Curriculum and module handbook

Master's degree programme in Information Systems (Wirtschaftsinformatik)

(Master of Science in Information Systems)

2018

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Content

1. Profile of the degree programme

1.1. Study profile

Information technology (IT) is ubiquitous in the worlds of business and government, so almost all companies, non-profits, and public administrations depend on **information systems**. Therefore, it has never been more important for managers – not only in Liechtenstein, but everywhere – to make sound decisions about how to develop and use information systems, how to exploit information systems' transformative potential, and how to design and implement efficient operations based on information systems.

The Master's degree programme in Information Systems is designed to prepare students to make such decisions and so to develop the managers of the future. In line with the **university's mission statement**, which is to prepare students to take on leading roles in business, academia, and government and to support them in their personal growth, Information Systems students acquire subject knowledge and methodological expertise at the interface of computer science and business administration in a course of study that also shepherds their personal development.

The degree programme provides state-of-the-art information on how to design, implement, and manage information systems, identify and exploit digital innovations, take on leadership responsibility, and work in teams. Students are also prepared for academic careers since they learn how to plan and execute research projects autonomously. They can choose among various **electives** and specialise in any of four subject areas that are important for the Liechtenstein industry and far beyond: Business Process Management, Data and Application Security, Data Science, and Digital Innovation.

The **Business Process Management** electives focus on the analysis, design, and implementation of business processes and cover topics like strategic alignment, governance, methods, IT, people, and culture. The **Data and Application Security** electives address security essentials by covering the preventive, reactive, and organisational aspects of security. The **Data Science** electives focus on the collection, management, and analysis of data and cover state-of-the-art methods from fields like artificial intelligence and machine learning, including deep learning. The **Digital Innovation** electives focus on the design and implementation of new processes, services, products, and business models that involve new combinations of digital and physical components.

The degree programme is designed to educate highly qualified IT specialists for industry, non-profits, and public administrations in Liechtenstein and internationally. Graduates have excellent technical, analytical, and methodological skills, along with creativity, leadership ability, and communication skills. The curriculum directly addresses the requirements of industry while also providing a sound scientific education, so students benefit from a practical education with the highest academic standards. To achieve these ambitious goals, the Master's degree programme in Information Systems leverages the university's small size and Liechtenstein's strong industry environment to create an **innovative and supportive learning environment** in which students acquire cutting-edge skills that allow them to take on leadership roles in business. In particular, the degree programme is based on the following six core principles:

1) **Practical relevance:** Through industry collaboration, knowledge transfer, networking, and a series of practical project seminars the degree programme provides several opportunities to learn from practice.
2) **Research orientation:** Students receive strong research training and can actively participate in research projects that are closely linked to their Master's thesis projects.
3) **Personal support:** Information Systems students benefit from a people-centred environment and direct interactions with lecturers.
4) **International focus:** An international student body and visiting professors from abroad offer an international learning atmosphere.
5) **Flexible organisation:** Students can specialise in any of four subject areas through electives, and the degree programme leaves them time to tend to their professional careers.
6) **Guided learning:** The degree programme strongly promotes students' personal development and helps them to acquire leadership and social skills, so it offers excellent career opportunities.

The degree programme is consistent with the **university's strategy** in that it follows a competitive approach to selecting the most talented students and hiring the most qualified teaching staff. The programme focuses on

Information Systems ("Wirtschaftsinformatik"), a core field that is highly relevant to both the business economy and society. The curriculum allows the flexibility to address developments in research and business so courses can be adapted quickly to the job market's emerging needs. Since the students solve throughout the course of their studies practically relevant IT problems in cooperation with regional industry, the degree programme supports dialogue between industry and university, enabling students to work with some world-leading companies even at the beginning of their studies.

1.2. Qualification profile

Students in the Master's degree programme in Information Systems acquire cutting-edge skills that allow them to pursue careers as chief information officers, chief digital officers, chief technology officers, consultants, data scientists, IT project managers, IT architects, IT security managers, and process analysts. The programme also provides a basis for academic careers, as graduates are eligible for doctoral degree programmes. In preparation for these careers, students acquire a wide range of **professional and academic skills** at the interface of computer science and business administration.

While undergraduate degree programmes in Information Systems typically cover basic and even generic IT concepts and methods — that is, a broad overview of Information Systems research and practice and an elementary academic foundation for professional entry – a master's degree programme typically offers a more focused education and imparts more **specialised knowledge and methodological skills**. The Master's degree programme in Information Systems at the University of Liechtenstein equips students with profound insight into the design, implementation, and management of information systems; basic skills related to project management, teamwork, leadership, communication, and data analysis; and methodological and technical expertise in any of four core subject areas: business process management, data and application security, data science, or digital innovation.

These four topics were selected as key subjects for the study programme because they are particularly relevant to regional and international business needs. As these topics are both practical and much sought after, the current and future demand on the labour market for graduates in Information Systems from Liechtenstein is high. Graduates who specialise in **Business Process Management** can design, improve, and innovate processes and manage processes in a variety of organisational contexts. Graduates who specialise in **Data and Application Security** understand the technical features of modern attacks against information systems and can design and manage instruments to detect, prevent, and mitigate security incidents. Graduates who specialise in **Data Science** can gain valuable insights from data by applying state-of-the-art technology and methods for collecting, managing, and analysing data. Graduates who specialize in **Digital Innovation** can design and implement digital innovations and can manage processes around digital innovation.

As information systems continue to revolutionise large parts of our private and professional lives, students learn to digitise, innovate, and transform corporate processes and functions. They acquire these skills in part through participation in practical project seminars held in cooperation with regional companies that foster creativity and "out-of-the-box" thinking. These project seminars ensure that the degree programme covers current and practically relevant IT topics and teach students how to work in teams, manage projects, present project results, collaborate with others, and lead project groups. As the degree programme is designed to give students job experience right from the start, it has a high degree of **practical relevance**. Regular guest lectures by business leaders give students important insights into business practice, and the close and ongoing contact with regional companies promotes students' personal development and helps them to plan and pursue their professional careers.

The degree programme also prepares graduates for **academic careers**. Students receive a profound scientific education during a research-methods lecture, develop research proposals for their master's theses with faculty in a research-seminar course, and receive regular and personal feedback on their progress outside the lecture hall. Students learn about qualitative, quantitative, and mixed-methods research designs and how to design and evaluate innovative and purposeful IT artefacts as part of Information Systems research. They become aware of the fundamentals of scientific writing and learn how to conduct rigorous literature reviews and how to cite sources according to common citation styles. They also become familiar with the most common issues related to research ethics, including plagiarism, and the Association for Information Systems (AIS) Code of Research Conduct.

The degree programme also prepares students to work in **international and intercultural teams**. The teaching language is English, the student body is international, and the teaching staff is supported by visiting professors

from abroad, so students learn in a personal international and intercultural environment. In addition, courses are often organised in partnership with international universities. For example, the Institute of Information Systems is a member of the European Research Center for Information Systems (ERCIS), an active university network that regularly organises joint project seminars, lectures, and exchange programmes. Information Systems students from Liechtenstein can spend a semester abroad at various universities, including the University of Würzburg, Germany, and take part in annual study trips to get to learn about other universities, countries, and cultures. Against this background, they are well-prepared for professional careers in international settings.

Finally, the degree programme is complemented by various cross-faculty elective subjects. Cross-faculty electives are conducted with students and faculty from the university's other departments, so they focus on **interdisciplinary topics** and, among others, provide students with social, political, historical, and philosophical knowledge. In addition, students can take cross-programme electives from other business-related Master's degree programmes, which further promote interdisciplinary learning.

