Master Track on Cyber-Physical and Social Systems (CPS²)

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Master in Computer Science at Université de Lyon

Disciplinary topics

▶ Information Systems, Data Science, Networks, Artificial Intelligence, Image Processing, Multimedia, Video Games

Tracks

▶ 13 tracks at Lyon
▶ 3 tracks at Saint-Etienne
  ▶ MLDM (international)
  ▶ CPS2 (international)
  ▶ DSC

Educational Elements

▶ 15 common ECTS: Networks, Optimization and OR, Complexity Analysis, Algorithmics and Advanced Programming, Integrated Project
▶ On-site training hours: 540h in M1, between 390 and 470 in M2
▶ Organization: Common admission commission, one coordinator per track
Cyber-Physical Social Systems (CPS²)

Definition (Murakami, 2012)
Merging computing, networking and society with physical systems to create new revolutionary science, technical capabilities and better quality of life

Motivations
▶ The last decade has seen human factors becoming increasingly important in computing systems
▶ Integrating human factors as part of a system
▶ Cyber-physical social systems (CPSS) encompass not only cyberspace and physical world, but also
  ▶ human knowledge,
  ▶ mental capacity
  ▶ sociocultural elements
▶ CPS² will transform the way people interact with every computing systems
Examples of CPS$^2$
Examples of CPS² (cont.)
Examples of CPS² (cont.)
CPS$^2$ Layers

- **Social**
- **Cyber**
- **Physical**
CPS$^2$ In a glance
Coordinators: Gauthier Picard, Pierre Maret

Master CPS$^2$ is an international track of the Master in Computer Science, Université de Lyon. It is one of the 3 tracks in Saint-Etienne:
http://depinfo.univ-st-etienne.fr/Master/

- CPS$^2$ track is a 2-years master level academic program
- Awarded by an internationally recognized French master’s degree in Computer Science
- CPS$^2$ is a joint-venture between University Jean Monnet / University of Lyon and Mines Saint-Etienne
- Specific courses are also given by the engineering school Telecom Saint-Etienne
- Provides the knowledge and skills for working on the new generation of IT systems
- Devised to prepare tomorrow’s project managers and developers to create intelligent autonomous systems
- Entirely taught in English
- Admittance in the second year is accepted
Objective

- CPS² Track aims to train high-level computer scientists
  - understand results of merging the physical, social and digital dimensions of our environments

- Application domains
  - Industry 4.0
  - Smart cities
  - Smart transport systems

- CPS² specialists will be able to master throughout their career challenges raised by these dimensions (cyber, physical, social)

- CPS² track aims to train
  - managers of IT field
  - cyber-physical system architects
  - supporting engineers in design and development of cyber-physical systems
  - experts in socio-technical systems
  - experts or functional consultant
  - project manager in applications such as health, transport, energy and environment
Expertises

Our courses aims the training of high-level professionals with a triple expertise:

1. **Technological**, by controlling the design and implementation of information systems and applications that integrate physical (communication, perception, action, etc.) and social (privacy, trust, community, etc.) characteristics.

2. **Functional**, by understanding the issues and challenges of digital systems to the combination of different dimensions of the new complex environments.

3. **Scientific**, by the mastery models necessary for the formalization of all interactions between the dimensions of a cyber-physical system.
The curriculum consists of courses providing:

1. **Theoretical training**: artificial intelligence, multi-agent systems, operational research and graph theory, computability and complexity, semantic web.

2. **Technical training**: network, middleware, integrated project, trust, privacy and security.

3. **Functional orientation**: Ambient Intelligence, smart cities (smart grid, intelligent transportation system), industry 4.0
Curriculum (cont.)

Theoretical Background
- Complexity
- Introduction to network
- Introduction to Artificial Intelligence
- Advanced Algorithmic and Programming
- Optimization and Operational Research
- Foreign Language
- Data Analysis

Specialty
- Social
  - Virtual Communities
  - Trust & Privacy
- Cyber
  - Web services
  - Cloud computing
  - Multi agent Programming
- Physical
  - Mobile computing
  - Internet of things
  - Semantic Web
  - CPS Project

Professional Application
- Research & Innovation
- International Project Management
- Internship

First Year
Second Year
## M2 Curriculum

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UE 1: Multi Agent Systems Coordination (4 ECTS)

This course explores the coordination techniques through the distributed AI and multi-agent paradigms. We first recap the AI basic, before expounding some useful multiagent techniques for cyberphysical and socio-technical systems: distributed optimisation, distributed planning, negotiation and auctions, and environment-mediated coordination.
UE 2: Semantic Web (5 ECTS)

This course presents the main technologies and standards used in the Semantic Web to publish, link, process and query data on the Web, as well as to reason automatically with Web ontologies. This course will teach the following topics (may be modified):

- Linked Data and Semantic Web principles
- RDF, syntax and semantics
- SPARQL 1.1 Query
- OWL2
- RDFa 1.1
- Apache Jena API, OWL API, Protégé
UE 3 : Web Services (3 ECTS)

