AALBORG UNIVERSITET

MASTER OF SCIENCE (MSC) IN ENGINEERING (VISION, GRAPHICS AND INTERACTIVE SYSTEMS), 2018 (DISP)

MASTER OF SCIENCE (MSC) IN ENGINEERING
AALBORG

MODULES INCLUDED IN THE CURRICULUM

TABLE OF CONTENTS

COMPUTER GRAPHICS

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The objective of this module is two-fold: 1) to provide students with core competencies within the area of real-time 3D computer graphics, enabling them to design and implement software systems that use synthetically generated images as output modality, and 2) to train students in working according to a scientific method and to report results in scientific forms, such as papers and posters.

LEARNING OBJECTIVES

KNOWLEDGE

- Must be able to explain the various stages in a graphics rendering pipeline, including geometric primitives, geometric and projective transformations, local illumination models, and rasterization techniques.
- Must understand the scientific communication processes related to conference presentations and related to publishing in peer-reviewed scientific journals
- Must know how to organize a scientific publication

SKILLS

- Must be able to apply a graphics API such as OpenGL in the design and implementation of a system which uses real-time 3D computer graphics as an output modality in a user-interface, or a system which aims at developing a novel solution to a computer graphics related problem.
- Can explain the process of and criteria for peer reviewed scientific communications,
- Can write a paper for a scientific conference/journal
- Can prepare and give an oral and poster presentation for a scientific conference

COMPETENCES

- Must be able to evaluate and select relevant computer graphics theories, methods, and tools, and synthesize them to produce new knowledge and solutions.
- Must be able to communicate and discuss research-based knowledge in the area of 3D computer graphics.
- Are able to judge and prioritize the validity of various sources of scientific information.
- Apply internationally recognized principles for acknowledging and citing work of others properly.
- Can formulate and explain scientific hypotheses and results achieved through scientific work
- Are able to analyze results and draw conclusions on a scientific basis

EXTENT AND EXPECTED WORKLOAD

Students are organized in groups of up to six members working according to the PBL concept at Aalborg University. Each group will be supervised by at least one staff member doing research within the main topic(s) addressed in the project.

On this semester the project has to be documented in the following forms (all in English):

- A scientific article
- An oral presentation
- A poster
- Edited worksheets, providing all relevant project details

For further information see the introduction to Chapter 3.

EXAM

EXAMS

Name of exam	Computer Graphics
Type of exam	Oral exam based on a project Oral examination with internal examiner based on written documentation including: a scientific article, slides from the oral presentation at the student conference (SEMCON), a poster and edited worksheets.
ECTS	15
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Computer grafik
Module code	ESNVGISK1P1
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	15
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

COMPUTER GRAPHICS PROGRAMMING

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds upon basic knowledge of linear algebra

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The course provides an introduction to real-time computer graphics concepts and techniques. The course focuses on programmable functionalities as offered by graphics APIs, supplemented with a presentation of the relevant underlying theories. The course also introduces the concepts of Virtual Reality and Augmented Reality, and how computer graphics is used in the context of these application areas.

LEARNING OBJECTIVES

KNOWLEDGE

- Must be able to describe the programmable graphics rendering pipeline as exposed for example by OpenGL.
- Must be able to explain relevant mathematical transformations, including rotations, translations and projections in terms of matrix operations in homogeneous coordinates.
- Must be able to explain real-time local illumination models, in particular the Phong reflection model, including the use of linearly interpolated attributes (colors and surface normals.)
- Must be able to explain rasterization techniques, including texture mapping (diffuse reflection maps, gloss maps, environment/reflection maps), framebuffer operations (blending, stencil tests, depth tests), and anti-aliasing techniques (super-sampling, mip-map texture filtering).
- Must be able to describe interpolation with Bezier and Hermite curves.
- Must be able to describe the concepts of Virtual Reality and Augmented Reality, including relevant display technologies.
- Must be able to discuss central issues relating to Virtual and Augmented Reality, including tracking, interaction possibilities, and degrees of realism.

