

Summer assignments (tasks) and instructions for 2014 new Master's degree students at the Department of Computer Science, University of Helsinki

Tiina Niklander, June 2014

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 2014 begins. These assignments include writing a short scientific essay and creating your own study plan for the first period.

The deadline for your essay submission is the 15th of August 2014. Please submit your scientific essay in PDF format to tiina.niklander.hy@analyysi.urkund.fi. The address goes to the automatic plagiarism detection used at the University of Helsinki. Do not worry too much about the plagiarism issue in this submission. I am using the address, just to give you feedback at the beginning of your studies. If you write your essay yourself and do not copy sentences from the original articles, then you are writing the essay as we expect you to do it.

The general contact address related to your Computer Science studies is cs-msc-programmes@cs.helsinki.fi.

Studying at the Department of Computer Science

The University of Helsinki is a strongly research-orientated 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 of different courses will share their knowledge and create tasks that help you to practise 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.

Please notice that the new name of Algorithms and Machine Learning is Algorithms, Data Analytics and Machine Learning. The modified name just reflects the strong emphasis on data analytics that has existed in the group already for several years. Please do not be confused with the name change. You might also find a new programme called Algorithmic Bioinformatics. It is a reorganisation of the old separate bioinformatics programme that is now integrated as part of the Computer Science major. This Summer letter contains only information for students in either the Algorithms, Data Analytics and Machine Learning or Networking and Services programmes.

Required skills

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 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 taking 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 our 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 adviser 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.

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 programme is given fully in English. Some courses might be organized with mixed language groups, but even then you can communicate with the teachers and your fellow students 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 your written English is poor, it 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 practise your writing. You can use the summer essay for this. All essay drafts submitted on July, 7, 2014, 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 a 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, Data Analytics 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 command-line interface (shell) to command them. *If you have never used a shell, please learn the basic skills on how to operate a computer with keyboard only.* You will participate in a course immediately during the first period to brush up on these skills and your computing environment. See this 2012 course for example exercises and make sure that you can complete the course: <http://blogs.helsinki.fi/tyovaline-2012/in-english/>. You must do the course in September, but learning all the content only then will make it very difficult to succeed well in the advanced CS courses overlapping with this one. You can study the material in advance, then you only need to demonstrate your skills after arrival. *If you do not understand what remote access to a computer means and cannot do that using a command-line interface, then again you may need to consider another university to continue your studies there.*

Preliminary assignments for summer 2014

There will be six assignments for summer 2014 in decreasing order of priority.

1. Write a short scientific report – 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 July 7 (Feedback by July 15).* – 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 assignments. 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 tiina.niklander.hy@analyysi.urkund.fi in PDF format.

1. Write a short scientific report

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 apply 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 (8-12 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. This means that the whole paper is written by you, you use citations and references, define all concepts used and target an audience of the same level of Computer Science knowledge as you have after your graduation.

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/>. There are several similar sources of information about academic writing. This is just one of them.

We will grade the courses on the scale 0-5, 0 being fail and 5 the highest 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 fulfil 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 (programme) that you are most interested in. You can find the PDF copies of the articles at <http://www.cs.helsinki.fi/u/niklande/papers/summer2014/>. 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. Keep in mind 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 argumentation. Remember also to justify all your claims carefully.

Your scientific report (essay) should cover the key points of the article you have selected. You may use external material to clarify the points. You must select an article from the list of your own programme.

In addition to the key points of the article, 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 that the presented idea is based on? Why?
- Would you be interested in using this algorithm/technique/idea/application? Why / why not?

What other application areas do you think would be suitable for these technologies? Why?

Articles 1-4 are targeted for Algorithms students and articles 5-8 to Networking and services students

1. Gog, S, Karhu, K, Kärkkäinen, J, Mäkinen, V & Välimäki, N, Multi-pattern matching with bidirectional indexes. Journal of Discrete Algorithms, vol 24, Jan 2014, pp. 26–39.
(<http://dx.doi.org/10.1016/j.jda.2013.03.007>)

