WISSEN
TECHNIK
LEIDENSCHAFT

Institute of Biomedical Informatics

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https://www.bioinfo.tugraz.at/

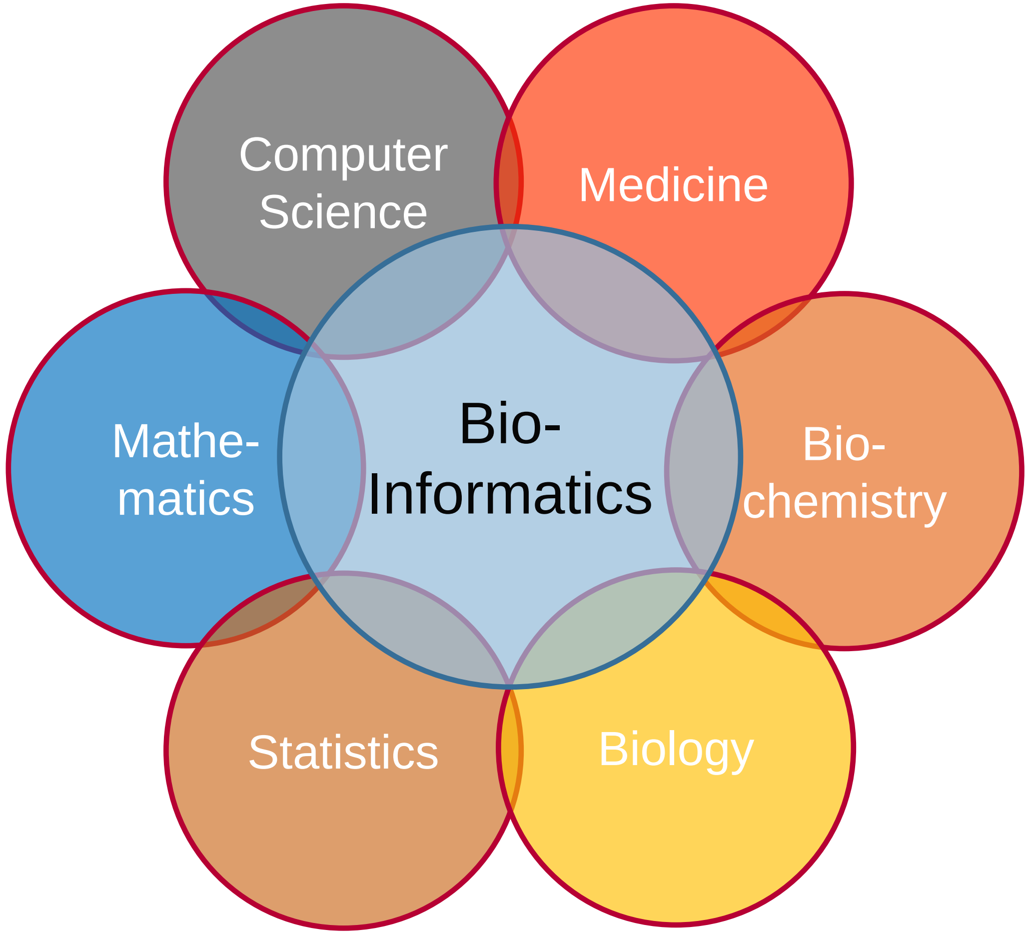
Bakk::Mas Days 2025

What is „Bioinformatics“

“Ask five bioinformaticians for a definition and you’ll get six different ones”

