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The proof of concept for a training program in cloud-based service creation

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DIHUB

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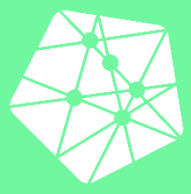
DIGITAL INNOVATION HUB FOR CLOUD BASED SERVICES

Table of Contents



DIHUB

1. Introduction to cloud job roles

This is the joint DIHUB curriculum for the four cloud specialist job roles defined in the DACUM analysis report by Algebra University College. The process of developing the this curriculum for the level of EQF 6 is explained in Aunimo et al. (2022). The European qualifications framework (EQF) is used, and the skills are mapped into the European Skills, Competences, Qualifications and Occupations framework (ESCO). This curriculum is defined for EQF6 and EQF4.

The deliverable " The proof of concept for a training program in cloud-based service creation" it is part of the WP3.

The DIHUB curriculum includes the best practices and describes skills relevant to cloud job roles. The skills relevant for cloud specialists at the level EQF 6 are depicted in figure 1. The curriculum may serve educational institutions or individuals looking for way to enter into or to improve cloud technology skills.

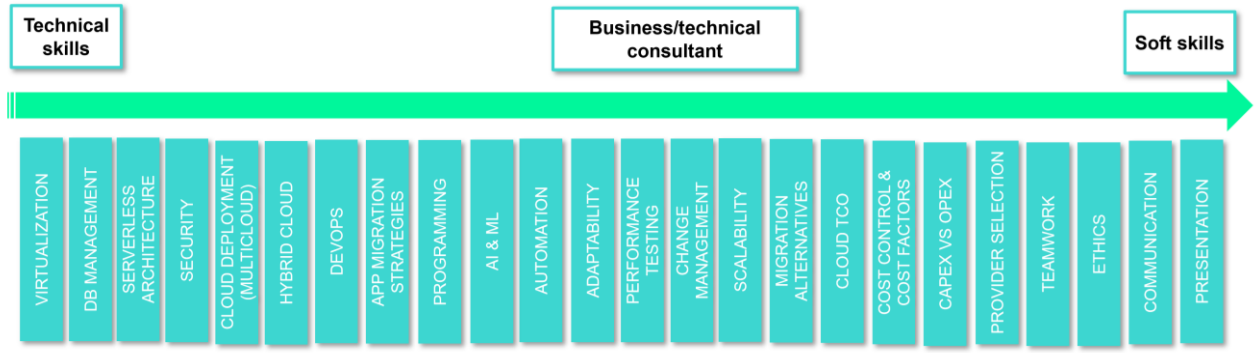


Figure 1: Cloud job roles and the relevant technical, business and soft skills for EQF 6.

A cloud computing specialist may be divided into several separate job roles. At the EQF 6 level, there are four roles: administrator, mogration expert, strategist and monetization expert and an application developer. The latter is called Cloud service/content creator in this document. At the level EQF 4, there is only one role: the cloud specialist in the IT-support.

The joint DIHUB curriculum covers following cloud jobs relevant across cloud landscape:

- Cloud manger/administrator
- Cloud migration expert
- Cloud strategist and monetization expert
- Cloud service/content creator
- IT-support cloud specialist (EQF 4)

All are empowered by selected technical, business and softs skills. The mapping of the skills to the job roles at the level EQF 6 is given in Figure 2. Next, the five diferente job roles will be explained. We will first descibe the job role for the EQF level 4 and subsequently the four job roles for the level 6.

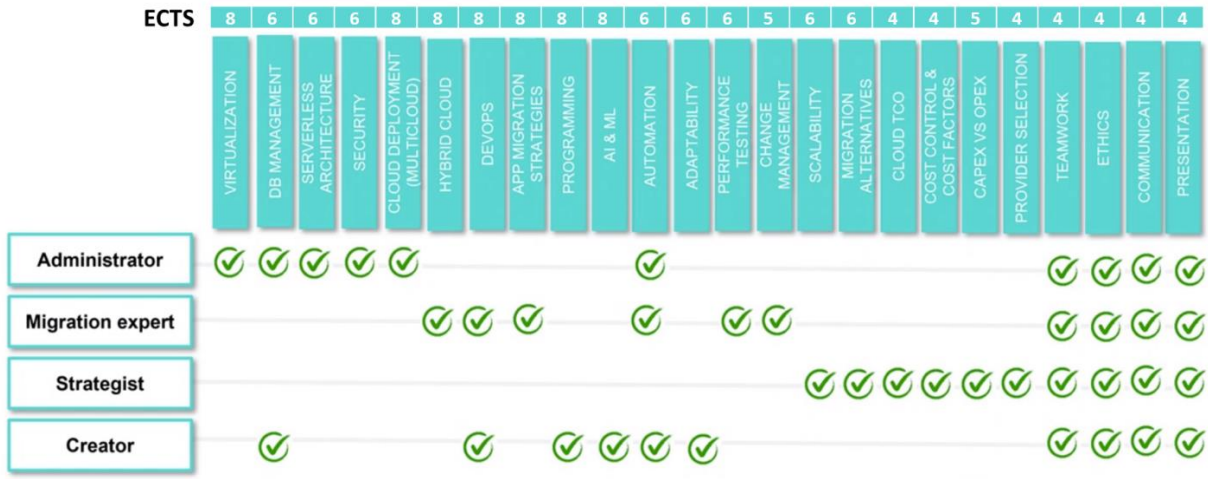


Figure 2: Mapping of the cloud specialist job roles at EQF level 6 to the skills required in each role.

1.1. IT-support Cloud Specialist, 45 ECVET

Holders of a vocational qualification in information and communications technology have the vocational skills required for carrying out tasks in the field of information and communications technology. They are able to work co-operatively in environments related to information and communications technology. Qualification holders know how to use the vocabulary specific to the field, find out the customers' needs and make customer-oriented decisions in tasks related to information and communications technology. They ensure that the final result meets the requirements set for the work. The individual in this position must have basic technical knowledge of operating systems, virtualization, networking and also understand three main types of cloud computing services: Infrastructure-as-a-Service (IaaS), Platforms-as-a-Service (PaaS), and Software-as-a-Service (SaaS).
IT-support cloud specialist is able to work in an information and communications technology environment both on cloud and on-premises environments consisting of workstations, network devices and accessories and areas of operation. They work as part of information management and help users with different technical problems in the cloud environment, customer's premises or through a remote connection.

This job role includes 45 ECVET points that are composed of the following skills:

- Serverless architecture
- Artificial intelligence and Machine learning
- DevOPS
- Programming
- Security

1.2. Cloud manager/administrator, 56 ECTS

A Cloud manager/administrator is responsible for working in a mixed software environment. The responsibility of the individual is to manage the instances of the cloud infrastructure services and the multiple cloud servers. The professional also leads, oversees and maintains, multiuser computing environment as per the requirements of the organization. The individual in this position must have strong technical knowledge of virtual machines (IaaS, Writing Code (PaaS) and Software as a Service (SaaS). The cloud systems administrator will have to develop, configure, implement and manage the systems that comprise the underlying cloud platform. The professional assists in setting up public or private cloud systems. They have to learn how to balance workload and deploy them in an automated way. The individual should monitor and alter the systems as per the prescribed methodology. The Cloud manager/administrator is the one who establishes and executes the cloud operations as per the specifications and parameters. They should select the cloud providers as well keeping in mind the requirements. The technicians must implement cost-effective cloud-based systems that will fulfill the technical requirements of the organization.

This job role includes 56 ECTS points that are composed of the following skills:

- Virtualization
- Database management
- Serverless architecture
- Security
- Cloud deployment including multicloud
- Automation
- Teamwork
- Ethics
- Communication
- Presentation

1.3. Cloud migration expert, 57 ECTS

The key objective of this position is to lead and drive the company's Cloud expert projects to successful completion. A Cloud Migration Specialist and Lead has the overall responsibility of designing and executing a cloud migration strategy; defining delivery architecture, creating the migration plans, designing the orchestration plans, and more. This position works closely with technology consultants, cloud architects and engineers in translating the company's cloud strategic goals, roadmaps, and business requirements into future state architectures designed to leverage the cutting-edge functionality delivered through commercial and open-source cloud service providers.

This job role includes 57 ECTS points that are composed of the following skills:

- Hybrid cloud
- DevOps
- Application migration strategies
- Automation
- Performance testing
- Change management
- Teamwork
- Ethics
- Communication
- Presentation

1.4. Cloud strategist and monetization expert, 45 ECTS

The primary focus of the Cloud strategist is to provide customers with in-depth knowledge and execution of cloud advisory services, focusing on assessment of current state and planning for migration activities. As a Monetization expert, expert will proactively identify new opportunities, develop, manage, and maximize growth opportunities from developers using technology products. Expert will use your influencing and relationship-building skills, product knowledge, industry insights, and sales skills to provide relevant solutions and client services. Job role include close work with sales, marketing, and data intelligence teams, gain industry insights, build sales strategies, and put them into practice, with the goal of expanding engagement with ad monetization solutions. Finally, role includes ideation and execution on exciting long-term strategic priorities in order to grow the web ecosystem.

This job role includes 45 ECTS points that are composed of the following skills:

- Scalability
- Migration alternatives
- Cloud TCO
- Cost control and cost factors
- CAPEX vs OPEX
- Vendor selection
- Teamwork
- Ethics
- Communication
- Presentation

1.5. Cloud developer and content creator, 58 ECTS

Cloud developers are primarily software engineers who specialize in cloud computing. Cloud developers need to have a solid understanding of cloud systems - how they work and how to deploy them safely, efficiently, and without downtime. In addition to the design and implementation of cloud infrastructures, cloud developers also ensure the efficient design of business processes in the cloud. Cloud developers have a deep understanding of cloud service provider architectures and can monitor the cloud's maintenance, design, security, and use throughout the enterprise. Tasks include scaling application components, encryption and access security issues, and continuous efficiency and performance optimisation. PaaS is a cloud computing service that provides cloud developers with a way to develop custom applications without the infrastructure or application hosting space. PaaS allows developers to automate the background work of setting up servers and will enable them to run transparently in the background. With PaaS, the development process can focus on coding, testing, and deploying applications instead of servers, storage, and backup.

This job role includes 58 ECTS points that are composed of the following skills:

- Database management
- DevOps

- Programming
- Artificial intelligence and Machine learning
- Automation
- Adaptability
- Teamwork
- Ethics
- Communication
- Presentation

2. Grading principles

2.1. Module marking

The module marking described below is the basis for grading at the EQF 6 level of studies.

Rank/Grade	Description
N/A	Work was not submitted or was plagiarised.
Fail	Failed to satisfactorily meet expectations for all learning outcomes
Pass	Met expectations for all minimum learning outcomes to a satisfactory level
Good	Met expectations for all minimum learning outcomes to a satisfactory level and some desired outcomes
Excellent	Met expectations for all minimum learning outcomes to a satisfactory level and most or all desired outcomes

2.2. Assesment criteria for EQF 4

The following table lists the criteria for marking for the courses at level EQF 4. At this level, knowledge and skills are typically demonstrated through practical laboratory exercises or via project work. The project may be excecuted individually or in a team. Typical other tasks that are assed are: presence in classroom learning or online learning, quizzes and assignments.

Descriptor	Student
Satisfactory 1	• carry out a set of tasks following instructions • work cooperatively • need additional instructions in some situations • draw on the underpinning knowledge required in a set of tasks • modify their actions based on the feedback they receive
Satisfactory 2	• carry out a set of tasks with initiative and following instructions • work cooperatively and interactively • rarely need additional instructions • use the knowledge needed in their set of tasks appropriately • modify their actions based on the feedback they receive and their personal observations
Good 3	• carry out a work process independently • work cooperatively and show initiative in interactive situations • cope with ordinary problem-solving situations • draw diversely on the knowledge required in their set of tasks • assess their performance realistically
Good 4	• plan and carry out a work process independently • work cooperatively and constructively in interactive situations • manage problem-solving situations, drawing on diverse methods • apply the knowledge required in their set of tasks diversely and with justifications

	• assess their performance realistically and recognise their strengths and development areas
Excellent 5	• plan and carry out a work process independently, taking other actors into consideration • work cooperatively and constructively, also in challenging interactive situations • apply the knowledge required in their set of tasks to problem-solving situations diversely and critically • make justified development proposals related to their set of tasks and operating environment • assess their performance realistically and suggest justified solutions for developing their competence • understand the importance of their work as part of a larger process

2.3. Assesment criteria for EQF 6

This section explains the assessment criteria for the courses at the level EQF 6. There are all in all five different types of execution methods that are assessed. They are: theoretical, practical, project, written paper and presentation skills assessment. Each execution method is briefly explained and the assessment criteria are then given.

Theoretical assessment. This type of knowledge and skills are typically demonstrated through theoretical exams. They may be written or oral.

Descriptor	Marking criteria
Excellent	The student demonstrates an excellent ability to use and accurately apply appropriate terminology and language in answering questions. The student demonstrates their excellent depth and breadth of knowledge and understanding with responses that are clear, highly coherent and structured and are highly consistent in using; examples, compared with other concepts, methods and techniques.
Very Good	The student demonstrates a very good ability to use and apply appropriate terminology and demonstrates their very good depth and breadth of knowledge and understanding with accurate responses that are clear and are consistent in using; examples, compare with other concepts, methods and techniques.
Good	The student demonstrates a good ability to use and apply appropriate terminology and demonstrates their good depth and breadth of knowledge and understanding with responses that are mostly accurate, clear and are consistent in using; examples, compare with other concepts, methods and techniques.
Pass	The student demonstrates an adequate ability to use and apply appropriate terminology and demonstrates some knowledge and understanding with responses that are sometimes accurate, mostly clear and that may use; examples, compare with other concepts, methods and techniques, however, this is consistent.
Fail / No evidence	The student demonstrates some-limited use of appropriate terminology. There is a lack of evidence of knowledge and understanding. Not all questions attempted.