2. Malone, B, Kangas, K, Järvisalo, M, Koivisto, M & Myllymäki, P, Predicting the Hardness of Learning Bayesian Networks. Proceedings of the 28th AAAI Conference on Artificial Intelligence (AAAI 2014), 2014. (<http://www.cs.helsinki.fi/group/bnlearn/mkjkm.aaai14.pdf>)
3. Oulasvirta, A, Roos, T, Modig, A & Leppänen, L, Information capacity of full-body movements. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2013, pp. 1289-1298.
4. Valitutti, A, Doucet, A, Toivanen, J & Toivonen, H, "Let Everything Turn Well in Your Wife": Generation of Adult Humor Using Lexical Constraints. The 51st Annual Meeting of the Association for Computational Linguistics (ACL), Volume 2: Short Papers, 2013, pp. 243.
5. Hemminki, S, Zhao, K, Ding, AY, Rannanjärvi, MT, Tarkoma, S & Nurmi, PT, CoSense: A Collaborative Sensing Platform for Mobile Devices. Proceedings of the 11th ACM Conference on Embedded Networked Sensor Systems (SenSys '13), 2013.
6. Glowacka, D, Ruotsalo, T, Konyushkova, K, Athukorala, K, Kaski, S & Jacucci, G, SciNet: A System for Browsing Scientific Literature through Keyword Manipulation. Proceedings of the International Conference on Intelligent User Interfaces (IUI'13 Companion), 2013, pp. 61-62.
7. Kutvonen, L, Enhancing the Maturity of Open Service Ecosystems and Inter-enterprise Collaborations. Proceedings of the 5th International IFIP Working Conference on Enterprise Interoperability (IWEI), Enschede, The Netherlands, March 27-28, 2013, Lecture Notes in Business Information Processing, vol. 144, pp. 6-21.
8. Wang, L & Kangasharju, J, Measuring Large-Scale Distributed Systems: Case of BitTorrent Mainline DHT. Peer-to-Peer Computing (P2P), 2013.

2. Create your own study plan

You need to figure out what courses you are going to take during your studies. The programme is relatively flexible and has a lot of variation between students. Therefore, it is really important to plan your studies in advance. During the autumn term you need to create a personal study plan for your whole Master's degree.

This summer task is to plan your studies for the autumn (fall) term 2014. More precisely, you need to know what courses you are going to take in period 1 immediately after arriving in Helsinki. It is better to plan this before arrival.

You can find the course list on the department web pages. You must also locate and read your degree requirements there. When you read the degree requirements, please make sure that you access the requirements for 2014 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.). You may also be

asked to do some bachelor-level (intermediate or subject level) courses for your degree. The typical examples of these courses are Model of Computation and C-programming. If you do not have similar courses in your bachelor's degree, then it is good to plan the course from the beginning. You are expected to master the content of these courses for the advanced (master-level) courses.

Suggested studies in the First period:

- 97000 Orientation to studies (starting on August 26, active participation in all orientation events like Welcome Fair, tutoring etc., including feedback form) – Arrive on time!
- 581324 Computing Tools for CS studies (Finnish name: Tietokone työvälineenä)
- 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 (Finnish name: FM-HOPS)
- 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, recommended for all) – you can find courses on the pages of the Department of Mathematics, please negotiate with your study adviser
- 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. Enter your individual study times in your calendar, too, along with which course you will be studying during that period.

Reserve enough time for individual study outside the class times.

- For lecture courses used at the department you need to reserve at least the same amount of extra time for solving weekly exercises and reading material as you have for lectures and exercise sessions.
- 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.
- For project courses, reserve approximately 25-30 hours for each credit. Project courses might have a small amount of contact teaching, but they require a lot of individual working time.

Studies in the latter periods must be planned as part of your personal study plan during September. 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 is one of the required courses you must do for your degree. Our 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 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 programme to improve the programming skills of our own students. The very first course is now also offered in English via mooc.fi to show you how we start our education. One of the later key courses in the skill-building is '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 most of the bachelor-level courses are not offered in English. And for some courses like Data Structure and Algorithms all the material provided by the teacher 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. Command-line based 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 a 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 skills to succeed in our master's level courses. In the Distributed systems course, for example, you need to be able to remotely control computers with the command-line interface only.

If you do not have the opportunity to install a Linux operating system to your own computer, you can practise the usage of the commands and scripting by services on the internet. We have installed a Linux emulator for you at the address <http://karkulah.users.cs.helsinki.fi/jor1k/> You can use this emulator to practice your shell usage skills during the summer. You should at least be able to write a simple shell script and run it in the emulator.

If you need to learn or brush-up your linux / unix skills, you may wish to study the on-line material created by Michael Stonebank for University of Surrey and available on the University of Surrey page: <http://www.ee.surrey.ac.uk/Teaching/Unix/>

A nice on-line tutorial about scripting can be found at <http://www.tldp.org/LDP/abs/html/index.html>

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 in the left-hand 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