

MitoOmics–GPU

A Cross-Modal “Mito Health Index” (MHI)
from EV/MDV Proteomics + Single-Cell



Nvidia Accelerate Omics Hackathon

Date : September 25, 2025

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UCI

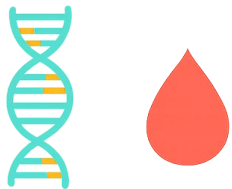
University of
California, Irvine



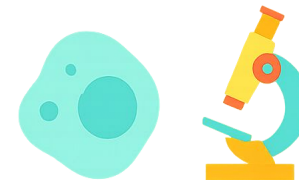
Stanford
MEDICINE



Northeastern
University



Team: Go Getters!



**Sayane
Shome, PhD**

Postdoctoral Fellow
AI in Healthcare
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**Seema
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Research Scientist
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**Hirenkumar
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Research Scientist
Ophthalmology
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University



**Ankit
Maisuriya**

PhD candidate
Quantum Photonics
Northeastern
University



**Medha
Bhattacharya**

Undergraduate
Computer Science
University of California
Irvine

Why Mitochondria ?

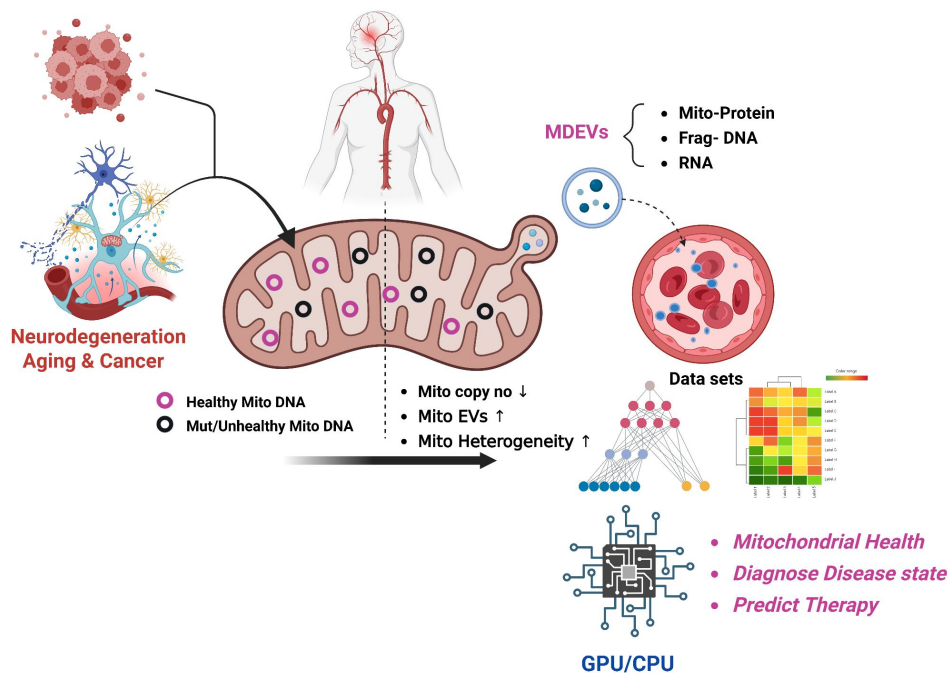
1. **Powerhouse** of the cell
2. **Biomarker** for disease and cellular health
3. **It reflects**
 - a. metabolic capacity and
 - b. cellular adaptation to stress
 - c. disease severity and progression.
 - d. mitochondrial QC pathways
 - e. easily detected in blood
4. **mtDNA copy and MDEVs determines:**
 - i. disease risk progression
 - ii. therapeutic monitoring
 - iii. Determine mitochondrial resilience and mitochondrial fitness
5. Integration Multi Omics data sets, Multimodal imaging and Clinical outcomes
Determine mitochondrial metrics for potential therapeutic intervention



