

Advanced Database Systems

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The objective of this course is to introduce students with the theory and technology needed for the implementation of advanced database systems including relational, temporal, deductive, object-oriented, active and graph databases. Additionally, different techniques of indexing, partitioning, optimization and denormalization will be covered. Students will get to know new trends and open questions in the field of database theory.		
Planned ECTS: 3		
Number of learners: 30		
Mode of delivery: Online		
Status: COMPLETED		
Course public access: Public		
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Course learning outcome	Level	Weight
Implement a basic data streaming system using a given data streaming system	Creating	1
Creating database analysis using a specific data model	Creating	1
Understanding database analytics in a practical SQL manner	Understanding	1
Analyze conflicts in active databases	Analysing	1
Implement an active database using a given database management system	Creating	1
Understand basic concepts of data streaming systems	Understanding	1
Design and implement a complex database application	Creating	10
Applying different optimization techniques in complex database applications	Applying	1
Temporal data management	Applying	1
Understanding different optimization techniques	Understanding	1

Understanding indexing and partitioning techniques										Understanding	1
Total weight: 20											
Topic / Unit name	Workload	Learning type	Mode of delivery	Groups	Collaboration	Feedback	Mandatory activity	Assessment			
								Points	Type	Providers	
Project											
Design and implement a complex database application (100%)											
Project initiation											
Introduction to the projects Overview, outcomes and requirements	45 min	Discussion	Online	Synchronous	Teacher present	No	No	No	No	No	
Teams creation and topic selection Teams creation and topic selection	30 min	Discussion	Online	Synchronous	Teacher present	Yes	Yes	No	No	No	
Total unit workload	1.25h										
Preparation for project											
Analysis of the selected domain Analysis of the selected domain	240 min	Investigation	Online	Asynchronous	Teacher not present	Yes	Yes	No	No	No	
Data model creation Data model creation	240 min	Production	Online	Asynchronous	Teacher not present	Yes	Yes	Teacher	No	No	

Features analysis of selected DBMS and tools Features analysis of selected DBMS and tools	240 min	Investigation	Online	Asynchronous	Teacher not present	Yes	Yes	No	No	No
Analysis of potential APIs for data sources Analysis of potential APIs for data sources	240 min	Investigation	Online	Asynchronous	Teacher not present	Yes	Yes	No	No	No
Total unit workload	16h									
Project implementation (realization)										
Data base schema creation Database schema creation	120 min	Production	Online	Asynchronous	Teacher not present	Yes	Yes	No	No	No
Data generation and loading Data generation and loading	240 min	Production	Online	Asynchronous	Teacher not present	Yes	Yes	No	No	No
Use case selection Use case selection	240 min	Production	Online	Synchronous	Teacher present	Yes	Yes	Teacher	No	No

Initial benchmarking Initial benchmarking	240 min	Production	Online	Asynchronous	Teacher not present	Yes	Yes	No	No	No			
Applying optimization techniques Applying optimization techniques	240 min	Production	Online	Asynchronous	Teacher not present	Yes	Yes	No	No	No			
Final benchmarking Initial benchmarking	240 min	Production	Online	Asynchronous	Teacher not present	Yes	Yes	No	No	No			
Total unit workload	22h												
Dissemination													
Preparing output for dissemination Preparing output for dissemination	480 min	Production	Online	Asynchronous	Teacher not present	Yes	Yes	No	No	No			
Results presentation Results presentation	30 min	Discussion	Online	Asynchronous	Teacher not present	Yes	Yes	Teacher	No	No			
Final grade Final grade	10 min	Assessment	Online	Synchronous	Teacher present	No	No	No	No	40	Summative	Teacher	
Total unit workload	8.66h												

Joint topics

Understanding database analytics in a practical SQL manner **(8%)**, Understand basic concepts of data streaming systems **(8%)**, Understanding different optimization techniques **(8%)**, Understanding indexing and partitioning techniques **(8%)**, Applying different optimization techniques in complex database applications **(8%)**, Temporal data management **(8%)**, Analyze conflicts in active databases **(8%)**, Implement a basic data streaming system using a given data streaming system **(8%)**, Creating database analysis using a specific data model **(8%)**, Implement an active database using a given database management system **(8%)**

Data Streaming

Introduction Introductory lecture on data streaming system and applications.	90 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No
Environment setup Students will install the appropriate data streaming system (for example Kafka) and setup the necessary environment.	30 min	Practice	Online	Asynchronous	Teacher not present	Yes	Yes	No	No	No
Examples Students will go through prepared examples and test each example on their environment.	30 min	Practice	Online	Asynchronous	Teacher not present	Yes	Yes	Automated	No	No