SKILLS

- Must be able to apply a graphics API such as OpenGL for procedurally generating and interactively controlling three-dimensional content.
- Must be able to program simple vertex and fragment shaders (e.g. implementing per-vertex diffuse lighting and normal mapping)

COMPETENCES

- Must be able to learn further graphics APIs (such as Direct3D, OpenGL ES, SVG, X3D, webGL in HTML5), game engines and APIs for user interaction

EXAM

EXAMS

Name of exam	Computer Graphics Programming
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination

Criteria of assessment	As stated in the Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Computergrafik programmering
Module code	ESNVGISK1K1A
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

MACHINE LEARNING

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The course gives a comprehensive introduction to machine learning, which is a field concerned with learning from examples and has roots in computer science, statistics and pattern recognition. The objective is realized by presenting methods and tools proven valuable and by addressing specific application problems.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about supervised learning methods including K-nearest neighbors, decision trees, linear discriminant analysis, support vector machines, and neural networks.
- Must have knowledge about unsupervised learning methods including K-means, Gaussian mixture model, hidden Markov model, EM algorithm, and principal component analysis.
- Must have knowledge about probabilistic graphical models, variational Bayesian methods, belief propagation, and mean-field approximation.
- Must have knowledge about Bayesian decision theory, bias and variance trade-off, and cross-validation.
- Must be able to understand reinforcement learning.

SKILLS

- Must be able to apply the taught methods to solve concrete engineering problems.
- Must be able to evaluate and compare the methods within a specific application problem.

COMPETENCES

- Must have competencies in analyzing a given problem and identifying appropriate machine learning methods to the problem.
- Must have competencies in understanding the strengths and weaknesses of the methods.

TYPE OF INSTRUCTION

As described in the introduction to Chapter 3.

EXAM

EXAMS

Name of exam	Machine Learning
Type of exam	Written or oral exam
ECTS	5
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Maskinlæring
Module code	ESNSPAK3K2FA
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

USER EXPERIENCE DESIGN FOR MULTI MODAL INTERACTION

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds upon basic knowledge of interaction design and usability

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

This course trains students to research, analyze, prototype, and conceptualize design considering all system aspects including the social and cultural contexts of use. The course gives a comprehensive knowledge about user involvement in the design process going beyond traditional methods such usability lab testing.

The objectives are realized by presenting methods and tools in a case based framework and through the students' active participation in workshops and assignments.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about system design methods including the social and cultural contexts of use.
- Must have knowledge derived from sociological and ethnographic fields for user behaviour research
- Must have knowledge about qualitative research methods involving end users in the field, such as interview techniques and analysis and experience sampling
- Must have knowledge about scenario-based design methods
- Must have knowledge about principles for multi modal interaction design
- Must have knowledge about methods for multi modal evaluation and field studies

SKILLS

- Must be able to apply the taught methods to solve concrete design problems.
- Must be able to evaluate and compare and apply the methods for a specific design problem
- Must be able to facilitate the design process involving users in real-life contexts

COMPETENCES

- Students will acquire the competencies to decide how to choose the appropriate method to suit different dimensions of a design problem at different stages in the process and the pitfalls of each approach
- Must have competencies in understanding the strengths and weaknesses of the methods
- Must have the competencies to facilitate the design process involving users in context

TYPE OF INSTRUCTION

As described in the introduction to Chapter 3.

EXAM

EXAMS

Name of exam	User Experience Design for Multi Modal Interaction
Type of exam	Written or oral exam
ECTS	5

Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Design af brugeroplevelsen for multimodal interaktion
Module code	ESNVGISK1K2B
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg, Campus Esbjerg, Campus Copenhagen
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT, Study Board of Media Technology
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

COMPUTER VISION

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds upon knowledge obtained during the 1st semester.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The objective of this course module is to provide students with core competencies within the field of computer vision and hereby enabling them to design and implement software systems for automatic or semi-automatic analysis of an image or sequence of images

