Module Catalogue
for the Subject
Games Engineering
as a Bachelor’s with 1 major
with the degree "Bachelor of Science"
(180 ECTS credits)

Examination regulations version: 2017
Responsible: Institute of Computer Science
## Contents

The subject is divided into

Content and Objectives of the Programme

Abbreviations used, Conventions, Notes, In accordance with

Compulsory Courses

- Game Lab I Principles and Languages
- Game Lab II Architectures and Components
- Game Lab III Systems
- Fundamentals of Programming
- Algorithms and data structures
- Software Technology
- Mathematics 1 for Games Engineering
- Mathematics 2 for Games Engineering
- Software Quality
- Network and Concurrent Programming
- Foundations of Human-Computer Interaction
- Asset Development (Modeling and Animation)
- Interactive Artificial Intelligence
- Interactive Computer Graphics
- Seminar - Current Trends of Games Engineering

Compulsory Electives

- Selected Topics of Games Engineering 1
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- Computer Science in Media 1
- Theoretical Informatics
- Tutorial Theoretical Informatics
- Logic for informatics
- Algorithmic Graph Theory
- Databases
- Knowledge-based Systems
- Advanced Programming
- Cryptography and Data Security
- 3D Point Cloud Processing
- Computer Architecture
- Computer Networks and Communication Systems
- Selected Basics of Computer Science

Transferable Skills

- General Key Skills

  - General Key Skills (subject-specific)
    - Work experience as a research and teaching assistant

- Subject-specific Key Skills

  - Practice/Job-oriented Internship

Thesis Area

- Exhibition: Game Lab III and Bachelor Thesis
- Bachelor Thesis Games Engineering
The subject is divided into

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Content and Objectives of the Programme

Games Engineering, B.Sc. (Bachelor of Science) is an undergraduate program of study offered by the Faculty of Mathematics and Computer Science at the JMU, with a scope of 180 ECTS points. The program conveys specialist competencies as well as basic competencies in Computer Science, as follows:

1) General Competencies
- Critical reflection and classification of scientific knowledge
- Written and oral presentation of acquired skills and knowledge
- Implementation of self-guided scientific and applied projects
- State-of-the-art authorship of scientific texts in the field
- Teamwork

2) Methodological Competencies
- Analytical procedures and systematic implementation
- Algorithmic thinking and design
- Understanding and structuring of complex relationships
- Methods of analysis, design and evaluation of game systems

3) Knowledge-based Competencies
- Programming and program-based methods
- Software design and software analysis
- Development of interactive systems
- Technological basics of computer systems
Abbreviations used

Course types: $E = \text{field trip}$, $K = \text{colloquium}$, $O = \text{conversatorium}$, $P = \text{placement/lab course}$, $R = \text{project}$, $S = \text{seminar}$, $T = \text{tutorial}$, $Ü = \text{exercise}$, $V = \text{lecture}$

Term: $SS = \text{summer semester}$, $WS = \text{winter semester}$

Methods of grading: $\text{NUM} = \text{numerical grade}$, $B/NB = (\text{not}) \text{ successfully completed}$

Regulations: $(L)\text{ASPO} = \text{general academic and examination regulations (for teaching-degree programmes)}$, $\text{FSB} = \text{subject-specific provisions}$, $\text{SFB} = \text{list of modules}$

Other: $A = \text{thesis}$, $LV = \text{course(s)}$, $PL = \text{assessment(s)}$, $TN = \text{participants}$, $VL = \text{prerequisite(s)}$

Conventions

Unless otherwise stated, courses and assessments will be held in German, assessments will be offered every semester and modules are not creditable for bonus.

Notes

Should there be the option to choose between several methods of assessment, the lecturer will agree with the module coordinator on the method of assessment to be used in the current semester by two weeks after the start of the course at the latest and will communicate this in the customary manner.

Should the module comprise more than one graded assessment, all assessments will be equally weighted, unless otherwise stated below.

Should the assessment comprise several individual assessments, successful completion of the module will require successful completion of all individual assessments.

