The Rutgers Health
Center for Biomedical Informatics & Health Artificial Intelligence (BMIHAI)
presents

Rutgers Health Roadmap Initiative

2025 Request for Applications

Summer Bootcamp in Biomedical Data Science and Health AI

Funding Opportunity Purpose:

The Summer Bootcamp is designed to augment Biomedical Data Science and Health AI training for Rutgers Health Postdocs and Graduate Students and introduce them to the value of using AI in Healthcare and Biomedical applications.

Release Date: February 21st, 2025

Information Webinar – March 10th, 2025, from 3:00-4:00 pm. Register here: https://rutgers.zoom.us/meeting/register/F3WpyHmnTcmZ33UHkLuRQw (hosted by Antonina Mitrofanova, Evan Johnson, Zeeshan Ahmed)

Application Deadline: March 22nd, 2025

Participation Confirmation: April 17th, 2025

Acceptance of participation and final registration: April 30th, 2025

Bootcamp Days: July 28th - August 8th, 2025

Location: Newark Health Science Campus, ICPH, Auditorium C-109 (225 Warren St, Newark)

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I. Overview of the Program

The Rutgers Health (RH) Center for Biomedical Informatics & Health Artificial Intelligence (BMIHAI) is proposed as a Rutgers Roadmaps Initiative to serve as the catalyst for a transformative effort that establishes Rutgers as a national and international leader in computational medicine and health AI. The overarching goal of this initiative is to bring together substantial existing, but currently siloed, strengths in the broad area of biomedical informatics, including in bioinformatics, clinical informatics, clinical research informatics, public health informatics, translational bioinformatics, etc., and substantially expanding them, especially in the area of health AI, making them collectively much more than the sum of their parts. Rutgers Health Roadmap initiative is co-led by Drs. Tobi Gerhard, David Foran, Antonina Mitrofanova, and Evan Johnson.

The Summer Bootcamp in Data Science and Health AI is one of the many Rutgers Health Roadmap Initiatives and is designed to augment Biomedical Data Science and Health AI training for Rutgers Health Postdocs and Graduate Students and introduce them to the value of using AI in Healthcare and Biomedical applications. The bootcamp is a two-week program that will cover data science and introductory machine learning (Week 1), and advanced machine learning and AI (Week 2) applied to RNA-seq data. Morning sessions will cover theoretical aspects of the state-of-the-art data science, machine learning, and AI algorithms (and will be open to Bootcamp participants in person and the whole Rutgers community via zoom) and afternoon sessions will include hands-on project-oriented training and will be open to the Bootcamp participants only. 30 participants will be selected from the pool of applicants to participate in this program each year. Applicants will have an option to participate in Week 1, Week 2, or both weeks of the program.

II. Requirements for 2025 RFA

- **Information Webinar**
  - Information webinar will be hosted to explain program requirements and topics covered. The information webinar will be held on **March 10th, 2025, 3:00-4:00**. To register please click here: https://rutgers.zoom.us/meeting/register/F3WpyHmnTcmZ33UHkLuRQw

- **Instructors**
  - Evan Johnson (Director of the Institute for Data Science and Professor, NJMS)
  - Zeeshan Ahmed (Assistant Professor, Department of Medicine, Rutgers Robert Wood Johnson Medical School, and Institute for Health, Health Care Policy and Aging Research, Rutgers Health)

- **Duration and program structure**
  - 2-week bootcamp spanning **July 28th - August 8th, 2025**
  - Week 1: Introduction to RNA-seq data science and machine learning
  - Week 2: Advanced RNA-seq data analysis and deep learning
  - Participants must indicate their interest in Week 1, Week 2, or both on their application form.
  - Morning lectures will focus on the theoretical foundations of state-of-the-art Health-related Data Science, Machine Learning, and AI techniques (will be open to in-person Bootcamp participants and to all via zoom for virtual auditing). For virtual attendance, register here https://rutgers.zoom.us/meeting/register/DVNPBbn0QIGSuvMFJ0utTw
  - PM sessions will focus on hands-on project-oriented training in Health-related Data Science, Machine Learning, and AI (open to in-person Bootcamp participants only)

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III. Application Process

Eligibility:

- Rutgers Health Postdoctoral Fellows and Graduate (e.g., PhD, Medical, Dental etc.) students are eligible.
- Students must indicate their current academic status and affiliation on their application.
- Participants must be familiar with R and have completed freshman-level statistics
- Participants must bring their own laptop (and charger)
- Rutgers Amarel account will be established for selected participants

Application Submission:

By **March 22nd, 2025**, interested students must apply here: https://form.jotform.com/250355236276154, and indicate their interest in participating in Week 1, Week 2, or both. There is a small fee ($25/week) to secure a spot.

Application Requirements:

To be considered complete, a Bootcamp application **must** include the following:

	Page Limits
Summer Bootcamp Application Form	online form
Statement of Interest, including experience with R programming language	up to 150 words
Resume/CV	up to 5 pages
Unofficial transcript (when applicable)	any

Application Review Process:

- Applicants will be screened for eligibility and selected for participation by the Review Committee. Bootcamp participation will be confirmed by **April 17th**. Acceptance of participation and final registration is due **April 30th**.
- If selected as Bootcamp participant (**by April 17th**), a participation fee is $25 for a 1-week or $50 for a 2-week attendance that must be paid during final registration (**by April 30th**).