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about the terminology within computer vision
- Must be able to understand how a particular computer vision system e.g. the Semester project of the student, relates to similar systems and, if relevant, to the surrounding society

SKILLS

- Must be able to analyze a problem and (if possible) suggest a solution that uses relevant theories and methods from computer vision
- Must be able to analyze a system that is based on computer vision and identify relevant constraints and assessment criteria.
- Must be able to synthesize, i.e., design and implement, a system (or parts hereof) using relevant theories and methods (if possible) from computer vision
- Must be able to evaluate a computer vision system (or parts hereof) with respect to the afore mentioned assessment criteria

COMPETENCES

- Must be able to communicate the above knowledge and skills (using proper terminology) both orally and in a written report
- Must be able to select relevant computer vision theories, methods, and tools, and synthesize them in a new context to produce new knowledge and solutions

TYPE OF INSTRUCTION

Project work

EXAM

EXAMS

Name of exam	Computer Vision
Type of exam	Oral exam based on a project
ECTS	15
Assessment	7-point grading scale
Type of grading	External examination

Criteria of assessment	As stated in the Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Computer vision
Module code	ESNVGISK2P1
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	15
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

IMAGE PROCESSING AND COMPUTER VISION

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds upon basic knowledge of linear algebra and statistics

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Cameras capture visual data from the surrounding world. Building systems which can automatically process such data requires computer vision methods. Students who complete the module will understand the nature of digital images and video and have an inside into relevant theories and methods within computer vision and an understanding of their applicability.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about the primary parameters of a camera system
- Must have knowledge about the representation and compression of digital images and video signal
- Must be able to understand the general framework of image processing as well as the basic point and neighborhood operations, i.e., binarization, color processing, BLOB analysis and filtering
- Must be able to explain the principles behind invariant feature point descriptors such as SIFT and Harris corners.
- Must have knowledge of different motion analysis methods, such as background subtraction and optical flow
- Must be able to understand the tracking frameworks such as the Kalman filter, mean-shift and the particle filter
- Must be able to understand different shape analysis methods such as active-shape models, procrustes, Hungarian method

SKILLS

- Must be able to apply stereo vision to generate 3D date from two or more cameras. This implies projective geometry, camera calibration, epipolar geometry, correspondence and triangulation
- Must be able to apply advanced 2D segmentation methods such as Hough transform, compound morphology, and histogram-of-oriented histograms.
- Must be able to demonstrate understanding of error propagation techniques as a tool for performance characterization of computer vision based solutions

COMPETENCES

- Must be able to learn further computer vision methods and theories, and select an appropriate solution for a given problem

TYPE OF INSTRUCTION

As described in the introduction to Chapter 3.

EXAM

EXAMS

Name of exam	Image Processing and Computer Vision
Type of exam	Written or oral exam
ECTS	5

Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Billedbehandling og computervision
Module code	ESNVGISK2K1A
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

MASTER'S THESIS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained from the 1st to the 3rd Semester

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- have knowledge, at the highest international level of research, of at least one of the core fields of the education
- have comprehension of implications of research (research ethics)

SKILLS

- are able to reflect on a scientific basis on their knowledge,
- can argue for the relevance of the chosen problem to the education including specifically account for the core of the problem and the technical connections in which it appears
- can account for possible methods to solve the problem statements of the project, describe and assess the applicability of the chosen method including account for the chosen delimitation and the way these will influence on the results of the product
- can analyze and describe the chosen problem applying relevant theories, methods and experimental data
- are able to describe the relevant theories and methods in a way that highlights the characteristics and hereby document knowledge of the applied theories, methods, possibilities and delimitations within the relevant problem area
- have the ability to analyze and assess experimental data, including the effect the assessment method has on the validity of the results.

COMPETENCES

- are able to communicate scientific problems in writing and orally to specialist and non-specialist.
- are able to control situations that are complex, unpredictable and which require new solutions,
- are able to independently initiate and to perform collaboration within the discipline and interdisciplinary as well, and to take professional responsibility,
- are able to independently take responsibility for his or her own professional development and specialization.