In accordance with

the general regulations governing the degree subject described in this module catalogue:

ASPO2015

associated official publications (FSB (subject-specific provisions)/SFB (list of modules)):

9-Aug-2017 (2017-53)

This module handbook seeks to render, as accurately as possible, the data that is of statutory relevance according to the examination regulations of the degree subject. However, only the FSB (subject-specific provisions) and SFB (list of modules) in their officially published versions shall be legally binding. In the case of doubt, the provisions on, in particular, module assessments specified in the FSB/SFB shall prevail.
Compulsory Courses

(135 ECTS credits)
## Module Catalogue for the Subject
Games Engineering
Bachelor's with 1 major, 180 ECTS credits

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<th>Module title</th>
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<td>Game Lab I Principles and Languages</td>
<td>10-GE-GL-1-162-m01</td>
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### Contents

In the GameLab 1, the foundations and languages of established engines are learned. In group work, the students conceptualise, develop, test and polish a comprehensive game prototype. Introductory lectures explain basic concepts from the world of computer games as well as comprehensive topics such as Serious Games. In addition, the lectures are held in related research areas, including software engineering, interactive computer graphics, interactive physics, visualisation, human-machine interaction, procedural content generation, sound and music production and scientific work.

### Intended learning outcomes

At the end of GameLab 1, the students have worked out the entire development cycle of a computer game. Accordingly, students acquired basic knowledge of the design, development and scientific testing of games and interactive, real-time systems in general.

### Courses

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<td>presentation of project results (30 to 45 minutes) Language of assessment: German and/or English creditable for bonus</td>
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### Allocation of places

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### Additional information

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

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Bachelor's with 1 major Games Engineering (2017)
### Module title
Game Lab II Architectures and Components

### Abbreviation
10-GE-GL-2-162-m01

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### Contents
Based on the knowledge and abilities learned in GameLab 1, GameLab 2 identifies specific ways to expand existing game engines. From now on, powerful and equally accessible engine extensions (including plugins) are being developed. In addition to the technical challenges, the technical documentation and the universal applicability of the software products are of great importance in order to meet the requirements of a product prototype. In the course of the lecture and practice the basic theoretical concepts and practical skills are learned in order to develop individual engine extensions in teams iteratively.

### Intended learning outcomes
At the end of the GameLab 2, the students worked out the entire development cycle of an engine extension. The domain of the learned knowledge is already deep in the programmatic backend of complex game engine frameworks. At the same time, students have learned how to design complex system components in an accessible way and how to document them in a sound and comprehensible manner.

### Courses
**R (10)**
Module taught in: German or English

**Method of assessment**
- presentation of project results (30 to 45 minutes)
- Language of assessment: German and/or English
- creditable for bonus

### Allocation of places
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### Additional information
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### Referred to in LPO I
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### Contents

The basic principles of game engines are taught in the classes of Human-Computer Interaction, Interactive Computer Graphics, Interactive Artificial Intelligence and Asset Development. In GameLab 3 these different aspects are integrated in order to develop a comprehensive engine independently. As in the GameLabs 1 and 2, the projects are realized in groups. Depending on the student's interest, highly specialized and innovative engines can be created. The necessary theoretical concepts and practical skills are strengthened within the framework of the lecture and practice.

### Intended learning outcomes

After completion of the course, students will have a deep understanding of the software architecture of Game Engines and the interplay of integrated subengines. In particular the uniform organization of large-scale software projects as well as a later application perspective can be realized by the students.

### Courses

- **R (10)**
  - Module taught in: German or English

### Method of assessment

- **presentation of project results (30 to 45 minutes)**
  - Language of assessment: German and/or English

### Allocation of places

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### Additional information

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### Referred to in LPO 1

- (examination regulations for teaching-degree programmes)
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<td>Fundamentals of Programming</td>
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**Module coordinator**
holder of the Chair of Computer Science II

**Module offered by**
Institute of Computer Science

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**Contents**
Data types, control structures, foundations of procedural programming, selected topics of C, introduction to object orientation in Java, selected topics of C++, further Java concepts, digression: scripting languages.

**Intended learning outcomes**
The students possess a fundamental knowledge about programming languages (in particular Java, C and C++) and are able to independently develop average to high level Java programs.

**Courses**
(type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

Module taught in: German or English

**Method of assessment**
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: German and/or English creditable for bonus

**Allocation of places**
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**Additional information**
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**Referred to in LPO I**
(examination regulations for teaching-degree programmes)

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Module title | Algorithms and data structures
---|---
Abbreviation | 10-GE-ADS-162-m01

Module coordinator | Dean of Studies Informatik (Computer Science)
Module offered by | Institute of Computer Science

ECTS | 10
Method of grading | numerical grade
Only after succ. compl. of module(s) | --

Duration | 1 semester
Module level | undergraduate
Other prerequisites | --

Contents
Design and analysis of algorithms, recursion vs. iteration, sort and search methods, data structures, abstract data types, lists, trees, graphs, basic graph algorithms, programming in Java.

