Master's Degree Programme in Bioinformatics

Department of Computer Science
Department of Mathematics and Statistics
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Web pages: www.cs.helsinki.fi/bioinformatiikka/mbi

Professor in charge: Juho Rousu, room A323, office hours Tue 9.30 – 10.00, Thu 16.30 – 17.00, ext. 51230
Coordinator: Esa Pitkänen, room A238, office hours Fri 11.00 – 12.00, ext. 51151

Bioinformatics as a discipline

Computer science, computational models, mathematics and statistics are an important part of modern biology, biotechnology and medicine. It is possible to study the infective potential of a virus by modelling its three-dimensional surface structure. The function of genes can be uncovered by a computational study of DNA sequences.

Bioinformatics is a multi-disciplinary field of study which develops computational models and methods for biological and medical applications.

In general terms, bioinformatics is computer-aided collecting, processing and analysing of biological and medical information. Mathematics, statistics and computer science methods provide the foundation of bioinformatics, but it is necessary to have a thorough understanding of both the application area and methods. Thus, a bioinformatician often acts as an important mediator between the methodological and biological sciences.

The University of Helsinki (UH) and Helsinki University of Technology (TKK) offer excellent opportunities for bioinformatics studies. Research in bioinformatics is of the highest quality in Europe. The universities have extensive contacts to universities and research institutes abroad. This guarantees wide-ranging options for student exchange and post-graduate studies.

Employment of bioinformaticians

Universities and other research institutes employ bioinformaticians in various research positions. Biotechnology companies have also been employing bioinformaticians as specialists in growing numbers. Biological and medical research groups require bioinformaticians for data analysis tasks and development of biodatabases. Furthermore, bioinformatics research groups need more theoretically oriented bioinformaticians for development of new statistical and computational bioinformatics methods. The current state of employment is very good: it has been estimated that the need for bioinformaticians will greatly exceed the number of bioinformaticians currently employed.

Organization

The Master's Degree in Bioinformatics Programme (MBI) is organized jointly by the University of Helsinki and Helsinki University of Technology. At the University of Helsinki, member faculties are the Faculties of Science, Biosciences, Medicine, and Forestry and Agriculture. At Helsinki University of Technology, the Programme is organized by the Department of Computer Science and Engineering.

The teaching is given by people working on the cutting edge of bioinformatics research. For example, people from three research units chosen to be Centres of Excellence by the Academy of Finland have a central role in the development and implementation of the programme.

Degrees

In bioinformatics, the basic degree is the Master of Science (in UH: MSc, filosofian maisteri; in TKK: MSc (Tech), diplomi-insinööri). The scope of the degree is 120 credits, and requires a suitable Bachelor's level degree as a prerequisite.

The degree consists of a minimum of 70 credits of advanced studies in bioinformatics and a minimum of 40 credits of minor subject studies, including biology, computer science and mathematics. The intended time to complete the degree is two years. The detailed structure of the MSc degree is described in the section on degree requirements.

Bioinformatics is implemented as a Master's level major subject in the Faculty of Science of the University of Helsinki within two degree programmes, Computer Science and Statistics, and one in Helsinki University of Technology: Computer Science. The degree requirements are identical in both degree programmes of the University of Helsinki, and almost identical in TKK. The biological minor subject courses are offered by the Faculties of Biosciences, Medicine as well as Forestry and Agriculture at the University of Helsinki.

The University of Helsinki has proposed adding the Master's Degree Programme in Bioinformatics to the Decree on Master's Degree programmes to the Ministry of Education. If and when this happens, the bioinformatics major subjects within the Computer Science and Statistics programmes will be merged, and the MSc degrees will be formally given by the MBI programme. Until then, the MSc degrees will formally be given by the two degree programmes.

Obtaining the right to study

The right to study is obtained via successful application. Students for the academic year 2006–07 will be selected by 21 June 2006. The calls for application for the academic year 2007–08 will be published in autumn 2006. Selection protocols, criteria and the schedule will be published on the web pages of the Master's Degree Programme in Bioinformatics (www.cs.helsinki.fi/bioinformatiikka/mbi).