TYPE OF INSTRUCTION

As described in the introduction to Chapter 3.

Problem based project oriented project work individual or in groups of 2-3 persons

EXAM

EXAMS

Name of exam	Master's Thesis
Type of exam	Oral exam based on a project

	The master thesis can be conducted as a long master thesis. If choosing to do a long master thesis, it has to include experimental work and has to be approved by the study board. The amount of experimental work must reflect the allotted ECTS.
ECTS	30
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	ESNVGISK4P1
Module type	Project
Duration	1 semester
Semester	Spring
ECTS	30
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

ALGORITHMS, DATA STRUCTURES AND SOFTWARE ENGINEERING FOR MEDIA TECHNOLOGY

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module adds to the knowledge obtained in the 1st semester.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

Objectives:

The goal of this module is to strengthen a student's ability to use efficient and appropriate algorithms, data structures and software engineering techniques in the design, implementation and analysis of media technology software.

The topics covered in the course may include: efficient data structures (e.g., trees and heaps), advanced algorithmic techniques (e.g., divide-and-conquer, dynamic programming, greedy algorithms), methods for analysing software (e.g., analysis of time and space complexity), machine-learning algorithms (e.g., k-NN, SVM, neural networks), and advanced software engineering concepts (e.g., generics, closures, reflection, GPU programming).

LEARNING OBJECTIVES

KNOWLEDGE

Students who complete the module will obtain the following qualifications:

- Must understand the fundamentals of algorithm design and analysis.
- Must understand methods for analysing time and space complexity.
- Must understand basic and advanced data structures used in various computational problems.
- Must understand advanced algorithmic techniques such as recursion and dynamic programming.
- Must have knowledge of basic machine learning algorithms and techniques.
- Must understand advanced software engineering concepts and programming techniques.

SKILLS

Students who complete the module will obtain the following qualifications:

- Must be able to select and implement efficient and appropriate algorithms, data structures and software engineering techniques to solve programming problems in media technology.
- Must be able to work in a group to build a substantial media-technological product that uses state-of-the-art programming techniques.

COMPETENCES

Students who complete the module will obtain the following qualifications:

- Ability to analyse multimedia software engineering problems and select and implement efficient and appropriate algorithms, data structures and software engineering techniques to develop successful solutions.
- Ability to analyse solutions and quantify their resource requirements in terms of time and space complexity.

TYPE OF INSTRUCTION

Refer to the overview of instruction types listed in the start of chapter 3. The types of instruction for this course are decided in accordance with the current Joint Programme Regulations and directions are decided and given by the Study Board for Media Technology.

EXAM

EXAMS

Name of exam	Algorithms, Data Structures and Software Engineering for Media Technology
Type of exam	Written or oral exam In accordance with the current Joint Programme Regulations and directions on examination from the Study Board for Media Technology: Oral or written examination with internal censor. The assessment is performed in accordance with the 7-point scale.
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 for the evaluation are specified in the Joint Programme Regulations.

FACTS ABOUT THE MODULE

Danish title	Algoritmer, datastrukturer og software engineering for medieteknologi
Module code	MSNMEDM2172
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg, Campus Copenhagen, Campus Esbjerg
Responsible for the module	Claus Brøndgaard Madsen

ORGANISATION

Study Board	Study Board of Media Technology
Department	Department of Architecture, Design and Media Technology
Faculty	Technical Faculty of IT and Design

NUMERICAL SCIENTIFIC COMPUTING

2018/2019

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about hardware and software platforms for scientific computing.
- Must have knowledge about the possible speedup by using parallelization (Amdahls law / Gustafson-Barsis' law) under different conditions.
- Must have knowledge about message and data passing in distributed computing.
- Must have knowledge about programming techniques, profiling, benchmarking, code optimization etc.
- Must have knowledge about numerical accuracy in scientific computing problems.
- Must have knowledge about what typically characterizes problem-specific scientific computing software vs. general, user-oriented commercial software
- Must have knowledge about one or more software development methods of relevance to development of scientific computing software

SKILLS

- Must be able to translate the covered principles regarding scientific computing and software development to practice in the programming language(s) utilized in the course
- Must be able to implement software programs to solve scientific computational problems using parallel computing.
- Must be able to implement software programs to solve scientific computational problems using distributed computing units or high-performance specialized computing units (such as GPU)
- Must be able to debug, validate, optimize, benchmark and profile developed software modules.
- Must be able to assess the performance of different hardware architectures for scientific computing problems.

