Master in Quantitative & Computational Biology

Classe LM-8 – Biotecnologie industriali

A joint initiative between:

• Centre for integrative biology (CIBIO)
• Department of Physics
• Department of Mathematics
• Department of Information Engineering and Computer Science (DISI)
Capturing the increasing need for researchers/experts able to:

- transform the enormous amount of biological information ("big data") into knowledge
- gain quantitative insight into the behaviour of biological systems by means of bio-mathematical and bio-physical models
For life scientists with expertise and an interest in bioinformatics, computer science, statistics, and related skill sets, the job outlook couldn’t be rosier.

Big pharma, biotech, and software companies are clamoring to hire professionals with experience in bioinformatics and the identification, compilation, analysis, and visualization of huge amounts of biological and health care information.
Navigating big data, to maximize its utility, will require specially designed training programs directed at early-career scientists.

“The opportunities are enormous for budding computer scientists, mathematicians, and engineers to meld with trainee biologists, neuroscientists, and clinicians in novel university courses constructed to focus on the truly 21st century phenomenon that is the data avalanche from large-scale biomedicine”
Exploiting key competences in Biology, Engineering and Computer Science, Mathematics, Physics available in Trento
The Centre for Integrative Biology

CANCER BIOLOGY & GENOMICS

CELL & MOLECULAR BIOLOGY

MICROBIOLOGY & SYNTHETIC BIOLOGY

NEUROBIOLOGY & DEVELOPMENT

ADVANCED IMAGING

HIGH THROUGHPUT SCREENING & MICROARRAY

BIO-ANALYTICAL MASS SPECTROMETRY

PROTEIN SCIENCE

LAB MANAGEMENT TEAM

COMPUTATIONAL BIOLOGY

BIOMEDICINE

CORE FACILITIES

BIOINFORMATICS

MODEL ORGANISM

NEXT GENERATION SEQUENCING

CELL ANALYSIS & SEPARATION

GRANT SUPPORT

Higher education

Independent PIs

Molecular basis of diseases

Research & Innovation

Research center
Physics Department

Fundamental and applied fields of study

- Experimental Gravitation
- Biophysics and Biosignals
- Bio-organic Chemistry
- Communication of Physical Sciences
- Atomic and Molecular Physics
- IdEA (Hydrogen, Energy, Environment)
- Structure and dynamics of complex systems
- Nanoscience
- Theoretical and computational physics

partner institutions

[Logos of TIFPA, Consiglio Nazionale delle Ricerche, BEC, and ECT*]
The Department of Information Engineering and Computer Science

Founded in January 2002 as a dynamic and qualified response to the ever-increasing, leading-edge competency demands in the field of ICT, drawing from a productive fabric at the local, national and international level.
Mathematics Department

- Analytic and Algebraic Geometry
- Calculus of Variations and Geometric Measure Theory
- Dynamical Systems and Control Theory
- Lie Algebras, Groups, Cryptography and Codes
- Mathematical Logic and Theoretical Computer Science
- Mathematical Physics and Geometrical Methods in Physics
- Nonlinear Partial Differential Equations
- Numerical Approximation of Partial Differential Equations
- Stochastic Processes

- Laboratory of Didactics and Communications of Mathematics
- Laboratory of Industrial Mathematics and Cryptography
- Laboratory of Mathematical and Computational Biology
Admission

First level University Degree in:

- Biotecnology
- Biological Sciences
- Science and agro-food technologies
- Pharmaceutical and Technological Sciences
- Chemical and Technological Sciences
- Physical and Technological Sciences
- Mathematical Sciences
- Information Sciences and Technology
- Information Engineering

...plus at least

- 6 CFU (ECTS) in BIO/CHEM
- 6 CFU (ECTS) in MATH
- 6 CFU (ECTS) PHSY
- 6 CFU (ECTS) in INF/ENG-INF

+ English B1

Two different tracks based on educational background

BIOTECHNOLOGY TRACK

COMPUTATIONAL TRACK
Courses

• **Mandatory Courses:** to allow students from different educational paths to harmonize their background (24 CFU/ECTS) and to acquire specific competencies (24 CFU/ECTS)

• **Elective courses:** to focus on selected biotechnological or computational topics (36 CFU/ECTS)

• **Free choice courses:** among courses offered by the UniTN Departments (12 CFU/ECTS)

• **Language,** English B2 or higher (3 CFU/ECS)

• **Traineeship** within the University of Trento organizations involved in the Master Degree, by other Italian or European Universities, or in industries operating in the biotechnology, bioinformatics and computational area (6 CFU/ECTS)

• **Thesis** (usually related to the traineeship activity; 15 CFU/ECTS)

**Total** 120 CFU/ECTS
Each course is composed by two integrated modules (6 CFU/ECTS each)
Computational track: mandatory

I anno

I semestre | II semestre

Mol. Basis of Cell Structure & Function

Cellular & Molecular Dynamics

General & Organic Chemistry

Analytical Chemistry & Biochemistry

Biostatistics & Probability

Biostatistical Computing

Algorithms & Data Structure

Scientific Programming

Atomic & Molecular Scale Physics

Quantum Mechanics

Computational Human Genomics

Computational Microbial Genomics

Genetic & Metabolic Engineering

Tissue Engineering

Biological Networks Analysis

Network Modeling & Simulation

I anno

II anno

I semestre

II semestre

Mathematical Modeling in Biology

Spatio-temporal Models in Cell & Tissue Biology

Physical Modeling of Biomolecules

Computer Simulation of Biomolecules

Machine Learning

Biological Data Mining

Economics & Management

Biotechnology Regulations

Other

DISI

CIBIO

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Computational track: 3 electives

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- **Cellular & Molecular Dynamics**
- **General & Organic Chemistry**
- **Analytical Chemistry & Biochemistry**
- **Biostatistics & Probability**
- **Biostatistical Computing**
- **Algorithms & Data Structure**
- **Scientific Programming**
- **Atomic & Molecular Scale Physics**
- **Intro to Quantum Mechanics**

#### II year
- **Mathematical Modeling in Biology**
- **Spatio-temporal Models in Cell & Tissue Biology**
- **Physical Modeling of Biomolecules**
- **Computer Simulation of Biomolecules**
- **Machine Learning**
- **Biological Data Mining**
- **Economics & Management**
- **Biotechnology Regulations**

#### Courses
- **Computational Human Genomics**
- **Computational Microbial Genomics**
- **Genetic & Metabolic Engineering**
- **Tissue Engineering**
- **Biological Networks Analysis**
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### Professional profiles at outcome

#### Biotecnologist
- Skills in experimental techniques and instrumentation and deep understanding of cellular and molecular processes
- Skills in dedicated software for laboratory equipment and raw data management
- Effective interaction both with laboratory personnel and analysts and ability to integrate workflows

#### Bioinformatician
- Development of software and computational tools for biological data analysis
- Skills in complex databases, web resources and in cluster- or cloud-based computational solutions
- Building and maintaining workflows and pipelines for raw biomolecular data analysis and integration

#### Computational Biologist
- Development of analytical methods for large-scale data (genomics, proteomics, metabolomics) and molecular interaction models
- Identification, development and test of computational methods for the discovery of active ligands and for drug development
- Design of in silico experiments to test data-driven hypotheses and interpretation of result

#### Biological Data and Systems Biology Analyst
- Skills in biostatistics for experimental design and advanced analysis of clinical and molecular data
- Curation of high-dimensional data for the representation of biological knowledge by integrated systems and biological networks
- Analysis of complex biological data derived from whole-cell measurements
Join us!