Programme-specific Section of the Curriculum for the MSc Programme in

Computer Science (Part-time)

at the Faculty of Science, University of Copenhagen

2019

Contents

1 Title, affiliation and language
A shared section that applies to all BSc and MSc Programmes at the Faculty of Science is linked to this programme-specific curriculum.

1.1 Title
The MSc Programme in Computer Science leads to a Master of Science (MSc) in Computer Science with the Danish title: *Cand.scient. (candidatus/candidata scientiarum) i datalogi*.

1.2 Affiliation
The programme is affiliated with the Study Board of Mathematics and Computer Science, and the students can both elect, and be elected, to this study board.

1.3 Corps of external examiners
The following corps of external examiners is used for the central parts of the MSc Programme:

- Corps of External Examiners for Computer Science (*datalogi*).

1.4 Language
The language of this MSc Programme is English.

2 Academic profile
2.1 Purpose
Computer science (Danish: datalogi) is concerned with the systematic processing of information, particularly for automatic processing by computers. The concept corresponds to Informatik (German) and informatique (French). Students learn how to identify and analyse complex issues within computation and information processing on a scientific basis and at a high level of abstraction, and, through the application of relevant results and methodologies, to solve computer science problems, both of a theoretical and a practical nature, including, in particular, to design and implement correct, efficient and useful software.

2.2 General programme profile
The MSc programme in Computer Science is a research-based two-year programme, building on top of a BSc programme in Computer Science or a closely related field. The programme includes a common compulsory part covering a broad range of core CS topics at a graduate level (first semester); an elective part containing both foundational courses within specific subareas (primarily second semester) and selected advanced and auxiliary topics (primarily third semester); and concluding with a MSc thesis (fourth semester).

Computer Science is the key subject area of the programme.

2.3 General structure of the programme
The MSc Programme is set at 120 ECTS.

The MSc Programme is offered as a part-time master's degree programme.

There are no defined specialisations in this programme.

2.4 Career opportunities
The MSc Programme in Computer Science qualifies students to become professionals within business functions and/or areas such as:

- A PhD programme
- Research, development, and consulting within the Information and Communication Technology sector.
- IT development and support within other sectors, such as the financial or biomedical industry, or in public administration.

3 Description of competence profiles

Students following the MSc Programme acquire the knowledge, skills and competences listed below. Students will also acquire other qualifications through elective subject elements and other study activities.

3.1 Competence profile

On completion of the programme, an MSc in Computer Science has acquired the following:

Knowledge about:

- State-of-the-art principles for program and system development, including appropriate use of structuring methodologies and programming paradigms.
- The relevant mathematical, statistical, and logical foundations for constructing effective and efficient solutions to a variety of computational problems.
- Academic literature, terminology, traditions and research methods within computer science in general, and their area of specialization in particular.
- Relevant real-world applications of computer science and information technology, e.g. in business, cultural, health, environmental, and other societal contexts.

Skills in/to:

- Identify opportunities for principled application of theoretical or foundational computer-science results or methods within practical or applied contexts.
- Design, implement, and maintain large and/or complex programs or systems, subject to external quality and performance constraints.
- Adapt and apply general mathematical models for analysis and classification of data.
- Combine relevant computer-science and other knowledge in order to analyse a problem with a significant computational or information-processing component, as well as assess previous attempts at solving the same problem and related problems.
- Select, combine, and where appropriate develop or refine theories and methods, and use these to make a significant contribution to solving computer-science problems or to promoting a scientific understanding of the problems.
- Evaluate a proposed solution to a problem objectively and systematically, and – where appropriate involving experiments – analyse the areas in which the solution is successful and unsuccessful, and identify its weaknesses, strengths and consequences.
- Document their own research results and discoveries in a manner that meets the requirements for academic publications.
- Apply and disseminate knowledge about information technology and participate in general debates on the subject.

Competences in/to:

- Acquire a comprehensive overview of complex scientific or organizational contexts, identify and analyse the computational or information-processing problems arising in such contexts, and decompose or transform the problems into a form amenable to solution by relevant computer-science methodology.
- Employ general theoretical results and methods to an extent and level of formality appropriate to the complexity and criticality of the concrete task at hand.
- Formulate, structure, and run research-based projects, computer-science development work and other advanced assignments within information technology.
- Participate in larger program- or system-development teams, properly applying the relevant principles for modular software construction, and understanding how the correctness and performance of the full product follows from those properties of the individual components.

