

In Silico Medicine @ FIIT

Matej Hrnčiar

Laboratories **Brainworks**

Faculty of Informatics and Information Technologies STU



Leadership

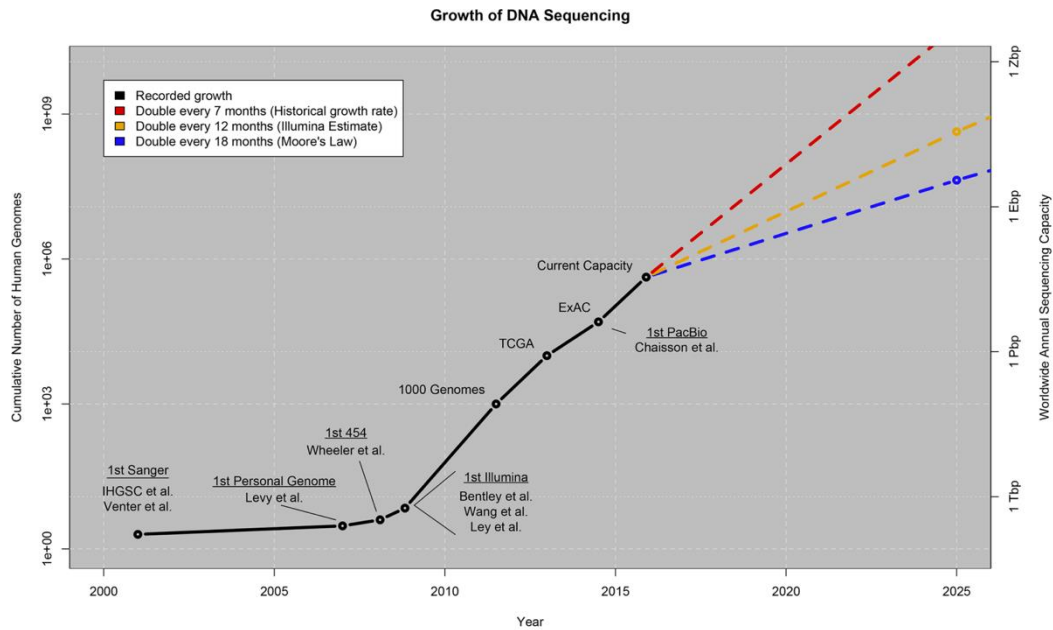
Michal Kováč

University of Oxford, University of Basel,
Roche

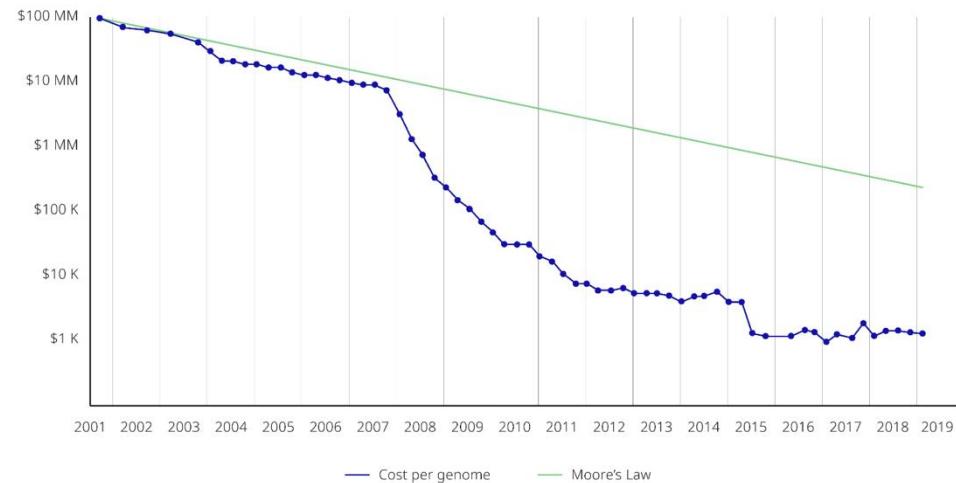
Genomics, big data, applied informatics,
LLMs, precision medicine.

