GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Cloud Storage and Computing (E017310)

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

Credits 4.0 **Study time 120 h**

Course offerings in academic year 2024-2025

A (semester 2)	English	Gent

Lecturers in academic year 2024-2025

Volckaert, Bruno	TWO5	lecturer-in-charge

Offered in the following programmes in 2024-2025	crdts	offering
Bridging Programme Master of Science in Bioinformatics(main subject Engineering)	4	A
Master of Science in Bioinformatics(main subject Engineering)	4	A
Master of Science in Computer Science	4	A
Master of Science in Computer Science Engineering	4	A
Master of Science in Computer Science Engineering	4	A
Exchange Programme in Computer Science (master's level)	4	A

Teaching languages

English

Keywords

Cloud, containers, Docker, Kubernetes, microservices, DevOps, agile, container orchestration, distributed storage, infrastructure-as-code, monitoring

Position of the course

As software systems are becoming more and more complex and fully intertwined with our daily lives, the need to operate these systems in a reliable and typically always-on manner is becoming more and more apparent. Companies with great ideas, can over the course of a few months time see global uptake of their software products, through proper use of cloud infrastructure in a pay-as-you-go model.
The goal of this course is to get to know how microservice based applications can lead to more agile ways of developing software and how the ensuing embrace failure mantra of distributed systems can be used to increase the reliability of said applications. The increased complexity of these multi-service applications can be countered by means of automation on numerous levels: introducing DevOps culture, CI/CD pipelines, infrastructure-as-code, testing automation, etc. Container technologies are identified as a prime candidate to deploy such microservices, while managing the complexity of running thousands of container instances is shown to be the work of a dedicated container orchestration platform. The course will provide students both theoretical and hands-on extensive knowledge of state-of-the-art techniques to develop, operate and support modern cloud-native applications.
This course builds on the knowledge gained in earlier courses on computer architecture, operating systems and computer networking.

Contents

- Cloud concepts: pay-per-use, cloud offerings (IaaS, CaaS, PaaS, SaaS, FaaS/serverless, MaaS), public / private / hybrid / multi-cloud choices, standards
- Microservice based application design: concept of applications as loosely coupled services, strengths and drawbacks, communication methods, patterns to increase resilience in highly distributed environments, etc.
- DevOps: from source code to operational support
- Virtualisation: overview of container technologies (OS-level virtualisation, microVMs, sandboxing, trusted computing, WebAssembly, etc.)
- Container orchestration: Kubernetes architecture and functionality

- Infrastructure-as-Code, automation / configuration management and provisioning tools
- Cloud Native Computing Foundation developments: service meshes, monitoring, policy agents, artefact registries, etc.
- Distributed storage systems: file stores, object stores, block stores

Initial competences

- Knowledge of computer architecture
- Knowledge of computer networking fundamentals
- Knowledge of web / service-oriented programming
- Knowledge of operating system internals
- Basic Linux (i.e. Bash) knowledge
- Programming in Python

Final competences

1 Understand and be able to use the terminology dealing with cloud-based distributed systems, OS-level virtualisation and orchestration
2 Knowledge of the drive and motivation behind microservice based applications
3 Deep understanding of OS-level virtualisation types, along with strengths and weaknesses in terms of security and performance
4 Deep understanding of container orchestration functionality, including attaching workloads to persistent storage
5 The ability to set up a Cloud-based application on a large public cloud vendor, using Infrastructure-as-Code tooling
6 The ability to set up a CI/CD pipeline transforming versioned source code into artefacts which automatically get tested and deployed on a container orchestration platform
7 Communicating and presenting domain-specific knowledge in a correct and clear manner, with the appropriate language skills, incl. the use of correct terminology

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

Lecture, Practical

Study material

Type: Slides

Name: Cloud Storage and Computing
Indicative price: Free or paid by faculty
Optional: no
Language : English
Number of Slides : 600
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No

References

- Building Microservices, 2nd edition, Sam Newman, 2021, ISBN: 978-1492034025
- Core Kubernetes, Jay Vyas and Chris Love, 2022, ISBN: 9781617297557
- Bootstrapping Microservices with Docker, Kubernetes, and Terraform, Ashley Davis, 2021, ISBN: 9781617297212

Course content-related study coaching

- Interactive support and coaching through the electronic learning platform appointments
- Teachers and assistants are available for extra help before and after contact hours, and via e-mail, chat and conf calls

Assessment moments

end-of-term and continuous assessment

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

Written assessment with open-ended questions

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

Written assessment with multiple-choice questions

Examination methods in case of permanent assessment

Participation, Peer and/or self assessment, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible in modified form

Extra information on the examination methods

- Periodic evaluation: written examination with open and closed questions on theory, with closed-book
- During semester: graded lab sessions (written reports)

Calculation of the examination mark

- 50% on permanent evaluation, 50% on periodic exam.
- Lack of participation in permanent evaluation for no valid reason results in a zero for that part.
- In the case of group assignments, the students in a group get the same score by default. Only when there is a clear difference in contribution, the students will be given different scores.
- The student must pass (>=10/20) both parts to pass the whole course. If they fail for one part while still scoring >=10/20 on average, the final score becomes 9/20.

Facilities for Working Students

Option to be freed from presence in labs after consultation with the responsible teacher (deadline of at least a week for labs). Option for feedback by appointment during and after business hours.