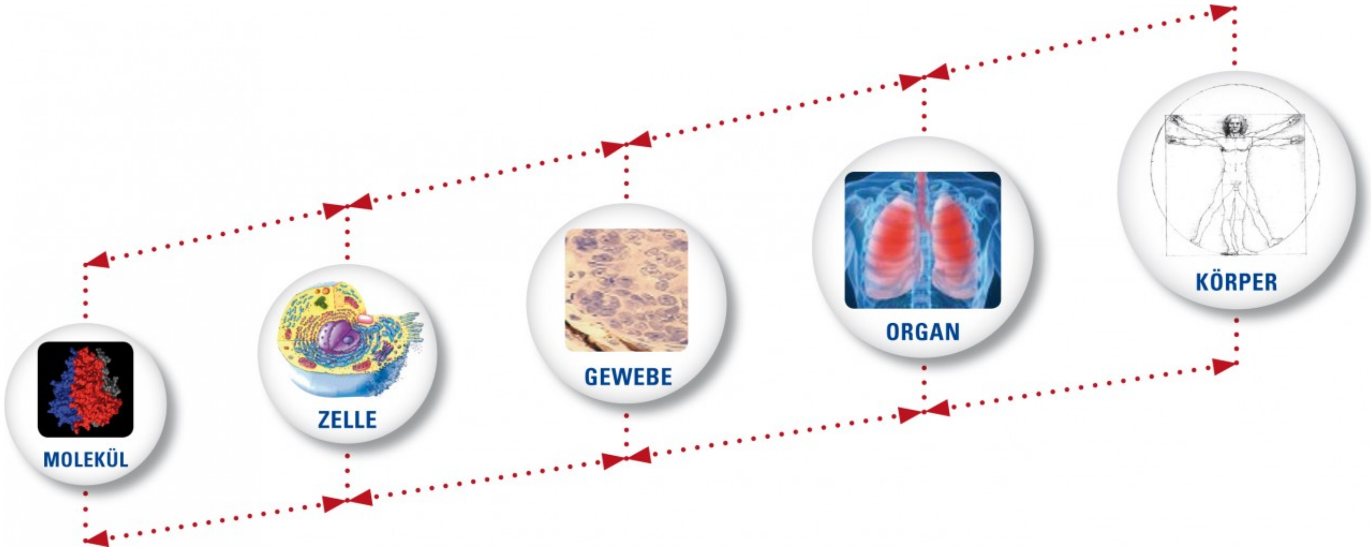
Biology and Informatics = Bioinformatics

- Theoretical biology
- Computational biology
- Systems biology
- (Theoretical) ecology
- Biomathematics
- Biostatistics
- Computational omics
