2013 New Master's degree students at the Department of Computer Science at the University of Helsinki

Introduction

Welcome to begin your Master's degree studies at the Department of Computer Science at the University of Helsinki! This document will give you some information on studying at our department, and it especially describes what kind of skills we assume that you have at the beginning of your studies. This document also contains a couple of preliminary assignments that we want you to complete during the summer before autumn term 2013 begins. Submit your essay assignment in a PDF format by the 19th of August 2013 to cs-msc-programmes@cs.helsinki.fi. (Draft deadline: 1st July)

Studying at the Department of Computer Science

The University of Helsinki is a strongly research-oriented university, which shows in our teaching and the skills required from our students. In addition to the basic skills of understanding and remembering, we expect you to be able to apply your new skills and knowledge to different problems as well as to analyze, evaluate, and create new information based on existing material. (See Bloom's taxonomy or its newer modification about the terms.)

You will be in charge of your studies. You are the manager of your own studies. Teachers will share their knowledge and create tasks that help you to practice the things to be learned, but they are not responsible for your learning. You must demonstrate your knowledge and skills in exercises and exams, as well as in the projects you are given during your studies. And you need to be able to reflect on your learning and improve those skills you do not yet master to pass the exams and the essays. We do expect you to be able to apply the knowledge, simply repeating the content will not even allow you to pass the courses. The depth of required knowledge surprises new Master's students every year.

The academic year at the University of Helsinki consists of two terms: an autumn term and a spring term. Some courses are also held during summer, but this mainly applies to courses at the Bachelor's level. Both the regular terms have two teaching periods that are seven weeks long (6 weeks for lectures and exercises and one week for exams). This means that the periods at the University of Helsinki are very intensive, and that our students have only a limited amount of time for learning things and adapting to the learning styles required. Some international Master students have found this very challenging, because our teaching and learning styles can be very different from what they were used to in their earlier education. For example, we expect our students to be in charge of their learning. This means that there are very few obligatory classes/sessions, but the lectures and exercise sessions are, of course, very useful for learning. Still, most of the learning happens outside the classrooms. A student who is not able to self-control his or her learning, might find it difficult to work and proceed with his or her studies properly.

Here is a more detailed list of the skills that we expect our Master's degree students to have:

- Independent problem-solving capabilities

In our courses, you typically get several exercise tasks per each week (typically 5-10 tasks per course per week). To prepare for this, see the more demanding exercises in almost any university-level course book. As you will be in several courses at the same time, this means that you are expected to solve dozens of such problems in total during each week. In addition to weekly exercises, or instead of them, you may need to write essays or implement small programs, etc.

Please note that you are expected to discuss the problems and your solutions or any difficulties encountered on the way with the teachers. The discussions require initiative on your part. Our teachers are not monitoring your progress, their assumption is that if you encounter a problem, you will be the active party and ask for help.

- Initiative

You are expected to contact teachers and instructors, if you encounter a problem. They are willing to help you, but they do not know the problem, unless you verbally present it to them. Teachers like to discuss matters with students, and most of the former students have said that they should have contacted the teachers earlier with their problems. However, please make an appointment with the teachers in advance.

University instructor, study advisor Tiina Niklander can guide you when you do not know whom to contact about the problem.

- Time management

You are in charge of your studies and learning, and you are the only person, who knows how much work you can handle during the periods. (To a certain limit, you are allowed to expand your study time and have slightly less courses for each period.) You must create your own study schedule and follow it. There are very few obligatory teaching sessions, and the focus is on the learning objectives and not on participation. This does not mean that you should not be present in class, it only reflects the fact that you are in charge of your studies. Be on time for all meetings, Finns are very punctual on that.

You must create your own weekly time table of class hours and individual study times. You also need to reserve time for exercises and reading in your time table. A four-credit course requires on average 100-120 hours of studying. This includes both the contact hours and individual study time. To be able to proceed at the expected pace, you must be efficient and be able to do the exercises in the time limit you gave yourself. Make sure that you use your time wisely.

- Communication skills

The teaching in our Master's degree programmes is given fully in English. You are expected to be able to communicate fluently in English with your fellow students and teachers both orally and in writing. This holds for lectures, exercises, scientific writing, as well as seminar presentations and discussions. Especially, if you are unclear in your written English, that may cause you reduced grades, because the majority of our courses will be graded based on written material, that is, exams or essays. Make sure that you practice your writing. You can use the

summer essay for this. All essay drafts submitted on 1 July 2013, at the latest will be read and you will receive feedback to improve it.

