new JButton("CANCEL");
        btnCancel.setBounds(450,550,120,30);
        btnCancel.setBackground(Color.BLACK);
        btnCancel.setForeground(Color.WHITE);
        btnCancel.addActionListener(this);
        this.add(btnCancel);

        /* 5. JFrame Configurations */
        // this.getContentPane().setBackground(new Color(166,164,252));
        this.setSize(900, 700);
        this.setLocation(350, 50);
        this.setLayout(null);
        this.setVisible(true);
    }

    @Override
    public void actionPerformed(ActionEvent ae){
        if(ae.getSource() == btnSubmit){
            String firstName = tfFirstName.getText();
            String lastName = tfLastName.getText();
            String contact = tfContact.getText();
            String dob = ((JTextField)
dateChooserDOB.getDateEditor().getUiComponent()).getText();
```

```
            // Address
            String addressStreet = tfAddressStreet.getText();
            String addressBuilding = tfAddressBuilding.getText();
            String addressPostCode = tfAddressPostCode.getText();
            String addressCity = tfAddressCity.getText();
            String address = addressBuilding + ", " + addressStreet + ", "
+ addressPostCode + ", " + addressCity;

            String building = tfBuilding.getText();
            String roomNumber = tfRoomNumber.getText();
            String hftCabin = building + "/" + roomNumber;

            String dept = (String) cbDepartment.getSelectedItem();
            String course = (String) cbCourse.getSelectedItem();

            // 2. Create connection from the instructor template

            Instructor newInstructor = new Instructor(firstName, lastName,
contact, dob, address, hftCabin, course, dept);
            Conn c = new Conn();

            // 3. Transactions - COMMIT and ROLLBACK

            try{
                c.conn.setAutoCommit(false);

                // Check if the new Instructor is more than 25 years old
                int result = newInstructor.insertIntoDB(c, 25);
                if(result==1) {
                    // COMMIT
                    c.conn.commit();

                    String query = """
                            update COURSE
                            set instructor_id=
                            (
                                select emp_id from INSTRUCTOR where
first_name='"""
                            + firstName +
                            """
                                    ' and last_name='"""
                            + lastName + "')" + "where upper(course_name) =
upper('" + course + "');";

                    c.stmt.executeUpdate(query);
                    c.conn.commit();

                    JOptionPane.showMessageDialog(null, "New Instructor
Successfully added!");
                    this.setVisible(false);
                }
                else if (result == 0) {
                    JOptionPane.showMessageDialog(null, "ERROR: All values
must be entered!");
                }
                else{
                    // ROLLBACK
                    // Instructor is less than or equal to 25 years and is
NOT eligible
                    c.conn.rollback();
```

```
                    JOptionPane.showMessageDialog(null, "ERROR: Age>=25
and/or Contact must follow german phone standards!");
                }
            }
            catch (Exception e){
                e.printStackTrace();
            }
        }
        else{
            // Cancel Button
            // Do nothing
            this.setVisible(false);
        }
    }

    public static void main(String[] args) {
        new AddInstructor();
    }
}
```

7.1.10 Java Swings Class to update/delete an existing instructor record – UpdateInstructor.java

```
package instructor;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.awt.*;
import javax.swing.*;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;
import java.awt.event.ItemEvent;
import java.awt.event.ItemListener;
import java.sql.*;

// Plugins

// Importing Custom Classes
import connections.Conn;
import oop.Instructor;

public class UpdateInstructor extends JFrame implements ActionListener{
    Choice empIDChoice;
    JLabel lblMainHeading, lblHeading,
            lblDepartment, lblCourse, lblDepartment2, lblCourse2,
            lblFirstName, lblLastName, lblFirstName2, lblLastName2,
            lblHFTCabin, lblHFTCabin2,
            lblEmail, lblEmail2,
            lblDOB, lblDOB2, lblContact, lblAddress;
    TextField tfContact, tfAddress;
    JButton btnUpdate, btnRemove, btnCancel;
```

```
    public UpdateInstructor(){

        /* 1. Form Heading */

        // 1.1 Heading
        lblMainHeading = new JLabel("Form: Update/Remove an existing
Instructor Record");
        lblMainHeading.setBounds(100, 10, 700, 50);
        lblMainHeading.setFont(new Font("serif",Font.BOLD,30));
        this.add(lblMainHeading);

        // 1.2 Choice
        lblHeading = new JLabel("Choose an Employee ID: ");
        lblHeading.setBounds(50,100,150,20);
        this.add(lblHeading);

        empIDChoice = new Choice();
        empIDChoice.setBounds(220,100,150,20);
        this.add(empIDChoice);
        empIDChoice.add("Select...");

        // 1.3 Connection to get a list of choice of emp ids
        try{
            Conn c = new Conn();
            String query = "select distinct emp_id from INSTRUCTOR;";
            ResultSet rs = c.stmt.executeQuery(query);
            while(rs.next()){
                empIDChoice.add(rs.getString("emp_id"));
            }
        }
        catch (Exception e){
            e.printStackTrace();
        }

        /* 2. Form Details */

        // 2.1 First Name
        lblFirstName = new JLabel("First Name: ");
        lblFirstName.setBounds(50, 150, 150, 30);
        lblFirstName.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblFirstName);

        lblFirstName2 = new JLabel();
        lblFirstName2.setBounds(200, 150, 150, 30);
        lblFirstName2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblFirstName2);

        // 2.2 Last Name
        lblLastName = new JLabel("Last Name: ");
        lblLastName.setBounds(400, 150, 150, 30);
        lblLastName.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblLastName);

        lblLastName2 = new JLabel();
        lblLastName2.setBounds(600, 150, 150, 30);
        lblLastName2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblLastName2);

        // 2.3 Email
        lblEmail = new JLabel("Email: ");
        lblEmail.setBounds(50, 200, 150, 30);
```

```
        lblEmail.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblEmail);

        lblEmail2 = new JLabel();
        lblEmail2.setBounds(200, 200, 500, 30);
        lblEmail2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblEmail2);

        // 2.6 Contact
        lblContact = new JLabel("Contact: ");
        lblContact.setBounds(50, 250, 150, 30);
        lblContact.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblContact);

        tfContact = new TextField();
        tfContact.setBounds(200, 250, 150, 30);
        this.add(tfContact);

        // 2.7 Date of Birth
        lblDOB = new JLabel("Date of Birth: ");
        lblDOB.setBounds(400, 250, 150, 30);
        lblDOB.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblDOB);

        lblDOB2 = new JLabel();
        lblDOB2.setBounds(600, 250, 150, 30);
        lblDOB2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblDOB2);

        // 2.8 HFT Cabin
        lblHFTCabin = new JLabel("HFT Cabin: ");
        lblHFTCabin.setBounds(400, 100, 150, 30);
        lblHFTCabin.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblHFTCabin);

        lblHFTCabin2 = new JLabel();
        lblHFTCabin2.setBounds(600, 100, 150, 30);
        lblHFTCabin2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblHFTCabin2);

        // 2.5 Address
        lblAddress = new JLabel("Home Address: ");
        lblAddress.setBounds(50, 300, 150, 30);
        lblAddress.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblAddress);

        tfAddress = new TextField();
        tfAddress.setBounds(200, 300, 550, 30);
        this.add(tfAddress);

        // 2.8 Department
        lblDepartment = new JLabel("Department: ");
        lblDepartment.setBounds(50,350,200,30);
        lblDepartment.setFont(new Font("serif",Font.BOLD,20));
        this.add(lblDepartment);

        lblDepartment2 = new JLabel();
        lblDepartment2.setBounds(200,350,200,30);
        lblDepartment2.setFont(new Font("serif",Font.BOLD,20));
        this.add(lblDepartment2);
```

```
        // 2.9 Course
        lblCourse = new JLabel("Course: ");
        lblCourse.setBounds(400,350,150,30);
        lblCourse.setFont(new Font("serif",Font.BOLD,20));
        this.add(lblCourse);

        lblCourse2 = new JLabel();
        lblCourse2.setBounds(500,350,250,30);
        lblCourse2.setFont(new Font("serif",Font.BOLD,20));
        this.add(lblCourse2);

        empIDChoice.addItemListener(new ItemListener() {
            @Override
            public void itemStateChanged(ItemEvent ie) {
                try {
                    Conn c = new Conn();
                    String choiceItem = empIDChoice.getSelectedItem();
                    String query = """
                        SELECT DISTINCT
                        I.EMP_ID, I.FIRST_NAME, I.LAST_NAME, I.CONTACT,
I.EMAIL, I.DOB, I.HOME_ADDRESS, I.HFT_CABIN,
                        C.COURSE_NAME, D.DEPT_NAME
                        FROM
                        INSTRUCTOR I
                        LEFT JOIN COURSE C
                        ON I.EMP_ID = C.INSTRUCTOR_ID
                        LEFT JOIN DEPARTMENT D
                        ON C.DEPT_ID = D.DEPT_ID
                        WHERE I.EMP_ID =
                        """ + choiceItem + ";";

                    ResultSet resultSet = c.stmt.executeQuery(query);

                    while (resultSet.next()) {

lblFirstName2.setText(resultSet.getString("first_name"));

lblLastName2.setText(resultSet.getString("last_name"));
                        lblEmail2.setText(resultSet.getString("email"));
                        lblDOB2.setText(resultSet.getString("dob"));

lblHFTCabin2.setText(resultSet.getString("hft_cabin"));

lblCourse2.setText(resultSet.getString("course_name"));

lblDepartment2.setText(resultSet.getString("dept_name"));
                    }
                }
                catch (Exception e){
                    e.printStackTrace();
                }}
        });

        /* 3. Buttons */

        // 3.1 Update
        btnUpdate = new JButton("UPDATE");
        btnUpdate.setBounds(250,550,120,30);
        btnUpdate.setBackground(Color.BLACK);
        btnUpdate.setForeground(Color.WHITE);
        btnUpdate.addActionListener(this);
```

```
        this.add(btnUpdate);

        // 3.2 Remove
        btnRemove = new JButton("REMOVE");
        btnRemove.setBounds(450,550,120,30);
        btnRemove.setBackground(Color.BLACK);
        btnRemove.setForeground(Color.WHITE);
        btnRemove.addActionListener(this);
        this.add(btnRemove);

