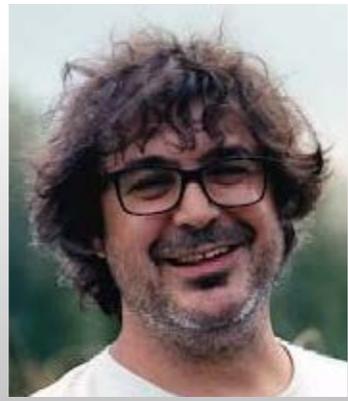


# Institute of Biomedical Informatics



Leila  
Taher



Fernando  
Fernandez Mendoza



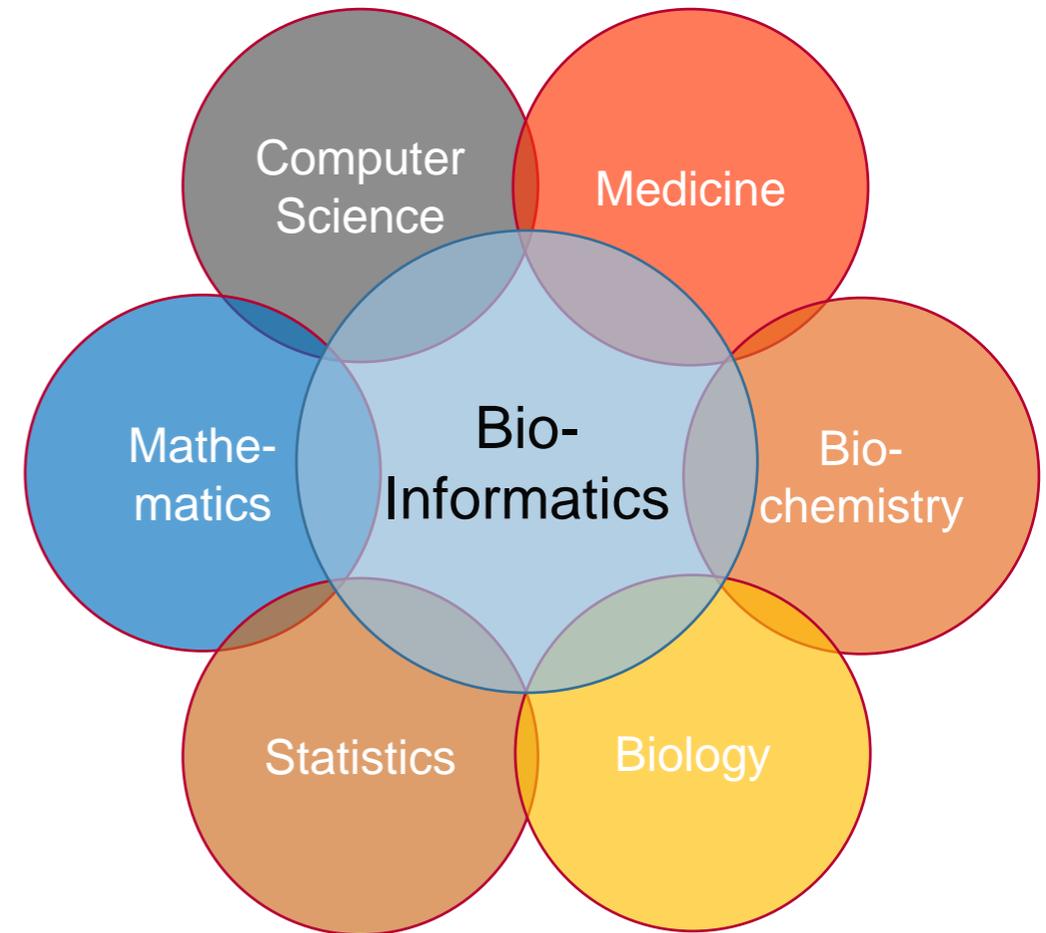
Gerhard  
Thallinger