1.3. Entry requirements

The Master's degree programme in Information Systems builds on a relevant bachelor's programme or an equivalent university programme. Proof of sufficient language proficiency is required. More information can be found in the degree programme's **admission guidelines**, which are available online.

1.4. Learning outcomes

In the NQ.FL-HS guidelines, "Nationaler Qualifikationsrahmen für den Hochschulbereich im Fürstentum Liechtenstein" ("National Qualifications Framework for Higher Education in the Principality of Liechtenstein"), from September 2013, learning outcomes are defined in terms of knowledge and understanding, applied knowledge and understanding, assessment and judgment, communication, and learning strategies. The master's degree programme's learning outcomes build on students' knowledge at the bachelor's level:

Knowledge and understanding

- Graduates understand the characteristics, boundaries, concepts, and theories of information systems design, implementation, and management.
- Graduates understand the intellectual and ethical issues related to information systems design, implementation, and management.

Applied knowledge and understanding

- Graduates use their problem-solving abilities and appropriate methods to design, implement, and manage information systems.
- Graduates recognise, understand, develop, and exploit digital innovations and use information systems to digitise and transform business processes and functions.

Assessment and judgment

- Graduates can critically analyse information systems and handle the complexity that is associated with information systems as socio-technical systems.
- Graduates consider the ethical and social aspects of their decisions on the design, implementation, and management of information systems.

Communication

- Graduates use appropriate methods to communicate to a range of audiences with varying levels of knowledge and expertise.
- Graduates can communicate results at an expert level in a variety of roles and contexts and can deliver professional presentations to representatives from practice and research.

Learning strategies

- Graduates exercise autonomy and initiative and work independently and reliably on practical IT projects and Information Systems research projects.

- Graduates efficiently manage their time and resources as individuals and as group members and collaborate with peers and others in sharing information, expertise, and research results.

1.5. Programme structure

The Master's degree programme in Information Systems is arranged in a modular structure that comprises four semesters of full-time study, which corresponds to 120 ECTS (European Credit Transfer System) credits. Table 1 provides an overview of the resulting structure of the programme.

Table 1: Programme structure

Semester	Module	ECTS credits
1	Management Information Systems	6
	Business Process Management	6
	Information Systems Modelling	3
	Information Systems Development	3
	Data Management	3
	Business Statistics	3
	Innovation Lab	3
	Cross-Faculty Elective I	3
	Total first-semester ECTS credits	30
2	Data and Application Security	6
	Digital Innovation	6
	Data Science	6
	Enterprise Architecture Management	3
	Core Elective I	3
	Digital Business	3
	Cross-Faculty Elective II	3
	Total second-semester ECTS credits	30
3	Emerging IT Topics	3
	Human-Centred Design	3
	Core Elective II	3
	Core Elective III	3
	Core Elective IV	3
	Research Methods	3
	Research Seminar	3
	Project Seminar	6
	Cross-Faculty Elective III	3
	Total third-semester ECTS credits	30
4	Master's Thesis	27
	Cross-Faculty Elective IV	3
	Total fourth-semester ECTS credits	30

The curriculum covers several core Information Systems courses that build on undergraduate knowledge and skills like *Information Systems Modelling*, *Information Systems Design*, and *Management Information Systems*, as well as more specialised Information Systems courses like *Human-Centred Design* and *Emerging IT Topics*. These courses cover the concepts, theories, and methods that a student must master to design, implement, and manage information systems successfully. As the students acquire subject and method knowledge at the interface of computer science and business administration, some **foundational courses** are technical (e.g., *Data Management*), while others are more business-oriented (e.g., *Enterprise Architecture Management*). The content of the *Emerging IT Topics* course changes from semester to semester so the degree programme can be adapted quickly to the job market's emerging needs and, as such, it can also flexibly address new developments in research.

The curriculum offers a series of **project seminars** in concert with regional companies. Students learn in small groups, work closely with companies, and must develop "out-of-the-box" solutions to contemporary IT problems. Accordingly, the project seminars provide practice-oriented learning. The first project seminar, *Innovation Lab*, is designed to foster basic skills in creativity, organising and planning, problem-solving, project management, teamwork, and communication. Students acquire social, methodological, and personal competencies in working with multiple large companies on practical IT projects. In the second project seminar, *Digital Business*, students collaborate with small and medium-sized companies to develop new business models, open up new markets, and innovate with existing products and services, so students learn to recognise, understand, develop, and exploit digital innovations. The last project seminar equips students with technical and methodological expertise in one of four subject areas: Business Process Management, Data and Application Security, Data Science, or Digital Innovation.

Table 2: Core elective modules

Semester	Module	ECTS credits
Business Process Management		
2	BPM and Organisational Practice	3
3	Business Process Analysis	3
3	Process Mining	3
Data and Application Security		
2	Security Management	3
3	Intrusion Detection and Mitigation	3
3	Network and System Security	3
Data Science		
2	Artificial Intelligence and Deep Learning	3
3	Advanced Machine Learning	3
3	Data Visualisation	3
Digital Innovation		
2	Digital Humanities	3
3	Digital Entrepreneurship	3
3	Autonomous Tools, Design, and Innovation	3
General		
2	Educational Journey	3

For each of the four subject areas, the curriculum consists of a six-ECTS-credit compulsory module, but students can further specialise in these areas by taking additional three-ECTS-credit **core electives**. While the subject areas are not certified as majors in the diploma, the electives taken are listed in the diploma supplement. The Business Process Management electives focus on methodological competencies for the analysis, implementation, improvement, and continuous management of business processes; the Data and Application Security electives focus on methodological competencies in addressing security threats and in assessing the risks associated with these

threats; the Data Science electives focus on methodological competencies in artificial intelligence and machine learning for turning information into competitive advantage; and the Digital Innovation electives focus on theoretical foundations and methodological competencies for the design and implementation of digital innovations. While a small part of these electives is offered in the summer semester, most of the electives are offered in the winter semester. Table 2 provides an overview.

The fourth semester is focused on the **Master's thesis**, which is typically related to one of the four subject areas that constitute the core of the curriculum (i.e., Business Process Management, Data and Application Security, Data Science, and Digital Innovation). Modules like *Research Methods* and *Business Statistics* help students prepare for the master's thesis, and students work on their research proposals in the *Research Seminar* course. They are continuously supported in writing their master's theses and receive regular feedback on their progress. The master's thesis requires an oral defence.

Finally, students can choose a maximum of twelve ECTS credits among various **cross-faculty electives** that focus on interdisciplinary topics, including social and ethical issues.

2. Formal aspects of the programme

The programme corresponds to Qualification Level 2 of the Bologna Programme and to Qualification Level 7 of the "European Qualifications Framework for Lifelong Learning" developed by the European Union. Table 3 provides an overview of the programme's formal aspects.

Table 3: Formal aspects of the programme

Official title	Wirtschaftsinformatik (English: Information Systems)
Duration and workload	4 semesters, 120 ECTS credits
Language	English
Credits	Courses are assigned a number of hours in class and a number of hours for individual coursework, where the sum of the two yields the actual work-load. Thirty work hours are equivalent to one ECTS credit point. Thirty ECTS credit points correspond to the average coursework of a semester at the University of Liechtenstein.
Academic degree	Master of Science in Information Systems
Official abbreviation	MSc
Admission requirements	Admission requirements are specified in the Admission Guidelines for the Master's degree programme in Information Systems.
Further educational options	The degree grants eligibility for a doctoral degree programme.