- Computational evolutionary biology
- Applied bioinformatics



What is „Bioinformatics“?

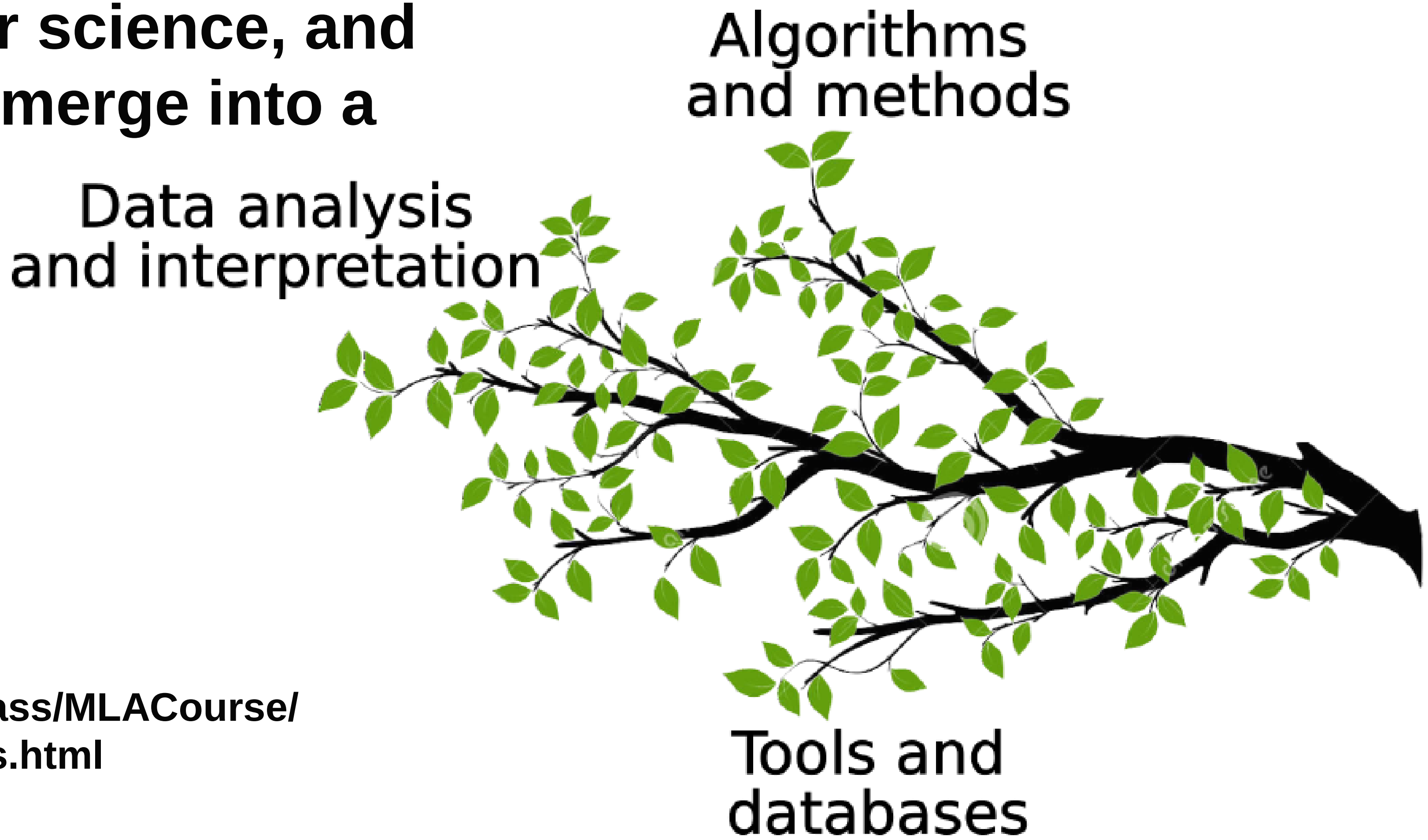
Elucidation of biomolecular relations in organisms at the cell-, tissue- and organ level ...



