AALBORG UNIVERSITET

STUDIEORDNING FOR KANDIDATUDDANNELSEN I LYD- OG MUSIKTEKNOLOGI, 2022, KØBENHAVN

CIVILINGENIØR
KØBENHAVN

MODULER SOM INDGÅR I STUDIEORDNINGEN

INDHOLDSFORTEGNELSE

FOUNDATIONS OF SMC

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Students are required to investigate sound and music computing from a formal perspective,work according to a scientific method, and report results in scientific forms of dissemination.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module will gain knowledge, skills and competences as follows:

- Must be able to apply the core elements in real-time sound processing and new interfaces for musical expression
- Must be able to apply principles of music perception and cognition

SKILLS

Students who complete the module will gain knowledge, skills and competences as follows:

- Must be able to **apply** theories of sound and music computing, to design, implement and evaluate a system which uses sound as input or output modality
- Produce a project report according to norms of the area, take into consideration relevant literature, apply correct terminology and convey the research-based foundation, problem and results of the project orally and in writing in a coherent manner, including the relationship between the problem formulation, the project's realization and its conclusions
- Evaluate and select relevant literature, scientific methods and models and other tools for application in the project work, and evaluate the project's problem area in a relevant scientific context

COMPETENCES

Students who complete the module will gain knowledge, skills and competences as follows:

- Must be able to synthesize relevant theory, techniques and tools to produce new knowledge and/or solutions
- Must be able to synthesize and discuss research-based knowledge in the area of sound and music computing, in the format of a scientific paper
- Plan, execute and manage complex research and/or development tasks, and assume a professional responsibility for carrying out, potentially cross-disciplinary, collaborations
- Assume responsibility for own scientific development and specialization

TYPE OF INSTRUCTION

Academically supervised student-governed problem oriented project work

EXAM

EXAMS

Name of exam	Foundations of SMC
Type of exam	Oral exam based on a project Oral exam with an internal censor based on a scientific paper written in English and a media-technological product, an AVproduction illustrating and summarizing the project, and edited worksheets/portfolio documenting project details.

ECTS	15
Permitted aids	With certain aids: Please see Semester Description
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Grundlæggende lyd- og musikteknologi
Module code	MSNSMCM1201
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Language of instruction	English
Location of the lecture	Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Sound and Music Computing)
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design

SOUND PROCESSING

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

This class introduces the fundamental sound technology of digital signal processing from the viewpoint of sound synthesis and digital audio effects. Signal processing is concerned with the theory and practice behind acquisition, analysis, modification, and reconstruction of signals. It involves such theory as sampling and quantization, linear time-invariant systems, difference equations, the Fourier transform in its various forms, and the z-transform. The proper application and development of such systems requires competences in the acquisition and manipulation of sounds.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the course module will obtain the following qualifications:

- Understand the basic filter types, such as low-pass, high-pass, band-pass, etc., filters and filter design methods
- Understand delay lines and delay based effects (flangers, vibrato, chorus, echo) as well as modulators and demodulators
- Understanding spatial effects

SKILLS

Students who complete the course module will obtain the following qualifications:

- Design, implement and apply filters to sound and music signals and evaluate the results
- Apply the z-transform to analysis and design of filters
- Apply signal processing theory to the design of filters and digital audio effects

COMPETENCES

Students who complete the course module will obtain the following qualifications:

- Apply appropriate methods and tools to the design of a sound processing system comprising filters and/or audio effects
- Apply appropriate methods, tools, and programming paradigms to implement real-time sound effects

TYPE OF INSTRUCTION

Lectures and laboratories.

EXAM

EXAMS

Name of exam	Sound Processing
Type of exam	Oral exam based on a project
ECTS	5
Permitted aids	With certain aids: Please see Semester Description.
Assessment	7-point grading scale
Type of grading	Internal examination

Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Lydprocessering
Module code	MSNSMCM1202
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Sound and Music Computing)
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design

NEW INTERFACES FOR MUSICAL EXPRESSION

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

This module focuses on the study of real-time interaction from two perspectives, conceptual and technological. Making music has always integrated the paradigm of rich and complex human creativity. The conceptual component of this course examines performance practices using advanced real-time technologies for interaction design and signal processing. From this perspective, the concepts of 'controller device', ‘synthesis/processing’ and 'mapping' are studied in depth. Musical context is a core focus in the class, including studying expert interaction, analyzing concepts such as playability, explorability, non-linearity, control, expressiveness and/or virtuosic interaction. The technical aspects of the course require studying and implementing both software (programming) and electronic transducers (sensor / actuator)-based designs for real-time interaction and performance. Different programming languages for signal processing and methods for interaction design are studied, as well as real-time communication protocols.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete this course must gain the following knowledge:

- **Understand** the concepts and history of real-time interaction for musical expression
- **Understand** the concepts of musical controller, mapping and feedback, including protocols for real-time interfaces for musical performance
- **Understand** real-time human-computer interaction in a musical performance perspective

SKILLS

Students who complete this course must gain the following skills:

- **Apply** knowledge to the design of a prototype interface for musical expression, using modern digital fabrication techniques
- **Apply** methods and theories for real-time interaction design, programming of signal processing, and appropriate design of electronic transducer based interfaces

COMPETENCES

Students who complete this course must gain the following competencies:

- **Synthesize** their own idea, from concept to realization, of a New Interface for Musical Expression, via the application of appropriate methods and tools to the design of a real-time interactive sound synthesis or processing system comprising a human interface appropriate to the concept

TYPE OF INSTRUCTION

Refer to the overview of instruction types listed in § 17.

EXAM

EXAMS

Name of exam	New Interfaces for Musical Expression
Type of exam	Oral exam based on a project
ECTS	5

Permitted aids	With certain aids: Please see Semester Description.
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Nye interfaces for musikudtrykkelse
Module code	MSNSMCM1203
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Sound and Music Computing)
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design

MUSIC PERCEPTION AND COGNITION

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Musical information is created, communicated and processed in a wide variety of contexts and activities. Musical information may encode musical sound, perceived musical structure, the affective or semantic content of music, musical gestures or musical interactions. The ability to design and build effective and efficient computing systems for processing musical information requires an understanding of how such information is created, represented, communicated and processed by humans.

This course introduces experimental, theoretical, computational and neuroscientific work that has contributed to our understanding of how musical information is created, represented, communicated and processed, both in the brain and the body, when humans perform musical tasks such as listening, dancing, performing, composing and improvising.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete this course must gain the following knowledge:

- Must **understand** the basic cognitive and motoric mechanisms underlying music perception and cognition when creating, communicating or interacting with music
- Must **understand** current theories of how perception of musical structure is influenced by cognitive and cultural variables
- Must **understand** current theories of how motion (embodiment) and emotion (affect) are represented and communicated by music

SKILLS

Students who complete this course must gain the following skills:

- **Apply** empirical methodologies in the design and execution of appropriate experiments for testing hypotheses in the field of music perception and cognition
- Must be able to **apply** knowledge on basic computational models of specific aspects of music perception and cognition (e.g., perception of musical streams, expressive timing)
- Must be able to **apply** theories and models of music perception and cognition

COMPETENCES

Students who complete this course must gain the following competencies:

- Must be able to **apply** and **synthesize** understanding of experimental, computational, theoretical and neuroscientific research on music perception and cognition in the design and testing of music computation systems

TYPE OF INSTRUCTION

Refer to the overview of instruction types listed in § 17.

EXAM

EXAMS

Name of exam	Music Perception and Cognition
Type of exam	Oral exam based on a project

ECTS	5
Permitted aids	With certain aids: Please see Semester Description.
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Musikperception og -kognition
Module code	MSNSMCM1204
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Sound and Music Computing)
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design

SONIC INTERACTION DESIGN

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Explore the field of sonic interaction design with a focus on one of the following applications: 1) Interactive product sound design, 2) sonic interactions in arts, 3) interactive sonification.

Perform an evaluation of the perceptual and/or cognitive aspects of sonic interactions from a human centered perspective.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module will gain knowledge as follows:

- Must be able to understand the discipline of sonic interaction design
- Must be able to understand action-perception relationships within sonic interaction and sonification
- Must be able to understand principles of embodied music perception, cognition and action

SKILLS

Students who complete the module will gain skills as follows:

- Must be able to apply the acquired knowledge to the design of a system where interactive sound plays a salient role, being either in an artistic context, in the field of interactive product sound design, or in the field of interactive sonification
- Must be able to apply knowledge in human sound perception and cognition to the evaluation of the proposed solution
- Produce a project report according to norms of the area, take into consideration relevant literature, apply correct terminology and convey the research-based foundation, problem and results of the project orally and in writing in a coherent manner, including the relationship between the problem formulation, the project's realization and its conclusions
- Evaluate and select relevant literature, scientific methods and models and other tools for application in the project work, and evaluate the project's problem area in a relevant scientific context

COMPETENCES

Students who complete the module will gain competences as follows:

- Must be able to evaluate the proposed application from a human centered perspective, and synthesize it to produce new knowledge and solutions
- Plan, execute and manage complex research and/or development tasks, and assume a professional responsibility for carrying out, potentially cross-disciplinary, collaborations
- Assume responsibility for own scientific development and specialization

TYPE OF INSTRUCTION

Academically supervised student-governed problem oriented project work.