Question & Answer Session Students will be able to ask questions about the installation, examples, exercises.	30 min	Discussion	Online	Synchronous	Teacher present	No	No	No	No	No			
Exercise Students will solve a prepared exercise that builds upon the given theory and examples.	120 min	Assessment	Online	Asynchronous	Teacher not present	Yes	Yes	Automated	No	5	Formative	Automated	
Total unit workload	5h												
Database Optimization Techniques													
Logical optimization techniques Learning about different optimization techniques and how to apply them.	45 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No			
Overview of PL/SQL Lite overview of PL/SQL concepts	35 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No			

Optimization techniques practice Optimization techniques practice	60 min	Practice	Online	Synchronous	Teacher present	No	Yes	Teacher	No	No		
Optimization techniques discussion Optimization techniques discussion	30 min	Discussion	Online	Synchronous	Teacher present	No	Yes	Teacher	No	No		
Mini test Mini test about covered topics in lectures	10 min	Assessment	Online	Asynchronous	Teacher not present	No	No	No	No	5	Formative	Automated
Total unit workload	3h											
Indexing and partitioning												
Indexing Getting to know different types of indices.	45 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No		
Partitioning Horizontal and vertical partitioning.	35 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No		
Indexing and partitioning practice Indexing and partitioning practice	60 min	Practice	Online	Synchronous	Teacher present	No	Yes	Teacher	No	No		

Indexing and partitioning discussion Discussion about indexing and partitioning	30 min	Discussion	Online	Synchronous	Teacher present	No	Yes	Teacher	No	No		
Mini test - Copy Mini test about covered topics in lectures	10 min	Assessment	Online	Asynchronous	Teacher not present	No	No	No	No	5	Formative	Automated
Total unit workload	3h											
Temporal databases												
Data type specification Date, Timestamp, Interval + variants across database systems	20 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No		
Functions related to the date management Functions and packages dealing with the Date and Time management, focusing on the SYSDATE, SYSTIMESTAMP and client perspective	30 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No		

Duration management + interval Modeling duration using Interval, explicit definition, transformations and relationships	20 min	Acquisition	Online	Synchronous	Teacher present	Yes	Yes	Teacher	No	No
Time zone reflection + cloud Cloud management, migrations with emphasis on the time zone reflection, region management	40 min	Discussion	Online	Synchronous	Teacher present	No	No	Teacher	No	No
Question & Answer Session Students will be able to ask questions about the Date and Time management	10 min	Discussion	Online	Synchronous	Teacher present	No	No	No	No	No
Date and time management lab Implementation (lab)	40 min	Practice	Online	Synchronous	Teacher present	Yes	Yes	Teacher	No	No

NLS parameter impacts National Language Support parameters - language, formats, territorial parameters	30 min	Assessment	Online	Synchronous	Teacher present	Yes	Yes	Teacher	No	No			
Own study and implementation	120 min	Investigation	Online	Asynchronous	Teacher not present	No	No	No	No	No			
Mini test Mini test about covered topics in lectures	10 min	Assessment	Online	Asynchronous	Teacher not present	No	No	No	No	5	Formative	Automated	
Total unit workload	5.33h												
Active Databases													
Introduction to active databases	10 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No			
Events, actions and transactions	30 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No			
Production rules and triggers	30 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No			
Conflicts in active databases	20 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No			

Implementing active databases in SQL	45 min	Practice	Hybrid	Synchronous	Teacher present	Yes	Yes	No	No	No		
Exercise Students will solve a prepared exercise that builds upon the given theory and examples.	120 min	Assessment	Online	Asynchronous	Teacher not present	Yes	Yes	Automated	No	5	Formative	Automated
Total unit workload	4.25h											
Database analytics												
Data warehouses, analytical databases Principles of data warehousing, ETL	40 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No		
Database analytics - analytical functions + dynamic windows Aggregate and analytical functions, principles, dynamic windows	60 min	Acquisition	Online	Synchronous	Teacher present	No	No	No	No	No		

Practical examples of database analytics Practical examples - race results, house building, managing markets	60 min	Practice	Online	Synchronous	Teacher present	Yes	Yes	Teacher	No	No		
Database analytics - discussions Q&A	20 min	Discussion	Online	Synchronous	Teacher present	No	Yes	Teacher, Peer	No	No		
Processing and analysing data from the student source	90 min	Practice	Online	Asynchronous	Teacher not present	Yes	Yes	Teacher	No	5	Formative	Teacher
Own study and implementation	120 min	Investigation	Online	Asynchronous	Teacher not present	No	No	No	No	No		
Total unit workload	6.5h											
Total course workload	75h											