CURRICULUM
BIOLOGICAL DATA ANALYTICS

Master of Science in Data Science
Damiano Piovesan
Introduction

- Advances in “omics” technologies opened new frontiers in biomedicine and biotechnology
- Modern life science is based on high-throughput experiments
- Data interpretation requires computational technology, advanced statistical analysis and mathematical tools
- Great need for specialists and analysts in research institutions, hospitals, pharma and diagnostic companies
What about BDA?

An example, the protein folding problem:

- **Molecular Dynamics** simulations take **years** of calculation
- **Deep learning** algorithms take **hours**

AlphaFold
Google DeepMind lab
What about BDA?

An example, precision medicine:

- Understanding diseases at the molecular level
- Target precision medicines against the causes of disease and not simply treat the symptoms
What about BDA?

With USD$99 you can (23andMe®):

• Ancestry Composition
• Traits
• Neanderthal Ancestry

With full genome:

• Genetic disease
• Dietary profile
• ...
What about BDA courses?

• Math
  • Statistics and applied mathematics
  • Machine Learning algorithms and tools

• Bio
  • Molecular and Cell Biology
  • Computational Biology and Bioinformatics
Prospective student’s background

We welcome students with a **good background** in:

- Computer science, Computer Engineering, ICT
- Mathematics, Statistics, Physics
- **Biology, Medicine** and related (with math/statistics fundamentals)

Prospective students should:

- Have an attitude on both basic science (biology, biochemistry, physics) and computer science
What we expect from students

• Tackle computational biology problems in a scientific, evidence-based manner
• Gain experience working in a true multidisciplinary mindset
• Effective management and exploitation of high-throughput experimental data

Students will have the opportunity to perform real lab experiments and understand how molecular data are generated
What to expect...

- Mathematical and computational methods in computational biology and bioinformatics
- Advanced **machine learning**, optimization and algorithms to model biological phenomena
- Analysis and interpretation of large datasets coming from high-throughput technologies ("omics" data)
- Fundamental aspects of **cell biology**
Our graduates

- Basic knowledge of life sciences
- Ability to deal with “omics” data and ability to model molecular systems
- Effective and attractive professional profile
- Excellent placement in the job market
Companies/Research Institutions dealing with big data in

- Biology and healthcare
- Drug design
- Precision medicine
- Diagnosis
- ...
Curriculum structure

- Two optional courses, two electives

- **COMPUTER SCIENCE**
  - MATHEMATICAL CELL BIOLOGY
  - HUMAN DATA ANALYTICS
  - GAME THEORY
  - NETWORK SCIENCE

- **BIOLOGY, ECONOMICS, HUMAN & SOCIAL SCIENCE**
  - BIOINFORMATICS
  - OMICS IN HUMAN DISEASE
  - LAW AND DATA

- **ELECTIVE**
  - 12 CFU
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