        // 3.2 Cancel
        btnCancel = new JButton("CANCEL");
        btnCancel.setBounds(650,550,120,30);
        btnCancel.setBackground(Color.BLACK);
        btnCancel.setForeground(Color.WHITE);
        btnCancel.addActionListener(this);
        this.add(btnCancel);

        /* 4. JFrame Configurations */
        // this.getContentPane().setBackground(new Color(166,164,252));
        this.setSize(900, 700);
        this.setLocation(350, 50);
        this.setLayout(null);
        this.setVisible(true);
    }

    @Override
    public void actionPerformed(ActionEvent ae){
        if(ae.getSource() == btnUpdate){
            String choiceItem = empIDChoice.getSelectedItem();
            if(!choiceItem.equals("Select...")){
                int dialogButton = JOptionPane.YES_NO_OPTION;
                int dialogResult = JOptionPane.showConfirmDialog(null,
"WARNING: You are about to update " + choiceItem +
"!","WARNING",dialogButton);

                Conn c = new Conn();

                try{
                    if(dialogResult == 0) {
                        // YES
                        String contact = tfContact.getText();
                        String address = tfAddress.getText();

                        c.conn.setAutoCommit(false);

                        Instructor existingInstructor = new Instructor();

                        if(existingInstructor.updateContactDB(c,
choiceItem, contact, address)==1){
                            // COMMIT
                            c.conn.commit();

                            JOptionPane.showMessageDialog(null, "UPDATE:
Instructor Record updated successfully!");
                            setVisible(false);
                        }
                        else{
                            // ROLLBACK
                            // Contact mistake
                            c.conn.rollback();
```

```
                            JOptionPane.showMessageDialog(null, "ERROR:
Contact must follow german phone standards!");
                        };
                    }
                    else{
                        // NO ACTION ITEM
                    }
                }
                catch (Exception e){
                    e.printStackTrace();
                }
            }
            else{
                JOptionPane.showMessageDialog(null, "ERROR: Select an
instructor employee number to update!");
            }
        }
        else if(ae.getSource() == btnRemove){
            String choiceItem = empIDChoice.getSelectedItem();
            if(!choiceItem.equals("Select...")){
                int dialogButton = JOptionPane.YES_NO_OPTION;
                int dialogResult = JOptionPane.showConfirmDialog(null,
"WARNING: You are about to remove " + choiceItem +
"!","WARNING",dialogButton);

                if(dialogResult == 0) {
                    // YES

                    Conn c = new Conn();

                    try {
                        c.conn.setAutoCommit(false);

                        String query = """
                                DELETE FROM INSTRUCTOR
                                WHERE EMP_ID =
                                """
                                + choiceItem + ";";

                        c.stmt.executeUpdate(query);
                        c.conn.commit();

                        JOptionPane.showMessageDialog(null, "UPDATE:
Instructor Record deleted successfully!");
                        setVisible(false);
                    } catch (Exception e) {
                        e.printStackTrace();
                    }
                }
                else{
                    // NO ACTION ITEM
                }
            }
            else{
                JOptionPane.showMessageDialog(null, "ERROR: Select an
instructor employee number to delete!");
            }
        }
        else{
            this.setVisible(false);
        }
```

```
    }

    public static void main(String[] args) {
        new UpdateInstructor();
    }
}
```

7.1.11 Java Swings Class to view an existing instructor record – ViewInstructor.java

```
package instructor;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.awt.*;
import javax.swing.*;
import javax.swing.table.TableColumn;
import javax.swing.table.TableColumnModel;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;
import java.sql.ResultSet;
import java.sql.ResultSetMetaData;

// Import Plugins
import net.proteanit.sql.DbUtils; // rs2xml.jar

// Importing Custom Classes
import connections.Conn;

public class ViewInstructor extends JFrame implements ActionListener {
    Choice empIDChoice;
    JLabel lblHeading;
    JTable tableAll;
    JButton btnSearch, btnPrint, btnCancel;
    JScrollPane scrollPane;

    public ViewInstructor(){

        // 0. Set Border Layout
        // Border Layout works best for tables, scrolling and printing
        this.setLayout(new BorderLayout());

        /* 1. Select the Instructor ID to view their details */

        // 1.1 Label
        lblHeading = new JLabel("Choose an Employee ID: ");

        // 1.2 Choice
        empIDChoice = new Choice();
        empIDChoice.add("All");

        // 1.3 Connection to get a list of choice of emp ids
        try{
```

```
            Conn c = new Conn();
            String query = "select distinct emp_id from INSTRUCTOR;";
            ResultSet rs = c.stmt.executeQuery(query);
            while(rs.next()){
                empIDChoice.add(rs.getString("emp_id"));
            }
        }
        catch (Exception e){
            e.printStackTrace();
        }

        // 1.4 Connection to get instructor info with course and dept info
        tableAll = new JTable();
        try{
            Conn c = new Conn();
            String query = """
                    SELECT DISTINCT
                    I.EMP_ID, I.FIRST_NAME, I.LAST_NAME, I.CONTACT,
I.EMAIL, I.DOB, I.HOME_ADDRESS, I.HFT_CABIN,
                    C.COURSE_NAME, D.DEPT_NAME
                    FROM
                    INSTRUCTOR I
                    LEFT JOIN COURSE C
                    ON I.EMP_ID = C.INSTRUCTOR_ID
                    LEFT JOIN DEPARTMENT D
                    ON C.DEPT_ID = D.DEPT_ID;
                    """;
            ResultSet rs = c.stmt.executeQuery(query);
            ResultSetMetaData metaData = rs.getMetaData();
            int totalColumns = metaData.getColumnCount();

            tableAll.setModel(DbUtils.resultSetToTableModel(rs));
            tableAll.setAutoResizeMode(JTable.AUTO_RESIZE_OFF);

            // Set column size
            TableColumnModel colModel = tableAll.getColumnModel();
            for(int i=0; i<totalColumns; i++){
                TableColumn tc = colModel.getColumn(i);
                tc.setPreferredWidth(130);
            }
        }
        catch (Exception e){
            e.printStackTrace();
        }

        // 1.5 Scroll Pane
        scrollPane = new JScrollPane(tableAll,
JScrollPane.VERTICAL_SCROLLBAR_AS_NEEDED,
JScrollPane.HORIZONTAL_SCROLLBAR_ALWAYS);

        // 1.6 Border Layout for Scroll Pane
        JPanel centerPanel = new JPanel();
        centerPanel.add(scrollPane);
        centerPanel.setPreferredSize(new
Dimension(900,(int)centerPanel.getPreferredSize().getHeight()));
        centerPanel.setLayout(new GridLayout(1, 3));
        this.add(centerPanel, BorderLayout.CENTER);

        /* 2. Buttons */

        // 2.1 Search
```

```
        btnSearch = new JButton("SEARCH");
        btnSearch.addActionListener(this);

        // 2.2 Print
        btnPrint = new JButton("PRINT");
        btnPrint.addActionListener(this);

        // 2.3 Cancel the operation
        btnCancel = new JButton("CANCEL");
        btnCancel.addActionListener(this);

        // 2.4 North Border Layout
        JPanel northPanel = new JPanel();
        northPanel.add(lblHeading);
        northPanel.add(empIDChoice);
        northPanel.add(btnPrint);
        northPanel.add(btnSearch);
        northPanel.add(btnCancel);
        northPanel.setPreferredSize(new
Dimension(900,(int)northPanel.getPreferredSize().getHeight()));
        this.add(northPanel, BorderLayout.NORTH);

        /* 3. JFrame Configurations */

        this.setTitle("Instructor Details");
        this.pack();
        this.setSize(900, 600);
        this.setLocation(350, 50);
        this.setVisible(true);
    }

    @Override
    public void actionPerformed(ActionEvent ae){
        if (ae.getSource() == btnSearch){
            try {
                Conn c = new Conn();
                String choiceItem = empIDChoice.getSelectedItem();
                if(!choiceItem.equals("All")){
                    String query = """
                    SELECT DISTINCT
                    I.EMP_ID, I.FIRST_NAME, I.LAST_NAME, I.CONTACT,
I.EMAIL, I.DOB, I.HOME_ADDRESS, I.HFT_CABIN,
                    C.COURSE_NAME, D.DEPT_NAME
                    FROM
                    INSTRUCTOR I
                    LEFT JOIN COURSE C
                    ON I.EMP_ID = C.INSTRUCTOR_ID
                    LEFT JOIN DEPARTMENT D
                    ON C.DEPT_ID = D.DEPT_ID
                    WHERE I.EMP_ID =
                    """ + choiceItem + ";";

                    ResultSet resultSet = c.stmt.executeQuery(query);

                    ResultSetMetaData metaData = resultSet.getMetaData();
                    int totalColumns = metaData.getColumnCount();


tableAll.setModel(DbUtils.resultSetToTableModel(resultSet));
                    tableAll.setAutoResizeMode(JTable.AUTO_RESIZE_OFF);
```

```
                    // Set column size
                    TableColumnModel colModel = tableAll.getColumnModel();
                    for(int i=0; i<totalColumns; i++){
                        TableColumn tc = colModel.getColumn(i);
                        tc.setPreferredWidth(130);
                    }
                }
                else{
                    String query = """
                    SELECT DISTINCT
                    I.EMP_ID, I.FIRST_NAME, I.LAST_NAME, I.CONTACT,
I.EMAIL, I.DOB, I.HOME_ADDRESS, I.HFT_CABIN,
                    C.COURSE_NAME, D.DEPT_NAME
                    FROM
                    INSTRUCTOR I
                    LEFT JOIN COURSE C
                    ON I.EMP_ID = C.INSTRUCTOR_ID
                    LEFT JOIN DEPARTMENT D
                    ON C.DEPT_ID = D.DEPT_ID
                    """;

                    ResultSet resultSet = c.stmt.executeQuery(query);
                    ResultSetMetaData metaData = resultSet.getMetaData();
                    int totalColumns = metaData.getColumnCount();


tableAll.setModel(DbUtils.resultSetToTableModel(resultSet));
                    tableAll.setAutoResizeMode(JTable.AUTO_RESIZE_OFF);