This course explores design and development techniques of web services. This course will teach the following topics (may be modified):

▶ Notion of web service
  ▶ Definition of web services
  ▶ Use cases

▶ SOAP – UDDI – WSDL
  ▶ HTTP protocol
  ▶ Presentation of the 3 components of web services (SOAP, UDDI, WSDL)
  ▶ Web services and J2EE, Servlet

▶ Tutorials and Lab works : Composition – Collaboration – Orchestration of services web
  ▶ Use of social networks APIs to develop applications (twitter, facebook, …)
UE 4: Distributed and Mobile Computing (3 ECTS)

This course explores client-serveur development architectures, development of J2E applications, and design and development of applications running on a mobile phone. This course will teach the following topics (may be modified):

- Server-side basic components
- Objects lifecycle
- Enterprise JavaBeans
- Introduction to mobile application development
- Web technologies and web standards (javascript, HTML5)
- Native and hybrid technologies (iOS, Android, Titanium)
UE 5 : Security Trust & Privacy (3 ECTS)

This course is an introduction to computer security. The objective is to be able to identify when security (confidentiality, availability and integrity) is required and to be able to choose and implement right solution. Keywords: security, risk, network, cryptography

This course will teach the following topics (may be modified):

- Information system security
- IP networks security
- Introduction to cryptography

It also presents technical solutions for access control, for the management and negotiation technics for trust, some know how to manage private data.
M2 Curriculum (cont.)

**UE 6 : Cloud Computing (3 ECTS)**

This course explores the technical and economical challenges of cloud architectures, the design and development of cloud services, clients, and cloud service hosting platform. This course will teach the following topics (may be modified):

▶ introduction to cloud architectures and their ecosystem
▶ the three layers of the cloud : IaaS, PaaS, SaaS

**UE 7 : Internet of Things (5 ECTS)**

This course overviews the domain of Internet-of-things, which links physical world to the internet and the web. We put the emphasis on relevant technologies and real applications. Hardware-wise, we look at some technologies used in the industry (Orange), and some easy-to-develop ones, like Arduino and Raspberry. Communication-wise, we study the different layers (link, transport, application) required to develop an end-to-end IoT platform.
UE 8 : CPS2 project (4 ECTS)

During the whole duration of the first semester of the second year, students have to drive by themselves a development project integrating all the different techniques expounded during the classes. For a selected application domain, major issues in the development of Cyber-physical social applications (e.g. transport, smart city, energy, health)
As to complete their master thesis, students have to follow an internship in a research team (validated by the track coordinator).

**Constraints**
- Minimum duration: 4 months
- Maximum: 6 months
- Period: February to June (see longer)
- Place: academic laboratory

**Contents**
- Research orientation
- The subject must be related to the models, tools and technologies of "CPS²"
- The subject is validated by the track coordinator
Remuneration

- Mandatory gratuity
- Minimum: 30% minimum wage of ~ € 436.05
- Maximum: none

Convention

- Mandatory, signed by the supervisor, the coordinator and the student
- Deadline: mid January (laboratory) in mid-February (business)
Assessments

▶ Classes
  ▶ Exam at the end of the course. No convocation. See professors
  ▶ General case: Module Grade = Theoretical part (coef 1) + Practical part (coef 1)
  ▶ No resit

▶ Internship (Defense + report)
  ▶ 3 grade criteria: achieved results, written report, oral defense
  ▶ No resit

▶ Graduation
  ▶ Theoretical grade average > 10 (Semester 3) and Internship grade > 10 (Semester 4)
  ▶ No compensation
Calendar

https://planning.univ-st-etienne.fr/direct/index.jsp?resources=4222&projectId=2&login=agenda&password=agenda

http://www.mines-stetienne.fr/cps2/edt-cps2.ics
Locations

- Site Carnot (Tram « Cité design »)
  - Cours (Bât B ou Télécom Saint-Etienne)
    - Laboratoire Hubert Curien (Bât F), Laboratoire LT2C (TSE)
- 158 cours Fauriel (Bus M6 « Ecole des Mines »)
- Espace Fauriel – EMSE (Bus M6 « Espace Fauriel »)
  - Courses
  - EMSE Computer Science Dept.
Locations (cont.)

Master CPS2 Locations

344 vues

PARTAGER

Main sites

- Espace Fauriel, MINES Saint-Étienne
- MINES Saint-Étienne
- UJEM - TSE

Cartes créées avec Google My Maps
How it runs?

Any issue?

- Act and inform as sooner as possible
- It is your (professional) responsibility to inform your colleagues

Use university services

- Sports
- Health (medical, psychological, social, …)
- Social assistance (budget, …)
- Foreign student helpdesk: 4 rue Leon Nautin 42000 St-Etienne
Latest News

Available at http://www.emse.fr/~picard/cours/cps2
Good luck for this new session of the Master track on CPS$^2$!