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The Rutgers Health

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

**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 | Dimension 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 |
| 2:15 – 2:30 | Break |
| 2:30 - 4:00 | Hands-on experience: More supervised machine learning on RNA-seq data |
| 4:00-5:00 | Office hours (with RAs) |

## Friday

|  |  |
| --- | --- |
| Morning session | |
| 9:00 – 10:15 | 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: Gene-disease associations for clinical transcriptomics |
| 10:15- 10:30 | Break |
| 10:30 – 12:00 | Lecture 2: Gene-disease data annotation using *GVViZ* |
| 12:00 - 1:00 | Lunch (will be provided) |
| Afternoon session | |
| 1:00 - 2:15 | Hands-on experience: Learning using PAS for gene-disease code integration |
| 2:15 – 2:30 | Break |
| 2:30 - 4:00 | Hands-on experience: Learning using *GVViZ* for gene-disease data annotation |
| 4:00-5:00 | Office hours (with RAs) |

## Thursday

|  |  |
| --- | --- |
| Morning session | |
| 9:00 – 10:15 | Lecture 1: AI/ML pipeline for biomarker discovery and predictive analysis |
| 10:15- 10:30 | Break |
| 10:30 – 12:00 | Lecture 2: Introduction to *IntelliGenes* |
| 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

|  |  |
| --- | --- |
| Morning session | |
| 9:00 – 10:15 | Lecture 1 - Case study# 1: Discovering biomarkers associated and predicting disease using RNA-seq data |
| 10:15- 10:30 | Break |
| 10:30 – 12:00 | Lecture 2 - Case study# 2: Multimodal AI/ML for discovering novel biomarkers and predicting disease |
| 12:00 - 2:00 | Lunch (will be provided) and networking |
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**Questions/Inquiries:**

For Inquiries, please email: BMIHAI\_bootcamp@shp.rutgers.edu