Recommended contents of a Bachelor's Degree

It is recommended that an applicant to the Programme would have studied the following subjects: algorithms, biomathematics, computational modeling, databases, discrete mathematics, linear algebra, probability calculus and statistics.

The old Bioinformatics sub-programme in the computer science degree programme

By the introduction of bioinformatics as a major subject, the bioinformatics sub-programme within the computer science degree programme will be phased out. Nevertheless, students that have started their studies before 1 August 2006 have the possibility to choose the bioinformatics sub-programme within the computer science degree programme, and to study according to the 2005–06 requirements. Students that have started their studies before 1 August 2005 also have the right to study according to the 2004–05 requirements which belong to the old study system, permitting that they complete their degree by 31 July 2008.

Student counselling and the personal study plan

Students are required to make a personal study plan (FM-HOPS) as part of their MSc degree, which is approved by the special tutor of the programme and the supervising professor. The personal study plan is to be approved by the end of the first period of the first year of study in the Programme. The study plan will be updated when needed as the studies progress.

In particular, it is important that the minor subject studies are planned to complement the previous studies in the Bachelor's degree, so that the methodological studies and biological studies form a meaningful whole.

Counseling for students are given by the following people:

University Lecturer Esa Pitkänen, special tutor of the programme, computer science (UH)
University Lecturer Jukka Corander, mathematics and statistics (UH)
University Lecturer Päivi Onkamo, minor subject studies in biology (UH)
University Lecturer Outi Monni, minor subject studies in medicine (UH)
Lecturing Researcher Janne Nikkilä (TKK)

More information can be found on the web pages on student counseling:
http://www.cs.helsinki.fi/bioinformatiikka/mbi/counselling/

Degree requirements

Students who have obtained the right to study in the Master's Degree Programme in Bioinformatics in Autumn 2006 will follow these requirements. The old requirements for the bioinformatics subprogramme within the computer science degree programme are available in old study guides. Requirements for TKK can be found in the study programme of TKK.

MASTER OF SCIENCE DEGREE (120 CREDITS)

1. Major subject studies (70 credits)

584329   ADVANCED STUDIES IN BIOINFORMATICS (70 CREDITS)

    582313 Introduction to bioinformatics, 4 cr

582604 Practical course in biodatabases, 4 cr

Optional advanced courses in bioinformatics (other than seminars), minimum of 16 cr

Seminars, 6 cr

Master's thesis, 40 cr
50039 Maturity test

2. Minor subject studies (minimum of 40 credits)

A minimum of 40 credits of the following subjects, in accordance with an approved personal study plan (FM-HOPS):
Computer science
Mathematics and statistics
Biology, medicine or other suitable subject

3. Other studies (minimum of 2 credits)

Personal study plan (FM-HOPS), 1 cr

Advanced internship or vocational orientation studies, 1–3 cr

Optional courses

In addition, the Bachelor's and Master's degree together must contain
- Studies in biology, medicine or other suitable subjects, minimum of 25 credits
- Studies in mathematics, statistics and computer science, minimum of 60 credits

General study instructions

Bioinformatics studies consist both of lectures and practical work. Major subject studies involve mostly lecture courses, where a lecture course may include practical project work. In minor subject courses in biology, practical work may include either computer classes, laboratory work (wetlab), or both.

Lecture courses

A lecture course typically contains lectures and exercises. As a general rule of thumb, a student should spend double the amount of time used for lectures and exercises for each course. In addition, attention should be paid to fulfilling the prerequisites before attending the course. Passing a lecture course usually requires completion of a sufficient number of exercises, and passing the course exam. An alternative way to pass a course is by a separate exam.

Laboratory courses ("wetlab")

Sufficient skills for further biological laboratory work will be provided during the courses Biology for methodological scientists and Measurement techniques for bioinformatics. The student is required to take these courses if he or she has not taken equivalent courses earlier.