Practical assessment. This type of knowledge and skills is typically demonstrated via practical laboratory exercises.

Descriptor	Marking criteria
Excellent	The student has answered all questions correctly with an excellent skill, knowledge and understanding demonstrated through the use of a variety of methods and techniques applied in in a unique and original way. All required evidence of the process is presented and evidences an excellent ability to independently interpret results.
Very Good	The student has answered all most all questions correctly with a very good skill, knowledge and understanding demonstrated through the use of a variety of methods and techniques applied in a exploratory way. All required evidence of the process is presented and evidences a very good ability to interpret results.
Good	The student has answered most questions correctly with a good skill, knowledge and understanding demonstrated through the use of the appropriate methods and techniques. All required evidence of the process is presented and demonstrates a good ability to interpret results.
Pass	The student has answered some questions correctly with an adequate skill, knowledge and understanding demonstrated through the inconsistent use of the appropriate methods and techniques. Required evidence of the process is inconsistently presented

Fail	The student has attempted to answer questions. Limited demonstration of skill, knowledge and understanding of appropriate methods and techniques. Required evidence of the process is not present or is limited.

Project assessment. This type of knowledge and skills is typically demonstrated via project work. The project may be excecuted individually or in a team.

Descriptor	Marking criteria
Excellent	The student has produced an excellent project and demonstrated an exceptional grasp of the skill, knowledge, understanding, methods and techniques described in the learning outcomes. They have applied this to produce highly ambitious and original work of excellent quality. Concepts and theories have been highly imaginatively used to generate and then create work-solutions of excellent depth, highly considerate of the practicalities of use/reception. The methods and processes used to produce the work show an extremely high level of problem-solving, exploration and imaginative and meaningful solutions are supported with highly thorough and appropriate research. The work has been communicated and presented in an extremely clear and impressively engaging way. Time and resources have been managed in an exemplary way.
Very Good	The student has exhibited very good skill, knowledge, understanding methods and techniques described in the learning outcomes and has applied this to produce ambitious and original work of very good quality. Ideas and problem-solving have been imaginatively used to generate and create solutions of considerable depth, considerate of the practicalities of use/reception. The methods and processes used to produce the work show a very good level of exploration and imaginative and meaningful solutions backed up with thorough and appropriate research. The work has been communicated and presented in a very clear and engaging way. Time and resources have been very well managed
Good	A good project that demonstrates the student has a good grasp of the skill, knowledge, understanding, methods and techniques specified in the learning outcomes. These are applied to produce work of some ambition and originality. Ideas and problem-solving have been used in producing the work and the practicalities of use/reception have been considered. The methods and processes used to produce the work show that the student has explored different possibilities throughout the work and developed the work-solution with some imagination. A good amount of research has been used to find and substantiate work. Time and resources have been well managed through and the work produced is of a good standard.
Pass	A competent project that shows that the student has a fair grasp of the skill, knowledge, understanding, methods and techniques described in the learning outcomes and has made a reasonable attempt to apply them in producing the work. Although ideas and problem-solving have been used to produce the work- the work is an adequate and/or not a successful response or practical application. The context of use/reception has been partially considered in the work. The methods and processes used to develop the work are competent but lack exploration-experimentation. Research is adequate but lacks breadth and/or depth or is not totally appropriate to the task. The project has been adequately managed and the work produced is technically competent.
Fail	The project may not be without merit but is not of degree level. The skill, knowledge, understanding, methods and techniques as described in the learning outcomes have not been attained. The work is deficient in the way theories and concepts have been used and applied in practice and it evidences minimal development and exploration. The work has been poorly executed and shows little in the way of ideas and imagination.

Written paper. This type of knowledge and skills is typically demonstrated via written reports. The reports may be related to a project work. See above for details on project assessment.

Descriptor	Marking criteria
Excellent	The form and content of the writing is of excellent quality and includes an introduction, main section and concluding remarks. The paper has a clear structure with sections and subsections in a logical order and is grounded in data. The student has demonstrated an excellent understanding of the problem, key concepts and issues with a clear focus built on thorough research, critical analysis and advanced interpretation of ideas and issues. The writing demonstrates a clear argument, has a highly cohesive and coherent structure and consistent and correct referencing of sources throughout. The correct use of language and subject-specific terminology is used very confidently and the findings and/or discussion is

	original, critical and/or creative with practical implications. Under appropriate conditions the work could be worthy of wider dissemination.
Very Good	The form and content of the writing is of a very good quality. The student has evidenced and demonstrated a very good understanding of the problem, key concepts and issues. The focus of the writing is clear and the student uses research, critical analysis and presents a balanced and extremely sound interpretation to support the ideas and issues. The writing is well-structured, well-expressed with a cogent and lucid argument consistently communicated with reference to sources to underpin and position the work. Correct use of language and subject-knowledge terminology is consistently demonstrated throughout the work
Good	The work is good, with the form and content of the paper demonstrating a good grasp of the knowledge, understanding and skills key concepts specified in the learning outcomes. The focus of the work has been identified and addressed in a good way. The student demonstrates a good understanding of the scope of the topic. The research, critical analysis and interpretations of the issues are of good quality, with coherent and sound ideas. The student demonstrates a certain level of ambition and shows some insight and originality. The form, structure and expression of the writing is of a good standard with mostly consistent and correct referencing to sources to support the argument and positioning, and good use of subject-specific terminology and language.
Pass	A competent piece of writing that shows that the student has a fair grasp of the knowledge, understanding and skills described in the learning outcomes. The writing exhibits some understanding of the key concepts and issues of the topic. A reasonable attempt has been made to focus the thesis and to engage with its implications and scope. The research, critical analysis and interpretations of the issues are adequate, with some ideas advanced and some coherence. The work is largely descriptive, demonstrating inconsistent insight and originality. The form, structure and expression of the writing are of an adequate standard and the work overall is adequate in its presentation and use of subject-specific terminology. Referencing to sources is inconsistent.
Fail	The work may not be without merit but is not of degree level. The knowledge, understanding and skills described in the learning outcomes for the most part have not been attained or have not been attained. The work is ill conceived and poorly considered. The work is not of a satisfactory standard in either what it sets out to express or in how it expresses it. The writing is deficient or lacking in a number of ways, ie. key concepts not being identified and/or addressed; research being minimal or non-existent; ideas being poorly formulated and/or substantiated; the writing being unfocused with irrelevant and inappropriate material included. Organisation and presentation are poor and there is limited to no evidence of reference to sources.

Presentation. This knowledge and skill is typically demonstrated by presentations given in class or virtually. However, also video presentations that are not real-time may be assessed here. The presentation may be part of a project work.

Descriptor	**Marking criteria**
Excellent	The presentation is excellent with the student consistently demonstrating an excellent knowledge and understanding of the topic with the use of highly relevant and appropriate information-materials that has been critically analysed and evaluated. Ideas are presented in a clear, concise, coherent and structured way with excellent depth and detail and highly appropriate conclusions. The presentation is within the specified length with excellent use of language that is easy to understand. Use of supporting materials ie. visual aids etc. is excellent and supports the main ideas of the presentation. Verbal communication is of an excellent level with volume, pace, diction and gestures highly considered. The student is highly consistent in their preparation, organisation and their engagement with the audience including; eye contact, and excellent listening skills and addressing audience questions with confidence and accuracy.
Very Good	The presentation is very good with the student consistently demonstrating a very good knowledge and understanding of the topic with the use of relevant and appropriate information-materials that have been critically analysed and evaluated. Ideas are presented in a clear, concise, coherent and structured way with very good depth and detail and highly appropriate conclusions. The presentation is within the specified length with very good use of language that is easy to understand. Use of supporting materials ie. visual aids etc. is very good and supports the main ideas of the presentation. Verbal communication is of a very good level with volume, pace, diction and gestures considered. The student is consistent in their preparation, organisation and their engagement with the audience

	including; eye contact, and very good listening skills and addressing audience questions with confidence and accuracy.
Good	The presentation is good with the student demonstrating a good knowledge and understanding of the topic with the use of relevant and appropriate information-materials that have been mostly critically analysed and evaluated. Ideas are presented in a clear, concise, coherent and structured way with good depth and detail and appropriate conclusions. The presentation is within the specified length with good use of language that is easy to understand. Use of supporting materials ie. visual aids etc. is good and supports the main ideas of the presentation. Verbal communication is of a good level with volume, pace, diction and gestures considered. The student is consistent in their preparation, organisation and their engagement with the audience including; eye contact, and good listening skills and addressing audience questions with confidence and accuracy.
Pass	The presentation is adequate with the student inconsistently demonstrating their knowledge and understanding of the topic. Mostly, but not always, relevant and appropriate information-materials have been used. Ideas are presented but are not consistently clear or have a logical structure and some conclusions are reached. The presentation is not within the specified length and the use of language is not always easy to understand. Use of supporting materials ie. visual aids etc. is not always appropriate or limited. Verbal communication is adequate with inconsistencies in volume, pace, diction and sometimes distracting gestures. The student is inconsistent in their preparation and organisation. Their engagement with the audience including; eye contact, etc is inconsistent and so is there listening skills resulting in difficulty addressing audience questions.
Fail	The presentation is inadequate and the student demonstrates limited-to no knowledge and understanding of the topic. Limited or inappropriate information-materials have been used. Ideas are presented are not in a logical structure and conclusions are lacking. The presentation is not within the specified length and the use of language is not appropriate or relevant. Supporting materials ie. visual aids etc. are not appropriate or limited. Verbal communication is poor with issues of volume, pace, diction and distracting gestures-postures. The student is not prepared and organisation. Their engagement with the audience including; eye contact, etc is limited and there are poor listening skills, an uneasiness and an inability to address audience questions.

3. The skills for the IT-support cloud specialist, EQF 4

The course desription for each skill is presented in the following.

3.1. Serverless Architecture, 6 ECVET

Learning objectives:
Students will be proficient in understanding

- Cloud computing concepts and cloud-based services.
- The cloud deployment model and concept of different cloud models: IaaS, PaaS & SaaS
- The phenomenon of moving towards the cloud
- Cloud Computing Standards
- Interoperability between cloud service providers
- Cloud Security issues
- Implementation architectures and technologies
- Service offerings and terms of use
- Server Technologies and storage technologies
- Deployment and Management of Cloud Services

Contents
Topics to be covered in the course include the following:

- Introduction to Cloud Computing
- Cloud Deployment Models (Public, Private, Hybrid)
- Primary models for Cloud Services (SaaS, PaaS & IaaS)
- Cloud Computing Standards
- Interoperability between cloud service providers
- Cloud Security basics
- Cloud Management and Deployment
- Introduction to major Cloud service platforms (Google, Microsoft, Amazon)

Learning materials

- Business College Helsinki - itsLearning course materials
- Google Cloud Training - https://cloud.google.com/training/
- Microsoft Learn – https://docs.microsoft.com/en-us/learn/paths/az-900-describe-cloud-concepts/
- AWS Fundamentals - https://aws.amazon.com/getting-started/fundamentals-core-concepts/

3.2. Artificial intelligence and Machine learning, 3 ECVET

Learning objectives:
Students will be proficient in understanding

- The concept of Artificial Intelligence.
- A.I. applications and use cases and how A.I. is transforming our lives
- Terms like Machine Learning, Deep Learning and Neural Networks
- Be able to describe several issues and ethical concerns surrounding AI
- Robotics and automation solutions and how they effect everyday life
- Basics of VR / AR / XR technology
- Basics of blockchain and cryptocurrencies

Contents
Topics to be covered in the course include the following:

- Artificial Intelligence principles
- Basic principles of NLP and Chatbot implementation
- Robotics and robots
- AI's life and business implications including ethical and social challenges (Ethics of AI)
- Understanding the value and recognizing building blocks in cognitive services including AI powered visual analytics
- Advanced Analytics, Data Driven Society, Social Physics (Big Data & Data analytics)
- VR / AR / XR

- Blockchain basics and cryptocurrencies

Learning materials

- Business College Helsinki – itsLearning course materials
- Teachable machine tutorials - https://teachablemachine.withgoogle.com/train
- Dihub Online learning materials – https://courses.dihub.cloud/course/introduction-to-artificial-intelligence/

3.3. Programming, 3 ECVET

Learning objectives:

Students will be proficient in understanding

- Basic coding skills
- Working with variables and data types
- How to work numeric data
- How to work with string data
- How to write simple programs in Python
- Simple program structures (conditions and loops)
- Basic functions in programs

Contents

Topics to be covered in the course include the following:

- Introduction to Python
- Information from the user
- Variables
- Arithmetic operations
- Conditional statements
- Programming terminology
- Combining conditions
- Simple loops
- Programming terminology
- Combining conditions
- Simple loops
- Working with strings
- Defining functions

Learning materials

- Helsinki University MOOC materials - https://programming-22.mooc.fi/
- Business College Helsinki – itsLearning course materials