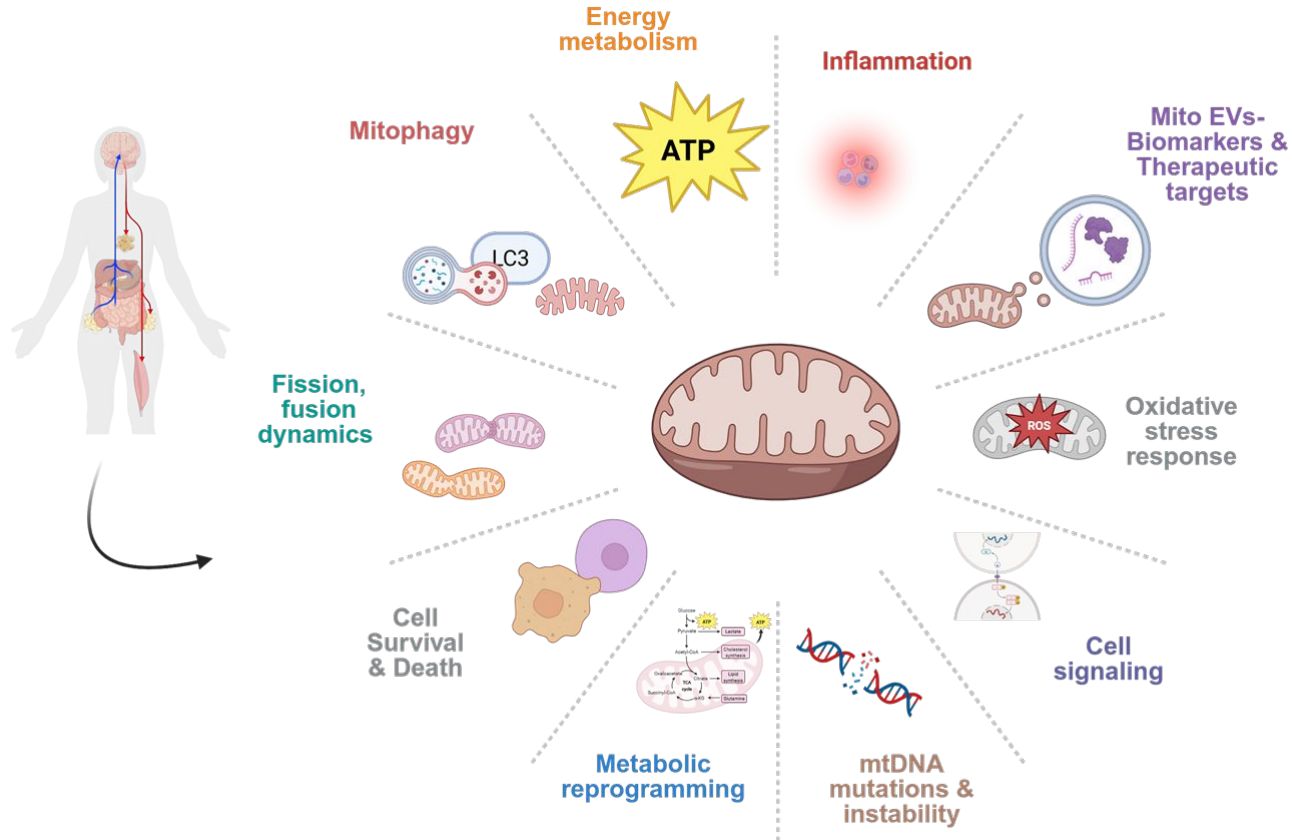
Objective

To develop GPU-accelerated pipeline to quantify and visualize mitochondrial health index (MHI) via circulating extracellular mitochondrial derived vesicle (EV/MDV) proteomics to mitochondrial DNA copy-number, from scRNA-seq with clear CPU-GPU speedups and a tidy PR to scverse/rapids-single cell.

