Module description
Bachelor in Computer Science, PO Version of 2015 (WT)

Contents

Compulsory modules of 1st phase of program

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### Elective modules of 2nd phase of program

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Module  BIN-100 Mathematics 1

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**Learning Outcomes**
- **Formal skills:** Knowledge of logics and familiarization with mathematical formalisms to describe facts
- **Algorithmic skills:** Getting to know algorithms and their complexity
- **Mathematical skills:** Selection and implementation of suitable solutions for elementary problems in mathematics and computer science
- **Interdisciplinary skills:** Communicative skills (presentation and discussion of solution proposals)
Submodule  BIN-100-01 Mathematics 1

Subheading  
(BIN-MAT1)

Person in Charge  
Sprengel, Frauke, Prof. Dr.

Language of Instruction  
German

Curriculum Allocation  
BIN, MDI

Course Type, Contact Hours per Week  
Lecture with exercise, 4 SWS

ECTS Credits  
6

Contact Hours / Independent Study Hours  
68 h / 112 h

Semester  
1

Suggestions for Independent Study  
see literature

Recommended Prerequisites  
none

Examination  
Examination (written or oral examination) and work on tasks as experimental work

Learning Outcomes
Formal skills: Knowledge of logics and familiarization with mathematical formalisms to describe facts
Algorithmic skills: Getting to know algorithms and their complexity
Mathematical skills: Selection and implementation of suitable solutions for elementary problems in mathematics and computer science
Interdisciplinary skills: Communicative skills (presentation and discussion of solution proposals)

Content
The basic principles taught in higher mathematics include topics in the following fields:
- Logics, Boolean algebra
- Set theory
- Number systems
- Functions and relations
- Graph theory
- Elementary number theory The corresponding standard software is used to illustrate terms and processes.

Requirements for Contact Hours
Active participation, individual task-solving, discussion

Requirements for Independent Study Hours
Preparation and postprocessing of the lectures, reading literature, individual task-solving, assessment of the solutions, individual discussion

Bibliography
Lecture notes
Teschl, G., Teschl, S.: Mathematik für Informatiker, Springer - Verlag
Hartmann, P.: Mathematik für Informatiker, Vieweg - Verlag
Module  BIN-101 Start Project

Subheading (BIN-STP)
Level of Module Basic module
Type of Module Compulsory module
Submodules BIN-101-01 Start Project, Compulsory
Person in Charge Garmann, Robert, Prof. Dr.
ECTS Credits 4
Contact Hours / Independent Study Hours 90 h / 30 h
Semester 1
Duration of Module 1 semester
Prerequisites none
Recommended Prerequisites none
Examination Examination (written or oral) and experimental work

Learning Outcomes
Personal skills: The students identify successful strategies of self-organization, self-initiative, research and knowledge acquisition
Social skills: The students have tried teamwork and know the importance of communication and presentation skills for project success.
Project management skills: The students know simple methods for project planning and project control and can apply them in a small project.
Professional skills: The students are familiar with the large number of applications of the discipline computer science. They are able to purposefully debate, analyze and discuss a specific problem and can develop a solution over several weeks.
Submodule BIN-101-01 Start Project

Subheading (BIN-STP)

Person in Charge Garmann, Robert, Prof. Dr.

Language of Instruction German

Curriculum Allocation BIN, MDI

Course Type, Contact Hours per Week Project, 4 SWS

ECTS Credits 4

Contact Hours / Independent Study Hours 90 h / 30 h

Semester 1

Suggestions for Independent Study Specific to project

Recommended Prerequisites none

Examination Examination (written or oral) and experimental work

Learning Outcomes

Personal skills: The students identify successful strategies of self-organization, self-initiative, research and knowledge acquisition

Social skills: The students have tried teamwork and know the importance of communication and presentation skills for project success.

Project management skills: The students know simple methods for project planning and project control and can apply them in a small project.

Professional skills: The students are familiar with the large number of applications of the discipline computer science. They are able to purposefully debate, analyze and discuss a specific problem and can develop a solution over several weeks.

Content

Working on a problem and developing its solution in a given topic such as game development, robotics, algorithms. Trying out methods that are taught during individual coaching talks in the project's context.

Requirements for Contact Hours

Active, self-responsible development of project results. Active participation in project planning and organization, in introductory workshops and team meetings. Presentation and discussion of results.

Requirements for Independent Study Hours

Active development of project results. Preparation and follow-up of team meetings.

Bibliography

Specific to project
Module  BIN-102  Programming 1

Subheading  (BIN-PR1)
Level of Module  Basic module
Type of Module  Compulsory module
Submodules  BIN-102-01  Programming 1, Compulsory
Person in Charge  Garmann, Robert, Prof. Dr.
ECTS Credits  6
Contact Hours / Independent Study Hours  68 h / 112 h
Semester  1
Duration of Module  1 semester
Prerequisites  none
Recommended Prerequisites  none
Examination  Examination (written or oral examination) and experimental work

Learning Outcomes
Algorithmic skills: analyze a given problem and solve it algorithmically, use basic algorithms and data structures to solve problems
Realization skills: mastering the imperative programming paradigm while using object libraries, creating and testing programs using appropriate tools
Submodule BIN-102-01 Programming 1

(BIN-PR1)

Garmann, Robert, Prof. Dr.

German

BIN

Lecture with exercise, 4 SWS

6

68 h / 112 h

1

see literature

none

Examination (written or oral examination) and experimental work

Algorithmic skills: analyze a given problem and solve it algorithmically, use basic algorithms and data structures to solve problems

Realization skills: mastering the imperative programming paradigm while using object libraries, creating and testing programs using appropriate tools

Introduction to the basic principles of object-oriented programming using the Java programming language, whose language constructs are presented with a number of important libraries. Many practical examples provide more insight into this subject area.

Topics include: basic principles of programming - problem, algorithm, program, basic principles of object-oriented programming - packages, classes, objects, simple and structured data types, Control structures, input/output, exception handling, abstraction, recursion

Active participation, working on exercises

Preparation and follow-up, working on exercises

Lecture notes

Reges, S., Stepp, M.: Building Java Programs, Prentice Hall
Module  BIN-103 Fundamentals of Computer Science

Subheading  (BIN-GDI)
Level of Module  Basic module
Type of Module  Compulsory module
Submodules  BIN-103-01  Fundamentals of Computer Science, Compulsory
Person in Charge  Wohlfeil, Stefan, Prof. Dr.
ECTS Credits  6
Contact Hours / Independent Study Hours  68 h / 112 h
Semester  1
Duration of Module  1 semester
Prerequisites  none
Recommended Prerequisites  none
Examination  Examination (written or oral examination) and experimental work

Learning Outcomes
Computer science competencies: Understand structure and operation of computers. Efficiently use UNIX systems from the console. Assembler programming. Understand structure and operation of networks such as the Internet. General competencies: Read and understand computer science topics by using appropriate (scientific) literature.
### Submodule BIN-103-01 Fundamentals of Computer Science

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**Suggestions for Independent Study**

**Recommended Prerequisites**

none

**Examination**

Examination (written or oral examination) and experimental work

**Learning Outcomes**

Computer science competencies: Understand structure and operation of computers. Efficiently use UNIX systems from the console. Assembler programming. Understand structure and operation of networks such as the Internet. General competencies: Read and understand computer science topics by using appropriate (scientific) literature.

**Content**

Structure of computers, CPU architectures, Storage structures, low level programming with assembler; information encoding (ASCII, UTF), representation of numbers and characters, Structure and functionality of operating systems; management of CPU, RAM and persistent storage; using bash on UNIX systems; Internet basics, DNS, HTTP.

**Requirements for Contact Hours**

Preparation and postprocession of all lectures and exercises. Notes-taking in lecture. Active participation.

**Requirements for Independent Study Hours**

Study all provided material; deepen knowledge using additional literature; sucessfully work on all exercises

**Bibliography**

Helmut Herold, Bruno Lutz, Jürgen Wohlrab; Grundlagen der Informatik; Pearson Studium; 2012
Module BIN-104 Theoretical Computer Science

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**Learning Outcomes**
- Formal, algorithmic, mathematical skills: Knowing formal languages, grammars generating them, automata accepting them, knowing and defining regular expressions for certain patterns
- Analysis and design skills: Knowing the concept of computability and identifying non-computable problems, defining own formal languages and implementing a parser for them, analyzing and abstracting problems and solving problems using regular and pushdown automata
- Methodological skills: Being able to recognize transferral of problems into different description options, being able to recognize and use alternative descriptions of the same language class
Submodule BIN-104-01 Theoretical Computer Science

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<td>Suggestions for Independent Study</td>
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**Learning Outcomes**

Formal, algorithmic, mathematical skills: Knowing formal languages, grammars generating them, automata accepting them, knowing and defining regular expressions for certain patterns

Analysis and design skills: Knowing the concept of computability and identifying non-computable problems, defining own formal languages and implementing a parser for them, analyzing and abstracting problems and solving problems using regular and pushdown automata

Methodological skills: Being able to recognize transferal of problems into different description options, being able to recognize and use alternative descriptions of the same language class

**Content**

Basic knowledge about automata and machine models of different complexity (finite automata, pushdown automata, Turing machines), different classes of formal languages, Chomsky hierarchy and different forms of description of languages in one class, basics of compiler structure

**Requirements for Contact Hours**

Lecture: Following presentations and examples, discussion, following executions and visualizations in learning software, reflection of content, self-contained application of subjects