Members

Monika Kováčová	Senior member
Ján Sliacky	Postdoctoral researcher
Martin Blažek	PhD student
Alona Buryk	PhD student
Olesia Buryk	PhD student
Martin Družbacký	PhD student
Matej Hrnčiar	PhD student
Katka Hutirová	PhD student
Peter Zigman	PhD student



Cost per Genome



PERSPECTIVE

Big Data: Astronomical or Genomical?

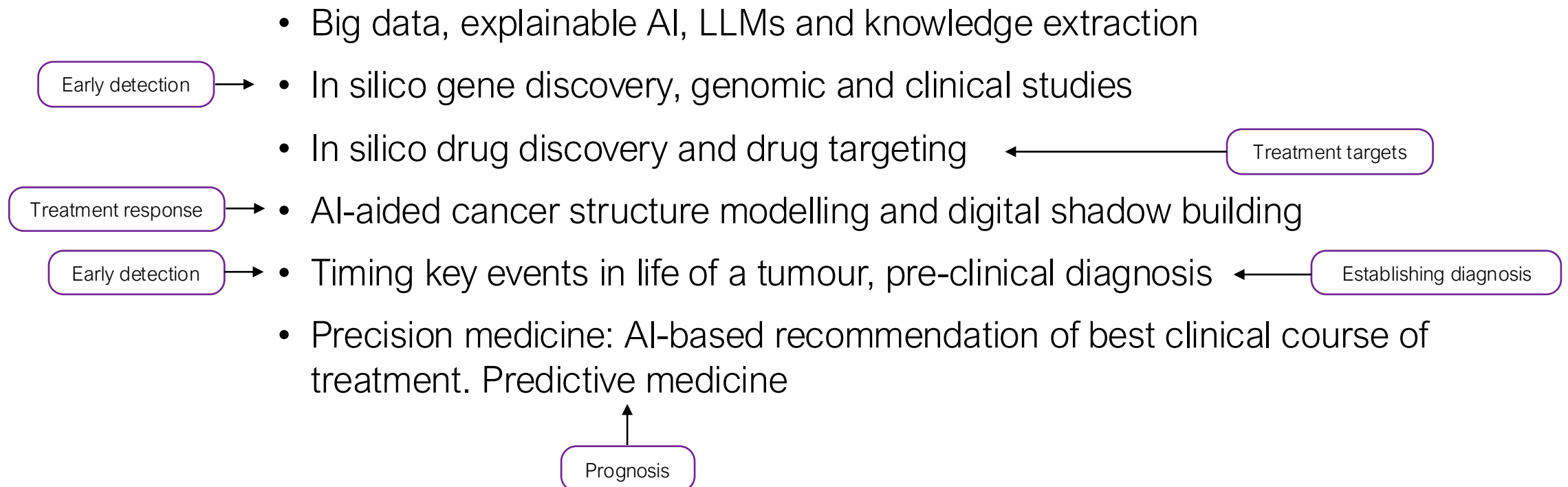
Zachary D. Stephens¹, Skylar Y. Lee¹, Faraz Faghri², Roy H. Campbell², Chengxiang Zhai³, Miles J. Efron⁴, Ravishankar Iyer¹, Michael C. Schatz^{5*}, Saurabh Sinha^{3*}, Gene E. Robinson^{6*}

Table 1. Four domains of Big Data in 2025. In each of the four domains, the projected annual storage and computing needs are presented across the data lifecycle.

