



Computer Science

Curriculum for the Computer Science Programme

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1 Curriculum

The Computer Science curriculum has been prepared according to the guidelines of the Order of the Danish Ministry of Education No. 623 of 18th June 2004, which is about Information Technology and Erhvervsakademiuddannelsen (AK). The curriculum is revised at the end of 2007 and thus this edition of the curriculum applies to students starting on the programme after 1st January 2008.

This education is a full time education prescribed to 2¼ years of study. One year of study work is equal to one fulltime candidate's work at one year. One year of study-work is equal to 60 points in the European Credit Transfer System (ECTS-point). Thus, the official points of the programme total 135 ECTS points.

The education is regulated by the following laws and regulations:

□ **KVU-law:** Law No. 1115 of December 29th 1997 concerning shorter further educations (erhvervsakademiuddannelser)

□ **Declaration of education:** Declaration No. 633 of June 18th 2007 concerning erhvervsakademiuddannelse (AK) concerning Information Technology (Datamatiker AK)

□ **Declaration of quality:** Declaration No. 635 of June 30th 2000 concerning quality and management of quality in the erhvervsakademi educations.

□ **Declaration of Access:** Declaration No. 167 of 22nd February 2007 concerning access,matriculate and leave e.g. at further educations.

□ **Declaration of exams:** Declaration No. 766 of 26th June 2007 concerning exams at certain further educations under the ministry of education.

□ **Declaration of marks:** Declaration No. 262 of 20th March 2007 concerning marks and evaluations.

□ **Declaration of external examiner:** Declaration No. 332 of May 25th 1993 concerning external examiner for certain further educations under the ministry of education.

□ **Open Education:** Law No. 508 of June 30th 1993 concerning open education etc.

Laws and announcements are available on the internet address www.uvm.dk.

2 Name of the Education, Title of Graduates

The name of the education in Danish is *Erhvervsakademiuddannelsen inden for Informationsteknologi*.

The graduate has the right to use the title *Datamatiker AK*.

In English the title *AP Graduate in Computer Science* will be used.

3 Purpose of the Education

The purpose of the education is to qualify the graduate to independently perform the job of analyzing, planning and completing a new development project and make development on existing systems and be able to implement IT solutions in private and state companies.

The graduate must be able to:

- combine basic company management and have knowledge of the technological concepts and be able to programme and make system design.

- use different principles and methods for planning and to control the development process from idea to implementation and to maintenance of operation.

- participate in management and to co-operate with other people from different educational, linguistic and cultural backgrounds

4 The Profile of the Computer Science Programme

The education comprises the following subjects:

- Programming 40 ECTS
- Systems Development 30 ECTS
- Technology 20 ECTS
- Business Management 10 ECTS
- Specialization 20 ECTS
- Main project 15 ECTS

Targets for the subjects have been described by keywords for each subject. The keywords reflect some of the functions that a Datamatiker is capable of handling.

4.1 Programming (40 ECTS)

Keywords

- Algorithms
- Abstractions, techniques and patterns
- Data structures and abstracts data types
- Programming languages
- Program quality
- Program design
- Language theory
- Database Programming
- Synchronization
- Distributed programming
- Software architecture

4.2 Systems Development (30 ECTS)

Keywords

- Modeling
- Method
- Pre-Analysis
- Analysis
- Design
- Data Modeling and Database Design
- Work Project
- IT tools
- Experiments
- Quality

4.3 Technology (20 ECTS)

Keywords

- Memory management
- Processes
- Security
- Computer Architecture
- Distributed Systems
- Network and Data transmission
- System Architecture
- Databases
- Standard Servers
- Development in Technology

4.4 Business Management (10 ECTS)

Keywords

- Organization and business understanding
- Business concepts using IT
- Enterprise Resource Planning for business planning
- IT development/procurement
- Organization and It-security

4.5 Specialization (20 ECTS)

The elective part gives the student the opportunity of achieving business competence during specializing and studying of subjects related to IT.

The school has organized the elective part by giving the students the possibility of choosing between different subjects.

4.6 Main project (15 ECTS)

In the final exam project the student must show the ability to: Work with complex IT in an analytic and methodical way, and to do this in a real life situation and practical way.

The final exam project must include central subjects within the education.