- Take professional responsibility for the quality of a completed analysis, design, implementation, or evaluation task, based on a sound understanding and application of the relevant assessment methodologies.
- Acquire new knowledge in an efficient and systematic manner, and familiarise themselves with evolving computer-science subject areas at a high scientific level.

4 Admission requirements

With a Bachelor's degree in Computer Science from the University of Copenhagen the student is granted reserved access and guaranteed a place on the MSc Programme in Computer Science if the student applies before the application deadline during the first application period after the completion of the Bachelor's degree.

4.1 Applicants with a Bachelor's degree in Computer Science from Danish universities

Applicants with a Bachelor's degree in the following are directly academically qualified for admission to the MSc Programme in Computer Science.

- Computer Science from the University of Copenhagen
- Computer Science from Aalborg University
- Computer Science from Aarhus University
- Computer Science from the University of Southern Denmark

4.2 Applicants with a Bachelor's degree in Science and IT

Applicants with a Bachelor's degree in Science and IT with the MSc admission course package in Computer Science from the University of Copenhagen are directly academically qualified for admission to the MSc programme in Computer Science.

4.3 Applicants with a related Bachelor's degree from Danish universities

Applicants with a Bachelor's degree in:

- Mathematics from the University of Copenhagen
- Physics from the University of Copenhagen
- Communication and IT from the University of Copenhagen
- Software Development from the IT University of Copenhagen
- Software Technology from the Technical University of Denmark
- Software from Aalborg University
- IT with a specialisation in Software Development from Aarhus University

may also be admitted if their programme includes the following:

- Courses in computer science corresponding to at least 45 ECTS, subject to the following distribution constraints:
  - A minimum of 10 ECTS within the field of programming, covering at least two substantially different programming paradigms.
  - A minimum of 10 ECTS within the field of computer systems architecture, including processor architecture, operating systems, data networks, databases, etc.
  - A minimum of 10 ECTS within the field of theoretical computer science, including algorithms and data structures, computability and complexity, formal languages, programming language theory and compilation, etc.
- Courses in mathematics corresponding to a total of at least 7.5 ECTS within the fields of discrete mathematics, linear algebra, and mathematical modelling.

4.4 Applicants with a Bachelor's degree in Computer Science from international universities

Applicants with a Bachelor's degree in Computer Science or an equivalent subject from international universities may also be admitted if their programme includes the following:

- Courses in computer science corresponding to at least 45 ECTS, subject to the following distribution constraints:
  - A minimum of 10 ECTS within the field of programming, covering at least two substantially different programming paradigms.
  - A minimum of 10 ECTS within the field of computer systems architecture, including processor architecture, operating systems, data networks, databases, etc.
  - A minimum of 10 ECTS within the field of theoretical computer science, including algorithms and data structures, computability and complexity, formal languages, programming language theory and compilation, etc.
- Courses in mathematics corresponding to a total of at least 7.5 ECTS within the fields of discrete mathematics, linear algebra, and mathematical modelling.

4.5 Other applicants

The Faculty may also admit applicants who, after a thorough academic assessment, are deemed to possess educational qualifications equivalent to those required in Subclauses 4.1-4.

4.6 Language requirements

Applicants must as a minimum document English language qualifications comparable to a Danish upper secondary school English B level or English proficiency corresponding to the tests and scores required. Accepted tests and required minimum scores are published online at www.science.ku.dk.

4.7 Supplementary subject elements

The qualifications of an applicant to the MSc program are assessed exclusively on the basis of the qualifying bachelor's degree. Supplementary subject elements passed between the completion of the bachelor's program and the admission to the MSc program cannot be included in the overall assessment.

However, subject elements passed before the completion of the bachelor's program may be included in the overall assessment. This includes subject elements completed as continuing education as well as subject elements completed as part of a former higher education program. A maximum of 30 ECTS supplementary subject elements can be included in the overall assessment.

Subject elements passed before completing the BSc programme which are to form part of the MSc programme to which the student has a legal right of admission (§9-courses) cannot be included in the overall assessment.

4.8 Relevant employment or entrepreneurship

Applicants must supply documentation of either:

a) Relevant employment based on their bachelor degree, of at least 25 hours per week on average.
b) Work as an independent business owner in a related field with revenue generating activities, or as an entrepreneur in association with a public or private entrepreneurial environment.

After admission to the part-time Master's degree programme, students must – every semester and for the duration of their studies – document that they remain in relevant employment or continue to run their entrepreneurial business.