3. Module structure

The **first-semester modules** consist of core Information Systems courses like *Management Information Systems* and *Data Management*; two courses that provide an introduction to *Data and Application Security* and *Business Process Management*; a *Business Statistics* course that covers quantitative methods to provide a methodological basis for the Master's thesis; and the first project seminar, *Innovation Lab*. Table 4 provides an overview of the first-semester modules.

Table 4: First-semester module structure

Semester	**Module** Course(s) in the module	Type	Taught units per semester (in units of 45 minutes)	ECTS credits
1	**Management Information Systems**	**CO**		**6**
	Management Information Systems	LE	60	6
	Business Process Management	**CO**		**6**
	Business Process Management	LE	60	6
	Information Systems Modelling	**CO**		**3**
	Information Systems Modelling	LE	30	3
	Information Systems Development	**CO**		**3**
	Information Systems Development	SE	30	3
	Data Management	**CO**		**3**
	Data Management	LE	30	3
	Business Statistics	**CO**		**3**
	Business Statistics	LE	30	3
	Innovation Lab	**CO**		**3**
	Innovation Lab	SE	23	3
	Cross-Faculty Elective I	**MG**		**3**

CO = compulsory modules; MG = module groups that categorise optional compulsory modules; LE = lectures; EX = exercises; SE = seminars

The **second-semester modules** consist of complementary fundamental Information Systems modules like *Information Systems Modelling*, *Information Systems Development*, and *Enterprise Architecture Management*; two courses that provide an introduction to *Data Science* and *Digital Innovation*; and the second project seminar, *Digital Business*. Table 5 provides an overview.

The **third-semester modules** consist of a course on *Emerging IT Topics,* with course content that changes from semester to semester to address recent technological trends; an advanced course on information systems development, *Human-Centred Design*; a *Research Methods* lecture, in which students learn how to conduct and report on scientific studies; and two seminars, the *Research Seminar* and the *Project Seminar*. Table 6 provides an overview.

Table 5: Second-semester module structure

Semester	Module Course(s) in the module	Type	Taught units per semester (in units of 45 minutes)	ECTS credits
2	**Data and Application Security**	**CO**		**6**
	Data and Application Security	LE	40	4
	Data and Application Security	EX	20	2
	Digital Innovation	**CO**		**6**
	Digital Innovation	LE	60	6
	Data Science	**CO**		**6**
	Data Science	LE	60	6
	Enterprise Architecture Management	**CO**		**3**
	Enterprise Architecture Management	SE	30	3
	Core Elective I	**MG**	See Table 7.	**3**
	Digital Business	**CO**		**3**
	Digital Business	SE	24	3
	Cross-Faculty Elective II	**MG**		**3**

CO = compulsory modules; MG = module groups that categorise optional compulsory modules; LE = lectures; SE = seminars

Table 6: Third-semester module structure

Semester	Module Course(s) in the module	Type	Taught units per semester (in units of 45 minutes)	ECTS credits
3	**Emerging IT Topics**	**CO**		**3**
	Emerging IT Topics	LE	30	3
	Human-Centred Design	**CO**		**3**
	Human-Centred Design	LE	30	3
	Core Elective II	**MG**	See Table 7.	**3**
	Core Elective III	**MG**	See Table 7.	**3**
	Core Elective IV	**MG**	See Table 7.	**3**
	Research Methods	**CO**		**3**
	Research Methods	LE	30	3
	Research Seminar	**CO**		**3**
	Research Seminar	SE	30	3
	Project Seminar	**CO**		**6**
	Project Seminar	SE	36	6
	Cross-Faculty Elective III	**MG**		**3**

CO = compulsory modules; MG = module groups that categorise optional compulsory modules; LE = lectures; SE = seminars

In addition, students take four **core-elective modules** in the second and third semesters. They can combine these courses however they like as long as they take at least four electives that are worth a total of twelve ECTS credits.

Core electives are only held when at least five students register for them. Table 7 provides an overview of the core electives students can choose.

Table 7: Core electives module structure

Semester	**Module** Course(s) in the module	Type	Taught units per semester (in units of 45 minutes)	ECTS credits
2	**BPM and Organisational Practice**	**OC**		**3**
	BPM and Organisational Practice	LE	30	3
	Security Management	**OC**		**3**
	Security Management	LE	30	3
	Artificial Intelligence and Deep Learning	**OC**		**3**
	Artificial Intelligence and Deep Learning	LE	30	3
	Digital Humanities	**OC**		**3**
	Digital Humanities	LE	30	3
	Educational Journey	**OC**		**3**
	Educational Journey	EC	30	3
3	**Network and System Security**	**OC**		**3**
	Network and System Security	LE	20	2
	Network and System Security	EX	10	1
	Intrusion Detection and Mitigation	**OC**		**3**
	Intrusion Detection and Mitigation	LE	30	3
	Business Process Analysis	**OC**		**3**
	Business Process Analysis	LE	30	3
	Process Mining	**OC**		**3**
	Process Mining	LE	30	3
	Advanced Machine Learning	**OC**		**3**
	Advanced Machine Learning	LE	30	3
	Data Visualisation	**OC**		**3**
	Data Visualisation	LE	30	3
	Digital Entrepreneurship	**OC**		**3**
	Digital Entrepreneurship	LE	30	3
	Autonomous Tools, Design, and Innovation	**OC**		**3**
	Autonomous Tools, Design, and Innovation	LE	30	3

OC = optional compulsory modules; LE = lectures; EC = excursion ; EX = exercises

The **fourth semester** focuses on the master's thesis, which must be presented and defended before a panel of experts. Table 8 provides an overview. Finally, students must take four **cross-faculty electives** during their studies – one elective per semester (i.e., 12 ECTS credits in total). The course offerings for cross-faculty electives vary and are available online. However, a maximum of two cross-faculty electives (i.e., 6 ECTS credits in total) can be substituted with one or two cross-programme electives from other degree programmes (i.e., 0 – 6 ECTS credits) and/or with a core elective from Table 7 (i.e., 0 – 3 ECTS credits). Cross-programme electives that Information Systems students may take are *International Business Finance* (Master's Degree Programme in Finance) and *Opportunity*

Recognition & Business Models (Master's Degree Programme in Entrepreneurship and Management). In turn, Finance students and Entrepreneurship and Management students may take the first-semester Information Systems course *Data Management*.

Table 8: Fourth-semester module structure

Semester	**Module** Course(s) in the module	Type	Taught units per semester (in units of 45 minutes)	ECTS credits
4	**Master's Thesis**	**CO**		**27**
	Master's Thesis	TH	0	26
	Presentation and Defence	MI	1	1
	Cross-Faculty Elective IV	**MG**		**3**

CO = compulsory modules; MG = module groups that categorise optional compulsory modules; MI = Miscellaneous; and TH = thesis

4. Module handbook

4.1. First semester

4.1.1. Management Information Systems

Module type	Compulsory
Courses	Lecture *Management Information Systems*
ECTS	6.0
Taught units per semester (in units of 45 minutes)	60.0
Private study time (in hours)	135.0
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Management Information Systems focuses on large-scale application software packages that support end-to-end processes, information and document flow, reporting, and data analytics in organizational settings. The course covers eight primary topics:

- Enterprise applications
- E-business
- Managing knowledge
- Enhancing decision-making
- Building management information systems (MIS)
- Managing projects and global systems
- MIS-related integration, transformation, innovation, and change
- Case studies on current MIS topics

Learning Outcomes

After successful completion of the course, students will

- understand the fundamental concepts and definitions in the area of enterprise systems and know application systems like ERP, CRM, and SCM systems
- understand the role of management information systems in achieving sustainable competitive advantage and integrating processes along the value chain
- be able to assess the applicability of software solutions in various business scenarios using comprehensive evaluation schemes
- be able to identify the business problems that typically emerge in enterprise systems design and use

Methods

- The course involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.

- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Case studies are used to discuss the course contents and to train students in using the methods covered.

Requirements

- Students are expected to have a basic background in enterprise systems and information systems.

4.1.2. Business Process Management

Module type	Compulsory
Courses	Lecture *Business Process Management*
ECTS	6.0
Taught units per semester (in units of 45 minutes)	60.0
Private study time (in hours)	135.0
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Business Process Management provides an introduction to fundamental concepts, frameworks, models, theories, and methods in process management and covers the operation, improvement, and innovation of business processes. Business Process Management (BPM) is one of the core topics of the degree programme, so the course also provides a basis on which students can choose their electives. The course covers eight primary topics:

- Business process operations
- Business process change
- Strategic alignment
- Business process governance
- Quality management
- Six Sigma
- BPM skills
- Organizational culture

Learning Outcomes

After successful completion of the course, students will

- understand the foundations and contextual roots of BPM (e.g., business process re-engineering, total quality management)
- understand the goals of BPM (e.g., time, cost, quality, sustainability)
- understand the core components of holistic BPM approaches (strategic alignment, governance, methods, technologies, people, culture)
- understand the key principles of good BPM

Methods

- The course involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Case studies are used to discuss the course contents and to train students in using the methods covered.

4.1.3. Information Systems Modelling

Module type	Compulsory
Courses	Lecture *Information Systems Modelling*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Information Systems Modelling focuses on systems analysis and design. In particular, the course covers methods of and approaches to modelling information systems in organisations. The course covers five primary topics:

- Introduction to object-oriented systems
- Project planning and initiation
- Requirements analysis (i.e. requirements gathering and structuring)
- Information systems modelling (i.e. UML modelling languages)
- Information systems documentation

Learning Outcomes

After successful completion of the course, students will

- know how information systems can be modelled
- know and apply basic methods of systems modelling and design (i.e. UML modelling languages)
- use systems-modelling methods to analyse, design, and implement information systems

Methods

- The course involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Case studies are used to show how the course contents are related.

4.1.4. Information Systems Development

Module type	Compulsory
Courses	Seminar *Information Systems Development*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Presentations, project results; attendance is mandatory (80%)

Content

Information Systems Development provides an introduction to programming including web frameworks that can be used in online environments such as e-commerce platforms or blog systems. The course covers six primary topics:

- Introduction to scripting / programming
- Software / programme development
- Web technologies and web development
- Web applications and their frameworks
- Programming using existing frameworks
- Project: Web platform

Learning Outcomes

After successful completion of the course, students will

- memorize programming concepts and web technologies for information systems development
- develop introductory software programs (or scripts)
- assess the advantages and disadvantages of various web frameworks
- produce an online platform (e.g., website, shop, blog) using an existing web application framework

Methods

- The course involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Case studies are used to discuss the course contents and to train students in using the methods covered.

Requirements

- Elementary knowledge of programming (preferably, a scripting language such as Python or a high level language such as Java)
- Elementary knowledge of web development (e.g., familiarity with HTML and CSS) and optonallyl of web frameworks (e.g., wordpress, django)

4.1.5. Data Management

Module type	Compulsory
Courses	Lecture *Data Management*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Data Management covers the modern data-management cycle, from the collection of data from diverse sources to the preparation of data for data-driven applications. Students learn how to handle various data formats, how to assess and improve data quality, and how to store and process data using SQL, NoSQL, and Hadoop technologies. The course covers eight primary topics:

- Modern data-management requirements
- Database system architecture
- Diagnosing and handling data quality problems
- Relational databases (SQL)
- Hands-on labs with MySQL
- Concurrency control techniques
- NoSQL databases (e.g., MongoDB)
- Apache Hadoop (HDFS, MapReduce)

Learning Outcomes

After successful completion of the course, students will

- understand the basic concepts and methods of modern data management
- be able to collect and prepare data for data-driven applications
- be able to select and apply appropriate technologies for building data-driven applications

Methods

- The module involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.

4.1.6. Business Statistics

Module type	Compulsory
Courses	Lecture *Business Statistics*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Business Statistics covers statistical methods that are used to support decision-making in business contexts, so it also provides a methodological foundation for the students' master's thesis projects. The course builds on the basic concepts of statistical testing and estimation theory that are usually taught in bachelor's programmes. The course covers five primary topics:

- Graphic and numeric characterizations of random variables and their distributions
- Framework and basic applications for testing hypotheses and estimating parameters
- The ordinary least squares (OLS) method
- Simple linear regression, including parameter estimation, diagnostic plots, hypothesis testing, predictions, and model specifications using log-transformations
- Introduction to the software package R

Learning Outcomes

After successful completion of the course, students will

- be able to present the distributions of random variables graphically and to calculate and interpret their moments
- understand the framework of testing hypotheses and estimating parameters
- know the assumptions made in basic testing and estimating procedures when drawing general conclusions
- be able to derive the minimum sample size for basic testing and estimation procedures
- be able to apply the ordinary least squares method to derive estimators and compare their statistical properties
- be able to explain the classic linear model assumptions, run simple linear regressions, check the diagnostics plots, use log-transformations to specify models, and interpret the results correctly

Methods

- The module involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- Students complete homework assignments after each lecture.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.

Requirements

- Basic knowledge of probability theory and statistics as typically taught in bachelor study programmes. The content of the module *Statistik* in the Bachelor Programme in Business Administration at the University of Liechtenstein can be taken as a reference for required knowledge.

4.1.7. Innovation Lab

Module type	Compulsory
Courses	Seminar *Innovation Lab*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	23.0
Private study time (in hours)	72.75
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Seminar paper, presentations, project results; attendance is mandatory (80%)

Content

In the *Innovation Lab* seminar, students work in small groups to solve practical IT problems in cooperation with multiple regional companies. Representatives of these companies regularly provide students with feedback at the university and take part in networking events. The seminar thus also supports dialogue between regional industry and the university, helping students to interact with world-renowned companies right from the start of their studies. Students learn to work independently, to work in a team, to take responsibility, and to present project results effectively. In addition to creative thinking, the use of skills related to problem-solving, organizing and planning, communication, and project management is encouraged. Course topics change from semester to semester.

Learning Outcomes

After successful completion of the course, students will be able to

- work in a team to solve IT problems
- plan and organize IT projects under time pressure in a competitive environment
- use creativity techniques and problem-solving tools to work on IT projects
- think creatively to create innovative business and IT solutions
- look at IT problems from multiple perspectives and develop alternative solutions
- deliver professional presentations to a demanding audience

Methods

- The course involves interactive seminars with workshops and regular presentations.
- The faculty and a jury of representatives from regional companies evaluate the students' solutions in terms of their innovativeness and usefulness and provide them with feedback and advice.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.