COMPETENCES

- The student must be able to apply the proper terminology in oral and written communication and documentation within the scientific domains of numerical scientific computing
- Must be able to assess and weigh resources spent on software development against total subsequent computing time for concrete scientific computing problems.
- Must be able to reflect on different software development methods and independently select and combine elements thereof for use in concrete scientific computing problems.
- Must be able to independently adapt and apply the covered methods and principles for complex scientific computing problems within the students' professional field.

TYPE OF INSTRUCTION

As described in the introduction to Chapter 3.

EXAM

EXAMS

Name of exam	Numerical Scientific Computing
Type of exam	Written or oral exam
ECTS	5
Assessment	Passed/Not Passed

Type of grading	Internal examination
Criteria of assessment	As stated in Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Numerisk videnskabelig beregning
Module code	ESNSPAK2K3
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

ROBOT VISION

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds upon basic knowledge of linear algebra and statistics

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- Must have gained an understanding of fundamental concepts related to robotics.
- Must have an understanding of how vision and other sensors can be integrated with a robot
- Must have an understanding of relevant technologies enabling the design of intelligent machines (artificial intelligence).
- Must have an understanding of highly flexible and integrated automation technologies.
- Must have an understanding of the business potential of intelligent manufacturing.

SKILLS

- Must be able to use various technologies to provide manufacturing systems with intelligent capabilities (reasoning, knowledge, planning, learning, communication, perception and the ability to move and manipulate objects).
- Must be able to model the direct and inverse kinematics of a robot.
- Must be able to design simple trajectory planners, including Cartesian and joint interpolators
- Must be able to program an industrial robot to carry out various tasks
- Must be able to integrate vision with an industrial robot.
- Must be able to integrate and implement intelligent machines into a small and limited manufacturing system.

COMPETENCES

- Must have the foundation to participate in projects aiming at designing intelligent manufacturing systems which more or less autonomously can adapt to variations in its environment and, over time, improve its performance.

TYPE OF INSTRUCTION

The form(s) of teaching will be determined and described in connection with the planning of the Semester. The description will account for the form(s) of teaching and may be accompanied by an elaboration of the roles of the participants. The course/project theme is performed in either English or Danish dependent of the language skills of the participants.

EXAM

EXAMS

Name of exam	Robot Vision
Type of exam	Written or oral exam Individual oral exam on the basis of a small report and a practical demonstration. An internal censor participates in the exam.
ECTS	5
Assessment	Passed/Not Passed

Type of grading	Internal examination
Criteria of assessment	As stated in Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Robot vision
Module code	ESNVGISK2K2
Module type	Course
Duration	1 semester
Semester	Spring
ECTS	5
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

INTERACTIVE SYSTEMS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on the knowledge obtained during the 1st and 2nd semester

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The objective of this project module is to equip students with the abilities to design, build and test advanced interactive system integrating the more traditional information sources with information derived from e.g. computer vision techniques, speech recognition, and contextual knowledge, such as location. Information visualization and presentation can also be considered in an integrated way as well.

The students can freely choose the focus within the above-mentioned fields, however interaction design issues must be considered and elements of user involvement, such as user requirements gathering and/or end user tests must be treated.

LEARNING OBJECTIVES

KNOWLEDGE

- Must be able to understand how a particular system e.g. the Semester project of the student, relates to similar systems and, if relevant, to the surrounding society
- Must be able to understand different aspects of user involvement in a particular system
- Must have knowledge about methods and architectures for fusion of information
- Must have knowledge about context-aware interaction.

