



Examensbevis/*Degree Certificate*

Jakob Nordström

har avlagt

Teknologie doktorsexamen

inom ämnet datalogi

och vid en offentlig disputation muntligen försvarat
en vetenskaplig avhandling

*has been awarded the degree of Doctor of Philosophy
in the subject area of Computer Science
after a public defence of a scientific thesis*

med titeln/*entitled*

Short Proofs May Be Spacious:
Understanding Space
in Resolution

utfärdat/*issued*

22 maj 2008

av rektor vid Kungliga Tekniska högskolan, KTH
by the President of the Royal Institute of Technology, Sweden

Peter Gudmundson



Examensbevis
Degree Certificate

Jakob Nordström

720411-0675

har i enlighet med bestämmelserna i högskoleförordningen (1993:100) för avläggande av teknologie doktorsexamen genomgått de kunskapsprov som ingår i utbildningen samt författat och vid en offentlig disputation, muntligen försvarat en vetenskaplig avhandling.

has, in accordance with the Swedish Higher Education Ordinance (1993:100) concerning the degree Doctor of Philosophy, passed the examinations included in the educational programme and publicly defended a scientific thesis.

Fordringarna för doktorsexamen är därmed uppfyllda den 9 maj 2008.

Requirements for the granting of a Doctor of Philosophy Degree have therefore been fulfilled on 9 May 2008.

Subjects	Credits	Date
Foundations of Cryptography	6.0	5 Sep 2002
Error Correcting Codes from a CS-Perspective	6.0	13 Mar 2003
Seminars on Theoretical Computer Science	6.0	17 Jun 2003
A Theorist's Toolkit	6.0	29 Sep 2005
Applied Pedagogy for Graduate Students	1.5	20 Dec 2005
Topics in Theoretical Computer Science, Circuit Complexity	6.0	18 Jan 2008
Transferred postgraduate courses		
Algebra from Stockholm University, Sweden	7.5	11 Mar 2002
Galois Theory, Advanced Course from Stockholm University, Sweden	7.5	11 Mar 2002
Semantics for Programming Language from Royal Institute of Technology, Sweden	6.0	11 Mar 2002
Mathematical Analysis, Advanced Course from Stockholm University, Sweden	7.5	11 Mar 2002
Theory of Distributed Systems from Royal Institute of Technology, Sweden	6.0	11 Mar 2002



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Subjects	Credits	Date
Complexity Theory from Stockholm University, Sweden	6.0	11 Mar 2002
Combinatorics, Advanced Course from Stockholm University, Sweden	7.5	11 Mar 2002
AVAL Advanced Algorithms from Stockholm University, Sweden	6.0	11 Mar 2002
Number Theory, Specialized Course from Stockholm University, Sweden	7.5	15 Sep 2002

Avhandlingens titel/*Title of thesis:*

Short Proofs May Be Spacious:
Understanding Space in Resolution

Handledare/*Supervisor/s:*
Professor Johan Håstad

Stockholm, Sweden 22 maj 2008

Susanne Öster
KTH, Examen/Degree Administration Office

For a verification of this Degree Certificate contact the Degree Administration Office at examen@kth.se



DIPLOMA SUPPLEMENT

This Diploma Supplement model was developed by the European Commission, Council of Europe and UNESCO/CEPES. The purpose of the supplement is to provide sufficient independent data to improve the international "transparency" and fair academic and professional recognition of qualifications (diplomas, degrees, certificates etc.). It is designed to provide a description of the nature, level, context, content and status of the studies that were pursued and successfully completed by the individual named on the original qualification to which this supplement is appended. It should be free from any value judgement, equivalence statements or suggestions about recognition. Information in all eight sections should be provided. Where information is not provided, an explanation should give the reason why.

1. INFORMATION IDENTIFYING THE HOLDER OF THE QUALIFICATION

- 1.1 Family name: Nordström
- 1.2 Given name: Jakob
- 1.3 Date of birth (day/month/year): 11 April 1972
- 1.4 Civic registration number: 720411-0675

2. INFORMATION IDENTIFYING THE QUALIFICATION

- 2.1 Date of issue: 22 May 2008
- 2.2 Name of qualification and (if applicable) title conferred (in original language):
Teknologie doktorsexamen.
- 2.3 Name of qualification and (if applicable) title conferred in official translation to English:
Degree of Doctor of Philosophy.
- 2.4 Main field(s) of study for the qualification: Computer Science.
- 2.5 Name (in original language) and status of awarding institution:
Kungliga Tekniska högskolan, (state higher education institution with status of university)
- 2.6 Name (in original language) and status of institution (if different from 2.5) administering studies:
Not applicable.
- 2.7 Language(s) of instruction: Swedish and English.