Seminars

At least two seminars (6 credits) have to be included in the Master's degree. A seminar usually consists of student presentations and discussion. Seminars usually meet once a week for two periods (a whole semester). Each student is required to give at least one presentation on the topic of the seminar and actively participate in discussions. Passing a seminar may additionally involve writing a seminar paper. Grading is based on the oral presentation, participation in discussions and the written paper. Students are required to be present during at least 3/4 of the weekly meetings.

Registration for the courses and examinations

Students register for courses and separate examinations offered by the University of Helsinki according to the registration practices in the department organizing the course. At the Department of Computer Science, the web address of the registration system is http://ilmo.cs.helsinki.fi, and at the Department of Mathematics and Statistics, the address is http://ilmo.cs.helsinki.fi/matematiikka. Students register for courses and separate examinations offered by Helsinki University of Technology with the following registration system: https://webtopi.tkk.fi/.

Teaching times

Teaching is given in four periods:
I 4 September – 22 October
II 30 October – 17 December
III 15 January – 4 March
IV 12 March – 6 May
Each period consists of six weeks of teaching, followed by an exam week. No teaching will be given during the period breaks 23–29 October and 5–11 March

Advanced internship

The degree includes an obligatory advanced internship phase. The internship position is intended to be either in a research group or in a company working in a related field. The aim of the internship is to familiarise the student with real-world bioinformatics and with people working with it. The internship position is agreed on with the student counselor as a part of the study plan. Some available positions for the internship will be announced on the MBI web page: http://www.cs.helsinki.fi/bioinformatiikka/mbi/internship.

Grading

All courses are graded either on the six-step scale 0–5 or the two-step scale fail/pass. On the former scale (UH), the lowest passing grade is 1/5, for which the student usually needs to get half the maximum points. To get the highest grade 5/5, the student usually needs at least 5/6 of the

maximum points.

Teaching language

The teaching language in the Programme is primarily English. Exceptions are noted in the Teaching programme.

Master's thesis

The Master's thesis is the final thesis done independently by the student for the MSc degree. The extent of the thesis is 40 credits (UH) or 30 credits (TKK). In the Master's Degree Programme in Bioinformatics, the Master's thesis is written during the second year of studies.

The topic of the thesis is agreed upon with a professor of the Programme. Usually the topic is related to research problems of a bioinformatics research group. Ideally, the work involves members from both methodological and application fields. The following list provides the names and some research interests of persons working with methodological bioinformatics. The list serves as a starting point for finding a suitable topic for the Master's thesis.

Biological data fusion: Samuel Kaski, Hannu Toivonen
Biological data mining: Heikki Mannila, Hannu Toivonen
Functional genomics: Jukka Corander, Liisa Holm, Samuel Kaski, Juho Rousu
Gene expression data analysis: Elja Arjas, Jukka Corander, Samuel Kaski
Genetic mapping: Elja Arjas, Heikki Mannila, Hannu Toivonen, Esko Ukkonen
Sequence analysis: Jukka Corander, Heikki Mannila, Esko Ukkonen
Metabolic networks: Juho Rousu, Esko Ukkonen
Structured population dynamics, evolution and natural selection, ecological modelling: Jukka Corander, Mats Gyllenberg

A more complete list is provided on the web pages of the Programme.

The work is divided into three phases. The first phase involves writing a one-page subject proposal where the research question is formulated. During the second phase, a research plan is written. The research plan should already contain most of the literature references of the final thesis. Both the proposal and the research plan must be approved by the instructor of the thesis. Finally, the thesis is written.

While working on the Master's thesis, the student is expected to participate in the Master's thesis seminar and present the research plan and the nearly complete thesis in the seminar. The Master's thesis seminar operates throughout the year.

Maturity test

At the University of Helsinki, the maturity test required for the Master's degree is taken as a separate exam when the Master's thesis has been submitted for evaluation. A new test is required even if the student has given the test at the Bachelor level.

At Helsinki University of Technology, the maturity test is required only if the student has not already given one at Bachelor level.