                    // Set column size
                    TableColumnModel colModel = tableAll.getColumnModel();
                    for(int i=0; i<totalColumns; i++){
                        TableColumn tc = colModel.getColumn(i);
                        tc.setPreferredWidth(130);
                    }
                }

            }catch (Exception e){
                e.printStackTrace();
            }
        }
        else if (ae.getSource() == btnPrint){
            try {
                tableAll.print();
            }catch (Exception e){
                e.printStackTrace();
            }
        }
        else {
            // Cancel Transaction
            this.setVisible(false);
        }
    }

    public static void main(String[] args) {
        new ViewInstructor();
    }
}
```

7.1.12 Java Swings Class to insert a new student record – AddStudent.java

```
package student;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.awt.*;
import javax.swing.*;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;
import java.util.HashMap;
import java.util.List;
import java.sql.*;
import java.time.LocalDate;

// Plugins
import com.toedter.calendar.JDateChooser;

// Importing Custom Classes
import connections.Conn;
import connections.DeptToCourseMapping;
import oop.Student;

public class AddStudent extends JFrame implements ActionListener{
    JLabel lblHeading, lblDepartment, lblCourse,
            lblFirstName, lblLastName, lblContact,
            lblDOB, lblAddressStreet, lblAddressBuilding,
lblAddressPostCode, lblAddressCity, lblXII, lblInternational;
    TextField tfFirstName, tfLastName, tfContact,
            tfAddressBuilding, tfAddressStreet, tfAddressPostCode,
tfAddressCity, tfXII;
    JDateChooser dateChooserDOB;
    JComboBox cbDepartment, cbInternational;
    JComboBox<String> cbCourse;
    JButton btnSubmit, btnCancel;

    DeptToCourseMapping dcm;

    public AddStudent(){

        /* 1. Form Heading */

        // 1. Heading
        lblHeading = new JLabel("Form: Add a New Student");
        lblHeading.setBounds(270, 30, 500, 50);
        lblHeading.setFont(new Font("serif",Font.BOLD,30));
        this.add(lblHeading);

        /* 2. Form Details */

        // 2.1 First Name
        lblFirstName = new JLabel("First Name: ");
        lblFirstName.setBounds(50, 150, 150, 30);
        lblFirstName.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblFirstName);

        tfFirstName = new TextField();
```

```
        tfFirstName.setBounds(200, 150, 150, 30);
        this.add(tfFirstName);

        // 2.2 Last Name
        lblLastName = new JLabel("Last Name: ");
        lblLastName.setBounds(400, 150, 150, 30);
        lblLastName.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblLastName);

        tfLastName = new TextField();
        tfLastName.setBounds(600, 150, 150, 30);
        this.add(tfLastName);

        // 2.3 Contact
        lblContact = new JLabel("Contact: ");
        lblContact.setBounds(50, 200, 150, 30);
        lblContact.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblContact);

        tfContact = new TextField();
        tfContact.setBounds(200, 200, 150, 30);
        this.add(tfContact);

        // 2.4 Date of Birth
        lblDOB = new JLabel("Date of Birth");
        lblDOB.setBounds(400, 200, 150, 30);
        lblDOB.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblDOB);

        dateChooserDOB = new JDateChooser();
        dateChooserDOB.setBounds(600, 200, 150, 30);
        this.add(dateChooserDOB);

        // 2.5 Address

        // // 2.5.1 Street
        lblAddressStreet = new JLabel("Street: ");
        lblAddressStreet.setBounds(50, 250, 150, 30);
        lblAddressStreet.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblAddressStreet);

        tfAddressStreet = new TextField();
        tfAddressStreet.setBounds(200, 250, 150, 30);
        this.add(tfAddressStreet);

        // // 2.5.2 Building Number
        lblAddressBuilding = new JLabel("Building: ");
        lblAddressBuilding.setBounds(400, 250, 150, 30);
        lblAddressBuilding.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblAddressBuilding);

        tfAddressBuilding = new TextField();
        tfAddressBuilding.setBounds(600, 250, 150, 30);
        this.add(tfAddressBuilding);

        // // 2.5.3 Post Code
        lblAddressPostCode = new JLabel("Post Code: ");
        lblAddressPostCode.setBounds(50, 300, 150, 30);
        lblAddressPostCode.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblAddressPostCode);
```

```
        tfAddressPostCode = new TextField();
        tfAddressPostCode.setBounds(200, 300, 150, 30);
        this.add(tfAddressPostCode);

        // // 2.5.4 City
        lblAddressCity = new JLabel("City: ");
        lblAddressCity.setBounds(400, 300, 150, 30);
        lblAddressCity.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblAddressCity);

        tfAddressCity = new TextField();
        tfAddressCity.setBounds(600, 300, 150, 30);
        this.add(tfAddressCity);

        // 2.6 Grade XII Marks
        lblXII = new JLabel("Grade XII: ");
        lblXII.setBounds(50, 350, 150, 30);
        lblXII.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblXII);

        tfXII = new TextField();
        tfXII.setBounds(200, 350, 150, 30);
        this.add(tfXII);

        /* 3. Hochschule Details */

        // 3.1 International Student Status
        lblInternational = new JLabel("International ?: ");
        lblInternational.setBounds(400, 350, 150, 30);
        lblInternational.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblInternational);

        String[] internationalStatus = {"Yes", "No"};
        cbInternational = new JComboBox(internationalStatus);
        cbInternational.setBounds(600, 350, 150, 30);
        cbInternational.setBackground(Color.WHITE);
        this.add(cbInternational);

        // 3.2 Department
        lblDepartment = new JLabel("Department");
        lblDepartment.setBounds(50,400,150,30);
        lblDepartment.setFont(new Font("serif",Font.BOLD,20));
        this.add(lblDepartment);

        dcm = new DeptToCourseMapping(); // Dynamic Department to Course
Mapping
        String[] dept = dcm.getDeptList();
        cbDepartment = new JComboBox(dept);
        cbDepartment.setBounds(200,400,150,30);
        cbDepartment.setBackground(Color.WHITE);
        this.add(cbDepartment);

        // 3.3 Course
        lblCourse = new JLabel("Course: ");
        lblCourse.setBounds(400,400,150,30);
        lblCourse.setFont(new Font("serif",Font.BOLD,20));
        this.add(lblCourse);

        cbCourse = new JComboBox<>();
        cbCourse.setBounds(500,400,250,30);
        cbCourse.setBackground(Color.WHITE);
```

```
        this.add(cbCourse);

        // Dynamic Mapping of Departments to Courses
        HashMap<String, List<String>> deptToCourse =
dcm.getDeptToCourseMapping();

        cbDepartment.addActionListener(new ActionListener() {
            @Override
            public void actionPerformed(ActionEvent e) {
                String deptStr = (String) cbDepartment.getSelectedItem();
                cbCourse.removeAllItems();
                for (String course : deptToCourse.get(deptStr)) {
                    cbCourse.addItem(course);
                }
            }
        });

        cbDepartment.setSelectedIndex(0); // Default Selection to 1st
Option

        /* 4. Buttons */

        // 4.1 Submit
        btnSubmit = new JButton("Submit");
        btnSubmit.setBounds(250,550,120,30);
        btnSubmit.setBackground(Color.BLACK);
        btnSubmit.setForeground(Color.WHITE);
        btnSubmit.addActionListener(this);
        this.add(btnSubmit);

        // 4.2 Cancel
        btnCancel = new JButton("Cancel");
        btnCancel.setBounds(450,550,120,30);
        btnCancel.setBackground(Color.BLACK);
        btnCancel.setForeground(Color.WHITE);
        btnCancel.addActionListener(this);
        this.add(btnCancel);

        /* 5. JFrame Configurations */
        this.setSize(900, 700);
        this.setLocation(350, 50);
        this.setLayout(null);
        this.setVisible(true);
    }

    @Override
    public void actionPerformed(ActionEvent ae){
        if(ae.getSource() == btnSubmit){

            // 1. Get the form information
            String firstName = tfFirstName.getText();
            String lastName = tfLastName.getText();
            String contact = tfContact.getText();
            String dob = ((JTextField)
dateChooserDOB.getDateEditor().getUiComponent()).getText();

            // // Address
            String addressStreet = tfAddressStreet.getText();
            String addressBuilding = tfAddressBuilding.getText();
            String addressPostCode = tfAddressPostCode.getText();
            String addressCity = tfAddressCity.getText();
```

```
            String address = addressBuilding + ", " + addressStreet + ", "
+ addressPostCode + ", " + addressCity;

            String gradeXII = tfXII.getText();
            String international = (String)
cbInternational.getSelectedItem();

            String dept = (String) cbDepartment.getSelectedItem();
            String course = (String) cbCourse.getSelectedItem();

            // 2. Create connection from the student template
            Student newStudent = new Student(firstName, lastName, contact,
dob, address, gradeXII, international, course, dept);
            Conn c = new Conn();

            // 3. Transactions - COMMIT and ROLLBACK

            try{
                c.conn.setAutoCommit(false);

                // Check if the new student is more than 16 years old
                int result = newStudent.insertIntoDB(c, 16);
                if(result == 1){
                    // COMMIT
                    c.conn.commit();

                    String deptID="", courseID="";
                    String matID = newStudent.getMatID();

                    // Get Course ID
                    String query = "select dept_id, course_id from COURSE
where upper(course_name) = upper('" + course + "');";
                    ResultSet rs = c.stmt.executeQuery(query);
                    while(rs.next()){
                        deptID = rs.getString("dept_id");
                        courseID = rs.getString("course_id");
                    }

                    System.out.println(dept + " " + course + " " + matID);

                    // Todays date
                    String today = String.valueOf(LocalDate.now());

                    query = "INSERT INTO ENROLLMENT (IMMA_ID, DEPT_ID,
COURSE_ID, IMMA_DATE, IMMA_STATUS) VALUES ('"
                            + matID + "','"
                            + deptID + "','"
                            + courseID + "','"
                            + today + "','ADMITTED');";
                    c.stmt.executeUpdate(query);
                    c.conn.commit();

