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/

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!**

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

How to enrol for the course?

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

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

Course material

l Course book: Richard C. Deonier, Simon Tavare & Michael S. Waterman: Computational Genome Analysis – an Introduction, Springer 2005

l 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)

l It is recommended that you have access to the course book!

l Slides for some lectures will be available on the course web page
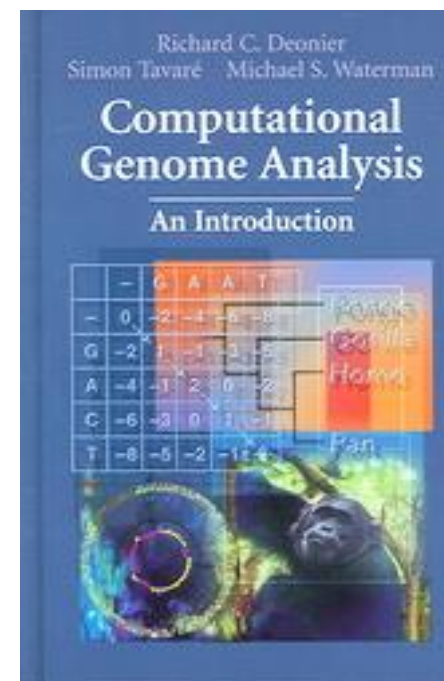
Course contents

- 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

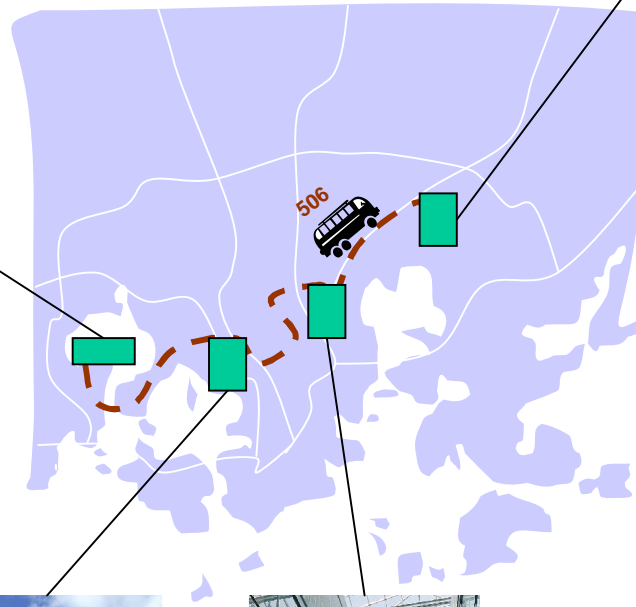| News & events | Programme | Studies | Admission | People | Contact |

News and Events

Institutions participating in MBI

Helsinki University of Technology
q **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
q **Department of Computer Science**
q **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/bioinformatiikka/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
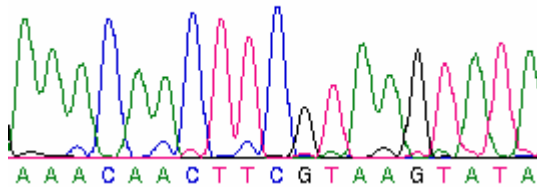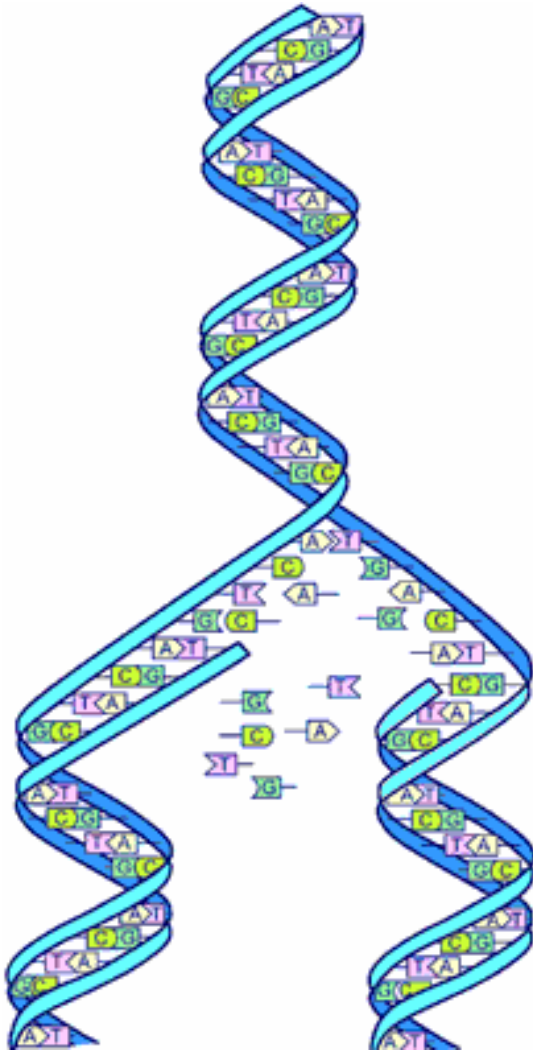
What is bioinformatics?

