Bioinformatics Algorithms
(Fundamental Algorithms, module 2)

Zsuzsanna Lipták

Masters in Medical Bioinformatics
academic year 2018/19, II semester

Organisation
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• **Title of course:** Bioinformatics Algorithms
  (Fundamental Algorithms, module 2)
  Master of Medical Bioinformatics (MB)
  6 CFU of a total of 12 CFU

• This course doubles as *(mutuato)*
  Algorithms for Computational Biology
  in the Master in Medical and Molecular Biotechnology (MMB)
  6 CFU
• course times: Tue 12:30 - 14:30 (aula L), Thu 11:30 - 14:30 (aula A)
• email: zsuzsanna.liptak@univr.it
  Please include the course title and your name in the email
• office: CV 2, 1st floor, room 1.79
• student hours: Wed 10-12 (9:30-11:30?) and by appointment
• webpage of course:
  http://profs.scienze.univr.it/~liptak/FundBA/
• **exam**: written and oral, admitted to oral only if you pass the written test
• **different exams** for students of MB and MMB
• There will be **two extra lectures** for students of MMB on computational complexity
• **takehome exercises** during term: will be discussed but not marked
• for Fundamental Algorithms **final grade** is 50% mod.1, 50% mod.2
Organisation (cont.)

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Questions?
Overview (tentative)

- Pairwise sequence analysis
  - Pairwise sequence alignment (global, local, other variants)
  - Pairwise alignment in practice: BLAST, Scoring matrices
  - String distances (edit distance, LCS distance, $q$-gram distance)
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- **Sequence assembly algorithms**
  - Sanger shotgun sequencing: SCS (recap)
  - Sequencing with de Bruijn graphs
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- **Multiple sequence alignment**
  - DP-algorithm, SP-score
  - Heuristic and approximation algorithms
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- **Basics of Phylogenetics**
  - distance-based data: UPGMA, Neighbor Joining
  - character-based data: Perfect Phylogeny, Small and Large Parsimony
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- **Introduction to string data structures**
  - Basics of Suffix Trees and Suffix Arrays
  - Some applications
Books

- **Enno Ohlebusch**: Bioinformatics Algorithms: Sequence Analysis, Genome Rearrangements, and Phylogenetic Reconstruction. Oldenbusch Verlag (2013)—recent, detailed, covers some but not all topics of this course, 3 copies in library
- **V. Mäkinen, D. Belazzougui, F. Cunial, A.I. Tomescu**: Genome-Scale Algorithm Design. Cambridge University Press (2015)—very recent, advanced
- **Neil C. Jones and Pavel A. Pevzner**: An Introduction to Bioinformatics Algorithms (2004)—3 copies in library
- **David M. Mount**: Bioinformatics: Sequence and Genome Analysis (2004)—biologically oriented book, detailed, not always sufficiently algorithmic
- **João Setubal, João Meidanis**: Introduction to Computational Molecular Biology (1997)—my old favorite but a bit dated, 1 copy in library
- **Dan Gusfield**: Algorithms on Strings, Trees, and Sequences (1997)—the bible of string algorithms, a bit dated now
- **Joseph Felsenstein**: Inferring Phylogenies (2004)—important book on phylogenetics, very understandably written
- **Cormen, Leiserson, Rivest (& Stein)**: Introduction to Algorithms (different editions, 1990-onwards)—the bible of algorithms, a must-have for anyone interested in algorithms (buy second hand, old editions are also fine)