SKILLS

- Must be able to analyze how a particular problem, e.g. the Semester project of the student, relates to an end-user
- Must be able to analyze a problem and, when relevant, suggest a solution that utilizes information derived from relevant modalities, such as vision, tactile or speech
- Must be able to design and develop a system- partly or in full - that fuses information from several information sources.
- Must be able to analyze the required response time of a given system and assess its potential for a realtime responsive implement

COMPETENCES

- Must be able to communicate the above knowledge and skills (using proper terminology) both orally and in a written report
- Must be able to select relevant theories, methods, and tools, and synthesize them in a new context to produce new knowledge and solutions

TYPE OF INSTRUCTION

Project work

EXAM

EXAMS

Name of exam	Interactive Systems

Type of exam	Oral exam based on a project
ECTS	20
Assessment	7-point grading scale
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Interaktive systemer
Module code	ESNVGISK3P1
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	20
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

PLATFORMS AND METHODS FOR MULTI MODAL SYSTEMS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds upon basic knowledge of human-computer interaction and software design

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The course will enable the student to understand the principles of multi modal user interaction, including speech based interaction and computer vision, and to extend the methods for HCI GUI design to analyze, design and synthesize multi modal user interaction

LEARNING OBJECTIVES

KNOWLEDGE

- Must have knowledge about integration of sensory information from non-standard signal sources.
- Must have knowledge about methods and architectures for fusion of multi modal information from e.g. speech, gaze, sound and gesture modalities.
- Must have knowledge about context-aware multimodal interaction.

SKILLS

- Must be able to apply the taught platforms and methods to analyze and design multi modal user interfaces.
- Must be able to evaluate and compare interaction modalities relevant to a specific application.

COMPETENCES

- Must have competencies in analyzing a given problem and identifying appropriate modalities and their fusion to the problem.
- Must have competencies in understanding the pros and cons of the modalities of relevance

TYPE OF INSTRUCTION

As described in the introduction to Chapter 3.

EXAM

EXAMS

Name of exam	Platforms and Methods for Multi Modal Systems
Type of exam	Written or oral exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Platforme og metoder til multi modale systemer
Module code	ESNVGISK3K1
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

RESEARCH IN VISION, GRAPHICS AND INTERACTIVE SYSTEMS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on basic skills within the fields of machine learning, computer graphics, computer vision and user interaction

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The goal of this course is to introduce the student to state-of-the-art theories and methods within the core topics of the program, i.e., vision, graphics and interactive systems.

LEARNING OBJECTIVES

KNOWLEDGE

- Must have an overview over theories for automatic detection and recognition of objects in natural scenes
- Must have an overview of fundamental real-time and non-real-time techniques for computer graphics rendering
- Must have an overview over theories for statistical user modeling and profiling
- Must have an understanding of selected methods for automatic detection and recognition of objects in natural scenes
- Must have an understanding of selected methods for advanced realistic graphics rendering of natural scenes
- Must have an understanding of selected methods for theories for data mining, statistical user modeling and profiling

SKILLS

- Must be able to analyse research papers related to the three main topics of this course and discuss these with peers in a structured manner
- Must be able to identify relevant state-of-the-art theories and methods given a concrete research problem related to Vision, Graphics or Interactive Systems
- Must be able to apply a relevant state-of-the-art method to a concrete research problem related to Vision, Graphics and Interactive Systems

COMPETENCES

- Must have the competences to devise and implement systems based on advanced topics in vision, graphics, and interactive systems, including AI and deep learning based systems for interaction as well as detection and recognition of objects, and image-based modelling, lighting, and radiometry.