IV. Bootcamp Schedule

Instructors: *Evan Johnson and Zeeshan Ahmed*

Week 1

Monday

Morning session	
9:00 – 10:15	Introduction to RNA-sequencing: QC, preprocessing, and alignment
10:15- 10:30	Break
10:30 – 12:00	Dimensionality reduction methods: PCA, NNMF, and UMAP
12:00 - 1:00	Lunch (will be provided)
Afternoon session	
1:00 - 2:15	Hands-on experience: From FASTQ to counts
2:15 – 2:30	Break
2:30 - 4:00	Hands-on experience: Exploring relationships in reduced-dimension data
4:00-5:00	Office hours (with RAs)

Tuesday

Morning session	
9:00 – 10:15	Differential expression analysis
10:15- 10:30	Break
10:30 – 12:00	Unsupervised machine learning, clustering, and classification
12:00 - 1:00	Lunch (will be provided)
Afternoon session	
1:00 - 2:15	Hands-on experience: Differential gene expression with DESeq2
2:15 – 2:30	Break
2:30 - 4:00	Hands-on experience: Heatmaps and clustering examples
4:00-5:00	Office hours (with RAs)

Wednesday

Morning session	
9:00 – 10:15	Pathway enrichment analysis, gene network analysis
10:15- 10:30	Break
10:30 – 12:00	Lasso, Ridge regression, and Elastic Net; Regularization and variable selection
12:00 - 1:00	Lunch (will be provided)
Afternoon session	
1:00 - 2:15	Hands-on experience
2:15 – 2:30	Break
2:30 - 4:00	Hands-on experience
4:00-5:00	Office hours (with RAs)

Thursday

Morning session	
9:00 – 10:15	Supervised kernel machine learning; Support Vector Machines
10:15- 10:30	Break
10:30 – 12:00	Decision trees, regression trees, and random forests
12:00 - 1:00	Lunch (will be provided)
Afternoon session	
1:00 - 2:15	Hands-on experience: Supervised machine learning on RNA-seq data I
2:15 – 2:30	Break
2:30 - 4:00	Hands-on experience: Supervised machine learning on RNA-seq data II
4:00-5:00	Office hours (with RAs)

Friday (short day)

Morning session	
9:00 – 10:15	Lecture: Validation and cross-validating in machine learning
10:15- 10:30	Break
10:30 – 12:00	Hands-on experience: Biomarker development in RNA-seq
12:00 - 2:00	Lunch (will be provided) and networking

Week 2

Monday

Morning session	
9:00 – 10:15	Lecture 1: Combining data from multiple batches and studies
10:15- 10:30	Break
10:30 – 12:00	Lecture 2: Methods for ensemble machine learning
12:00 - 1:00	Lunch (will be provided)
Afternoon session	
1:00 - 2:15	Hands-on experience: Batch correction using ComBat
2:15 – 2:30	Break
2:30 - 4:00	Hands-on experience: Ensemble biomarkers from multiple studies
4:00-5:00	Office hours (with RAs)

Tuesday

Morning session	
9:00 – 10:15	Lecture 1: Methods for single cell RNA-seq
10:15- 10:30	Break
10:30 – 12:00	Lecture 2: Introduction to multi-layer feedforward Neural Networks
12:00 - 1:00	Lunch (will be provided)
Afternoon session	
1:00 - 2:15	Hands-on experience: ScRNA-seq data analysis

2:15 – 2:30	Break
2:30 - 4:00	Hands-on experience: Neural Networks Practicum
4:00-5:00	Office hours (with RAs)

Wednesday

Morning session	
9:00 – 10:15	Lecture 1: 100 Years of evolving gene-disease complexities.
10:15- 10:30	Break
10:30 – 12:00	Lecture 2: Human gene-disease associations for clinical transcriptomics.
12:00 - 1:00	Lunch (will be provided)
Afternoon session	
1:00 - 2:15	Hands-on experience: *GVViZ* for gene-disease data annotation – Part 1.
2:15 – 2:30	Break
2:30 - 4:00	Hands-on experience: *GVViZ* for gene-disease data annotation – Part 2.
4:00-5:00	Office hours (with RAs)

Thursday

Morning session	
9:00 – 10:15	Lecture 1: Applying AI/ML for analyzing gene expression patterns.
10:15- 10:30	Break
10:30 – 12:00	Lecture 2: AI/ML pipelines for biomarker discovery and disease predictions.
12:00 - 1:00	Lunch (will be provided)
Afternoon session	
1:00 - 2:15	Hands-on experience: *IntelliGenes* – command line interface.
2:15 – 2:30	Break
2:30 - 4:00	Hands-on experience: *IntelliGenes* – desktop interface and 3D visualization.
4:00-5:00	Office hours (with RAs)

Friday (short day)

Morning session	
9:00 – 10:15	Lecture 1 - Case study# 1: Discovering biomarkers and predicting diseases using integrated clinical and gene expression data.
10:15- 10:30	Break
10:30 – 12:00	Lecture 2 - Case study# 2: Multimodal AI/ML for disease predictions and translational research.
12:00 - 2:00	Lunch (will be provided) and networking

Questions/Inquiries:

For Inquiries, please email: BMIHAI_bootcamp@shp.rutgers.edu