- 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 Tekaia

- "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

l Computational biology

- Application of computing to biology (broad definition)

- Often used interchangeably with bioinformatics

l Biometry: the statistical analysis of biological data

l Biophysics: "an interdisciplinary field which applies techniques from the physical sciences to understanding biological structure and function" -- British Biophysical Society

l 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

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/
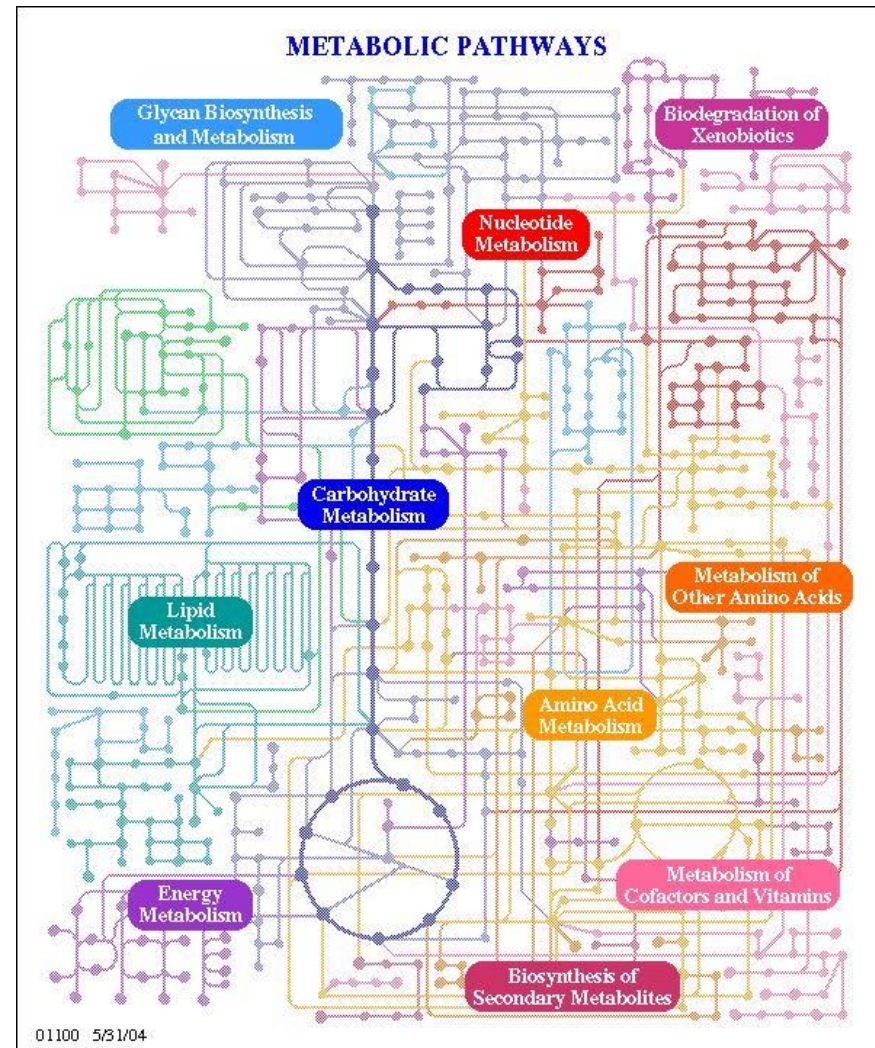
Biological background

⊢ Molecular Biology Primer: www.bioalgorithms.info