- Strong programming skills

You are expected to be able to implement a program of hundreds (or even thousands) of lines. The strongly modular program must be commented and written in a style that makes it easy for others to read and modify. Structures like lists, trees, arrays, etc. with their handling algorithms should be something you know by heart. Networking and services students are also expected to know how to write a network program. That is a program that has two parties, a client and a server, on separate computers, and those parties are communicating with each other for a joint task. The programming language is not an issue, these skills are common to all languages, and if you master one or two languages, it is easy to learn new ones.

To check your programming skills during the summer, you should take our first-period bachelor course 'Object-Oriented Programming with Java, Part I'. The course is offered as massive open online course (MOOC) in English, so you can do it at your own pace during the summer. See mooc.fi for information about the course. *Please notice, that if you are struggling with this first bachelor-level course, then the University of Helsinki may not be the place to continue your education.* This course represents the starting point and our own students build a lot more skills on top of this first course. You are expected to have the same skills from your previous education.

- Mathematical skills

Our Master's students are assumed to have strong mathematical skills. Knowledge of statistics is also important in studies at our department. This holds especially for students in the programme on Algorithms and Machine Learning.

- Scientific reading and writing

At our department, we expect our students to be able to read scientific articles (published in scientific journals and conference or workshop proceedings), and to write seminar papers, conference papers and a thesis following the writing practices used in science. That is, finding references, using proper citation techniques, following the ethical writing practices, structuring the text properly, etc. If this is totally new for you, you should consider reading a book about scientific writing. In our Bachelor-level studies, the students use Justin Zobel's book "Writing for Computer Science" for this purpose. If you are not able to access the book, you can read any other book about scientific writing or one of the net guides, like the Writer's handbook from the University Wisconsin-Madison at http://writing.wisc.edu/Handbook/index.html, for example. Make sure that you know the scientific writing practices before arrival. You will need to demonstrate them immediately after arrival. *If you are not able to write good quality scientific text in English from the beginning, you will not be able to graduate within two years.* You will only get a limited number of opportunities to improve your skills on this.

- Computer skills

Our classrooms have Linux computers. You are expected to be able to fluently use them immediately after your arrival. Linux is freely available, so our recommendation is for you to

install it and start using it immediately. Knowing how to use a Linux computer will be really important for you during your studies.

You will also do a lot of your projects using remote computers with only a text-based shell interface to command them. *If you have never used shell, please learn the basic skills on how to operate a computer with keyboard only*. Our first-year bachelor students do a course called 'Introduction to the Use of Computers'. Do not be misled by the course name, it contains a lot of issues that have been very difficult for the Master students of previous years. See last year's exercises and make sure that you master the content: http://blogs.helsinki.fi/tyovaline-2012/in-english/. You must do the course in September, but learning the content from the beginning at the same time with a full workload from other courses may be too much. You can however, study the content in advance and just demonstrate your skills after arrival. *If you do not understand what remote access to a computer means and cannot do that using text-based interface, then again you may need to consider another university to continue your studies there.*

Preliminary assignments for summer 2013

There will be six assignments for the summer 2013 in decreasing order of priority.

1. Write an essay – submission deadline 19th August, 2013. If you miss the deadline you are expected to participate in the course "Academic Writing for Students in English-Medium Master's Degree Programmes 1" during Period 1. *Guidance available for drafts submitted by 1st July* (Feedback by 15th July). – Draft submission recommended
2. Create your study plan and time table for the first period – bring it with you when you arrive or send by email before arrival
3. Check your basic programming skills and do the MOOC course (see mooc.fi)
4. Practice your computer skills, especially the Linux command-line interface called shell. As soon as September during your weekly exercises, you may need to use remote computers to do some tasks for you. You will not have time to learn these basic skills at that point.
5. Study the learning objective matrices of our department
6. Read several scientific articles. Pay attention to the presentation style in addition to the content.

Make sure that you submit your essay on time to cs-msc-programmes@cs.helsinki.fi in PDF format.

1. Write an essay

Our experience is that scientific reading and writing are skills that most students need to improve. You will have several opportunities for this during your studies, but it is a good idea to start working on these skills immediately. That is to start to learn to become an expert, who is able to find scientific articles on a given topic and who is able to read, understand and use the material in them.