5 Structure of the Education



1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester
Software	Computer Architecture (10ECTS)	Computer Network (15ECTS)	Specialization (20ECTS)	Main Project (15ECTS)
	Construction (25ECTS)	Software Architecture & Distributed Programs (15ECTS)		
Software	Design (15ECTS)		Systems Development Methods (15ECTS)	
Information Technology in Organizations (10ECTS)				

6 Exam (external)

Structure of the examination

All external examinations at the Computer Science programme education are marked by the 7-point grading-scale.

Exams after 1st Year

The 1st Year Exam (Project)

The exam is based on all four subjects at the first year of study.

The exam: The exam is a project orientated exam. The exam is based on the work done during the project, containing comprehensive and essential topics from the first year of study.

The project scope is corresponding to 12 ECTS points and is carried out by the project group and based on a form given by the school. The project is a controlled project, using the methods, techniques and tools that have been used in the lessons. The group hands in a project report. The project must not exceed 60 standard pages plus program listing and a CD with the operational system.

The examination: The group is allowed ½ hour to present the project. After this each member in the group is examined for ½ hour including assessment.

The mark: An individual mark is given based on a general impression of the written project work and the oral part of the exam.

The 2nd Year Exam

After 3rd Semester: *Programming (Oral)*

The exam: The exam is divided into different subjects. The subjects are Programming and Computer Network and Distributed systems.

The examination: The student draws one main question in the subject Programming plus a secondary question in the subject Computer Network and Distributed Systems. The questions include both theoretical and practical elements. The student has 80 minutes for preparation for the examination. The preparation time is followed by the examination which last 40 minutes including assessment.

According to regulations the programming question counts 80%.

After 4th Semester: *Systems Development (Project)*

The exam: A system development project defined by the students themselves with a size of 6 ECTS points. The oral examination is based on topics in system development. The project is carried out in projects groups of up to 3-4 students. They hand in a complete project report of maximum 40 standard pages.

The examination: The group is given ½ hour to present the project. After presentation an individual exam lasting ½ hour including assessment is held.

Marks: An individual mark is given based on the general impression from the written project work and the oral part of the exam.

After 4th Semester: *Specialization (Synopsis)*

The exam: Topics from the specialization. The Synopsis has a size of 10 ECTS and is carried out in project groups of up to 3 students. The Synopsis, which has a size of max 15 standard pages plus appendix, is handed in.

Type of exam: Synopsis examination.

The examination: Each student is given 30 minutes to present and defend their synopsis.

Main Project

The final project is carried out as one major project. The subject for this final exam project is formulated by the student together with the school and as far as possible together with a company.

The school must approve the project.

The exam: The exam in the final project consists of a written project report and an oral part. There will be given only one mark for the oral part and the written project. The final examination must document that the graduation level of competence has been reached by the student.

The project is carried out in groups typically consisting of 3 students. The school makes a more precise decision together with the students.

The exam project is handed in as a report plus a product to the school in 4 copies. The maximum size of the report exclusive appendix is 60 standard pages.

The examination of the final project: The final project is defended at an oral examination. The exam will last 30 minutes + n * 20 minutes, where n = number of students. If the project has been carried out by a group, the group is allowed to be present during the examination. The examination will however be individual.

7 The Education Subject and Targets.

Overview of the subjects

Computer Architecture and Operating Systems

- Memory Management
- Processes
- Processes Computer Architecture
- Development in Technology
- Databases

Computer Network and Distributed Systems

- Security
- Processes
- Distributed Systems
- Data Transmission Network
- System Architecture
- Standard Servers
- Databases

Software Construction

- Programming Languages
- Database Programming
- Language Theory
- Programme Quality
- Algorithms
- Abstractions, Techniques and patterns
- Data Structures and Abstracts Data Types
- Synchronization

Information Technology in Organizations

- Organization and Business Understanding
- It Business Concepts
- Enterprise Resource Planning for Business Planning
- It Development/It Purchase
- Organization and It Security

System Development

Methods

- Methods
- Design
- Project Work
- It Tools
- Experiments
- Analysis
- Quality

Specialization

Main

Project

7.1 - 1st Year

The purpose of the 1st year study is to give the students the ability to independently and together with other candidates to develop single-user systems. Technically this year covers pre analysis, maintenance and operation. This is carried out by a systematic procedure, supported by technological and business aspects.