Exercise: Self-contained work on problems on paper and by using learning software, theoretical problems, presentation of problem solutions and project results

**Requirements for Independent Study Hours**

Preparation and post-processing of lectures and exercises, self-contained work on problems, turning in homework in small groups, self-contained work on a project task in small groups, exam preparation, reading literature

**Bibliography**

G. Vossen/K.-U. Witt: Grundkurs Theoretische Informatik, 3. Auflage, Vieweg
J. Hopcroft/R. Motwani/J. Ullman: Introduction to Automata Theory, Languages and Computation (2.Auflage), Addison-Wesley
Module BIN-105 Mathematics 2

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Learning Outcomes

Formal and mathematical skills: knowing the concepts, algorithms and techniques of linear algebra that are required to understand applications in numerical analysis, computer graphics, image processing and animation; being able to use the methods of linear algebra in other areas of applied computer science. General skills: acquiring communicative competence (presenting and discussing proposed solutions).
Submodule  BIN-105-01 Mathematics 2

Subheading  Linear Algebra and Analytic Geometry (BIN-MAT2)
Person in Charge  Pigors, Adrian, Prof. Dr.
Language of Instruction  German
Curriculum Allocation  BIN, MDI
Course Type, Contact Hours per Week  Lecture with exercise, 4 SWS
ECTS Credits  6
Contact Hours / Independent Study Hours  68 h / 112 h
Semester  2
Suggestions for Independent Study  See literature
Recommended Prerequisites  BIN-100 Mathematical foundations of computer science (BIN-MAT1)
Examination  Written or oral examination, experimental work

Learning Outcomes
Formal and mathematical skills: knowing the concepts, algorithms and techniques of linear algebra that are required to understand applications in numerical analysis, computer graphics, image processing and animation; being able to use the methods of linear algebra in other areas of applied computer science.
General skills: acquiring communicative competence (presenting and discussing proposed solutions).

Content
The essentials of linear algebra as part of higher mathematics, including selected topics from the areas:
- vectors and vector spaces,
- matrices and
- systems of linear equations, each with numerical methods and application examples. To illustrate the concepts and techniques, appropriate standard software is used.

Requirements for Contact Hours
Participating actively, solving exercise problems

Requirements for Independent Study Hours
Preparing and following up lectures, solving exercise problems, discussing material

Bibliography
Lecture notes
Teschl, G., Teschl, S.: Mathematik für Informatiker, Springer
Hartmann, P.: Mathematik für Informatiker, Vieweg
Locher, F.: Numerische Mathematik für Informatiker, Springer
Schwarz, H. R.: Numerische Mathematik, Teubner
Module BIN-106 Database Systems 1

Subheading: (BIN-DBS1)

Level of Module: Basic module

Type of Module: Compulsory module

Submodules: BIN-106-01 Database Systems 1, Compulsory

Person in Charge: Heine, Felix, Prof. Dr.

ECTS Credits: 6

Contact Hours / Independent Study Hours: 68 h / 112 h

Semester: 2

Duration of Module: 1 semester

Prerequisites: None

Recommended Prerequisites: BIN-102 Programming 1 (BIN-PR1)

Examination: Written or oral examination, experimental work

Learning Outcomes:
Analytical skills: Be able to become acquainted with an application domain, extract requirements, understand and structure a complex domain using ER diagrams
Design skills: Derive a database design from requirements
Technological skills: Database design as a process
Interdisciplinary skills: Social skills (team work), ability to transfer
Submodule  BIN-106-01 Database Systems 1

Subheading (BIN-DBS1)
Person in Charge Heine, Felix, Prof. Dr.
Language of Instruction German
Curriculum Allocation BIN, MDI
Course Type, Contact Hours per Week Lecture with exercise, 4 SWS
ECTS Credits 6
Contact Hours / Independent Study Hours 68 h / 112 h
Semester 2
Suggestions for Independent Study See literature
Recommended Prerequisites BIN-102 Programming 1 (BIN-PR1) or MDI-102 Programming 1 (MDI-PR1)
Examination Written or oral examination, experimental work

Learning Outcomes
Analytical skills: Be able to become acquainted with an application domain, extract requirements, understand and structure a complex domain using ER diagrams
Design skills: Derive a database design from requirements
Technological skills: Database design as a process
Interdisciplinary skills: Social skills (team work), ability to transfer

Content
In this module, important elements and concepts like data modeling and relational data models are presented. Among others, the following topics are dealt with:
- Creation of a database design and translation into a database schema
- Data manipulation in the relational model
- SQL
- Introduction to database programming
- Normalization The topics are trained practically and deepened using a database system.

Requirements for Contact Hours
Active participation, solving exercise problems

Requirements for Independent Study Hours
Preparation and postprocessing

Bibliography
R. Elmasri, S. Navathe; Grundlagen von Datenbanksystemen; Pearson Education, 2009
A. Heuer, G. Saake; Datenbanken: Konzepte und Sprachen; mitp, 2013
A. Kemper, A. Eickler; Datenbankensysteme; Oldenburg, 2015
Kudraß, T. (Hrsg.): Taschenbuch Datenbanken, Hanser, 2015
Module BIN-107 Statistics

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<td>BIN-107-01 Statistics, Compulsory</td>
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<td>Ahlers, Volker, Prof. Dr.</td>
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<td>Recommended Prerequisites</td>
<td>BIN-100 Mathematical Foundations of Computer Science (BIN-MAT1)</td>
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<tr>
<td>Examination</td>
<td>Written or oral examination, experimental work</td>
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Learning Outcomes
Algorithmic and mathematical skills: Getting to know, using, comparing, and evaluating stochastic terms and methods for the description and analysis of large datasets. Interpretation and evaluation of results of stochastic methods and statistical anlysis.
Interdisciplinary skills: Communicative skills (presentation and discussion of solution approaches).
Submodule BIN-107-01 Statistics

Subheading (BIN-STAT)
Person in Charge Ahlers, Volker, Prof. Dr.
Language of Instruction German
Curriculum Allocation BIN, MDI
Course Type, Contact Hours per Week Lecture with exercise, 4 SWS
ECTS Credits 6
Contact Hours / Independent Study Hours 68 h / 112 h
Semester 2
Suggestions for Independent Study see literature
Recommended Prerequisites BIN-100 Mathematical Foundations of Computer Science (BIN-MAT1) or MDI-100 Mathematical Foundations of Computer Science (MDI-MAT1)
Examination Written or oral examination, experimental work

Learning Outcomes
Algorithmic and mathematical skills: Getting to know, using, comparing, and evaluating stochastic terms and methods for the description and analysis of large datasets. Interpretation and evaluation of results of stochastic methods and statistical analysis.
Interdisciplinary skills: Communicative skills (presentation and discussion of solution approaches).

Content
Fundamental terms and methods of probability theory and statistics, such as:
- Descriptive statistics: mean, standard deviation, median, quantile, histogram, regression and correlation analysis
- Combinatorics
- Probability theory: event, probability, Bayes' theorem, random variable, expectation value, variance, discrete and continuous distributions, fundamental theorem of statistics, limit theorems
- Pseudorandom numbers
- Inferential statistics: estimation, tests, significance levels, type I and type II errors The methods are practised using well-established statistics software.

Requirements for Contact Hours
Active participation, solving exercise problems

Requirements for Independent Study Hours
Preparation and review of the lectures, reading literature

Bibliography
Lecture notes
Sachs, M.: Wahrscheinlichkeitsrechnung und Statistik, Hanser
Teschl, G., Teschl, S.: Mathematik für Informatiker, Band 2, Springer
Module BIN-108 Programming 2

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<td>Examination (written or oral examination) and experimental work</td>
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</table>

**Learning Outcomes**

Algorithmic skills: analyze a specific problem and solve it algorithmically.
Analytical skills: ability to (semi-)formally describe an informally presented problem using a modeling language (UML)
Design skills: Turning UML models into executable programs, taking the basic rules of the software architecture into account
Realization skills: mastering the object-oriented programming paradigm, creating and testing programs using appropriate tools.
Submodule  BIN-108-01 Programming 2

Subheading  (BIN-PR2)
Person in Charge  Garmann, Robert, Prof. Dr.
Language of Instruction  German
Curriculum Allocation  BIN
Course Type, Contact Hours per Week  Lecture with exercise, 4 SWS
ECTS Credits  6
Contact Hours / Independent Study Hours  68 h / 112 h
Semester  1
Suggestions for Independent Study  see literature
Recommended Prerequisites  BIN-102 (BIN-PR1)
Examination  Examination (written or oral examination) and experimental work

Learning Outcomes
Algorithmic skills: analyze a specific problem and solve it algorithmically.
Analytical skills: ability to (semi-)formally describe an informally presented problem using a modeling language (UML)
Design skills: Turning UML models into executable programs, taking the basic rules of the software architecture into account
Realization skills: mastering the object-oriented programming paradigm, creating and testing programs using appropriate tools.

Content
Based on the principles learned in Programming 1 further concepts of object-oriented programming are presented. Specific topics include: inheritance and polymorphism, concurrent programming and the development of graphical user interfaces. In addition, the basic principles of object-oriented analysis and design are introduced based on the UML class diagram.