3.4. DevOPS, 3 ECVET

Learning objectives:

- Can explain what images and containers are and how they're related. Can build images with Docker for existing projects and run them.
- Run containerized applications
    - Containerize applications
    - Utilize volumes to store data persistently outside of the containers.
    - Use port mapping to enable access via TCP to containerized applications
    - Share your own containers publicly
- Can utilize SCRUM -method in project work
- Understand the basics of service design and can utilize the service design concept in service planning
- Can work, communicate and co-create in a development team efficiently and collaboratively

Contents

- DEVOPS definitions and basic concepts
- Running and stopping containers
- In-depth dive to images

- Defining start conditions for the container
- Interacting with the container via volumes and ports
- Utilizing tools from the Registry
- Basics of SCRUM-method; using Trello
- Basics of Service design
- Basic team working and documentation skills

Learning materials

- https://devopswithdocker.com/part-1
- https://scrumguides.org/scrum-guide.html
- https://www.interaction-design.org/literature/topics/service-design
- https://www.emergeinteractive.com/insights/detail/why-co-creation-is-the-new-collaboration/

3.5. Google Cloud Platform fundamentals, 6 ECVET

Learning objectives:

Students will be proficient in understanding:

- Identify the purpose and value of Google Cloud products and services
- Interact with Google Cloud services
- Describe ways in which customers have used Google Cloud
- Choose among and use application deployment environments on Google Cloud
- Use Google Cloud storage options
- Make basic use of BigQuery, Google's managed data warehouse for analytics.
- Make basic use of Google Cloud Deployment Manager

Contents

- Cloud Computing vs On-Premise
- Cloud Identities
- Google Cloud Platform resource hierarchy
- Virtualization & Virtual Machines (VM)
- Basics of IAM
- Google Cloud Big Query
- Google Cloud Total Cost of Ownership (TCO)
- Introduction to App Engine
- Basics of Cloud Storage

Learning materials

- Business College Helsinki - itsLearning course materials
- Google - https://cloud.google.com/training

3.6. Microsoft Azure fundamentals, 6 ECVET

Learning objectives:

Students will be proficient in understanding:

- Understand the benefits of cloud computing in Azure
- Explain different cloud concepts (high availability, scalability, elasticity, agility, disaster recovery)
- Describe core Azure architecture components (subscriptions, management groups, resources, resource groups)
- Summarize geographic distribution concepts (Azure regions, region pairs, availability zones)

Contents

- Introduction to core Azure fundamentals
- Core Azure services (AI machine learning, Azure DevOps, monitoring fundamentals, management fundamentals, serverless computing fundamentals and IoT fundamentals)
- Basics of Azure AD
- Azure solutions and management tools
- Basics of Azure security
- Identity, privacy and compliance features

- Azure cost management (Plan and manage your Azure costs)

Learning materials

- Business College Helsinki - itsLearning course materials
- Microsoft Learn for Azure https://docs.microsoft.com/fi-fi/learn/azure/
- Microsoft Azure Fundamentals: Describe core Azure concepts https://docs.microsoft.com/en-us/learn/paths/az-900-describe-cloud-concepts/

3.7. Google Workspace fundamentals, 6 ECVET

Learning objectives:

Students will be proficient in understanding:

- Google Docs
- Google Sheets
- Google Slides
- Google Calendar
- Google Drive
- Google Meet
- Google Chat

Contents

- Administrating Google Workspace services
- Define and modify services in Google Workspace
- Understand licensing & TOC
- Basics of AD, Google Cloud computing and servers

Learning materials

- Business College Helsinki - itsLearning course materials
- Google - https://workspace.google.com/training/

3.8. M365/O365 fundamentals, 6 ECVET

Learning objectives:

Students will be proficient in understanding:

- Understand M365 license models and their costs
- Implement M365 services in the admin role
- Define and make changes in the M365 management environment
- Understand the benefits and uses of the end user for M365 services
- Understand in principle the following concepts and how they are related: M365, AD, AZURE, Cloud, Servers

Contents

- Administrating M365 services
- Define and modify services in O365/M365 admin portal
- Azure AD Directory
- Administer users
- Understand licensing
- Basics of Cloud Identity, Cloud computing and servers
- Introduction to SharePoint
- Introduction to Power Apps

Learning materials

- Business College Helsinki - itsLearning course materials
- Microsoft Learn for Microsoft 365 - https://support.microsoft.com/en-us/training

3.9. Security, 6 ECVET

Learning objectives:

- Protect devices with updates and software
- Manages devices with management tools
- Compares different encryption methods and selects the appropriate encryption method
- Monitors the data network using various analysis tools
- Scans for vulnerabilities in the hosted network under review
- Can verify system vulnerabilities
- Makes development proposals to improve cybersecurity
- Is familiar with laws, regulations and other official regulations related to data security and data protection
- Illustrates cyber threats and related risks
- Provides guidance on cyber security or privacy issues

Contents

- Check for device updates
- Antivirus and firewalls
- Disk Encryptions
- Computer management
- Group policies
- Cryptography and encryption
- Nmap / Zenmap
- Wireshark
- Security onion
- Sql Injections
- Metasploit, Armitage
- Social engineering
- GDPR, Katakri, ISO 27000
- SSL

Learning materials

- Business College Helsinki - itsLearning course materials

4. The specialist skills for the cloud job roles, EQF 6

The course desription for each skill is presented in the following. They are ordered as presented in the Figure 2, from the technical skills to the soft skills, passing through the business skills. For each skill, we give the learning objectives, contents, assessment criteria and learning materials. The assesment criteria are explained in datil in the Section 2.3 above. Execution methods are not described at all because they vary depending on the mode of delivery of the course that is related to the skill. For example, if a course is delivered via a MOOC, the execution methods are very different from the execution methods in a traditional classroom setting.

4.1. Virtualization, 8 ECTS

Learning objectives

Upon successful completion of this course, the student should be able to:

- Identify the ICT infrastructure and functionalities
- Recognize information networks and networked services operating principles.
- Identify security threats.
- Operate in network- and system environments considering information security.
- Understand the cloud service implementation technologies and principles
- Knows the services contract practices
- Evaluate and choose the company's cloud service solutions
- Knows how to use and manage Cloud Services

Contents

Topics to be covered in the course include the following:

- Topic areas covering the course project work
- hardware configurations and interfaces
- Operating systems: windows and linux
- Workstations and servers
- Information security, anti-virus programs, malware, network security
- Data network structure and functions.
- Tcp / ip protocols, networking devices.
- Cloud services technologies, iaas, paas, saas
- Implementation architectures and technologies
- Service offering and terms of use
- Server virtualization and application virtualization
- Server technologies and storage technologies
- Deployment and management of cloud services

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Essential reading

- Syrewicze, A., Siddaway, R. (2018) Pro Microsoft Hyper-V 2019, One New York Plaza, Suite 4600, New York, NY 10004-1562, Apress Media.

Recommended reading

- Graves, J., Stidley, J. (2017) Exam Ref 70-745 Implementing a Software-Defined DataCenter, [s.l.] Microsoft Press.
- Patel, H. (2021) Exam Ref AZ-104 Microsoft Azure Administrator [s.l.], Microsoft Press.

4.2. Database Management, 6 ECTS

Learning objectives

Upon successful completion of this course, the student should be able to:

- Explain the basic concepts and terminology of data management and databases
- Explain the principles, structure, and terminology of the relational database
- Explain the dbms services and their importance and value in software development
- Explain what database transaction is and why it has a crucial role in reliable software systems
- Explain the database design methodology
- Use data-oriented er diagrams and database diagrams written in uml
- Create a small and simple database in sql server and mariadb
- Write intermediate-level sql queries to retrieve and manipulate the database's data.
- Explain the basic concurrency mechanisms and concurrency conflicts
- Use SQL transactions efficiently to ensure database performance and consistency
- Explain transaction logging and database recovery
- Perform database backup and restore operations.

Contents

Topics to be covered in the course include the following:

- Basic concepts and terminology of data management and databases
- Principles, structure, and terminology of the relational database
- Dbms services and their importance and value in software development
- Database transactions
- Database design methodology
- Data-oriented er diagrams and database diagrams written in uml
- Creating create a small and simple database in sql server and mariadb
- Writing intermediate-level sql queries to retrieve and manipulate the database's data.
- Data integrity enforcement
- Database performance, database indexes
- Concurrency control and transaction management in the multi-user environment
- Transaction logging and database recovery, backup and restore
- Database security.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- Connolly, T. & Begg, C. Database Systems. Addison Wesley Longman, London. 3rd edition or later SQL Zoo online SQL tutorial and W3Schools online SQL tutorial

For additional reading:

- Dewson, R. Beginning SQL Server for Developers: From Novice to Professional. New York: Springer-Verlag New York Inc. (SQL Server version 2008 edition or later)
- Course handouts take away
- Starting level and linkage with other courses

The student has completed the course Orientation to Software Engineering (SWD1TF001), or can demonstrate equivalent skills and knowledge. In addition, the course Orientation to ICT Infrastructures (ICT1TF010) is recommended to be completed before taking the Data Management and Databases course.

4.3. Serverless Architecture, 6 ECTS

Learning objectives

Upon successful completion of this course, the student should be able to:

- Describe how cloud adoption transforms the way IT systems work
- Describe the benefits of cloud computing with Amazon Web Service
- Discuss how to design systems that are secure, reliable, high-performing, and cost-efficient
- Describe principles to consider when migrating or designing new applications for the cloud
- Identify the design patterns and architectural options applied in a variety of use cases
- Define high availability, fault tolerance, and scalability
- Discuss how to avoid single points of failure
- List AWS services that have built-in fault tolerance or can be designed for fault tolerance
- Describe why load balancing is a key architectural component for AWS-powered applications
- Identify the benefits of Infrastructure as Code
- Describe how to leverage the capabilities of AWS to support automation
- Create, manage, provision, and update related resources using AWS CloudFormation
- Articulate the importance of making systems highly cohesive and loosely coupled
- Describe system coupling to support the distributed nature of applications built for the cloud
- Describe database services for storing and deploying web-accessible applications
- Compare structured query language (SQL) databases with NoSQL databases
- Describe how the AWS Well-Architected Framework improves cloud-based architectures
- Describe the business impact of design decisions
- Identify the design principles and best practices of the Operational Excellence pillar
- Describe how to secure data at every layer in the application
- Describe the appropriate tools and services to provide security-focused content
- Describe the design principles and best practices of the Reliability pillar.
- Select compute, storage, database, and networking resources to improve performance
- Evaluate the most important performance metrics for your applications
- Follow best practices to eliminate unneeded costs or suboptimal resources
- Troubleshoot common errors

Contents

AWS Academy Cloud Architecting covers the fundamentals of building IT infrastructure on AWS. The course is designed to teach solutions architects how to optimize their use of the AWS Cloud by understanding AWS services and how they fit into cloud-based solutions. Although architectural solutions can differ depending on the industry, type of application, and size of the business, this course emphasizes best practices for the AWS Cloud that apply to all of them. It also recommends various design patterns to help you think through the process of architecting optimal IT solutions on AWS. Throughout the course, students will explore case studies that showcase how some AWS customers have designed their infrastructures and the strategies and services that they have implemented. Finally, this course provides opportunities for students to build a variety of infrastructures through a guided, hands-on approach.

Execution methods

- Online
  APL (Accreditation of prior learning):
- Student provides the corresponding valid AWS Certification (AWS Cloud Solutions Architect Associate)
- Student delivers 30 minutes presentation to other participants of course implementation, on his/her work role relating to cloud computing.
- Student must pass the written final exam of the course to get a grade

Learning materials

- Full AWS Academy Cloud Solutions Architect Associate Certification Preparation Course with access to AWS Digital Certification materials and labs

- After completing the course, the student knows cloud computing architectures and applications. Full AWS Academy Cloud Solution Architect Associate Certification Preparation Course with access to AWS Digital Certification materials and labs. At completion of the course students are offered one 50% discount voucher for AWS Cloud Solution Architect certification.
- Starting level and linkage with other courses

Course prerequisites:

- A prior completed Cloud technologies or Cloud Services Course or AWS Cloud Practitioner Certificate
- Student can install and administer Windows or Linux-servers and IP-networks.
- Student should have hands on experience and working knowledge of SME Corporate IT-services Recommended skills prior attending: Cisco RSCCNA 1 version 6.x or later; Linux operating systems; Windows server administration

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- The course web page
- Online material
- Other appropriate materials, handouts

4.4. Security, 6 ECTS

Learning objectives

Upon successful completion of this course, the student should be able to:

- Understand the needs of enterprise information security and the importance of risk management
- Be familiar with the laws and regulations related to information security
- Identify company's security risks
- Know the company's security policies
- Protect against security risks

Contents

Topics to be covered in the course include the following:

- Security and Risk Management
- Protection of information assets
- Security Engineering
- Communications and Network Security
- Identity and Access Management
- Security Assessment and Testing
- Security Operations
- Security in the Software Development
- OWASP

Execution methods

- Teaching 48 h
- Independent study 87 h
- The assessment of one’s own learning 1 h
- Studying includes lectures and exercises

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams
- Example: theoretical and practical assessment

Learning materials

- The course web pages
- Online material
- Mark Ciampa: CompTIA Securtiy+ SY0-401 in Depth, Cengage Learning PTR, 2014. (Safari Books Online)
- Adam Gordon: Official (ISC)2 Guide to the CISSP CBK, CRC Press, 2015. (Safari Books Online)
- Andress, J., (2015). The basics of information security. Waltham: Syngress.
- Rhodes-Ousley, M. (2013) Information Security: The Complete Reference. 2nd edn. New York: McGraw-Hill Education.
- Liu, V. and Sullivan, B. (2011) Web Application Security, A Beginner’s Guide. New York: McGraw-Hill Education.