Intended learning outcomes
The students are able to independently design algorithms as well as to precisely describe and analyse them. The students are familiar with the basic paradigms of the design of algorithms and are able to apply them in practical programs. The students are able to estimate the run-time behaviour of algorithms and to prove their correctness.

Courses
(type, number of weekly contact hours, language — if other than German)
V (4) + Ü (2)

Method of assessment
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
written examination (approx. 60 to 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).
Language of assessment: German and/or English creditable for bonus

Allocation of places
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Additional information
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**Module coordinator**  
Dean of Studies Informatik (Computer Science)

**Module offered by**  
Institute of Computer Science

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**Contents**

Object-oriented software development with UML, development of graphical user interfaces, foundations of databases and object-relational mapping, foundations of web programming (HTML, XML), software development processes, unified process, agile software development, project management, quality assurance.

**Intended learning outcomes**

The students possess a fundamental theoretical and practical knowledge on the design and development of software systems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Written examination (approx. 60 to 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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<td>Dean of Studies Mathematik (Mathematics)</td>
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**Contents**

Propositional logic, set theory, proof techniques, relations; sequences, limits and lambda-symbols; the ring of integers; elementary group theory; residue class rings; basics in linear algebra, linear maps and matrix calculus, systems of linear equations.

**Intended learning outcomes**

The student gets acquainted with fundamental concepts and methods of advanced mathematics. He/She learns to apply these methods to problems in natural and engineering sciences, in particular in computer science, and is able to interpret the results.

**Courses**

(type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--
Module title: Mathematics 2 for Games Engineering
Abbreviation: 10-M-GE-2-162-m01

Module coordinator: Dean of Studies Mathematik (Mathematics)
Module offered by: Institute of Mathematics

ECTS: 10
Method of grading: numerical grade
Only after succ. compl. of module(s): --

Duration: 1 semester
Module level: undergraduate
Other prerequisites: --

Contents:
Determinants, eigenvalue theory; event and probability spaces, combinatorics, random variables, examples of distributions, parameter estimates; basics in analysis.

Intended learning outcomes:
The student gets acquainted with fundamental concepts and methods of advanced mathematics. He/She learns to apply these methods to problems in natural and engineering sciences, in particular in computer science, and is able to interpret the results.

Courses:
(type, number of weekly contact hours, language — if other than German)
V (4) + Ü (2)

Method of assessment:
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
a) written examination (approx. 90 to 180 minutes, usually chosen) or b) oral examination of one candidate each (15 to 30 minutes) or c) oral examination in groups (groups of 2, 10 to 15 minutes per candidate)
Language of assessment: German and/or English
creditable for bonus

Allocation of places:
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Additional information:
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Referred to in LPO I (examination regulations for teaching-degree programmes):
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Module Catalogue for the Subject
Games Engineering
Bachelor's with 1 major, 180 ECTS credits

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<td>Software Quality</td>
<td>10-GE-SQ-162-m01</td>
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**Contents**

How do we develop high quality software? How do we write good code? This module will teach students how to recognise and write high quality software code.

The module will focus on developing the skills to meet critical software quality requirements such as reliability, testability, accuracy, security, portability and maintainability as well as efficiency in time and space. Programming guidelines as well as code examples will illustrate concepts, techniques and tools that lead to professional code quality and ensure high software quality production. Different programming languages will be used to highlight typical examples and key concepts.

**Intended learning outcomes**

At the end of the course, the students will have gained a solid background knowledge on the theory and the methods for producing high quality code. They will also have gained a broad understanding of testing techniques and software requirements specifications.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (2)
Module taught in: German or English

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 120 minutes)
Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Contents**

This module will give the students the opportunity to learn and practice the skills essential to the development of networked and multithreaded applications. This module will give an overview of networking protocols and related APIs (application programmer interfaces), and familiarize the students with concurrent and distributed programming paradigms, focusing in particular on the realtime interactive systems (RIS) domain (such as video games, virtual reality or mixed reality applications). Issues faced when developing a concurrent or distributed application will be tackled, including synchronization and security issues. Examples of abstractions will be studied, including concurrency design patterns, distributed objects models and architectures. Classical and innovative architectures and deployment will be studied. Students will be given the opportunity to experiment and practice with the issues studied through the use of suitable libraries and middleware (e.g., game engine) during the exercise sessions.

