Université Paris-Saclay

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M1 Distributed, Parallel, and Quantum Computing (1st year Master's DiPaQ)

Master's degree
Specialisation Computer Science
Enrolment type
Formation initiale
Language(s) of instruction
English

The **M1 DiPaQ** master's program focuses on topics in **high-performance (HPC), distributed, and quantum computing** to master the use of **large-scale computational systems**. Students learn to **design fast, scalable, and robust solutions** that address the computational demands of applications in **artificial intelligence (AI)**, **big data analytics**, and **quantum** and **scientific computing**. The program prepares graduates for careers in engineering and Ramp;D or doctoral studies.

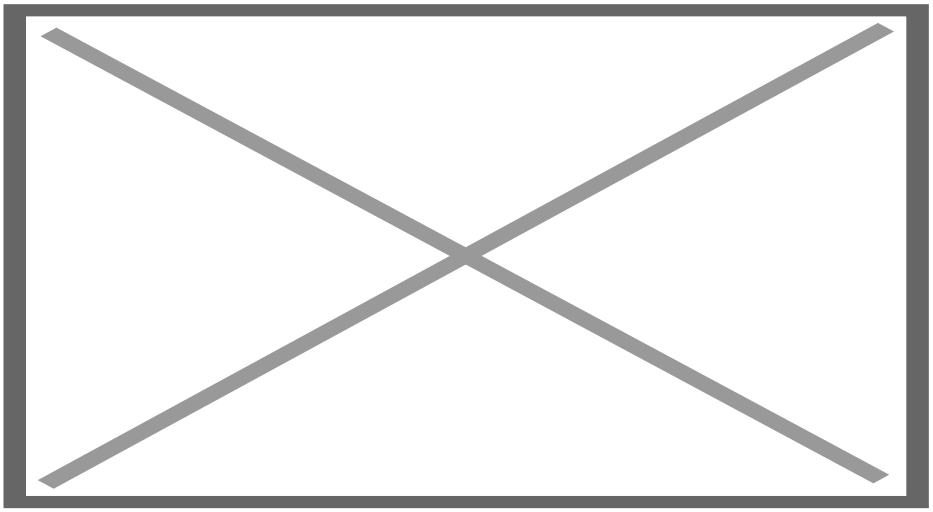
The curriculum includes **twelve core disciplinary courses** in **high performance**, **parallel**, **distributed**, and **quantum computing**. In addition, students take **supplementary courses** from other master tracks to learn the fundamentals of **AI** and **data science**. Finally, a **project course** (TER), an **M1 summer internship or summer school** on DiPaQ-related themes, and a **course on sustainable development** completes the program.

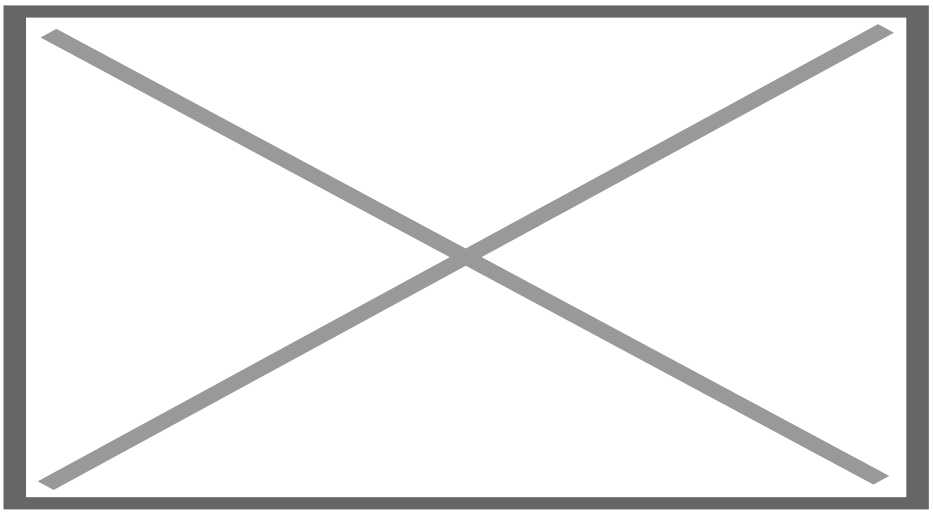
The program's **official language is English**; all courses are taught in **English**. Most of our faculty are also fluent in **French**; hence interaction in French is possible in the courses and assignments (homework, exams, etc.).