EXAM

PREREQUISITE FOR ENROLLMENT FOR THE EXAM

- An approved PBL competency profile is a prerequisite for participation in the project exam

EXAMS

Name of exam	Sonic Interaction Design
Type of exam	Oral exam based on a project The project documentation is comprised of: 1) a written project report, 2) a media technological product 3) an AV-production, illustrating and summarising the project
ECTS	15
Permitted aids	With certain aids: Please see Semester Description.
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Sonisk interaktion
Module code	MSNSMCM2201
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Language of instruction	English
Location of the lecture	Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Sound and Music Computing)
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design

EMBODIED INTERACTION

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objectives

The course presents the emerging theory of embodied interaction interleaved with practical implementations of intelligent systems. The concept of embodiment includes both the physical presence of system and user as well as the social embedding in a network of interaction practices that are largely based on the information provided by the human (or artificial) body. Examples include but are not limited to movement, haptics, or tangible interactions.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module will obtain:

- knowledge of standard methods and techniques in embodied interaction
- understanding of multimodal interpretation of bodily forms of expression both as input and output channel for intelligent systems

SKILLS

Students who complete the module will be able to:

- apply methods and techniques to real world scenarios (e.g., games, robots, public installations, etc.).
- apply established and novel methods for evaluating embodied interaction in real world scenarios

COMPETENCES

Students who complete the module will be able to:

- evaluate the potential of different methods and techniques in order to make the proper design choices for embodied interaction
- synthesize and develop intelligent systems allowing for embodied interaction

TYPE OF INSTRUCTION

Refer to the overview of instruction types listed in § 17.

EXAM

PREREQUISITE FOR ENROLLMENT FOR THE EXAM

- To be eligible to take the exam, the student must timely have handed in any mandatory assignments

EXAMS

Name of exam	Embodied Interaction
Type of exam	Oral exam based on a project
ECTS	5
Permitted aids	With certain aids: See semester description

Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Embodied Interaction
Module code	MSNMEDM2224
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg, Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Medialogy
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design

SOUND AND MUSIC SIGNAL ANALYSIS

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The course introduces the fundamentals sound and music analysis: 1) methods required to perform analysis of sound and music signals; 2) representations commonly used in sound and music analysis; 3) various analysis tasks involving sound and music representations. The first part focuses on the basic methods, e.g., spectral analysis, parameter estimation, audio decomposition methods, filterbanks, etc. The second part includes commonly used representations for characterizing sound and music signals, e.g., parametric models, spectrograms, mel-frequency cepstral cofficients, chromagrams, and source-filter models. The third part focuses on examples of sound and music analysis tasks, e.g., tuning of musical instruments, transcription of music, key and chord detection, musical structure analysis, and modification of sound and music signals.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the course module will obtain the following qualifications:

- Must be able to **understand** and **describe** spectral analysis, parameter estimation, methods for audio decompositions, and filterbanks
- Must be able to **distinguish** between pitch, loudness and timbre, and **explain** how these relate to the various representations
- Must be able to **understand** and **identify** the characteristics of music and sound

SKILLS

Students who complete the course module will obtain the following qualifications:

- Must be able to **analyze** and **explain** the tools and representation used for a given sound and music analysis task
- Must be able to **select**, **implement** and **apply** selected methods for analysis of sound and music signals
- Must be able to **evaluate** the performance and properties of the selected methods and representations for sound and music analysis
- Must be able to **explain** and **argue** for the assumptions made when using particular tools and representations for sound and music analysis

COMPETENCES

Students who complete the course module will obtain the following qualifications:

- Must be able to discuss and **evaluate** the appropriateness of various representations for a given sound and musical analysis task
- Must be able to **choose** between and **judge** methods and representations for sound and music analysis

TYPE OF INSTRUCTION

Lectures with exercises.