**Intended learning outcomes**

The students possess an solid understanding of computer network systems, classical networking protocols and communication models on private networks and Internet, and of the issues faced when developing distributed applications with strong realtime interactive requirements such as digital games, virtual reality or mixed reality applications.

The students are able to design and develop concurrent and networked applications through the use of adequate design patterns and communication models and have an overview of different concurrent programming models, such as threads and processes, and the different communication models they can support.

**Courses**

(type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

Module taught in: German or English

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 60 to 120 minutes) or b) presentation of project results (approx. 20 minutes)

Language of assessment: German and/or English

creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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<table>
<thead>
<tr>
<th>Module title</th>
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<tr>
<td>Foundations of Human-Computer Interaction</td>
<td>10-GE-GMCS-162-m01</td>
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**Contents**

Human-Computer Interaction is concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. This course gives an introduction into the principle biological, physiological, and psychological constraints as defined by the human user and relates these constraints to the conceptual and technical solutions of today’s computer systems and existing as well as prospective interaction metaphors between humans and computers.

The course covers topics about human perception and cognition, memory and attention, the design of interactive systems, prominent evaluation methods, the principles of computer systems, typical input processing techniques, interface technology, and examples of typical interaction metaphors, from text-based input to graphical desktops to multimodal interfaces. Accompanying lab-work will introduce students to typical tasks involved in this field, i.e., prominent evaluation methods and prototyping of interfaces.

**Intended learning outcomes**

After the course, the students will have a broad understanding of the underlying principles of human users and computer systems. They will understand the constraints and capabilities of current user interfaces and they will learn about the necessary steps applied in user-centered design and development approaches.

**Courses**

(type, number of weekly contact hours, language — if other than German)

V (2) + Ü (1)

Module taught in: German or English

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 120 minutes)

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Contents**

The precise mapping of the world or the attractive representation of complex content ensures an important basic functionality for the effective use of interactive, real-time systems and enables atmospheric computer games. In this module, basic methods of modeling three-dimensional assets are learned - from the design of mesh-based graphical objects to the rigging of complex animated characters. These manual approaches are complemented by automatic forward calculations of physical processes by means of appropriate, real-time engines. We will work with these engines and understand their basic principles.

**Intended learning outcomes**

After completion of the course, students have a solid background knowledge about the creation, presentation and animation of graphical, three-dimensional objects.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

Module taught in: German or English
Course type: alternatively S (2) instead of V

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 60 to 120 minutes) or b) presentation of project results (approx. 20 minutes)

Language of assessment: German and/or English
Creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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## Interactive Artificial Intelligence

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<td>Interactive Artificial Intelligence</td>
<td>10-GE-IKI-162-m01</td>
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### Module coordinator

holder of the Chair of Computer Science IX

### Module offered by

Institute of Computer Science

### ECTS  | Method of grading | Only after succ. compl. of module(s) |
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### Contents

Artificial Intelligence (AI) studies the science and engineering of making intelligent machines, that is, methods which let machines or software exhibit intelligent behaviour. This course specifically concentrates on interactive methods applicable to novel human-computer interfaces and computer games. The course will cover topics about problem solving in general, search methods, semantic representation, logic and deduction methods, constraint satisfaction methods, as well as algorithmical approaches to apply these methods to interactive systems. The latter includes the identification of necessary software modules and requirements for AI-enabled systems as well as APIs for building so-called world interfaces. An introduction to inductive learning approaches, in particular Q-Learning and Evolutionary Algorithms concludes the lecture.

### Intended learning outcomes

After the course, the students will have a broad understanding of the underlying theoretical models and methods used in interactive Artificial Intelligence. They will be able to implement a prominent variety of these methods, to build their own intelligent interactive applications, and to choose the right software tool for this task.