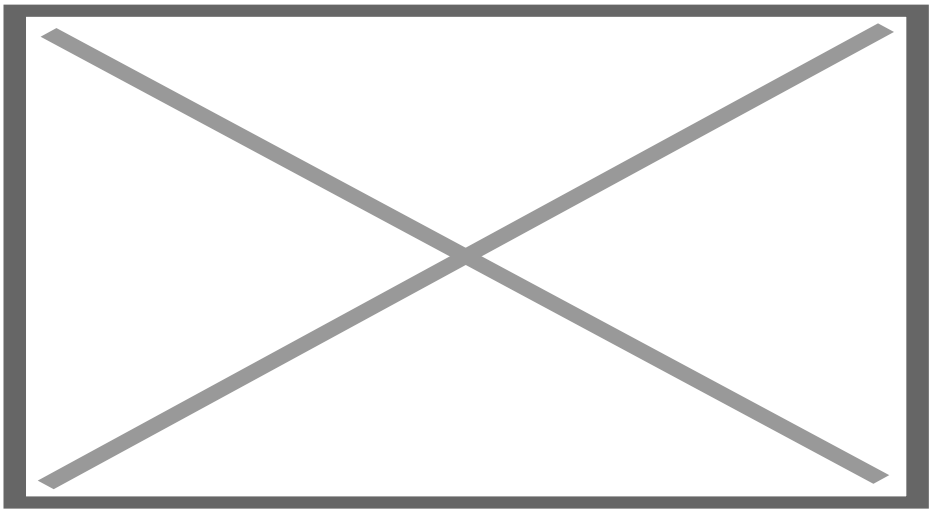
The program is closely integrated within the Paris-Saclay ecosystem of research laboratories and industrial partners.

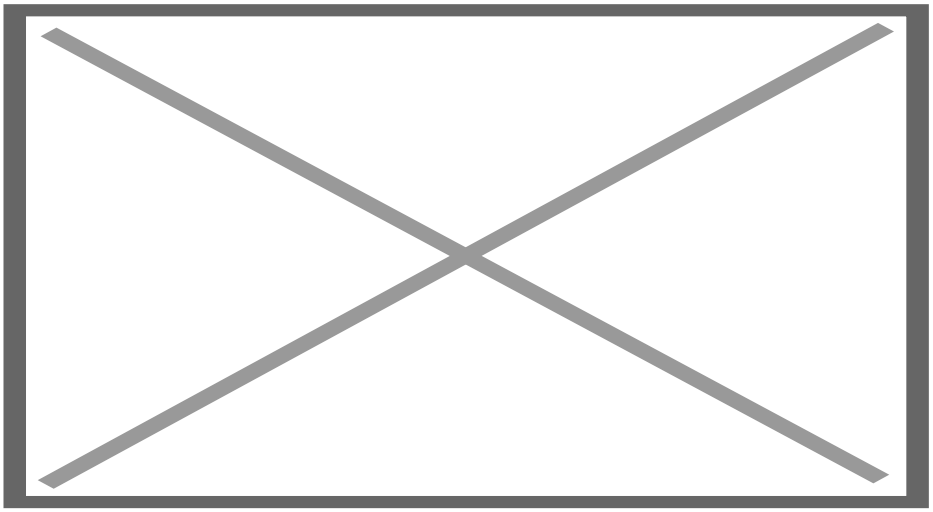
M1 DiPaQ graduates can either pursue **M2 DiPaC**, focusing on **HPC** and **distributed computing** with specialization in **AI/big data analytics** or **hybrid classical/quantum computing**, or apply for **M2 QMI**, specializing on **quantum information technologies**.

