UNIVERSITY OF GOTHENBURG

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DIT055 Sustainable computing, 7.5 credits

Hållbar databehandling, 7,5 högskolepoäng

Second Cycle

Confirmation

This course syllabus was confirmed by Department of Computer Science and Engineering on 2019-12-17 and was last revised on 2019-12-17 to be valid from 2020-08-31, autumn semester of 2020.

Field of education: Science 100%
Department: Department of Computer Science and Engineering

Position in the educational system

The course is offered within several programmes. It is also a single subject course at the University of Gothenburg.

The course can be part of the following programmes: 1) Computer Science, Master's Programme (N2COS) and 2) Computer Science, Bachelor's Programme (N1COS)

Main field of studies	*Specialization*
Computer Science	A1F, Second cycle, has second-cycle course/s as entry requirements

Entry requirements

Students must have completed 7.5 credits in computer architecture (e.g., DIT051 Computer Architecture, or equivalent).

Applicants must prove knowledge of English: English 6/English B or the equivalent level of an internationally recognized test, for example TOEFL, IELTS.

Learning outcomes

On successful completion of the course the student will be able to:

Knowledge and understanding

- describe why sustainable computing is an important current topic
- describe the electrical mechanisms that cause power to be dissipated
- describe circuit techniques for reducing power dissipation and the impact on performance
- describe computer architecture, memory, and secondary storage techniques for reducing energy consumption
- describe techniques at the operating system, runtime, and application for reducing energy consumption
- explain what affects the energy consumption of computer systems especially concerning their architecture

Competence and skills

- use specific devices to directly measure energy consumption of the whole system
- use performance counters to measure the energy consumption of certain components in the system
- use simulation tools to estimate the energy consumption of different system configurations

Judgement and approach

- identify the strengths and weaknesses of different classes of computer system components (e.g. processor, memory), with respect to energy efficiency
- evaluate and compare different architecture and system techniques in terms of the energy efficiency
- explain the methods for evaluating and reporting the energy consumption in computer systems and how these can be used to optimize the system
- judge the importance of energy consumption from societal and ethical perspectives
- interpret requirements on the architecture of computer systems to meet societal needs for sustainability

The course is sustainability-focused, which means that at least one of the learning outcomes clearly shows that the course content meets at least one of the University of Gothenburg's confirmed sustainability criteria. The content also constitutes the course's main focus.

Course content

The aim of the course is to make students aware of the importance of sustainability in computing and to show techniques to achieve it at the different levels of a computer system.

The course is intended to give an overview of the energy efficiency aspects of computer systems and computing, ranging from the electronic circuits up to the applications for systems ranging from small IoT devices to large data centers. For instance, students will learn about approaches to measuring and estimating the energy consumption of different architectural components as well as architecture and software techniques to save energy in the system.

Sub-courses

1. **Written exam** *(Tentamen),* 6 credits
   Grading scale: Pass with Distinction (VG), Pass (G) and Fail (U)
2. **Laboratory** *(Laboration),* 1.5 credits
   Grading scale: Pass (G) and Fail (U)

Form of teaching

Teaching is through lectures, class exercises, and laboratory sessions. The course consists of a lecture series, homework assignments, and labs assignments including a group project.

Students will present the results of their homework and in-class assignments through short oral presentations to demonstrate their understanding and to facilitate discussion. Discussions will not only focus on technology, but also on how that technology affects the world's carbon footprint and will likely impact society now and in future generations.

Language of instruction: English

Assessment

The course is examined by an individual written exam done in an examination hall and approved lab exercises. The lab work is done in groups of normally 2-3 students.

If a student, who has failed the same examined component twice, wishes to change examiner before the next examination, a written application shall be sent to the department responsible for the course and shall be granted unless there are special reasons to the contrary (Chapter 6, Section 22 of Higher Education Ordinance).

In cases where a course has been discontinued or has undergone major changes, the student shall normally be guaranteed at least three examination occasions (including the ordinary examination) during a period of at least one year from the last time the course was given.

Grades
The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).
A Pass grade (G) for the entire course requires at least a Pass grade for all sub-courses.
In order to be awarded the grade Pass with Distinction (VG), the student must in addition obtain the grade Pass with Distinction on the sub-course Written exam.

Course evaluation
The course is evaluated through meeting after the course between teachers and student representatives. Further, an anonymous questionnaire is used to ensure written information. The outcome of the evaluations serves to improve the course by indicating which parts could be added, improved, changed or removed.

Additional information
The course is a joint course together with Chalmers.

Course literature to be announced the latest 8 weeks prior to the start of the course.

The course replaces the course DIT053 Energy Aware Computing, 7.5 credits. The course cannot be included in a degree which contains DIT053. Neither can the course be included in a degree which is based on another degree in which the course DIT053 is included.