Recommended reading:

- Brooks, C., Grow, C., Craig, P. and Short, D., (2018). Cybersecurity Essentials. Hoboken: John Wiley & Sons.
- Chell, D. (2015) The Mobile Application Hacker’s Handbook. Indianapolis: John Wiley & Sons.
- Kim, P. (2018) the Hacker Playbook 3. Arlington: Createspace.

4.5. Cloud Deployment (Multicloud), 8 ECTS

Learning objectives

Upon successful completion of this course, the student should be able to:

- Able to use and further learn software development, version management and project management tools and techniques needed on the Software Project course.
- Topics included: Software Development, Database, Version management and team work management tools and technologies. Contents change for each semester depending on the need.

Contents

Topics to be covered in the course include the following:

- Argue the management of objects in the cloud
- Critically argue managing objects in the cloud
- Support security settings and subscription concepts
- Recommend security settings and subscription concepts
- Assess the use of storage space, computer resources and virtual networks
- Suggest options for the use of storage space, computer resources and virtual networks
- Argue management of advanced storage settings
- Suggest options for management of advanced storage settings
- Support the management of advanced virtual network solutions settings
- Suggest options for management of advanced virtual network solutions settings
- Support monitoring and backup in cloud solutions
- Defend stance for monitoring and backup in cloud solutions

Execution methods

- Contact lessons, assignments, case assignment, and independent studies OR
- Self-study, assignments, case assignment, and written examinations OR
- On-the-job learning, portfolio, and written examinations.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- Foulds, I. (2020) Learn Azure in a Month of Lunches, 20 Baldwin Road, PO Box 761, Shelter Island, NY 11964, Manning Publications.
- Lakhera, P. (2021) AWS for System Administrators, Livery Place, 35 Livery Street, Birmingham B3 2PB, UK, Packt Publishing.

Recommended reading:

- Patel, H. (2021) Exam Ref AZ-104 Microsoft Azure Administrator [s.l.], Microsoft Press.
- Artasanchez, A. (2021) AWS for Solutions Architects, Livery Place, 35 Livery Street, Birmingham B3 2PB, UK, Packt Publishing.

4.6. Hybrid Cloud, 8 ECTS

Learning objectives:
Upon successful completion of this course, the student should be able to

- Acquire the knowledge of basic concepts in cloud administration
- Create a cloud-based environment that will be appropriate for a company that wants to use public cloud infrastructure
- Learn the knowledge and understanding of administering cloud solutions like microsoft azure and amazon aws.

Contents:
As companies of all sizes are increasingly using cloud it is becoming absolutely essential to have the know-how to administer and engineer appropriate and relevant hybrid cloud solutions and networking with security being a key focus.

It is important for students to take this module because cloud is used by startups/small companies and enterprise companies alike, and cloud market penetration makes it absolutely critical for students to gain knowledge and understanding of cloud administration and engineering skills. This module will expose students to practical aspects of managing hybrid cloud infrastructure for different, pre-assigned scenarios.

Topics to be covered in the course include the following:

- Managing cloud objects in a chosen hybrid cloud solution
- Using subscriptions and security settings in a chosen hybrid cloud solution
- Configure and use storage, networking and compute in a chosen hybrid cloud solution
- Advanced settings for storage and networking for a chosen hybrid cloud solution
- Monitoring, backup and disaster recovery for a chosen hybrid cloud solution

Execution methods

- The studies consist of classroom teaching and the student's independent study.
- Project work and lectures, OR
  Working life project or project participation
- Accreditation of prior learning (APL) is observed on the course according to separate instructions.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- The course web page
- Online material
- Other appropriate materials, handouts

Essential reading:

- Mulder, J. (2020) *Multi-Cloud Architecture and Governance*, Livery Place, 35 Livery Street, Birmingham B3 2PB, UK, Packt Publishing.

Further reading:

- Patel, H. (2021) Exam Ref AZ-104 Microsoft Azure Administrator [s.l.], Microsoft Press.
- Artasanchez, A. (2021) AWS for Solutions Architects, Livery Place, 35 Livery Street, Birmingham B3 2PB, UK, Packt Publishing.

4.7. DevOps, 8 ECTS

Learning objectives:
Upon successful completion of this course, the student should be able to

- Can explain what is DevOps and the advantages it brings to software businesses.
- Can explain the Culture Automation Measurement Sharing (CAMS) model.
- Can explain the key reasons behind automation and how it is achieved with DevOps.
- Knows the continuous delivery and deployment pipelines.
- Can use the git version control system in a simple setting.
- Knows how to use Hugo to create a simple static website.
- Knows how to use GitHub actions to automate software workflows.
- Can explain what images and containers are and how they're related. Can build images with Docker for existing projects and run them.
- Can manage complex multi-container applications with docker-compose.
- Can optimize images sizes and security for production. Knows why docker-compose is not an optimal production solution and what is.

Contents:
Topics to be covered in the course include the following:

- What is DevOps and the advantages it brings to software businesses.
- The Culture Automation Measurement Sharing (CAMS) model and discusses the first term: culture.
- The Culture Automation Measurement Sharing (CAMS) model and discusses the second term: automation.
- The key reasons behind automation and how it is achieved with DevOps.
- Continuous delivery and deployment pipelines.
- The use of the git version control system to the extent that is needed for this course.
- How to use Hugo to create a simple static website.
- How to use GitHub actions to automate software workflows.
- This part introduces containerization with Docker and relevant concepts such as image and volume.
- This part introduces container orchestration with docker-compose and relevant concepts such as docker network.

This part introduces production-ready practices such as container optimization and deployment pipelines. We'll also familiarize ourselves with other container orchestration solutions:

Execution methods:
Virtual, independent learning.
Discussion forum is available.
Completing all of the required exercises and the project work.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials:
Mastering DevOps [Video]
https://www.packtpub.com/product/mastering-devops-video/9781786468048
Materials available through links at https://devopswithdocker.com/

Further Information:
Teachers can freely use the Docker course in their own implementations under certain conditions. For more information, see here: https://www.mooc.fi/en/teachers/

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

4.8. Application migration strategies, 8 ECTS

Learning objectives:
This module introduces students to the fundamentals of application migration strategies.

Students will learn about:

- Web application functionalities, usage, and most common behaviour.
- Progressive Web application
- How to use mobile oriented libraries and follow the latest development standards.
- How to structure a highly scalable project that can serve as a personal framework for developing further cloud applications.
- Architectural pattern usage (MVC)

The module is taught through integration of theory, know-how and individual practical learning and problem solving. The module assessment is based on individual student projects, and homework with individual approach. Individual student project is based on an individual practical approach to creation of a web application by using an open-source framework and applying learned techniques and methods.

This module is a part of the front-end core of the study, actively taking students through multimedia solution development, specifically focusing on Web applications. Skills learnt in this module will contribute significantly to other subsequent front-end core module.

Contents:
Topics to be covered in the course include the following:

- How to use mobile oriented libraries and follow the latest development standards.
- How to structure a highly scalable project that can serve as a personal framework for developing further cloud applications.
- Valorise simple web application.
- Valorise and choose the appropriate elements of a complex web application.
- Create simple REST API as part of web application
- Reconsider appropriate elements of REST API and create complex REST API as part of web application
- Create a simple front-end web application in an open-source JavaScript library
- Reconsider appropriate elements of front-end web application and create complex front-end web application in an open-source JavaScript library

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

The homework aims to encourage students to work independently and to provide their work in a timely manner. In each homework, students will typically have a one or two practical problems. Students are asked to solve each problem and submit the work before deadline to achieve points. Students individually work on the project during the whole semester. Students are expected to create a web application by using an open-source framework.

Learning materials

Essential reading:

- Banks. A. and Porcello. E.(2020) Learning React: Modern Patterns for Developing React Apps. Sebastopol: O'Reilly Media
- Biilmann, M. and Hawksworth, P. (2019) Modern Web Development on the JAMstack. Sebastopol: O'Reilly Media

Recommended reading:

- Zammetti, F. (2020) Practical JAMstack: Blazing Fast, Simple, and Secure Web Development, the Modern Way. New York: Apress.

- Pecoraro, V. and Gambino, V. (2021) Jumpstart Jamstack Development. Birmingham: Packt Publishing.

Further reading:

- Frain, B. (2020). Responsive Web Design with HTML5 and CSS: Develop future-proof responsive websites using the latest HTML5 and CSS techniques. 3rd Edition. Birmingham: Packt Publishing.
- Jobsen, B. (2016) Sass and Compass Designer's Cookbook. Birmingham: Packt Publishing
- Jakobus, B. and Marah, J. (2018) Mastering Bootstrap 4 - Second Edition. Birmingham: Packt Publishing
- Moreto, S. (2016) Bootstrap 4 By Example. Birmingham: Packt Publishing

4.9. Programming, 12 ECTS

Learning objectives
Upon successful completion of the course the student is able to:

- Explain the software engineering profile and the rough contents of its courses
- Communicate the components and phases of software engineering (software development)
- Create simple program logic and write the code in javascript
- Create web pages that contain simple functionality implemented with browser programming
- Use the needed development tools and publish the pages on a web server.
- Use technical documentation while needing information or help.
- Explain basic concepts and terminology of the java programming language and object-oriented programming
- Design and write small and simple java programs in the object-oriented way
- Use an ide for writing and debugging java programs

Contents
Topics to be covered in the course include the following:

- Software engineering; goals, main concepts, and challenges
  main phases/disciplines in software engineering processes
- Few methods and models visualizing the software development work in practice
- Main principles for creating technically sound web pages (with html5 and css)
- Development environment and publishing the web site on a web server
- All linkages between the web page and the javascript program
- Designing and implementing simple programming logic (with javascript, i.e. Ecmascript)
- Using following features of the programming language: selection and repetition structures, arrays and Functions
- The technical documentation needed in basic web development and the ways to utilize it
- The java language, java api, jdk, jre, and ide
- Creating, running, and debugging small stand-alone java programs in a modern ide
- Java program structure and life cycle
- Elementary programming techniques in java
- Console input and output
- Data types, variables, and type conversions
- Statements, expressions, and operators
- Control structures
- Sub-programs (methods)
- Exception handling
- String handling and regular expressions in java
- Manipulating aggregate data structures
- Arrays and lists
- Object-oriented thinking
- Object-oriented programming with classes and objects

Execution methods
Individual activity is emphasized. Students will also learn how to learn technical issues. That must be the main goal of the first semester studies.

Learning materials
w3schools HTML tutorial
w3schools JavaScript tutorial
Recommended textbooks (any edition will do):

- Lewis & Loftus: Java Software Solutions
- Deitel & Deitel: Java. How to Program
- Liang, Daniel Y. Introduction to Java Programming and Data Structures. Pearson.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

4.10. AI & ML, 10 ECTS

Learning objectives
Upon successful completion of the course the student is able to:

- Interpret the definition of a range of neural network models.
- Be able to derive and implement optimisation algorithms for these models
- Interpret neural implementations of attention mechanisms and sequence embedding models and how these modular components can be combined to build state-of-the-art NLP systems
- Be able to implement and evaluate common neural network models for language
- Interpret model selection process in order to describe a particular type of data
- Evaluate a learned model in practice
- Interpret the mathematics necessary for constructing novel machine learning solutions
- Be able to design and implement various machine learning algorithms in a range of real-world applications
- Interpret fundamental ideas behind cloud computing, the evolution of the paradigm, its applicability benefits, as well as current and future challenges;
- Interpret basic ideas and principles in data centre design; cloud management techniques and cloud analytics deployment considerations
- Evaluate the economics of cloud computing
- Accurately evaluate distributed computing challenges and opportunities and apply this knowledge to real-world projects
- Introduce students with cloud analytic concepts and general insights into analytical services in the cloud, including also 3 major market players (e.g. IBM, Oracle and Microsoft).
- can recognize ethical challenges related to applying AI in business
- can apply a machine learning method in a business case

Contents:
Machine learning forms the foundation of today's data science. Data processing by machine learning methods results in a predictive model, but applications are far wider than the prediction itself, so machine learning is used for any input and output mapping that is too hard to manually input or for which there are no clearly defined rules to be entered, or these rules change too often. Machine Learning is divided into supervised, uncontrolled and awarded. This module will deal primarily with supervised machine learning, although the part will be dedicated to uncontrolled. Awarded learning is part of advanced topics, and this topic will be discussed in other modules.

In this module students will learn how to manage data analytics and cloud computing to help direct business strategy to optimize resources and maximize profits. Ideally data analytics helps eliminate much of the guesswork involved in trying to understand clients, instead systemically tracking data patterns to best construct business tactics and operations to minimize uncertainty. Not only does analytics determine what might attract new customers, often analytics recognizes existing patterns in data to help better serve existing customers, which is typically more cost effective than establishing new business. It is important for students to take this module to be able to manage ever-changing business world subject to countless variants in cloud empowered analytics solutions. Analytics gives companies the edge in recognizing changing climates so they can take initiate appropriate
action to stay competitive. Alongside analytics, cloud computing is also helping make business more effective and the consolidation of both clouds and analytics could help businesses store, interpret, and process their big data to better meet their clients' needs.