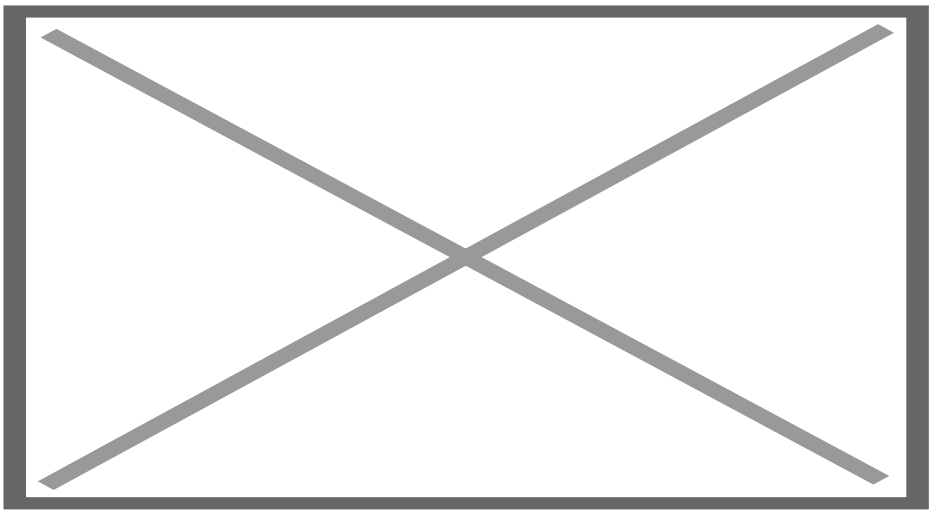
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Information

- Overview
- Application requirements
- Schedule

Présentation

Skills

M1 DiPaQ students will gain **competencies and skills** in:

- Understanding current and emerging challenges in distributed, parallel, and quantum systems; assessing their impact on application domains in AI and data science.
- Designing, proving, and analyzing distributed, parallel, and quantum algorithms and protocols, with complexity analyses in time, memory, communication, and energy.
- Mastering the fundamentals of quantum algorithms and complexity; programming quantum circuits with standard libraries.
- Applying parallel programming models and performance engineering on distributed supercomputers and multicore machines.

- Designing and analyzing distributed algorithms with theoretical guarantees.
- Learning the basics of data analysis and AI for large-scale learning tasks.
- Performing code profiling and tracing, diagnosing bottlenecks, and tuning performance.
- Practicing software engineering for HPC using modern C++, profiling, testing, continuous integration, and reproducibility.
- Using version control with Git and maintaining rigorous documentation.
- Communicating technical content and scoping projects in research and industry contexts.
- Adopting responsible, reliable, and sustainable computing practices.

Objectives

Computer systems are evolving toward higher efficiency and richer functionality across three major, interconnected scientific fields:

- **Distributed systems** deliver connectivity and dependable operation across the Internet, clouds, clusters, and sensors, addressing hard problems in synchronization, security, concurrency, and robustness.
- **High-performance and parallel computing (HPC)** tackles intensive workloads in science and AI by exploiting supercomputing architectures and rigorous performance engineering.
- **Quantum computing** provides algorithms and hardware that exploit quantum parallelism to achieve gains unreachable by classical paradigms.

The **M1 DiPaQ master's program** provides students with a deep knowledge of these three fields through both advanced theoretical courses and extensive practice of programming techniques. **Distributed systems** deal with protocols and algorithms that allow connectivity and efficient functionality for network based systems, like Internet, Cloud, sensor networks, computing clusters, blockchain distributed systems, and even microbiological circuits. For these systems, the challenges include synchronization, security, concurrency and robustness. Similar issues arise in the field of **HPC** which aims at efficiently solving computationally intensive problems in applied science or artificial intelligence. **HPC** pushes modern parallel computer architectures to their limits by using various forms of parallelism, data representations and code optimization. So does **distributed computing** by means of various methods of communication and algorithmics. They thereby draw the frontier between what can be achieved within the realm of classical Computer Science, and what will only be accessible through a new paradigm: that of **Quantum Computing**. Quantum Computing and Quantum Information feature novel algorithms and protocols, bringing radical performance gains, together with their own set of conceptual and technical challenges.