EXAM

EXAMS

Name of exam	Sound and Music Signal Analysis
Type of exam	Oral exam based on a project

ECTS	5
Permitted aids	With certain aids: Please see Semester Description.
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Analyse af musik- og lydsignaler
Module code	MSNSMCM2203
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Location of the lecture	Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Sound and Music Computing)
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design

PHYSICAL MODELS FOR SOUND SYNTHESIS

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The module gives an in-depth introduction to physical models for sound synthesis,including digital waveguide models, mass-spring systems and finite difference schemes. Students who complete this module will understand how to simulate physics based sound and music systems such as musical instruments and everyday objects.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module will gain knowledge as follows:

- Must have **knowledge** about mass-spring systems, digital waveguides and numerical sound synthesis
- Must be able to **understand** how to simulate the sound produced by a musical instrument or everyday object

SKILLS

Students who complete the module will gain skills as follows:

- Must be able to **apply** knowledge to the creation of a physics based sound system.
- Must be able to **understand** how to calculate and model forces of dynamic systems
- Must be able to **understand** virtual analogue synthesis

COMPETENCES

Students who complete the module will gain competences as follows

- Must be able to **understand** how to collaborate within teams designing, building and modelling physical artefacts
- Must be able to **synthesize** methods for modelling of physical systems and analogies between various dynamic systems such as electronic and acoustics systems

TYPE OF INSTRUCTION

Refer to the overview of instruction types listed in § 17.

EXAM

EXAMS

Name of exam	Physical Models for Sound Synthesis
Type of exam	Oral exam based on a project
ECTS	5
Permitted aids	With certain aids: Please see the semester description
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Fysiske modeller for lydsyntese
Module code	MSNSMCM2204
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Location of the lecture	Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Sound and Music Computing)
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design

SOUND AND MUSIC INNOVATION

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Explore the field of sonic interaction design with a focus on one of the following applications: 1) Interactive product sound design, 2) sonic interactions in arts, 3) interactive sonification.

Perform an evaluation of the perceptual and/or cognitive aspects of sonic interactions from a human centered perspective.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module will gain knowledge as follows:

- Must be able to understand the discipline of sonic interaction design
- Must be able to understand action-perception relationships within sonic interaction and sonification
- Must be able to understand principles of embodied music perception, cognition and action

SKILLS

Students who complete the module will gain skills as follows:

- Must be able to apply the acquired knowledge to the design of a system where interactive sound plays a salient role, being either in an artistic context, in the field of interactive product sound design, or in the field of interactive sonification
- Must be able to apply knowledge in human sound perception and cognition to the evaluation of the proposed solution
- Produce a project report according to norms of the area, take into consideration relevant literature, apply correct terminology and convey the research-based foundation, problem and results of the project orally and in writing in a coherent manner, including the relationship between the problem formulation, the project's realization and its conclusions
- Evaluate and select relevant literature, scientific methods and models and other tools for application in the project work, and evaluate the project's problem area in a relevant scientific context

COMPETENCES

Students who complete the module will gain competences as follows:

- Must be able to evaluate the proposed application from a human centered perspective, and synthesize it to produce new knowledge and solutions
- Plan, execute and manage complex research and/or development tasks, and assume a professional responsibility for carrying out, potentially cross-disciplinary, collaborations
- Assume responsibility for own scientific development and specialization

TYPE OF INSTRUCTION

Academically supervised student-governed problem oriented project work.

EXAM

PREREQUISITE FOR ENROLLMENT FOR THE EXAM

- An approved PBL competency profile is a prerequisite for participation in the project exam

EXAMS

Name of exam	Sound and Music Innovation
Type of exam	Oral exam based on a project The project documentation is comprised of: 1) a written project report, 2) a media technological product 3) an AV-production, illustrating and summarising the project
ECTS	20
Permitted aids	With certain aids: Please see Semester Description.
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Innovation i lyd og musik
Module code	MSNSMCM3221
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	20
Language of instruction	English
Location of the lecture	Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Sound and Music Computing)
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design

RESEARCH IN SOUND AND MUSIC COMPUTING

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The goal of this course is to perform advanced work in one specific area of sound and music computing, building upon the foundations gained in the 1st and 2nd semesters. Students explore state of the art theories and techniques in a formalized manner by analyzing a selection of new research texts in a specific area of sound and music computing through, e.g., critical annotations, paper presentations, reproduction of experiments, etc.