Registration of completed modules

To register the study module Advanced Studies in Bioinformatics, the student should hand in a copy of the transcript of records maintained by the university and an application form with the list of courses that the student wants to include in the module. The application form and contact information of persons who approve the application are available from the Programme webpage.

Bioinformatics as a minor subject

The recommended way to study bioinformatics as a minor subject is to take the Basic module in genetic bioinformatics offered by the Faculty of Bioscience.

Basic module in genetic bioinformatics for minor subject studies (25 cr)
A. Compulsory studies (15 cr)
399672 Biology for methodological scientists (2-8 cr) or optionally 529001 Biotieteiden perusteet I ja II
52746 Genetic analysis (3 cr)
52912 Genomes (3 cr)
52739 Genetic bioinformatics (3 cr)
52926 Book exam (3 cr)

B. Optional studies (10 cr)
81055 Population and quantitative genetics (3 cr)
52714 Human genetics (3 cr)
52910 Ihmisen perimän kartoitus (3 cr)
52930 Protein informatics (3 cr)
52931 Exercises in protein informatics (5 cr)
52920 Exercises in bioinformatics (5 cr)
52939 From genomes to gene function (6 cr)
Or other studies in genetics or related subjects as agreed in the personal study plan (HOPS).

For more information, contact either Professor Liisa Holm or University Lecturer Päivi Onkamo.

Computer access

The Departments of Computer Science and Mathematics provide classrooms with computers that may be used in studies. To access the computers, you need a personal user account. Please see the Study guide sections for Computer Science and Mathematics and Statistics for details.

Post-graduate studies

Post-graduate studies aiming for a Doctor of Philosophy or Licenciate of Philosophy degree are typically pursued in conjunction with research groups working in the field of Bioinformatics. A list of such groups can be found on the web pages of the Master's programme.

The Graduate School in Computational Biology, Bioinformatics, and Biometry: ComBi

The Graduate School in Computational Biology, Bioinformatics, and Biometry (ComBi) is a post-graduate programme jointly offered by the Universities of Helsinki, Tampere and Turku as well as

Helsinki University of Technology. The school was established at the beginning of 1998, and the Department of Computer Science at the University of Helsinki is the coordinating institution. The research goal of ComBi is to develop computational, mathematical, and statistical methods and models for natural sciences. The thesis projects are carried out in close cooperation with one or more research groups in the application fields (such as biochemistry, molecular biology, genetics and biotechnology, ecology, research into evolution and systematics, geography and economics). More information including activities, application deadlines, funding of studies, etc. may be acquired from the director of the graduate school, Academy Professor Heikki Mannila (UH), and from the general secretary Heikki Lokki (UH) as well as electronically on the web page http://www.cs.helsinki.fi/combi/ or by email to combi@cs.helsinki.fi.

ComBi is a partner programme in Bioinformatics Research and Education Workshop (BREW). BREW aims to introduce PhD students to the work modes of international conferences at an early stage in their PhD work, to bring together PhD students and experienced researchers in an atmosphere of cooperation and inspiration, to establish research contacts across Europe, to be utilized in the student's subsequent research and to contribute to the development of bioinformatics education and to the formation of the research community across Europe. More information on BREW is available on the ComBi web page.

Other related graduate schools

The following list includes graduate schools that offer postgraduate programmes in fields related to bioinformatics in the Helsinki region. Contact information for graduate schools can be found on the MBI web pages.

Biomaterial Graduate School
Clinical Drug Trials Graduate School
Finnish Graduate School in Plant Biology
Finnish Graduate School of Neuroscience
Functional Research in Medicine Graduate School
Graduate School in Computational Methods of Information Technology (ComMIT)
Graduate School in Pharmaceutical Research
Helsinki Biomedical Graduate School
Helsinki Graduate School in Biotechnology and Molecular Biology
Helsinki Graduate School in Computer Science and Engineering (HeCSE)
National Graduate School of Clinical Investigation
The Finnish Graduate School on Applied Bioscience: Bioengineering, Food & Nutrition Environment (ABS)
Viikki Graduate School in Biosciences

Course descriptions

For each term, major subject courses are given first, then the courses for the minor subject in biology which have been organized specifically for the Programme, or courses which are included in the Basic module in genetic bioinformatics. The complete list of courses suitable for minor subjects is given on the web: http://www.cs.helsinki.fi/bioinformatiikka/mbi/studies/.