... by developing and applying methods from computer science, mathematics and statistics on “wet-lab” generated data.

What is „Bioinformatics“?

“Bioinformatics is the field of science in which biology, computer science, and information technology merge into a single discipline.”*

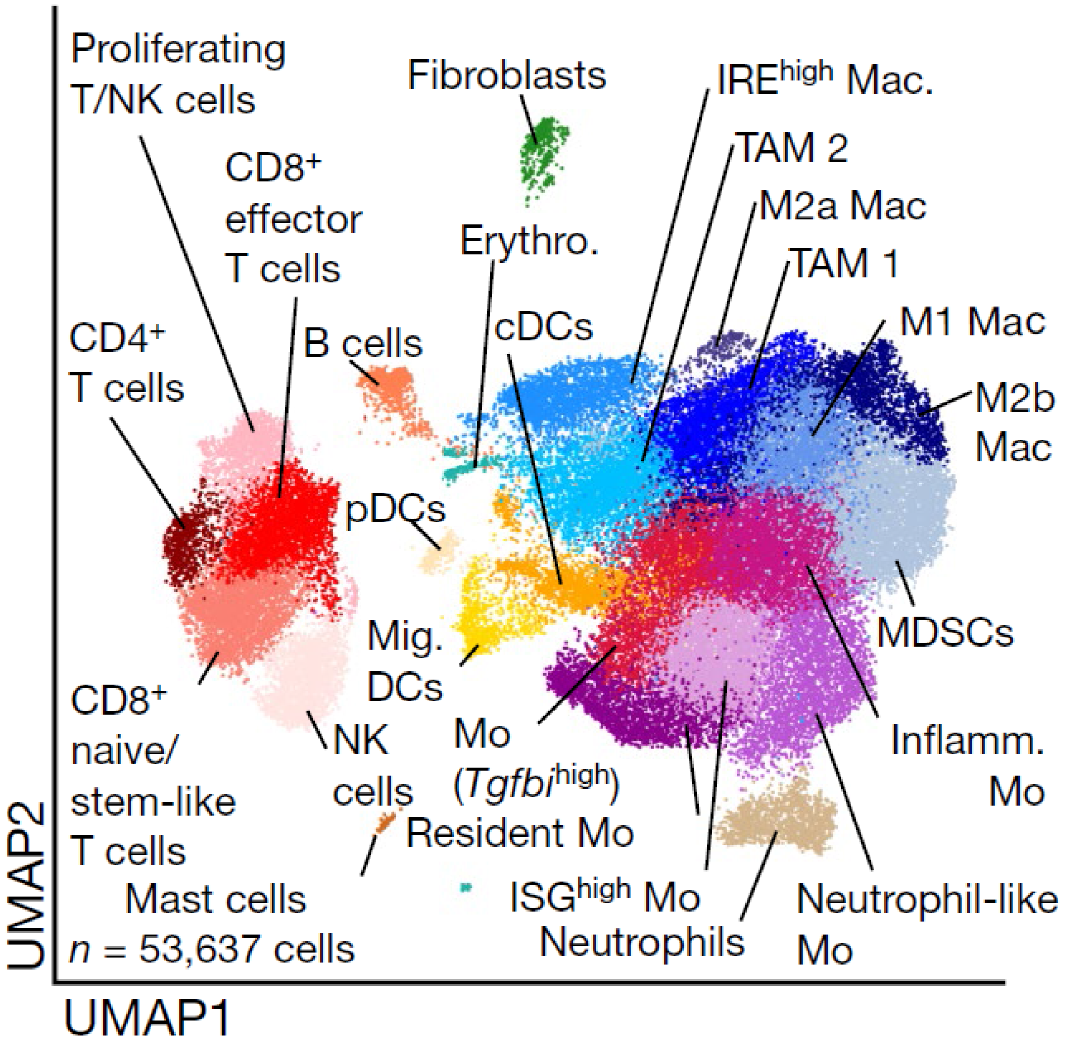


*** NCBI, https://www.ncbi.nlm.nih.gov/Class/MLACourse/Modules/MolBioReview/bioinformatics.html**

Bioinformatics applications

Fight resistance to cancer immunotherapy*

- Single-cell sequencing data analysis
- Flow cytometry data analysis

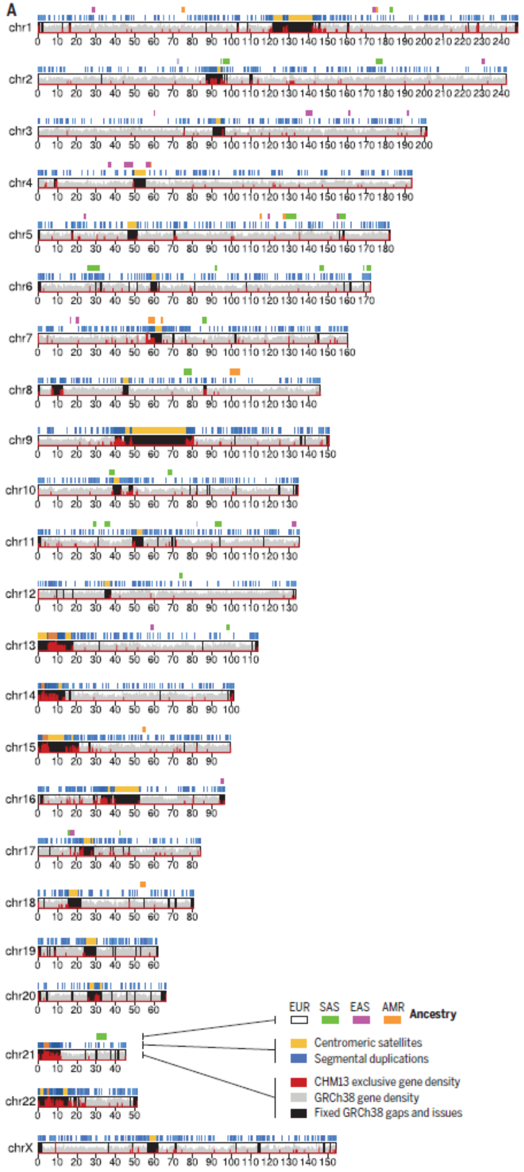


*Sun et al. Targeting TBK1 to overcome resistance to cancer immunotherapy, Nature 2023