# What is „Bioinformatics“

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

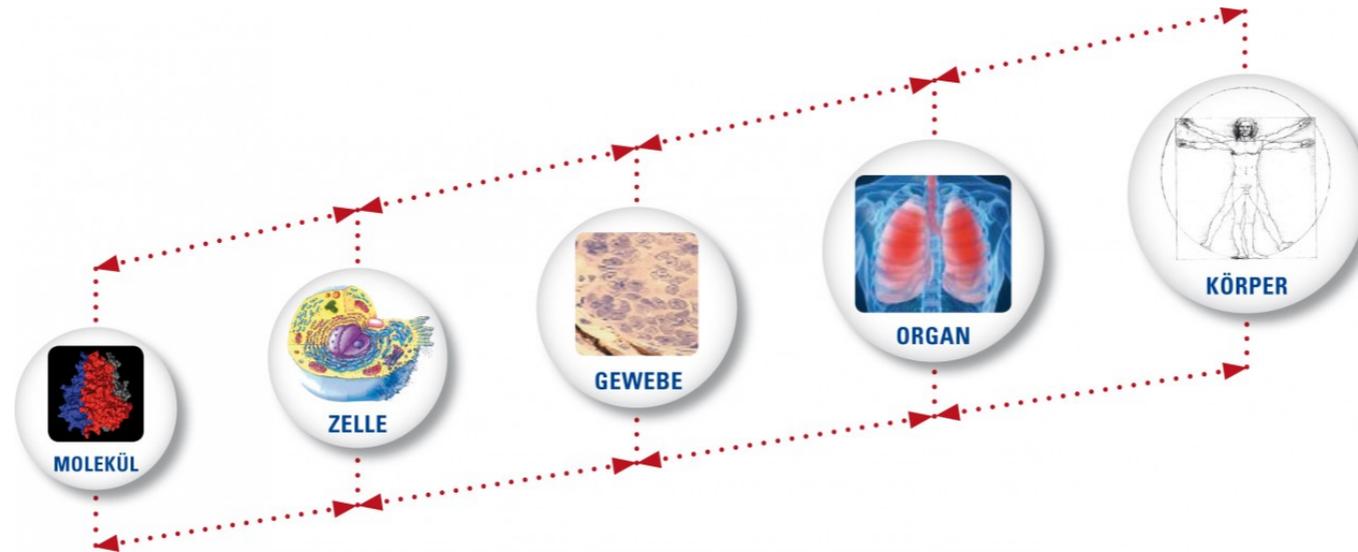
**Biology and Informatics = Bioinformatics**

- 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/MoIBioReview/bioinformatics.html>