7.1.1 Subject: Software Construction

Purpose:

The subject must give the student the ability to implement systems with the relevant performance.

The subject has close relations to the subject system development, software design and computer architecture operating systems.

Contents:

Programming language

The student should

1. be able to use the language to implement algorithms, patterns, abstractions and data structures.
2. be able to use the language to implement design models.
3. be able to make use of the attached libraries in the language.
4. be able to use the language for designing user interface using the attached program libraries for the implementation.
5. be able to use the development tools for the language

Database programming

The student should

1. be able to carry out models in a database system
2. be able to design programs, using a database interface.
3. be able to carry out DDL and DML

Language theory

The student should

1. Achieve knowledge about describing syntax and semantics of programming languages.
2. Achieve knowledge about type systems and abstraction mechanisms in modern programming languages

Program quality

The student should

1. Obtain knowledge about criteria for program quality.
2. be able to use tools to achieve quality

Algorithm

The student should

1. be able to specify and express algorithms.
2. be able to understand quality and quantitative properties with algorithms.

Templates, techniques and patterns

The student should

1. be able to use fundamental algorithms and programming techniques.
2. be able to use central design patterns.

Data structures and abstract data types

The student should

1. Process knowledge in both quantitative, qualitative characteristic with standard external and internal data structures.
2. be able to choose and use suitable data structures for implementations of abstract data types.
3. be able to use classical abstract data type during design of programs.
4. be able to understand specifications and implementation of the abstract data types.
5. be able to make a qualified choice between different abstract data types

Synchronism

The student should

1. be able to design a program which cooperating processes.
2. be able to use multitasking techniques for designing programs.

7.1.2 Subject: Software Design

Purpose:

The purpose of this subject is to qualify the student to do research and development, changing existing products and integrate IT-systems of different kind and types. The student must be able to do it in a systematic way using specific methods and using system development tools.

The subject must qualify the student to ensure that the right IT systems with the relevant qualities are developed effectively. This will ensure that the other subjects on the first year are connected.

Contents:

Modeling

The student should

1. Understand the meaning of modeling as regards to system development
2. be able to use tools and techniques for construction of relevant models
3. Make models based on patterns

Method

The student should

1. be able to use a certain method for system development
2. be able to use techniques for involvement of user in system development

Pre-analysis

The student should

1. be able to formulate the needs for IT systems in companies
2. be able to use methods for description and analysis of a company's business areas and business processes
3. be able to understand the innovation process and take part in development of new IT related solutions

Analysis

The student should

1. To create and complete system development problem domains with reference to the understandings of business and technological terms and create a specification

Design

The student should

1. be able to design appropriate IT-systems and be able to evaluate different solutions compared to specifications and terms.
2. be able to design an architecture overview of a system.
3. be able to design user interfaces
4. be able to design databases

Project work

The student should

1. be able to join a development project as a competent participant

IT-tools

The student should

1. be able to use it-tools for support in the system design phase

Experiments

The student should

1. Understand the relevance of experiments as a part of or supplement for system development method.
2. be able to use experiments for systematic coverage of user demands.

Quality

The student should

1. Process the understanding for the importance of quality insurance during the system development process concerning the final product.
2. be able to secure the quality of a product and the design process.

7.1.3 Subject: Information Technology in Organizations

Purpose:

The purpose of this subject is to qualify the student to find relevant company aspects and to process business understanding together with system development. This line must qualify the student to work in a system development organization and participate in the research and development, change of existing systems and work with integration of it systems of different kinds in organizations.

Contents:

Organization and business understanding

The student should

1. be able to understand the organization structures and the factors which defines the structure of the organization.
2. be able to understand the company management and business process.
3. be able to understand different types of management like, project management, different person's characters and different groups' behavior in an organization.
4. be able to understand the change in an organization in connection with introduction of new IT-systems.

Business concepts using IT

The student should

1. be able to understand business concepts that use information technology.
2. Process knowledge about company strategy with reference to be able to design an it strategy.
3. be able to describe systems supporting company strategies and IT-strategies.