Requirements for Contact Hours
Active participation, working on exercises

Requirements for Independent Study Hours
Preparation and follow-up, working on exercises

Bibliography
Lecture notes
Reges, S., Stepp, M.: Building Java Programs, Prentice Hall
Module  BIN-109 Algorithms and Data Structures

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**Learning Outcomes**

Formal and algorithmic skills: Knowing expense estimates with the help of O notation and using them on algorithms, ability to compare algorithms with respect to their runtime, knowing and comparing good algorithms for important standard problems (e.g. sorting)

Analysis, design and realization skills: Knowing important linear and non-linear data structures and using them sensibly for a given problem, ability to know, compare and select different implementation variants for important data structures, ability to develop efficient data structures and algorithms for new problems, knowing and efficiently applying data structures from standard libraries
Submodule  BIN-109-01 Algorithms and Data Structures

Subheading  (BIN-DA)
Person in Charge  Kleiner, Carsten, Prof. Dr.
Language of Instruction  German
Curriculum Allocation  BIN, MDI
Course Type, Contact Hours per Week  Lecture with exercise, 4 SWS
ECTS Credits  6
Contact Hours / Independent Study Hours  68 h / 112 h
Semester  2
Suggestions for Independent Study  Work on slides and literature, reflection and self-contained application of content
Recommended Prerequisites  BIN-102 (BIN-PR1) or MDI-109 (MDI-PR1)
Examination  Written or oral examination, experimental work

Learning Outcomes
Formal and algorithmic skills: Knowing expense estimates with the help of O notation and using them on algorithms, ability to compare algorithms with respect to their runtime, knowing and comparing good algorithms for important standard problems (e.g. sorting)
Analysis, design and realization skills: Knowing important linear and non-linear data structures and using them sensibly for a given problem, ability to know, compare and select different implementation variants for important data structures, ability to develop efficient data structures and algorithms for new problems, knowing and efficiently applying data structures from standard libraries

Content
Basic knowledge of structured and efficient software development: analysis of algorithm efficiency, linear and non-linear data structures (lists, trees, heaps), sorting algorithms, paradigms of efficient algorithms

Requirements for Contact Hours
Lecture: Following presentations and examples, discussion, following executions and visualizations in learning software, reflection of content, self-contained application of subjects
Exercise: Self-contained work on problems on paper and by using learning software, theoretical problems, presentation of problem solutions and project results

Requirements for Independent Study Hours
Preparation and post-processing of lectures and exercises, self-contained work on problems, turning in homework in small groups, self-contained work on a project task in small groups, exam preparation, reading literature

Bibliography
T.H. Cormen, C.E. Leiserson, R.L. Rivest; Introduction to Algorithms; MIT Press
Module BIN-110 Programming 3

Subheading C/C++ (BIN-PR3)
Level of Module Basic module
Type of Module Compulsory module
Submodules BIN-110-01 Programming 3, Compulsory
Person in Charge Peine, Holger, Prof. Dr.
ECTS Credits 6
Contact Hours / Independent Study Hours 68 h / 112 h
Semester 3
Duration of Module 1 semester
Prerequisites none
Recommended Prerequisites BIN-102 Programming I (BIN-PR1)
BIN-108 Programming II (BIN-PR2)

Examination Written or oral exam, experimental work

Learning Outcomes
Technological skills: Students can use the tools gcc, g++ and make umgehen and understand compiler error
types.
Design, implementation and methodic skills: Students understand the C memory model and can solve typical
programming problems in C. Students have a good command of the core concepts of object orientation in C++
and can solve simple C++ programming problems.
Submodule BIN-110-01 Programming 3

Subheading (BIN-PR3)
Person in Charge Peine, Holger, Prof. Dr.
Language of Instruction German
Curriculum Allocation BIN
Course Type, Contact Hours per Week Lecture, 4 SWS
ECTS Credits 6
Contact Hours / Independent Study Hours 68 h / 112 h
Semester 3
Suggestions for Independent Study Siehe Literatur
Recommended Prerequisites BIN-102 Programming I (BIN-PR1)
BIN-108 Programming II (BIN-PR2)
Examination Written or oral exam, experimental work

Learning Outcomes
Technological skills: Students can use the tools gcc, g++ and make umgehen and understand compiler error messages
Design, implementation and methodic skills: Students understand the C meory model and can solve typical programming problems in C. Students have a good command of the core concepts of object orientation in C++ and can solve simple C++ programming problems.

Content
Structure and building of C programs
Control structures
Kontrollstrukturen
Data organisation
Pointers
Functions
Input/output
C++ vs. C
Reference types
Classes, constructors, destructors, object composition
Operators
Inheritance, polymorphism

Requirements for Contact Hours
Active participation, solving exercise problems

Requirements for Independent Study Hours
Preparation and postprocessing of the lectures, reading literature

Bibliography
Vogt, Carsten: C für Java Programmierer, Hanser 2007
C und C++ für Java-Programmierer, Regionales Rechenzentrum für Niedersachsen, Leibniz Universität Hannover
Wolf, Jürgen: C von A-Z, 2. Auflage, Galileo (as of now: Rheinwerk) 2006
Bruce Eckel: Thinking in C++, Prentice Hall
Module  BIN-111 Mathematics 3

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<td>BIN-100 Mathematical foundations of computer science (BIN-MAT1)</td>
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<tr>
<td>Examination</td>
<td>Written or oral examination, experimental work</td>
</tr>
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</table>

**Learning Outcomes**

- Formal and mathematical skills: knowing the concepts, algorithms and techniques of mathematical analysis and numerical mathematics that are required to understand mathematical statistics and applications in the fields of information systems and animation; being able to use the methods of analysis in other areas of applied computer science.
- General skills: acquiring communicative competence (presenting and discussing proposed solutions).
Submodule  BIN-111-01 Mathematics 3

Subheading  Calculus (BIN-MAT3)
Person in Charge  Pigors, Adrian, Prof. Dr.
Language of Instruction  German
Curriculum Allocation  BIN
Course Type, Contact Hours per Week  Lecture with exercise, 4 SWS
ECTS Credits  6
Contact Hours / Independent Study Hours  68 h / 112 h
Semester  3
Suggestions for Independent Study  See literature
Recommended Prerequisites  BIN-100 Mathematical foundations of computer science (BIN-MAT1)
Examination  Written or oral examination, experimental work

Learning Outcomes
Formal and mathematical skills: knowing the concepts, algorithms and techniques of mathematical analysis and numerical mathematics that are required to understand mathematical statistics and applications in the fields of information systems and animation; being able to use the methods of analysis in other areas of applied computer science.
General skills: acquiring communicative competence (presenting and discussing proposed solutions).

Content
Selected topics from the areas:
- differential calculus of one and several variables,
- integral calculus of one variable and
- function series, each with numerical methods and application examples. To illustrate the concepts and techniques, appropriate standard software is used.

Requirements for Contact Hours
Participating actively, solving exercise problems

Requirements for Independent Study Hours
Preparing and following up lectures, solving exercise problems, discussing material

Bibliography
Lecture notes
Teschl, G., Teschl, S.: Mathematik für Informatiker 1/2, Springer
Hartmann, P.: Mathematik für Informatiker, Vieweg
Brill, M.: Mathematik für Informatiker, Hanser
Locher, F.: Numerische Mathematik für Informatiker, Springer
Schwarz, H. R.: Numerische Mathematik, Teubner
Module  BIN-112 Operating Systems and Networks 1

Subheading  (BIN-BSN1)
Level of Module  Basic module
Type of Module  Compulsory module
Submodules  BIN-112-01  Operating Systems and Networks 1, Compulsory
Person in Charge  Hovestadt, Matthias, Prof. Dr.
ECTS Credits  6
Contact Hours / Independent Study Hours  68 h / 112 h
Semester  3
Duration of Module  1 semester
Prerequisites  none
Recommended Prerequisites  BIN-103 Fundamentals of Computer Science (BIN-GDI), BIN-102 Programming 1 (BIN-PR1), BIN-108 Programming 2 (BIN-PR2)
Examination  Written or oral examination, experimental work

Learning Outcomes
Technological skills: Students have knowledge on basics on architecture, structure and operation of operating systems and computer networks, particularly the concept of processes, file management and network layers.
Design, implementation and methodic skills: Students are able to analyze typical issues at the system level, generating appropriate programming based solutions. Students are able to work in a UNIX-based environment with a core set of UNIX commands.
Comprehensive: social skills (team work), transfer skills.
Submodule  BIN-112-01 Operating Systems and Networks 1

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<td>Semester</td>
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<td>Suggestions for Independent Study</td>
<td>Using a Linux-based environment for tasks on exercise sheets is highly recommended. Linux may be executed in a virtual machine, using any available virtualization platform.</td>
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</table>
| Recommended Prerequisites | BIN-103 Fundamentals of Computer Science (BIN-GDI), BIN-102 Programming 1 (BIN-PR1)  
BIN-108 Programming 2 (BIN-PR2)  
resp.  
MDI-103 Fundamentals of Computer Science (MDI-GDI), MDI-102 Programming 1 (MDI-PR1)  
MDI-109 Programming 2 (MDI-PR2) |
| Examination | Written or oral examination, experimental work |
| Learning Outcomes | Technological skills: Students have knowledge on basics on architecture, structure and operation of operating systems and computer networks, particularly the concept of processes, file management and network layers.  
Design, implementation and methodic skills: Students are able to analyze typical issues at the system level, generating appropriate programming based solutions. Students are able to work in a UNIX-based environment with a core set of UNIX commands.  
Comprehensive: social skills (team work), transfer skills. |
| Content | Fundamentals of modern operating systems, history of UNIX operating systems, using bash, interrupts, processes, file operation, network access, network layer model, physical layer, data link layer, network layer, transport layer |
| Requirements for Contact Hours | Active participation, solving exercise problems |
| Requirements for Independent Study Hours | Preparation and postprocessing of the lectures, reading literature |
| Bibliography | Helmut Herold: Linux- Unix Grundlagen. Kommandos und Konzepte, Addison-Wesley  
H. Herold: Linux- Unix- Systemprogrammierung, Addison-Wesley  
Tanenbaum, Andrew S.: Moderne Betriebssysteme, Pearson Studium |
Module  BIN-113 Database Systems 2

