Reg.no:

Faculty of Health, Science and Technology

Study Plan for Doctoral Studies in Computer Science

(Utbildning på forskarnivå i Datavetenskap)

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Study Plan Approval

The study plan was approved by the Faculty Board of Health, Science and Technology on 23 April 2020 and valid from this date.
Revised by the Faculty Board of Health, Science and Technology on 18 March 2021 and valid from this date.

General stipulations for PhD programmes are provided in the Higher Education Act and in the Higher Education Ordinance. The PhD programme is offered to the extent permitted by available resources.

1. General Information

The subject Computer Science includes everything from studies of hardware in computer systems to the design of software to be executed in these computer systems.
Computer Science is a broad field of science ranging from basic theoretical studies of algorithms and their complexity to more applied areas such as software development, compiler construction, database technology, computer networking, data security, personal integrity, artificial intelligence and more. The research at Karlstad University focuses on software development, computer networking, data security and personal integrity.

2. Programme Outcomes

The general outcomes of licentiate or doctoral studies in terms of knowledge and understanding, competence and skills, and judgement and approach are specified as follows in the System of Qualifications (Higher Education Ordinance, annex 2):

Degree of Licentiate

Knowledge and understanding

*For a **Degree of Licentiate** the third-cycle student shall demonstrate knowledge and understanding in the field of research including current specialist knowledge in a limited area of this field as well as specialised knowledge of research methodology in general and the methods of the specific field of research in particular.*

Competence and skills

*For a **Degree of Licentiate** the third-cycle student shall*
- *demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to plan and use appropriate methods to undertake a limited piece of research and other qualified tasks within predetermined time frames in order to contribute to the formation of knowledge as well as to evaluate this work*
- *demonstrate the ability in both national and international contexts to present and discuss research and research findings in speech and writing and in dialogue with the academic community and society in general, and*
- *demonstrate the skills required to participate autonomously in research and development work and to work autonomously in some other qualified capacity.*

Judgement and approach
*For a **Degree of Licentiate** the third-cycle student shall*
- *demonstrate the ability to make assessments of ethical aspects of his or her own research*
- *demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used, and*
- *demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning.*

Degree of Doctor

Knowledge and understanding
*For the **Degree of Doctor** the third-cycle student shall*
- *demonstrate broad knowledge and systematic understanding of the research field as well as advanced and up-to-date specialised knowledge in a limited area of this field, and*

- *demonstrate familiarity with research methodology in general and the methods of the specific field of research in particular.*

Competence and skills
*For the **Degree of Doctor** the third-cycle student shall*
- *demonstrate the capacity for scholarly analysis and synthesis as well as to review and assess new and complex phenomena, issues and situations autonomously and critically*
- *demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to plan and use appropriate methods to undertake research and other qualified tasks within predetermined time frames and to review and evaluate such work*
- *demonstrate through a dissertation the ability to make a significant contribution to the formation of knowledge through his or her own research*
- *demonstrate the ability in both national and international contexts to present and discuss research and research findings authoritatively in speech and writing and in dialogue with the academic community and society in general*
- *demonstrate the ability to identify the need for further knowledge and*
- *demonstrate the capacity to contribute to social development and support the learning of others both through research and education and in some other qualified professional capacity.*

Judgement and approach
*For the **Degree of Doctor** the third-cycle student shall*
- *demonstrate intellectual autonomy and disciplinary rectitude as well as the ability to make assessments of research ethics, and*
- *demonstrate specialised insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used.*

Subject-specific outcomes

The aim of doctoral studies in Computer Science is to prepare students for independent research and development work within academia or the business sector in Sweden as well as abroad that requires expertise and innovative abilities within the subject. This is achieved by students acquiring broad knowledge in the field of Computer Science, expertise in a specific sub-field, methodological skills and research experience.

3. Entry Requirements

The requirements for admission to third-cycle courses and study programmes are that the applicant meets the general and specific entry requirements, and is considered in other respects to have the ability required to benefit from the course or study programme.