4.2. Second semester

4.2.1. Data and Application Security

Module type	Compulsory	
Courses	Lecture *Data and Application Security*	Exercise *Data and Application Security*
ECTS	4.0	2.0
Taught units per semester (in units of 45 minutes)	40.0	20.0
Private study time (in hours)	90.0	45.0
Min. enrollment	—	
Frequency	Once a year	
Language	English	
Recommended literature	Accessible via the university intranet	
Assessment	Written exam	Assignments

Content

Data and Application Security provides an introduction to cyber security and covers issues related to computer and information security. Security is one of the core topics of the degree programme, so the course also provides a basis on which students can choose their electives. The course covers nine primary topics:

- Security goals and design principles
- Economic aspects of security and risk analysis
- Basics of cryptography
- Authentication and access control
- Key instruments of network security
- Key instruments of web security
- Software security, vulnerabilities, and attacks
- Email and mobile device security

Students are required to pass this course in order to register for *Network and System Security* and *Intrusion Detection and Mitigation* courses.

Learning Outcomes

After successful completion of the course, students will

- understand the main concepts and methods of computer and information security
- understand the principles and key requirements of security management
- be able to analyse, configure, and manage practical security instruments

Methods

- The module involves interactive lectures to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Lab exercises are used to support the acquisition of practical skills.

Requirements

- Intermediate knowledge of programming (Python or similar high-level language)

4.2.2. Digital Innovation

Module type	Compulsory
Courses	Lecture *Digital Innovation*
ECTS	6.0
Taught units per semester (in units of 45 minutes)	60.0
Private study time (in hours)	135.0
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Digital Innovation covers the fundamentals of digital innovation and the development and implementation of novel and original solutions in which the innovation process, its outcomes, or the ensuing organisational and social transformation is embodied in or enabled by digital technologies. Digital Innovation is one of the core topics of the degree programme, so the course also provides a basis on which students can choose their electives. The course covers six primary topics:

- Fundamental properties of digital technologies and digital innovation
- Organising for digital innovation
- Digital platforms and ecosystems
- Digital innovation and capital creation
- Digital business models
- Digital entrepreneurship

Learning Outcomes

After successful completion of the course, students will

- understand the main concepts, theories, and methods related to digital innovation
- be able to analyse the role of digital technologies in existing business models
- be able to develop business models that consider options created through digital technologies

Methods

- The module involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Case studies are used to discuss the course contents. Contemporary scientific publications from Information Systems and Management are discussed in class.

4.2.3. Data Science

Module type	Compulsory
Courses	Lecture *Data Science*
ECTS	6.0
Taught units per semester (in units of 45 minutes)	60.0
Private study time (in hours)	135.0
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Data Science covers statistical and exploratory techniques that are used to make sense of the vast and complex data sets that have emerged in business. Data Science is one of the core topics of the degree programme, so the course also provides a basis on which students can choose their electives. Students learn to detect patterns in large data sets in quantitative and qualitative formats to translate them into actionable insights. The course covers seven primary topics:

- Data visualisation and exploration
- Supervised learning techniques for regression (e.g. logistic regression)
- Supervised learning techniques for classification (e.g. classification trees)
- Unsupervised learning techniques (e.g. clustering, dimensionality reduction)
- Fundamentals of deep learning
- Text mining (e.g. topic modelling)
- Hands-on labs with Python

Learning Outcomes

After successful completion of the course, students will

- understand the basic concepts and methods of data mining and predictive analytics
- be able to assess the assumptions and quality of statistical models
- be able to select and apply the right statistical models for a given task or data set
- be able to derive actionable insights from statistical results

Methods

- The course involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.

Requirements

- Basic knowledge of statistics and linear algebra is recommended but not mandatory.

4.2.4. Enterprise Architecture Management

Module type	Compulsory
Courses	Seminar *Enterprise Architecture Management*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Assignments, written exam

Content

Today, virtually all large organizations have to cope with growing complexity in their enterprise architectures (EA), which often comprise several hundreds or even thousands of IT applications that support an increasing variety of business processes. The underlying software components run on several generations of IT infrastructure, and digitization leads to increased intensity in inter-organizational interfaces and customer-centric solutions. As a consequence, EA comprises not only the fundamental structure and dependencies of business processes, IT applications, software components, IT infrastructure, and data in an enterprise, but also connected components of business ecosystem partners and customers. Changing only one of these EA components can impact a potentially large number of related components. Simultaneously changing several of these components in a number of change projects or transformation programs leads to potentially redundant (i.e. inefficient) and/or inconsistent processes, software systems, and/or IT infrastructure components. The short-term consequence is a waste of resources, and the longer-term consequences are increased effort and difficulty in maintaining existing information systems (because of excessive complexity) and shortage of resources that can be used for innovation.

EA management (EAM) is a management discipline that guides EA's design and evolution. The goals of EAM are to control complexity, reduce inconsistencies, and leverage synergies in EA. EAM also supports the implementation of business innovation from a holistic perspective. This course covers EA and EAM, incorporating both research findings and current examples from business practice. The course covers four primary topics:

- Core concepts and the necessity of EAM
- EAM use cases
- EA modelling and analysis
- Continuous improvement and maturity of EAM

Learning Outcomes

After successful completion of the course, students will

- understand the fundamentals of EAM
- understand EA's complexity and know how to align the components in an EA and how to align EA with organisational strategies and structures
- be able to use methods for modelling, analysing, and improving EA
- be able to evaluate the consistency, fit, and effectiveness of EAM initiatives in organizations

Methods

- The course involves interactive lectures, class room exercises, and practitioner presentations to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course materials and for information and discussion.
- Case studies are used to integrate the aspects of EA/EAM covered in the course.
- Students complete homework assignments between lectures.

4.2.5. Digital Business

Module type	Compulsory
Courses	Seminar *Digital Business*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	24.0
Private study time (in hours)	72.0
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Seminar paper, presentations, project results; attendance is mandatory (80%)

Content

In *Digital Business*, students collaborate with small and medium-sized companies to develop new business models, open new markets, and innovate with existing products and services, so students learn to recognise, understand, develop, and exploit digital innovations. The course topics change from semester to semester, but the course usually addresses seven grand themes:

- Designing digital business strategy
- Digital entrepreneurship and intrapreneurship
- Opportunity recognition
- Business model innovation
- Value creation and cocreation
- Digital transformation
- Project management

Learning Outcomes

After successful completion of the course, students will

- understand the complex nature of digitalisation in small and medium-sized enterprises as well as start-up ventures
- understand the entrepreneurial aspects in digital business: from opportunity recognition to designing digital strategy and business model and convincing potential stakeholders
- demonstrate readiness to innovate and to view an idea, a problem, or a solution from several different angles
- be able to articulate their ideas clearly in an elevator pitch, in order to persuade potential collaborators and sponsors of the values of their ideas
- be able to outline a project plan to implement their ideas and complete the project under time pressure
- be able to collaborate in teams and with external partners
- be able to develop feasible solutions to their identified issues and evaluate them using appropriate methods

Methods

- The course involves interactive seminars with workshops and regular presentations.
- The faculty and a jury of representatives from regional companies evaluate the students' solutions in terms of innovativeness and usefulness and provide them with feedback and advice.
- The e-learning platform Moodle will be used throughout the course for the dissemination of course material and for information and discussion.

Requirements

- Basic knowledge of project management is required; though not mandatory, students should thus have attended the *Innovation Lab* course.

4.3. Third semester

4.3.1. Emerging IT Topics

Module type	Compulsory
Courses	Lecture *Emerging IT Topics*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Emerging IT Topics addresses recent technological trends and developments in research and business, so its content can be adapted quickly to the job market's emerging needs. Accordingly, the course content changes from semester to semester.