3. INFORMATION ON THE LEVEL OF THE QUALIFICATION

- 3.1 Level of qualification: Third level education.
For more information on higher education in Sweden, please see point 8, appendix 2.
- 3.2 Official length of programme: A degree of Doctor is obtained after the research student has completed an educational programme of 240 higher education credits in a subject of education at the third level of higher education.
For a degree of Doctor the research student must have received a passing grade on a scholarly dissertation (doctoral dissertation) worth at least 120 higher education credits.

- 3.3 Access requirement(s): A person has basic eligibility for third level education if he or she 1. has taken a second level qualification, 2. has completed course requirements of at least 240 higher education credits, including at least 60 higher education credits at second level, or 3. has acquired essentially corresponding knowledge in some other way in Sweden or abroad. The faculty board may permit an exemption from the requirement of basic eligibility in the case of an individual applicant, if there are special grounds.

4. INFORMATION ON THE CONTENTS AND RESULTS GAINED

4.1 Mode of study: Full-time equivalent.

4.2 Degree requirements:

Higher Education Ordinance (SFS 1993:100) Degree of Doctor (Doktorsexamen)

Scope

A degree of Doctor is obtained after the research student has completed an educational programme of 240 higher education credits in a subject of education at the third level of higher education.

Objectives

Knowledge and understanding

For a degree of Doctor research students must

- demonstrate broad knowledge in and a systematic understanding of the field of research, together with deep and up-to-date specialist knowledge in a defined part of the field of research; and - demonstrate familiarity with scholarly methods in general and with methods in the specific field of research in particular.

Skills and abilities

For a degree of Doctor research students must

- demonstrate an ability to engage in scholarly analysis and synthesis and in independent, critical examination and assessment of new and complex phenomena, issues and situations; - demonstrate an ability to identify and formulate issues, critically, independently and creatively, and proceeding with scientific precision, and to plan and, using appropriate methods, conduct research and other advanced tasks within specified time limits, and to scrutinise and evaluate such work; - demonstrate, in a dissertation, their ability to make a substantial contribution to the development of knowledge by their own research; - demonstrate an ability to present and discuss research and research results with authority, in dialogue with the scholarly community and society in general, orally and in writing, in both national and international contexts; - demonstrate an ability to identify their need of further knowledge; and - demonstrate a potential to contribute to the development of society and support other people's learning, both in the field of research and education and in other advanced professional contexts.

Judgement and approach

For a degree of Doctor research students must

- demonstrate intellectual independence and scholarly integrity and an ability to make ethical assessments relating to research; and - demonstrate deeper insight into the potential and limitations of scholarship, its role in society and people's responsibility for how it is used.

Scholarly dissertation (doctoral dissertation)

For a degree of Doctor the research student must have received a passing grade on a scholarly dissertation (doctoral dissertation) worth at least 120 higher education credits.

Other

For a degree of Doctor with a certain area of specialisation more precise requirements are also to apply, as determined by each higher education institution itself within the framework of the requirements in this qualification description.

Local Regulations

Doktorsexamen – Doctorates – are awarded after completion of studies within one of KTH's subjects at postgraduate level. Studies encompass 240 credits.

In addition to a scientific dissertation/thesis of at least 120 credits, doctorates include courses of at least 60 credits. The syllabus for the subject may require more credits from the course component. Of the total course component, at least 60 percent must be at postgraduate level.

Courses at undergraduate level within the academic area of engineering may not be included in this degree. For students with qualifying educational programmes other than the engineering background, deviations may be made from this requirement. Students with such educations may, to a certain extent, utilise courses outside the academic area of engineering as replacements for compulsory courses in the syllabus for the subject. This is to be documented in the student's individual course plan.

Additional goals within the framework of the Higher Education Ordinance Degree procedures (HF Annex 2) and the goals stated in this local degree procedure are established by the Faculty Board in the syllabus for the subject at postgraduate level. For detailed information on programme goals please refer to each syllabus. This degree is entitled "Teknologie doktorsexamen" (PhD). In individual cases nomenclature other than "teknologie" may be used. Such decisions are to be taken by the President.

- 4.3 Programme details (e.g. modules or units studied), and the individual grades/marks/credits obtained: See degree certificate/Official transcript.
- 4.4 Grading scheme and, if available, grade distribution guidance: Not applicable.
- 4.5 Overall classification of the qualification (in original language): Not applicable for Swedish degrees.

