UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Green Computing

2425-1-FDS01Q041

Aims

- Understand the fundamental principles of green computing and its importance.
- Analyze and apply energy-efficient algorithms and techniques in data science and AI
- Conduct lifecycle assessments of computing resources.
- Use data science tools and techniques to promote and measure sustainability efforts.

Contents

The course consists of the following modules:

Module 1 - Overview of Sustainability and Impact of Computing
Module 2 - Energy efficient architectures, computing, and software engineering
Module 3 - Data Science, AI and sustainability

Detailed program

Module 1 - Overview of Sustainability and Impact of Computing

Introduction to Green Computing

- Definition and significance of green computing.
- Historical context and evolution.
- Key drivers and stakeholders in green computing.

Environmental Impact of Computing

- Energy consumption in computing.
- Carbon footprint of data centers.
- E-waste management.

Module 2 - Energy efficient oriented architectures, computing, and software engineering

Energy-Efficient Algorithms

- Principles of energy-efficient computing.
- Energy efficient architectures
- Energy-efficient algorithms.

Green Software Engineering

- Sustainable software development practices.
- Tools and techniques for green software engineering.
- Performance vs. sustainability trade-offs.

Lifecycle Assessment of Computing Resources

- Methods for lifecycle assessment (LCA).
- LCA of hardware components.
- LCA of software applications.

Sustainability from IoT to Cloud

- Role of virtualization in green computing.
- Energy efficiency in cloud computing.
- Energy-efficient data center design.
- Renewable energy sources for data centers.
- Energy-efficient IoT devices and systems.
- Sustainable IoT applications.

Green Computing Metrics and Standards

- Metrics for measuring energy efficiency and sustainability.
- Tools for monitoring and reporting sustainability metrics.

Module 3 - Data Science, AI and Sustainability

Data Science and Sustainability

- Environmental impact of Big Data.
- Energy-efficient Big Data processing.
- Sustainable data storage solutions.
- Data science applications in green computing.
- Predictive analytics for energy consumption.

Machine Learning for Green Computing

- Machine learning techniques for optimizing energy use.
- Applications of ML in smart grids and energy management.
- Research trends in ML and green computing.

Case Studies

Prerequisites

- Basic knowledge of computer science and data science.
- Understanding of basic concepts in statistics and machine learning.

Teaching form

The course comprises

- classroom lectures (DE 30 hours)
- interactive exercises in the classroom (DI 16 hours)

The course will be delivered in English

Textbook and teaching resource

Lecture notes, slide decks and articles provided by the lecturer.

Semester

Second year, Second semester

Assessment method

The written exam consists of open-ended questions (50%) and problems (50%).
During the exam, books and notes can be consulted, and the use of a calculator is allowed.
There are no midterm exams.

Evaluation criteria:

Open Questions

- Understanding of Concepts: The ability to clearly explain the key concepts and theories related to the course material.
- Clarity and Coherence: The clarity, coherence, and organization of the responses.
- Relevance: The relevance and accuracy of the information presented in relation to the questions asked.

Analytical Solutions of Problems

- Accuracy: Correctness of the mathematical computations and solutions.
- Methodology: The appropriateness and correctness of the methods and approaches used to solve the problems.
- Clarity of Work: Clear presentation of the solutions, including all steps and justifications.

Office hours

Appointment to be agreed by email.

Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE | SUSTAINABLE CITIES AND COMMUNITIES | RESPONSIBLE CONSUMPTION AND PRODUCTION | CLIMATE ACTION