TYPE OF INSTRUCTION

The course will first use lectures to introduce the students to core theories and methods. Hereafter the students will be assigned essential research papers that are discussed in the following lectures. The process will be lecturer-guided, but the initiative will be the students. Lastly students are given state-of-the-art research problems and asked to identify and implement relevant solution methods. Results are presented and discussed

EXAM

EXAMS

Name of exam	Research in Vision, Graphics and Interactive Systems

Type of exam	Written or oral exam
ECTS	5
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Forskning inden for vision, grafik og interaktive systemer
Module code	ESNVGISK3K2
Module type	Course
Duration	1 semester
Semester	Autumn
ECTS	5
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

ACADEMIC INTERNSHIP

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

An academic internship agreement approved by the company, an AAU supervisor and the study board for electronics and it (ESN).

The academic internship must have a scope that correspond the ECTS load.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The student stays in a company with the purpose of learning and applying theories and methods to address engineering problems in an industrial context. In addition, the student will be introduced to business procedures and policies.

LEARNING OBJECTIVES

KNOWLEDGE

- Has knowledge about the organization of the company and business procedures and policies.
- Has knowledge about performance measures in the company.
- Has developed a fundamental business sense.
- Has knowledge of the competence profile of the program and how the academic internship contributes to the competence profile.
- Has gained deepened knowledge into engineering theories and methods within the program.

SKILLS

- Can initiate and ensure the completion of an agreement for the academic internship, with learning objectives corresponding to the semester at the master's program.
- Can apply analytic, methodological and/or theoretic skills to address advanced engineering problems in an industrial context.
- Can contribute in a professional manner to company objectives as an individual and in teams in accordance with the project management model applied in the company.
- Can collaborate and communicate with peers, managers and others.
- Can document the academic internship in a report and defend it orally.

COMPETENCES

- Can discuss and reflect on the learning outcomes of the academic internship.
- Can discuss the need for knowledge transfer between academia and industry.
- Has a deepened understanding of the academic interests to pursue in the master's thesis and possible job positions to aim at after graduation.

TYPE OF INSTRUCTION

Project work

EXAM

EXAMS

Name of exam	Academic Internship

Type of exam	Oral exam based on a project
ECTS	20
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Projektorienteret forløb
Module code	ESNVGISK3P2A
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	20
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

ACADEMIC INTERNSHIP

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

An academic internship agreement approved by the company, an AAU supervisor and the study board for electronics and it (ESN).

The academic internship must have a scope that correspond the ECTS load.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The student stays in a company with the purpose of learning and applying theories and methods to address engineering problems in an industrial context. In addition, the student will be introduced to business procedures and policies.

LEARNING OBJECTIVES

KNOWLEDGE

- Has knowledge about the organization of the company and business procedures and policies.
- Has knowledge about performance measures in the company.
- Has developed a fundamental business sense.
- Has knowledge of the competence profile of the program and how the academic internship contributes to the competence profile.
- Has gained deepened knowledge into engineering theories and methods within the program.

SKILLS

- Can initiate and ensure the completion of an agreement for the academic internship, with learning objectives corresponding to the semester at the master's program.
- Can apply analytic, methodological and/or theoretic skills to address advanced engineering problems in an industrial context.
- Can contribute in a professional manner to company objectives as an individual and in teams in accordance with the project management model applied in the company.
- Can collaborate and communicate with peers, managers and others.
- Can document the academic internship in a report and defend it orally.

COMPETENCES

- Can discuss and reflect on the learning outcomes of the academic internship.
- Can discuss the need for knowledge transfer between academia and industry.
- Has a deepened understanding of the academic interests to pursue in the master's thesis and possible job positions to aim at after graduation.

TYPE OF INSTRUCTION

Project work

EXAM

EXAMS

Name of exam	Academic Internshipd

Type of exam	Oral exam based on a project
ECTS	25
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Projektorienteret forløb
Module code	ESNVGISK3P3A
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	25
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

ACADEMIC INTERNSHIP

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

An academic internship agreement approved by the company, an AAU supervisor and the study board for electronics and it (ESN).

The academic internship must have a scope that correspond the ECTS load.

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

The student stays in a company with the purpose of learning and applying theories and methods to address engineering problems in an industrial context. In addition, the student will be introduced to business procedures and policies.