Learning Outcomes

After successful completion of the course, students will

- have profound knowledge of current topics in IT
- be able to assess the usefulness and potential applications of emerging IT applications
- be current on recent scientific results on emerging IT topics

Methods

- The course involves interactive lectures that integrate theoretical knowledge with analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course materials and for information and discussion.
- Contemporary scientific publications from the fields of Information Systems and Management are discussed in class.

4.3.2. Human-Centred Design

Module type	Compulsory
Courses	Lecture *Human-Centred Design*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Human-Centred Design is an approach that places people at the core of every decision point throughout the design process. Identifying, understanding and fulfilling people's needs, desires, wishes, and goals are imperative in human-centred design. The approach is relevant to any design endeavour that aims to deliver useful products, services, and combinations of both to people as the end-users. The same applies to the design of software, mobile applications, collaboration platforms, and other information systems.

This course is designed with Information Systems students' needs and goals in mind. Students are guided through their journey in understanding the basics of human cognition and human behaviour that are relevant to the design of information systems. They also learn several methods of human-centred design that are applicable in their projects.

Learning Outcomes

After successful completion of the course, students will

- understand the basics of human cognition and human behaviour that are relevant to the design of information systems
- understand different human-centred design methods
- be able to apply the understanding and the design methods into their own design projects or illustrative cases

Methods

- The module involves interactive lectures with exercises to integrate theoretical knowledge with critical analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Case studies are used to discuss the course contents.
- Contemporary scientific publications from Information Systems and Human-Centred Design are discussed in class.

4.3.3. Research Methods

Module type	Compulsory
Courses	Lecture *Research Methods*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

In *Research Methods*, students learn to identify pertinent research questions, conduct systematic literature reviews, apply appropriate research methods, and report on their results. The course covers nine primary topics:

- Introduction to scientific research
- Scientific writing
- Ethical standards
- Literature reviews
- Qualitative research
- Quantitative research
- Mixed-methods research
- Design science research
- Theories used in Information Systems research

Learning Outcomes

After successful completion of the course, students will

- understand the historical development and concept of scientific research
- understand the fundamentals of scientific writing
- be familiar with the most common issues related to research ethics, including plagiarism
- know the Association for Information Systems (AIS) Code of Research Conduct
- be able to identify appropriate theories to explain empirical phenomena
- be able to identify suitable research methods so they can seek answers to specific research questions
- be able to use appropriate qualitative, quantitative, mixed-method, and design-oriented approaches to scientific research

Methods

- The course involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.

4.3.4. Research Seminar

Module type	Compulsory
Courses	Seminar *Research Seminar*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Seminar paper, presentation

Content

In the *Research Seminar* course, students learn to apply in practice what they learned in the *Research Methods* course. The seminar covers issues related to identifying and formulating research questions, choosing a suitable research design to use in answering these questions, evaluating the feasibility of a planned research study, and writing research proposals. Together with faculty, students develop research proposals (so-called “exposés”) for their master’s theses.

Learning Outcomes

After successful completion of the course, students will

- know what makes a good research topic and that the search for a research topic is a challenging endeavour
- know what methods can be applied to identify research ideas and refine them into research questions
- be able to develop research questions that are both practical and academically relevant
- be able to conduct systematic and effective literature reviews to demonstrate the novelty of their research ideas and provide background for their research
- develop qualitative, quantitative, mixed-method, and design-oriented research designs
- recognize and analyse the ethical problems in designing and conducting research in the field of Information Systems
- know how to consider issues of feasibility in planning their research studies
- be able to write effective research proposals

Methods

- The course involves interactive seminars with workshops and regular presentations.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.

Requirements

- Though not mandatory, students should attend the *Research Methods* course, which also takes place in the third semester, in parallel.

4.3.5. Project Seminar

Module type	Compulsory
Courses	Seminar *Project Seminar*
ECTS	6.0
Taught units per semester (in units of 45 minutes)	36.0
Private study time (in hours)	153.0
Min. enrollment	—
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Seminar paper, presentations, project results; attendance is mandatory (80%)

Content

In *Project Seminar*, students analyse a real-world case from a specific industry. Students divide into groups according to their preferences and work on one of four cases through the lens of process management, data and application security, data science, or digital innovation. The course topics change from semester to semester.

Learning Outcomes

After successful completion of the course, students will be able to

- analyse real-world cases
- collect and prepare data for analysis
- build and evaluate statistical models
- integrate areas of knowledge to identify areas of improvement or innovation
- use appropriate methods to develop recommendations for a case company

Methods

- The course involves interactive seminars with workshops and regular presentations.
- The faculty and a jury of representatives from regional companies evaluate the students' solutions in terms of innovativeness and usefulness and provide them with feedback and advice.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.

Requirements

- Though not mandatory, students should have profound knowledge in Business Process Management, Data and Application Security, Data Science, or Digital Innovation depending on their choice of project.

4.4. Fourth semester

4.4.1. Master's Thesis

Module type	Compulsory	
Courses	Thesis *Master's Thesis*	Miscellaneous *Presentation and Defence*
ECTS	26.0	1.0
Taught units per semester (in units of 45 minutes)	0.0	1.0
Private study time (in hours)	780.0	29.25
Min. enrollment	—	
Frequency	Every semester	
Language	English	
Recommended literature	Accessible via the university intranet	
Assessment	Thesis	Presentation and Defence

Content

In their *Master's Thesis*, students use scientific methods to answer a research question and work in accordance with standards of scientific writing. The master's thesis is typically related to one of the four subject areas that constitute the core of the curriculum (i.e., Business Process Management, Data and Application Security, Data Science, and Digital Innovation).

Learning Outcomes

After successful submission of the master's thesis, students will have demonstrated their ability to plan, execute, and manage research projects autonomously.

Methods

- The thesis is assessed by a faculty member from the Institute of Information Systems (professor, assistant professor, visiting professor or senior lecturer).
- The thesis is presented and defended in an oral examination. The examination committee is composed of the Academic Director, another faculty member, and an external expert appointed by the Vice-Rector for Teaching.
- The time for producing the completed thesis is defined on the thesis proposal ("exposé") and may not exceed 22 weeks.

Requirements

- A minimum of 60 ECTS must be achieved before a student may register for this module.
- The student must have passed the *Business Statistics* course before registering for the course. Exceptions are possible only after consultation with the study administration. Though not mandatory, students should have attended the *Research Methods* course.
- A research proposal ("exposé") signed by the supervisor and the academic director must be submitted to the study administration in parallel with the student's registration for the module by 01 February (summer semester) or 01 July (winter semester). If the student has passed the *Research Seminar* module, the seminar paper that has been developed in the *Research Seminar* module serves as an exposé and must then not be submitted to the study administration by the student. (The module coordinator will forward all positive seminar papers / exposés to the Academic Board.). It is thus highly recommended that the exposé be developed during the *Research Seminar* course.