### Courses

(type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

Module taught in: German or English

### Method of assessment

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 60 to 120 minutes) or b) presentation of project results (approx. 20 minutes)

Language of assessment: German and/or English

Creditable for bonus

### Allocation of places

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### Additional information

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

--
Interactive Computer Graphics

Module coordinator: holder of the Chair of Computer Science IX
Module offered by: Institute of Computer Science

ECTS: 5
Method of grading: numerical grade
Duration: 1 semester
Module level: graduate
Other prerequisites: --

Contents

Computer graphics studies methods for digitally synthesising and manipulating visual content. This course specifically concentrates on interactive graphics with an additional focus on 3D graphics as a requirement for many contemporary as well as for novel human-computer interfaces and computer games. The course will cover topics about light and images, lighting models, data representations, mathematical formulations of movements, projection as well as texturing methods. Theoretical aspects of the steps involved in ray-tracing and the raster pipeline will be complemented by algorithmical approaches for interactive image syntheses using computer systems. Accompanying software solutions will utilise modern graphics packages and languages like OpenGL, GLSL and/or DirectX.

Intended learning outcomes

At the end of the course, the students will have a broad understanding of the underlying theoretical models of computer graphics. They will be able to implement a prominent variety of these models, to build their own interactive graphics applications and to choose the right software tool for this task.

Courses (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)
Module taught in: German or English

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 60 to 120 minutes) or b) presentation of project results (approx. 20 minutes)
Language of assessment: German and/or English
creditable for bonus

Allocation of places

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Additional information

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Referred to in LPO I (examination regulations for teaching-degree programmes)

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<td>Seminar - Current Trends of Games Engineering</td>
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</table>

**Contents**

Independent review of a current topic in the field of Games Engineering based on literature and, where applicable, software with written and oral presentation.

**Intended learning outcomes**

The students possess the skills to independently review a current topic in the field of Games Engineering, to summarize the main points in written form and to give a pleasant oral presentation.

**Courses** (type, number of weekly contact hours, language — if other than German)

| S (2) |

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Presentation (approx. 20 minutes) with handout (approx. 5 pages)

Language of assessment: German and/or English

Creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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Compulsory Electives

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<td>Selected Topics of Games Engineering 1</td>
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**Module coordinator**

holder of the Chair of Computer Science IX

**Module offered by**

Institute of Computer Science

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**Duration**

1 semester

**Module level**

undergraduate

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### Contents

Selected chapters of Games Engineering.

### Intended learning outcomes

The students possess special knowledge in the area of Games Engineering. They are able to understand solutions of complex problems in this area and can transfer them to related questions.

**Courses**

(type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

Module taught in: German or English

Course type: alternatively S (2) instead of V, T (2) instead of Ü

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 60 to 120 minutes) or b) presentation of project results (approx. 20 minutes)

Language of assessment: German and/or English

creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

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**Module title** | **Abbreviation**
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Selected Topics of Games Engineering 2 | 10-GE-AT-2-162-m01

**Module coordinator** | **Module offered by**
--- | ---
holder of the Chair of Computer Science IX | Institute of Computer Science

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**Contents**
Selected chapters of Games Engineering.

**Intended learning outcomes**
The students possess special knowledge in the area of Games Engineering. They are able to understand solutions of complex problems in this area and can transfer them to related questions.

**Courses** (type, number of weekly contact hours, language — if other than German)
- V (2) + Ü (2)
- Module taught in: German or English
- Course type: alternatively S (2) instead of V, T (2) instead of Ü

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
- a) written examination (approx. 60 to 120 minutes) or b) presentation of project results (approx. 20 minutes)
- Language of assessment: German and/or English
- creditable for bonus

**Allocation of places**
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**Additional information**
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**Contents**

The module Medieninformatik 1 (Media Informatics 1) provides students with a basic knowledge and a practical overview of current digital media types.

**Intended learning outcomes**

Students are familiar with the concepts of media informatics. They have basic knowledge of information processing with a special focus on digital media.

**Courses**

(type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

Course type: alternatively T (2) instead of Ü

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) written examination (approx. 60 minutes) or b) oral examination (approx. 20 minutes) or c) term paper (approx. 20 pages) or d) portfolio (approx. 20 pages)

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

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**Contents**
Computability, decidability, countability, complexity of calculations, Boolean functions and circuits, finite automata and regular sets, generative grammars, context-free languages, context-sensitive languages.

**Intended learning outcomes**
The students possess fundamental and applicable knowledge in the area of computability, decidability, countability, complexity of calculations, Boolean functions and circuits, finite automata and regular sets, generative grammars, context free languages, context sensitive languages.