Subheading  (BIN-DBS2)
Level of Module  Specific module
Type of Module  Compulsory module
Submodules  BIN-113-01 Database Systems 2, Compulsory
Person in Charge  Koschel, Arne, Prof. Dr.
ECTS Credits  6
Contact Hours / Independent Study Hours  68 h / 112 h
Semester  3
Duration of Module  1 semester
Prerequisites  none
Recommended Prerequisites  BIN-106 (BIN-DBS1), BIN-108 Programming 2 (BIN-PR2)
Examination  Written or oral examination, experimental work

Learning Outcomes
Analytical skills: Ability to derive for a given application area requirements with respect to data access, ability to compare, evaluate and select DB access technologies based on the application, have knowledge of standard situations in the field of data access (pattern, Web and enterprise architectures).
Methodological skills: Transfer skills for existing data access technologies to introduce new IT methods into an IT infrastructure that has often evolved over time.
Technological skills: Understanding for the concepts and functioning of: DBS programming, O/R mapping, persistence frameworks, DBS transactions.
Submodule  BIN-113-01 Database Systems 2

Subheading (BIN-DBS2, MDI-DBS2)

Person in Charge Koschel, Arne, Prof. Dr.

Language of Instruction German

Curriculum Allocation BIN, MDI

Course Type, Contact Hours per Week Lecture with exercise, 4 SWS

ECTS Credits 6

Contact Hours / Independent Study Hours 68 h / 112 h

Semester 3

Suggestions for Independent Study See literature

Recommended Prerequisites BIN-106 (BIN-DBS1), BIN-108 (BIN-PR2) or MDI-107 (MDI-DBS1), MDI-109 (MDI-PR2)

Examination Written or oral examination, experimental work

Learning Outcomes
Analytical skills: Ability to derive for a given application area requirements with respect to data access, ability to compare, evaluate and select DB access technologies based on the application, have knowledge of standard situations in the field of data access (pattern, Web and enterprise architectures).
Methodological skills: Transfer skills for existing data access technologies to introduce new IT methods into an IT infrastructure that has often evolved over time.
Technological skills: Understanding for the concepts and functioning of: DBS programming, O/R mapping, persistence frameworks, DBS transactions

Content
Data access and data management in software and/or information systems - concepts, technologies, architectures, evaluation. Topics include:
- DB-internal programming (stored procedures, trigger)
- Relational DB integration (static, dynamic) client-DB server
- Persistence frameworks. O/R mapping
- DBS transactions
- potentially selected additional advanced topics in DBS such as Key Value stores or embedded OO-DBS

Requirements for Contact Hours
Active participation, solving exercise problems

Requirements for Independent Study Hours
Preparation and postprocessing of the lectures, reading literature

Bibliography
Lecture notes (script)
Kudraß, T. (Hrsg.): Taschenbuch Datenbanken, Hanser, newest release.
Current (Web) sources , for example, about the Java Persistence API.
Module  BIN-114 Programming Project

Subheading                  (BIN-PP)
Level of Module             Basic module
Type of Module              Compulsory module
Submodules                  BIN-114-01  Programming Project, Compulsory
Person in Charge            Dunkel, Jürgen, Prof. Dr.
ECTS Credits                4
Contact Hours / Independent Study Hours  68 h / 52 h
Semester                    3
Duration of Module          1 semester
Prerequisites               none
Recommended Prerequisites   BIN-102 (BIN-PR1), BIN-108 (BIN-PR2)
Examination                 experimental work

Learning Outcomes
Design and realization skills: Using technical knowledge acquired to solve a problem; creating and testing a larger software program in the team
Project management skills: Ability to organize and guide projects
Social skills: Teamwork, communication, practicing presentations
**Submodule BIN-114-01 Programming Project**

<table>
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<td><strong>Examination</strong></td>
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**Learning Outcomes**
- Design and realization skills: Using technical knowledge acquired to solve a problem; creating and testing a larger software program in the team
- Project management skills: Ability to organize and guide projects
- Social skills: Teamwork, communication, practicing presentations.

**Content**
- Developing a software system to a specific problem. Preparing the project by literature research.
- Project planning, design, implementation and documentation.

**Requirements for Contact Hours**
- active involvement in the project, also organizational roles

**Requirements for Independent Study Hours**
- implementation of specific project tasks: e.g. design, programming, testing, documentation

**Bibliography**
- project specific
Module  BIN-115 Business Administration

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<td>Examination</td>
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**Learning Outcomes**

Students have a basic understanding of an entrepreneur's economic challenges. Students have a good command of business definitions and are able to use them selectively. They can create an advance turnover tax return, maintain a simple bookkeeping as well as analyze a simple annual financial statement.
Submodule BIN-115-01 Business Administration

Subheading (BIN-BW)
Person in Charge Peine, Holger, Prof. Dr.
Language of Instruction German
Curriculum Allocation BIN, MDI
Course Type, Contact Hours per Week Lecture, 2 SWS
ECTS Credits 2
Contact Hours / Independent Study Hours 17 h / 34 h
Semester 3
Suggestions for Independent Study See literature
Recommended Prerequisites none
Examination Written or oral exam, experimental work

Learning Outcomes
Students have a basic understanding of an entrepreneur’s economic challenges. Students have a good command of business definitions and are able to use them selectively. They can create an advance turnover tax return, maintain a simple bookkeeping as well as analyze a simple annual financial statement.

Content
Business goals, legal forms of companies, tax law, financial reporting, company organization, operating process, operational cost structure, management accounting, operational cost and activity accounting.

Requirements for Contact Hours
Active participation, solving exercise problems

Requirements for Independent Study Hours
Preparation and postprocessing of the lectures, reading literature

Bibliography
1) Einführung in die Allgemeine Betriebswirtschaftslehre, 4. September 2013 von Günter Wöhe und Ulrich Döringmax
2) Grundzüge der Betriebswirtschaftslehre, 22. August 2012 von Henner Schierenbeck und Claudia B Wöhle
4) Praxisleitfaden Steuerrecht für Existenzgründer von Karin Nickening (erscheint voraussichtlich Aug./Sept. 2015, Springer-Verlag)
5) Vorlesungsskript für internes und externes Rechnungswesen, Mai 2015
Module BIN-116 English

Subheading (BIN-EN)

Level of Module Basic module

Type of Module Compulsory module

Submodules BIN-116-01 English, Compulsory

Person in Charge Peine, Holger, Prof. Dr.

ECTS Credits 2

Contact Hours / Independent Study Hours 17 h / 43 h

Semester 1

Duration of Module 1 semester

Prerequisites none

Recommended Prerequisites none

Examination Written or oral exam, experimental work

Learning Outcomes
Extension of basic subject vocabulary and of general word power. Acquiring knowledge of creating subject-specific texts in English. Discussion and presentation skills. Subject-specific presentation.
## Submodule BIN-116-01 English

<table>
<thead>
<tr>
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<th>(BIN-EN)</th>
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<tbody>
<tr>
<td>Person in Charge</td>
<td>Peine, Holger, Prof. Dr.</td>
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<tr>
<td>Language of Instruction</td>
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<td>Written or oral exam, experimental work</td>
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</table>

### Learning Outcomes
Extension of basic subject vocabulary and of general word power. Acquiring knowledge of creating subject-specific texts in English. Discussion and presentation skills. Subject-specific presentation.

### Content
Working through the chapters of the employed literature including learning of subject-specific vocabulary, discussion of grammar issues with corresponding exercises, discussion of subject-specific and general issues like software development, customer care, dealing with customers and complaints, after sales service, business travel and business dinners, small talk, presentations.

### Requirements for Contact Hours
Active participation, solving exercise problems

### Requirements for Independent Study Hours
Preparation and postprocessing of the sessions, reading literature

### Bibliography
- English for IT Professionals, Cornelsen Verlag
- In Company, MacMillan Verlag
- Log On - English for IT Professions, Hueber Verlag
Module BIN-200 Computer Graphics 1

Subheading (BIN-CG1)
Level of Module Basic module
Type of Module Compulsory module
Submodules BIN-200-01 Computer Graphics 1, Compulsory
Person in Charge Sprengel, Frauke, Prof. Dr.
ECTS Credits 6
Contact Hours / Independent Study Hours 68 h / 112 h
Semester 4
Duration of Module 1 semester
Prerequisites All module examinations from 1st semester
Recommended Prerequisites Mathematics 1-3, programming 1-3
Examination Examination (written or oral examination) and experimental work

Learning Outcomes
Mathematical, algorithmic, interdisciplinary skills: Knowledge of the basic mathematical-geometrical and physical principles of rendering and lighting objects in space and the practical application of this knowledge. Analysis, design and realization skills: Application of the skills acquired in smaller projects using a graphics library
Submodule  BIN-200-01 Computer Graphics 1

Subheading (BIN-CG1)

Person in Charge Sprengel, Frauke, Prof. Dr.