5. INFORMATION ON THE FUNCTION OF THE QUALIFICATION

- 5.1 Access to further study: Not applicable.
- 5.2 Professional status (if applicable): Not applicable.

6. ADDITIONAL INFORMATION

- 6.1 Additional information: Admitted to studies at the third level (doctoral studies) according to transitional provisions. The holder of the degree met general requirements for admission before 1 July 2007.
- 6.2 Further information sources:

Swedish National Agency for Higher Education (Högskoleverket) has been commissioned to act as the Swedish ENIC/NARIC. The NARIC/ENIC office provides information on education in Sweden. The address to the Agency is Swedish National Agency for Higher Education (Högskoleverket), P.O. Box 7851, SE-103 99 Stockholm, phone + 46 8 563 085 00, fax + 46 8 563 086 50 www.hsv.se

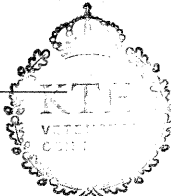
Kungliga Tekniska högskolan, KTH (Royal Institute of Technology), Valhallavägen 79
SE-100 44 Stockholm, Sweden, www.kth.se

7. CERTIFICATION OF THE SUPPLEMENT

- 7.1 Date: 22 May 2008
- 7.2 Signature and official stamp or seal (if used)



Susanne Öster



- 7.3 Capacity: Official Responsible for Degrees

8. INFORMATION ON THE NATIONAL HIGHER EDUCATION SYSTEM

(The following description is approved by the National Agency for Higher Education)

GENERAL

Higher education institutions have great autonomy in the organisation of studies, use of resources and general administration. The Government may award the status of university to higher education institutions that meet certain criteria. Independent higher education providers may be recognised by the Government, obtain the right to award degrees and receive state subsidies. Diplomas from all higher education institutions that are recognised by the Government have equal official value. The same law governs all state higher education institutions. All Swedish degrees are issued in accordance with the same degree ordinance.

QUALITY ASSURANCE

The Swedish National Agency for Higher Education is responsible for quality evaluation.

All programmes and major subjects have been evaluated during the six-year period 2001-2007. The Swedish National Agency for Higher Education has also completed two rounds of quality audits of higher education institutions. Evaluation reports are public.

ACCESS AND ADMISSION TO HIGHER EDUCATION

Higher education at all levels has two strata of eligibility: general/basic and (additional) specific requirements. General eligibility to the first level is the same for all higher education. General eligibility is attained either by a) completing an upper-secondary school programme and obtaining a Pass grade or better in courses comprising at least 90 percent of the credits required for the programme, or b) having the potential to benefit from the education, by virtue of other education, practical experience or other circumstances. People who are at least 25 years old, who have been employed for four years and have a command of English and Swedish corresponding to that obtained by completing a national upper-secondary programme are also considered to have general eligibility. The specific requirements vary according to the field of higher education and are expressed in terms of upper-secondary school qualifications in specific subjects. Restricted admission is used for all study programmes and courses.

ENTITLEMENT TO AWARD DEGREES

The Swedish National Agency for Higher Education decides which state institutions may grant permission to award degrees at the first and second level. All state higher education institutions may award general degrees at the first level and *magisterexamen*. General permission to grant *masterexamen* and degrees at the third level may be given to higher education institutions in the fields in which they are permitted to offer the third level degrees. Other institutions may be permitted to award *masterexamen* after appraisal and official recognition of their academic standards.

There are no general rules for permission to grant professional degrees. The Swedish National Agency for Higher Education is responsible for giving permission to award professional degrees after reviewing applications to do so.

DEGREES

Higher education in Sweden is divided into three levels; the first, second and third. All degrees are awarded at one of these levels. Higher education at the first and second levels is provided in the form of courses. Courses may be grouped together into programmes with varying levels of individual choice. Students themselves are also able to combine different

courses towards a degree. A course syllabus is required for each course at the first and second level and a curriculum for

each degree programme. Educational level and intended learning outcomes have to be specified for each course. Sweden has a system of higher education credits (*högskolepoäng*); a normal 40-week academic year corresponds to 60 higher education credits. The system is compatible with ECTS credits.