**Courses** (type, number of weekly contact hours, language — if other than German)
V (4)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
Written examination (approx. 60 to 120 minutes).
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

**Allocation of places**
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**Additional information**
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**Module coordinator**

Dean of Studies Informatik (Computer Science)

**Module offered by**

Institute of Computer Science

**ECTS**

5

**Method of grading**

Only after succ. compl. of module(s)

**Duration**

1 semester

**Module level**

undergraduate

**Other prerequisites**

--

**Contents**

Computability, decidability, countability, finite automata, regular sets, generative grammars, context-free languages, context-sensitive languages, complexity of calculations, P-NP problem, NP completeness.

**Intended learning outcomes**

The students possess a fundamental and applicable knowledge in the areas of computability, decidability, countability, finite automata, regular sets, generative grammars, context-free languages, context-sensitive languages, complexity of computations, P-NP problem, NP completeness.

**Courses** (type, number of weekly contact hours, language — if other than German)

Ü (2)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

a) exercises (consisting in completion of approx. 11 home work exercise sheets, presentation of own solutions in the exercise groups as well as approx. 5 short assessments written in the exercise group) or b) Written examination (approx. 180 to 240 minutes)

Die Prüfungsart ist vom Prüfling festzulegen

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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**Module coordinator**

Dean of Studies Informatik (Computer Science)

**Module offered by**

Institute of Computer Science

**Contents**

Syntax and semantics of propositional logic, equivalence and normal forms, Horn formulas, SAT, resolution, infinite formula sets, syntax and semantics of predicate logic.

**Intended learning outcomes**

The students are proficient in the following areas: syntax and semantics of propositional logic, equivalence and normal forms, Horn formulas, SAT, resolution, infinite formula sets, syntax and semantics of predicate logic.

**Courses**

V (2) + Ü (2)

**Method of assessment**

written examination (approx. 60 to 120 minutes). If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate). Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--
### Algorithmic Graph Theory

**Module title**: Algorithmic Graph Theory  
**Abbreviation**: 10-GE-AGT-162-m01

**Module coordinator**: holder of the Chair of Computer Science I  
**Module offered by**: Institute of Computer Science

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**Duration**: 1 semester  
**Module level**: undergraduate  
**Other prerequisites**: --

**Contents**

We discuss typical graph problems: We solve round trip problems, calculate maximal flows, find matchings and colourings, work with planar graphs and find out how the ranking algorithm of Google works. Using the examples of graph problems, we also become familiar with new concepts, for example how we model problems as linear programs or how we show that they are fixed parameter computable.

**Intended learning outcomes**

The students are able to model typical problems in computer science as graph problems. In addition, the participants are able to decide which tool from the course helps solve a given graph problem algorithmically. In this course, students learn in detail how to estimate the run time of given graph algorithms.

**Courses** (type, number of weekly contact hours, language — if other than German)

- V (2) + Ü (2)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 120 minutes).  
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).  
Language of assessment: German and/or English  
creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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### Module coordinator
Dean of Studies Informatik (Computer Science)

### Module offered by
Institute of Computer Science

### ECTS
5

### Method of grading
numerical grade

### Only after succ. compl. of module(s)
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### Duration
1 semester

### Module level
undergraduate

### Other prerequisites
--

### Contents
Relational algebra and complex SQL statements; database planning and normal forms; transaction management.

### Intended learning outcomes
The students possess knowledge about database modelling and queries in SQL as well as transactions.

### Courses
(type, number of weekly contact hours, language — if other than German)
V (2) + Ü (2)

### Method of assessment
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
written examination (approx. 60 to 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

### Allocation of places
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### Additional information
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<tr>
<th>Duration</th>
<th>Module level</th>
<th>Other prerequisites</th>
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<tbody>
<tr>
<td>1 semester</td>
<td>undergraduate</td>
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</tbody>
</table>

**Contents**

Foundations in the following areas: knowledge management systems, knowledge representation, solving methods, knowledge acquisition, learning, guidance dialogue, semantic web.

**Intended learning outcomes**

The students possess theoretical and practical knowledge for the understanding and design of knowledge-based systems including knowledge formalisation and have acquired experience in a small project.