                    JOptionPane.showMessageDialog(null, "New Student
Successfully added!");
                    this.setVisible(false);
                }
                else if (result == 0) {
                    JOptionPane.showMessageDialog(null, "ERROR: All values
must be entered!");
                }
                else{
```

```
                    // ROLLBACK
                    // Student is less than or equal to 16 years and is NOT
eligible for enrollment
                    c.conn.rollback();
                    JOptionPane.showMessageDialog(null, "ERROR: Age>=16
and/or Contact must follow german phone standards!");
                }
            }
            catch (Exception e){
                e.printStackTrace();
            }
        }
        else{
            // Cancel Button
            // Do nothing
            this.setVisible(false);
        }
    }

    public static void main(String[] args) {
        new AddStudent();
    }
}
```

7.1.13 Java Swings Class to update/deregister an existing student record – UpdateStudent.java

```
package student;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.awt.*;
import javax.swing.*;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;
import java.awt.event.ItemEvent;
import java.awt.event.ItemListener;
import java.util.Random;
import java.sql.*;
import java.time.LocalDate;

// Plugins
import net.proteanit.sql.DbUtils;

// Importing Custom Classes
import connections.Conn;
import oop.Student;

public class UpdateStudent extends JFrame implements ActionListener{
    Choice studIDChoice;
    JLabel lblMainHeading, lblHeading,
            lblDepartment, lblCourse, lblDepartment2, lblCourse2,
            lblFirstName, lblLastName, lblFirstName2, lblLastName2,
            lblInternational, lblInternational2,
```

```
            lblEmail, lblEmail2, lblIMMAStatus, lblIMMAStatus2,
lblFeeStatus, lblFeeStatus2,
            lblDOB, lblDOB2, lblContact, lblAddress;
    TextField tfContact, tfAddress;
    JButton btnUpdate, btnRemove, btnCancel;

    public UpdateStudent(){

        /* 1. Form Heading */

        // 1.1 Heading
        lblMainHeading = new JLabel("Form: Update an existing Student
Record");
        lblMainHeading.setBounds(100, 10, 700, 50);
        lblMainHeading.setFont(new Font("serif",Font.BOLD,30));
        this.add(lblMainHeading);

        // 1.2 Choice
        lblHeading = new JLabel("Choose a Matriculation ID: ");
        lblHeading.setBounds(50,100,170,20);
        this.add(lblHeading);

        studIDChoice = new Choice();
        studIDChoice.setBounds(220,100,150,20);
        this.add(studIDChoice);
        studIDChoice.add("Select...");

        // 1.3 Connection to get a list of choice of emp ids
        try{
            Conn c = new Conn();
            String query = "select distinct imma_id from STUDENT;";
            ResultSet rs = c.stmt.executeQuery(query);
            while(rs.next()){
                studIDChoice.add(rs.getString("imma_id"));
            }
        }
        catch (Exception e){
            e.printStackTrace();
        }

        /* 2. Form Details */

        // 2.1 First Name
        lblFirstName = new JLabel("First Name: ");
        lblFirstName.setBounds(50, 150, 150, 30);
        lblFirstName.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblFirstName);

        lblFirstName2 = new JLabel();
        lblFirstName2.setBounds(200, 150, 150, 30);
        lblFirstName2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblFirstName2);

        // 2.2 Last Name
        lblLastName = new JLabel("Last Name: ");
        lblLastName.setBounds(400, 150, 150, 30);
        lblLastName.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblLastName);

        lblLastName2 = new JLabel();
        lblLastName2.setBounds(600, 150, 150, 30);
```

```
        lblLastName2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblLastName2);

        // 2.3 Email
        lblEmail = new JLabel("Email: ");
        lblEmail.setBounds(50, 200, 150, 30);
        lblEmail.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblEmail);

        lblEmail2 = new JLabel();
        lblEmail2.setBounds(200, 200, 500, 30);
        lblEmail2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblEmail2);

        // 2.4 Matriculation Status
        lblIMMAStatus = new JLabel("IMMA Status: ");
        lblIMMAStatus.setBounds(50, 250, 150, 30);
        lblIMMAStatus.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblIMMAStatus);

        lblIMMAStatus2 = new JLabel();
        lblIMMAStatus2.setBounds(200, 250, 150, 30);
        lblIMMAStatus2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblIMMAStatus2);

        // 2.5 Fee Status
        lblFeeStatus = new JLabel("Fees Status: ");
        lblFeeStatus.setBounds(400, 250, 150, 30);
        lblFeeStatus.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblFeeStatus);

        lblFeeStatus2 = new JLabel();
        lblFeeStatus2.setBounds(600, 250, 150, 30);
        lblFeeStatus2.setFont(new Font("serif", Font.BOLD, 15));
        this.add(lblFeeStatus2);

        // 2.6 Contact
        lblContact = new JLabel("Contact: ");
        lblContact.setBounds(50, 300, 150, 30);
        lblContact.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblContact);

        tfContact = new TextField();
        tfContact.setBounds(200, 300, 150, 30);
        this.add(tfContact);

        // 2.7 Date of Birth
        lblDOB = new JLabel("Date of Birth");
        lblDOB.setBounds(400, 300, 150, 30);
        lblDOB.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblDOB);

        lblDOB2 = new JLabel();
        lblDOB2.setBounds(600, 300, 150, 30);
        lblDOB2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblDOB2);

        // 2.8 International Student Status
        lblInternational = new JLabel("International ?: ");
        lblInternational.setBounds(400, 100, 150, 30);
        lblInternational.setFont(new Font("serif", Font.BOLD, 20));
```

```
        this.add(lblInternational);

        lblInternational2 = new JLabel();
        lblInternational2.setBounds(600, 100, 150, 30);
        lblInternational2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblInternational2);

        // 2.5 Address
        lblAddress = new JLabel("Home Address: ");
        lblAddress.setBounds(50, 350, 150, 30);
        lblAddress.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblAddress);

        tfAddress = new TextField();
        tfAddress.setBounds(200, 350, 550, 30);
        this.add(tfAddress);

        // 2.8 Department
        lblDepartment = new JLabel("Department");
        lblDepartment.setBounds(50,400,200,30);
        lblDepartment.setFont(new Font("serif",Font.BOLD,20));
        this.add(lblDepartment);

        lblDepartment2 = new JLabel();
        lblDepartment2.setBounds(200,400,200,30);
        lblDepartment2.setFont(new Font("serif",Font.BOLD,20));
        this.add(lblDepartment2);

        // 2.9 Course
        lblCourse = new JLabel("Course: ");
        lblCourse.setBounds(400,400,150,30);
        lblCourse.setFont(new Font("serif",Font.BOLD,20));
        this.add(lblCourse);

        lblCourse2 = new JLabel();
        lblCourse2.setBounds(500,400,250,30);
        lblCourse2.setFont(new Font("serif",Font.BOLD,20));
        this.add(lblCourse2);

        studIDChoice.addItemListener(new ItemListener() {
            @Override
            public void itemStateChanged(ItemEvent ie) {
            try {
                Conn c = new Conn();
                String choiceItem = studIDChoice.getSelectedItem();
                String query = """
                        SELECT DISTINCT
                        S.IMMA_ID, S.FIRST_NAME, S.LAST_NAME, S.CONTACT,
S.EMAIL, S.DOB, S.HOME_ADDRESS, S.INTERNATIONAL_STUDENT,
                        C.COURSE_NAME, D.DEPT_NAME,
                        E.IMMA_DATE, E.IMMA_STATUS, F.FEES_PAID
                        FROM
                        STUDENT S
                        LEFT JOIN ENROLLMENT E
                        ON S.IMMA_ID = E.IMMA_ID
                        LEFT JOIN FEES F
                        ON S.IMMA_ID = F.STUDENT_ID
                        LEFT JOIN COURSE C
                        ON E.COURSE_ID = C.COURSE_ID
                        LEFT JOIN DEPARTMENT D
                        ON C.DEPT_ID = D.DEPT_ID
```

```
                        WHERE S.IMMA_ID =
                        """ + choiceItem + ";";

                ResultSet resultSet = c.stmt.executeQuery(query);

                while (resultSet.next()) {

lblFirstName2.setText(resultSet.getString("first_name"));
                    lblLastName2.setText(resultSet.getString("last_name"));
                    lblEmail2.setText(resultSet.getString("email"));
                    lblDOB2.setText(resultSet.getString("dob"));

lblInternational2.setText(resultSet.getString("international_student"));
                    lblCourse2.setText(resultSet.getString("course_name"));

lblDepartment2.setText(resultSet.getString("dept_name"));

lblIMMAStatus2.setText(resultSet.getString("imma_status"));

lblFeeStatus2.setText(resultSet.getString("fees_paid"));
                }
            }
            catch (Exception e){
                e.printStackTrace();
            }}
        });

        /* 3. Buttons */

        // 3.1 Update
        btnUpdate = new JButton("UPDATE");
        btnUpdate.setBounds(250,550,120,30);
        btnUpdate.setBackground(Color.BLACK);
        btnUpdate.setForeground(Color.WHITE);
        btnUpdate.addActionListener(this);
        this.add(btnUpdate);

        // 3.2 Remove
        btnRemove = new JButton("DEREGISTER");
        btnRemove.setBounds(450,550,120,30);
        btnRemove.setBackground(Color.BLACK);
        btnRemove.setForeground(Color.WHITE);
        btnRemove.addActionListener(this);
        this.add(btnRemove);

        // 3.2 Cancel
        btnCancel = new JButton("CANCEL");
        btnCancel.setBounds(650,550,120,30);
        btnCancel.setBackground(Color.BLACK);
        btnCancel.setForeground(Color.WHITE);
        btnCancel.addActionListener(this);
        this.add(btnCancel);

        /* 4. JFrame Configurations */
        this.setSize(900, 700);
        this.setLocation(350, 50);
        this.setLayout(null);
        this.setVisible(true);
    }

