UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Ambient Intelligence and Domotics

2324-1-F9102Q030-F9102Q032M

Aims

The continuous and rapid development of sophisticated sensing devices and advanced AI methods makes it possible to realize intelligent environments that unobtrusively support people in their daily life. Such systems may operate indoors (e.g., smart homes, smart buildings) as well as outdoors (e.g., smart cities). The aim of this course is to teach how to design and implement intelligent systems in such Ambient Intelligence scenarios, considering both technological and methodological aspects.

Contents

The course will introduce context-awareness as a fundamental concept for Ambient Intelligence systems. The program includes a presentation of relevant technologies (e.g., devices, networks, architectures, data integration, and storage platforms) as well as AI methods and applications for Ambient Intelligence (e.g., human activity recognition).

Detailed program

- Introduction to context-awareness and ambient intelligence
- Introduction to Smart-Homes and Domotics (Devices, networks, and architectures; Data integration and storage platforms)
- Context Modeling and Representation
- Sensing in mobile and wearable computing
- Sensor data management
- Micro-localization in Indoor Smart Environments
- Smart Energy Management in Smart Homes

- AI methods for Human Activity Recognition
- Single and Multi-inhabitant Activity Recognition in Smart-Homes
- Abnormal behaviors detection in Smart-Homes
- Personalized Ambient Intelligence methods
- The data scarcity problem
- Hybrid knowledge-based and data-driven approaches
- Advanced AI methods for Ambient Intelligence (e.g., federated learning, continual learning)
- Explainable AI for Ambient Intelligence
- Data Privacy aspects of Ambient Intelligence

The lab lessons will propose practical hands-on on AI methods for Ambient Intelligence

Prerequisites

Python programming, distributed systems, basics of supervised and unsupervised deep learning.

Teaching form

Frontal theory lessons (32 hours) and lab lessons (24 hours).
Attendance to all classes is highly recommended. Lectures will be held in presence, unless further COVID-19 related restrictions are imposed.

Textbook and teaching resource

The main teaching resources are the slides and online material.
We will also provide relevant scientific papers for each covered topic.

Some relevant surveys:

- Bettini, C., Brdiczka, O., Henricksen, K., Indulska, J., Nicklas, D., Ranganathan, A., & Riboni, D. (2010). A survey of context modelling and reasoning techniques. Pervasive and mobile computing, 6(2), 161-180.
- De Silva, L. C., Morikawa, C., & Petra, I. M. (2012). State of the art of smart homes. Engineering Applications of Artificial Intelligence, 25(7), 1313-1321.
- Chen, K., Zhang, D., Yao, L., Guo, B., Yu, Z., & Liu, Y. (2021). Deep learning for sensor-based human activity recognition: Overview, challenges, and opportunities. ACM Computing Surveys (CSUR), 54(4), 1-40.

Recommended textbooks:

- “Ubiquitous Computing: Smart Devices, Environments and Interactions” (S. Poslad, Wiley, 2009)
- “Human Activity Recognition and Behaviour Analysis: For Cyber-physical Systems in Smart Environments” (L. Chen and C. Nugent, Springer, 2020)

Semester

Second semester

Assessment method

Written exam and individual project.
The written exam will be a combination of multiple choices and open questions on the theory part.
The individual project will be chosen by the student in agreement with the teachers, and it will include the implementation of AI methods for Ambient Intelligence and their evaluation on a public dataset.

Office hours

On appointment. Contact the teachers via email.

Sustainable Development Goals

QUALITY EDUCATION