



HELSINKI UNIVERSITY OF TECHNOLOGY
LABORATORY OF COMPUTER AND INFORMATION SCIENCE

Bioinformatics in Laboratory of Computer and Information Science

Samuel Kaski



Research

Two centers of excellence of the Academy of Finland:

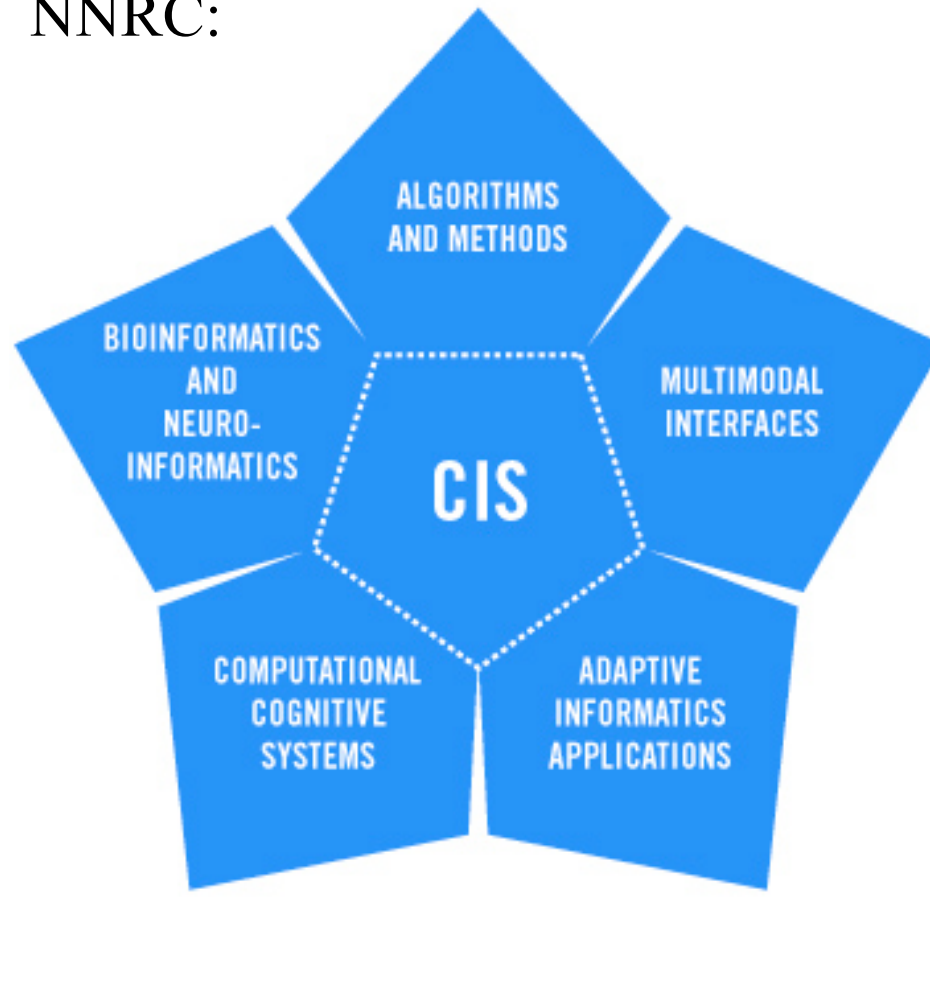
Neural Networks Research Centre (beginning 2006: **Adaptive Informatics Research Center**)

From Data to Knowledge Research Unit

Each has a closely collaborating bioinformatics/ computational biology research group. Professors Heikki Mannila, Samuel Kaski, Jaakko Hollmen.



NNRC:



+ Pattern discovery group of FDK



Mission of CIS: Adaptive informatics

By *adaptive informatics* we mean a field of research where automated learning algorithms are used to discover the relevant informative concepts, components, and their mutual relations from large amounts of data.

Adaptivity enables computers to adapt to the needs of individuals, groups, enterprises and organizations in the changing world.