Enterprise Resource Planning systems for Company Management

The student should

1. Process knowledge to enterprise resource planning systems characteristic, design and mode of operation.
2. Process knowledge about economic terms, principles and methods for handling registration of information for management.
3. Process knowledge about techniques for covering of enterprise resource planning and adaptation
4. be able to use models for the description of a company system.

It-development/It-Purchase

The student should

1. Understand and describe the consequences of IT development/procurement
2. Process knowledge about procedures when an IT system is implemented.

Organization and It-security

The student should

1. be able to analyze the way a company organizes its IT security.
2. Process knowledge about the organization structure and its importance for the IT security.
3. Process knowledge about risks and vulnerability.

7.1.4 Subject: Computer Architecture and Operating Systems

Purpose:

The purpose of this subject is to qualify the student to be able to make contributions to the choice of technology. This must be done in connection with system development and programming of single user and multi user IT-systems, plus give the student a basic knowledge about the technological aspects.

Contents:

Memory management

The student should

1. Process knowledge about the importance of memory management consequences for a program under execution.
2. Process knowledge about facilities in modern file systems.

Processes

The student should

1. be able to understand the organization and execution of processes and threads
2. be able to use communications options and principles for resource sharing resources

Computer architecture

The student should

1. Process knowledge about the layer orientated computer and principles for the way the layers interact with each other
2. be able to understand how the lower layers support the design in the chosen program language

Technology development

The student should

1. Process knowledge about the technological development including future development trends

Databases

The student should

1. be able to understand the possibilities and the operation of a modern database server, be able to understand transaction.
2. be able to understand how a database server handles enquires

7.2 - 2nd Year Study

Impart competence to the student to independently and in collaboration with others to be able to evaluate a company's IT development. The student must, based on that be able to develop, renovate and maintain a distributed IT-system, using a systematic procedure.

7.2.1 Subject: Systems Development Methods

Purpose:

The purpose of this subject is to qualify the student for doing development, redesign or integration of distributed IT systems of different origin. This must be done in a systematic way based on modern methods and the use of system development methods. The subject must qualify the student and make sure that the student develops the right system with the right qualities in an efficient way. This links to the obligatory subjects on 2nd year.

Contents:

Method

The student should

1. Process knowledge about other system development methods such as older used methods and new promising methods
2. In a given situation be able to choose and/or adjust a method

Analysis

The student should

1. be able to implement an analysis of a system developments problem domain concerning understanding the business and technological terms, plus lay down the specifications

Design

The student should

1. be able to design suitable IT-systems designs and give an estimate on different solutions in relation to specifications and terms
2. be able to design an architecture overview of a system
3. be capable of designing a centralized as well as a distributed system with several users operating simultaneous

Project work

The student should

1. be capable to participate as a competent partner in a research and development project
2. be able to understand a project organizations characteristic
3. be able to organize and control smaller development projects
4. Process knowledge in a wide aria of process models
5. Based on a situation be able to choose and/or adjust a process model. In other words make a project strategy

IT-tools

The student should

1. be able to use IT-tools to support the activities in a system development phase

Experiments

The student should

1. Understand the relevance of experiments as a part of or supplement for system development method
2. be able to use experiments for systematic examination for technological possibilities and limitations

Quality

The student should

1. be able to ensure the quality of the product and process

7.2.2 Subject: Software Architecture and Distributed Programs

Purpose:

The subject must qualify the student to effectively to implement distributed systems with the relevant qualities. The subject is the key subject which has close relations to the mandatory subjects on 2nd years study.

Contents:

Synchronism

The student should

1. be able to design a program, which uses cooperating processes
2. be able to use techniques that have the ability to operate with several simultaneous users

Distributed programming

The student should

1. be able to design programs based on cooperating processes in a distributed architecture
2. be able to design programs using a network interface.

Software Architecture

The student should

1. be able to use patterns for software architecture
2. be able to use and develop software components

Language theory

The student should

1. Achieve knowledge about type system and abstraction mechanisms in modern programming languages

Program quality

The student should

1. be able to use tools and methods to obtain quality programs

Templates, techniques and patterns

The student should

1. be able to use fundamental algorithms and program techniques
2. be able to use central design patterns

Algorithms

The student should

1. be able to specify and design algorithms
2. be able to understand quantitative and qualitative properties for different algorithms

Data structures and abstract data types

The student should

1. Process knowledge about quantitative and qualitative properties for typical external and internal data structures
2. be able to choose and use suitable data structures for implementing abstract data types
3. be able to use typical abstract data types in program design
4. be able to understand specification and implementation of abstract data types
5. be able to carry out a qualified choice between different abstract data types

7.2.3 Subject: Computer Network and Distributed Systems

Purpose:

The purpose of this subject is to qualify the student to be able to contribute to the choice of technology in connection with system development and programming of distributed IT-systems, plus give the student knowledge about technical aspects.