Topics to be covered in the course include the following:

- Evaluate the strengths and weaknesses of machine learning algorithms
- Appraise the suitability of a machine learning algorithm to solve a given problem
- Formulate appropriate methodologies to evaluate the accuracy and robustness of machine learning algorithms.
- Implement machine learning algorithms to solve classification and regression problems.
- Develop predictive models with machine learning algorithms.
- Design unsupervised clustering programs based on machine learning algorithms.
- Choose one problem and describe most common algorithm to solve that problem.
- Choose the best algorithm to solve each problem.
- Identify components of selected machine learning algorithms.

- Critically judge the components of selected machine learning algorithms.
- Explain process of feature reduction using machine learning algorithms.
- Evaluate the impact of different feature reductions using machine learning algorithms.
- Choose one problem and describe steps in solution for that problem using machine learning
- Apply the selected machine learning method to the given problem.
- Define steps in most common basic depth learning algorithms
- Explain how the basic depth learning algorithms work.
- Explain changes in information during passage through an artificial neuron.
- Critically judge changes in information during passage through an artificial neuron.
- Explain impact of different components of deep neural architectures
- Evaluate the impact of different components of deep neural architectures.
- Describe steps in selected project based on deep learning architecture for specific business problem.
- Apply the chosen deep learning architecture to the problems.

Students learn to identify and understand basic algorithms for automatic data processing.

It is important for students to take this module in order to adopt basic machine learning algorithms and basic techniques of their optimization, as well as the methods of reduction of features, needed for other modules in this study programme. Students learn to build and maintain machine learning models including deep learning models, today the most important machine learning method used in the world's most important production systems for various tasks. Through this module, students will acquire and implement basic deep learning techniques on examples from natural language processing such as machine translation, sentiment analysis, and recognition of named entities. Also, the module will handle deep and awarded learning. It is important for students to take this module in order to enable students to deepen their understanding of mathematics and algorithms of deep neural architecture and deep learning, as well as acquire practical knowledge to implement deep learning. Students will acquire the skills of designing deep architecture in TensorFlow, as well as hand-made deep neural networks that can be implemented later in any programming language.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- James, G., Witten, D., Hastie T., Tibshirani R. (2017) Introduction to Statistical Learning, New York: Springer-Verlag
- Skansi, S. (2018) Introduction to Deep Learning, Cham: Springer International Publishing
- Getting started with Artificial Intelligence by Tom Markiewicz and Josh Zheng, O'Reilly Media, 2018.

Recommended reading:

- Géron, A. (2019) Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Massachusetts: O'Reilly
- Goodfellow, I., Bengio, Y., Courville, A. (2016) *Deep Learning (Adaptive Computation and Machine Learning series),* Cambridge: MIT Press, available at https://arxiv.org/abs/1609.08144

4.11. Automation, 6 ECTS

Learning objectives

This module introduces students to automationthat is acieved in business through a use cases such as marketing and pobotic process automation (RPL). The student knows the fundamentals of CRM and marketing automation both in theory and practice.

The objectives of this module are to enable students to:

- Principles and methodologies of cloud-based automation,
- Critically assess cloud functionalities to support business goals,
- Recommend optimal tool that will support business processes,
- Evaluate trends and challenges in cloud-based automation.

Throughout the semester students will be exposed to business cases and s scenarios where the usage of cloud and complimentary tools add value to business processes. Students will learn where, how, and why cloud technologies are used, how to detect opportunities for such implementation and usage, and have a deep understanding of the overall market and global trends and importance of such platforms. Furthermore, additional emphasis will be on low code/no code platform as a foundation for cloud tools. Both lectures and practical part of this module is based on real life examples from local market and global examples how to/not to approach to cloud while working and discussing on latest cases across industries.

Transferable skills acquired through this module will make an excellent addition to the core marketing skills developed through other modules and they will contribute significantly to students' development as complete business professionals. Module will prepare them both as practitioners and experts.

Contents:

Topics to be covered in the course include the following:

- Determine how automation adds value in integrated and complex business processes.
- Evaluate the impact of automation implementation on business in a given example.
- Evaluate cloud technology and solution for required business process.
- Prioritize cloud automation functionality modules for required business processes and determine the implementation plan according to given business goals.
- Argue cloud project management plan within defined business process.
- Determine cloud project implementation and management plan for integrated business processes.
- Critically evaluate the importance of marketing strategy in the MAT context, recognize challenges and requirements.
- Create and implement successful automation strategy, recognize challenges and offer the best solution for successful implementation.
- Conclude the difference among available low code/no code solutions and successfully apply them in practice.
- Create low code/no code applications and successfully integrate them into existing cloud environment.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- Baran, R. J. & Galka, R. J. (2017) Customer Relationship Management: The Foundation of Contemporary Marketing Strategy, New York, NY: Routledge
- Microsoft Inc. (2021) Microsoft Dynamics 365 training [Online]. Available at: https://docs.microsoft.com/en-us/dynamics365/get-started/training/ (Accessed 10 May 2021)
- Salesforce (2021) Trailhead [Online]. Available at: https://trailhead.salesforce.com/en/home (Accessed 10 May 2021)
- Salesforce (2021) Learning Centre [Online]. Available at: https://www.salesforce.com/eu/learning-centre/ (Accessed 10 May 2021)
- HubSpot (2021) HubSpote Learning Center [Online]. Available at: https://app.hubspot.com/ (Accessed 10 May 2021)

Recommended reading:

- Powerobjects (2021) Dynamics 364 University Training Catalog [Online]. Available at: https://powerobjects.com/courses/ (Accessed 10 May 2021)

- Buttle. F. & Maklan, S. (2019a) Customer Relationship Management, 4th edn, Abingdon, OX: Routledge

Further reading:

- Fatouretchi, M. (2019) The Art of CRM: Proven strategies for modern customer relationship management, Birmingham: Pactk Publishing
- Peelen, E. (2013) Customer Relationship Management, 2nd edn, London: Pearson Education
- Parekh, L (2021) Cracking the CRM Code: How to Prevent Failures in Buying, Implementing and Using CRM, Chenai: Notion Press

4.12. Project management in software development, 6 ECTS

Learning objectives
This module introduces students to the project approach of software application development and provides an overview of methods, techniques, and practices to use during the development process.

Upon successful completion of the course the student is able to:

- The different aspects of working on a software development project
- The various roles, responsibilities of a team
- The importance of teamwork for a project to succeed.
- How to gather and structure functional and non-functional requirements based on client's needs.
- How to organize work in project teams
- How to monitor the execution of tasks.
- How to test and improve the quality of the software application.

Contents:
Students can use any programming language, tool and platform they choose. The module assessment is based on group student projects. In these projects, students must create the functional specification and the application to solve the given problem.

Topics to be covered in the course include the following:

- Independently create a functionality specification document based on collected and ranked user requests.
- Independently create a functionality specification document based on collected and ranked user requests and formatted according to good practices.
- Design the application according to the given architecture.
- Design the application and the workflow through it according to the given architecture.
- Design programming tasks based on user requirements and recommend their distribution by project iterations.
- Design fine-grained programming tasks based on user requirements and recommend their distribution by project iterations.
- Use the basic functionalities of the selected versioning system in the project team.
- Use the advanced functionalities of the selected versioning system in the project team.
- Independently apply different types of functionality and application characteristics testing.
- Independently apply different types of automated functionality and application characteristics testing.
- Independently create a basic user manual document for a given application.
- Independently create an advanced user manual document for a given application.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- Rothman, J. (2017) Create Your Successful Agile Project: Collaborate, Measure, Estimate, Deliver. 1st edn. Raleigh: Pragmatic Bookshelf.

Recommended reading:

- Stark, E. (2014) Agile Project Management QuickStart Guide: A Simplified Beginners Guide To Agile Project Management. Scotts Valley: CreateSpace Independent Publishing Platform.

4.13. Performance testing, 6 ECTS

Learning objectives
Upon successful completion of the course the student is able to:

- How to design and implement software solutions, which are valuable skills for their future challenges as software architects.
- How to identify the need to apply appropriate design patterns in the data, business, and presentation application layer.

This module is built to develop more knowledge in performance testing. Module will be presented through an enterprise network environment that have to poerform 24x7x365. Goal it to provide student with knowledge and ability to assess a testing skills across a broad spectrum of real-world postures.

Contents:
Topics to be covered in the course include the following:

- Advanced Windows attacks
- Attacking IOT systems
- Writing exploits
- Bypassing a filtered network
- Testing operational technology
- Access hidden networks with pivoting and double pivoting
- Privilege escalation
- Evading defence mechanisms
- Attack automation with scripts
- Weaponization
- Writing professional reports.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

1. Walker M., 2019, *CEH Certified Ethical Hacker All-in-One Exam Guide*, 4th Edition, New York: McGraw-Hill Education
2. Stuttard, D. and Pinto, M., (2011). *The web application hacker's handbook*. Indianapolis: Wiley.
3. Litchfield, D., (2005). *The database hacker's handbook*. Indianapolis: Wiley.
4. [Anon.] (2021), *WSTG - v4.1*. Available at: https://owasp.org/www-project-web-security-testing-guide/v41/ (Accessed: 2 May 2021).
5. [Anon.] (2021), *OWASP Top Ten Web Application Security Risks*. Available at: https://owasp.org/www-project-top-ten/ (Accessed: 2 May 2021).

4.14. Change management, 5 ECTS

Learning objectives
The objectives of this module are to enable students to learn to:

- Analyse and evaluate the process of managing a group of people, a department, or an organization
- Interpret and create fundamental elements that make up successful management.

Understanding the elements and processes of management will enable students to manage the part of the organization for which they are in charge, as well as the opportunity to make better business decisions in the field of business management.

Completion of this module is important for students to understand business and management processes, which makes them better members of business organizations or managers of their own businesses.

Students also gain self-confidence in solving future cases in the field of planning, organizing, leading and controlling and acquire the competencies needed to understand organizational problems and find quality solutions to these problems. These problems are illustrated with real-life examples and studied through the analysis of all elements of management from examples of real business organizations.

Contents:
Topics to be covered in the course include the following:

- Explain management, its functions, activities, manager roles and management skills.
- Analyse management, its functions, activities and manager roles and management skills.
- Perform the analysis of internal and external environment of the organization.
- Interpret the elements of the external and internal environment of the organization.
- Explain the relationship and connection of different planning elements.
- Design the core elements of a Company plan.
- Apply certain decision making techniques.
- Critically evaluate the decision-making stages and various models and decision-making techniques.
- Analyse the advantages and disadvantages of different organizational structures.
- Create organizational structure of a department or organization.
- Apply different human resource management elements in the enterprise example.
- Argue the importance of human resource management in the enterprise.
- Analyse the advantages and disadvantages of different leadership models and motivation theories.
- Apply the appropriate leadership and motivation model in the Business case example.
- Explain the importance of the organization's controlling process.
- Create a control system on a business case example.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- Robbins, S.P., Coulter, M.A. and De Cenzo, D.A. (2019) Fundamentals of Management. 11th Edition, [s.l.], Pearson.

Recommended reading:

- Lussier, R.N. (2018) Management Fundamentals: Concepts, Applications, and Skill Development. 8th Edition, [s.l.], SAGE Publications.
- Drucker, P.F. (2006) The Effective Executive: The Definitive Guide to Getting the Right Things Done. Reissue edition, [s.l.], Harper Business.

Further reading:

- Drucker, P.F. (2006) The Practice of Management. Reissue edition. [n.k.], [s.l.], Harper Business.
- Zhuo, J. (2019) The Making of a Manager: What to Do When Everyone Looks to You. [n.k.], New York: Portfolio/Penguin.
- Robbins, S. and Judge, T. (2018) Organizational Behavior (What's New in Management). 18th Edition, [s.l.], Pearson.

4.15. Scalability, 6 ECTS

Learning objectives
The objectives of this module are to enable students to learn to:

- Analyse different structures, concepts and standards of information systems management
- Plan and demonstrate the application of standards in information systems management

Contents:
Evaluate the role of analytics systems in the cloud and the main advantages and disadvantages over traditional "on premise" systems. Define steps in migration plan for cloud analytics implementation process together with key milestones. Explain the technologies on which cloud analytics is based and design the process and prerequisites for migrating an existing or implementing a new cloud analytics system. Select most suitable technologies and evaluate cost per key resources for cloud analytics system adoption for selected case (migration of existing/new development). Identify most common cloud analytics platforms, their components and describe key differences between them. Apply a cloud analytics tool to analyze data on a real-world example and your own data set. Identify most common cloud based cognitive services, their components and describe key differences between them. Analyze and apply cognitive services as part of data science solution in the cloud, including infrastructure planning and value proposition for selected case.

Topics to be covered in the course include the following:

- The terms, concepts and standards used in information management systems.
- The purpose and application of information systems management with emphasis on principles of a good practices
- The application of standards in information systems management.
- How to explores problems and approaches in information systems management in organizations
- How information systems can support, enable, or integrate into different types of organizational services.
- Describe basic terms and concepts of information systems management.
- Distinguish terms and concepts of information systems management.
- Explain the purpose and application of information systems management.
- Explain the application and principles of a good practices in information systems management.
- Describe standards applicable to information systems management.
- Plan and demonstrate the application of standards in information systems management.
- Define the stages in managing information services.
- Plan implementation and management in accordance with stages in information services management.