Students who change jobs or stop running their entrepreneurial business and transfer to other relevant employment must apply to the Faculty of Science for continued enrolment on the part-time Master's degree programme.

5 Prioritisation of applicants

If the number of qualified applicants to the programme exceeds the number of places available, applicants will be prioritised as follows:

1) Applicants with a Bachelor's degree in Computer Science from the University of Copenhagen seeking admission by way of direct extension of their completed BSc programme.
2) Applicants with a Bachelor's degree in Computer Science from Danish Universities
3) Applicants with a Bachelor's degree in Science and IT with the MSc admission course package in Computer Science from the University of Copenhagen.
4) Other applicants.

If the number of qualified applicants within a category exceeds the number of places available, applicants will be prioritised according to the following criteria (listed below in prioritised order):

- Total number of ECTS within computer science and the grades obtained. If different grading systems make comparison impossible, applicants will be prioritised on the basis of an individual evaluation by the Admission Committee

6 Structure of the programme

The compulsory subject elements, restricted elective subject elements and the thesis constitute the central parts of the programme (Section 21 of the Ministerial Order on Bachelor and Master's Programmes (Candidatus) at Universities).

6.1 Programme components

The programme is set at 120 ECTS and consists of the following:

- Compulsory subject elements, 30 ECTS.
- Restricted elective subject elements, 30 ECTS.
- Elective subject elements, 30 ECTS.
- Thesis, 30 ECTS.

6.1.1 Compulsory subject elements

All of the following subject elements are to be covered (30 ECTS):

• NDAA09013U	Advanced Programming	AP	Block 1	7.5 ECTS
• NDAA09023U	Advanced Algorithms and Data Structures	AADS	Block 1	7.5 ECTS
• NDAK15006U	Advanced Computer Systems	ACS	Block 2	7.5 ECTS
• NDAK15007U	Machine Learning	ML	Block 2	7.5 ECTS

6.1.2 Restricted elective subject elements

30 ECTS are to be covered as subject elements from the following list:

• NDAK14008U	Programming Massively Parallel Hardware	PMPH	Block 1	7.5 ECTS
• NDAK10006U	IT Innovation and Change	ITIaC	Block 1	7.5 ECTS
• NDAK16000U	Algorithm Engineering	AE	Block 1	7.5 ECTS

• NDAK10005U	Medical Image Analysis	MIA	Block 1	7.5 ECTS
• NDAK15004U	Computer Game Development Project	DADIU	Block 1+2	30 ECTS
• NDAK17000U	Collaborative Computing	CollComp	Block 2	7.5 ECTS
• NDAK16009U	Visualization	Vis	Block 2	7.5 ECTS
• NDAK16007U	Software Engineering	SE	Block 3	7.5 ECTS
• NDAK15012U	Advanced Topics in Human-Centered Computing	ATHCC	Block 3	7.5 ECTS
• NDAA09007U	Computability and Complexity	CoCo	Block 3	7.5 ECTS
• NDAK10009U	Computational Geometry	CG	Block 3	7.5 ECTS
• NDAA08006U	Semantics and Types	SaT	Block 3	7.5 ECTS
• NDAA09027U	Signal and Image Processing	SIP	Block 3	7.5 ECTS
• NDAA09009U	Numerical Optimization	NO	Block 3	7.5 ECTS
• NDAK16006U	Software Architecture	SA	Block 4	7.5 ECTS
• NDAK15005U	Information Retrieval	IR	Block 4	7.5 ECTS
• NDAK15018U	Large-Scale Data Analysis	LSDA	Block 4	7.5 ECTS
• NDAK16004U	Mobile Computing	MC	Block 4	7.5 ECTS
• NDAK16005U	Program Analysis and Transformation	PAT	Block 4	7.5 ECTS
• NDAK16008U	User Interface Technology	UIT	Block 4	7.5 ECTS
• NDAK14005U	Randomized Algorithms	RA	Block 4	7.5 ECTS
• NDAK12006U	Computational Methods in Simulation	CMIS	Block 4	7.5 ECTS
• NDAK16001U	Approximation Algorithms	APX	Block 4	7.5 ECTS
• NDAA09031U	Proactive Computer Security	PCS	Block 4	7.5 ECTS
• NFKK14001U	Project outside the course scope		Block 1-5	7.5 ECTS
• NFKK14005U	Project outside the course scope		Block 1-5	15 ECTS

6.1.3 Elective subject elements

30 ECTS are to be covered as elective subject elements.
All subject elements at MSc level may be included as elective subject elements in the MSc Programme.