    @Override
```

```
    public void actionPerformed(ActionEvent ae){
        if(ae.getSource() == btnUpdate){
            String choiceItem = studIDChoice.getSelectedItem();
            if(!choiceItem.equals("Select...")){
                int dialogButton = JOptionPane.YES_NO_OPTION;
                int dialogResult = JOptionPane.showConfirmDialog(null,
"WARNING: You are about to update " + choiceItem +
"!","WARNING",dialogButton);

                Conn c = new Conn();

                try {
                    if(dialogResult == 0) {
                        // YES
                        String contact = tfContact.getText();
                        String address = tfAddress.getText();

                        c.conn.setAutoCommit(false);

                        Student existingStudent = new Student();

                        if(existingStudent.updateContactDB(c, choiceItem,
contact, address)==1){
                            // COMMIT
                            c.conn.commit();

                            JOptionPane.showMessageDialog(null, "UPDATE:
Student Record updated successfully!");
                            setVisible(false);
                        }
                        else{
                            // ROLLBACK
                            // Contact mistake
                            c.conn.rollback();
                            JOptionPane.showMessageDialog(null, "ERROR:
Contact must follow german phone standards!");
                        };
                    }
                    else {
                        // NO ACTION ITEM
                    }
                }
                catch (Exception e){
                    e.printStackTrace();
                }
            }
            else{
                JOptionPane.showMessageDialog(null, "Select a student
matriculation number to update!");
            }
        }
        else if(ae.getSource() == btnRemove){
            String choiceItem = studIDChoice.getSelectedItem();
            if(!choiceItem.equals("Select...")){
                int dialogButton = JOptionPane.YES_NO_OPTION;
                int dialogResult = JOptionPane.showConfirmDialog(null,
"WARNING: You are about to remove " + choiceItem +
"!","WARNING",dialogButton);

                if(dialogResult == 0) {
                    // YES
```

```
                    Conn c = new Conn();

                    try {

                        c.conn.setAutoCommit(false);

                        String query = """
                            DELETE FROM STUDENT
                            WHERE IMMA_ID =
                            """
                                + choiceItem + ";";

                        c.stmt.executeUpdate(query);
                        c.conn.commit();

                        JOptionPane.showMessageDialog(null, "UPDATE:
Student Record deleted successfully!");
                        setVisible(false);
                    }
                    catch (Exception e){
                        e.printStackTrace();
                    }
                }
                else {
                    // NO ACTION ITEM
                }
            }
            else{
                JOptionPane.showMessageDialog(null, "ERROR: Select a
student matriculation number to delete!");
            }
        }
        else{
            this.setVisible(false);
        }
    }

    public static void main(String[] args) {
        new UpdateStudent();
    }
}
```

7.1.14 Java Swings Class to view an existing student record – ViewStudent.java

```
package student;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.awt.*;
import javax.swing.*;
import javax.swing.table.TableColumn;
import javax.swing.table.TableColumnModel;
import java.awt.event.ActionEvent;
```

```
import java.awt.event.ActionListener;
import java.sql.ResultSet;
import java.sql.ResultSetMetaData;

// Plugins
import net.proteanit.sql.DbUtils; // rs2xml.jar

// Importing Custom Classes
import connections.Conn;

public class ViewStudent extends JFrame implements ActionListener {
    Choice studIDChoice;
    JLabel lblHeading;
    JTable tableAll;
    JButton btnSearch, btnPrint, btnCancel;
    JScrollPane scrollPane;

    public ViewStudent(){

        // 0. Set Border Layout
        // Border Layout works best for tables, scrolling and printing
        this.setLayout(new BorderLayout());

        /* 1. Select the Student Matriculation ID to view their details */

        // 1.1 Label
        lblHeading = new JLabel("Choose a Matriculation ID: ");

        // 1.2 Choice
        studIDChoice = new Choice();
        studIDChoice.add("All");

        // 1.3 Connection to get a list of choice of emp ids
        try{
            Conn c = new Conn();
            String query = "select distinct imma_id from STUDENT;";
            ResultSet rs = c.stmt.executeQuery(query);
            while(rs.next()){
                studIDChoice.add(rs.getString("imma_id"));
            }
        }
        catch (Exception e){
            e.printStackTrace();
        }

        // 1.4 Connection to get student info with course and dept info
        tableAll = new JTable();
        try{
            Conn c = new Conn();
            String query = """
                    SELECT DISTINCT
                    S.IMMA_ID, S.FIRST_NAME, S.LAST_NAME, S.CONTACT,
S.EMAIL, S.DOB, S.HOME_ADDRESS, S.INTERNATIONAL_STUDENT,
                    C.COURSE_NAME, D.DEPT_NAME,
                    E.IMMA_DATE, E.IMMA_STATUS, F.FEES_PAID
                    FROM
                    STUDENT S
                    LEFT JOIN ENROLLMENT E
                    ON S.IMMA_ID = E.IMMA_ID
                    LEFT JOIN FEES F
                    ON S.IMMA_ID = F.STUDENT_ID
```

```
                    LEFT JOIN COURSE C
                    ON E.COURSE_ID = C.COURSE_ID
                    LEFT JOIN DEPARTMENT D
                    ON C.DEPT_ID = D.DEPT_ID;
                    """;
            ResultSet rs = c.stmt.executeQuery(query);
            ResultSetMetaData metaData = rs.getMetaData();
            int totalColumns = metaData.getColumnCount();

            tableAll.setModel(DbUtils.resultSetToTableModel(rs));
            tableAll.setAutoResizeMode(JTable.AUTO_RESIZE_OFF);

            // Set column size
            TableColumnModel colModel = tableAll.getColumnModel();
            for(int i=0; i<totalColumns; i++){
                TableColumn tc = colModel.getColumn(i);
                tc.setPreferredWidth(130);
            }
        }
        catch (Exception e){
            e.printStackTrace();
        }

        // 1.5 Scroll Pane
        scrollPane = new JScrollPane(tableAll,
JScrollPane.VERTICAL_SCROLLBAR_AS_NEEDED,
JScrollPane.HORIZONTAL_SCROLLBAR_ALWAYS);

        // 1.6 Border Layout for Scroll Pane
        JPanel centerPanel = new JPanel();
        centerPanel.add(scrollPane);
        centerPanel.setPreferredSize(new
Dimension(900,(int)centerPanel.getPreferredSize().getHeight()));
        centerPanel.setLayout(new GridLayout(1, 3));
        this.add(centerPanel, BorderLayout.CENTER);

        /* 2. Buttons */

        // 2.1 Search
        btnSearch = new JButton("SEARCH");
        btnSearch.addActionListener(this);

        // 2.2 Print
        btnPrint = new JButton("PRINT");
        btnPrint.addActionListener(this);

        // 2.3 Cancel the operation
        btnCancel = new JButton("CANCEL");
        btnCancel.addActionListener(this);

        // 2.4 North Border Layout
        JPanel northPanel = new JPanel();
        northPanel.add(lblHeading);
        northPanel.add(studIDChoice);
        northPanel.add(btnPrint);
        northPanel.add(btnSearch);
        northPanel.add(btnCancel);
        northPanel.setPreferredSize(new
Dimension(900,(int)northPanel.getPreferredSize().getHeight()));
        this.add(northPanel, BorderLayout.NORTH);
```

```
        /* 3. JFrame Configurations */

        this.setTitle("Student Details");
        this.pack();
        this.setSize(900, 600);
        this.setLocation(350, 50);
        this.setVisible(true);

    }

    @Override
    public void actionPerformed(ActionEvent ae){
        if (ae.getSource() == btnSearch){
            try {
                Conn c = new Conn();
                String choiceItem = studIDChoice.getSelectedItem();
                if(!choiceItem.equals("All")){
                    String query = """
                    SELECT DISTINCT
                    S.IMMA_ID, S.FIRST_NAME, S.LAST_NAME, S.CONTACT,
S.EMAIL, S.DOB, S.HOME_ADDRESS, S.INTERNATIONAL_STUDENT,
                    C.COURSE_NAME, D.DEPT_NAME,
                    E.IMMA_DATE, E.IMMA_STATUS, F.FEES_PAID
                    FROM
                    STUDENT S
                    LEFT JOIN ENROLLMENT E
                    ON S.IMMA_ID = E.IMMA_ID
                    LEFT JOIN FEES F
                    ON S.IMMA_ID = F.STUDENT_ID
                    LEFT JOIN COURSE C
                    ON E.COURSE_ID = C.COURSE_ID
                    LEFT JOIN DEPARTMENT D
                    ON C.DEPT_ID = D.DEPT_ID
                    WHERE S.IMMA_ID =
                    """ + choiceItem + ";";

                    ResultSet resultSet = c.stmt.executeQuery(query);

                    ResultSetMetaData metaData = resultSet.getMetaData();
                    int totalColumns = metaData.getColumnCount();


tableAll.setModel(DbUtils.resultSetToTableModel(resultSet));
                    tableAll.setAutoResizeMode(JTable.AUTO_RESIZE_OFF);

                    // Set column size
                    TableColumnModel colModel = tableAll.getColumnModel();
                    for(int i=0; i<totalColumns; i++){
                        TableColumn tc = colModel.getColumn(i);
                        tc.setPreferredWidth(130);
                    }

                }
                else{
                    String query = """
                    SELECT DISTINCT
                    S.IMMA_ID, S.FIRST_NAME, S.LAST_NAME, S.CONTACT,
S.EMAIL, S.DOB, S.HOME_ADDRESS, S.INTERNATIONAL_STUDENT,
                    C.COURSE_NAME, D.DEPT_NAME,
                    E.IMMA_DATE, E.IMMA_STATUS, F.FEES_PAID
                    FROM
```

```
                    STUDENT S
                    LEFT JOIN ENROLLMENT E
                    ON S.IMMA_ID = E.IMMA_ID
                    ON S.IMMA_ID = F.STUDENT_ID
                    LEFT JOIN COURSE C
                    ON E.COURSE_ID = C.COURSE_ID
                    LEFT JOIN DEPARTMENT D
                    ON C.DEPT_ID = D.DEPT_ID;
                    """;

                    ResultSet resultSet = c.stmt.executeQuery(query);