Autumn term 2006

Major subject

582606 Introduction to bioinformatics (4 cr)
University Lecturer Esa Pitkänen, I period, Tue, Fri 14–16 Exactum C222
This course gives an introduction to the central topics in bioinformatics, and gives a foundation for further courses in the Master's Degree Programme in Bioinformatics. Course literature: Richard C. Deonier, Simon Tavare & Michael S. Waterman: Computational Genome Analysis - An Introduction, Springer 2005. Course exam Mon 16th October from 16.00 to 19.00.

582604 Practical course in biodatabases (4 cr)
PhD Petteri Sevon, II period, Mon, Tue 14–16 Exactum D122
Techniques for accessing and integrating data in biology databases are studied. The course contains project work as a component. Prerequisites: basic programming skills, database basics, 582313 Introduction to bioinformatics. Course exam Fri 15th December from 9.00 to 12.00.

582468 Computational neuroscience (6 cr)
D. Sc. (Tech.) Jarmo Hurri, D. Sc. (Tech.) Harri Valpola (TKK), II period, Mon 12–14, Wed 10–12 Exactum C221
The topic of this course is mathematical modeling of information processing taking place in the brain. Contents: 1. Introduction to brain physiology 2. Modeling response properties of individual neurons 3. Example: early visual system. 4. Network models. 5. Plasticity and learning. Course requirements: examination and project work. Prerequisites: programming skills, calculus, probability calculus, linear algebra. Course exam Thu 14th December from 16.00 to 19.00.

57390 Modelling fluctuating populations (10 cr)
University Lecturer Stefan Geritz, I and II periods, Tue 12–14 Exactum C124, Thu 12–14 Exactum C122
This course is based on the book "Modelling fluctuating populations" by Nisbet and Gurney (1982). A short list of the topics: Systems driven by fluctuating parameters, general principles, mathematical techniques for analyzing driven systems; Delayed regulation, distributed delays; Linear and non-linear birth-death processes in a static environment, demographic stochasticity, stationary and quasi-stationary probability distributions, extinction times; Stochastic environments, quasi-cyclic fluctuations.

T-61.6080 Special course in bioinformatics II (3–7 cr)
Lecturing Researcher Janne Nikkilä, I and II periods, Thu 14–16 T5, TKK
Advanced graduate or postgraduate level course on a timely topic in bioinformatics. In 2006 the topic is data integration and fusion in bioinformatics.

T-61.5080 Signal Processing in Neuroinformatics (5 cr)
Docent Ricardo Vigario, I and II periods, Wed 12–14 (lectures), Wed 14–16 (exercises), T5, TKK
The goal of the course is to give an overview of some of the main biomedical signal processing techniques. Regarding EEG and MEG, we should see something about modeling, artifact identification and removal, nonparametric and model-based spectral analysis, segmentation and joint time-frequency analysis. Some closer attention will be given as well to the analysis of event related data. In ECG, we will see standard filtering, QRS detection and data compression methods. The study of arrhythmias will get particular attention. Prerequisites: basic mathematics courses.

Seminars

A complete list of seminars can be found on the Programme website.

Minor subject

399672 Biology for methodological scientists (8 cr)
Docent Outi Monni, M.Sc. (Tech.) Anna-Kaarina Järvinen, MSc Henrik Edgren, PhD Kaisa Silander, PhD Anu Loukola, PhD Tiina Immonen, University Lecturer Päivi Onkamo, I-IV periods, Biomedicum and Viikki Biocenter
This course gives an introduction to basic concepts of microarrays, genetics, molecular medicine and developmental biology. Particularly, the students will get familiar with biological problems that require computational methods to be solved. No previous experience about molecular biology is required. The course will be organized annually.