M1 DiPaQ establishes the foundations in **HPC**, **distributed systems**, and **quantum computing** for **large-scale systems** and **applications** in **AI** and **applied science**, with strong ties to the **Paris-Saclay** research and industry ecosystem leveraging these technologies. Students master the fundamentals of these three interconnected disciplines and thereby learn to design fast, scalable, and robust solutions for real-world computational challenges in **big data analytics**, **AI**, **scientific simulations**, and **quantum-enabled workflows** with following objectives:

Knowledge objectives:

- Efficient parallel algorithms and programming on distributed and multi-core parallel machines with vector processing units,
- Advanced C++ programming, debugging, profiling, and performance tuning of HPC kernels
- Large-scale distributed algorithms and systems: replication, consensus, consistency, robustness

- Fundamentals of quantum technologies, algorithms, and programming
- Basics of AI, data science, and optimization for high performance data analytics, machine learning, and scientific computing

Skill objectives:

- Building high-quality parallel and distributed algorithms and software that meet latency, throughput, and performance targets on modern HPC architectures.
- Developing and analyzing scalable, robust algorithms with theoretical guarantees on scalability, consensus, termination, and fault tolerance.
- Optimizing HPC algorithms and code across the stack: complexity, memory locality, vectorization, communication, I/O, and networks.

Resources and practice:

- Access to university clusters and partner supercomputers for hands-on labs, course projects, code development, and tuning.
- Use of open-source toolchains and libraries widely adopted by the HPC community.
- Acquiring modern HPC software engineering practices with advanced C++, IDEs, version control (git), documentation, and continuous integration.

Débouchés

Career prospects

After a Master's or Master's + PhD: engineer (R&D, control, production, etc.)
After a Master's or Master's + PhD: researcher or lecturer
After a Master's + PhD: researcher or lecturer
After a Master's or Master's + PhD: engineer (Research & Development, control, production, etc.)
R&D Engineer
R&D Project Manager
Project Manager
Development Manager
Consulting
Information Systems Manager
Research & Development Engineer
Research and Innovation Manager

Project Manager
Validation/qualification Manager
Lecturer (after a PhD)
Research Engineer
Head of mission / projects
Scientific expertise coordinator
Head of development
Consultant
After Master and PhD : reseacher or assistant professor or professor

Further Study Opportunities

Engineering, research and development
Engineering methods and industrialisation
In particular, this track prepares students for applied research activities, usually undertaken after a PhD, whether in academia or in R&D.
R&D researcher or data modelling and analysis expert in leading-edge companies or laboratories.
2nd year Master's
Head of project/mission
Head of development
Consultant

Calendar

Start of programme (indicative date)
04/09/2026
End of programme (indicative date)
30/09/2027
Admission

Admission Route

Computer Science
Mathematics
Physics
Undergraduate double degree Mathematics - Physics

Capacity

Available Places

20

Target Audience and Entry Requirements

Prior studies in computer science or a related discipline are desirable. However, students from other fields such as mathematics or physics who have foundational knowledge in computer science (algorithms and programming) can also apply to the **M1 DiPaQ** master's program.

A limited number of scholarships (Eiffel, IDEX, Quantum Saclay) are available for exceptional candidates.

Période(s) de candidature

Inception Platform

From 15/01/2026 to 16/03/2026

MonMaster Platform

From February 17th to March 16th, 2026

To find out which platform you should apply through, please see the Masters' applications and enrolment page.

Supporting documents

Compulsory supporting documents

Course selection sheet.

https://cirrus.universite-paris-saclay.fr/s/jDS4JG5znqpeqRi

Motivation letter.

A letter detailing the motivation and reasons for willing to study quantum, parallel and distributed computing in the DiPaQ master's program in the light of previous studies and experiences as well as future career plans.