Possible areas of research are music information retrieval, music perception and cognition, sonic interaction design, sound and music signal analysis and synthesis and new interfaces for musical expression.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module will gain knowledge as follows:

- Must be able to **understand** theories and principles related to a specific area of sound and music computing

SKILLS

Students who complete the module will gain skills as follows:

- Must be able to **analyze** research papers related to a specific area of sound and music computing
- Must be able to **apply** concepts, tools, theories and technologies of sound and music computing to address a specific research problem

COMPETENCES

Students who complete the module will gain competences as follows:

- Must be able to **synthesize** scientific knowledge in a specific topic in sound and music computing

TYPE OF INSTRUCTION

Refer to the overview of instruction types listed in § 17.

EXAM

EXAMS

Name of exam	Research in Sound and Music Computing
Type of exam	Oral exam based on a project
ECTS	5
Permitted aids	With certain aids: Please see Semester Description.
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Studier i lyd og musik
Module code	MSNSMCM3202
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Sound and Music Computing)
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design

MACHINE LEARNING FOR MEDIA EXPERIENCES 2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objectives

In designing and developing interactive media systems and technology, one is often faced with looking for interesting patterns and trends. This course presents theoretical concepts and practical tools for analyzing data for multimedia applications and solving machine learning problems, such as classification, in media technology. Many of these methods are used in, e.g., automatic speech recognition, face detection, web page ranking, autonomous driving, etc. The course includes the following topics: multivariate probability density functions, Bayesian classification, estimation, and detection, parametric (e.g., Gaussian density-based) and non-parametric classifiers (e.g. k-nn, parzen, convolutional neural networks), regression, data fitting, evaluation of classifiers and estimators, unsupervised and supervised learning (e.g., reinforcement learning), feature selection and reduction. The course will contextualize these techniques by how they apply as tools for addressing media creation challenges.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module will obtain:

- understanding of multivariate statistics and how to model multivariate data, e.g., using probabilistic and parametric descriptions
- understanding of the principles of supervised (e.g., Bayesian classification, SVM, least squares regression, deep learning) and unsupervised learning methods, (e.g., k-means, hierarchical clustering, Gaussian mixture models)
- understanding of features, feature selection, feature learning, and dimensionality reduction (e.g., forward feature selection, principal component analysis, autoencoder)
- knowledge of the application of machine learning techniques and tools to address media creation problems (e.g. visual effects, games, procedural generated content, motion capture etc.)

SKILLS

Students who complete the module will be able to:

- choose, implement and apply machine learning methods to solve typical machine learning problems (e.g., classification, detection, regression)
- apply knowledge to compare machine learning methods in terms of performance and complexity
- apply the theory of multivariate statistics to analyze multimedia data (e.g., speech and music, images of faces, gestures, etc.)

COMPETENCES

Students who complete the module will be able to:

- apply multivariate statistics to analyze multimedia data, and reflect on a variety of possibilities to recommend a solution to the related machine learning problem(s)
- apply machine learning methods to such problems and evaluate, discuss and generalize the results and reflect on their implications regarding the problems and the data

TYPE OF INSTRUCTION

Refer to the overview of instruction types listed in § 17.

EXAM

PREREQUISITE FOR ENROLLMENT FOR THE EXAM

- To be eligible to take the exam, the student must timely have handed in any mandatory assignments

EXAMS

Name of exam	Machine Learning for Media Experiences
Type of exam	Oral exam based on a project
ECTS	5
Permitted aids	With certain aids: See semester description
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Machine Learning for Media Experiences
Module code	MSNMEDM1222
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg, Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Medialogy
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design

PROJECT-ORIENTED STUDY IN AN EXTERNAL ORGANISATION

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The Project-Oriented Study in an External Organisation must have a scope that corresponds the ECTS load.

Develop and evaluate a novel system that uses concepts and technologies in sound and music computing with a focus on exploring 1) its commercial aspects, and/or 2) its socio-cultural implications, and/or 3) its use in generating scientific knowledge.

The purpose of this project module is to give the student the opportunity to acquire practical, real-world experience with developing Sound and Music Computing products within the context of a company or an organization. The development must be subject to relevant constraints and conditions of the real-world context.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module will gain knowledge as follows:

- Must be able to understand core state-of-the-art concepts, theories, techniques and methodologies relating to the sub-area of sound and music that has been applied in the project.
- Must be able to synthesize relevant concepts in media commercialization and innovation
- Must be able to understand professional, business-related and organizational concepts that are relevant for the hosting organization and the developed project
- Account for the scientific foundation, and scientific problem areas, of the specialization
- Describe the state of the art of relevant research in the specialization

SKILLS

Students who complete the module will gain skills as follows:

- Must be able to apply market and trend analysis methods to a media product or production involving sound and/or music processing
- Must be able to apply sound and music related tools and technologies to create products that are viable from a commercial, socio-cultural, and/or scientific perspective
- Must be able to apply host relevant constraints and affordances in the product design
- Master the scientific methods and general skills associated with the specialization
- Produce a project report according to norms of the area, apply correct terminology, document extensive command over relevant literature, communicate and discuss the research-based foundation, problem and results of the project orally, graphically and in writing in a coherent manner
- Critically evaluate the results of the project in relation to relevant literature and established scientific methods and models, evaluate and discuss the project’s problem area in a relevant scientific context
- Evaluate and discuss the project’s potential for further development

COMPETENCES

Students who complete the module will gain competences as follows:

- Must be able to evaluate and select relevant sound and music theories, methods, and tools, with the specific aim of working towards creating new products, commercially viable products, or new knowledge
- Participate in, and independently carry out, technological development and research, and apply scientific methods in solving complex problems
- Plan, execute and manage complex research and/or development tasks, and assume a professional responsibility for independently carrying out, potentially cross-disciplinary, collaborations
- Independently assume responsibility for own scientific development and specialization

TYPE OF INSTRUCTION

Academically supervised student-governed problem oriented project work.

EXAM

EXAMS

Name of exam	Project-Oriented Study in an External Organisation
Type of exam	Oral exam based on a project Oral examination on basis of a submitted Company Stay Report.
ECTS	30
Permitted aids	With certain aids: Please see Semester Description.
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Projektorienteret forløb i en virksomhed
Module code	MSNSMCM3205
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	30
Language of instruction	English
Location of the lecture	Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Sound and Music Computing)
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design

MASTER'S THESIS

2023/2024

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

To document that the student, independently or in a small group, is capable of planning and completing a major research project in sound and music computing. The final thesis must document the student's ability to apply scientific theories and methods, critically analyze existing work, and synthesize new knowledge.

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module will gain knowledge as follows:

- Must have **knowledge** and **understanding** in one or more subject areas that are representative of the state of the art in the research community of sound and music computing
- Can **understand** and, on a scientific basis, apply an area of sound and music computing and identify scientific problems
- **Account** for the scientific foundation, and scientific problem areas, of the specialization
- **Describe** the state of the art of relevant research in the specialization

SKILLS

Students who complete the module will gain skills as follows:

- **Synthesize** scientific methods and tools and general skills related to sound and music computing
- Can **evaluate** and **select** among scientific theories, methods, tools and general skills, and on a scientific basis, advance new analysis methods and solutions in sound and music computing
- Can **synthesize** research-based knowledge and **discuss** professional and scientific problems with both peers and non-specialists
- **Master** the scientific methods and general skills associated with the specialization
- **Produce** a project report according to norms of the area, apply correct terminology, document extensive command over relevant literature, communicate and discuss the research-based foundation, problem and results of the project orally, graphically and in writing in a coherent manner
- Critically **evaluate** the results of the project in relation to relevant literature and established scientific methods and models, evaluate and discuss the project's problem area in a relevant scientific context
- **Evaluate** and **discuss** the project's potential for further development

COMPETENCES

Students who complete the module will gain competences as follows:

- Can **synthesize** work and development situations that are complex, unpredictable and require new solutions
- Can **apply** acquired **knowledge** to independently initiate and **implement** discipline-specific and interdisciplinary cooperation, and assume professional responsibility
- Can independently **synthesize** and take responsibility for their own professional development and specialisation
- **Participate** in, and independently carry out, technological development and research, and apply scientific methods in solving complex problems
- **Plan**, **execute** and **manage** complex research and/or development tasks, and assume a professional responsibility for independently carrying out, potentially cross-disciplinary, collaborations
- Independently **assume** responsibility for own scientific development and specialization

TYPE OF INSTRUCTION

Academically supervised student-governed problem oriented project work.

The project is carried out individually or in small groups of a maximum of three students. At least one internal supervisor is assigned, who deals with the primary area of the project in his or her research.

EXAM

EXAMS

Name of exam	Master’s Thesis
Type of exam	Master's thesis/final project
ECTS	30
Permitted aids	With certain aids: Please see Semester Description.
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	The criteria of assessment are stated in the Examination Policies and Procedures

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	MSNSMCM4201
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	30
Language of instruction	English
Location of the lecture	Campus Copenhagen
Responsible for the module	Madsen

ORGANISATION

Education owner	Master of Science (MSc) in Engineering (Sound and Music Computing)
Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	The Technical Faculty of IT and Design