Language of Instruction German

Curriculum Allocation BIN

Course Type, Contact Hours per Week Lecture with exercise, 4 SWS

ECTS Credits 6

Contact Hours / Independent Study Hours 68 h / 112 h

Semester 4

Suggestions for Independent Study see literature

Recommended Prerequisites BIN-100 Mathematical foundations of computer science (BIN-MAT1)
BIN-105 Linear Algebra and Analytic Geometry (BIN-MAT2)
BIN-111 Calculus (BIN-MAT3)
BIN-102 Programming I (BIN-PR1)
BIN-108 Programming II (BIN-PR2)
BIN-110 Programming III (BIN-PR3)

Examination Examination (written or oral examination) and experimental work

Learning Outcomes
Mathematical, algorithmic, interdisciplinary skills: Knowledge of the basic mathematical-geometrical and physical principles of rendering and lighting objects in space and the practical application of this knowledge. Analysis, design and realization skills: Application of the skills acquired in smaller projects using a graphics library

Content
Basic principles, affine transformations and perspective projection in descriptive geometry, curves and areas, visibility, transparency, lighting models, introduction to a standard 3D library, programming examples

Requirements for Contact Hours
Active participation, individual task-solving in small groups, discussion

Requirements for Independent Study Hours
Preparation and postprocessing of the lectures, reading literature, individual or group task-solving, individual discussion

Bibliography
Lecture notes
Alan Watt: 3D-Computergraphik, Pearson Studium
Alfred Nischwitz, Peter Haberacker: Computergraphik und Bildverarbeitung, Vieweg
Module BIN-201 Software Engineering 1

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<td>Programming 1-3, databases 1, programming project</td>
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<tr>
<td>Examination</td>
<td>Examination (written or oral examination) and experimental work</td>
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</table>

**Learning Outcomes**

Analytical skills: Ability to familiarize oneself in an area of application, extract requirements, record, structure and model a complex domain, knowledge of standard situations in the field of modeling (pattern, architecture).

Design skills: Ability to derive a system concept from requirements (from the knowledge of standard architectures), transfer a system concept into a productively functional implementation, understanding quality control as an integral element of the development project.

Interdisciplinary skills: Setting up and implementing projects, social skills (teamwork), transfer skills, independent processing of new methods.
Submodule BIN-201-01 Software Engineering 1

Subheading (BIN-SE1)
Person in Charge Bruns, Ralf, Prof. Dr.
Language of Instruction German
Curriculum Allocation BIN, MDI
Course Type, Contact Hours per Week Lecture with exercise, 4 SWS
ECTS Credits 6
Contact Hours / Independent Study Hours 68 h / 112 h
Semester 4
Suggestions for Independent Study See literature
Recommended Prerequisites Programming 1-3, databases 1, programming project
Examination Examination (written or oral examination) and experimental work

Learning Outcomes
Analytical skills: Ability to familiarize oneself in an area of application, extract requirements, record, structure and model a complex domain, knowledge of standard situations in the field of modeling (pattern, architecture)
Design skills: Ability to derive a system concept from requirements (from the knowledge of standard architectures), transfer a system concept into a productively functional implementation, understanding quality control as an integral element of the development project
Interdisciplinary skills: Setting up and implementing projects, social skills (teamwork), transfer skills, independent processing of new methods

Content
Software development models, processes and methods to develop large-scale software systems, patterns. The different phases and work steps are presented in detail for a standard software development process. This means
- the basic principles, results and procedure are dealt with for each phase of the software development,
- modeling (with UML) is practiced in the project context,
- an introduction to analysis, design and architecture patterns, and
- basic methods for quality control are presented.

Requirements for Contact Hours
Active participation, solving exercises

Requirements for Independent Study Hours
Pre- and post-preparation of the content

Bibliography
Grechenig, T., Bernhart, M., Breiteneder, R., Kappel, K.: Softwaretechnik, Pearson Studium.
Gamma, E. R., Helm, R. Johnson, J. Vlissides: Design Patterns, Reading, MA, Addison Wesley.
Module BIN-202 Operating Systems and Networks 2

Subheading (BIN-BSN2)
Level of Module Basic module
Type of Module Compulsory module
Submodules BIN-202-01 Operating Systems and Networks 2, Compulsory
Person in Charge Hovestadt, Matthias, Prof. Dr.
ECTS Credits 6
Contact Hours / Independent Study Hours 68 h / 112 h
Semester 4
Duration of Module 1 semester
Prerequisites All module examinations from 1st semester.
Recommended Prerequisites BIN-103 Fundamentals of Computer Science (BIN-GDI), BIN-102 Programming 1 (BIN-PR1), BIN-108 Programming 2 (BIN-PR2), BIN-112 Operating Systems and Networks I (BIN-BSN1)

Examination Written or oral examination, experimental work

Learning Outcomes
Technological skills: Students have advanced knowledge on computer networks, particularly dynamic routing protocols and IPv6. Students also have advanced knowledge on operating systems including parallel computing and signals.
Design, implementation and methodic skills: Students are able to analyze typical issues at system level, generating appropriate programming based solutions. Students are able to work in a UNIX-based environment with a core set of UNIX commands.
Comprehensive: social skills (team work), transfer skills.
Submodule  BIN-202-01 Operating Systems and Networks 2

Subheading  (BIN-BSN2)
Person in Charge  Hovestadt, Matthias, Prof. Dr.
Language of Instruction  German
Curriculum Allocation  BIN, MDI
Course Type, Contact Hours per Week  Lecture with exercise, 4 SWS
ECTS Credits  6
Contact Hours / Independent Study Hours  68 h / 112 h
Semester  4
Suggestions for Independent Study  Using a Linux-based environment for tasks on exercise sheets is highly recommended. Linux may be executed in a virtual machine, using any available virtualization platform.
Recommended Prerequisites  BIN-103 Fundamentals of Computer Science (BIN-GDI), BIN-102 Programming 1 (BIN-PR1)
BIN-108 Programming 2 (BIN-PR2), BIN-112 Operating Systems and Networks I (BIN-BSN1) resp.
MDI-103 Fundamentals of Computer Science (MDI-GDI), MDI-102 Programming 1 (MDI-PR1)
MDI-109 Programming 2 (MDI-PR2), MDI-114 Operating Systems and Networks I (MDI-BSN1)
Examination  Written or oral examination, experimental work

Learning Outcomes  Technological skills: Students have advanced knowledge on computer networks, particularly dynamic routing protocols and IPv6. Students also have advanced knowledge on operating systems including parallel computing and signals.
Design, implementation and methodic skills: Students are able to analyze typical issues at system level, generating appropriate programming based solutions. Students are able to work in a UNIX-based environment with a core set of UNIX commands.
Comprehensive: social skills (team work), transfer skills.

Content  File programming, forking of processes, threads, inter-process communication, signals, network programing, routing algorithms, IPv6, network security

Requirements for Contact Hours  Active participation, solving exercise problems

Requirements for Independent Study Hours  Preparation and postprocessing of the lectures, reading literature

Bibliography  Helmut Herold: Linux- Unix Grundlagen. Kommandos und Konzepte, Addison-Wesley
H. Herold: Linux- Unix- Systemprogrammierung, Addison-Wesley
Tanenbaum, Andrew S.: Moderne Betriebssysteme, Pearson Studium
Module BIN-203 Web Technologies

Subheading (BIN-WT)

Level of Module Basic module

Type of Module Compulsory module

Submodules BIN-203-01 Web Technologies, Compulsory

Person in Charge Dunkel, Jürgen, Prof. Dr.

ECTS Credits 6

Contact Hours / Independent Study Hours 68 h / 112 h

Semester 4

Duration of Module 1 semester

Prerequisites BIN-108 Programming II (BIN-PR2)
Operatings systems and networks.

Recommended Prerequisites BIN-102 Programming I (BIN-PR1),
BIN-108 Programming II (BIN-PR2)
BIN-110 Programming III (BIN-PR3)
BIN-112 Operating systems and networks 1 (BIN-BSN1)

Examination Examination (written or oral examination) and experimental work

Learning Outcomes

Technological skills: knowledge about the essential components of websystems, in particular how they interact using specific protocols
Design skills: ability to design of websystems taking user ergonomics into account.
Choosing and applying an appropriate software architecture.
Realization skills: implementation of websystems applying current technologies.
Submodule BIN-203-01 Web Technologies

Subheading (BIN-WT)
Person in Charge Dunkel, Jürgen, Prof. Dr.
Language of Instruction German
Curriculum Allocation BIN, MDI
Course Type, Contact Hours per Week Lecture with exercise, 4 SWS
ECTS Credits 6
Contact Hours / Independent Study Hours 68 h / 112 h
Semester 4
Suggestions for Independent Study see literature
Recommended Prerequisites BIN-102 Programming I (BIN-PR1),
      BIN-108 Programming II (BIN-PR2)
      BIN-110 Programming III (BIN-PR3)
      BIN-112 Operating systems and networks 1 (BIN-BSN1)
Examination Examination (written or oral examination) and experimental work

Learning Outcomes
Technological skills: knowledge about the essential components of websystems, in particular how they interact using specific protocols
Design skills: ability to design of websystems taking user ergonomics into account.
Choosing and applying an appropriate software architecture.
Realization skills: implementation of websystems applying current technologies.

