Optimization Master Program

A Master Program of Université Paris-Saclay

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A high-level master program devoted to optimization in a broad sense: optimal control, game theory, calculus of variations, stochastic optimization and stochastical methods for optimization, operation research, advanced algorithms for continuous optimization... Successful students are expected to go on for a PhD, either in academics or industry, or to work as mathematical engineers in a company.

The list of courses below is a tentative one, to be confirmed

Intensive training period (two weeks : September 5 to 16)

- Functional Analysis
- Scientific Computing and Programming
- Probability
- Bases of Optimization

These courses have no exams, and aim at freshening up the main notions needed in the rest of the year.

First term classes

Basic courses (mid-September to mid-November)

- Advanced Continuous Optimization I
- Optimal Control of ODEs
- Introduction to Operation Research and Combinatorics
- Dynamical Programming
- Game Theory

Advanced courses (mid-November to end of January)

- Advanced Continuous Optimization II
- Calculus of Variations
- Derivative-Free Optimization
- Stochastic Optimization
- Dynamic games

Students must validate six among the above courses; other choices from partner master programs are possible, and in particular from the MPRO program (Operation Research): complexity; optimization in graphs; mathematical programming.

Second term courses

- Optimal Transport
- Geometric Control
- Tropical Algebra in Games and Optimization
- Optimal Control of PDEs
- Sequential Learning, Sequential Optimization
- Advanced Game Theory

Other courses are possible, either from partner programs, or invited courses. Courses typically last between 18 and 24h and are held in February-March. Students are asked to attend and validate 2 or 3 courses. International students can also validate a French course. Attending some of the many research seminars in optimization which are held in Paris can also be validated.

Invited courses

The program invites each year two world-known professors (from abroad, or from other universities in France) to deliver a 10h high-level lecture for students of the master, as well as for PhD students, researchers and engineers interested in optimization. A first course is integrated in the Adv. Cont. Opt. II class, a second in the 2nd term can be validated independently.
The themes of the course change year by year.

Personal research project

Each student will develop a personal research project, taking either the form of a research internship in a company or public laboratory, or of a research-level dissertation (*mémoire*, i.e. Master Thesis) under the guidance of a professor from Paris-Saclay or other universities in France or abroad. It will typically last at least three months and often lead to a PhD thesis. The project ends with a public defense, in July or September, and is graded by a Jury committee.

F.A.Q.

- **What is Paris-Saclay?** Paris-Saclay is the federation of many research institues, engineering schools and universities located in the south of Paris. It includes, among others, Université Paris-Sud, constantly ranked among the 10 best institutions worldwide for mathematics, and École Polytechnique, a prestigiuous institution dating back to the end of the 18th century.
- **Which of the institution of Paris-Saclay participate to this master?** The program is ruled by Univ. Paris-Sud, École Polytechnique, ENSTA (another engineering school with a strong math component) and HEC (business school). Other institutions participate via common courses with other partner programs.
- **Where do the courses take place?** Most of them are in the joint campus of Polytechnique-ENSTA (in Palaiseau), and some in Univ. Paris-Sud (in Orsay). The two campuses are half an hour away from each other by public transit. The schedule is studied so as to avoid commuting during a same half-day.
- **With which other programs do you share some courses?** We have courses in common with the master programs of Saclay in PDEs, Statistics, Pure Maths, Operation Research, and Economics. Few courses are also in common with some programs from downtown Paris (but usually take place in the Saclay area).
- **Who can apply?** If you have finished (or will have by September) four years of studies after high school you can apply. The standard profile is a student having 4 or 5 years of studies in Maths or Applied Maths. We also consider students from engineering, computer sciences or economics, provided they have a very solid mathematical background.
- **Do you admit everybody?** Admission is selective, but we do not have a maximal number of students. We accept any good student interested in optimization, with a solid mathematical background.
- **What's the deadline for enrolling?** you can submit your application till early September, but do it soon!
- **Do I need special procedures to come to France and enroll?** It depends on your nationality. If you are European there is nothing to do! If not, pay attention to visa schedules and the CampusFrance procedure.
- **How much does it cost to enroll to Paris-Saclay for this Master?** Tuition fees are approximately 260 euros per year (+ Social Security if you need, depending on your status). Besides that, you should obviously consider living expenses: Paris is an expensive city, but southern suburbs are much less.
- **Should I know French to follow your courses?** No need! the courses of our master are 100% in English.
- **Do you have many foreign students?** A lot! this year, more than 70% of the students were foreigners.
- **Will you keep me for PhD?** If you are brilliant student, we will fight to convince you to stay! We have several different sources of PhD scholarships: it's competitive, but more than feasible.
- **What if I have further questions?** Look at our website, or write an email: `florence.rey@math.u-psud.fr` (for administrative questions), or `filippo.santambrogio@math.u-psud.fr` (for pedagogical ones).
- **Is it possible to have a scholarship?** It is still possible to apply for a scholarship by the PGMO progam, (deadline May 1st). If you apply for admission to the program by the end of April, you can also be proposed to apply for a scholarship by Paris-Saclay