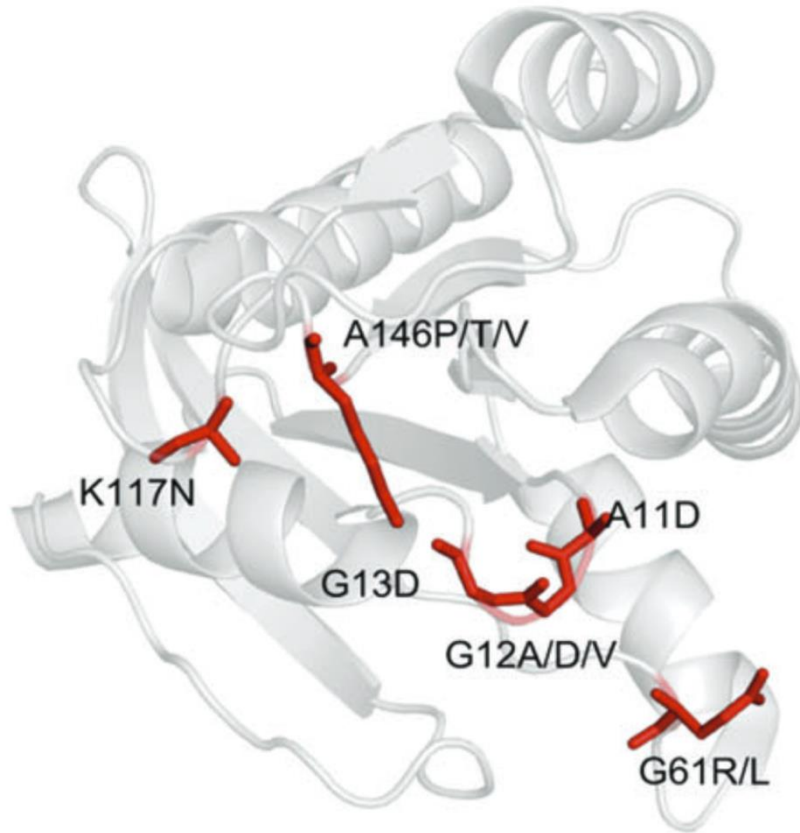
Data Phase	Astronomy	Twitter	YouTube	Genomics
Acquisition	25 zetta-bytes/year	0.5–15 billion tweets/year	500–900 million hours/year	1 zetta-bases/year
Storage	1 EB/year	1–17 PB/year	1–2 EB/year	2–40 EB/year
Analysis	In situ data reduction	Topic and sentiment mining	Limited requirements	Heterogeneous data and analysis
	Real-time processing	Metadata analysis		Variant calling, ~2 trillion central processing unit (CPU) hours
	Massive volumes			All-pairs genome alignments, ~10,000 trillion CPU hours
Distribution	Dedicated lines from antennae to server (600 TB/s)	Small units of distribution	Major component of modern user's bandwidth (10 MB/s)	Many small (10 MB/s) and fewer massive (10 TB/s) data movement

doi:10.1371/journal.pbio.1002195.t001

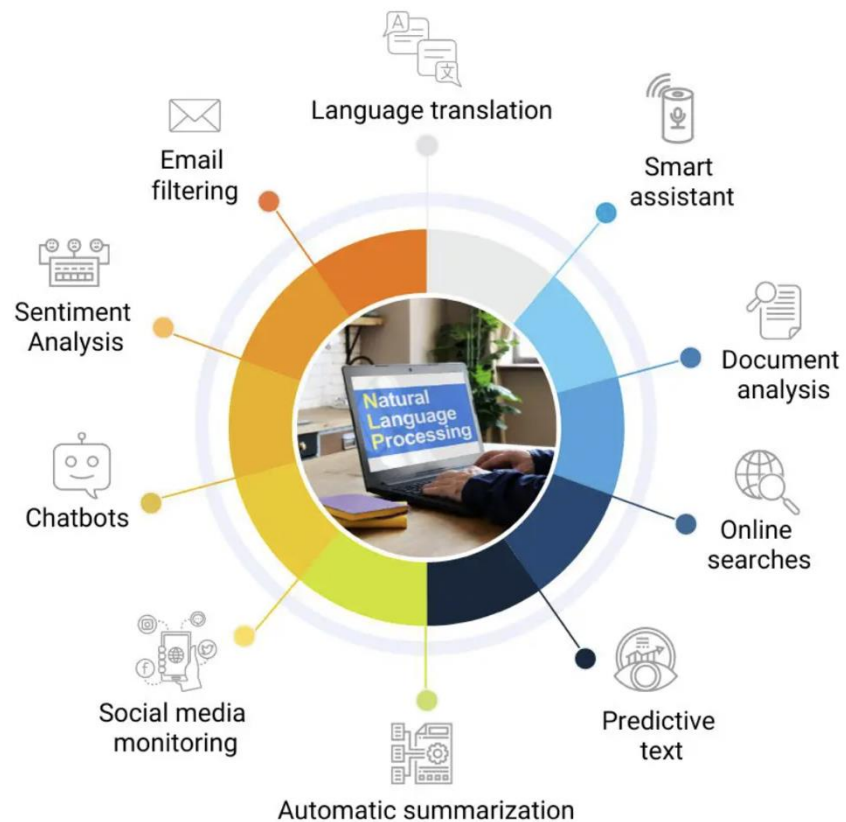
Research Focus and Main Collabs



Finding Faulty DNA Changes in Human Genome with AI



- Integration of multiple layers of omics data and image data
- Testing for association between faulty variants and disease phenotype
- DNA test design to identify at-risk individuals
- DNA mutation “sentiment”
- GPU-accelerated genome analysis

