Spring 2021

BiS800: Special Lecture on Bio and Brain Engineering:
Methods in functional genomics and computational molecular biology
Tues/Thurs, 9:00 am - 10:30 am

Instructor: Prof. Young-suk Lee
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Office hour: Tues/Thurs, 10:30 am - 12:00 am (Rm#1113, E16)
TAs: TBD

Course Objectives
At the end of this course, students will be able to:

- effectively read and evaluate the method section of research papers,
- systematically write their own computational method section, and
- tackle emerging problems in modern biology and bioengineering based on insights hidden in the growing literature of computational biology.

Course Description
The method section in research papers is arguably the most overlooked and underappreciated part for both the readers and even the authors themselves. Yet, key principles and insights that have driven scientific discovery and engineering breakthroughs are embedded in this section. The goal of this course is to enable students to strategically extract and communicate these insights within the vast field of bioinformatics and computational biology. To do so, the first half of this course establishes general principles in data science, applied statistics, and machine learning that have guided the development of new computational methods. The remaining half consists of student-driven discussions on how to apply these principles, particularly in terms of reading and (re)writing the method section of published papers in functional genomics and computational molecular biology.

Recommended Prerequisites
* Please contact the instructor for questions regarding prerequisites

- MAS250 Probability and Statistics or equivalent
- BiS232 Bio-Data Structures or equivalent
- BIS335 Biomedical Statistics Statistical Learning or equivalent
- BiS438 Bioinformatics or equivalent

Textbooks (Optional)

- “R for Data Science” by Hadley Wickham and Garrett Grolemund
- “Bioinformatic Algorithms” by Phillip Compeau and Pavel Pevzner
- “The Hundred-Page Machine Learning Book” by Andriy Burkov

Grading
Participation 25%, Written Assignments 25%, Oral Presentations 25%, One Final Report 25%

Tentative Schedule

Week 1: Why is the computational method section so important

Week 2: What is data science, and why is it key for modern biology

Week 3: What is the rationale behind n = 3, and how to handle (i.e. model) uncertainty

Week 4: Show me your data

Week 5: Show me your method

Week 6: How to read deep into the specifics of applied machine learning papers

Week 7: Can this biological question be solved by artificial intelligence

Week 8: Catch up week

Week 9: Methods for high-dimensional data

Week 10: Methods for RNA-Seq data

Week 11: Methods for single-cell RNA-Seq data

Week 12: Methods for publicly available data

Week 13: Methods for RNA Biology

Week 14: How much “biology” do you need to know to do research in bioengineering

Week 15: How much “computing techniques” do you need to know to do research in biology