

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS credits	Module Code	Module Title
		5	CMPU4012	Bioinformatics

1.1.11. Bioinformatics

Module author: Bioinformatics group

Module Description:

This course introduces the student Bioinformatics, which uses computer databases to store, retrieve and assist in understanding biological information. Genome-scale sequencing projects have led to an explosion of genetic sequences available for automated analysis. These gene sequences are the codes, which direct the production of proteins that in turn regulate all life processes such as normal organism development and many pathological conditions. The student will be shown how gene expressions lead to the creation of proteins the building blocks of cells which in turn are the foundation of all organisms. Analysis these sequences by micro-array data lead to a much fuller understanding of many biological processes. Students will be introduced to the basic concepts behind Bioinformatics and Computational Biology tools.

Module aim:

The aim is to introduce computer science students a background and better understanding of the process of how genes through the process of regulation result after a number of intermediate stages in the formation of an amino acid sequence which has a direct relationship to the underlying gene base pair sequence. To show how this relationship leads to the inheritance of characteristics and the evolutionary process in general. Emphasise the significance amino acid sequences in the formation of proteins and specifically the regions involved in protein functionality. To develop the theory of how these basic building blocks lead to cell functionality and different biological processes e.g. organism development. To familiarise the student with how data can be generated and obtained, which can then used to develop a further understanding of the aforementioned biological processes.

Learning Outcomes:

On completion of this module, the student will be able to:

- Discuss the process of genes, hereditary, gene regulation and evolution of the genome.
- Discuss the importance of gene sequences in the genomic process and how it relates to the formation of amino acid sequences.
- Analyse an amino acid sequence or gene sequence and discuss how it can result in the formation of the primary, secondary and tertiary structures of proteins the basic building blocks of all organisms.
- Discuss the fundamental principles of cell biology
- Describe and analyse the principles of micro-arrays and their importance to the field of bioinformatics.
- Discuss how to obtain and use the freely available micro-array data
- Develop an understanding of the underlying computational techniques used in bioinformatics.

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Learning and Teaching Methods:

This module will employ teaching methods and learning situations such as lectures, seminars and tutorials, as well as case studies

Module content:

- What is meant by the genome, what are genes and how is their expression regulated, what are the main types of genomes and their properties and how the genes establish different physical traits and how mutations result in the evolution of organisms.
- How gene sequence produce basic amino acid sequences : the transcription of DNA and the translation of RNA.
- How are the basic amino acid sequences converted into function proteins ..
- What are cells and their different components. What are the functions of the different components of a cell. How to these components interact to produce cell functionality.
- Evaluate the principles of micro-array analysis and discuss how such techniques allow for the observation of the expression of thousands at the same time.
- What techniques can be applied to micro-array data to remove background noise and thus ensure the micro-array data is more accurate for analysis.
- Discuss probability theory and its role in Statistical Inference.

Module Assessment:

Continuous assessment (30%); A report discussing how biological data can be utilised to evaluate biological systems.

Written examination (70%); A two hour end of semester written exam.

Essential Reading:

- Alberts Bruce and Martin Raff, 2003 Essential Cell Biology: An introduction to the molecular biology of the cell. Garland Science Textbooks.
- Clark, David P. 2005. Molecular Biology, Elsevier Academic Press
- Microarray Gene Expression Data Analysis: A Beginner's Guide, Helen C. Causton, John Quackenbush, Alvis Brazma, 2003, Blackwell Publishers
- **Markley Scott and Leon Darryll Sequence Analysis in a Nutshell: A Guide to Tools A Guide to Common Tools and Databases 2003**
- Bower, James M and Bolouri Hamid, 2001, *Computational modelling of genetic and biochemical networks* Cambridge, Massachusetts; London, England: The MIT Press.

Supplemental Reading:

To be supplied before commencement of the module

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Web references, journals and other:

- [Genetics Virtual Library](#)
- [Microbiology Resources](#)
- [Biology related search engine](#)
- [Gene Expression and Micro-array analysis resources](#)

Further Details

Further Details: 2-hour lecture, and 1-hour tutorial. To be delivered in one semester.