

CS-352 **Theoretical computer science**

Cursus	Sem.	Type
Communication systems	BA5	Opt.
Computer science	BA5	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
<b>Hours</b>	<b>3 weekly</b>
Courses	2 weekly
Exercises	1 weekly
<b>Number of positions</b>	

**Remark**

pas donné en 2016-17

**Summary**

An in-depth introduction to some of the key ideas and tools of Theoretical Computer Science. Covered material touches upon: streaming algorithms, spectral graph theory, interactive and zero-knowledge proofs, pseudorandomness, algorithmic game theory, and quantum computing.

**Content**

- Basics of streaming algorithms
- Fundamentals of spectral graph theory
- The power of randomness and interaction (zero-knowledge proofs and PCP theorem)
- Theory of pseudorandomness and one-way functions
- Introduction to algorithmic game theory
- Nature-inspired models of computations (quantum computing)

**Keywords**

theoretical computer science, algorithms, computational complexity, streaming algorithms, spectral graph theory, randomness, pseudorandomness, algorithmic game theory, quantum computing

**Learning Prerequisites****Required courses**

CS-150 Discrete Structures

CS-250 Algorithms

CS-251 Theory of Computation (former name: Theoretical Computer Science/Informatique théorique)

Mathematical maturity, i.e., ability to read and write mathematical proofs

**Learning Outcomes**

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

- Analyze computational models
- Apply mathematical tools to understand computational processes

- Design space-/time-efficient algorithms for graph and estimation problems
- Formalize properties of interactive and cryptographic protocols
- Describe quantum model of computation
- Model game-theoretic aspects of real-world scenarios
- Explain the concept of pseudorandomness
- Perform a rigorous study of performance of an algorithm or a protocol

### **Transversal skills**

- Use a work methodology appropriate to the task.
- Continue to work through difficulties or initial failure to find optimal solutions.

### **Teaching methods**

Ex cathedra with exercises

### **Assessment methods**

Continuous control (problem sets and exams during the semester, no final exam)