Bioinformatics applications

Completion of the human genome*

- Long-read sequencing
- Genome assembly
- Genome annotation and visualization

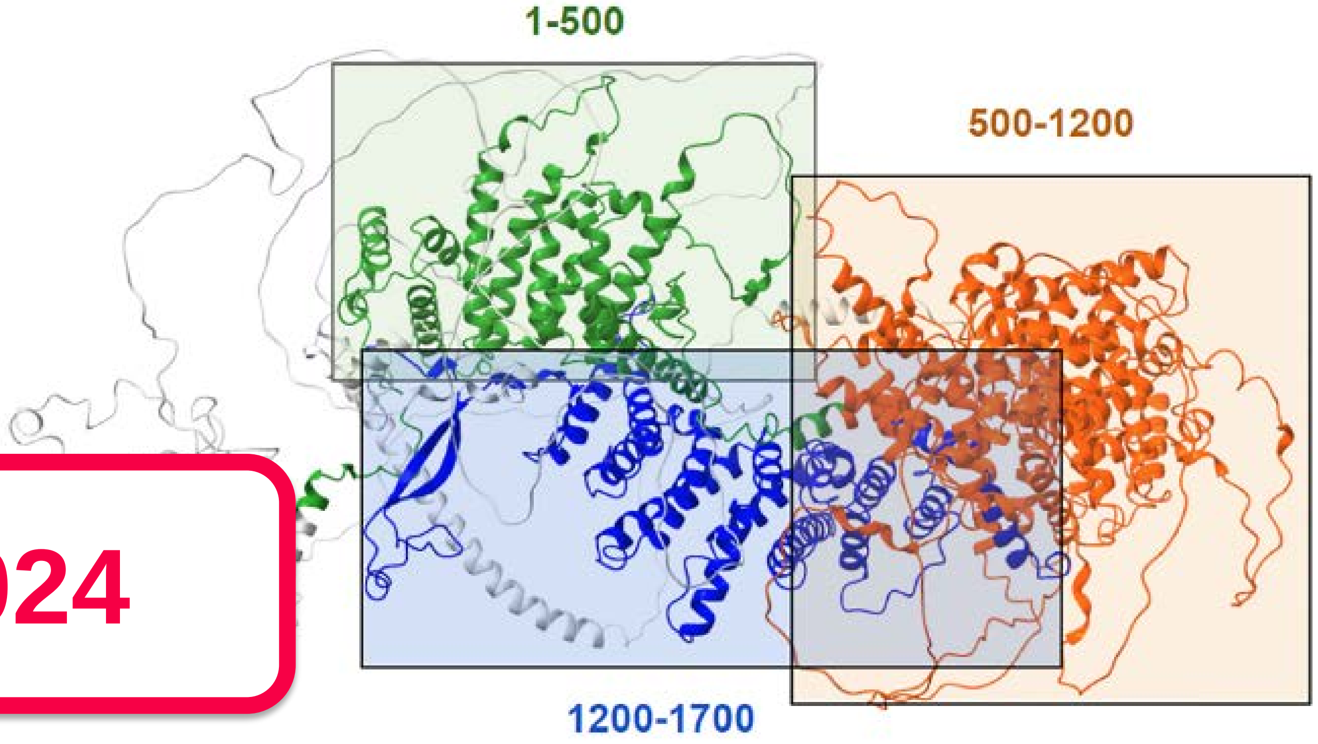


***Nurk et al. The complete sequence of a human genome, Science 2022**

Bioinformatics applications

3D Structure database of all known proteins*

- Deep-learning for structural prediction
- Database application
- Web-frontend



Nobel Price 2024

***Varadi et al. AlphaFold Protein Structure Database: massively expanding the structural coverage of protein-sequence space with high-accuracy models, Nucleic Acids Res 2022**

Bioinformatics in the BME curriculum I

Bachelor:

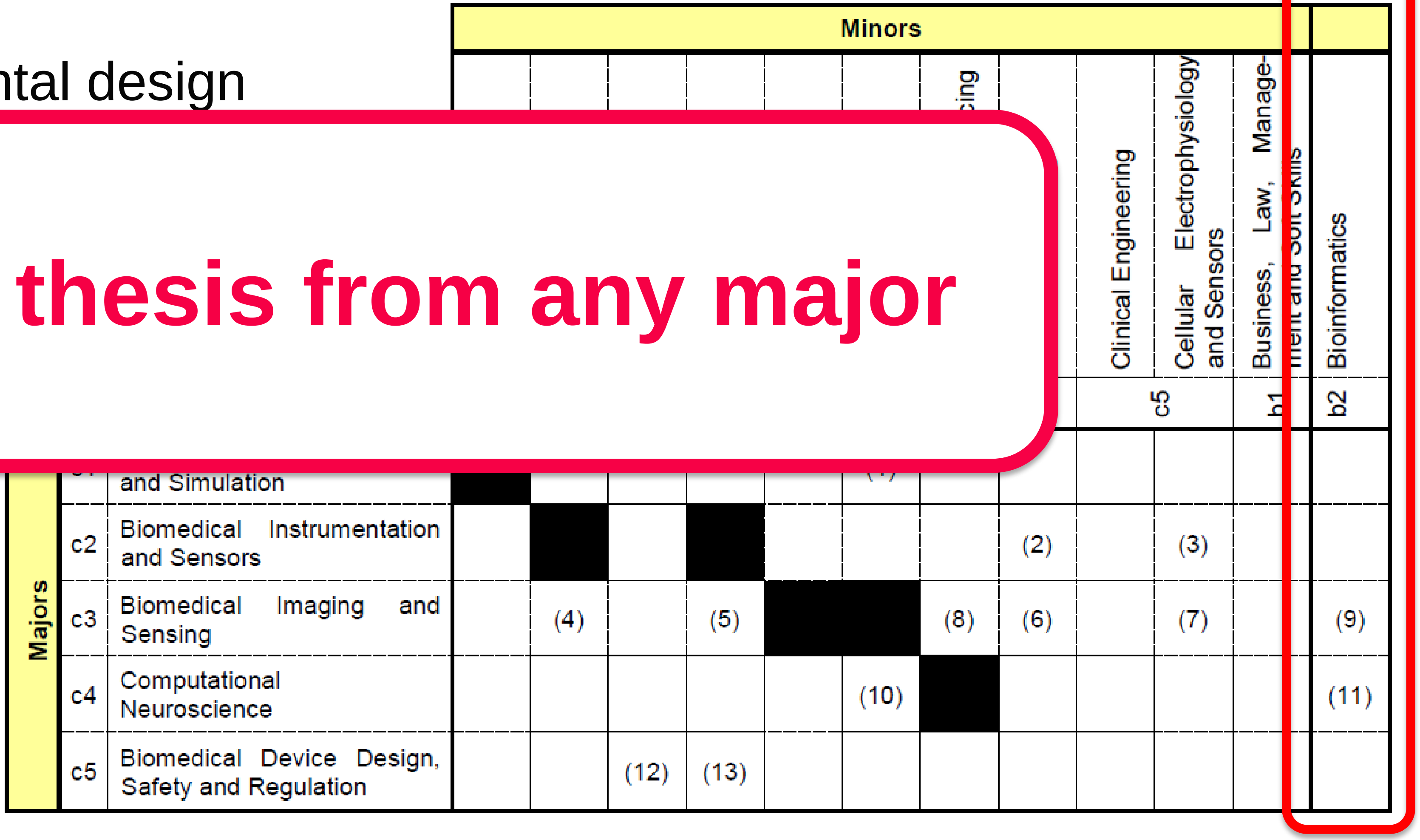
- Grundlagen der Informatik
- Grundlagen der Molekular- und Zellbiologie
- Algorithmen in der Bioinformatik
- Verfassen wissenschaftlicher Arbeiten

Bioinformatics in the BME curriculum II

Master:

- Biostatistics and experimental design
- Evoluti
- Molecu
- Statisti
- System
  (coming
- DNA-RNA sequencing

Master‘s thesis from any major



		Minors											
								cing		Clinical Engineering	Cellular Electrophysiology and Sensors	Business, Law, Management and Soft Skills	Bioinformatics
											c5	b1	b2
Majors	c1	and Simulation	■					[illegible]					
	c2	Biomedical Instrumentation and Sensors		■		■				(2)		(3)		
	c3	Biomedical Imaging and Sensing		(4)		(5)	■	■	(8)	(6)		(7)		(9)
	c4	Computational Neuroscience						(10)	■					(11)
	c5	Biomedical Device Design, Safety and Regulation			(12)	(13)								