**Courses**

(type, number of weekly contact hours, language — if other than German)

S (2) + Ü (2)

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

Written examination (approx. 60 to 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I**

(examination regulations for teaching-degree programmes)

--
Module title | Abbreviation
--- | ---
Advanced Programming | 10-GE-APR-172-m01

Module coordinator: holder of the Chair of Computer Science II  
Module offered by: Institute of Computer Science

ECTS | Method of grading | Only after succ. compl. of module(s)
--- | --- | ---
5 | numerical grade | --

Duration: 1 semester  
Module level: graduate  
Other prerequisites: --

Contents
With the knowledge of basic programming, taught in introductory lectures, it is possible to realize simpler programs. If more complex problems are to be tackled, suboptimal results like long, incomprehensible functions and code duplicates occur. In this lecture, further knowledge is to be conveyed on how to give programs and code a sensible structure. Also, further topics in the areas of software security and parallel programming are discussed.

Intended learning outcomes
Students learn advanced programming paradigms especially suited for space applications. Different patterns are then implemented in multiple languages and their efficiency measured using standard metrics. In addition, parallel processing concepts are introduced culminating in the use of GPU architectures for extremely quick processing.

Courses (type, number of weekly contact hours, language — if other than German)
V (2) + Ü (2)

Method of assessment (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
written examination (approx. 60 to 120 minutes).  
If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).  
Language of assessment: German and/or English creditable for bonus

Allocation of places
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Additional information
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Referred to in LPO I (examination regulations for teaching-degree programmes)
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<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>Cryptography and Data Security</td>
<td>10-GE-KD-162-m01</td>
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**Module coordinator**

Dean of Studies Informatik (Computer Science)

**Module offered by**

Institute of Computer Science

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**Duration**

1 semester

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<tr>
<td>undergraduate</td>
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</table>

**Contents**

Private key cryptography systems, Vernam one-time pad, AES, perfect security, public key cryptography systems, RSA, Diffie-Hellman, Elgamal, Goldwasser-Micali, digital signature, challenge-response methods, secret sharing, millionaire problem, secure circuit evaluation, homomorphous encryption.

**Intended learning outcomes**

The students possess a fundamental and applicable knowledge in the areas of private key cryptography systems, Vernam one-time pad, AES, perfect security, public key cryptography, RSA, Diffie-Hellman, Elgamal, Goldwasser-Micali, digital signature, challenge-response method, secret sharing, millionaire problem, secure circuit evaluation, homomorphous encryption.

**Courses**

(type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

**Method of assessment**

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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<td>3D Point Cloud Processing</td>
<td>10-GE-3D-162-m01</td>
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<td>holder of the Chair of Computer Science VII</td>
<td>Institute of Computer Science</td>
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</table>

**Contents**

Laser scanning, Kinect and camera models, basic data structures (lists, arrays, octrees), calculating normals, k-d trees, registration, features, segmentation, tracking, applications for airborne mapping, applications to mobile mapping.

**Intended learning outcomes**

Students understand the fundamental principles of all aspects of 3D point cloud processing and are able to communicate with engineers / surveyors / CV people / etc. Students are able to solve problems of modern sensor data processing and have experienced that real application scenarios are challenging in terms of computational requirements, in terms of memory requirements and in terms of implementation issues.

**Courses** (type, number of weekly contact hours, language — if other than German)

S (2) + Ü (2)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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<td>Computer Architecture</td>
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<tr>
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<td>Institute of Computer Science</td>
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</tbody>
</table>

**Contents**

Instruction set architectures, command processing through pipelining, statical and dynamic instruction scheduling, caches, vector processors, multi-core processors.

**Intended learning outcomes**

The students master the most important techniques to design fast computers as well as their interaction with compilers and operating systems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (2) + Ü (2)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

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<table>
<thead>
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<td>Computer Networks and Communication Systems</td>
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<tr>
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<tbody>
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</table>

**Contents**


**Intended learning outcomes**

The students possess an intricate knowledge of the structure of computer networks and communication systems as well as fundamental principles to rate these systems.

**Courses** (type, number of weekly contact hours, language — if other than German)

V (4) + Ü (2)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

written examination (approx. 60 to 120 minutes).

If announced by the lecturer at the beginning of the course, the written examination may be replaced by an oral examination of one candidate each (approx. 20 minutes) or an oral examination in groups of 2 candidates (approx. 15 minutes per candidate).

Language of assessment: German and/or English creditable for bonus

**Allocation of places**

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**Additional information**

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<table>
<thead>
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<tr>
<td>Selected Basics of Computer Science</td>
<td>10-GE-GI-162-m01</td>
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**Module coordinator**

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**Contents**

Selected topics in computer science.

**Intended learning outcomes**

The students are able to understand solutions to fundamental problems in computer science and to transfer them to related topics.

