Syllabus: Computational Approaches to Cognitive Impairment Research
Sub-title: Machine Learning and AI for Medical
Students **Term:** Spring 2026 | **Final Presentation:** May 2026
Program Overview
This interdisciplinary training initiative is designed to equip medical students with the computational tools necessary to investigate the molecular heterogeneity of Alzheimer's Disease and Mild Cognitive Impairment (MCI). Rather than focusing on diagnostic tool development, this course emphasizes **molecular stratification** identifying distinct biological subtypes within clinically similar patient populations.

Supervision & Team

- **Academic Supervisor:** Prof. Dr. Süleyman Yıldırım
- **Active Training & Project Lead:** Büşranur Delice
- **Students:** Ahmet, Onuralp

Learning Objectives

By the conclusion of this program, students will be able to:

1. **Code in Python:** Perform data manipulation and visualization fluently.
2. **Analyze Transcriptomics:** Interpret and preprocess high-throughput gene expression data (GEO).
3. **Apply Unsupervised ML:** Implement dimensionality reduction (PCA/UMAP) and clustering.
4. **Biological Synthesis:** Translate mathematical clusters into biological pathways and molecular signatures.
5. **Reproducible Science:** Manage research workflows using Git and GitHub.

Course Schedule

Phase	Weeks	Content Focus
Phase 0	Weeks 1–3	Python Foundations, GitHub Workflow, Data Visualization
Phase 1	Weeks 4–6	Transcriptomic Data Familiarization and Exploratory Analysis

Phase 2	Weeks 7–12	Unsupervised Machine Learning and Molecular Stratification
Phase 3	Weeks 13–16	Biological Interpretation and Pathway Analysis
Phase 4 (Optional)	Extension	AI-Assisted Clinical Interpretation

Technical Stack

- **Language:** Python (Local/Anaconda or Google Colab)
- **Version Control:** GitHub
- **Project Management:** Trello
- **Key Libraries:** Scikit-learn, Pandas, Seaborn, Scanpy (optional for transcriptomics).

Evaluation & Deliverables

This is a **project-based** initiative. Evaluation is continuous and based on:

1. **Reproducibility (25%):** Clean, documented code and regular GitHub commits.
2. **Phase Reports (25%):** Brief summaries of findings at the end of each phase.
3. **Final Notebook (25%):** A complete, executable pipeline demonstrating molecular stratification.
4. **Final Presentation (25%):** A defense of the biological findings (May 2026).

Academic Integrity

While AI is encouraged as a supportive analytical tool, students must:

- Independently write all reports.
- Document exactly how and where AI was used.
- Maintain full transparency regarding data sources and citations.