Detailed teaching programme for semester 1 (S1)
Academic Master
Specialty: Networks and Distributed Systems (Field: Computer Science)

Course Title: Advanced DataBases **Semester: 1 Type: UEF11**

Total hours: 63h Weekly hours: 4h30 Lecture: 1h30
Tutorial: 1h30 Lab: 1h30 Personal work hours: 42h
Coefficient: 3 **Credits:** 5

Course Objectives

This course focuses on the essential concepts and technologies for the design, management and operation of modern database systems, covering both theoretical and practical aspects, and enables students to update and deepen their knowledge of databases.

Recommended prior knowledge

Basic database concepts, SQL language, relational algebra.

Course content

Lectures: 21h

1-Introduction to databases

- Review of fundamental concepts: relational model, DBMS, query languages.
- Types of databases: relational, NoSQL, object, etc.
- DBMS architecture: client-server, distributed architectures.
- Transaction, concurrency and data recovery concepts.

2-Advanced SQL programming

- SQL: review (joins, subqueries, aggregate functions, views, stored functions and procedures),
- Advanced SQL: triggers, error handling and management,
- Data manipulation languages for NoSQL: JSONiq, Cypher.

3-The Object-Relational model

- Overview of the Object model
- Overview of the Object-Relational model
- Concepts of the OR model (complex types, inheritance…)
- Querying Object-Relational databases (SQL3)

4-NoSQL databases

- Introduction to NoSQL databases: types of databases (key-value, document, graph, column).
- NoSQL data models: advantages and drawbacks.
- Case studies: MongoDB, Cassandra, Neo4j.

5-Distributed databases

- Architecture of distributed systems.
- Replication and partitioning techniques.
- Data consistency in a distributed environment: ACID vs BASE.

6-Databases in the cloud

- Service models: IaaS, PaaS, SaaS.
- Cloud computing and databases.
- Security considerations in the cloud.

7-Database performance and security - SQL query optimisation.

- Indexing and access strategies.
- Security: access control, data encryption, auditing.
- Security management in distributed databases.

Assessment method (must be communicated to students at the start of each semester) On-site semester examination (60%).
Continuous assessment (CA) (40%): tests, personal work.

Bibliography

- R. Elmasri & S. Navathe (2016). *Fundamentals of Database Systems*, 7th Edition, Pearson.
- R. Elmesri & B. Navathe (2016). *Fundamentals of Database Systems*, 7th Edition, Pearson Editions.
- T. Connolly & C. Begg (2014). *Database Systems: A Practical Approach to Design, Implementation, and Management*, 6th Edition, Pearson.
- Christian Soutou (2013). *SQL pour Oracle*. Éditions Eyrolles.
- Silberschatz, H., Korth, S., & Sudarshan, S. (2019). *Database System Concepts*, 7th Edition, McGraw-Hill.
- Mohamed Fadhel Saad (2016). *PL/SQL sous Oracle 12c – Guide du développeur*.
- R. G. G. Cattell (1994). *Object Data Management*. Addison-Wesley.
- P. Selmer (2012). *NoSQL Stores and Data Analytics Tools*. In *Advances in*