Contents:

Security

The student should

1. Process knowledge about principles in designing fault tolerant systems
2. be able to use standard components to ensure reliable communication
3. be able to understand basic security concepts including authorization, authentication, confidentiality and traceability
4. Process knowledge about central threats of technical character that IT-systems may face and know how to deal with them

Processes

The student should

1. be able to understand how processes and threats are organized
2. be able to use mechanism for communication and use principles for sharing resources

Distributed systems

The student should

1. be able to understand principles for design and implementation of distributed systems
2. be able to use standard application protocols in design of distributed systems
3. be able to understand techniques for integration of non homogeneous systems

Data transmission network

The student should

1. Process knowledge about the layer orientated communication model
2. be able to use a network program interface
3. be able to understand addressing in a network
4. Process knowledge about different types of nets and components

System architecture

The student should

1. be able to analyze the architecture and be able to make decisions among different solutions in a given situation

Standard servers

The student should

1. be able to understand different types of standard servers such as web servers, application servers and object containers
2. be able to use services offered by the standard server

Databases

The student should

1. be able to understand the options and the way a modern database server operates. This includes transactions
2. be able to understand how a database server handles requests

7.2.4 Specialization

Purpose:

Enable the student to specialize in different subjects that are related to the IT-world. The students make their choice from what the academy can offer, however, there is a possibility to take other subject at other academies in Denmark as well as abroad. Agreement about this will be made with the academy.

7.3 Main Project

Purpose

The purpose of the final exam project is: The student must be able, on an analytic and methodical basis, to work with a complex and practical IT job. The project must be equal to 35 ECTS-points.

The student must complete the final exam project using subjects within the scope of the education.

8 Internal Exams & Compulsory assignments.

Internal exams

There are no internal exams on this education.

Compulsory assignments

There will be a number of individual written exercises during the first year of study. To be able to access the first year's exam, the student must obtain approval for at least 9 reports.

9 Signing up for the Exam

The student must - in time and in writing - sign up for all exams no matter whether they are external exams, make-up exams or any other exam on the academy exam entry form.

Make-up Exams and New Exam

The academy's aim is to hold all make-up exams just after or in the beginning of the next semester.

Examinations, Re-entry

The student has a right to two extra exams. However, it is on condition that the student has participated in the ordinary exam.

1st make-up exam will take place no later than the next ordinary exam.

The make-up exams are only available at oral exams: writing exam and oral exam/-defense. The exam has to be notified at least two weeks before taking place. There will always be an external examiner. The student must sign up for the exam and fill in a written form.

2nd make-up exam will typically take place shortly after the ordinary exam.

10 Complaints

Complaints about the exam or other evaluation that is included in the exam should be filed with the head of department.

Complaints must be delivered no later than two weeks after the result of the exam. The delivery is however, from the date where the result was made public according to § 22, part 2 and 3 in the words of the rules for the exam.

11 Teaching and Working Methods

The teaching uses a combination of class education, lectures, workshops, study group, exercises and larger project works. The teaching has been organized in a way that is related to relevant business practice and used theories.

In the education there will be types of teaching, which enable the candidates to be more independent, better to collaborate and give a better ability to create new material. Teaching in how to start-up companies, environmental questions and interaction between different cultures, is included in so far as it is relevant for the education.

12 Duties to Participate in the Lessons

It is expected that the student is active and participates in the prescribed project work and tasks, according to the mandatory rules.

13 Rules of Credit Transfer

This education will give full transfer of qualifications to all schools in Denmark, who offers the same education, after 1st year of study. This plan complies with the plan that all other schools and education centers uses, however, there is one exception: EDB-skolen at Vejle Handelsskole.

Established Transfers of Credits

All established transfers of credits are available on www.erhvervsakademierne.dk or www.furthereducation.dk or the school's homepage.