

CS-460

**Systems for data management and data science**

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Cursus	Sem.	Type
Civil & Environmental Engineering		Opt.
Computational science and Engineering	MA2, MA4	Opt.
Computer and Communication Sciences		Opt.
Computer science minor	E	Opt.
Computer science	MA2, MA4	Obl.
Cybersecurity	MA2, MA4	Obl.
Data Science	MA2, MA4	Obl.
Data science minor	E	Opt.
SC master EPFL	MA2, MA4	Opt.

Language of teaching	English
Credits	8
Session	Summer
Semester	Spring
Exam	Written
Workload	240h
Weeks	14
<b>Hours</b>	<b>6 weekly</b>
Lecture	2 weekly
Exercises	2 weekly
Practical work	2 weekly
<b>Number of positions</b>	

**Summary**

This course is intended for students who want to understand modern large-scale data analysis systems and database systems. The course covers fundamental principles for understanding and building systems for managing and analyzing large amounts of data. It covers a wide range of topics and technology

**Content**

Topics include large-scale data systems design and implementation, and specifically :

- Distributed data management systems
- Data management : locality, accesses, partitioning, replication
- Modern storage hierarchies
- Query optimization, database tuning
- Transaction management
- Data structures : File systems, Key-value stores, DBMS
- Consistency models
- Large-scale data analytics infrastructures
- Parallel Processing
- Data stream and graph processing

**Learning Prerequisites****Recommended courses**

- CS-107 Introduction to programming
- CS-206 Parallelism and concurrency
- CS-322 Introduction to database systems
- CS-323 Introduction to operating systems
- CS-452 Foundations of software

**Important concepts to start the course**

- Algorithms and data structures.

- Scala and/or Java programming languages will be used throughout the course. Programming experience in one of these languages is strongly recommended.
- Basic knowledge of computer networking and distributed systems.

## Learning Outcomes

By the end of the course, the student must be able to:

- Understand how to design big data analytics systems using state-of-the-art infrastructures for horizontal scaling, e.g., Spark
- Implement algorithms and data structures for streaming data analytics
- Decide between different storage models based on the offered optimizations enabled by each model and the expected query workload
- Compare concurrency control algorithms, and algorithms for distributed data management
- Configure system parameters, data layouts, and application designs for database systems
- Develop data-parallel analytics programs that make use of modern clusters and cloud offerings to scale up to very large workloads
- Analyze the trade-offs between various approaches to large-scale data management and analytics, depending on efficiency, scalability, and latency needs

## Teaching methods

Lectures, project, homework, exercises and practical work

## Expected student activities

- Attend lectures and participate in class
- Complete a project as per the guidelines posted by the teaching team

## Assessment methods

- Project
- Midterm (as needed)
- Final exam

## Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

## Resources

### Bibliography

J. Hellerstein & M. Stonebraker, Readings in Database Systems, 4th Edition, 2005  
 R. Ramakrishnan & J. Gehrke: "Database Management Systems", McGraw-Hill, 3rd Edition, 2002.  
 A. Rajaraman & J. Ullman: "Mining of Massive Datasets", Cambridge Univ. Press, 2011.

### Ressources en bibliothèque

- [Mining of Massive Datasets / Rajaraman](#)

- [Readings in Database Systems / Hellerstein](#)
- [Database Management Systems / Ramakrishnan](#)

**Moodle Link**

- <https://go.epfl.ch/CS-460>