Our Master students are expected to have some basic level of scientific writing skills from the beginning. There is a special scientific writing course in the first period. During that course you will write one scientific article (10-15 pages) based on existing articles. To estimate your starting level and to prepare suitable teacher resources for this course, you need to write and submit a scientific essay following all the scientific writing practices you are able to use already.

Your essay (1-2 pages, 500-800 words) must have a title, your name, email address and a list of references. Remember to use proper citations. Make sure that you write in your own voice and do not directly copy any sentences from the article. This is important, primarily, for you to improve your own presentation and, secondarily, because copying is considered cheating!

If you do not know what an essay is, please see the following page, for example:
http://www1.aucegypt.edu/academic/writers/

We will grade the courses on the scale 0-5, 0 fail and 5 best grade. When we transfer the scale to essays, it would mean something like this in essay grading:

0. Failed. Not submitted, wrong content, did not follow the instructions, cut-and-paste material, … There can be several reasons why the essay does not fulfill the minimum acceptance criteria.
1. Weak, barely acceptable, essay that omits several aspects. Poor language.
2. Structurally OK essay, but still missing some required aspects.
3. Satisfactory essay that fulfils the (minimum) requirements and shows some individual thinking and/or deeper knowledge. Proper language.
4. Fine essay that follows the scientific writing practices properly and discusses the required aspects and clearly shows individual thinking.
5. Excellent essay that clearly shows that the student masters the content and scientific writing practices very well. Excellent language.

Essay Topic Alternatives:

Here are your alternatives. Select an article from your own specialization area that you are most interested in. You can find the PDF copies of the articles at http://www.cs.helsinki.fi/u/niklande/papers/summer2013/. If you are not able to access the article you want to write about, please ask cs-msc-programmes@cs.helsinki.fi for the article and we will send you a PDF copy.

Remember to write your own essay in your own voice. Remember that you are required to write a full essay, not just answers to these or similar questions. It is very important that you use a scientific writing style and justify all your claims carefully.

Algorithms and Machine Learning:

1. Compression of weighted graphs. Based on the article *H. Toivonen, F. Zhou, A. Hartikainen, and A. Hinkka: Compression of weighted graphs. In Proceedings of the 17th ACM SIGKDD international conference on Knowledge discovery and data mining (KDD '11). ACM, 2011, pp. 965-973* write your own essay about the basic ideas of the paper and your own ideas on this matter. You may consider questions like

- How do you see this matter?
- What is the article's key point? Argue for and against its feasibility.
- What are the key principles on which the compression algorithm is based? Why?
- Would you be interested in using this algorithm? Why / why not?
- What other application areas do you think would be suitable for these technologies? Why?
- …

2. Significant matches of position weight matrices. Based on the article *C. Pizzi, P. Rastas, and E. Ukkonen: Finding Significant Matches of Position Weight Matrices in Linear Time. IEEE/ACM Transactions on Computational Biology and Bioinformatics 8, 1 (January 2011), pp.*

69-79 write your own essay about the basic ideas of the paper and your own ideas on this matter. You may consider questions like

- How do you see this matter?
- What is the article's key point? Argue for and against its feasibility.
- What are the key interface technologies used in the prototype? Why?
- Would you be interested in using this application? Why / why not?
- What other application areas do you think would be suitable for these technologies? Why?
- …

3. Semi-supervised learning for WLAN positioning. Based on the article *T. Pulkkinen, T. Roos, and P. Myllymäki: Semi-supervised learning for WLAN positioning. In Proceedings of the 21th international conference on Artificial neural networks - Volume Part I (ICANN'11), Timo Honkela, Duch Włodzisław, Mark Girolami, and Samuel Kaski (Eds.), Vol. Part I. Springer-Verlag, Lecture Notes in Computer Science, 2011, Vol. 6791, pp.355-362.* write your own essay about the basic ideas of the paper and your own ideas on this matter. You may consider questions like

- How do you see this matter?
- What is the article's key point? Argue for and against its feasibility.
- How does the method work? Why?
- Would you be interested in using an application doing this? Why / why not?
- What applications do you think would benefit from this method? Why?
- …

Networking and Services:

4. Collaborative energy debugging. Based on the article *Adam J. Oliner, Anand Iyer, Eemil Lagerspetz, Sasu Tarkoma, and Ion Stoica*: *Collaborative energy debugging for mobile devices. In Proceedings of the Eighth USENIX conference on Hot Topics in System Dependability (HotDep'12). USENIX Association, Berkeley, CA, USA, 2012* write your own essay about the basic ideas of the paper and your own ideas on this matter. You may consider questions like