All transcripts of the years / semesters validated since the high school diploma at the date of application.

Grades of all courses since high school.

Curriculum Vitae.

A CV detailing all previous studies, internships, trainings, work experience (if any), distinctions and awards, as well as other personal interests and activities.

Additional supporting documents

Copy diplomas.

Letter of recommendation or internship evaluation.

Document at your convenience.

VAP file (obligatory for all persons requesting a valuation of the assets to enter the diploma).

only needed in case you have officially validated your prior professional experience to count as equivalent to a university degree

Supporting documents :
- Residence permit stating the country of residence of the first country
- Or receipt of request stating the country of first asylum
- Or document from the UNHCR granting refugee status
- Or receipt of refugee status request delivered in France
- Or residence permit stating the refugee status delivered in France
- Or document stating subsidiary protection in France or abroad
- Or document stating temporary protection in France or abroad.

Programme

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	di le c
[M1 DiPaQ] Introduction to parallel algorithms and programming Charger le détail	3	Semester 1	10.5		10.5				
[M1 DiPaQ] High performance computing on multicore architectures Charger le détail	3	Semester 1	10.5		10.5				

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed	Lecture/practical	directed study/practical class	di le c
[M1 DiPaQ] MPI programming for distributed memory architectures	3	Semester 2	10.5		10.5				
Charger le détail									
[M1 DiPaQ] Advanced C++ programming	3	Semester 1	10.5		10.5				
Charger le détail									
[M1 QDCS] Optimization for scientific computing	3	Semester 2							
Charger le détail									
[M1 DiPaQ] Introduction to quantum algorithms and programming	3	Semester 1	10.5		10.5				
Charger le détail									
[M1 DiPaQ] Foundations of quantum algorithms	3	Semester 2	10.5	10.5					
Charger le détail									
[M1 DiPaQ] Quantum combinatorial optimization	3	Semester 2	10.5	10.5					
Charger le détail									
[M1 DiPaQ] Robust distributed algorithms	3	Semester 1	10.5	10.5					
Charger le détail									

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	di le c
[M1 DiPaQ] Self-stabilizing distributed algorithms	3	Semester 2	10.5	10.5					
Charger le détail									
[M1 DiPaQ] Graphs and algorithms	3	Semester 1	10.5	10.5					
Charger le détail									
[M1 DiPaQ] Probabilistic algorithms	3	Semester 2	10.5	10.5					
Charger le détail									

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practic class
[DKAI] MATHEMATICS FOR DATA SCIENCE	3	Semestre 1	12	4.5	4.5			
Charger le détail								
[AI] Hands on machine learning with scikitlearn	3	Semestre 1	9	12				
Charger le détail								
[AI] Machine Learning Basics 1	3	Semestre 1						
Charger le détail								

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	dis lea c
Computer Science and Environment	3	Semester 2	10.5	10.5					
Charger le détail									