BSc subject elements corresponding to 15 ECTS may be included in the MSc Programme.

Projects outside the course scope may be included in the elective section of the programme with up to 15 ECTS. Note that Projects outside the course scope may not exceed 15 ECTS in total on the restricted elective and elective section of the programme. The regulations are described in Appendix 5 to the shared section of the curriculum.

Projects in practice may be included in the elective section of the programme with up to 15 ECTS. The regulations are described in Appendix 4 to the shared section of the curriculum.

6.1.4 Thesis

The MSc Programme in Computer Science includes a thesis corresponding to 30 ECTS, as described in Appendix 2 to the shared curriculum. The thesis must be written within the academic scope of the programme.

7 Exemptions

In exceptional circumstances, the study board may grant exemptions from the rules in the curriculum specified solely by the Faculty of Science.

8 Commencement etc.

8.1 Validity

This subject specific section of the curriculum applies to all students enrolled in the programme – see however Appendix 2.

8.2 Transfer

Students enrolled on previous curricula may be transferred to the new one as per the applicable transfer regulations or according to an individual credit transfer by the study board.

8.3 Amendments

The curriculum may be amended once a year so that any changes enter into force on the start of the academic year. Amendments must be proposed by the study board and approved by the Dean.

Notification about amendments that tighten the admission requirements for the programme will be published online at www.science.ku.dk one year before they come into effect.

If amendments are made to this curriculum, an interim arrangement may be added if necessary to allow students to complete their MSc Programme according to the amended curriculum.

Appendix 1 Tables

Table - MSc Programme in Computer Science

	Block 1	Block 2	Block 3	Block 4
1st year	Advanced Programming	Advanced Computer Systems	Restricted elective	Restricted elective
	Relevant employment or entrepreneurship			
2nd year	Advanced Algorithms and Data Structures	Machine Learning	Restricted elective	Restricted elective
	Relevant employment or entrepreneurship			
3rd year	Elective	Elective	Elective	Elective
	Relevant employment or entrepreneurship			
4th year	Thesis			
	Relevant employment or entrepreneurship			

Compulsory

Restricted elective

Elective

The table illustrates the recommended academic progression. The student is allowed to plan an alternative progression within the applicable rules.

Appendix 2 Interim arrangements

The Shared Section of the BSc and MSc Curricula for Study Programmes applies to all students.

There are currently no interim arrangements to this curriculum.

Appendix 3 Description of objectives for the thesis

After completing the thesis, the student should have:

Knowledge about:

- The core subject area of the thesis, as well as - where applicable - any relevant auxiliary areas, both within and outside of computer science.
- General principles for scientific research work, including adaptive project planning, hypothesis generation and testing, and design and execution of experiments.
- General principles for scientific and technical writing, including an appropriate level of formality, and correct use of references and citations.

Skills in/to:

- Clearly formulate, delineate, motivate, and situate a scientific problem, containing a substantial computer-science component.
- Employ state-of-the-art methods and theories to analyze and decompose the problem, and to survey and evaluate previous attempts at solving the problem and/or related problems.
- Critically evaluate, select, and non-trivially combine or extend relevant results and techniques, to make significant contributions to the solution of the problem, or to the scientific understanding of the problem.
- Give a precise, operational description of all important aspects of the developed solution, with particular emphasis on own contributions.
- Objectively and systematically, and where appropriate involving experiments, assess to what extent the problem under study has been solved, and point out particular strengths, weaknesses, and consequences of the solution.
- Report the findings of the project in a well-structured, coherent, and comprehensive report, in accordance with academic standards for referencing and integrity, and including illustrations, tables, formulas, code, and other non-textual elements to an extent appropriate to the nature of the problem and its solution.
- Orally summarize and explain the main objectives, methods, results, and conclusions of the project; and interactively discuss and justify the chosen approach and resulting findings at a scientific level.
- Demonstrably meet the project-specific learning objectives stipulated in the thesis contract.

Competences in/to:

- Identify and solve a non-trivial problem within computer science, or with a significant computational or IT content.
- Independently plan and execute, with limited supervision, a research project around the problem, and report its findings and conclusions to high standards of correctness and integrity.
- Assess and discuss the significance and relevance of the obtained results to the scientific discipline of computer science, as well as any possible technological or societal implications.