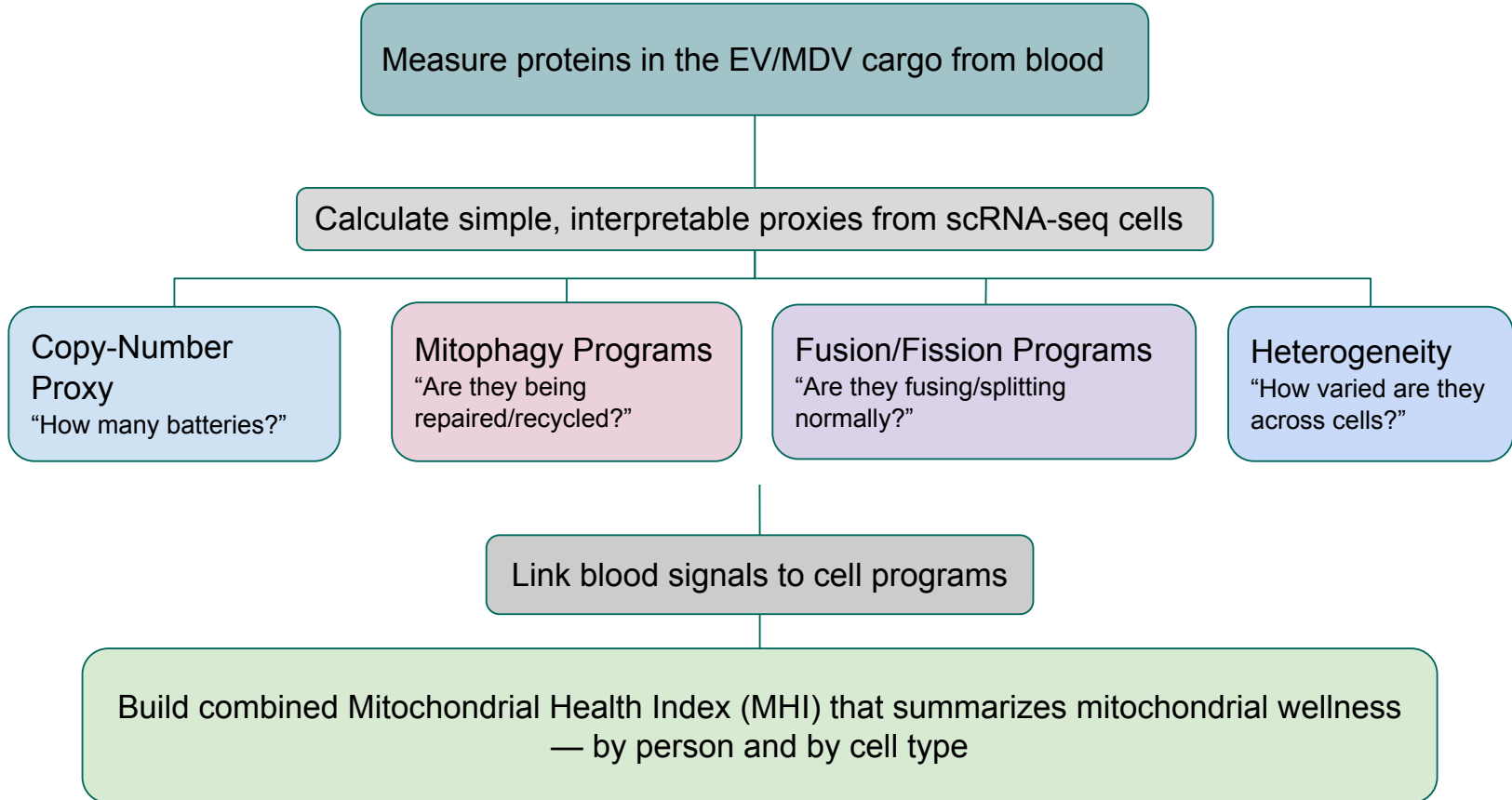
To accelerate and predict mitochondrial health, biogenesis, heterogeneity and disease condition for potential therapeutic targets



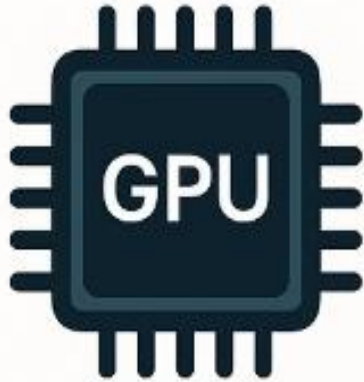
Mitochondria Fate In Health and Disease: at crossroads?



Computational Workflow

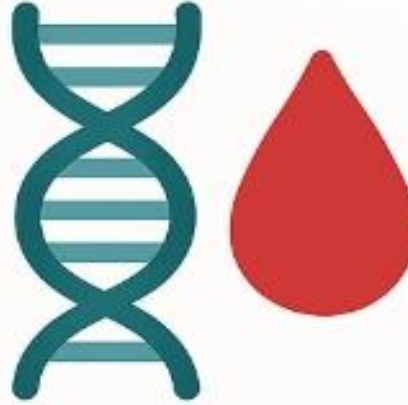


GPU acceleration



Why GPUs matter:

Huge datasets → GPUs crunch them **much faster**



What's new vs. today:

Combines blood and single-cell signals

Generates MHI



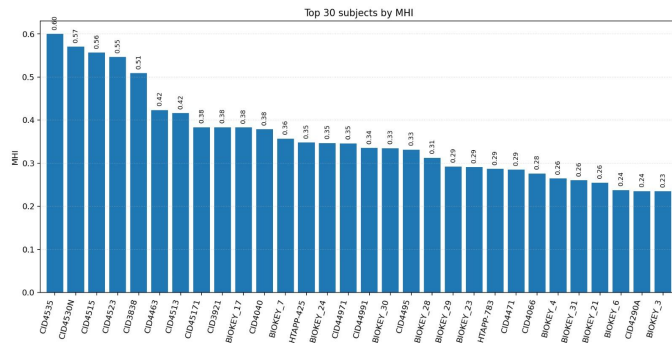
Who benefits and how:

Researchers/clinicians

Trials/biotech

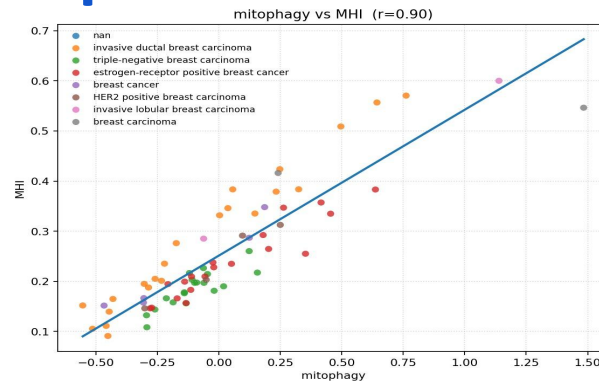
Key Insights - output plots

Mitochondrial Health Index



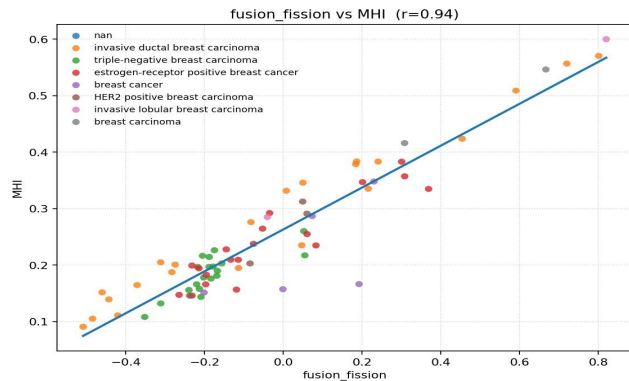
Patient Datasets/Biological Identifier

Mitochondrial Health Index



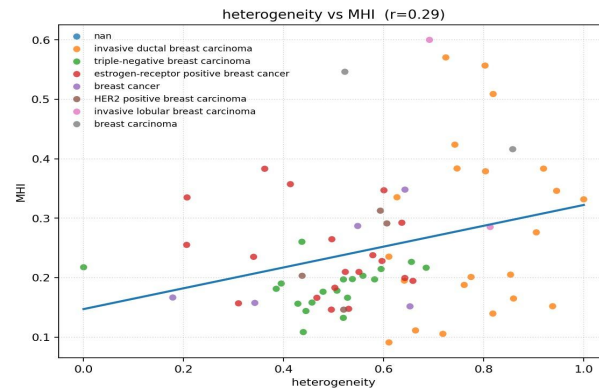
Mitophagy (mito-recycling)

Mitochondrial Health Index



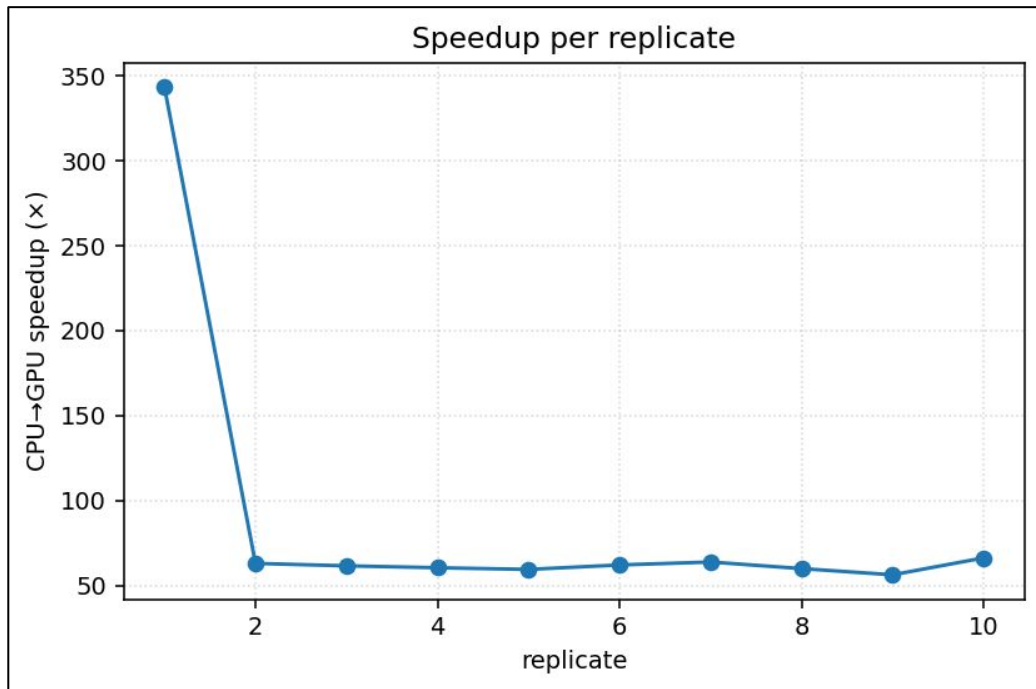
Mitochondrial Biogenesis Fusion and Fission