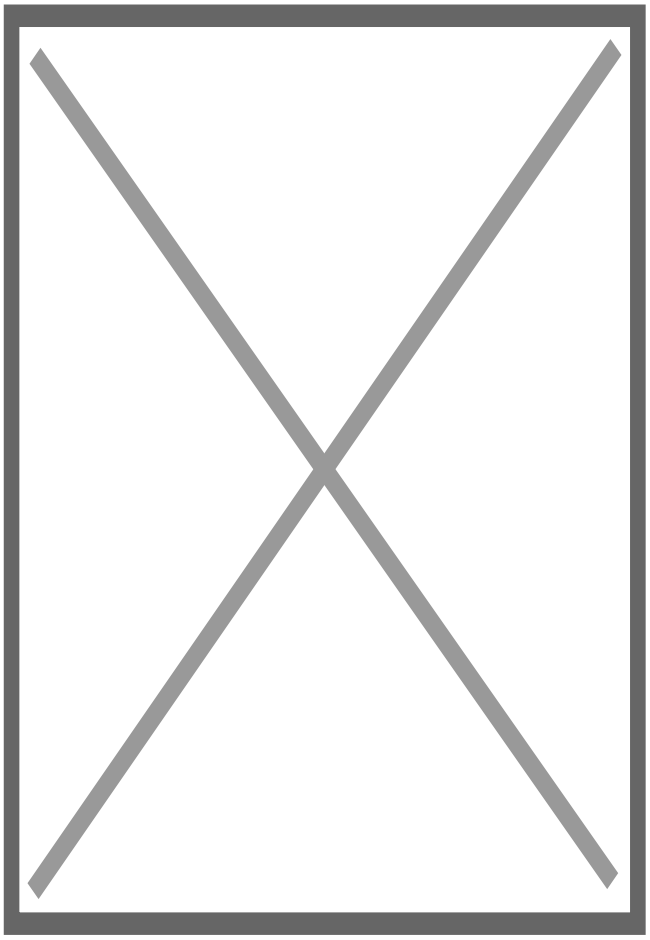
Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	dis lea co
[M1 DiPaQ] Project / research studies (TER)	6	Semester 2							
Charger le détail									
[M1 DiPaQ] Internship or summer school	6	Semester 2							
Charger le détail									

Teaching Location(s)

ORSAY
GIF SUR YVETTE

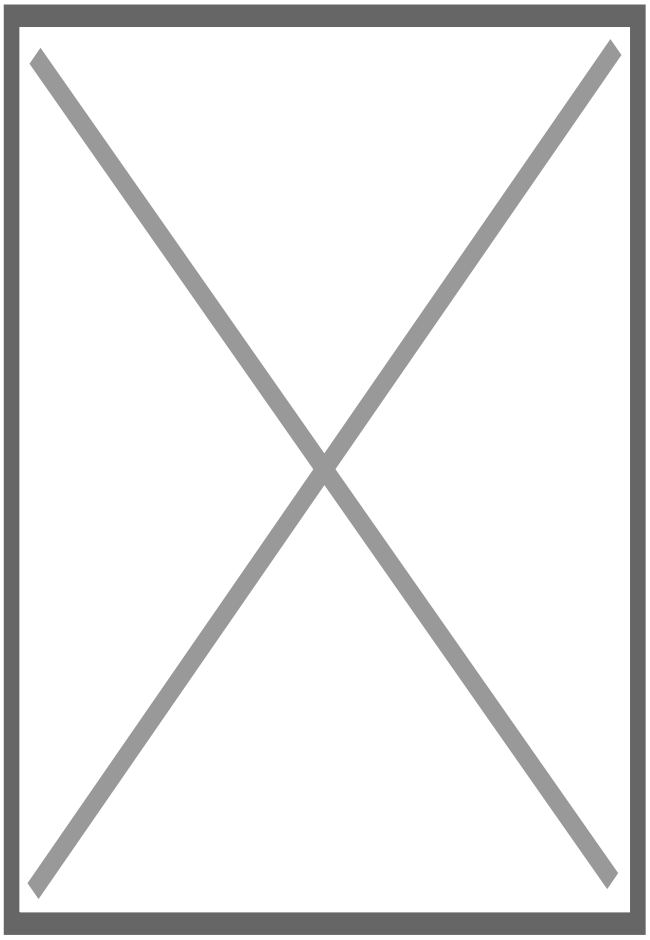
Training campus

Javascript est requis pour visualiser cette carte.



Orsay Bures

Orsay / Bures-sur-Yvette
Bus 4607, 4626
RER B Orsay ville ou Bures-sur-Yvette
Voir
Library
Community center



Saclay Corbeville

Saclay / Palaiseau
Bus 4606, 4627, 5154, 9105, 9108
RER B Palaiseau, Palaiseau villebon ou Lozère
Voir
Student restaurant (CROUS)
Student residence
Sports facilities

Contact

- **Oguz KAYA**
- **Thomas GALLEY**

http://www.universite-paris-saclay.fr/formation/master/informatique/distributed-parallel-and-quantum-computing-m1-dipaq