It is important for students to take this module to understand the value of good information systems scalability management which may benefit their businesses and help them in controlling the internal and external processes. The knowledge students acquire in this module will contribute to the overall skillset for their future employment.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- Laudon K., Laudon, J. (2020.), Management Information Systems, 16TH edition, [s.l.]: Pearson
- Hager, G., Wellein, G. (2010) Introduction to High Performance Computing for Scientists and Engineers, https://www.amazon.de/Introduction-Performance-Computing-Scientists-Computational/dp/143981192X, available at pdf: https://pdfs.semanticscholar.org/d45e/c41b45caa8686fa1788d9191ab4044a18a83.pdf

Recommended reading:

- Keri E. Pearlson, Carol S. Saunders, Dennis F. Galletta (2016.), Managing and Using Information Systems: A Strategic Approach, 6th Edition, [s.l.]: Wiley Global Education
- Olson, D. (2014.), Information Systems Project Management, [s.l.]: Business Expert Press
- Valacich, J. and Schneider, C. (2017) Information Systems Today: Managing the Digital World, 8th Edition, [s.l.]: Pearson

Further reading:

- AXELOS (2019) ITIL v4 Foundation, [s.l.]: TSO (The Stationery Office)
- Harisaiprasad, K. (2020) COBIT 2019 and COBIT 5 Comparison, [s.l.]: ISACA

4.16. Migration alternatives, 6 ECTS

Learning objectives
The objectives of this module are to enable students to learn to:

- Deploying necessary packages and services on Microsoft-based operating systems
- Managing necessary services to secure access to web-based content on Windows and open source operating system

This module is important to support student's understanding and ability to implement necessary roles and features to host a service, like secure web server. After successfully passing this module students will be able to implement and maintain Microsoft or open source-based secure web infrastructure. This is essential for many other services that can be provided via secure web infrastructure - web shops, web hosting, remote access technologies etc. This will offer a chance for students to learn more about security as one of the key IT infrastructure principles.

Contents:
Topics to be covered in the course include the following:

- Anticipate software components of the environment based on Microsoft technologies
- Recommend software components of an environment based on Microsoft technologies
- Recommend the implementation of software components for secure access to web applications and content based on Microsoft technologies
- Select options for implementation of software components for secure access to web applications and content based on Microsoft technologies
- Anticipate software components of the environment based on open source technologies
- Recommend software components of the environment based on open source technologies
- Recommend the implementation of software components for secure access to web applications and content based on open source technologies
- Select options for implementation of software components for secure access to web applications and content based on open source technologies

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- Allen, F., Andrade, A., Quatremain H., Costea, V., Snehangashu K., Kesler, M., Saumik, P., (2019) Red Hat Enterprise Linux 8.0 RH134 Red Hat System Administration II, Red Hat [s.l.]
- Krause, J. (2019) Mastering Windows Server 2019: The complete guide for IT professionals to install and manage Windows Server 2019 and deploy new capabilities, 2nd edition, Livery Place, 35 Livery Street, Birmingtham B3 2PB, Packt Publishing

Recommended reading:

- Thomas, O. (2020) Windows Server 2019 Inside Out, Microsoft Press [s.l.]

Further reading:

- Allen, F., Kesler, M., Saumik, P., Snehangashu K., Costea, V. (2019) Red Hat Enterprise Linux 8.0 RH124 Red Hat System Administration I, Red Hat [s.l.]

4.17. Cloud TCO, 4 ECTS

Learning objectives
The objectives of this module are to enable students to learn to:

- Deploy and manage cloud solution based on open source software
- Configure and manage Microsoft Azure-based cloud solution
- Acquire the knowledge of advanced deployment concepts for open-source and Microsoft Windows-based environments
- Acquire the knowledge about descriptive and non-descriptive technologies to customize deployed solutions further

After successfully passing this module students will be able to implement and maintain cloud-based environments based on two commonly used cloud technologies. It will also help them understand the correct way to move workloads to public cloud.

Contents:
Topics to be covered in the course include the following:

- Justify elements of cloud computing based on open source technology or Microsoft technology
- Critically review options for cloud computing based on open source technology or in the cloud-based on Microsoft technology
- Select options for configuring virtual networks, virtual storage, and cloud security concepts based on open source technology
- Design virtual networks, virtual storage, and cloud security concepts based on open source technology
- Choose settings for administering instances, users, groups, profiles, and scalable cloud applications based on open source technology
- Evaluate settings for administering instances, users, groups, profiles, and scalable cloud applications based on open source technology
- Select options for deploying virtual networks and a virtual cloud storage system based on Microsoft technology
- Defend stance on deploying virtual networks and a virtual cloud storage system based on Microsoft technology
- Select options for administering instances, users, groups, profiles, and scalable applications in the cloud-based on Microsoft technology
- Determine correct options for administering instances, users, groups, profiles, and scalable applications in the cloud-based on Microsoft technology

This module is important to support student's knowledge and understanding to implement cloud environment based on open-source or Microsoft Azure and it enables them to learn about similarities and subtle differences of these cloud technologies, as well as how to administer them and use them for a pre-assigned use case.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams.

Learning materials

- Vazquez, A., Chang C., Allen, F., Quatremain, H., Weetman M., Karmakar, S. (2017) Red Hat Openstack Administration I: Core operations for cloud operators, [s.l.], Red Hat.
- Cheshire, J. (2020) Exam Ref AZ-900 Azure Fundamentals [s.l.], Microsoft Press.

Recommended reading:

- Patel, H. (2021) Exam Ref AZ-104 Microsoft Azure Administrator [s.l.], Microsoft Press.

Further reading:

- DiCola, N., Roman, A. (2021) Microsoft Azure Network Security [s.l.], Microsoft Press.
- Diogenes, Y., Shinder, T., Shinder, D. (2016) Microsoft Azure Security Infrastructure [s.l.], Microsoft Press.

4.18. Cost control and Cost factors, 4 ECTS

Learning objectives
The objectives of this module are to enable students to learn to:

- Analyse different methodologies, concepts and structures of project management
- Initiate, plan and manage projects using appropriate project management software.

Students will learn the value of methodology and organization of work as a project, and about the identification of different project roles and responsibilities.

It is important for students to take this module to understand the value of good project management and get insight into systematic and efficient access to the resources of space, time, work force and finance. The students will therefore be able to select and recommend processes and organize them according to project requirements, to apply software management and reporting, which will contribute to the overall skillset for their future employment.

Contents:
Topics to be covered in the course include the following:

- Explain basic values of the methodology, project charter and organizational structures. Develop the project's WBS structure, milestones and activities.
- Choose the methodology, WBS structure and develop the project charter. Design integrated project plan.
- Calculate project plan and know how to control project by using Critical path method.
- Explain basic parameters of Earned Value Method.
- Use Earned Value Method as a tool for managing projects in detail by all parameters.
- Explain basic concepts of managing issues, scope, communication, risks, quality, and metrics.
- Choose techniques of managing issues, scope, communication, risks, quality and metrics.
- Create a project timetable with project activities and resources by using tools for project management.
- Create a project timetable with time floats and constraints, addressing overallocated resources by using tools for project management.
- Update project plan and create a report on the progress and cost of the project by using tools for project management.
- Evaluate the basic indicators of the project success by using tools for project management.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- Publications Office of the EU (2018) PM² project management methodology [online] available at: https://op.europa.eu/en/publication-detail/-/publication/ac3e118a-cb6e-11e8-9424-01aa75ed71a1/language-en

Recommended reading:

- [Anon.] (2017) A Guide to the Project Management Body of Knowledge (PMBOK® Guide).6th edn. [s.l.] Project Management Institute.
- IPMA (2016) Individual Competence Baseline, Version 4.0 (ICB4) [online] available at: https://www.ipma.world/individuals/standard/

Further reading:

- Kerzner, H. (2005) Project Management: A Systems Approach to Planning, Scheduling and Controlling.12thedn.[s.l.] Wiley.

4.19. Principles of Economics, 5 ECTS

Learning objectives
The objectives of this module are to enable students to learn to:

- Present basic elements of micro- and macroeconomics and economic system as a whole
- Interpret the relationship between different elements of economic system in order to be able to make good economic decisions.

Upon completion of undergraduate studies, students may work in the economy, either as sole proprietors or as part of larger business organizations. They will need to contribute to business solutions and participate in business decision making. Knowing the economy and the way the economic system works will help them make better decisions and thus contribute to better business results.

The importance of this module is reflected in the adoption of an economic mindset and economic skills in general that can be important not only for the business, but also for the private context. Students will gain self-confidence in solving problems based on economic issues and the ability to suggest possible solutions. The economic problems covered in this module are illustrated with real examples and current events, which allows students to identify, analyse and solve such problems in their future careers.

The objectives of this module is to enable students to:

- Develop understanding of fundamental changes in the economic environment at the beginning of the 21st century which enabled emergence of the Creative Economy,
- Evaluate the role of Creative Economy as one of the drivers of economic growth and local development, and
- Critically evaluate evolution of human creativity from elitist and folk arts to pop-culture, cultural and creative industries and Creative Economy as the system for production, exchange and consumption of creative products and services.

Students learn how to develop an in-depth understanding of particular creative industries and the role of intellectual property rights protection and how to contextualise this understanding in terms of entrepreneurship. The module forms the vital core of the programme as it combines strategic thinking with theoretical knowledge of creative industries.
It is important for students to take this module in order to develop skills to apply systematic knowledge and understanding of the Creative Economy to a specific entrepreneurial need. Through a series of lectures and tutorials, students will develop a sense of relevance of intellectual capital and intellectual property rights in creative industries.

Contents:
Topics to be covered in the course include the following:

- Present the basic elements of the economic system.
- Analyse the interaction of the basic elements of the economic system.
- Explain market, supply, demand and the concept of elasticity of supply and demand.
- Evaluate the impact of various factors on market decisions, supply, demand and on the elasticity of supply and demand.
- Analyse the factors influencing consumer behaviour and producer decisions.
- Interpret how different factors influence consumer behaviour and producer decisions.
- Explain the characteristics of production inputs.
- Compare the characteristics of production inputs.
- Explain the interaction of macroeconomic objectives, instruments and indicators.
- Analyse the impact of elements of economic activity on the economic results of the economy.
- Explain the impact of various factors on economic growth and development.
- Analyse different strategies of economic growth and development.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- Samuelson, P.A. and Nordhaus, W.D. (2009) Economics. [s.l.] McGraw-Hill Education.

Recommended reading:

- Mankiw, N.G. (2011) Principles of Economics. [s.l.] Cengage Learning
- Pindyck, R.S. i Rubinfeld, D.L. (2012) Microeconomics.8th edn. [s.l.] Pearson.

Further reading:

- Raworth, K. (2018) Doughnut Economics: Seven Ways to Think Like a 21st Century Economist. [s.l.] Chelsea Green Publishing.
- Sowell, T. (2014) Basic Economics.5th edn. [s.l.] Basic Books.
- DK (2018) The Economics Book: Big Ideas Simply Explained. [s.l.] DK.
- Hazlitt, H. (1988) Economics in One Lesson: The Shortest and Surest Way to Understand Basic Economics. [s.l.] Currency.

4.20. Threat and incident management in Enterprise Environments, 4 ECTS

Learning objectives
This module is designed and developed in collaboration with sales experts across the globe to support organizations identify and mitigate business risks by converting unknown internal and external threats into known threats when dealing with vendor strategies and policies.

This is a comprehensive programme where students learn structured approaches for building effective intelligence including:

- Key issues plaguing the information security world
- Importance of threat intelligence in risk management, SIEM, and incident response
- Various types of cyber threats, threat actors and their motives, goals, and objectives of cybersecurity attacks
- Decode the various steps involved in planning an incident handling and response program
- Fundamentals of incident management including the signs and costs of an incident
- Cyber kill chain methodology, Advanced Persistent Threat (APT) lifecycle, Tactics, Techniques, and Procedures (TTPs), Indicators of Compromise (IoCs), and pyramid of pain
- Different types of data feeds, sources, and data collection methods
- Threat intelligence data collection and acquisition through Open Source Intelligence (OSINT), Human Intelligence (HUMINT), Cyber Counterintelligence (CCI), Indicators of Compromise (IoCs), and malware analysis
- Creating effective threat intelligence reports
- Different data analysis, threat modeling, and threat intelligence tools
- Skills in handling different types of cybersecurity incidents
- Apply the right techniques to different types of cybersecurity incidents in a systematic manner including malware incidents, email security incidents, network security incidents, web application security incidents, cloud security incidents, and insider threat-related incidents

This module enables students to recognise threats and how to deal with incidents in enterprise environments.

Contents:
Topics to be covered in the course include the following:

- Explain the concepts of threat management and relate them to the stages of an attack
- Evaluate the concepts of threat management
- Evaluate different methods of data collection and processing
- Design solution for data collection and processing
- Apply threat assessment techniques and apply risk mitigation procedures
- Design threat assessment solution
- Assess different cyber security threats, attack vectors, actors and their motives and goals
- Evaluate different cyber security threats, attack vectors, actors and their goals
- Explain the concepts of incident management
- Design solution for incident respond
- Evaluate various best practices, standards, cyber security frameworks, laws, acts and regulations in dealing with incidents
- Valorise various best practices, standards, cyber security frameworks, laws, acts and regulations in dealing with incidents

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- Palacín, V. (2021). Practical Threat Intelligence and Data-Driven Threat Hunting, Birmingham: Packt.
- Anson, S., (2020). Applied Incident Response. New York: John Wiley & Sons.