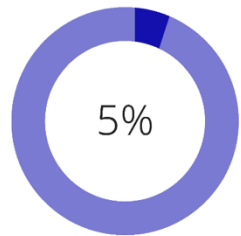


LLMs and Mutation

“Sentiment” Analysis

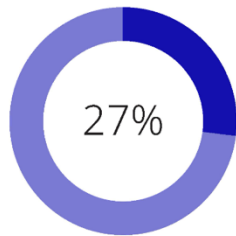
- LLM applications into text mining and subsequent classification
- Variety of resources, current focus on ClinVar, PubMed, gnomAD, etc.
- ACMG-classification

Personalized medicines accounted for just 5% of new molecular entities approved by the FDA in 2005. In 2018, they accounted for more than 40%



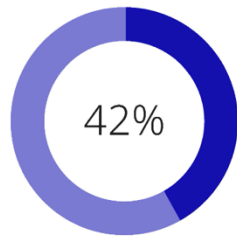
2005

5% of the new molecular entities approved by FDA were personalized.



2016

27% of the new molecular entities approved by FDA were personalized.



2018

42% of the new molecular entities approved by FDA were personalized.

The Future in Cancer Medicine are AI Recommendation Systems

- Moving away from descriptive studies to real-life tracking of disease progression
- AI-aided recommendations in cancer patient therapy
- Multi-layer omics data integration (+ images = pathonomics)
- Focus on time-to-delivery

Building a Digital Shadow of a Tumour

- Embrace diversity in patients and their diseases.
- Unidirectional flow of information.
- AI infers cancer cell types in a heterogeneous tumour mass, their weaknesses and population prevalences.
- Identify new therapies and therapy outcomes by running simulations on a digital shadow of a tumour



Lynch_2026

Owner

Edit

Share

Disease: lynch syndrome

Created at: 12 Jan 2026 at 12:31

Patients: 2

Samples: 10

Files: 10

Dataset ID: 019bb1f9-b41b-79d8-a5e8-bc47111add57

Imported by: MH Matej Hrnčiar

Tags:

Imported using: N/A

Sample sheet: N/A

Active Runs 1 run

This dataset is currently being used by the following runs. You cannot delete it while runs are in progress.

run1 Processing

Started Not started

Progress

0% →

0/100 tasks

Search by file or sample

All Types

All Patients

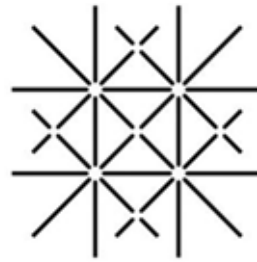
Columns

Generate sample sheet

☐	↕ File name	Sample name	Patient ID	Sample type	File type	File path
☐	Lynch.1121.1.N.bam	1121.1.N	1121.1	Normal	BAM	resources/test/1121.1/Lynch.1121.1.N.bam
☐	Lynch.1121.1.T.1.bam	1121.1.T.1	1121.1	Tumour	BAM	resources/test/1121.1/Lynch.1121.1.T.1.bam
☐	Lynch.1121.1.T.2.bam	1121.1.T.2	1121.1	Tumour	BAM	resources/test/1121.1/Lynch.1121.1.T.2.bam



University of Oxford



University of Basel



Technical University
Munich



NÁRODNÝ
ONKOLOGICKÝ
ÚSTAV
umenie liečiť



FIGHT
OSTEO-
SARCOMA
THROUGH
EUROPEAN
RESearch



LEKÁRSKA FAKULTA
Univerzita Komenského
v Bratislave

FIITCAST



Michal: Supporting
excellence in science



Matej: BrAlnworks
profile & activities