399673 Measurement techniques for bioinformatics (4 cr)
University Lecturer Päivi Onkamo, Docent Outi Monni, I-IV periods, Viikki and Biomedicum
This course introduces students to the most fundamental molecular biology technologies including NMR, mass spectrometry, microarrays, immunohistochemistry, phylogenetics and cellular imaging. The course is particularly tailored for students with no previous molecular biology background.
Prerequisites: 399672 Biology for methodological scientists

399671 Practical bioinformatics (8 cr)
Docent Outi Monni, MSc Sami Kilpinen, PhD Jarno Tuimala, PhD Massimiliano Gentile, University Lecturer Päivi Onkamo, I–IV periods, Biomedicum
This course approaches various biocomputational analysis methods essential in life sciences from a practical point of view. The course consists of four modules (modules I–IV, 2 cr each) that are organized in four different periods. Module contents: I Basics of Unix and Perl, II Biodatabases, III Microarray data processing and management, IV Gene mapping. Each module consists of 28 hours of lectures and practical exercises in a computer class. Additionally, the modules will include homework and an exam. Each module can also be taken independently. A maximum of twenty students will be accepted for each module. The selection of the students is performed based on the phase of the studies.

52920 Exercises in bioinformatics (5 cr)
University Lecturer Päivi Onkamo, period II, 23.10.–3.11. 12-17, Viikki Infoclass 138 (hands-on computer exercises)
Practical exercises in fetching information from the bioresources on the web and using the most common bioinformatics applications, such as programs for computing multiple alignments, phylogenetics, simple microarray analysis, promoter analysis, deciphering Gene Ontology, etc. Successful passing of the course requires passed exam and a homework. Prerequisites: 52739 Genetic Bioinformatics or equivalent. The fall course in given in Finnish but there is an English-speaking course coming in April.

52714 Human genetics (3 cr)
Professor Jim Schröder, I–II periods, 10.10.–30.11. Tue and Thu 10–12, Viikki Info Auditorium 2
The lecture series will cover the inheritance of both normal properties, and disease in man. Different modes of inheritance will be highlighted with relevant diseases, where an integrated description from the symptoms of the disorders, to molecular pathology will be covered. Special attention will also be paid to prenatal diagnosis and cancer genetics. The lectures are given in Finnish unless otherwise required (in English).

81055 Population and quantitative genetics (3 cr)
University Lecturer Helena Korpelainen, period II, 31.10.-5.12. Tue and Thu 12-14, Viikki Info2
Introduction to theoretical and molecular population and quantitative genetics. The influence of different factors on the population genetic structures, the nature of genetic variation, and the research methods used. Mathematical exercises. The course will be given in Finnish.

52931 Exercises in protein informatics (5 cr)
Professor Liisa Holm, II period, 14.11.–2.12., Mon–Fri 12–17, Viikki Info 170
Practical course where we aim to infer protein function and structure as well as possible from the amino acid sequence. Tools include public web servers. The course contains guided exercises and a group work where a target protein is analyzed. Prerequisite: 53739 Genetic bioinformatics.

Spring term 2007

Major subject

582483 Biological sequence analysis (6 cr)
Professor Esko Ukkonen, III period, Mon, Tue 14–16 Exactum D122
The course covers the basic probabilistic methods for modelling and analysis of biological sequences. Prerequisites: 582313 Introduction to bioinformatics, probability calculus. Course literature: R. Durbin, S. Eddy, A. Krogh and G. Mitchinson: Biological sequence analysis, Cambridge University Press, 1998. Course exam: Wed 28th February from 16.00 to 19.00.

582605 Metabolic modeling (4 cr)
Professor Juho Rousu, IV period, Mon, Tue 14–16 Exactum B222
Computational methods in the analysis of metabolic networks, including the analysis of metabolic fluxes and the regulation of metabolism. Prerequisites: 582313 Introduction to bioinformatics, linear algebra. Recommended: basics on Matlab, Measurement techniques for bioinformatics. Course exam Wed 2nd May from 9.00 to 12.00.