                    ResultSetMetaData metaData = resultSet.getMetaData();
                    int totalColumns = metaData.getColumnCount();


tableAll.setModel(DbUtils.resultSetToTableModel(resultSet));
                    tableAll.setAutoResizeMode(JTable.AUTO_RESIZE_OFF);

                    // Set column size
                    TableColumnModel colModel = tableAll.getColumnModel();
                    for(int i=0; i<totalColumns; i++){
                        TableColumn tc = colModel.getColumn(i);
                        tc.setPreferredWidth(130);
                    }

                }
            }catch (Exception E){
                E.printStackTrace();
            }
        }
        else if (ae.getSource() == btnPrint){
            try {
                tableAll.print();
            }catch (Exception e) {
                e.printStackTrace();
            }
        }else {
            // Cancel Transaction
            setVisible(false);
        }
    }

    public static void main(String[] args) {
        new ViewStudent();
    }
}
```

7.1.15 Java Swings Class to view the fee structures – FeeStructure.java

```
package student;

// Only illustrates the structure of Fees
// Includes the necessary details for the students

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */
```

```java
// General Libraries
import java.awt.*;
import javax.swing.*;

public class FeeStructure extends JFrame{
    JLabel lblMainHeading, lblHeading,
            lblTuitionFees, lblTuitionFees2,
            lblSemesterFees, lblSemesterFees2,
            lblDTicket, lblDTicket2, lblVariable, lblVariable2;

    public FeeStructure(){
        /* 1. Form Heading */

        // 1.1 Heading
        lblMainHeading = new JLabel("Fee Structure for Students");
        lblMainHeading.setBounds(230, 10, 500, 50);
        lblMainHeading.setFont(new Font("serif",Font.BOLD,30));
        this.add(lblMainHeading);

        /* 2. Form Details */

        // 2.1 Tuition Fees
        lblTuitionFees = new JLabel("Tuition Fees: ");
        lblTuitionFees.setBounds(50, 100, 150, 30);
        lblTuitionFees.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblTuitionFees);

        lblTuitionFees2 = new JLabel("Only for International Students -
€1500,00 / Semester");
        lblTuitionFees2.setBounds(250, 100, 500, 30);
        lblTuitionFees2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblTuitionFees2);

        // 2.2 Semester Fees
        lblSemesterFees = new JLabel("Semester Fees: ");
        lblSemesterFees.setBounds(50, 150, 150, 30);
        lblSemesterFees.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblSemesterFees);

        lblSemesterFees2 = new JLabel("For All - € 200,00 / Semester");
        lblSemesterFees2.setBounds(250, 150, 500, 30);
        lblSemesterFees2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblSemesterFees2);

        // 2.3 D-Ticket (Optional)
        lblDTicket = new JLabel("D-Ticket: ");
        lblDTicket.setBounds(50, 200, 150, 30);
        lblDTicket.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblDTicket);

        lblDTicket2 = new JLabel("Optional - € 180,00 / Semester");
        lblDTicket2.setBounds(250, 200, 500, 30);
        lblDTicket2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblDTicket2);

        // 2.4 Variable Fees
        lblVariable = new JLabel("Variables: ");
        lblVariable.setBounds(50, 250, 150, 30);
        lblVariable.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblVariable);
```

```
        lblVariable2 = new JLabel("Includes any variable fees / fines");
        lblVariable2.setBounds(250, 250, 500, 30);
        lblVariable2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblVariable2);

        /* 3. JFrame Configurations */
        this.setSize(900, 700);
        this.setLocation(350, 50);
        this.setLayout(null);
        this.setVisible(true);
    }

    public static void main(String[] args) {
        new FeeStructure();
    }
}
```

7.1.16 Java Swings Class to pay the fees – FeesForm.java

```
package student;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.awt.*;
import javax.swing.*;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;
import java.awt.event.ItemEvent;
import java.awt.event.ItemListener;
import java.util.Random;
import java.sql.*;
import java.time.LocalDate;

// Plugins
import net.proteanit.sql.DbUtils;


// Importing Custom Classes
import connections.Conn;
import oop.Student;

public class FeesForm extends JFrame implements ActionListener{
    Choice studIDChoice;
    JLabel lblMainHeading, lblHeading,
            lblTuitionFees, lblTuitionFees2,
            lblSemesterFees, lblSemesterFees2,
            lblDTicket, lblVariable,
            lblFeesPaid, lblTotalFees;
    JTextField tfVariable;
    JComboBox cbDTicket;
    JButton btnPay, btnCancel, btnReset, btnCalculate;

    public FeesForm(){
        /* 1. Form Heading */
```

```
        // 1.1 Heading
        lblMainHeading = new JLabel("Form: Student Fees");
        lblMainHeading.setBounds(230, 10, 500, 50);
        lblMainHeading.setFont(new Font("serif",Font.BOLD,30));
        this.add(lblMainHeading);

        // 1.2 Choice
        lblHeading = new JLabel("Choose a Matriculation ID: ");
        lblHeading.setBounds(20,60,170,20);
        this.add(lblHeading);

        studIDChoice = new Choice();
        studIDChoice.setBounds(190,60,150,20);
        this.add(studIDChoice);
        studIDChoice.add("Select...");

        // 1.3 Connection to get a list of choice of emp ids
        try{
            Conn c = new Conn();
            String query = "select distinct imma_id from STUDENT;";
            ResultSet rs = c.stmt.executeQuery(query);
            while(rs.next()){
                studIDChoice.add(rs.getString("imma_id"));
            }
        }
        catch (Exception e){
            e.printStackTrace();
        }

        /* 2. Form Details */

        // 2.1 Fees Status and Total Fees
        lblFeesPaid = new JLabel();
        lblFeesPaid.setBounds(50, 100, 150, 30);
        lblFeesPaid.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblFeesPaid);

        lblTotalFees = new JLabel("NOT CALCULATED");
        lblTotalFees.setBounds(500, 100, 200, 30);
        lblTotalFees.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblTotalFees);


        // 2.2 Tuition Fees
        lblTuitionFees = new JLabel("Tuition Fees: ");
        lblTuitionFees.setBounds(50, 150, 150, 30);
        lblTuitionFees.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblTuitionFees);

        lblTuitionFees2 = new JLabel();
        lblTuitionFees2.setBounds(200, 150, 150, 30);
        lblTuitionFees2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblTuitionFees2);

        // 2.3 Semester Fees
        lblSemesterFees = new JLabel("Semester Fees: ");
        lblSemesterFees.setBounds(400, 150, 150, 30);
        lblSemesterFees.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblSemesterFees);

        lblSemesterFees2 = new JLabel();
```

```
        lblSemesterFees2.setBounds(600, 150, 150, 30);
        lblSemesterFees2.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblSemesterFees2);

        // 2.4 D-Ticket (Optional)
        lblDTicket = new JLabel("D-Ticket: ");
        lblDTicket.setBounds(50, 200, 150, 30);
        lblDTicket.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblDTicket);

        cbDTicket = new JComboBox(new String[]{"YES", "NO"});
        cbDTicket.setBounds(200, 200, 150, 30);
        cbDTicket.setFont(new Font("serif", Font.BOLD, 15));
        this.add(cbDTicket);

        // 2.5 Variable Fees
        lblVariable = new JLabel("Variables: ");
        lblVariable.setBounds(400, 200, 150, 30);
        lblVariable.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblVariable);

        tfVariable = new JTextField();
        tfVariable.setBounds(600, 200, 150, 30);
        tfVariable.setFont(new Font("serif", Font.BOLD, 20));
        this.add(tfVariable);

        studIDChoice.addItemListener(new ItemListener() {
            @Override
            public void itemStateChanged(ItemEvent ie) {
                try {
                    Conn c = new Conn();
                    String choiceItem = studIDChoice.getSelectedItem();
                    String query = """
                        SELECT *
                        FROM
                        FEES
                        WHERE STUDENT_ID =
                        """ + choiceItem + ";";

                    ResultSet resultSet = c.stmt.executeQuery(query);

                    while (resultSet.next()) {
                        lblFeesPaid.setText("Fees Paid?: " +
resultSet.getString("fees_paid"));

lblTuitionFees2.setText(resultSet.getString("tuition_fees"));

lblSemesterFees2.setText(resultSet.getString("semester_fees"));
                    }
                }
                catch (Exception e){
                    e.printStackTrace();
                }}
        });

        /* 3. Buttons */

        // 3.1 Calculate
        btnCalculate = new JButton("CALCULATE");
        btnCalculate.setBounds(100,250,120,30);
        btnCalculate.setBackground(Color.BLACK);
```

```
        btnCalculate.setForeground(Color.WHITE);
        btnCalculate.addActionListener(this);
        this.add(btnCalculate);

        // 3.2 Pay
        btnPay = new JButton("PAY");
        btnPay.setBounds(250,250,120,30);
        btnPay.setBackground(Color.BLACK);
        btnPay.setForeground(Color.WHITE);
        btnPay.addActionListener(this);
        this.add(btnPay);

        // 3.3 Cancel
        btnCancel = new JButton("CANCEL");
        btnCancel.setBounds(400,250,120,30);
        btnCancel.setBackground(Color.BLACK);
        btnCancel.setForeground(Color.WHITE);
        btnCancel.addActionListener(this);
        this.add(btnCancel);

        // 3.4 Reset
        btnReset = new JButton("RESET");
        btnReset.setBounds(550,250,120,30);
        btnReset.setBackground(Color.BLACK);
        btnReset.setForeground(Color.WHITE);
        btnReset.addActionListener(this);
        this.add(btnReset);

        /* 4. JFrame Configurations */
        this.setSize(900, 450);
        this.setLocation(350, 50);
        this.setLayout(null);
        this.setVisible(true);
    }

    @Override
    public void actionPerformed(ActionEvent ae){
        if(!studIDChoice.getSelectedItem().equals("Select...")){
            if(ae.getSource() == btnCalculate){
                double tuitionFees =
Double.parseDouble(lblTuitionFees2.getText());
                double semesterFees =
Double.parseDouble(lblSemesterFees2.getText());