3.1 General Entry Requirements

A person meets the general entry requirements if he or she has been awarded a second-cycle qualification, has satisfied the requirements for courses comprising at least 240 credits of which at least 60 credits were awarded in the second-cycle, or has acquired substantially equivalent knowledge in some other way in Sweden or abroad. The faculty board may permit an exemption from the general entry requirements for an individual applicant, if there are special grounds. (Higher Education Ordinance, Chap. 6)

3.2 Specific Entry Requirements

A person meets the specific entry requirements if he or she

- has completed a Degree of Master (60 ECTS credits) in Computer Science
- has completed a Degree of Master (120 ECTS credits) in Computer Science, or
- has completed a Master of Science Degree in Computer Engineering.

A person who, in some other way in the country or abroad has acquired equivalent knowledge, also meets the specific entry requirements.

4. Admission

Applications for admission to doctoral studies are processed in accordance with the procedures prescribed by Karlstad University's admission regulations.

5. Selection

Candidates will be selected based on their assessed capacity to successfully complete a programme at the doctoral level.

Only candidates who are deemed to have the capacity to successfully complete a programme at the doctoral level within a total of four years of full-time study will be admitted.
The assessment is based on the candidate's previous credits awarded, the quality of previous research or investigative work, and relevant work experience. In addition, an assessment is made of the candidate's general competence and personal qualities. In the case of equivalent qualifications, preference is given to candidates from the underrepresented gender among the research students in the subject. In this context, underrepresented gender means the gender that represents less than 40% of the students.

6. Content and Outline

The doctoral programme can lead to a licentiate or doctoral degree. The licentiate degree requires two years of study, the equivalent of 120 ECTS credits. The doctoral degree requires four years of study, the equivalent of 240 ECTS credits. The studies include course work as well as an independent project (licentiate or doctoral thesis).

To earn a licentiate degree, the candidate is required to complete 30 ECTS credits of course work and a thesis comprising 90 ECTS credits.

To earn a doctoral degree, the candidate must complete 60 ECTS credits of course work and a thesis comprising 180 ECTS credits.

Third-cycle students who intend to complete a doctoral degree are still advised to complete a licentiate degree halfway through their studies. If a student decides not to complete a licentiate degree, a halfway review should be carried out instead. The review should take place two years after admission or upon completion of the equivalent of two years of third-cycle studies, and its purposes include

- providing the student with feedback on their thesis work from experienced researchers with no connection to the student or their supervisor, and
- identifying potential areas of improvement.

Unlike a licentiate degree, a halfway review is not an examination. For that reason, it should take place when the third-cycle student is halfway through their studies rather than upon completion of any specific components.

6.1 Courses

Courses and other credit-bearing elements shall provide broader insights into the subject in addition to the expertise obtained through the research work. In the subject of Computer Science, a doctoral degree requires courses or other credit-bearing elements of 60 ECTS credits in total, and 30 ECTS credits for a licentiate degree. The exact distribution of courses and other credit-bearing elements must be stated in the individual study plan. Courses or other credit-bearing elements that are included in the programme can be completed both at and outside of Karlstad University. The examiner determines the number of ECTS credits that shall be transferred for courses or other credit-bearing elements, regardless of where they were obtained.

The courses for a doctoral or licentiate degree are divided into a compulsory part, which is the same for all students in the programme, and an elective part.
The purpose of the courses is to provide third-cycle students with an understanding of different research methods as well as a broader foundation within their own subject. They also aim to provide third-cycle students with the skills and knowledge that give a holistic perspective on the sciences, applications and realisation of technology.

Elective courses shall be selected based on the student's needs and be planned by the student in consultation with the principal supervisor, examiner and any assistant supervisor, and be included in the individual study plan. A substantial part of the elective courses shall be third-cycle courses: at least 50% of the courses for a licentiate degree and at least 60% of the courses for a doctorate. It is recommended that the elective courses include both subject-specific courses, complementary courses, as well as courses that introduce the research student to theoretical and practical methods relevant to research in Computer Science, e.g. statistics, queueing theory, cryptology, optimisation, experimental design, etc.

The course part of the degree may include courses with a specialisation in higher education pedagogy. Third-cycle students who intend to participate in teaching at first-cycle level are recommended to complete the course *Teaching at university: knowledge, learning and practical teaching (KLL)* or a corresponding course.