582450 Modeling of vision (5 cr)
Docent Aapo Hyvärinen, III period: Thu 14-16 Exactum C221, IV period: TKK
The topics are mechanisms and modelling of human perception. The emphasis is on modelling of visual feature extraction, and modeling of object and scene recognition. The course is most suitable for students specializing in bioinformatics or intelligent systems.

52930 Protein informatics (3 cr)
Professor Liisa Holm, IV period, 21.3.–25.4.2007 Wed, Fri 14–16, Viikki
Protein sequence and structure analysis based on Mount: Bioinformatics - sequence and structure analysis. Focus is on biological applications. Prerequisites: Geneettinen bioinformatiikka (52739).

57391 Evolution and the theory of games (5 cr)
University Lecturer Stefan Geritz, III period, Tue 12–14 Exactum C123, Thu 12–14 Exactum C122
A game is a mathematical model of a situation of conflict of interests in which the optimal strategy for one player not only depends on his own decisions but also on the decisions of his opponents. The course is an introduction to game theory with emphasis on applications in evolutionary and behavioural biology.

582612 Practical course in microarray data analysis (4 cr)

Dr. Alvis Brazma, III period, 13.02.–20.02. Tue 10-12 Exactum B119, 15.02.–02.03. Thu, Fri 14-16 Exactum B119

The course gives an introduction to the analysis of microarray data. Topics include processing of microarray information, experiment design, statistical analysis of data and inference of gene regulation networks. The course contains an obligatory practical work. The course 582612 can also be taken as a part of T-61.5050 High-throughput bioinformatics.

T-61.5050 High-throughput bioinformatics (5–7 cr)

Lecturing Researcher Janne Nikkilä, III and IV periods, TKK

The course introduces computational and statistical methods for analyzing modern high-throughput biological data, in particular microarray and mass spectrometry data, and their use in systems biology. The necessary biological background is reviewed briefly. Prerequisites: 582313 Introduction to bioinformatics, basics on linear algebra, analysis, probability calculus and statistics. In 2007 the course 582612 Practical course in microarray data analysis is integrated into T-61.5050 and a part of the T-61.5050 lectures is replaced with the lectures of 582612.

T-61.6070 Special course in bioinformatics I (3–7 cr)

Professor Samuel Kaski, III and IV periods, TKK

Advanced graduate or postgraduate level course on a timely topic in bioinformatics. Either seminar or lecture course. In 2007 the topic of the course is "Modeling biological networks."

T-61.5090 Image Analysis in Neuroinformatics (5 cr)

Docent Ricardo Vigario, III and IV periods, TKK

The goal of the course is to give an overview of some of the main biomedical image processing techniques. Topics range from artifact removal and image enhancement to pattern classification and diagnostic decision. Prerequisites: basic mathematics courses.

Seminars

A complete list of seminars can be found on the Programme website.

Minor subject

52746 Genetic analysis (3 cr)

University Lecturer Päivi Onkamo, IV period, 18–20 April at 10–12 (lectures), 2–16 May at 13–17 (exercises in English), Viikki

This course considers classical genetics, like Mendelian inheritance, pedigree/family tree analysis, hybridization experiments, linkage and basics of population genetics. The course consists of three lectures (basic maths and statistics only, aimed for biologists) and seven math exercises with short recaps of the days' topic. Note: Lectures in Finnish, the exercise group III (2-16 May) in English. Course exam: 22 May.

52912 Genomes (3 cr)

Professor Tapio Palva, IV period, 20 April Thu at 12–16, 24 April – 29 May Mon at 12–16, Viikki auditorium 1041

Introduction to genome analysis, genome structure and organization, genome elements, comparative genomics, functional genomics: transgenic organisms, reverse genetics, ESTs, expression analysis, transcriptional profiling, proteomics, metabolomics, genome evolution

52939 From genomes to gene function (6 cr)
Asst Tarja Kariola, Asst Elina Helenius, Viikki, April-May
A problem-based approach starting with sequence database searches and ending with functional characterization of specific genes using plants as model organisms. Basic lab and bioinformatic skills are expected.