Thesis topics I

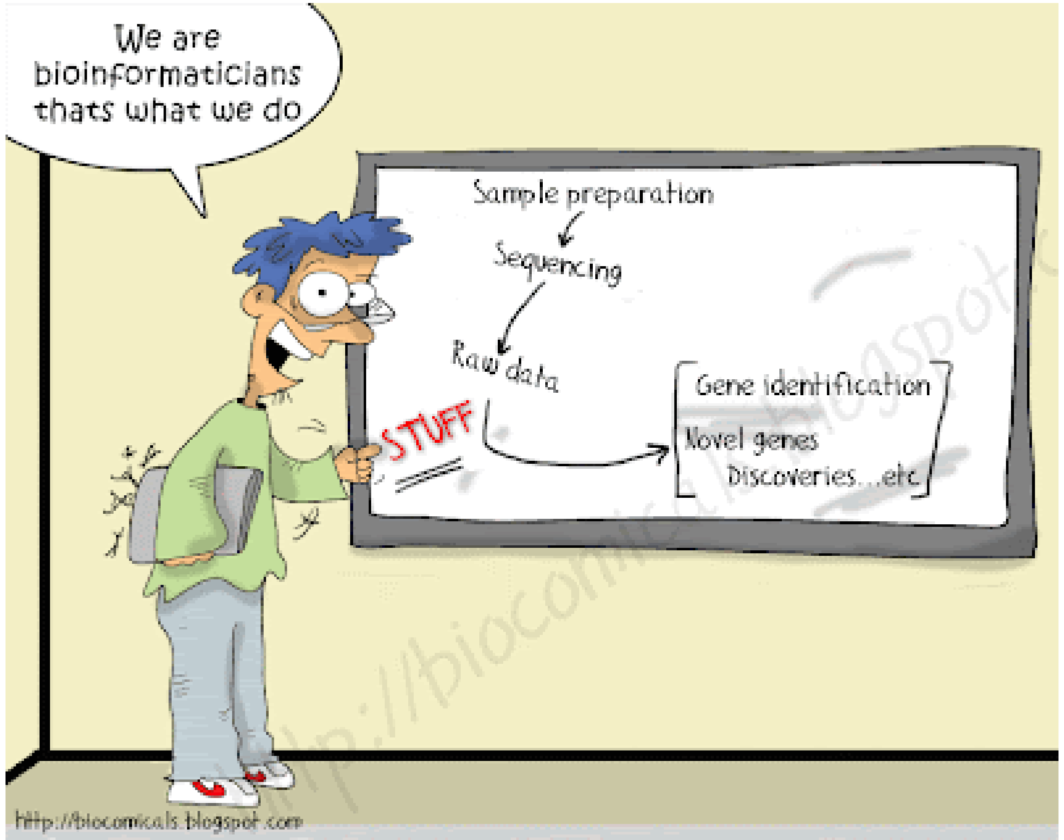
- Characterization of transposons as drivers of genome evolution
- Generation and/or analysis of Oxford Nanopore sequencing data
- Identification of structural variants associated with different cancer types
- Comparative transcriptomic analysis of cancer tumours and derived cell lines
- Implementation of models for simulating different population genetics scenarios
- Investigation of the relationship between enhancer RNA (eRNA) secondary structure and DNA enhancer function
- Application of deep learning in the analysis of omics data
- Long-read transcriptomics (ISO-seq) of fungi
- Summarization of functional enrichment analyses

Thesis topics II

- Genome assembly and annotation
- Visualization of genome annotation
- Investigation of the lipidome using mass spectrometry
- Integrative analysis of data from different omics technologies with applications in biotechnology
- Microbiome characterization
- Comparative genomics of microorganisms and fungi
- Comparative genomics of butterflies and moths
- Expansion of the regulatory network of a yeast
- Analysis of the alterations of the genome and epigenome of mammalian cells during fermentation

Bioinformatics core skills

- Proficiency in at least one programming language. R, Python and/or Bash knowledge is a plus
- For specific projects you may need to be familiar with other programming languages
- (Good) understanding of molecular cell biology
- Linux (command line)
- Algorithms
- Online databases
- Statistics
- Time management
- Readiness for self-study
- Patience



http://biocomicals.blogspot.com

What you should expect

- No pure literature work (there is always a practical part)!
- Frequent (weekly or biweekly) meetings between you and your supervisor
- Thesis supervision agreement
- Research proposal and short presentation at the beginning of your project
- Final presentation shortly before submitting your thesis
- Regular participation in our weekly lab meetings

Collaborations

Collaboration with:

- Harvard Medical School (Boston)
- Sloan Kettering Cancer Center (New York)
- New York University, Department of Medicine (New York)
- COST-Project 10kLepGenomes (All Europe)

=> Stay abroad possible

Thesis combined with a Fem In Tech scholarship:

- Female students only
- 2-6 month scholarship
- Attractive remuneration

Contact

Talk to us. If you are interested in a particular bioinformatics topic that is not part of the list, we will do our best to design a project around it!

mailto:Bakk-Mas@genome.tugraz.at

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