6.1.1 Degree of Licentiate

Mandatory courses for a Degree of Licentiate:

- *Introduction to Research Studies in Computer Science* (7DAV002),
- *Computer Science Colloquium* (7DAV001),
- *Philosophy and Theory of Science for Doctoral Students* (6HIS070),
- *Research Ethics for Doctoral Students, basic course* (7OMV002)

6.1.2 Degree of Doctor

Mandatory courses for a Degree of Doctor:

- *Introduction to Research Studies in Computer Science* (7DAV002),
- *Computer Science Colloquium* (7DAV001),
- *Philosophy and Theory of Science for Doctoral Students* (6HIS070),
- *Research Ethics for Doctoral Students, basic course* (7OMV002),
- *Peer Reviewing in Computer Science* (7DAV008)
- *Communicating Science* (HS 2017/142).

6.2 Licentiate and Doctoral Thesis

Third-cycle students are required to write a thesis for a doctoral or a licentiate degree, either as a monograph or as a compilation thesis.
Candidates are required to defend their licentiate thesis at a seminar and their doctoral thesis at a public examination. Further information is provided by Karlstad University's policy document Regulations for Third-Cycle Studies at Karlstad University (C2020/447). The topic of the licentiate or doctoral thesis is chosen in consultation with the supervisor and the examiner. Licentiate and doctoral theses in Computer Science are usually written in English.

If the licentiate or doctoral thesis is written in a language other than English, an English summary must be provided.

6.2.1 Licentiate Thesis

The licentiate thesis shall comprise 90 ECTS credits and be written either as a compilation thesis or a monograph. A compilation thesis consists of attached copies of a number of research articles, as well as an introductory chapter. The research articles may be written by the research student him-/herself or together with others, but the introductory chapter must be written independently by the research student. It should be possible to distinguish the contributions of the different authors in the included research articles. Parts or a summary of the research results shall meet the quality requirements for publication in internationally recognised journals and conferences with a review procedure. The summary shall consist of an introduction to the subject area of the licentiate thesis, as well as a presentation and discussion of the results in the research articles.

6.2.2 Doctoral Thesis

The doctoral thesis shall comprise 180 ECTS credits and be written either as a compilation thesis or a monograph. A compilation thesis consists of attached copies of a number of research articles, as well as an introductory chapter. The research articles may be written by the research student him-/herself or together with others, but the introductory chapter must be written independently by the research student. The majority of the research articles shall meet the quality requirements for publication in internationally recognised journals and conferences (with a review procedure), and it should be possible to distinguish the contributions of the different authors in the included research articles. The summary shall consist of an introduction to the subject area of the doctoral thesis, as well as a presentation and discussion of the results in the research articles.

6.3 Supervision

Doctoral students are entitled to a supervisor in accordance with the current admission regulations for third cycle education at Karlstad University.

6.4 Individual Study Plan

Each doctoral student must draw up an individual study plan in consultation with their supervisors at the start of their studies. The plan should include a realistic estimate of time for course work, thesis work and supervision as well as an introduction to the proposed research field, problem, aim, methodological and theoretical frames, and relevant ethical considerations.

The individual study plan shall use the form or system approved by the university.

The individual study plan is subject to continual written revision (at least once a year). If this results in changes in terms of timetable or project plan, the individual study plan must be revised.

Goal attainment of the research programme shall be reviewed on two occasions during the course of the programme. After one year, an individual goal matrix shall be formulated and added to the research student's individual study plan as an appendix.

One year before the planned date for the licentiate degree and two years before the planned date for the doctoral degree, the outcome of the individual goal matrix is evaluated in connection with the revision of the individual study plan. If the evaluation shows that the goal attainment is not satisfactory, the plan for the continuing studies will be revised to ensure that the national goals are met by the time of examination. A revised goal matrix is attached to the revised individual study plan.

6.5 Examination

Doctoral students are examined in accordance with the requirements of each individual course syllabus. Licentiate and doctoral theses are examined in accordance with the Higher Education Ordinance (Ch. 6, sect. 33–35) and Karlstad University's current regulations.