52739 Genetic bioinformatics (3 cr)
University Lecturer Päivi Onkamo, period III, 16.1.–27.2. Tue and Fri 10–12 Viikki
This lecture course presents all the basic tools and data banks used in bioinformatics – what every biologist or scientist working in close contact with biology should know. The emphasis is more on applicatory side of the methods, though the basic principles how the tools work are presented (e.g., Needleman-Wunsch algorithm). The topics include e.g. BLAST, EMBOSS package (sequence analysis), multiple sequence alignment, molecular phylogenetics methods, promoter analysis, basics of gene expression analysis and biodatabanks. The lectures are given in Finnish.

52920 Exercises in bioinformatics (5 cr)
University Lecturer Päivi Onkamo, University Lecturer Markku K Aalto, IV period, 29.3.–30.3., Viikki Info 138
Practical exercises in fetching information from the bioresources on the web and using the most common bioinformatics applications, such as programs for computing multiple alignments, phylogenetics, simple microarray analysis, promoter analysis, deciphering Gene Ontology, etc. Successful passing of the course requires passed exam and a homework. Prerequisites: 52739 Genetic Bioinformatics or equivalent.

52910 Mapping of the human genome (3 cr)
Docent Nina Horelli-Kuitunen, IV period, 12.3.-25.4. Mon and Wed 10-12, Viikki Info 3

Teaching staff

Please contact teachers during their office hours. Contact information and office hours are available at http://www.cs.helsinki.fi/bioinformatiikka/mbi/people.

Aalto, Markku K., PhD, University Lecturer, UH
Arjas, Elja, PhD, Professor, UH
Brazma, Alvis, PhD, Visiting Professor, European Bioinformatics Institute
Corander, Jukka, PhD, Docent, University Lecturer, UH
Edgren, Henrik, MSc, UH
Gentile, Massimiliano, PhD, UH
Geritz, Stefan, PhD, University Lecturer, UH
Gyllenberg, Mats, D.Sc. (Tech.), Professor, UH
Järvinen, Anna-Kaarina, M.Sc. (Tech.), UH
Helenius, Elina, MSc, Assistant, UH
Holm, Liisa, PhD, Professor, UH
Hurri, Jarmo, D.Sc. (Tech.), Post-doctoral Assistant, UH
Hyvärinen, Aapo, PhD, Docent, Academy Fellow, UH
Immonen, Tiina, PhD, UH
Kariola, Tarja, MSc, Assistant, UH
Kaski, Samuel, D.Sc. (Tech.), Professor, TKK
Kilpinen, Sami, MSc, UH
Kisdi, Eva, PhD, UH

Korpelainen, Helena, PhD, Docent, University Lecturer, UH
Loukola, Anu, PhD, UH
Mannila, Heikki, PhD, Academy Professor, HIIT and TKK
Mäkinen, Veli, PhD, Postdoctoral Fellow, UH
Monni, Outi, PhD, Docent, UH
Nikkilä, Janne, D.Sc. (Tech.), Lecturing Researcher, TKK
Onkamo, Päivi, PhD, Docent, University Lecturer, UH
Palva, Tapio, PhD, Professor, UH
Pitkänen, Esa, MSc, University Lecturer, Coordinator, UH
Rousu, Juho, PhD, Docent, Professor (acting), UH
Schröder, Jim, PhD, Professor, UH
Sevon, Petteri, PhD, UH
Silander, Kaisa, PhD, UH
Toivonen, Hannu, PhD, Professor, on leave of absence
Tuimala, Jarno, PhD
Ukkonen, Esko, PhD, Professor, Research Director of HIIT, UH
Valkonen, Jari, D.Sc. (Agr. & For.), Academy Professor, UH
Valpola, Harri, D.Sc. (Tech.), Academy Research Fellow, TKK
Varvio, Sirkka-Liisa, PhD, Docent, UH
Vigario, Ricardo, D.Sc. (Tech.), Docent, TKK