HALMSTAD UNIVERSITY
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School of Information Technology

Python - a Gateway to Machine Learning 7.5 credits

Python - en inkörsport till Machine Learning 7.5 hp

Second cycle
Main field: Computer Science and Engineering, Second cycle, has only first-cycle course/s as entry requirements (A1N)
Syllabus is adopted by the Research and Education Board (2024-03-20) and is valid for students admitted for the autumn semester 2024.

Placement in the Academic System

The course is included in the master of science in engineering Intelligent Systems (300 credits), the master's program Information Technology (120 credits) and the master's program Embedded and Intelligent Systems (120 credits). The course is also offered as a freestanding course.

Prerequisites and Conditions of Admission

Degree of Bachelor of Science or Degree of Bachelor of Science in Engineering. Courses in computer science, computer engineering or electrical engineering 60 credits including thesis, and programming 7,5 credits. The degree must be equivalent to a Swedish kandidatexamen or Swedish högskoleingenjörsexamen and must have been awarded from an internationally recognised university. English 6. Exemption of the requirement in Swedish is granted.

Course Objectives

The course builds on on the student's knowledge and skills in basic programming techniques and focuses on the student being able to recognize, select and use techniques for constructing algorithms, techniques for analyzing algorithms and techniques for organizing data in programs. The purpose of the course is also to prepare the student for further studies and/or work within machine learning by providing training in the programming language Python. The course gives the student the opportunity to learn the programming language Python, but also general programming concepts such as algorithm complexity, algorithm design and classic data structures, and how such concepts are used to handle Big Data problems. Building on basic programming knowledge and programming practice, the course prepares the student to participate in major programming projects. The course introduces well established techniques for solving problems that arise often and prepares the student to make well founded decisions when choosing among alternative solutions. An additional goal of the course is that the student offers the opportunity to learn and use advanced programming language constructions.

Following successful completion of the course the student should be able to:

Knowledge and understanding

- explain how to estimate the execution time of programs.
- describe algorithm design techniques such as divide & conquer, recursion and dynamic programming
- identify data structures and algorithms for sorting and searching, such as quicksort, hash tables and binary search trees

Skills and ability

- identify the need for and be able to use data structures as modules to build efficient programs
- use algorithm design techniques to solve problems with efficient programs
- use basic programming techniques for distributed file systems, tabular data and linear algebra

Judgement and approach

- judge how suitable a program is given the algorithms and data structures used
- choose adequate implementations of algorithms and data structures from program libraries
- choose suitable frameworks for processing big data and tabular data and for linear algebra

Primary Contents

Introduction to the programming language used in the course.

Introduction to the analysis of complexity of algorithms, including asymptotic Big-O notation. Design and analysis of algorithms using recursion and divide & conquer. Algorithms for sorting and searching. Introduction to data structures including heaps, hash tables and binary search trees as well as how they are present in the programming language Python.

Introduction to Python's libraries to process tabular data (Pandas), for linear algebra (NumPy) and to the frameworks for processing Big Data on distributed file systems.

Teaching Formats

Teaching consists of lectures and programming exercises as well as supervision for laboratory and project work.
Teaching is conducted in English.

Examination

The overall grades of Fail, 3, 4 or 5 will be awarded for the course.
The course is examined with a individual written exam and individual oral and written presentation of laboratory work and projects.

Name of the test		**Grading**
Witten Examination	3 credits	U/3/4/5
Laborations and Project	4,5 credits	U/G

If there are special reasons, the examiner may make exceptions from the specified examination format and allow a student to be examined in another way. Special reasons can e.g. be a decision on learning support.

For elite sports students according to Riktlinjer för kombinationen studier och elitidrott vid Högskolan i Halmstad, DNR: L 2018/177, the examiner has the right to decide on an adapted examination component or let the student complete the examination in an alternative way.

Course Evaluation

Course evaluation is part of the course. This evaluation should offer guidance in the future development and planning of the course. Course evaluations should be documented and made available to the students.

Course Literature and Other Study Resources

Tim Roughgarden. *Algorithms Illuminated*. Soundlikeyourself Publishing, LCC. San Francisco. 2017- 2019 (Online material freely available: `www.algorithmsilluminated.org`)

John DeNero. *Composing Programs*. Freely available: `http://composingprograms.com`

Sam Lau, Joey Gonzalez and Deb Nolan. Principles and Techniques of Data Science (kapitel 7).
Freely available on: `https://www.textbook.ds100.org/intro.html`

Jeffrey Dean and Sanjay Ghemawat. MapReduce: Simplified Data Processing on Large Clusters. OSDI 2004. `https://ai.google/research/pubs/pub62`

Craig Chambers, Ashish Raniwala, Frances Perry, Stephen Adams, Robert Henry, Robert Bradshaw and Nathan Weizenbaum. FlumeJava: Easy, Efficient Data-Parallel Pipelines. ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI) 2010. `https://ai.google/research/pubs/pub35650`