Content
Basic concepts and technologies of websystems.
- websystem architecture and network protocols (HTTP)
- markup languages (HTML, CSS, XML, JSON)
- Responsive design
- Serverside technologies (e.g. servlets, JSPs, PHP, ..)
- clientside technologies (JavaScript, Ajax)
- selected frameworks (bspw. JSF, Angular, ..)
- web project

Requirements for Contact Hours
Active participation, solving exercises, project work

Requirements for Independent Study Hours
Pre- and post-preparation of the content

Bibliography
A. Tannebaum: Computernetzwerke, Pearson.
P. Müller: Webseiten gestalten mit HTML und CSS, galileo.
A. Ertel, K. Laborenz: Responsive Web Design
M. Kurz: JavaServer Faces, dpunkt.
C. Wentz: JavaScript, galileo.
further literature to special topics
Module BIN-204 Seminar

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<td>Submodules</td>
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<td>Recommended Prerequisites</td>
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<td>Examination</td>
<td>Term paper, presentation, compulsory attendance</td>
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**Learning Outcomes**

Computer science competencies: Students deepen the contents of some modules of semesters 1, 2, and 3 or complete it. By working with literature and working on new topics students increase their analytical competencies and technological competencies. Social competencies: Students learn to work with literature on their own. They can present scientific contents written and orally. They use correct language and present convincingly. In discussions they learn to critically reflect the contents of the seminar.
Submodule BIN-204-01 Seminar

Subheading (BIN-BSEM)

Person in Charge Wohlfeil, Stefan, Prof. Dr.

Language of Instruction German

Curriculum Allocation BIN, MDI

Course Type, Contact Hours per Week Seminar, 4 SWS

ECTS Credits 4

Contact Hours / Independent Study Hours 34 h / 86 h

Suggestions for Independent Study

Recommended Prerequisites All modules of semesters 1, 2, and 3

Examination Term paper, presentation, compulsory attendance

Learning Outcomes

Computer science competencies: Students deepen the contents of some modules of semesters 1, 2, and 3 or complete it. By working with literature and working on new topics students increase their analytical competencies and technological competencies. Social competencies: Students learn to work with literature on their own. They can present scientific contents written and orally. They use correct language and present convincingly. In discussions they learn to critically reflect the contents of the seminar.

Content

Requirements for Contact Hours
Give presentation about assigned topic. Listen to all other presentations. Ask questions and participate in discussions. (compulsory attendance)

Requirements for Independent Study Hours
Search literature about assigned topic using the library and the Digital Libraries of ACM, IEEE. Prepare a presentation about the topic and write a paper (report) about it.

Bibliography
Module BIN-205 Software Engineering 2

Subheading (BIN-SE2)

Level of Module Basic module

Type of Module Compulsory module

Submodules BIN-205-01 Software Engineering 2, Compulsory

Person in Charge Bruns, Ralf, Prof. Dr.

ECTS Credits 6

Contact Hours / Independent Study Hours 68 h / 112 h

Semester 5

Duration of Module 1 semester

Prerequisites All module examinations from 1st and 2nd semester

Recommended Prerequisites Software Engineering 1

Examination Examination (written or oral examination) and experimental work

Learning Outcomes

Project management skills: Ability to plan, manage and control projects; knowing and being able to evaluate basic economic conditions and their effects; understanding HR management as a success factor

Design skills: Ability to transfer a system concept into a productively functional implementation, understanding quality assurance and usability engineering as integral elements in the development project

Technological skills: Sound knowledge in the selected subject area of software technology

Interdisciplinary skills: Setting up and implementing projects, social skills (teamwork), transfer skills, independent processing of new methods, conflict management
Submodule BIN-205-01 Software Engineering 2

Subheading (BIN-SE2)

Person in Charge Bruns, Ralf, Prof. Dr.

Language of Instruction German

Curriculum Allocation BIN, MDI

Course Type, Contact Hours per Week Lecture with exercise, 4 SWS

ECTS Credits 6

Contact Hours / Independent Study Hours 68 h / 112 h

Semester 5

Suggestions for Independent Study See literature

Recommended Prerequisites Software Engineering 1

Examination Examination (written or oral examination) and experimental work

Learning Outcomes
Project management skills: Ability to plan, manage and control projects; knowing and being able to evaluate basic economic conditions and their effects; understanding HR management as a success factor

Design skills: Ability to transfer a system concept into a productively functional implementation, understanding quality assurance and usability engineering as integral elements in the development project

Technological skills: Sound knowledge in the selected subject area of software technology

Interdisciplinary skills: Setting up and implementing projects, social skills (teamwork), transfer skills, independent processing of new methods, conflict management

Content
Advanced design patterns, classical and agile software development processes, project management, quality management, usability engineering, other selected topics in the field of software technology

Requirements for Contact Hours
Active participation, solving exercises

Requirements for Independent Study Hours
Pre- and post-preparation of the content

Bibliography
Grechenig, T., Bernhart, M., Breiteneder, R., Kappel, K.: Softwaretechnik, Pearson Studium.
Gamma, E. R., Helm, R. Johnson, J. Vlissides: Design Patterns, Reading, MA, Addison Wesley.
Balzert, H.: Lehrbuch der Softwaretechnik, Spektrum Akademischer Verlag
**Module BIN-206 Practical Project 1**

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<td>Submodules</td>
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<td>Examination</td>
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**Learning Outcomes**

Analytical skills: Ability to independently analyze a given question using scientific methods and findings, ability to familiarize oneself with problems in different areas of application

Design/realization skills: Developing solution strategies and implementing them using the knowledge and skills acquired

Technological skills: Combining and specifically applying knowledge from different fields

Methodological skills: Ability to use different innovative methods to solve practical problems

Project management skills: Skills required for project planning, to set up an organizational structure and to steer projects

Social skills: Application of conflict-solving strategies, teamwork, communication
Submodule BIN-206-01 Practical Project 1

Person in Charge  
Bruns, Ralf, Prof. Dr.

Language of Instruction  
German

Curriculum Allocation  
BIN

Course Type, Contact Hours per Week  
Project, 8 SWS

ECTS Credits  
10

Contact Hours / Independent Study Hours  
300 h / 0 h

Semester  
5

Suggestions for Independent Study  
Specific to project

Recommended Prerequisites  
Specific to project

Examination  
Experimental work

Learning Outcomes
Analytical skills: Ability to independently analyze a given question using scientific methods and findings, ability to familiarize oneself with problems in different areas of application
Design/realization skills: Developing solution strategies and implementing them using the knowledge and skills acquired
Technological skills: Combining and specifically applying knowledge from different fields
Methodological skills: Ability to use different innovative methods to solve practical problems
Project management skills: Skills required for project planning, to set up an organizational structure and to steer projects
Social skills: Application of conflict-solving strategies, teamwork, communication

Content
Working through a complex task in a practical field of application in a project group. The work is characterized by the project-specific organization, planning and execution. The project duration is usually two semesters.

Requirements for Contact Hours
Active participation in project

Requirements for Independent Study Hours
Solve tasks independently

Bibliography
Specific to project
Module  BIN-207 Computer Graphics 2

Subheading  Digital Image Processing (BIN-CG2)
Level of Module  Basic module
Type of Module  Compulsory module
Submodules  BIN-207-01  Computer Graphics 2, Compulsory
Person in Charge  Ginkel, Ingo, Prof. Dr.
ECTS Credits  6
Contact Hours / Independent Study Hours  68 h / 112 h
Semester  5
Duration of Module  1 semester
Prerequisites  All module examinations from 1st to 2nd semester
Recommended Prerequisites  BIN-100 / BIN-105 / BIN-111
(Mathematics 1/2/3)
BIN-107 (Statistics)
BIN-200 (Computer Graphics 1)
Examination  Written or oral examination, experimental work

Learning Outcomes
Algorithmic and mathematic competence: understanding basic algorithms of digital image processing.
Design competence: Selection and application of suitable methods for image enhancement in varying application scenarios and their realisation in hard- and software.
Interdisciplinary competence based on theoretical and practical experience gained by application of digital image processing methods in different applications.
Social competences: Teamwork, presentation and discussion of proposed solutions for selected exercises.
Submodule BIN-207-01 Computer Graphics 2

Subheading          Digital Image Processing (BIN-CG2)
Person in Charge    Ginkel, Ingo, Prof.Dr.
Language of Instruction    German
Curriculum Allocation  BIN
Course Type, Contact Hours per Week    Lecture with exercise, 4 SWS
ECTS Credits          6
Contact Hours / Independent Study Hours 68 h / 112 h
Semester              5
Suggestions for Independent Study    See Literature
Recommended Prerequisites  BIN-100 / BIN-105 / BIN-111
(Mathematics 1/2/3)
BIN-107 (Statistics)
BIN-200 (Computer Graphics 1)
Examination            Written or oral exam, experimental work

Learning Outcomes
Algorithmic and mathematic competence: understanding basic algorithms of digital image processing.
Design competence: Selection and application of suitable methods for image enhancement in varying
application scenarios and their realisation in hard- and software.
Interdisciplinary competence based on theoretical and practical experience gained by application of digital
image processing methods in difference applications.
Social competences: Teamwork, presentation and discussion of proposed solutions for selected exercises.

