Master’s programmes in Computer Science at X

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First year programme

“Pure” computer science

The Computer Science programme organises its modules according to four themes:

- Design of Computer Systems (COMASIC)
- Networks and Security
- Algorithms and Foundations of Programming Languages
- Algorithmics and Efficiency
First year programme

Joint programmes

Other combinations form bi-disciplinary curriculum between mathematics and computer science:

- MAP-INFO curriculum "Image-Vision-Machine Learning"
- MAP-INFO curriculum "Optimisation"
- MAP-INFO curriculum "Data Science"
- Parcours MAP-INFO "High-Performance Computing"
- MAT-INFO curriculum
Organization

- 2 semesters, at least 4 courses (4 ECTS each) per semester
- 1 project over the 2 semesters, or 2 extra courses (8 ECTS)
- Internship (20 ECTS)
### First semester

3 compulsory courses

- INF557a Introduction to Communicating Systems (Thomas Clausen)
- INF559 Computer Architecture and Operating Systems (Francesco Zappa Nardelli)
- INF551 Computational Logic : Artificial Intelligence in Mathematical Reasoning (Stéphane Lengrand)

And one among :

- MAP555 Signal Processing (Eric Moulines)
- MAP557 Operational Research (Stéphane Gaubert)
- INF585 C++ programming and modern software engineering (Stéphane Redon)
Second semester

Compulsory:
- INF564 Compilation (François Pottier)
- INF569 Modeling and Analysis of Cyber-Physical Systems (Sylvie Putot)
- INF586 Network security (Julien Cervelle)

One among:
- MAP561 Control theory (Ugo Boscain, Yacine Chitour)
- INF560 Concurrent and Distributed algorithms (Frédéric Magoules)
- INF580 Mathematical Programming (Leo Liberti)
Example: Data Science

First semester
3 compulsory courses:
- MAP 553 - The art of regression
- MAP - Statistics in action
- INF 553 - Database Management Systems
1 "Elective" Course: INF - EA / topological data analysis etc.

Second semester
3 Mandatory Courses:
- MAP - Foundation of Machine learning
- INF 582 - Applied Machine Learning
- INF - Big Data Systems
1 "Elective" Course: MAP - Data Camp
Drone: from modelling to verification, and construction (5 students)
Sample projects and internships in M1 COMASIC

Guaranteed integration of Delay-Differential Equations (Sahlman)

**Zonotopic rigorous DDE integration**

This algorithm for rigorous integration given in Sczesniak's thesis can directly be adapted to affine arithmetic by replacing the interval arithmetic operators by their corresponding affine forms. What needs to be changed is further explained and illustrated by an example hereafter.

**Setting**

Consider for an arbitrary but fixed $\tau > 0$ the real-valued DDE

$$\dot{x} = f(t, x(t - \tau))$$

with initial condition on $t \in [-\tau, 0]$

$$x(t) = x_0(t, \beta)$$

The initial condition is assumed to depend on a parameter $\beta \in [b_0, b_1]$, which parameterizes a whole family of initial functions. Expressed as affine form, $\beta$ can be represented by $m + 1$ parameters $a_i \in \mathbb{R}$ and the noise symbols $c_i \in [-1, 1]$

$$\beta = a_0 + \sum_{i=1}^{m} a_i c_i$$

Internship : proofs of hybrid systems in Keymaera (at CMU)
This is done with Paris-Saclay University (cluster of schools and universities, among which Ecole Polytechnique)

- Advanced Communication Networks (ACN)
- Design, Modelling and Architecture of Complex Industrial Systems" (COMASIC)
- Algorithmics and Foundations of Programming (AFP)
- Operational Research (MPRO)
- Learning and Vision
- DataSciences and Big Data
- Machine Learning, Information and Content (AIC)
- etc.