In the Degree Ordinance, the Government has laid down which degrees may be awarded and the objectives as well as intended learning outcomes for these degrees. In the Swedish higher education system there are generally no intermediate qualifications. All degrees are regarded as final qualifications, even if there is a possibility to continue studying. Degrees are divided into general degrees and professional degrees. Translations into English of all degree names are regulated at the national level. An institution of higher education may decide that a discipline precedes a degree name e.g. *filosofie kandidatexamen* or *medicine doktorexamen* or/and add a major subject/field of studies e.g. *civilingenjörsexamen i maskinteknik*.

GENERAL DEGREES

FIRST LEVEL:

1. *Högskoleexamen* (University Diploma) requires 120 higher education credits and a diploma project. The corresponding degree in artistic disciplines is *konstnärlig högskoleexamen* (University Diploma in).
2. *Kandidatexamen* (Degree of Bachelor) requires 180 higher education credits with a defined main field of studies determined by each higher education institution itself. At least 90 higher education credits with increasingly in-depth studies including a diploma project of 15 higher education credits have to be completed in the main field of study. The corresponding degree in artistic disciplines is *konstnärlig kandidatexamen* (*Degree of Bachelor of Arts in*).

SECOND LEVEL:

1. *Magisterexamen* (Master's Degree - One Year) requires 60 higher education credits with a defined main field of studies. At least 30 credits have to be completed in the main field of study including a thesis of 15 credits. In addition, normally the student must hold either a *kandidatexamen* or a professional degree of at least 180 higher education credits or an equivalent foreign degree. *Konstnärlig magisterexamen* (Degree of Master of Arts - One Year) is awarded in artistic disciplines.
2. *Masterexamen* (Degree of Master (Two Years)) requires 120 higher education credits with a defined main field of studies. At least 60 credits have to be completed in the main field of study including a thesis of 30 credits. In addition, in general, the student must hold either a *kandidatexamen* or a professional degree of at least 180 higher education credits or an equivalent foreign degree. *Konstnärlig masterexamen* (Degree of Master of Arts (Two Years)) is awarded in artistic disciplines. The most advanced courses for *Masterexamen* may be accepted as partial fulfilment of the requirements for a doctoral programme.

General admission requirements to general degrees or degrees in arts at the second level are: degree at the first level of at least 180 higher education credits or a corresponding foreign degree. In addition, admission may be granted to an applicant who has the potential to benefit from the education, by virtue of other educational achievements, practical experience or other circumstances.

PROFESSIONAL DEGREES:

Professional degrees are awarded in the fields of engineering, health care, agriculture, law, education, etc. Professional degrees may be awarded at either the first or the second level. With a few exceptions, general entry requirements to professional degrees are the same as to the first level. There are about 40 professional degrees. Programmes

leading to professional degrees vary in length depending on their character.

THIRD LEVEL:

The Faculty Board decides which subjects may be offered at the third level. For every subject, a general study plan should be drawn up and approved by the Faculty Board. The study plan must state the principal organisation of the studies, the specific admission requirements, the examinations required towards the degree and whether the study programme may end with the award of a *licentiatexamen*.

Two degrees are offered in the third level:

1. *Licentiatexamen* (Degree of Licentiate) requires at least 120 higher education credits including a thesis of at least 60 credits. The Faculty Board may also decide that a *licentiatexamen* can be awarded as an intermediate degree towards *doktorsexamen*.

A person who met general requirements for admission before 1 July 2007 should be considered as eligible for admission until 30 June 2015.

2. *Doktorsexamen* (Degree of Doctor) requires 240 higher education credits including a thesis of at least 120 credits. The thesis has to be defended publicly.

Admission requirements to the third level are:

The applicant has to be deemed to have ability to benefit from the education.

General requirements to the third level are: 1. a second level degree or 2. completed course requirements of at least 240 higher education credits of which 60 credits at the second level or 3. equivalent level of knowledge acquired in Sweden or abroad. Transitional provisions: 1 July 2007 should be considered as eligible for admission until 30 June 2015.

The general requirements before 1 July 2007 were:

1. completed undergraduate programme of at least 120 credits (equivalent to 180 higher education credits) or
2. largely equivalent knowledge acquired in some other system in this country or abroad.

GRADING

The Higher Education Ordinance states that the following grades may be awarded: Pass with Distinction (*väl godkänd*), Pass (*godkänd*) or Fail (*underkänd*) unless the institution decides to grade on some other scale. A number of courses use only two grades: Pass or Fail. Others, for example in Law and Engineering, traditionally use scales with several levels - expressed as letters or numbers. No overall grade is given for a degree and students are not ranked.

THE SWEDISH HIGHER EDUCATION SYSTEM HSVFS 2007:5