Further reading:

- [Anon.] (2010). Good Practice Guide for Incident Management. [s.l.]: ENISA.
- Bartock, M. et al. (2016). SP 800-184, Guide for Cybersecurity Event Recovery, [s.l.]: NIST

5. The Common Soft Skills

5.1. Teamwork, 4 ECTS

Learning objectives
The objectives of this module are to enable students to learn to:

- Determine all the requirements important for optimal participation in teamwork.
- Define team roles based on team member type
- Define optimal work processes and support efficiency
- Communicate in team and accept feedback
- Conduct a constructive and efficient meeting.

Contents
Students will learn about teamwork: from defining team roles, understanding different types of team members and managing them, creating a motivating atmosphere of mutual consensus and goal orientation, conflict resolution and time management in teamwork. Throughout the module, students will have the opportunity to test all the learned settings, and they will spend most of the time in practical teamwork on the project. All of the above should ensure that students have an easy transition to work in a team in their future jobs, but also provide them with basic knowledge about team management.

It is important for students to take this module in order to learn how to be a functional part of a team and increase its productivity and efficiency. It encourages students to use various elements of teamwork, which assist in conflict resolution, and prepares them to take care of different issues that may arise, and maintain group productivity. This module will expose students to a particular experience that will contribute to the overall skillset for their future employment.

Contents:
Topics to be covered in the course include the following:

- Compare basic roles in the team and ways of understanding different types of team members.
- Revise the behaviours of different types of team members and recommend different approaches taking into account the different roles of team members.
- Apply basic methods of conflict resolution in the thymus
- Compare different methods of resolving conflicts in the team with regard to the given problem.
- Apply tools to create a motivating team atmosphere and team goal orientation.
- Propose different tools to create a motivating atmosphere in the team given the given problem.
- Debate activities to optimize teamwork in given situations with a focus on time optimization.
- Evaluate tools and methods and recommend the best solution to achieve maximum results in teamwork with regard to various given problems.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- Gostick, A. & Elton, Ch. (2018) The Best Team Wins: The New Science of High Performance, New York, NY: Simon & Schuster
- Google Inc. (2021) Google Ventures YouTube Channel [Online]. Available at: https://www.youtube.com/user/GoogleVentures (Accessed: 10 May 2021)

Recommended reading:

- Coryell, E. (2019) Revolutionize Team Work, Naperville, IL: Simple Truths
- Fitzpatrick, B. W. & Collins-Sussman, B. (2015) Debugging Teams: Better Productivity through Collaboration, 1st edn, Sebastopol, CA: O'Reilly Media
- Coyle D. (2018) The Culture Code: The Secrets of Highly Successful Groups, New York, NY: Bantam Books
- Lencioni, P. (2002) The Five Dysfunctions of a Team: A Leadership Fable, San Francisco, CA: Jossey-Bass
- Teamwork (2021) The Teamwork Resource Center [Online]. Available at: https://www.teamwork.com/resources/
- Atlassian (2021) Work Life – Atlassian Blog [Online]. Available at:

https://www.atlassian.com/blog/teamwork (Accessed: 10 May 2021)

Further reading:

- Maxwell, J. C. (2013) The 17 Indisputable Laws of Teamwork Workbook: Embrace Them and Empower Your Team, Nashville, TN: HarperCollins Leadership
- Holpp, L. (1998) Managing Teams, 1st edn, Madison, WI: McGraw-Hill Education
- Tarricone P. & Luca, J. (2002) " Successful teamwork: A case study“ Research and Development in Higher Education: Quality Conversations, vol. 25, pp. 640-646 [online] Available at: http://www.unice.fr/crookall-cours/teams/docs/team%20Successful%20teamwork.pdf (Accessed: 10 May 2021)
- Sycara, K., Sukthankar, G. (2006) „Literature Review of Teamwork Models“, Research Gate [online] Available at https://www.researchgate.net/publication/246704657_Literature_Review_of_Teamwork_Models (Accessed: 10 May 2021)

5.2. Ethics, 4 ECTS

Learning objectives
The objectives of this module are to enable students to learn to:

- Understand the basic terminology and concepts of business ethics
- Compare and critically evaluate different organizational standards and principles, as well as individual contents in the creative industries in the context of their compliance with legal and ethical standards.

Students learn the principles and values that govern decisions and actions within companies, but also in their own work. This learning enables students to know the difference between right and wrong in doing business. It encourages them to apply this knowledge in practical situations taught in in other modules of this study programme.

Students who choose this module will further develop their logical and reasoning skills needed to understand ethical principles and moral or ethical problems that they might face in a business environment. The knowledge students acquire in this module will contribute to the overall skillset for their future employment in the field of visual communications design. It applies to all aspects of business conduct and is relevant to the conduct of individuals and entire organizations.

Contents:
Topics to be covered in the course include the following:

- Define the basic terminology and concepts of business ethics.
- Compare and critically evaluate the basic concepts of business ethics.
- Define the main features of the relationship between employers and employees in traditional forms of work and in the modern work environment, and compliance with ethical principles.
- Evaluate the individual contents of the contemporary work environment and alternatives to traditional forms of work and their compliance with ethical principles.
- Identify and explain moral responsibility in marketing and responsible advertising.
- Recommend guidelines for moral responsibility in marketing and responsible advertising.
- Identify and formulate legal (regulatory) and ethical (self-regulatory) standards in creative industries.
- Compare and critically evaluate the individual contents in the creative industries in the context of their compliance with legal (regulations) and ethical (self-regulation) standards.

Assessment

- Weekly hands-on lab assignments, a comprehensive group work case assignment, activity in the group, learning diary, written exams

Learning materials

- Byars, S.M., Stanberry, K. (2018). Business Ethics. Openstax, Rice University; Houston, Texas. Accessed 5 May 2021, <https://openstax.org/details/books/business-ethics>.

Recommended reading:

- European Commission (2021). Horizon 2020 Online Manual; Ethics (Rules & Codes of Conduct, General Guidance for Ethics Self-assessment, Domain-specific Guidance). Accessed 5 May 2021, <https://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/ethics_en.htm>.
- European Commission (2021). Corporate Social Responsibility & Responsible Business Conduct. Accessed 5 May 2021, <https://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/ethics_en.htm>.
- European Commission (2021). Labour law: Emplyment, Social Affairs & Inclusion. Accessed 5 May 2021, <https://ec.europa.eu/social/main.jsp?catId=157&langId=en>.
- European Commission (2021). European Ombudsman. Accessed 5 May 2021, <https://europa.eu/european-union/about-eu/institutions-bodies/european-ombudsman_en>.
- European Commission (2021). MOBBING I. Accessed 5 May 2021, <https://ec.europa.eu/justice/grants/results/daphne-toolkit/content/mobbing-i-raising-awareness-women-victims-exchange-good-practices_en>.
- Alliance (2021). European Advertising Standards. Accessed 5 May 2021, <https://www.easa-alliance.org/>.
- European Parliament (2021). Intellectual, industrial and commercial property. Accessed 5 May 2021, <Intellectual, industrial and commercial property | Fact Sheets on the European Union | European Parliament (europa.eu)>.

5.3. Communication, 4 ECTS

Learning objectives
The objectives of this module are to enable students to learn to:

- Communicates responsibly orally and in writing, with regard to the goals and the target group
- Is able to make use of different communication methods, channels and platforms
- Identifies one's own competence level and how to market one's own competencies convincingly
- Is able to interact and listen to others in addition to giving and receiving feedback
- Is able to communicate in various business and intercultural environments
- Is able to critically evaluate different communication sources, their operating practices and motives as well as the different responsibilities that go with the information they convey
- Forms of crisis communication,
- Organizing meetings
- Business negotiations
- To develop models of intercultural communication
- To synthesize verbal and non-verbal communication in a meaningful whole

Stundets learn how to evaluate various forms of speech, design different types of written communication, present different views and contents, and conduct successful team communication. This module enables students to effectively present arguments in business meetings, but also to recommend models of verbal and non-verbal communication to negotiating teams and people who are in direct contact with their own staff or clients on a daily basis.

It is important for students to take this module to be able to learn how to argue their opinions through various forms (ways) of communication. Students will use this knowledge and understanding to validly and critically judge written business content and create other successful ways of business communication. This will empower students to defend their views in business negotiations and avoid conflict situations. This will contribute to the overall skillset for their future employment.

Contents:
Topics to be covered in the course include the following:

- Corporate and business communications
- Informative writing and distinguishable communication
- Personal branding and digital footprint
- Critical literacy
- Recommend ways and patterns of planning, writing, and concluding business messages, create basic patterns of routine, positive and negative messages and explain their content, form, and effectiveness
- Interpret ways and patterns of planning, writing, and concluding business messages, create basic patterns of routine, positive and negative messages and explain their content, form, and effectiveness
- Recommend ways and patterns of planning, writing, and completing persuasive messages, reports, and proposals, explain their specifics and forms, and present, evaluate and explain the importance and effectiveness of visual communications
- Interpret ways and patterns of planning, writing and completing persuasive messages, reports and proposals, explain their specifics and forms, and present, evaluate and explain the importance and effectiveness of visual communications
- Recommend basic ways of collecting, analysing, and using business information, suggest basic forms of negotiation, distinguish ways of successful and unsuccessful team communication, suggest ways of overcoming conflicts and conducting meetings, recognize cultural differences and prepare for business
- Interpret basic ways of collecting, analysing, and using business information, suggest forms of negotiation, distinguish ways of successful and unsuccessful team communication, suggest ways of overcoming conflicts and conducting meetings, recognize cultural differences and prepare for business
- Recommend a way of crisis communication immediately after the crisis, create models of presentations, suggest a way to prepare for a job interview and write a successful resume.
- Interpret a way of crisis communication immediately after the crisis, create models of presentations, suggest a way to prepare for a job interview and write a successful resume.
- Create a simple presentation, analyse the audience and present the content.
- Create a more complex presentation, analyse the audience and present the content.

Execution methods
Lectures, student's individual and independent work, and teamwork totaling to 135 hrs of student's workload.

Learning materials

- Bovee, C.L.. and Thill, J.V. (2020) Business Communication Today.15th edn. Upper Saddle River, New Jersey: Pearson.
- Rouse, M.J. i Rouse, S. (2002) Business Communications: A Cultural and Strategic Approach. London: Thomson Learning.
- Kortesuo, K. 2019. Kaikenkattava sisällöntuotannon opas yrityksille. Helsingin seudun kauppakamari. Helsinki
  Kurvinen, J., Tolvanen V. & Laine T. 2017. Henkilöbrändi. Asiantuntijasta vaikuttajaksi. Alma Media. Helsinki.
  Virtanen, S. 2020. Somemarkkinoinnin työkirja. Helsingin seudun kauppakamari. Helsinki

Recommended reading:

- Dick, R., (2000) Get it across: Effective Communication at Work. Tadworth: Elliot Right Way Books.
- Davies, HB. R. (2008) Mastering Communications: 10 secrets to fast, clear, persuasive communications. Toronto: McLuhan & Davies Communications, Inc.
- Kozicki, S. (1998) Creative Negotiating: Proven Techniques for Getting What You Want from Any Negotiation. Halbrook: Adams Media Corporation.
- Borg, J. (2008) Persuasion: The Art of Influencing People.2nd edn. New Jersey: FT Press.

Further reading:

- Lane, S. D. (2010) Interpersonal Communication: Competence and Contexts.2nd edn. Boston: Allyn & Bacon: University of Texas at Dallas.
- Pease A. and Pease B. (2004) The Definitive Book of Body Language. Buderim: Pease International.
- Navarro J. (2008) What Every Body is Saying: an ex-FBI agent's guide to speed-reading people. New York: Collins Living.
- Luecke, R. (2004) Crisis management: master the skills to prevent disasters. Boston: Harvard Business School Press.

5.4. Presentation, 4 ECTS

Learning objectives

- The objectives of this module are to enable students to learn to: Is able to plan and make presentations to different audiences both in face-to-face and virtual environments.
- Knows how to use multimedia tools to support his/her presentation.
- Complies to time limitations during a presentation.
- Is able to interact with the audience
- Anticipates questions from the audience and respond to it.
- Evaluates and assess presentations from others.
- Is able to make use of received feedback to improve own's presentation skills.
- Apply appropriate communication technique in given situation
- Understand the influence of different cultural, social and business context and its influence on communication
- Become familiar with basic negotiating principles
- Learn the principles of interpersonal communication
- Implement the elements of verbal and nonverbal communication and situations during presentation

This module teaches students theoretical and practical foundations of communication and presentation skills. This module is the second careers module and it prepares students for communication at academic and business level and for presentations for a wide audience.

The knowledge and skills that students acquire on this module will be essential for their career development. Students will be exposed to practical experience and mentored in their practical skill development.

