APPLICATION PROCESS
CV and cover letter

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FOR MORE INFORMATION
exed.polytechnique.edu

LANGUAGE
Training in English

DURATION AND FORMAT
16 days of in-person instruction
Classes are held on Fridays and Saturdays

CERTIFICATION CNCP 1544

LOCATION
École polytechnique, Palaiseau

INTERNET OF THINGS
This program targets engineers, wishing to add to their competencies an in-depth understanding of “The Internet of Things” (IoT): what technologies does the IoT encompass, what are their limitations, and what opportunities are enabled by the IoT? When designing connected objects, what are the necessary considerations for building safe and secure systems? What platforms, operating systems, and frameworks exist for developing IoT systems?

AUDIENCE

Recognizing that, today, (almost) all modern physical objects are connected, this program provides the skills necessary for:
- Software and hardware engineers, developers, and systems integrators, with or without a networking background, who desire the skill set needed to develop IoT products.
- Technical product & project managers, needing an understanding of the “IoT Landscape” to lead their teams in developing products for the 21st century.
- Engineers from other domains (biology, mechanical engineering, …) with some software development experiences, who wish to understand the challenges and opportunities offered by the IoT.

PEDAGOGICAL METHODS

Structured in 8 thematic modules, the program covers all necessary technologies and considerations for designing connected objects for the Internet of Things. Roughly evenly divided between a study of the “communications stack” and then the “software stack”, the program contains both lectures, theoretical exercises, and practical hands-on experiences.

Every participant is invited to develop its own project and work on it.

PROGRAM

Internet Basics
This module will review basic networking terminology, architectures and concepts, laying the necessary foundation for developing IPv6-based IoT networking.

The Upper Half: From Topology Management to Applications
Bringing the first two modules together, this module maps the Internet architecture and protocol family to the constraints of IoT interconnects: 6LowPAN, IoT routing protocols transport and application layer adaptations (CoAP, CORE) IoT application protocol design for the IoT.

The Lower Half: Physical IoT Interconnect Technologies
This module will offer tutorials on the ever-evolving set of Link Layers and physical interconnect technologies: IEEE 802.15.4, ZigBee, Z-Wave, Bluetooth/LE, ANT/ANT+, etc.

IoT Middleware
Middleware serves to abstract architectural complexities of a given platform, away from applications and application development – to allow an application developer to focus on the application and system logic. A great diversity of such IoT middleware exists – this module will provide a basic taxonomy and survey of these, as well as an in-depth tutorial and hands-on experiences with selected middleware platforms.

Energy Efficiency
A key challenge for the IoT is energy efficiency, and the trade-offs necessary to permit (for example) a wireless object to appear “connected” 24/7, yet still operate for days, weeks, or months, on a small battery. This module will explore energy efficiency in design – of communications protocols, architectures, and applications.

Operating Systems and Platforms for the IoT
As with middleware, a multitude of IoT “operating systems” exist. Designed for efficiency, in terms of memory footprint, these systems differ in philosophy, architectures, and (of course) use. This module will provide a basic taxonomy and survey of IoT operating systems, as well as an in-depth tutorial and hands-on experiences with selected IoT operating systems.

IoT Security
This module will address the challenge of securing the IoT. This includes understanding why “classic” solutions such as RSA or HTTPS are not directly applicable, and looking at minimum-overhead cryptology. With no “one size fits all” solution to security, this module will review a large selection of security protocols, architectures, and cryptological algorithms and primitives, suitable for the IoT.

Embedded Protocol and Software Safety
This module will review formal techniques for, when designing embedded, and communicating, systems to do so in ways that avoid bugs. To this end, the topic of formal program and protocol analysis is introduced, and a set of tools for automating (as much as possible) the verification process is introduced.

Big Data and Data Science for Sensor Data
The IoT is one of the enablers of massive data acquisition. A trivial example is the emergence of the personal health tracker, which permits an unprecedented access to quantifying an individual. This module will provide an introduction to how to deal with “Big Data from the IoT”, to thinking “data” when building “devices” – and will introduce selected tools, models, and methodologies.