Mitochondrial Health Index



Mitochondrial Heterogeneity

Key Insights - GPU/CPU comparison speedups



rep	CPU(s)	GPU(s)	speedup
1	2.016	0.006	343.50x
2	0.366	0.006	62.95x
3	0.343	0.006	61.53x
4	0.331	0.005	60.40x
5	0.330	0.006	59.42x
6	0.348	0.006	62.04x
7	0.345	0.005	63.77x
8	0.332	0.006	59.88x
9	0.374	0.007	56.24x
10	0.384	0.006	66.21x

Key takeaways

01

Biological Implications

- Biomarker discovery
- Disease prediction, prognosis, progression etc
- Patient stratification for effective drug response
- Improve quality of life & reduce economic burden

02

What we learnt?

- Predictive Models
- Data Integration Pipelines
- Visualization Dashboards
- Tools for Biomarker Discovery

03

Future Directions

- Cross-disease biomarker
- Precision medicine
- Bridging bench-to-bedside
- Develop therapeutic interventions targeting mitochondrial health

Conclusion and Future directions

Summary



Unified MHI
(EV/MDV proteomics +
scRNA-seq)



GPU-accelerated single-cell
analysis



Open-source pipeline
(ready for integration)

Future Directions



Add more modalities
(scATAC, etc.)



Web-server/pip access for
biologists/end-users



Clinical validation with
partners & cohorts



ML upgrades: pattern
discovery & prediction on
MHI

Github and Contact details

github.com/sayaneshome/MitoOmics-GPU/tree/main

README

MitoOmics-GPU [Work in Progress]

GPU-accelerated multi-omics pipeline to quantify and visualize the *Mitochondrial Health Index (MHI)* by integrating extracellular vesicle/mitochondrial-derived vesicle (EV/MDV) proteomics with single-cell RNA-seq.

Hackathon project by *Team Go Getters* at the NVIDIA Accelerate Omics Hackathon (8-25 Sept 2025).

Team Go Getters

- Sayane Shome, PhD (AI in Healthcare, Stanford)
- Seema Parte, PhD (Ophthalmology, Stanford)
- Hirenkumar Patel, PhD (Ophthalmology, Stanford)
- Ankit Maisuriya (PhD candidate, Quantum Photonics, Northeastern)
- Medha Bhattacharya (CS undergrad, UC Irvine)

Project Objective

- Develop a GPU-accelerated pipeline for mitochondrial health analysis.
- Link blood-derived EV/MDV proteomics with mitochondrial DNA copy-number proxies from scRNA-seq.
- Provide interpretable measures:
 - Biogenesis (capacity to grow new mitochondria)
 - Fusion/Fission (structural remodeling)
 - Mitophagy (repair/recycling)
 - Heterogeneity (variation across cells).
- Output: a unified *Mitochondrial Health Index (MHI)* summarizing mitochondrial resilience, fitness, and disease risk.

Packages

No packages published
[Publish your first package](#)

Languages

Python 100.0%

Suggested workflows

Based on your tech stack

Python application

Configure

Create and test a Python application.

Publish Python Package

Configure

Publish a Python Package to PyPI on release.

Pylint

Configure

Lint a Python application with pylint.

More workflows

Dismiss suggestions

Contact : sshome@stanford.edu



Questions?