Algorithms  
and methods

Data analysis  
and interpretation



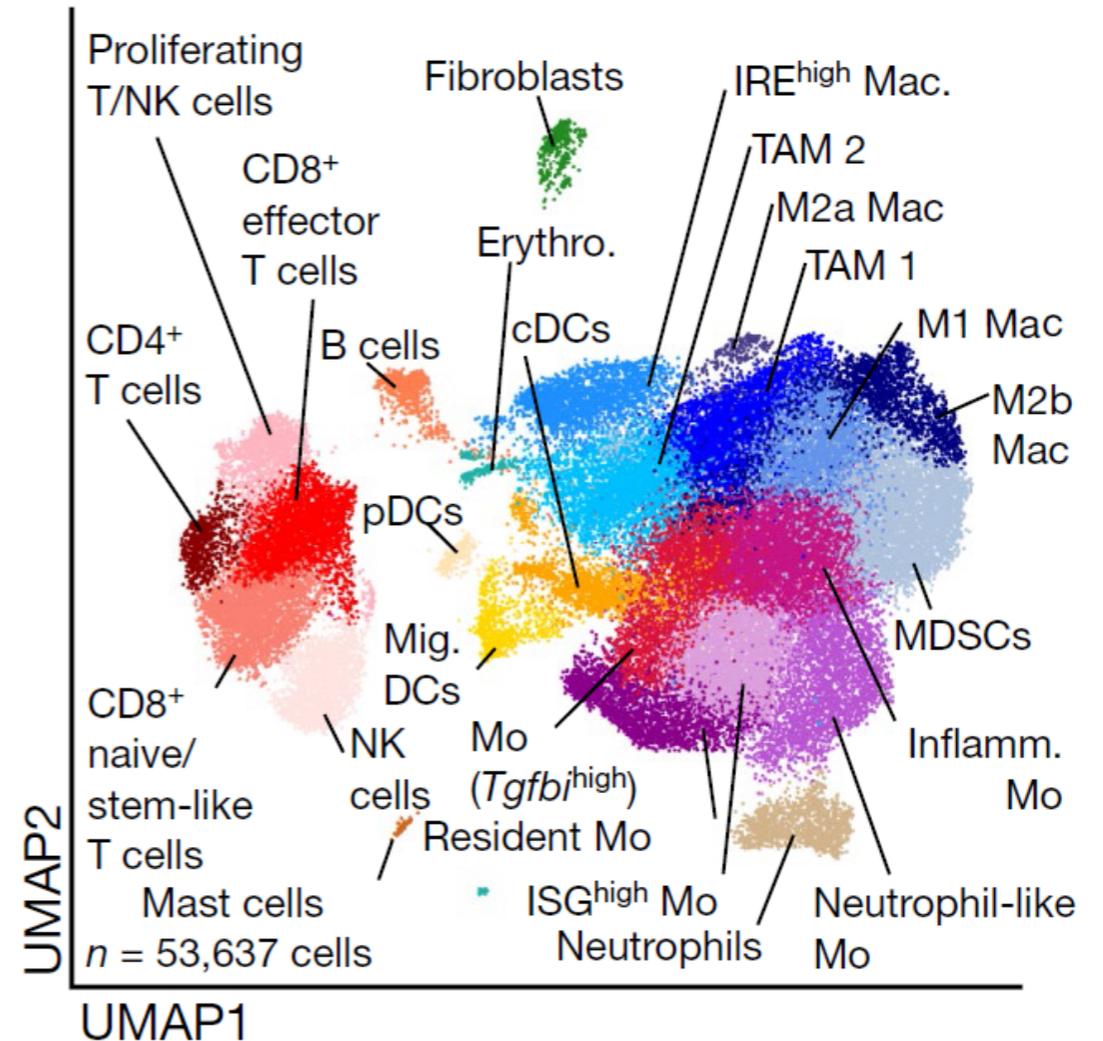
Tools and  
databases

# Bioinformatics applications

## Fight resistance to cancer immunotherapy\*

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

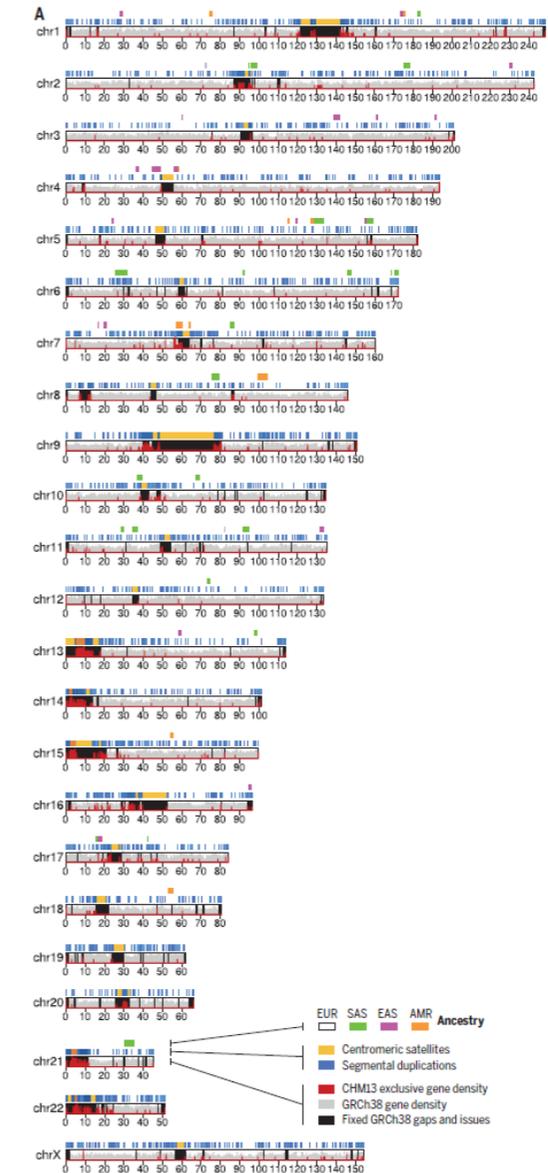
\*Sun et al. Targeting TBK1 to overcome resistance to cancer immunotherapy, Nature 2023



