GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Sustainable Computing (E034500)

Course size *(nominal values; actual values may depend on programme)*

Credits 3.0 **Study time 90 h**

Course offerings and teaching methods in academic year 2025-2026

A (semester 2)	English	Gent	seminar
			lecture

Lecturers in academic year 2025-2026

Eeckhout, Lieven	TW06	lecturer-in-charge

Offered in the following programmes in 2025-2026	crdts	offering
Master of Science in Electrical Engineering (main subject Communication and Information Technology)	3	A
Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems)	3	A
Master of Science in Computer Science	3	A
Master of Science in Computer Science Engineering	3	A
Exchange Programme in Computer Science (master's level)	3	A

Teaching languages

English

Keywords

Computer systems, sustainability, energy efficiency, power efficiency, thermal efficiency, modeling, measurement, hardware specialization, hardware re-configurability, QoS/SLA-aware computing, approximate computing, mobile devices, multicore processors, datacenters, fault tolerance, reliability

Position of the course

The aim of the course is to make computer science engineering students aware of the importance of sustainability in computing and to cover techniques to improve sustainability across the computer system stack. The course is intended to give an overview of the impact of computing on sustainability and various energy efficiency aspects of computer systems and computing, ranging from production to use and end-of-life, from electronic circuits up to the applications, and for systems ranging from small mobile devices to large data centers.

Contents

Topics to be covered in the course:

- Lifetime of a computer system (from production, to usage, to recycling, to waste) and its impact on sustainability
- Power, energy and thermal-aware management of computing systems
- Modeling and measurement
- Management at the hardware level: voltage and frequency management, re-configurability, dark silicon, heterogeneity, specialization
- Management at the runtime level: operating system, hypervisor, language runtime
- Management at the application level: QoS/SLA-aware computing, approximate computing
- Management at the system level: mobile devices, multicore processors, datacenters (cooling)
- Interplay of sustainable computing with performance, fault tolerance, reliability and security
- Optional topics: energy harvesting, intermittent computing, biodegradable

computing, etc.

The course will have a strong emphasis on hot research topics in sustainable computing. The course will consist of theory lectures, seminar-type assignments and hands-on experiments through which the students will characterize and analyze the sustainability of modern-day computer systems.

Initial competences

The students should have taken systems courses on computer architecture, operating systems, and parallel computer systems.

Final competences

1 Understand the impact of computing on sustainability.
2 Be able to explain sustainable computing systems.
3 Be able to measure and model the power and energy efficiency of a computer system.
4 Be able to analyze and optimize computer systems for improved sustainability.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture

Extra information on the teaching methods

The course will consist of theory lectures, seminar-type assignments and hands-on experiments through which the students will characterize and analyze the sustainability of modern-day computer systems.

Study material

Type: Syllabus

Name: articles, exams from previous years
Indicative price: Free or paid by faculty
Optional: no
Language : English
Number of Pages : 400
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No

Type: Slides

Name: theory
Indicative price: Free or paid by faculty
Optional: no
Language : English
Number of Slides : 500
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No

References

A variety of sources including recently published articles (provided to the students as recommended reading) on various topics pertaining to sustainable computing, including the following synthesis lectures:

- The Datacenter as a Computer: Designing Warehouse-Scale Machines, Third Edition, Morgan & Claypool Publishers, Luiz André Barroso, Urs Hölzle, Parthasarathy Ranganathan, October 2018
- Power-Efficient Computer Architectures: Recent Advances, Morgan & Claypool Publishers, Magnus Själander, Margaret Martonosi, Stefanos Kaxiras, December 2014
- Fault Tolerant Computer Architecture, Morgan & Claypool Publishers, Daniel J. Sorin, 2009

Course content-related study coaching

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment

Examination methods in case of periodic assessment during the second examination period

Written assessment

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Extra information on the examination methods

End-of-term evaluation and continuous assessment:

- End-of-term evaluation: written exam, open book
- The continuous assessment consists of (i) discussion and critical analysis of recent scientific articles during the coached exercise sessions, and (ii) executing and reporting practical computer exercises.

Calculation of the examination mark

End-of-term evaluation (75%) and continuous assessment (25%)