- How do you see this matter?
- What is the article's key point? Argue for and against its feasibility.
- Which communication technique would your choose to use in such a situation, if they were all available? Why?
- Would you be interested in using this application? Why / why not?
- What other application areas do you think would be suitable for this method? Why?
- …

5. Floating content. Based on the *article J. Ott, E. Hyytiä, P. Lassila, T. Vaegs and J. Kangasharju: Floating Content: Information Sharing in Urban Areas. 2011 IEEE International*

Conference on Pervasive Computing and Communications (PerCom), IEEE, 2011, pp. 136-146 write your own essay about the basic ideas of the paper and your own ideas on this matter. You may consider questions like

- How do you see this matter?
- What is the article's key point? Argue for and against its feasibility.
- What kinds of information do your think would have the longest floating times? Why? Give an example (if possible)
- What kind of application or test scenario would you like to build using this idea? Why?
- How would you attract users for such an application or test?
- …

6. Mobile interfaces for energy awareness. Based on the article *A. Spagnolli, N. Corradi, L. Gamberini, E. Hoggan, G. Jacucci, C. Katzeff, L. Broms and L. Jönsson: Eco-Feedback on the Go: Motivating Energy Awareness. IEEE Computer, May 2011, pp. 38-45* write your own essay about the basic ideas of the paper and your own ideas on this matter. You may consider questions like

- How do you see this matter?
- What is the article's key point? Argue for and against its feasibility.
- What are the key interface technologies used in the prototype? Why?
- Would you be interested in using this application? Why / why not?
- What other application areas do you think would be suitable for these technologies? Why?
- …

2. Create your own study plan

You need to know what courses you are planning to take during your studies. During the autumn term you need to create a personal study plan for your whole Master's degree. This initial planning task is to plan your studies for autumn term 2013.

Find the course list on the department web pages. Find also your degree requirements there. When you read the degree requirements, please make sure that you access the requirements for 2012 and not the older ones. There are some differences in the requirements. Select courses for periods 1 and 2 in such a way that the total number of credits per period is approximately 15-16. Please notice that some courses span over both periods and some courses cover just one period. In addition to the obligatory courses, select the optional courses that are most interesting to you. Do not forget possible studies in minor subjects (like mathematics and statistics) or other studies (Finnish and English language courses, scientific writing, orientation, etc.).

Suggested studies in the First period:

- 97000 Orientation to studies (starting at August 28, active participation in all orientation events like Welcome Fair, tutoring etc., including feedback form) – Arrive on time!

- 581324 Introduction to the use of computers
- 993734 Academic Writing for Students in English-Medium Master's Degree Programmes 1 (if you have not submitted the summer essay or the coordinator asks you to do it)
- 582519 Scientific Writing for MSc in Computer Science
- 582510 Personal Study Plan
- 582417 Distributed systems (for NESE students, available for all)
- 582630 Design and Analysis of Algorithms (for Algorithm students, available for all)
- 58127 C-programming (for NESE students, if not in Bachelor degree, available for all)
- 582206 Models of Computation (for all, if not in Bachelor degree)
- Mathematics studies (for Algorithm students, available for all) – you can find courses on the pages of the Department of Mathematics, please negotiate with the study advisor
- One (or two) optional (advanced) courses of your own choice, if the target of 15 credits is not filled otherwise.

Make your own weekly timetable based on the courses you select. Mark in it all your lectures and exercises. Reserve enough time for individual study outside the class times. The rule of thumb used at the department is to reserve the same amount of time for solving weekly exercises and reading material as is used for lectures and exercise sessions. Enter the individual study times in your calendar along with which course you will be studying during that period.
In the case of Paja, enter the times when there is guidance available and select the most suitable times for you, starting with the earliest possible times. Here you do not need to reserve that much time for working outside Paja, but you can do that.

Studies in the later periods:
Part of your personal study plan. See the department's study guide for general instructions. No specific model available. Goal 30 credits each term. If the first year is done properly, plan to start your thesis during the 4th period of your first year. You must start your thesis at the beginning of your second year, at the latest, or be prepared not to graduate in two years. For graduation in two years, the thesis must be submitted for grading at the latest in April of the second spring.
582351 Linux Fundamentals in Period 2 is a must for students who are not fluent in script languages and shell programming. You are expected to have the skills in several lecture and project courses without any guidance during those courses.

