UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Introduction To Computer Science

2223-1-E3401Q038

Aims

The main objective of the course is to provide fundamental expertise and practical skills on computer science and data analysis, with particular focus on the possible applications to the sphere of geological sciences.

Contents

The course will allow to:

- Understand what computer science is
- Know the history of computer science
- Understand what computer science is important in geological sciences
- Learning notions related to network technologies, understanding the difference between the Internet and the Web
- Understanding the problem of access to data and information
- Understand the logic and architecture of computers
- Become familiar with the organization, analysis, and visualization of data
- Become familiar with the concept of relational database and SQL query language
- Become familiar with algorithms
- Transform theories into practical applications
- Learn to use Excel and Python to store, process and analyze data, produce graphs, implement algorithms

Detailed program

Introduction

- Introduction to the course, organization of lectures and exercises.
- What is information technology
- Data and information
- What are algorithms
- Why computer science for the earth sciences.
- G.I.S. (Geographical Information System).

History of Computer Science

- Prehistory and early "steps" of computer science.
- The definition of the theoretical foundations (logic, Boolean algebra, the first programs).
- The electromechanical machines
- The Turing machine
- ENIAC and the ancestors of the digital computer.
- Transistors, chips and microprocessors
- The first personal computers
- Data storage and transmission (protocols).
- Moore's law
- ARPANET and the path leading to the internet.
- The spread to the general public of computers (before) and the network (after).

Computer architecture

- The hardware
- Von Neumann's architecture.
- CPU, Memory, I/O, BUS
- The software
- The operating system

Computer networks

- The components of a computer network.
- Classification of networks by extent
- Classification of networks by topology
- Classification of networks by transmission medium.
- The communication protocols.
- The Internet and the Internet of Things
- The services of the Internet: Web, e-mail, DNS.

Internet and the Web

- Difference between the Internet and the Web
- The World Wide Web
- Static Web and dynamic Web
- Web 1.0, 2.0, 3.0, 4.0
- The Social Web

The problem of information access

- Introduction to the problem.
- The search engines
- Recommender systems
- The access to information on social media
- Analysis of social media data.

The representation of data in the binary system

- The numbering systems
- The decimal system
- The binary system
- Conversion of numbers to different bases
- The representation in modulus and sign
- The representation in two's complement
- Boolean algebra and electronic circuits.

The encoding of text, images and sound

- The representation of text
- The characters
- The ASCII and Unicode representation systems
- The representation of images
- Raster graphics
- Vector graphics
- The representation of sound
- Audio sampling
- Audio quality in digital representation.

Databases and the relational model

- Data and information
- Information systems
- The information system
- Databases
- Database management systems
- The relational model
- Relationships between tables (one-to-one, one-to-many, many-to-many).

The SQL language

- Definitions of schemas and instances in SQL.
- Syntax and elementary domains.
- Interrelational constraints
- Projection and selection
- Data selection from multiple tables.

Introduction to algorithms and programming

- What is an algorithm
- The properties of algorithms
- Flowcharts (conditional instructions and loops).
- The pseudocode
- The programming languages
- The programming paradigms

The procedural languages

- Variables and constants
- The assignment statements
- The data types (elementary and derived).
- The functions

- The control structures (conditional and iterative).

Introduction to Python - Part One

- Recapitulation of the fundamental concepts of procedural programming
- Example algorithm (flowchart, pseudocode and Python code)
- Description of the Python programming environment
- Basic Usage
- Variables in Python

Introduction to Python - Part Two

- Scalar values, lists and data structures in Python
- Accessing the elements of data structures
- Operations on variables and data structures
- Operators
- Control structures (if-else, for, while).

During the Exercises, the use of Excel and its main functions will also be demonstrated in practice, and the use of Python for defining algorithms for data processing and analysis will be explored.

Prerequisites

None

Teaching form

Lectures (Dr. Marco Viviani)

Laboratory exercices (different teaching shifts)

The course is delivered in **Italian**

Textbook and teaching resource

Suggested **textbooks (in Italian language)**

Fundamentals of computer science:

- Informatica. Una panoramica generale J. Glenn Brookshear Pearson
- Informatica arte e mestiere. MacGrawHill

Python:

- Introduzione a Python. Per l'informatica e la data science. Ediz. MyLab. Con Contenuto digitale per accesso on line Copertina flessibile, di Paul J. Deitel (Autore), Harvey M. Deitel (Autore), Pietro Codara (a cura di),

Carlo Mereghetti (a cura di), Diego Valota (Traduttore).

Online resources suggested in class

Semester

March - June 2020

Assessment method

Computer test (in a laboratory or online): theoretical questions + practical exercises

- 6 questions with multiple choice for the extensive control of theoretical and theoretical-practical concepts illustrated in class
- 1 open questions for intensive preparation control on the exam program (theoretical aspects)
- 3 exercises for verifying the learning of using Excel, the knowledge of the SQL language, the fundamental concepts of programming using Python.

Oral test (optional)

Office hours

By appointment

Sustainable Development Goals