                // D Ticket
                String dTicket =
String.valueOf(cbDTicket.getSelectedItem());
                double d_ticket = (dTicket.equals("YES") ? 180 : 0);

                double variables = Double.parseDouble(
                        (tfVariable.getText().isEmpty() ? "0" :
tfVariable.getText())
                );

                double totalFees = tuitionFees + semesterFees + d_ticket +
variables;

                lblTotalFees.setText("Total: €" +
String.valueOf(totalFees));
            }
            else if(ae.getSource() == btnPay){
```

```
                if(lblTotalFees.getText().equals("NOT CALCULATED")){
                    JOptionPane.showMessageDialog(null, "Calculate the
amount first!");
                }
                else{
                    // D Ticket
                    String dTicket =
String.valueOf(cbDTicket.getSelectedItem());
                    double d_ticket = (dTicket.equals("YES") ? 360 : 0);

                    double variables = Double.parseDouble(
                            (tfVariable.getText().isEmpty() ? "0" :
tfVariable.getText())
                    );

                    Conn c = new Conn();
                    Student s = new Student();
                    String immaID = studIDChoice.getSelectedItem();
                    System.out.println(immaID);

                    if(s.updateFeesDB(c, immaID, String.valueOf(d_ticket),
String.valueOf(variables))==1){
                        try {
                            c.conn.commit();

                            String query = "UPDATE ENROLLMENT SET
IMMA_STATUS = 'ENROLLED' WHERE IMMA_ID = '" + immaID + "';";
                            c.stmt.executeUpdate(query);

                            c.conn.commit();

                            JOptionPane.showMessageDialog(null, "Fees
paid!");
                            this.setVisible(false);
                        }
                        catch (Exception e){
                            e.printStackTrace();
                        }
                    }
                    else {
                        JOptionPane.showMessageDialog(null, "The student
has already paid the fees!");
                    }
                }
            }
            else if(ae.getSource() == btnReset){
                Conn c = new Conn();

                try{
                    c.conn.setAutoCommit(false);

                    String immaID = studIDChoice.getSelectedItem();

                    // TRANSACTIONS - COMMIT ROLLBACK
                    try{
                        String query = "UPDATE FEES SET D_TICKET = '0',
RESEARCH_VARIABLE = '0', FEES_PAID='NO';";
                        c.stmt.executeUpdate(query);
                        c.conn.commit();

                        query = "UPDATE ENROLLMENT SET IMMA_STATUS =
```

```
'ADMITTED' WHERE IMMA_ID = '" + immaID + "';";
                        c.stmt.executeUpdate(query);
                        c.conn.commit();
                    }
                    catch (Exception ee){
                        c.conn.rollback();
                    }

                    JOptionPane.showMessageDialog(null, "Warning: Fees
Status changed to NOT PAID! ");
                    this.setVisible(false);
                }
                catch (Exception e){
                    e.printStackTrace();
                }
            }
            else{
                this.setVisible(false);
            }
        }
        else{
            JOptionPane.showMessageDialog(null, "Select a Student
Matriculation Number!");

        }

    }

    public static void main(String[] args) {
        new FeesForm();
    }
}
```

7.1.17 Java Swings Class to insert grades for subjects – InsertGrades.java

```
package grades;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.awt.*;
import javax.swing.*;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;
import java.awt.event.ItemEvent;
import java.awt.event.ItemListener;
import java.sql.ResultSet;
import java.util.HashMap;
import java.util.Random;

// Plugins
import com.toedter.calendar.JDateChooser;
import connections.Conn;

// Importing Custom Classes

public class InsertGrades extends JFrame implements ActionListener{
```

```
    Choice studIDChoice;
    JComboBox cbSemester;
    JLabel lblMainHeading, lblHeading, lblSemester,
            lblSubject, lblGrades, lblCourse;
    String courseID;
    JTextField tfSubject1, tfSubject2, tfSubject3, tfSubject4, tfSubject5,
tfElective1,
    tfGrade1, tfGrade2, tfGrade3, tfGrade4, tfGrade5, tfGrade6;
    JButton btnSubmit, btnCancel;

    public InsertGrades(){
        /* 1. Form Heading */

        // 1.1 Heading
        lblMainHeading = new JLabel("Form: Insert Grades for a Student");
        lblMainHeading.setBounds(230, 10, 500, 50);
        lblMainHeading.setFont(new Font("serif",Font.BOLD,30));
        this.add(lblMainHeading);

        // 1.2 Choice
        lblHeading = new JLabel("Choose a Matriculation ID: ");
        lblHeading.setBounds(50,60,200,20);
        this.add(lblHeading);

        studIDChoice = new Choice();
        studIDChoice.setBounds(270,60,150,20);
        this.add(studIDChoice);
        studIDChoice.add("Select...");

        // 1.3 Connection to get a list of choice of emp ids
        try{
            Conn c = new Conn();
            String query = "select distinct imma_id from STUDENT;";
            ResultSet rs = c.stmt.executeQuery(query);
            while(rs.next()){
                studIDChoice.add(rs.getString("imma_id"));
            }
        }
        catch (Exception e){
            e.printStackTrace();
        }

        // Course Label
        lblCourse = new JLabel();
        lblCourse.setBounds(20, 100, 150, 20);
        this.add(lblCourse);

        // Get the course id
        studIDChoice.addItemListener(new ItemListener() {
            @Override
            public void itemStateChanged(ItemEvent ie) {
                try {
                    Conn c = new Conn();
                    String choiceItem = studIDChoice.getSelectedItem();
                    String query = """
                        SELECT DISTINCT
                        C.COURSE_ID, C.COURSE_NAME
                        FROM
                        STUDENT S
                        LEFT JOIN ENROLLMENT E
                        ON S.IMMA_ID = E.IMMA_ID
```

```
                        LEFT JOIN COURSE C
                        ON E.COURSE_ID = C.COURSE_ID
                        WHERE S.IMMA_ID =
                        """ + choiceItem + ";";

                    ResultSet resultSet = c.stmt.executeQuery(query);

                    while (resultSet.next()) {

lblCourse.setText(resultSet.getString("course_name"));
                        courseID = resultSet.getString("course_id");
                    }
                }
                catch (Exception e){
                    e.printStackTrace();
                }}
        });

        /* 2. Form Details */

        // 2.1 Select Semester
        lblSemester = new JLabel("Select Semester: ");
        lblSemester.setBounds(50,110,150,20);
        this.add(lblSemester);

        String[] semester = {"1","2","3","4","5","6","7","8"};
        cbSemester = new JComboBox(semester);
        cbSemester.setBounds(270,110,150,20);
        cbSemester.setBackground(Color.WHITE);
        this.add(cbSemester);

        // 2.2 Headings for Subjects and Marks
        lblSubject = new JLabel("Subject: ");
        lblSubject.setBounds(100,150,200,40);
        lblSubject.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblSubject);

        lblGrades = new JLabel("Grades: ");
        lblGrades.setBounds(400,150,200,40);
        lblGrades.setFont(new Font("serif", Font.BOLD, 20));
        this.add(lblGrades);

        // 2.3 Subjects
        tfSubject1 = new JTextField();
        tfSubject1.setBounds(100,200,200,20);
        this.add(tfSubject1);

        tfSubject2 = new JTextField();
        tfSubject2.setBounds(100,230,200,20);
        this.add(tfSubject2);

        tfSubject3 = new JTextField();
        tfSubject3.setBounds(100,260,200,20);
        this.add(tfSubject3);

        tfSubject4 = new JTextField();
        tfSubject4.setBounds(100,290,200,20);
        this.add(tfSubject4);

        tfSubject5 = new JTextField();
        tfSubject5.setBounds(100,320,200,20);
```

```
        this.add(tfSubject5);

        tfElective1 = new JTextField();
        tfElective1.setBounds(100,350,200,20);
        this.add(tfElective1);

        // 2.4 Grades
        tfGrade1 = new JTextField();
        tfGrade1.setBounds(350,200,200,20);
        this.add(tfGrade1);

        tfGrade2 = new JTextField();
        tfGrade2.setBounds(350,230,200,20);
        this.add(tfGrade2);

        tfGrade3= new JTextField();
        tfGrade3.setBounds(350,260,200,20);
        this.add(tfGrade3);

        tfGrade4 = new JTextField();
        tfGrade4.setBounds(350,290,200,20);
        this.add(tfGrade4);

        tfGrade5 = new JTextField();
        tfGrade5.setBounds(350,320,200,20);
        this.add(tfGrade5);

        tfGrade6 = new JTextField();
        tfGrade6.setBounds(350,350,200,20);
        this.add(tfGrade6);

        /* 3. Buttons */

        // 3.1 Submit
        // 3.1 Insert
        btnSubmit = new JButton("INSERT");
        btnSubmit.setBounds(150,400,120,30);
        btnSubmit.setBackground(Color.BLACK);
        btnSubmit.setForeground(Color.WHITE);
        btnSubmit.addActionListener(this);
        this.add(btnSubmit);

        // 3.2 Cancel
        btnCancel = new JButton("CANCEL");
        btnCancel.setBounds(370,400,120,30);
        btnCancel.setBackground(Color.BLACK);
        btnCancel.setForeground(Color.WHITE);
        btnCancel.addActionListener(this);
        this.add(btnCancel);

        /* 4. JFrame Configurations */
        this.setSize(900, 700);
        this.setLocation(350, 50);
        this.setLayout(null);
        this.setVisible(true);
    }

    @Override
    public void actionPerformed(ActionEvent ae){
        if(ae.getSource() == btnSubmit){
            String choiceItem = studIDChoice.getSelectedItem();
```

```
            if(!choiceItem.equals("Select...")){

                Conn c = new Conn();

                try {

                    c.conn.setAutoCommit(false);

                    // Check if there are no duplicates
                    String query = """
                            select count(*) student_id from SUBJECT
                            where student_id = '"""
                            + choiceItem + "' and semester = '" +
cbSemester.getSelectedItem() + "';";

                    ResultSet rs = c.stmt.executeQuery(query);
                    String rowCount="";

                    while(rs.next()){
                        rowCount = rs.getString("student_id");
                    }

                    if(rowCount.equals("0")){
                        query = "INSERT INTO SUBJECT VALUES('" + choiceItem
+ "', '" + courseID + "', '" + cbSemester.getSelectedItem() + "', '" +
                                tfSubject1.getText() + "', '" +
tfSubject2.getText() + "', '" + tfSubject3.getText() + "', '" +
tfSubject4.getText() + "', '" + tfSubject5.getText() + "', '" +
tfElective1.getText() + "');";