Comments

- *Exposé:* The seminar paper that is developed in the *Research Seminar* module serves as an exposé for the master's thesis if the student has passed the *Research Seminar* module and if the student has not submitted another exposé signed by the supervisor to the study administration (master.information-systems@uni.li) by 01 February (summer semester) or 01 July (winter semester).
- *Regulations and forms:* Students must adhere to the *Guidelines for Writing Academic Papers in Economics* and are asked to use the university's official *Template* for writing their master's theses. In addition, students must carefully review the *Study and Assessment Regulations* and *Master Thesis Assessment Criteria*. All documents are available on the university's intranet ("Regulations and Forms").
- *Submission:* The completed master's thesis must be submitted to the central service desk by 30 June (summer semester) or 30 November (winter semester). (Students should check the opening times of the central service desk, especially during the summer months.) If either of these dates falls on a weekend or a public holiday, the deadline is automatically extended to the next workday. The submission must include: (1) two signed copies in adhesive binding and (2) two signed copies in spiral binding. In addition, students must upload their completed theses as pdf documents to Moodle.
- *Presentation and defence:* The master's thesis must have been evaluated with a grade of 3.8 or higher to attend the *Presentation and Defence* course. A detailed schedule will be announced via Moodle and/or via e-mail. Students have 12-15 minutes to present their theses, another 15 minutes is for discussion. Apart from subject knowledge, grading criteria are presentation structure (information flow, line of argument etc.), design (formatting, figures, animations etc.), mechanics (grammar, typos, citation etc.), appearance (eye contact, gestures etc.), and elocution (language, clarity, rhetoric etc.).

4.5. Core electives

4.5.1. BPM and Organisational Practice

Module type	Optional compulsory
Courses	Lecture *BPM and Organisational Practice*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	5 students
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

BPM and Organisational Practice explores Business Process Management (BPM) through an organisational-studies lens, so it is a BPM elective. Emphasizing the duality of stability and change in organisational work, the course covers the factors, mechanisms, and interventions that affect how processes behave over time. The course covers six primary topics:

- Organisation theory
- Process- and practice-based research
- Organisational routines
- Intra-organisational dynamics and endogenous change

- Organisational learning, unlearning, and forgetting
- The role of agency and intention in the execution of organisational work

Learning Outcomes

After successful completion of the course, students will

- understand the basics of organisation theory
- be able to relate BPM to insights from organisational studies
- understand how and why processes change and evolve over time, even in unpredictable ways
- be able to design interventions to facilitate stability and/or change in process-related organisational work

Methods

- The course involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.

4.5.2. Network and System Security

Module type	Optional compulsory	
Courses	Lecture *Network and System Security*	Exercise *Network and System Security*
ECTS	2.0	1.0
Taught units per semester (in units of 45 minutes)	20.0	10.0
Private study time (in hours)	45.0	22.5
Min. enrollment	5 students	
Frequency	Once a year	
Language	English	
Recommended literature	Accessible via the university intranet	
Assessment	Written exam	Lab Assignments

Content

Network and System Security covers advanced security mechanisms in computer networks and systems and attacks against information systems. The course focuses on eight primary topics:

- Essential network-security protocols
- Attacks against common network protocols
- Security issues in web applications
- Security mechanisms in operating systems
- Advanced exploitation techniques

Learning Outcomes

After successful completion of the course, students will

- understand the typical attacks against various components of information systems
- understand the main network security protocols and their implementation
- understand the main preventive security mechanisms in operating systems

Methods

- The module involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Lab exercises and programming assignments are used to support the acquisition of practical skills.

Requirements

- Successful completion of the *Data and Application Security* course. Exceptions are possible only after consultation with the lecturer and the study program management.

4.5.3. Artificial Intelligence and Deep Learning

Module type	Optional compulsory
Courses	Lecture *Artificial Intelligence and Deep Learning*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	5 students
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Artificial Intelligence and Deep Learning covers the basics of artificial intelligence and deep learning and recent technological trends. The course covers five primary topics:

- Fundamentals of artificial intelligence
- Fundamentals of deep learning, network design, and training
- Convolutional neural networks, illustrated through image recognition
- Recurrent neural networks, illustrated through text mining
- Deep reinforcement learning – Learning to play games and beyond: Google's AlphaGo

Learning Outcomes

After successful completion of the course, students will

- understand the basic concepts and methods of artificial intelligence and deep learning
- be able to identify suitable applications for artificial intelligence and deep learning
- be able to select, use, and adjust existing models and methods for a given task or data set

Methods

- The course involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.

Requirements

- Though not mandatory, students should attend the *Data Science* course, which also takes place in the second semester, in parallel. Any other basic course on data science, data mining or machine learning is also accepted. Exceptions are only possible after consultation with the lecturer and the study program management.

4.5.4. Digital Humanities

Module type	Optional compulsory
Courses	Lecture *Digital Humanities*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	5 students
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Digital Humanities stands at the intersection between digital technology and social action – between computing and humanities. Besides enabling digital innovation, digital technology has fundamentally changed the way we see the world, work, and socialise. We are increasingly challenged to make sense of data and information, and turn them into things we can use for different goals. On the other hand, we also need to adjust ourselves in order to collaborate with each other through digital technology – and sometimes even with digital technology itself. How far should we go? How do we find a balance? This course is primarily concerned with understanding different and sometimes contradicting views on the relationship between digital technology and social action. The course covers five primary topics:

- Introduction to digital humanities
- The computational turn
- Favourable views on digitization and digitalization
- Critical views on digitization and digitalization
- Examples of digital humanities projects

Learning Outcomes

After successful completion of the course, students will

- understand the basic concepts and underlying theories related to digital humanities
- understand different and sometimes contradicting views on the relationship between digital technology and social actions
- be able to analyse everyday examples based on these initial understandings

Methods

- The module involves interactive lectures with exercises to integrate theoretical knowledge with critical analysis skills.

- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Case studies are used to discuss the course contents.
- Recent cientific publications from Information Systems and Digital Humanities are discussed in class.

4.5.5. Educational Journey

Module type	Optional compulsory
Courses	Excursion *Educational Journey*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	5 students
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

The *Educational Journey* covers lectures at a foreign university, company visits, and leisure activities. Course topics change from semester to semester.

Comments

The trip typically lasts from Tuesday to Saturday (including travel). A detailed schedule will be announced via e-mail and during a kick-off session at the University of Liechtenstein in February. Attendance at all days and events is mandatory. Registration is possible until the end of February.

4.5.6. Intrusion Detection and Mitigation

Module type	Optional compulsory
Courses	Lecture *Intrusion Detection and Mitigation*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	5 students
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

The course *Intrusion Detection and Mitigation* covers the essential techniques for detection and mitigation of attacks against information systems. The course covers the following topics:

- Taxonomy of Intrusion-detection methods
- Implementation of intrusion detection systems
- Malware functionality and operation
- Static and dynamic malware analysis
- Malware detection and classification
- Security incident response

Learning Outcomes

After successful completion of the course, students will

- understand the key techniques deployed in complex attacks against information systems
- understand the methods used in detection of various kinds of attacks
- know the main types of modern malware
- understand the methods used for malware analysis
- be able to apply detection methods on exemplary attack data
- be able to analyse exemplary malware data

Methods

- The module involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Homework and programming assignments are used to support the acquisition of practical skills.

Requirements

- Successful completion of the *Data and Application Security* course. Exceptions are possible only after consultation with the lecturer and the study program management.

4.5.7. Security Management

Module type	Optional compulsory
Courses	Lecture *Security Management*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	5 students
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Security Management covers technical and organizational methods for the definition and implementation of security policies. The course covers six primary topics:

- Definition of security policies
- Security measures and their implementation
- Risk analysis in information security
- Security audit
- Standardization of security management
- Security management tools and best practices

Learning Outcomes

After successful completion of the course, students will:

- understand the key concepts of security management
- understand the main security standards
- be able to carry out risk analyses and use it in planning security measures
- be able to perform an elementary security audit

Methods

- The module involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Homework assignments are used to deepen students' understanding of the analytical methods of security management.