LEARNING OBJECTIVES

KNOWLEDGE

- Has knowledge about the organization of the company and business procedures and policies.
- Has knowledge about performance measures in the company.
- Has developed a fundamental business sense.
- Has knowledge of the competence profile of the program and how the academic internship contributes to the competence profile.
- Has gained deepened knowledge into engineering theories and methods within the program.

SKILLS

- Can initiate and ensure the completion of an agreement for the academic internship, with learning objectives corresponding to the semester at the master's program.
- Can apply analytic, methodological and/or theoretic skills to address advanced engineering problems in an industrial context.
- Can contribute in a professional manner to company objectives as an individual and in teams in accordance with the project management model applied in the company.
- Can collaborate and communicate with peers, managers and others.
- Can document the academic internship in a report and defend it orally.

COMPETENCES

- Can discuss and reflect on the learning outcomes of the academic internship.
- Can discuss the need for knowledge transfer between academia and industry.
- Has a deepened understanding of the academic interests to pursue in the master's thesis and possible job positions to aim at after graduation.

TYPE OF INSTRUCTION

Project work

EXAM

EXAMS

Name of exam	Academic Internship

Type of exam	Oral exam based on a project
ECTS	30
Assessment	Passed/Not Passed
Type of grading	Internal examination
Criteria of assessment	As stated in the Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Projektorienteret forløb
Module code	ESNVGISK3P4A
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	30
Language of instruction	English
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design

MASTER'S THESIS

2018/2019

PREREQUISITE/RECOMMENDED PREREQUISITE FOR PARTICIPATION IN THE MODULE

The module builds on knowledge obtained from the 1st to the 3rd Semester

CONTENT, PROGRESS AND PEDAGOGY OF THE MODULE

LEARNING OBJECTIVES

KNOWLEDGE

- have knowledge, at the highest international level of research, of at least one of the core fields of the education
- have comprehension of implications of research (research ethics)

SKILLS

- are able to reflect on a scientific basis on their knowledge,
- can argue for the relevance of the chosen problem to the education including specifically account for the core of the problem and the technical connections in which it appears
- can account for possible methods to solve the problem statements of the project, describe and assess the applicability of the chosen method including account for the chosen delimitation and the way these will influence on the results of the product
- can analyze and describe the chosen problem applying relevant theories, methods and experimental data
- are able to describe the relevant theories and methods in a way that highlights the characteristics and hereby document knowledge of the applied theories, methods, possibilities and delimitations within the relevant problem area
- have the ability to analyze and assess experimental data, including the effect the assessment method has on the validity of the results.

COMPETENCES

- are able to communicate scientific problems in writing and orally to specialist and non-specialist.
- are able to control situations that are complex, unpredictable and which require new solutions,
- are able to independently initiate and to perform collaboration within the discipline and interdisciplinary as well, and to take professional responsibility,
- are able to independently take responsibility for his or her own professional development and specialization.

TYPE OF INSTRUCTION

As described in the introduction to Chapter 3.

Problem based project oriented project work individual or in groups of 2-3 persons

EXAM

EXAMS

Name of exam	Master's Thesis
Type of exam	Oral exam based on a project

	The master thesis can be conducted as a long master thesis. If choosing to do a long master thesis, it has to include experimental work and has to be approved by the study board. The amount of experimental work must reflect the allotted ECTS.
ECTS	50
Assessment	7-point grading scale
Type of grading	External examination
Criteria of assessment	As stated in the Joint Programme Regulations http://www.en.tech.aau.dk/education-programmes/Education+and+Programmes/

FACTS ABOUT THE MODULE

Danish title	Kandidatspeciale
Module code	ESNVGISK4P2
Module type	Project
Duration	1 semester
Semester	Autumn
ECTS	50
Empty-place Scheme	Yes
Location of the lecture	Campus Aalborg
Responsible for the module	Ove Kjeld Andersen

ORGANISATION

Study Board	Study Board of Electronics and IT
Department	Department of Electronic Systems
Faculty	Technical Faculty of IT and Design