Interfacing with the continuously growing amounts of data in scientific, medical, industrial, and financial fields and their transformation to intelligible form for the human user is one of our main foci. Techniques that can quickly discover and analyze complex patterns and learn from new data will be indispensable for information-intensive applications.



Bioinformatics research topics 1/2

The research builds on the strong methodological research of the laboratory in

- statistical machine learning
- data mining and pattern discovery
- pattern recognition
- statistical modeling



Bioinformatics research topics 2/2

Applications in

- Gene expression
- Gene mapping
- Computational genomics
- Systems biology
- Soon in metabolomics and proteomics

TEKES MASI Programme: “*In silico* models of disease pathogenesis and therapy”. VTT Biotechnology (Oresic), VTT Information Technology, Helsinki University of Technology (Kaski), University of Turku



Collaboration!

Most bioinformatics research is done in collaboration with biological and medical groups.

The research groups of CIS have an extensive collaboration network that students can utilize.

Teaching

Bioinformatics teaching in CIS is based on the active research of the laboratory in both methods and in bioinformatics. We offer two variants of a major level module Bioinformatics A3. It can be included into

1. **Computer and Information Science major** in Computer Science Study Programme, and into
2. **Bioinformation Technology Study Programme**.

In other degree programmes it may be possible to take the module as a minor. Alternatively, the new degree system makes changing the programme after the Bachelor easy.

The goal of the studies is to gain an advanced understanding of the computational, modeling, and data mining methods required for understanding biological and medical systems, analyzing large datasets measured from them, and in solving modern biomedical research problems. Since all advances in the field cannot be predicted, the studies include a strong general-purpose methodological basis which does not leave the students speechless when the field progresses. At the moment, for instance data analysis experts are needed in research institutions and companies in the biotech, medical, and pharmaceutical industries.

The studies consist of advanced studies in at least one of the subfields of bioinformatics or neuroinformatics. Lecture courses and special courses on timely topics are available for that. Additionally, a strong general-purpose understanding of the methods is needed: data mining, statistical modeling or machine learning. Within these limits the studies can be planned freely.

Suoritettavat kurssit:

- Välttämättömät taustatietokurssit. Vähintään 4 op seuraavista, ellei jo sisälly aikaisempaan moduuliin:
 - S-114.2500 Solubiosysteemit (5 op)
 - S-114.2510 Laskennallinen systeemibiologia (5 op)
 - Tfy-99.4247 Ihmisaivojen rakenne ja toiminta (4 op)
- Pakolliset kurssit. Vähintään 5 op seuraavista:
 - T-61.5050 High-throughput bioinformatics (5 tai 7 op)
 - T-61.6070 Bioinformatiikan erikoiskurssi I (3-7 op)
 - T-61.6080 Bioinformatiikan erikoiskurssi II (3-7 op)
 - T-61.5080 Biolääketieteellinen signaalinkäsittely (5 op)
 - T-61.5090 Biolääketieteellinen kuvankäsittely (5 op)
- Seuraavia kursseja siten, että 20 op täyttyy:
 - T-61.3020 Hahmontunnistuksen perusteet (4 op)
 - T-61.3030 Neuraalilaskennan perusteet (5 op)
 - T-61.3040 Signaalien tilastollinen mallinnus (5 op)
 - T-61.5010 Informaation visualisointi (5 op)
 - T-61.5030 Neuraalilaskennan jatkokurssi (5 op)
 - T-61.5040 Oppivat mallit ja menetelmät (5 op)
 - T-61.5060 Tiedon louhinnan algoritmiset menetelmät (5 op)
 - T-61.5100 Digitaalinen kuvankäsittely (5 op)
 - T-106.5400 Merkkijonoalgoritmit (5 op)
 - S-114.3200 Laskennallisen tekniikan erikoiskurssi I (6 op)
 - S-114.2601 Bayesilaisen mallintamisen perusteet (5 op)
 - T-79.5203 Graafiteoria (5 op)
 - T-79.5204 Kombinatoriset mallit ja stokastiset algoritmit (6 op)