Personal Study Plan:
The degree requirements in computer science at the University of Helsinki contain a lot of options. Every graduating Master has their unique set of courses and, thus, unique expertise. Masters are experts and there is a good reason to avoid identical experts. This means that you must from the very beginning know what your future career goals are, and make your course selections in such a way that they support your goal. As a short-term goal, your course selection must support your Master's thesis. If you do not know your interests yet, then you are expected to figure them out during the courses you select in your first year.
So write in your plan your short- and long-term goals first, and then let your course selection reflect them.

3. Programming skills

There are several courses in our Bachelor program to improve the programming skills of our own students. The very first course is now offered also in English via mooc.fi to show you how we start our education. One of the later key courses in the skill-building is the 'Data Structures and Algorithms'. Read the learning objective matrix. *If you have never studied this kind of course, then you might not be able to succeed in your studies here at University of Helsinki.* Please note that the course is not offered in English. All the material is available only in Finnish. The course book is in English. You can find exercises from the earlier course version, year 2008, on page http://www.cs.helsinki.fi/u/jkivinen/opetus/tira/k08/ However, the course has been modified heavily after that.

For a computer science Master student, especially networking and services, the following question should be trivial to solve: A randomly selected question from *Kurose&Ross: Computer networking:* "Write a simple TCP program for a server that accepts lines of input from a client and prints the lines on the server's standard input. [To test your program, write a simple client program that connects to it and sends some lines of text to the server. As next step,] on any other machine [than the one running your server program] that contains a Web browser, set the proxy server in the browser to the host that is running your server program; also configure the port number appropriately. Your browser should now send its GET request messages to your server and your server should display the messages on its standard output." If you do not know how to solve this question, you need to learn the basics of network programming or choose a different university to continue your studies. You already need these skills in the distributed systems course during the first autumn and its project in spring.

4. Computer usage

If you have only been using computers via a graphical user interface, now is a good time to start learning how to use a command line interface, as well, and learning the shell commands. You must also learn scripting and shell programming. There will be a course about these called Linux Fundamentals available in Period 2, but learning the basics during the summer will make your adjustment to our department services a bit easier. The course Linux fundamentals assumes that you know the command-line interface usage well and have written some simple scripts.

If you have never used Linux or UNIX computers, you need to work really hard during the summer to improve your skills to meet our minimum requirement level. Install the Linux operating system to your computer and start using it. You need to master the command-line interface, so only learning one of the several graphical interfaces for basic use of Linux, is not enough. You need to master commands like bash, ssh, cp, ls, bg, fg, head, tail, cat, more, popd, chmod, pwd, grep, find, kill, du, diff – just to name few of them. If you have never used these you need to study them with their parameters. Also learn pipes and the basics of regular expressions and one text-based editor like GNU emacs or nano. When you can demonstrate

and explain how the commands and tools are used and which the most common parameters of the commands are, then you have the same skills as our second-year Bachelor students.

5. Study the learning objective matrices

Our department uses the learning objective matrices as a tool to define the learning outcomes of each course. These matrices represent the learning goals for students and evaluation guidelines for teachers. There is a matrix for every stable course. Some advanced-level courses do not have one, because they are continuously changing or have been lectured only a few times.

You can find the matrices on the web page of each course. The link to the matrix is always located on the left-hand side column.

6. Read scientific articles

Read at least one, but preferably several published journal or conference papers during the summer. Get yourself accustomed to the writing style used in those articles and the way they justify all their claims and arguments about their findings. You can find a lot of suitable articles in the references lists of the articles mentioned in this document.

While reading the articles, think about questions like these and try to answer them. You can even make notes for yourself:

- What is the goal / construction of this article?
- What is the research area considered in the article? What are the typical challenges in that area?
- What is the specific research question in this article?
- What are the assumptions or hypotheses of the authors?
- How is the research question studied, validated and justified?
- What are the main results presented in the article?
- What did you learn from the article?
- Did you find any mistakes or flaws in the research done? – This can happen.
- What key words are related to the article? What phrases would you use to find more information on the topic of the article?
- Who are the authors of the article? Where would you start searching for more information on them?

Please note that all articles do not contain answers to all of these questions. Some may have omitted parts of the process, or selected a different approach. In such a case, you will need to apply the question, or clarify why the article does not cover this issue.