                        c.stmt.executeUpdate(query);
                        c.conn.commit();

                        query = "INSERT INTO GRADES VALUES('" + choiceItem
+ "', '" + courseID + "', '" + cbSemester.getSelectedItem() + "', '" +
                                tfGrade1.getText() + "', '" +
tfGrade2.getText() + "', '" + tfGrade3.getText() + "', '" +
tfGrade4.getText() + "', '" + tfGrade5.getText() + "', '" +
tfGrade6.getText() + "');";
                        c.stmt.executeUpdate(query);
                        c.conn.commit();

                        JOptionPane.showMessageDialog(null, "Grades
inserted successfully!");
                        setVisible(false);
                    }
                    else{
                        JOptionPane.showMessageDialog(null, "Value exists
for the selected student and semester! Please try again!");
                    }
                }
                catch (Exception e){
                    e.printStackTrace();
                }
            }
            else{
                JOptionPane.showMessageDialog(null, "Select a student
matriculation number to insert!");
            }
        }
        else{
```

```
            this.setVisible(false);
        }
    }

    public static void main(String[] args) {
        new InsertGrades();
    }
}
```

7.1.18 Java Swings Class to view results – ViewGrades.java

```
package grades;

/**
 @author Sanjay Prabhu Kunjibettu
 @author Tanay Khilare
 */

// General Libraries
import java.awt.*;
import javax.swing.*;
import javax.swing.table.TableColumn;
import javax.swing.table.TableColumnModel;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;
import java.sql.ResultSet;
import java.sql.ResultSetMetaData;

// Import Plugins
import net.proteanit.sql.DbUtils; // rs2xml.jar

// Importing Custom Classes
import connections.Conn;

public class ViewGrades extends JFrame implements ActionListener{
    Choice studIDChoice;
    JLabel lblHeading;
    JTable tableAll;
    JButton btnSearch, btnPrint, btnCancel;
    JScrollPane scrollPane;

    public ViewGrades(){

        // 0. Set Border Layout
        // Border Layout works best for tables, scrolling and printing
        this.setLayout(new BorderLayout());

        /* 1. Select the Student Matriculation ID to view their details */

        // 1.1 Label
        lblHeading = new JLabel("Choose a Matriculation ID: ");

        // 1.2 Choice
        studIDChoice = new Choice();
        studIDChoice.add("All");

        // 1.3 Connection to get a list of choice of emp ids
        try{
```

```
            Conn c = new Conn();
            String query = "select distinct imma_id from STUDENT;";
            ResultSet rs = c.stmt.executeQuery(query);
            while(rs.next()){
                studIDChoice.add(rs.getString("imma_id"));
            }
        }
        catch (Exception e){
            e.printStackTrace();
        }

        // 1.4 Connection to get student info with course and dept info
        tableAll = new JTable();
        try{
            Conn c = new Conn();
            String query = """
                    SELECT DISTINCT S.FIRST_NAME, S.LAST_NAME,
C.COURSE_NAME, SUB.*, G.*
                    FROM
                    SUBJECT SUB
                    LEFT JOIN GRADES G
                    ON SUB.STUDENT_ID = G.STUDENT_ID and SUB.COURSE_ID =
G.COURSE_ID and SUB.SEMESTER = G.SEMESTER
                    LEFT JOIN STUDENT S
                    ON S.IMMA_ID = SUB.STUDENT_ID
                    LEFT JOIN ENROLLMENT E
                    ON S.IMMA_ID = E.IMMA_ID
                    LEFT JOIN COURSE C
                    ON E.COURSE_ID = C.COURSE_ID
                    """;
            ResultSet rs = c.stmt.executeQuery(query);
            ResultSetMetaData metaData = rs.getMetaData();
            int totalColumns = metaData.getColumnCount();

            tableAll.setModel(DbUtils.resultSetToTableModel(rs));
            tableAll.setAutoResizeMode(JTable.AUTO_RESIZE_OFF);

            // Set column size
            TableColumnModel colModel = tableAll.getColumnModel();
            for(int i=0; i<totalColumns; i++){
                TableColumn tc = colModel.getColumn(i);
                tc.setPreferredWidth(130);
            }
        }
        catch (Exception e){
            e.printStackTrace();
        }

        // 1.5 Scroll Pane
        scrollPane = new JScrollPane(tableAll,
JScrollPane.VERTICAL_SCROLLBAR_AS_NEEDED,
JScrollPane.HORIZONTAL_SCROLLBAR_ALWAYS);

        // 1.6 Border Layout for Scroll Pane
        JPanel centerPanel = new JPanel();
        centerPanel.add(scrollPane);
        centerPanel.setPreferredSize(new
Dimension(900,(int)centerPanel.getPreferredSize().getHeight()));
        centerPanel.setLayout(new GridLayout(1, 3));
        this.add(centerPanel, BorderLayout.CENTER);
```

```
        /* 2. Buttons */

        // 2.1 Search
        btnSearch = new JButton("SEARCH");
        btnSearch.addActionListener(this);

        // 2.2 Print
        btnPrint = new JButton("PRINT");
        btnPrint.addActionListener(this);

        // 2.3 Cancel the operation
        btnCancel = new JButton("CANCEL");
        btnCancel.addActionListener(this);

        // 2.4 North Border Layout
        JPanel northPanel = new JPanel();
        northPanel.add(lblHeading);
        northPanel.add(studIDChoice);
        northPanel.add(btnPrint);
        northPanel.add(btnSearch);
        northPanel.add(btnCancel);
        northPanel.setPreferredSize(new
Dimension(900,(int)northPanel.getPreferredSize().getHeight()));
        this.add(northPanel, BorderLayout.NORTH);

        /* 3. JFrame Configurations */

        this.setTitle("Student Results Details");
        this.pack();
        this.setSize(900, 600);
        this.setLocation(350, 50);
        this.setVisible(true);

    }

    @Override
    public void actionPerformed(ActionEvent ae){
        if (ae.getSource() == btnSearch){
            try {
                Conn c = new Conn();
                String choiceItem = studIDChoice.getSelectedItem();
                if(!choiceItem.equals("All")){
                    String query = """
                    SELECT DISTINCT S.FIRST_NAME, S.LAST_NAME,
C.COURSE_NAME, SUB.*, G.*
                    FROM
                    SUBJECT SUB
                    LEFT JOIN GRADES G
                    ON SUB.STUDENT_ID = G.STUDENT_ID and SUB.COURSE_ID =
G.COURSE_ID and SUB.SEMESTER = G.SEMESTER
                    LEFT JOIN STUDENT S
                    ON S.IMMA_ID = SUB.STUDENT_ID
                    LEFT JOIN ENROLLMENT E
                    ON S.IMMA_ID = E.IMMA_ID
                    LEFT JOIN COURSE C
                    ON E.COURSE_ID = C.COURSE_ID
                    WHERE SUB.STUDENT_ID =
                    """ + choiceItem + ";";

                    ResultSet resultSet = c.stmt.executeQuery(query);
```

```
                    ResultSetMetaData metaData = resultSet.getMetaData();
                    int totalColumns = metaData.getColumnCount();


tableAll.setModel(DbUtils.resultSetToTableModel(resultSet));
                    tableAll.setAutoResizeMode(JTable.AUTO_RESIZE_OFF);

                    // Set column size
                    TableColumnModel colModel = tableAll.getColumnModel();
                    for(int i=0; i<totalColumns; i++){
                        TableColumn tc = colModel.getColumn(i);
                        tc.setPreferredWidth(130);
                    }
                }
                else{
                    String query = """
                    SELECT DISTINCT S.FIRST_NAME, S.LAST_NAME,
C.COURSE_NAME, SUB.*, G.*
                    FROM
                    SUBJECT SUB
                    LEFT JOIN GRADES G
                    ON SUB.STUDENT_ID = G.STUDENT_ID and SUB.COURSE_ID =
G.COURSE_ID and SUB.SEMESTER = G.SEMESTER
                    LEFT JOIN STUDENT S
                    ON S.IMMA_ID = SUB.STUDENT_ID
                    LEFT JOIN ENROLLMENT E
                    ON S.IMMA_ID = E.IMMA_ID
                    LEFT JOIN COURSE C
                    ON E.COURSE_ID = C.COURSE_ID
                    """;

                    ResultSet resultSet = c.stmt.executeQuery(query);

                    ResultSetMetaData metaData = resultSet.getMetaData();
                    int totalColumns = metaData.getColumnCount();


tableAll.setModel(DbUtils.resultSetToTableModel(resultSet));
                    tableAll.setAutoResizeMode(JTable.AUTO_RESIZE_OFF);

                    // Set column size
                    TableColumnModel colModel = tableAll.getColumnModel();
                    for(int i=0; i<totalColumns; i++){
                        TableColumn tc = colModel.getColumn(i);
                        tc.setPreferredWidth(130);
                    }
                }
            }catch (Exception E){
                E.printStackTrace();
            }
        }
        else if (ae.getSource() == btnPrint){
            try {
                tableAll.print();
            }catch (Exception e) {
                e.printStackTrace();
            }
        }else {
            // Cancel Transaction
            setVisible(false);
        }
```

```
    }

    public static void main(String[] args) {
        new ViewGrades();
    }
}
```

7.2 Other sources of inspiration for the project

Our primary inspiration was derived from the official HFT Stuttgart website, which we found to be exceptionally simple, concise, and one of the best Hochschule websites we have encountered. Additionally, we were impressed by the quicklinks portal, which facilitated easy access to other platforms such as LSF and Moodle.

We have identified several areas for future development, including Row Level Security and the capability to assign deans automatically on a round-robin basis, among other enhancements.

Our initial objective was to fulfill all the requirements specified in the Moodle document. Moving forward, our next goal is to begin work on these future proposals. Prior to moving on this next phase, we would greatly appreciate feedback from the Professors. Such feedback would not only delight us but also significantly aid in refining our approach.