Contents:
Topics to be covered in the course include the following:

- Face-to-face and virtual presentation environments
- Presentation tools
- Interaction with audiences
- Giving and receiving feedback
- Identify and explain different communication styles.
- Demonstrate different communication styles and techniques to improve them.
- Identify the differences between verbal and nonverbal communication.
- Apply appropriate verbal and nonverbal techniques in conversation.
- Identify barriers to communication and compare cultural aspects of communication.
- Argue communication strategies for resolving conflict situations and present constructive criticism.
- Select the appropriate elements in making an effective presentation of a given case.
- Create a presentation for a given topic taking into account good practices of making an effective presentation using a tool of your choice.
- Select appropriate non-verbal elements in the preparation of the presentation.
- Argue appropriate verbal and nonverbal techniques during the presentation.
- Demonstrate presentation skills.
- Demonstrate presentation skills in front of an audience and using online communication tools in a given form.

Execution methods
Exercising practical presentation situations in interactive face-to-face or virtual environments.

Learning materials
Teacher's workshop materials

- Dionne: Presentation Skills for Scientists and Engineers: The Slide Master 1st ed. 2021 Edition, Kindle Edition
- Sanchez: Presenting Virtually: Communicate and Connect With Online Audiences
- Reynolds: Presentation Zen: Simple Ideas on Presentation Design and Delivery (Voices That Matter), 3rd Edition
- Acker, M. (2019) Speak With No Fear: Go from a nervous, nauseated, and sweaty speaker to an excited, energized, and passionate presenter, Advance, Coaching & Consulting, Galston, NSW

- (2021) Design School by Canva [Online]. Available at: https://designschool.canva.com/ (Accessed: 5 May 2021)

Recommended reading:

- Berkun S., (2011) Confessions of a Public Speaker, O'Reilly Media, 1st edn, Sebastopol, CA
- Cialdinin, R. B. (2006) Influence: The Psychology of Persuasion, Harper Business, New York, NY
- (2021) Prezi Blog [Online]. Available at: https://blog.prezi.com/ (Accessed: 05 May 2021)
- (2021) Duarte Blog [Online]. Available at: https://www.duarte.com/presentation-skills-resources/ (Accessed: 05 May 2021)

Further reading:

- Anderson, Ch. (2017) TED Talks: The Official TED Guide to Public Speaking, Mariner Book, Boston, MA
- Tracy, B. (2008) Speak to Win: How to Present with Power in Any Situation, 1st edn, AMACOM, New York, NY
- Gallo, C. (2015) Talk Like Ted, Smp Trade Paper, London
- Marshall, L. B. (2016) Like, Eliminate Ums and Ahs, Right?, podcast, 27 May, viewed 6 May 2021
- Isherwood, B 2012, Where ideas come from, podcast, 12 September (Accessed: 05 May 2021)
- (2021) Public Words Blog [Online]. Available at: https://publicwords.com/blog/ (Accessed: 05 May 2021)

6. Mapping DIHUB Skills to ESCO 1.0

DIHUB Skill	ESCO Concept
DIHUB Skill#1 **Virtualization**	manage ICT virtualisation machines http://data.europa.eu/esco/skill/ae4f0cc6-e0b9-47f5-bdca-2fc2e6316dce
DIHUB Skill#2 **Database management**	manage database http://data.europa.eu/esco/skill/29fb0fb5-dfc4-4098-ac9b-3a712000f48f
DIHUB Skill#3 **Serverless architecture**	ICT architectural frameworks http://data.europa.eu/esco/skill/c453cf81-6197-428e-84c6-70c773b63f27
DIHUB Skill#4 **Security**	ICT security standards http://data.europa.eu/esco/skill/3ff589b7-68df-4ea5-ae41-b395bdb2378f
DIHUB Skill#5 **Cloud deployment including multicloud**	solution deployment http://data.europa.eu/esco/skill/1d86f05e-e9cc-40ce-99d8-2b21cc71b16b
DIHUB Skill#6 **Hybrid cloud**	hybrid control systems http://data.europa.eu/esco/skill/a2b566b0-1070-47a4-adc8-88839942ce25
DIHUB Skill#7 **DevOps**	DevOps http://data.europa.eu/esco/skill/f0de4973-0a70-4644-8fd4-3a97080476f4
DIHUB Skill#8 **Application migration strategies**	develop automated migration methods http://data.europa.eu/esco/skill/0b0335f3-0aa1-491e-895e-81fc8774a300
DIHUB Skill#9 **Programming**	ICT system programming http://data.europa.eu/esco/skill/b105ec9b-0857-41d6-8d07-a83e58b73d90
DIHUB Skill#10 **Artificial intelligence and Machine learning**	principles of artificial intelligence http://data.europa.eu/esco/skill/e465a154-93f7-4973-9ce1-31659fe16dd2 utilise machine learning http://data.europa.eu/esco/skill/8369c2d6-c100-4cf6-bd83-9668d8678433
DIHUB Skill#11 **Automation**	(TO BE DEFINED – NEW SKILL) Update: introduced and recognized in ESCO v1.1
DIHUB Skill#12 **Adaptability**	adapt to changes in technological development plans http://data.europa.eu/esco/skill/f5308e60-d763-4ead-be95-88c96fb3e02b
DIHUB Skill#13 **Performance testing**	perform business analysis http://data.europa.eu/esco/skill/27ed854c-15b8-4ba2-90e9-ae888a219703
DIHUB Skill#14 **Change management**	apply change management http://data.europa.eu/esco/skill/3c03ee71-4a23-448f-b79e-81fd75d27dca
DIHUB Skill#15 **Scalability**	(TO BE DEFINED – NEW SKILL) Update: introduced and recognized in ESCO v1.1
DIHUB Skill#16 **Migration alternatives**	perform business analysis http://data.europa.eu/esco/skill/27ed854c-15b8-4ba2-90e9-ae888a219703
DIHUB Skill#17 **Cloud TCO**	cost management http://data.europa.eu/esco/skill/7d35602d-bc94-4975-aa7c-f4e8e05ce8e0
DIHUB Skill#18 **Cost control and cost factors**	compare production forecasts with actual results http://data.europa.eu/esco/skill/1ba35185-09cc-4b54-a3c5-57b87be4d9d1
DIHUB Skill#19 **CAPEX vs OPEX**	make investment decisions

	http://data.europa.eu/esco/skill/0c9da986-721e-4f75-b566-0c6c212a8f60
DIHUB Skill#20 **Vendor selection**	market research http://data.europa.eu/esco/skill/8770350e-746f-4adb-9556-18ca68104be6
DIHUB Skill#21 **Teamwork**	teamwork principles http://data.europa.eu/esco/skill/a5b0cd5c-e13a-4ab3-8d93-4d242adcfb01
DIHUB Skill#22 **Ethics**	ethics http://data.europa.eu/esco/skill/cef5c0f8-1e40-4c09-b6a7-aa7811849e5d
DIHUB Skill#23 **Communication**	Communication http://data.europa.eu/esco/skill/15d76317-c71a-4fa2-aadc-2ecc34e627b7
DIHUB Skill#24 **Presentation**	prepare presentation material http://data.europa.eu/esco/skill/1ba59ce0-7fec-434b-8d5c-9b275250a26c

Figure 3: Figure 2 The mapping of the Dihub skills to the ESCO vocabular.

During time DIHUB project was delivered, ESCO Team introduce recognition for skills **DIHUB Skill#11** Automation and **DIHUB Skill#15** Scalability in ESCO 1.1 as follows.

6.1. DIHUB Skill#11 Automation

DIHUB Skill#11 Automation described as

“automate cloud tasks” member of sector specific skills and competences essential for cloud engineer occupation.

Description: Automate manual or repeatable processes to minimize management overhead. Evaluate cloud automation alternatives for network deployments and tool-based alternatives for network operations and management.

http://data.europa.eu/esco/skill/ce8ae6ca-61d8-4174-b457-641de96cbff4

Cloud engineer occupation description: Cloud engineers are responsible for the design, planning, management and maintenance of cloud-based systems. They develop and implement cloud-applications, handle the migration of existing on-premise applications to the cloud, and debug cloud stacks.

http://data.europa.eu/esco/occupation/349ee6f6-c295-4c38-9b98-48765b55280e

6.2. DIHUB Skill#15 Scalability

DIHUB Skill#15 Scalability described as sector specific skills and competences

“design cloud architecture” member of sector specific skills and competences essential for cloud engineer occupation.

Skill description: Design a multi-tier cloud architecture solution, which tolerates faults and is fit for the workload and other business needs. Identify elastic and scalable computing solutions, select high-performing and scalable storage solutions, and choose high-performing database solutions. Identify cost-effective storage, computing, and database services in the cloud.

http://data.europa.eu/esco/skill/11430d93-c835-48ed-8e70-285fa69c9ae6

Cloud engineer occupation description: Cloud engineers are responsible for the design, planning, management and maintenance of cloud-based systems. They develop and implement cloud-applications, handle the migration of existing on-premise applications to the cloud, and debug cloud stacks.

http://data.europa.eu/esco/occupation/349ee6f6-c295-4c38-9b98-48765b55280e

7. Mapping DIHUB Skills to ESCO 1.1

DIHUB Skill	ESCO Concept	Update
DIHUB Skill#1 **Virtualization**	manage ICT virtualisation environments http://data.europa.eu/esco/skill/ae4f0cc6-e0b9-47f5-bdca-2fc2e6316dce	✓
DIHUB Skill#2 **Database management**	manage database http://data.europa.eu/esco/skill/29fb0fb5-dfc4-4098-ac9b-3a712000f48f	
DIHUB Skill#3 **Serverless architecture**	ICT architectural frameworks http://data.europa.eu/esco/skill/c453cf81-6197-428e-84c6-70c773b63f27	
DIHUB Skill#4 **Security**	ICT security standards http://data.europa.eu/esco/skill/3ff589b7-68df-4ea5-ae41-b395bdb2378f	
DIHUB Skill#5 **Cloud deployment including multicloud**	solution deployment http://data.europa.eu/esco/skill/1d86f05e-e9cc-40ce-99d8-2b21cc71b16b	
DIHUB Skill#6 **Hybrid cloud**	hybrid control systems http://data.europa.eu/esco/skill/a2b566b0-1070-47a4-adc8-88839942ce25	
DIHUB Skill#7 **DevOps**	DevOps http://data.europa.eu/esco/skill/f0de4973-0a70-4644-8fd4-3a97080476f4	
DIHUB Skill#8 **Application migration strategies**	develop automated migration methods http://data.europa.eu/esco/skill/0b0335f3-0aa1-491e-895e-81fc8774a300	
DIHUB Skill#9 **Programming**	ICT system programming http://data.europa.eu/esco/skill/b105ec9b-0857-41d6-8d07-a83e58b73d90	
DIHUB Skill#10 **Artificial intelligence and Machine learning**	principles of artificial intelligence http://data.europa.eu/esco/skill/e465a154-93f7-4973-9ce1-31659fe16dd2 utilise machine learning http://data.europa.eu/esco/skill/8369c2d6-c100-4cf6-bd83-9668d8678433	
DIHUB Skill#11 **Automation**	automate cloud tasks http://data.europa.eu/esco/skill/ce8ae6ca-61d8-4174-b457-641de96cbff4	✓
DIHUB Skill#12 **Adaptability**	adapt to changes in technological development plans http://data.europa.eu/esco/skill/f5308e60-d763-4ead-be95-88c96fb3e02b	
DIHUB Skill#13 **Performance testing**	perform business analysis http://data.europa.eu/esco/skill/27ed854c-15b8-4ba2-90e9-ae888a219703	
DIHUB Skill#14 **Change management**	apply change management http://data.europa.eu/esco/skill/3c03ee71-4a23-448f-b79e-81fd75d27dca	
DIHUB Skill#15 **Scalability**	design cloud architecture http://data.europa.eu/esco/skill/11430d93-c835-48ed-8e70-285fa69c9ae6	✓
DIHUB Skill#16 **Migration alternatives**	perform business analysis http://data.europa.eu/esco/skill/27ed854c-15b8-4ba2-90e9-ae888a219703 develop automated migration methods http://data.europa.eu/esco/skill/0b0335f3-0aa1-491e-895e-81fc8774a300	✓
DIHUB Skill#17 **Cloud TCO**	cost management http://data.europa.eu/esco/skill/7d35602d-bc94-4975-aa7c-f4e8e05ce8e0	
DIHUB Skill#18 **Cost control and cost factors**	compare production forecasts with actual results	

	http://data.europa.eu/esco/skill/1ba35185-09cc-4b54-a3c5-57b87be4d9d1	
DIHUB Skill#19 **CAPEX vs OPEX**	make investment decisions http://data.europa.eu/esco/skill/0c9da986-721e-4f75-b566-0c6c212a8f60	
DIHUB Skill#20 **Vendor selection**	perform market research http://data.europa.eu/esco/skill/fe39d4db-4cb5-4299-bb9f-896c8fd6ab13	✓
DIHUB Skill#21 **Teamwork**	teamwork principles http://data.europa.eu/esco/skill/a5b0cd5c-e13a-4ab3-8d93-4d242adcfb01	
DIHUB Skill#22 **Ethics**	ethics http://data.europa.eu/esco/skill/cef5c0f8-1e40-4c09-b6a7-aa7811849e5d	
DIHUB Skill#23 **Communication**	use communication techniques http://data.europa.eu/esco/skill/7ff2c668-0e86-418a-a962-4958262ee337	✓
DIHUB Skill#24 **Presentation**	prepare presentation material http://data.europa.eu/esco/skill/1ba59ce0-7fec-434b-8d5c-9b275250a26c	

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