

COMP 356E Database Systems Technology

Professor: Rafael Pachón Alvarez

Office: CUI

Email:

Office Hours: By appointment (please allow at least 48 hours for your instructor to respond to your emails)

Course information:

Fall 2023

Course Description

This course is an introduction to database systems. We will explain how to query database systems via languages such as SQL. Then, we will see how database systems work internally, how they store and index data, how they process and optimize queries, and how they process transactions while providing guarantees such as isolation, atomicity, and durability (ACID guarantees).

Different database systems such as a distributed DBMS, In-Memory databases and NoSQL databases will also be introduced.

Course Goals

It is expected that students get to know how a database works under different situations and with different technologies. This knowledge should help students to understand and solve different practical problems that can happen in their future professional career.

In addition, students will be introduced to different database types to provide them with an overview about benefits and drawbacks of each one.

Finally, we will explain how data can be uploaded to and fetched from a database so it can be added to a regular calculation procedure in a programming language.

Methodology

This course consists of 25 face-to-face sessions where both theoretical knowledge and practical sessions will be taught.

Students will be given both comprehensive documentation and slides for each session. It is recommended that students look at the documentation in advance.

Class attendance and participation will be mandatory as, at the end of each unit, practical exercises will be proposed. Presentations or discussion among students will be requested so everyone can learn from other's experience and conclusions.



Technical Requirements

This course will require students to bring their laptop for the classes that require running databases examples. (Databases will not be running on tablets or smartphones).

Course Materials

Textbooks are not required for this course as documentation will be provided in advance.

Complementary Bibliography

1. Fundamentals of database systems. Ramez Elmasri, Shamkant B. Navathe. Addison-Wesley
2. Database Systems. Thomas Connolly, Carolyn Begg. Addison-Wesley

Course Requirements and Grading

Your final grade will be calculated as follows:

- Class participation: 15%
- In-class presentations: 15%
- Mid-term exam: 35%
- Final exam: 35%

Exams and every other assignment will be marked following the Spanish numerical range. Here is a table to illustrate differences in conversion between the Spanish, U.S. and Standard European grading systems:

		9,9	9,4	8,9	8,4	7,9	7,4	6,9	6,4	5,9	5,4	4,9
SPAIN	10	-	-	-	-	-	-	-	-	-	-	-
		9,5	9	8,5	8	7,5	7	6,5	6	5,5	5	0
USA	A+	A	A-	B+	B	B	B-	C+	C	C	C-	F
ECTS	A	B	B	C	C	C	C	D	D	E	E	F

General Course Policies

Each student is expected to be familiar with the course syllabus. Students are expected to focus their full attention on the class, arrive on time, and stay until class ends. Leaving the classroom on repeated occasions is disturbing to both your professor and your classmates and may adversely affect your participation grade. Please make use of the 10-minute breaks in between classes to fill up your water bottle, use the restroom, etc.

Students are expected to listen and respect other points of view. Phone calls, social media, email, or Internet browsing at any time during class are not acceptable except for specific class-related activities expressly approved by your instructor. You are responsible for any course material covered in class, announcements, and/or handouts if you are not present for any reason. Students will be held responsible to be up to date by attending class regularly and

checking both email and the Blackboard site of the course frequently (monitor your email and Blackboard announcements at least once every 24 hours).

Communicating with the instructor: Please allow at least 48 hours for your instructor to respond to your emails. The weekend is not included in this timeframe. If you have an urgent request or question for your professor, be sure to send it during the week.

