

582606 Introduction to bioinformatics

Autumn 2006
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Master's Degree Programme in Bioinformatics (MBI)
Department of Computer Science, University of Helsinki
<http://www.cs.helsinki.fi/mbi/courses/06-07/itb/>

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Administrative issues

- Master level course
- Obligatory course in Master's Degree Programme in Bioinformatics
- 4 credits
- Prerequisites: basic mathematical skills
- Lectures: Tuesdays and Fridays 14-16 in Exactum C222
- Exercises: Fridays 12-14 in Exactum C222
 - **Note: exercises start on Friday 22.9.2006!**

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Teachers

- Esa Pitkänen, Department of Computer Science, University of Helsinki
- Prof. Elja Arjas, Department of Mathematics and Statistics, University of Helsinki
- Prof. Samuel Kaski, Helsinki University of Technology

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How to enrol for the course?

- Use the registration system of the Computer Science department: <https://ilmo.cs.helsinki.fi>

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How to successfully pass the course?

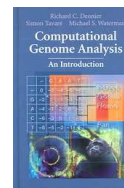
- You can get a maximum of 60 points
 - Course exam: maximum of 50 points
 - Exercises: maximum of 10 points
 - 0% completed assignments gives you 0 points, 80% gives 10 points
- Course will be graded on the scale 0-5
 - To get the lowest passing grade 1/5, you need to have at least 30 points
- Course exam: Monday 16.10. at 16.00-19.00

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Course material

- Course book: Richard C. Deonier, Simon Tavare & Michael S. Waterman: Computational Genome Analysis – an Introduction, Springer 2005
- Available at Kumpula and Viikki science libraries; Yliopistokirjakauppa 69€, Akateeminen 75€, Suomalainen 87€, amazon.com \$66.57, amazon.co.uk £47.50 (6.9.2006)
- It is recommended that you have access to the course book!
- Slides for some lectures will be available on the course web page



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Course contents

- Biological background (book chapter 1)
- Probability calculus (chapters 2 and 3)
- Sequence alignment (chapter 6)
- Phylogenetics (chapter 12)
- Expression data analysis (chapter 11)

Master's Degree Programme in Bioinformatics (MBI)

- Two-year MSc programme
- Offered jointly by the University of Helsinki and Helsinki University of Technology
- Admission for 2007-2008 in January 2007



MBI MASTER'S DEGREE
PROGRAMME IN BIOINFORMATICS

www.cs.helsinki.fi/mbi



Institutions participating in MBI

Helsinki University of Technology

□ Laboratory of Computer and Information Science



University of Helsinki
Faculty of Biosciences
Faculty of Agriculture and Forestry

University of Helsinki
Faculty of Medicine



University of Helsinki
Faculty of Science
□ Department of Computer Science
□ Department of Mathematics and Statistics

Bioinformatics courses at the University of Helsinki

- Department of Computer Science
 - Practical course in biodatabases (II period): techniques for accessing and integrating data in biology databases.
 - Computational neuroscience (II period): mathematical modeling of information processing taking place in the brain.
 - Biological sequence analysis (III period): basic probabilistic methods for modelling and analysis of biological sequences.
 - Modeling of vision (III period): mechanisms and modeling of human perception.
 - Metabolic modeling (IV period): metabolic networks, fluxes and regulation of metabolism.

Bioinformatics courses at the University of Helsinki

- Department of Mathematics and Statistics
 - Modelling fluctuating populations (I and II periods): systems driven by fluctuating parameters
 - Evolution and the theory of games (III period): introduction to game theory with emphasis on applications in evolutionary and behavioural biology

Bioinformatics courses at Helsinki University of Technology

- Laboratory of Computer and Information Science
 - Special course in bioinformatics II (I and II periods): data integration and fusion in bioinformatics.
 - Signal processing in neuroinformatics (I and II periods): overview of some of the main biomedical signal processing techniques
 - High-throughput bioinformatics (III and IV periods): computational and statistical methods for analyzing modern high-throughput biological data
 - Image analysis in neuroinformatics (III and IV periods): biomedical image processing techniques

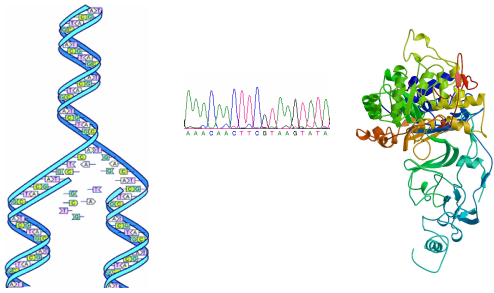
Biology for methodological scientists (8 cr)

- Course organized by the Faculties of Bioscience and Medicine for the MBI programme
- Introduction to basic concepts of microarrays, genetics, molecular medicine and developmental biology
- Organized in four modules, 2 cr each
- Each module has an individual registration so you can participate even if you missed the first module
- www.cs.helsinki.fi/bioinformatikka/mbi/courses/06-07/bfms/

Bioinformatics courses

- Visit the website of Master's Degree Programme in Bioinformatics for up-to-date course lists:
<http://www.cs.helsinki.fi/mbi>

An introduction to bioinformatics



What is bioinformatics?

- Solving biological problems with computation?
- Collecting, storing and analysing biological data?
- Informatics - library science?

What is bioinformatics?

- Bioinformatics, *n.* The science of information and information flow in biological systems, esp. of the use of computational methods in genetics and genomics. (Oxford English Dictionary)
- "The mathematical, statistical and computing methods that aim to solve biological problems using DNA and amino acid sequences and related information."
-- Fredj Tekaiia
- "I do not think all biological computing is bioinformatics, e.g. mathematical modelling is not bioinformatics, even when connected with biology-related problems. In my opinion, bioinformatics has to do with management and the subsequent use of biological information, particular genetic information."
-- Richard Durbin

What is not bioinformatics?

- Biologically-inspired computation, e.g., genetic algorithms and neural networks
- However, application of neural networks to solve some biological problem, could be called bioinformatics
- What about DNA computing?

Related concepts

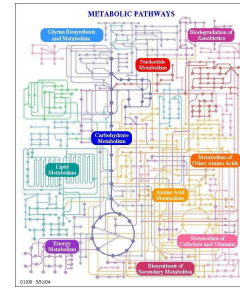
- Computational biology
 - Application of computing to biology (broad definition)
 - Often used interchangeably with bioinformatics
- Biometry: the statistical analysis of biological data
- Biophysics: "an interdisciplinary field which applies techniques from the physical sciences to understanding biological structure and function" -- British Biophysical Society
- Mathematical biology "tackles biological problems, but the methods it uses to tackle them need not be numerical and need not be implemented in software or hardware." -- Damian Counsell

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Related concepts

- Systems biology
 - "biology of networks"
 - integrating different levels of information to understand how biological systems work



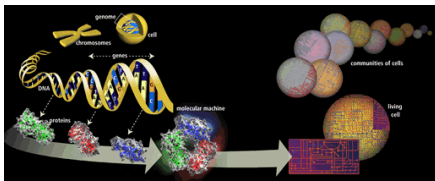
Overview of metabolic pathways in KEGG database, www.genome.jp/kegg/

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Biological background

- Molecular Biology Primer: www.bioalgorithms.info



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