Content
basic knowledge of internal structure and operation principle of digital image processing systems in
practical applications,
Basic concepts of digital images and their representation in position space and frequency domain,
color models and color management, methods for image enhancement in position space and frequency
domain,
simple image segmentation algorithms
implementation of image processing algorithms

Requirements for Contact Hours
Active participation, solving exercises

Requirements for Independent Study Hours
preparation and postprocessiong of the lecture

Bibliography
lecure slides,
Burger, w., Burge, M.J.: Digitale Bildverarbeitung, x.media.press, Springer Verlag
Module  BIN-208 Practical Project 2

Level of Module  Specific module
Type of Module  Compulsory module
Submodules  BIN-208-01  Practical Project 2, Compulsory
Person in Charge  Bruns, Ralf, Prof. Dr.
ECTS Credits  7
Contact Hours / Independent Study  210 h / 0 h
Semester  6
Duration of Module  1 semester
Prerequisites  All module examinations from 1st to 3rd semester
Recommended Prerequisites  Specific to project
Examination  Experimental work

Learning Outcomes
Analytical skills: Ability to independently analyze a given question using scientific methods and findings, ability to familiarize oneself with problems in different areas of application
Design/realization skills: Developing solution strategies and implementing them using the knowledge and skills acquired
Technological skills: Combining and specifically applying knowledge from different fields
Methodological skills: Ability to use different innovative methods to solve practical problems
Project management skills: Skills required for project planning, to set up an organizational structure and to steer projects
Social skills: Application of conflict-solving strategies, teamwork, communication
Submodule  BIN-208-01 Practical Project 2

Person in Charge  Bruns, Ralf, Prof. Dr.
Language of Instruction  German
Curriculum Allocation  BIN
Course Type, Contact Hours per Week  Project, 6 SWS
ECTS Credits  7
Contact Hours / Independent Study Hours  210 h / 0 h
Semester  6
Suggestions for Independent Study  Specific to project
Recommended Prerequisites  Specific to project
Examination  Experimental work

Learning Outcomes
Analytical skills: Ability to independently analyze a given question using scientific methods and findings, ability to familiarize oneself with problems in different areas of application
Design/realization skills: Developing solution strategies and implementing them using the knowledge and skills acquired
Technological skills: Combining and specifically applying knowledge from different fields
Methodological skills: Ability to use different innovative methods to solve practical problems
Project management skills: Skills required for project planning, to set up an organizational structure and to steer projects
Social skills: Application of conflict-solving strategies, teamwork, communication

Content
Continuation of the Practical Project 1 module from the previous semester

Requirements for Contact Hours
Active participation in project

Requirements for Independent Study Hours
Solve tasks independently

Bibliography
Specific to project
Module BIN-209 Special Topics

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<td>Person in Charge</td>
<td>Hovestadt, Matthias, Prof. Dr.</td>
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<tr>
<td>Examination</td>
<td>Written or oral examination, presentation, experimental work</td>
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Learning Outcomes
Students broaden their knowledge by building competencies in a general subject. (Varying courses are offered resp. can be accepted; three courses must be chosen, one of them being a course in business administration)
Module BIN-210 Bachelor Thesis with Colloquium

<table>
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<th>Subheading</th>
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<tr>
<td>Person in Charge</td>
<td>Kleiner, Carsten, Prof. Dr.</td>
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<td>Duration of Module</td>
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<td>Prerequisites</td>
<td>All modules of semesters 1 to 3 of BIN programme; at least 134 CP in BIN programme</td>
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<td>Recommended Prerequisites</td>
<td>All modules of semesters 4 and 5 in the chosen specialization, BIN-204 (BIN-BSEM), BIN-206 (BIN-BPR1)</td>
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<tr>
<td>Examination</td>
<td>Written thesis, colloquium</td>
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</table>

**Learning Outcomes**

- Analysis, design and realization skills: Ability to independently analyze and use scientific methods to treat a topic area from the group of subjects selected, conceiving and realizing solutions
- Technological skills: Ability to select technologies from the chosen subject area and use them to solve the problem at hand
- Interdisciplinary skills: The topic selected may be worked through in cooperation with an industrial company; the conditions in that company are to be included in the solution
- Methodological skills: Developing state-of-the-art knowledge on the topic chosen using scientific methods, ability to adapt and expand known solutions for the given topic
- Project management skills: Ability to complete the task in the time given, planning of the delegation of tasks required and keeping to the time schedule, employing self organization and meeting deadlines
- Personal skills: Ability to properly present the topic selected along with the solution developed, ability to answer specific questions on the topic, ability to discuss and assess alternative solutions
Submodule BIN-210-01 Bachelor Thesis with Colloquium

Subheading (BIN-BAA)
Person in Charge Kleiner, Carsten, Prof. Dr.
Language of Instruction by agreement
Curriculum Allocation BIN
Course Type, Contact Hours per Week Final Thesis
ECTS Credits 15
Contact Hours / Independent Study Hours 0 h / 450 h
Semester 6
Suggestions for Independent Study Scientific treatment of the individual topic, parallel work on subjects and thesis document, regular meetings and discussion of work with supervisor
Recommended Prerequisites All modules of semesters 4 and 5 in the chosen specialization, BIN-204 (BIN-BSEM), BIN-206 (BIN-BPR1)
Examination Written thesis, colloquium

Learning Outcomes
Analysis, design and realization skills: Ability to independently analyze and use scientific methods to treat a topic area from the group of subjects selected, conceiving and realizing solutions
Technological skills: Ability to select technologies from the chosen subject area and use them to solve the problem at hand
Interdisciplinary skills: The topic selected may be worked through in cooperation with an industrial company; the conditions in that company are to be included in the solution
Methodological skills: Developing state-of-the-art knowledge on the topic chosen using scientific methods, ability to adapt and expand known solutions for the given topic
Project management skills: Ability to complete the task in the time given, planning of the delegation of tasks required and keeping to the time schedule, employing self organization and meeting deadlines
Personal skills: Ability to properly present the topic selected along with the solution developed, ability to answer specific questions on the topic, ability to discuss and assess alternative solutions

Content
Self-contained work on an individual topic from applied computer science, preparation of a written thesis document, oral presentation and critical discussion of results; the topic should be selected in close cooperation with external enterprises

Requirements for Contact Hours
None

Requirements for Independent Study Hours
Self-contained scientific work, writing a thesis document, preparation and execution of a presentation

Bibliography
Depends on specific topic
Module  BIN-211 Computer Graphics 3

Subheading            Animation (BIN-CG3)
Level of Module       Specific module
Type of Module        Optional module
Submodules            BIN-211-01   Computer Graphics 3, Compulsory
Person in Charge      Ginkel, Ingo, Prof. Dr.
ECTS Credits          6
Contact Hours / Independent Study Hours  68 h / 112 h
Semester              5
Duration of Module    1 semester
Prerequisites         All module examinations from 1st to 2nd semester
Recommended Prerequisites  BIN-200 (Computer Graphics 1)
Examination           Written or oral examination, experimental work

Learning Outcomes
Algorithmic and mathematic competence: Exploring, using, evaluating and comparing methods and techniques for computer-based animation and simulation. Implementation and practical evaluation of different methods.
Communicative competence: Presentation and discussion of proposed solutions
Submodule  BIN-211-01 Computer Graphics 3

Subheading  Animation (BIN-CG3)
Person in Charge  Ginkel, Ingo, Prof.Dr.
Language of Instruction  by agreement
Curriculum Allocation  BIN, MDI
Course Type, Contact Hours per Week  Lecture with exercise, 4 SWS
ECTS Credits  6
Contact Hours / Independent Study Hours  68 h / 112 h
Semester  5
Suggestions for Independent Study  See Literature
Recommended Prerequisites  BIN-200 Computer Graphics 1 (BIN-CG1)
Examination  Written or oral exam, experimental work

Learning Outcomes
Algorithmic and mathematic competence: Exploring, using, evaluating and comparing methods and techniques for computer-based animation and simulation. Implementation and practical evaluation of different methods.
Communicative competence: Presentation and discussion of proposed solutions

Content
Principles of Computer Animation, Description of trajectories for camera movement using splines, Orientation in space and interpolation using quaternions, physically based animation using particle systems, mass-spring-systems, bounding boxes and space partitioning techniques, hierarchical animation, kinematic chains

Requirements for Contact Hours
Active participation, solving exercises

Requirements for Independent Study Hours
preparation and postprocessing of the lecture

Bibliography
lecture slides,
Ericson,C.: Real-Time Collision Detection, Elsevier
Witkin,A.: Physically Based Modeling - Principles and Practice, Siggraph Course Notes
Module  BIN-212 Software Engineering 3

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**Learning Outcomes**
Technological skills: Having an understanding of the way in which distributed systems and applications work
Design skills: Knowing and being able to apply the basic construction principles of complex software architectures. Using suitable design patterns to develop distributed systems
Realization skills: Ability to configure and use complex infrastructures
Submodule BIN-212-01 Software Engineering 3

Subheading (BIN-SE3)

Person in Charge Koschel, Arne, Prof. Dr.

Language of Instruction by agreement

Curriculum Allocation BIN, MDI

Course Type, Contact Hours per Week Lecture, 4 SWS

ECTS Credits 6

Contact Hours / Independent Study Hours 68 h / 112 h

Suggestions for Independent Study See literature

Recommended Prerequisites BIN-201 (BIN-SE1), BIN-203 (BIN-WT)
or MDI-201 (MDI-SE1), MDI-203 (MDI-WT)

Examination Written or oral examination, experimental work

Learning Outcomes
- Technological skills: Having an understanding of the way in which distributed systems work, for example, distributed component based systems.
- Design skills: Knowing and being able to apply the basic construction principles of complex software architectures. Using suitable design patterns to develop distributed systems.
- Realization skills: Ability to configure and use complex infrastructures.