Attendance and Punctuality

Attendance is mandatory in all classes. As we understand that you might fall ill or be unable to come to class (e.g. due to a religious holiday, a flight delay, a family wedding/reunion, a graduation, a job interview, etc.) at some point during the semester, you are allowed up to 4 absences. You will be responsible for the material covered and any work missed. You will not need to justify your absences (up to 4) in any way unless you miss an exam, a presentation, a quiz, etc. In this case, you must present a doctor's note (signed, stamped and dated) to be able to reschedule the exam, etc. It will still count as an absence but you will be allowed to retake the exam, etc. We don't encourage you to use all 4 days unless you really need them as your participation grade may suffer if you are not in class. If used unwisely and you get sick late in the semester, the following penalties will apply:

- On your 5th absence, 1 point will be taken off of your final Spanish grade
- On your 6th absence, 3 points will be taken off of your final Spanish grade
- On your 7th absence, you will automatically fail the class

For classes that meet once a week, each absence counts as two. For classes that meet daily, the penalties outlined above apply if you go over 6 absences (7th absence=5th absence above). Exams missed due to an excused absence must be made up within a week of returning to classes. Talk to your professor immediately after your return.

COVID-19

If an absence is related to COVID-19 the procedure to follow will be in accordance with the current legislation in the region of Andalucía, Spain.

Academic Honesty

Academic integrity is a guiding principle for all academic activity at Pablo de Olavide University. Cheating on exams and plagiarism (which includes copying from the Internet) are clear violations of academic honesty. A student is guilty of plagiarism when they present another person's intellectual property as their own. The penalty for plagiarism and cheating is a failing grade for the assignment/exam and a failing grade for the course. The International Center may also report this to your home university. Avoid plagiarism by citing sources properly, using footnotes and a bibliography, and not cutting and pasting information from various websites when writing assignments.

Learning Accommodations

If you require special accommodations or have any other medical condition you deem may affect your class performance, you must stop by the International Center to speak to Marta Carrillo (mcaroro@acu.upo.es) to either turn in your documentation or to confirm that our office has received it. Marta will explain the options available to you.

Behavior Policy

Students are expected to show integrity and act in a professional and respectful manner at all times. A student's attitude in class may influence his/her participation grade. The professor has a right to ask a student to leave the classroom if the student is unruly or appears intoxicated. If a student is asked to leave the classroom, that day will count as an absence regardless of how long the student has been in class.

Course Contents

Unit 1. Introduction to databases

- Introduction
- History of Database Applications
- Databases vs File system
- Characteristic of the database approach
- Summary

Unit 2. SQL review

- Entity-Relation model
- Data Definition Language (DDL)
- Data Manipulation Language (DML)
- Cardinality restrictions
- Summary
- Examples

Unit 3. Transaction Management

- Introduction
- ACID concept
- Properties
- Concurrency of users
- Sequentially and interference
- Isolation level
- Failure recovery
- Roles on DBMS
- Summary and review questions

Unit 4. Query Processing

- Translating SQL into linear algebra
- Algorithms for external sorting
- Algorithms for SELECT and JOIN operations
- Implementing Aggregate Operations and OUTER JOINS
- Pipelining
- Summary and review questions

Unit 5. Query Optimization

- Heuristic query optimization
- Selectivity and Cost Estimates in query optimization
- Semantic query optimization
- Summary and Review questions

Unit 6. Index structures

- Disk storage, basic file structure and hashing
- Single-Level ordered Indexes
- Multilevel indexes
- Dynamic multilevel Indexes using B/B*-Trees and B+-Trees
- Summary and review questions

Unit 7. Distributed DBMS

- Differences between distributed database systems, distributed processing, and parallel database systems
- Advantages and disadvantages of distributed DBMS
- Problems of heterogeneity
- Basic networking concepts
- Summary

Unit 8. In-Memory databases

- Description
- Advantages and disadvantages
- ACID support
- Hybrids with on-disk databases
- Summary
- SQL Lite exercises

Unit 9. Alternative database models

- NoSQL vs SQL
- Architecture
- Advantages and disadvantages
- noSQL systems
- Document oriented database: MongoDB
- Columnar Database: MariaDB
- Graph oriented database: Neo4j
- Exercises

Unit 10. Connection to programming languages

- JPA
- ADO
- SQLAlchemy
- Exercises