**Courses**

<table>
<thead>
<tr>
<th>Type, number of weekly contact hours, language — if other than German</th>
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<tbody>
<tr>
<td>V (4) + Ü (2)</td>
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**Method of assessment**

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</table>

**Allocation of places**

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**Additional information**

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**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--
Transferable Skills
(20 ECTS credits)
General Key Skills
(5 ECTS credits)

Students may also take modules offered as part of the pool of general transferable skills (ASQ) of JMU.
General Key Skills (subject-specific)
(ECTS credits)
<table>
<thead>
<tr>
<th>Module title</th>
<th>Abbreviation</th>
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<tbody>
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<td>Work experience as a research and teaching assistant</td>
<td>10-GE-Tut-ASQ-162-m01</td>
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<td>Institute of Computer Science</td>
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<tbody>
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<td>1 semester</td>
<td>undergraduate</td>
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</table>

**Contents**

Tutoring activities in the area of computer science.

**Intended learning outcomes**

Imparting knowledge and skills to students of computer science.

**Courses** (type, number of weekly contact hours, language — if other than German)

P (0)

**Method of assessment** (type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

report (approx. 2 pages)

**Allocation of places**

--

**Additional information**

--

**Referred to in LPO I** (examination regulations for teaching-degree programmes)

--
Subject-specific Key Skills

(15 ECTS credits)
Practice/Job-oriented Internship

Module title

Abbreviation

Practice/Job-oriented Internship

10-GE-BPrakt-162-m01

Module coordinator

holder of the Chair of Computer Science IX

Module offered by

Institute of Computer Science

ECTS

Method of grading

Only after succ. compl. of module(s)

15

(not) successfully completed

--

Duration

Module level

Other prerequisites

undergraduate

--

Contents

Practical experience is an important skill and source of information for application-oriented aspects of various sciences and the related job descriptions. This is also true for Games Engineering. This course requires the participants to take part in an internship either in the academic field or in the industry.

Intended learning outcomes

The participants will learn how potential future jobs and employments will be characterized and what kind of qualifications will be expected from them.

Courses

(type, number of weekly contact hours, language — if other than German)

P (0)

Method of assessment

(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)

report on practical course (approx. 5 pages)

Language of assessment: German or English

Allocation of places

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Additional information

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Referred to in LPO I

(examination regulations for teaching-degree programmes)

--
Thesis Area

(15 ECTS credits)
<table>
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<tbody>
<tr>
<td>Exhibition: Game Lab III and Bachelor Thesis</td>
<td>10-GE-EX-162-m01</td>
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**Module coordinator**
holder of the Chair of Computer Science IX

**Module offered by**
Institute of Computer Science

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**Duration**
1 semester

**Module level**
undergraduate

**Other prerequisites**
--

**Contents**
Presentation and communication are important skills for application-oriented and practical aspects of various sciences. This is specifically true for Games Engineering. This course requires the participants to present the results of an associated project to a larger audience in a and exhibition-like setup.

**Intended learning outcomes**
The participants will learn how to present their own work to a larger audience, how to plan, design and set-up the different parts of an own exhibition booth, and how to react individually to questions from the audience.

**Courses**
(type, number of weekly contact hours, language — if other than German)

S (1)
Module taught in: German or English

**Method of assessment**
(type, scope, language — if other than German, examination offered — if not every semester, information on whether module is creditable for bonus)
presentation of results of Game Lab III project and of Bachelor’s thesis (approx. 10 minutes)
Language of assessment: German and/or English
creditable for bonus

**Allocation of places**
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**Additional information**
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**Referred to in LPO I**
(examination regulations for teaching-degree programmes)
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<table>
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<td>Bachelor Thesis Games Engineering</td>
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### Contents

The students have to individually work on an assigned well-defined problem in the field of Games Engineering and document their results using good scientific standards.

### Intended learning outcomes

Participants will learn how to apply scientific methods from the Games Engineering field. They will learn a structured approach starting from a definition and motivation of research questions and the discussion and summary of related work from scientific publications and prior approaches. Following this they will learn how to develop own concepts and methods to tackle the questions and how to implement them and potentially to evaluate the results.

### Courses

No courses assigned to module

### Method of assessment

Bachelor's thesis (approx. 30 pages)

Language of assessment: German or English

### Allocation of places

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### Additional information

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### Referred to in LPO I

(examination regulations for teaching-degree programmes)

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