4.5.8. Business Process Analysis

Module type	Optional compulsory
Courses	Lecture *Business Process Analysis*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	5 students
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Business Process Analysis focuses on process analysis, covering approaches and methods for designing, analysing, and simulating processes in organisations. The course covers four primary topics:

- Introduction to process analysis
- Process modelling and design

- Process flow analysis
- Process simulation

Learning Outcomes

After successful completion of the course, students will:

- know how processes can be modelled, analysed, and simulated
- know the basic methods of process modelling for analysing, designing, and implementing information systems in organisations
- be able to use the methods of process flow analysis and simulation to analyse, design, and improve business processes in organisations

Methods

- The course involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.

4.5.9. Process Mining

Module type	Optional compulsory
Courses	Lecture *Process Mining*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	5 students
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Process Mining covers conceptual foundations, methods, and technologies for analysing business processes with the help of digital trace data that stems from information technology. In particular, students learn how to mine digital trace data. The course focuses on three primary topics:

- Petri-net foundations of process analysis
- Process mining algorithms
- Process mining tools and applications

Learning Outcomes

After successful completion of the course, students will

- understand the foundational concepts of process mining
- understand how process mining algorithms work
- understand how a process mining project can be conducted in practice

Methods

- The course involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.

Requirements

- Though not mandatory, students should have attended the first-semester course *Business Process Management*.

4.5.10. Advanced Machine Learning

Module type	Optional compulsory
Courses	Lecture *Advanced Machine Learning*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	5 students
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Advanced Machine Learning covers several advanced topics in the field of machine learning and is concerned with requirements engineering in particular. Students learn to analyse certain types and large amounts of data. The course covers seven primary topics:

- Requirements engineering for machine learning and business intelligence projects
- Frequent patterns and association rules
- Explaining decisions of machine learning models
- Time series analysis
- Anomaly detection
- Fundamentals of computational efficiency and distributed and parallel computing
- Hadoop ecosystems, with a focus on Spark and MLlib

Learning Outcomes

After successful completion of the course, students will

- have deepened their understanding in the field of machine learning and acquired a larger set of machine-learning techniques
- understand the challenges and solutions of processing large amounts of data
- be able to gather requirements for projects in the field of machine learning and business intelligence

Methods

- The course involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.

Requirements

- Successful completion of the *Data Science* course or any other basic course on data science, data mining or machine learning. Exceptions are possible only after consultation with the lecturer and the study program management.

4.5.11. Data Visualisation

Module type	Optional compulsory
Courses	Lecture *Data Visualisation*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	5 students
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Data Visualisation covers techniques for creating effective data visualisations based on principles from statistics, cognitive science, and graphic design to help analysts and decision-makers understand and explore big data. The course covers eight primary topics:

- Visualising univariate and multivariate numerical data
- Visualising time series data
- Visualising geospatial data
- Visualising networked data
- Visualising high-dimensional data
- Visualising textual data
- Interactive dashboards
- Animations

Learning Outcomes

After successful completion of the course, students will

- understand the main concepts, theories, and methods of data visualisation
- recognise the typical challenges of visualising large and complex data sets
- be able to create graphs like bar charts, scatterplots, line charts, and heatmaps to represent various types of data sets visually

- be able to use data-visualisation methods to analyse business problems, generate possible solutions, and compare these solutions in terms of their effectiveness and efficiency

Methods

- The course involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Real-life examples are used to show how the course content can be applied in practice.

4.5.12. Digital Entrepreneurship

Module type	Optional compulsory
Courses	Lecture *Digital Entrepreneurship*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	5 students
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Digital Entrepreneurship covers the intersection between digital technology and new venture creation, i.e., company start-up activity. It addresses venture creation of digital artefacts as the core market offering (e.g., software, hardware, smart devices), digital technology as enablers of new venture creation (e.g., 3D printing, crowdfunding, platforms such as appStore), and venture creation in technology-intensive contexts (e.g., BioTech, IT Healthcare, FinTech). The course covers six primary topics:

- Forms and processes of entrepreneurship
- Business planning for new ventures
- Digital technologies as enablers and triggers for entrepreneurial activity
- Digital technologies as market offerings of emergent ventures
- Start-up activity in technology-intensive sectors

Learning Outcomes

After successful completion of the course, students will

- understand the fundamentals of entrepreneurship
- understand the unique challenges and opportunities of digital entrepreneurship
- understand peculiarities of digital technologies with respect to new venture emergence processes
- assess and evaluate the role of digital technologies in different phases of entrepreneurship

Methods

- The module combines interactive lectures with case studies and exercises to integrate theoretical knowledge with practical start-up and business planning skills.

- The e-learning platform Moodle will be used throughout the course to disseminate course material and for information and discussion.
- Case studies will be used to discuss and illustrate course contents.
- Contemporary scientific publications from Information Systems and Entrepreneurship will be discussed in class.

4.5.13. Autonomous Tools, Design, and Innovation

Module type	Optional compulsory
Courses	Lecture *Autonomous Tools, Design, and Innovation*
ECTS	3.0
Taught units per semester (in units of 45 minutes)	30.0
Private study time (in hours)	67.5
Min. enrollment	5 students
Frequency	Once a year
Language	English
Recommended literature	Accessible via the university intranet
Assessment	Written exam

Content

Autonomous design tools are fundamentally changing how designers work across various industries. Autonomous design tools make independent design decisions and in, some cases, execute entire design processes. They employ technologies typically associated with artificial intelligence, including machine learning, pattern recognition, meta-heuristics, and evolutionary algorithms.

Autonomous design tools allow for the generation of a variety of diverse design artifacts, including next-generation computer chips, software for specific domains, three-dimensional virtual worlds, and large amounts of content for video games and feature films. The applications for such autonomous design tools are also expanding to other industries, such as mechanical engineering, aerospace, and architecture.

Instead of creating artifacts by directly manipulating their representations, designers select tools, decide on design parameters, set values for these parameters, and evaluate and learn from the analysis of the results the tools produce. Design work in such situations involves intense interaction with autonomous tools. Designers need to be mindful of the logic, capabilities, and limitations of the tools, and the algorithms these tools employ, and find ways to make sense of and deal with the often unanticipated outputs of such tools.

The course addresses this increasingly important role of autonomous design tools by

- discussing the conceptual foundations of autonomous design tools;
- discussing how autonomous design tools change the nature of work and the role of human designers;
- analyzing examples of using autonomous tools in design practice;
- providing hands-on experience in agent-based modelling for students to simulate the behavior of these tools; and
- providing hands-on experience in using autonomous design tools for the design of virtual worlds.

Learning Outcomes

After successful completion of the course, students will

- understand the main concepts, theories, and methods related to autonomous design tools

- be able to analyze how autonomous design tools change work processes
- be able to develop agent-based models for simulating autonomous design tools

Methods

- The module involves interactive lectures with exercises to integrate theoretical knowledge with practical design and analysis skills.
- The e-learning platform Moodle is used throughout the course to disseminate course material and for information and discussion.
- Contemporary scientific publications from Information Systems, Management, and Computer Science are discussed in class.
- The NetLogo software is used to model and simulate autonomous design agents.
- Further software tools may be used throughout class.

Requirements

- Knowledge of R, Python, or Java is helpful but is not required.

4.6. Cross-faculty and cross-programme electives

The course offerings for cross-faculty electives vary and are available online. Information about the cross-programme electives *International Business Finance* (Master's Degree Programme in Finance) and *Opportunity Recognition & Business Models* (Master's Degree Programme in Entrepreneurship and Management) can be found in these programs' module handbooks.