

Discrete Biological Models

(Modelli Biologici Discreti)

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Laurea Triennale in Bioinformatica
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- **corso:** mar 11:30 - 13:30, mer 10:30 - 13:30 (aula C)
- **Attenzione!** Il corso non si terrà 14 + 15/10 (mar + mer)
- **webpage** (coming soon):
<http://profs.sci.univr.it/~liptak/MBD/>
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Mettere "corso Modelli Biologici Discreti" nell'oggetto della mail
- **studio:** CV 2, 1° piano, stanza 1.79
- **ricevimento:** giovedì 8:30-10:30 e su appuntamento
- **prerequisiti:** Algoritmi per la Bioinformatica (2° anno)
- **voto:** 50% scritto (in itinere), 50% orale (seconda parte o tutto)
- **prospettiva:** Si può poi approfondire un argomento del corso per una tesi (da decidere da gennaio).

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Goals of this course:

- learn about some **discrete models** used in bioinformatics: models that use **strings** (= sequences), **graphs**, **integer matrices**, **permutations**, ...
- **recognize** situations where similar models can be applied, and **develop** simple models for given phenomena
- improve knowledge of **discrete mathematics** (combinatorics, strings, graphs)

For this we will need to:

- study in detail some **discrete models used in biology**
- study **basic discrete mathematics** (combinatorics, counting, fundamental sequences, strings, graphs, trees)
- understand **NP-completeness**

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Overview

- **Introduction**
- Some basics of **discrete mathematics**
- Some basics of **molecular biology** (from a math point of view)
- **Discrete models for biological problems**, e.g.
 - sequence assembly: overlap graphs
 - sequencing by hybridization: deBruijn graphs
 - RNA structure prediction: modelling RNA folding
 - mass spectrometry data interpretation: Money Changing Problem
 - genome rearrangements: strings and permutations
 - haplotyping: 0-1-2 matrices
 - other common applications of graphs: phylogenetic trees, protein interaction networks, protein folding
- **Detour:** NP-completeness

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Books: Discrete Mathematics, Algorithms

- **Martin Aigner**: Discrete Mathematics (2007)—[nice concise book on discrete mathematics with many exercises](#)
- **R. Graham, D. Knuth, O. Patashnik**: Concrete mathematics (1994)—[the bible of discrete mathematics](#)
- **Stein, Drysdale, Bogart**: Discrete Mathematics for Computer Scientists (2010)
- **V.K. Balakrishnan**: Introductory Discrete Mathematics (1991)
- **Cormen, Leiserson, Rivest (& Stein)**: Introduction to Algorithms (different editions, 1990-onwards)—[the bible of algorithms, a must if you are interested in algorithms \(buy an old edition second hand\)](#)

Books: Bioinformatics

- **João Setubal, João Meidanis**: Introduction to Computational Molecular Biology (1997)—[my favourite](#)
- **R. Durbin, S. Eddy, A. Krogh, G. Mitchinson**: Biological Sequence Analysis (1998)—[oriented towards probabilistic models](#)
- **Dan Gusfield**: Algorithms on Strings, Trees, and Sequences (1997)—[the bible of string algorithms with applications to mol.biol.](#)
- **Michael Waterman**: Introduction to Computational Biology: Maps, sequences and genomes (1995)—[a classic](#)
- **Hans-Joachim Böckenhauer and Dirk Bongartz**: Algorithmic Aspects of Bioinformatics (2010)—[quite formal, mathematical](#)
- **Joseph Felsenstein**: Inferring Phylogenies (2004)—[a classic book on phylogenetics](#)