# Bioinformatics applications

## Completion of the human genome\*

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

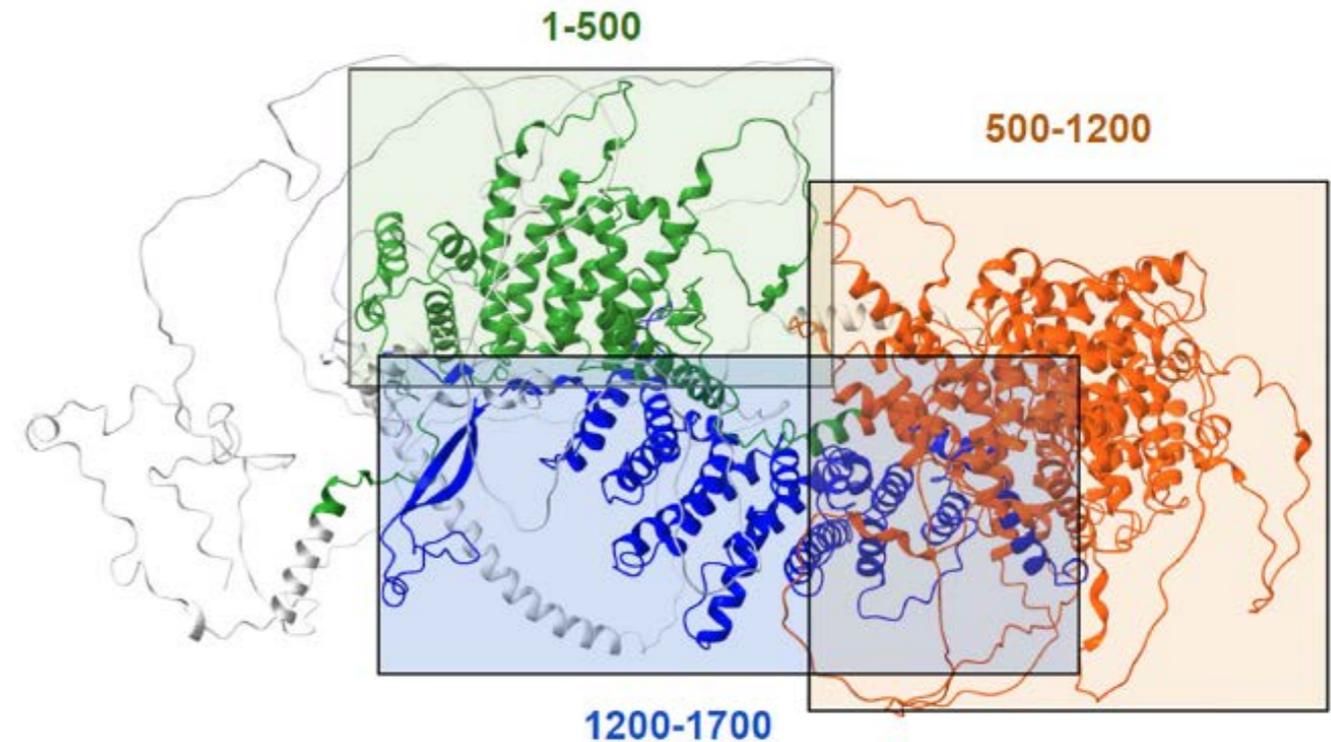


\*Nurk et al. The complete sequence of a human genome, Science 2022

# Bioinformatics applications

## 3D Structure database of all known proteins\*

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



**\*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



# Thesis topics I

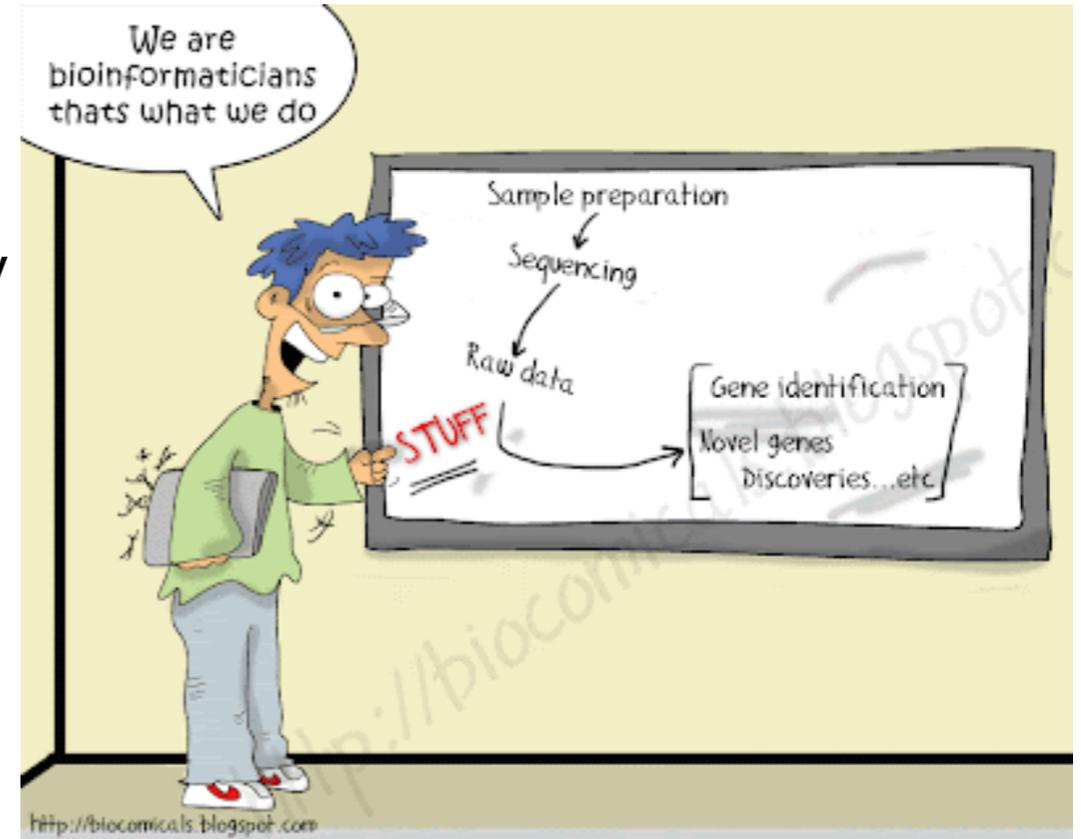
- Characterization of transposons as drivers of genome evolution
- Generation and/or analysis of Oxford Nanopore sequencing data
- Identification of structural variants associated with different cancer types
- Comparative transcriptomic analysis of cancer tumours and derived cell lines
- Implementation 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

# Thesis topics II

- Genome assembly and annotation
- Summarization of functional enrichment analyses
- Visualization of genome annotation
- Investigation of the lipidome using mass spectrometry
- Integrative analysis of data from different omics technologies with applications in biotechnology
- Characterization of the microbiome
- Comparative genomics of microorganisms
- 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 Perl 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
- Databases
- Statistics
- Time management
- Readiness for self-study
- Patience



# 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)

**=> 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>



Leila Taher



Fernando  
Fernandez Mendoza



Gerhard Thallinger