Content
- Basic concepts of software architectures, particularly for the development of distributed systems.
- The development of frameworks is presented on the basis of a simple persistence framework.
- Basic concepts of distributed systems, distributed software architectures, multi-layer architecture, middleware.
- Implementation of distributed systems: sockets, RMI, MoM, Web services.
- Architecture and development of Internet-based systems: Java EE (JSPs, EJBs etc.)
- Potentially selected additional current topics in distributed systems.

Requirements for Contact Hours
Active participation, solving exercise problems

Requirements for Independent Study Hours
Preparation and postprocessing of the lectures, reading literature

Bibliography
J. Dunkel, A. Holitschke: Softwarearchitektur für die Praxis, Springer Verlag
G. Bengel: Grundkurs verteilte Systeme, vieweg
M. Boger: Java in verteilten Systemen, dpunkt.verlag
A. Eberhart, S. Fischer: Web Services, Hanser Verlag
Current literature, e.g., on Java EE, Cloud C.
Module BIN-213 Operating Systems and Networks 3

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<td>All modules of semesters 1, 2, and 3, Operating Systems and Networks 1 (BIN-BSN1), Operating Systems and Networks 2 (BIN-BSN2)</td>
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<tr>
<td>Examination</td>
<td>Examination (written or oral examination) and experimental work</td>
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**Learning Outcomes**

Technological competencies: Architecture, functionality and implementation of operating systems and networks. Latest trends and technologies in this area. Analysis and implementation competencies: Students learn to evaluate the properties and application areas of these technologies.
Submodule BIN-213-01 Operating Systems and Networks 3

Subheading (BIN-BSN3)
Person in Charge Wohlfeil, Stefan, Prof. Dr.
Language of Instruction by agreement
Curriculum Allocation BIN, MDI
Course Type, Contact Hours per Week Lecture with exercise, 4 SWS
ECTS Credits 6
Contact Hours / Independent Study Hours 68 h / 112 h
Suggestions for Independent Study Practical exercises use a Linux environment. Students may use a virtual machine on their laptop.
Recommended Prerequisites All modules of semesters 1, 2, and 3. BIN-202 Operating Systems and Networks 2 (BIN-BSN2)
Examination Examination (written or oral examination) and experimental work

Learning Outcomes
Technological competencies: Architecture, functionality and implementation of operating systems and networks. Latest trends and technologies in this area. Analysis and implementation competencies: Students learn to evaluate the properties and application areas of these technologies.

Content
New trends and technologies in operating systems and computer Networks

Requirements for Contact Hours
Preparation and postprocession of all lectures and exercises. Notes-taking in lecture. Active participation.

Requirements for Independent Study Hours
Study all provided material; deepen knowledge using additional literature; sucessfully work on all exercises

Bibliography
provided by lecturer
Module BIN-214 Database Systems 3

Level of Module: Specific module
Type of Module: Optional module
Submodules: BIN-214-01 Database Systems 3, Compulsory
Person in Charge: Kleiner, Carsten, Prof. Dr.
ECTS Credits: 6
Contact Hours / Independent Study Hours: 68 h / 112 h
Semester: 5
Duration of Module: 1 semester
Prerequisites: All modules of semester 1 and 2 of BIN course
Recommended Prerequisites: BIN-113
Examination: Written or oral examination, experimental work

Learning Outcomes
Formal and algorithmic skills: Knowledge and implementation competency of modeling techniques for database systems, knowledge and judgement competency of processing, execution and optimization of database queries, knowledge and application competency of standard as well as novel data organization strategies in database systems
Analysis, design and implementation skills: Knowledge, application and implementation of principles of data logging and recovery as well as database optimization
Technological skills: knowledge of internal organization and memory management of database systems, knowledge and application of methods for transaction integrity, knowledge and application of novel relational database's internal memory organization
Submodule  BIN-214-01 Database Systems 3

Person in Charge
Kleiner, Carsten, Prof. Dr.

Language of Instruction
by agreement

Curriculum Allocation
BIN, MDI

Course Type, Contact Hours per Week
Lecture with exercise, 4 SWS

ECTS Credits
6

Contact Hours / Independent Study Hours
68 h / 112 h

Semester
5

Suggestions for Independent Study
Work on slides and literature, reflection and self-contained application of content

Recommended Prerequisites
BIN-113 (BIN-DBS2) or MDI-221 (MDI-DBS2), BIN-109 or MDI-202

Examination
Written or oral examination, experimental work

Learning Outcomes
Formal and algorithmic skills: Knowledge and implementation competency of modeling techniques for database systems, knowledge and judgement competency of processing, execution and optimization of database queries and according algorithms, knowledge and application competency of standard as well as novel data organization strategies in database systems
Analysis, design and implementation skills: Knowledge, application and implementation of principles of data logging and recovery as well as database optimization
Technological skills: knowledge of internal organization and memory management of database systems, knowledge and implementation skills for database recovery operations, knowledge and application of novel relational database's internal memory organization

Content
Internal database and memory organization, processing, execution and optimization of database queries, effort estimation for query execution, query execution algorithms, backup and recovery of database systems, novel relational database memory organization (main memory, column-oriented, parallel query execution)

Requirements for Contact Hours
Lecture: Following presentations and examples, discussion, following executions and visualizations in learning software, reflection of content, self-contained application of subjects
Exercise: Self-contained work on problems on paper and by using learning software, theoretical problems, presentation of problem solutions and project results

Requirements for Independent Study Hours
Preparation and post-processing of lectures and exercises, self-contained work on problems, turning in homework in small groups, self-contained work on a project task in small groups, exam preparation, reading literature

Bibliography
R. Elmasri, S. Navathe: Grundlagen von Datenbanksystemen, Pearson Studium
Module BIN-215 Parallel Programming

Subheading (BIN-PAR)
Level of Module Specific module
Type of Module Optional module
Submodules BIN-215-01 Parallel Programming, Compulsory
Person in Charge Peine, Holger, Prof. Dr.
ECTS Credits 6
Contact Hours / Independent Study Hours 68 h / 112 h
Semester 5
Duration of Module 1 semester
Prerequisites All module examinations from 1st to 2nd semester
Recommended Prerequisites BIN-102 Introduction to Programming (BIN-PR1), BIN-108 Object-oriented Programming (BIN-PR2)
Examination Written or oral examination, experimental work

Learning Outcomes
Technological skills:
Students are able to use the core means of the Java programming language and its library for the development of parallel applications.

Design, implementation and methodic skills:
Students can decompose applications into concurrent parts; can recognize and avoid data races, deadlocks and unnecessary performance bottlenecks; can distinguish programming models with and without shared data.
Submodule BIN-215-01 Parallel Programming

Subheading (BIN-PAR)
Person in Charge Peine, Holger, Prof. Dr.
Language of Instruction by agreement
Curriculum Allocation BIN, MDI
Course Type, Contact Hours per Week Lecture, 4 SWS
ECTS Credits 6
Contact Hours / Independent Study Hours 68 h / 112 h
Semester 5
Suggestions for Independent Study See literature
Recommended Prerequisites BIN-102 Introduction to Programming (BIN-PR1) or MDI-102 Introduction to Programming (MDI-102), BIN-108 Object-oriented Programming (BIN-PR2) or MDI-109 Object-oriented Programming (MDI-109)
Examination Written or oral examination, experimental work

Learning Outcomes
Technological skills:
Students are able to use the core means of the Java programming language and its library for the development of parallel applications.
Design, implementation and methodic skills:
Students can decompose applications into concurrent parts; can recognize and avoid data races, deadlocks and unnecessary performance bottlenecks; can distinguish programming models with and without shared data.

Content
Processes and threads, data races, data consistency, concurrency, causal dependency, (conditional) critical sections, visibility, semaphores, deadlocks, nonblocking synchronisation, structuring as concurrent tasks and other design patterns, actor model, parallelization by compilers, cluster programming

Requirements for Contact Hours
Active participation, solving exercise problems

Requirements for Independent Study Hours
Preparation and postprocessing of the lectures, reading literature

Bibliography
Urs Gleim, Tobias Schüle: Multicore-Software, dpunkt 2012
Brian Goetz: Java Concurrency in Practice, Addison -Wesley 2006
Peter S. Pacheco: Parallel programming with MPI, Kaufmann 199
### Module BIN-216 Current Aspects of Computer Science

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<td>Person in Charge</td>
<td>Salzwedel, Jussi, M. Sc.</td>
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Submodule BIN-216-01 Current Aspects of Computer Science

Subheading (BIN-AAI)

Person in Charge Salzwedel, Jussi, M. Sc.

Language of Instruction by agreement

Curriculum Allocation BIN, MDI

Course Type, Contact Hours per Week Lecture, 4 SWS

ECTS Credits 6

Contact Hours / Independent Study Hours 68 h / 112 h

Semester 5

Suggestions for Independent Study Specific to topic

Recommended Prerequisites All required modules from semesters 1 through 5

Examination Written or oral examination, experimental work

Learning Outcomes Specific to topic

Content
An advanced topic in computer science of current interest

Requirements for Contact Hours
Active participation, solving exercise problems

Requirements for Independent Study Hours
Preparation and postprocessing of the lectures, reading literature

Bibliography
Specific to topic