Temple University

CIS 5528:

Machine Learning for Bioinformatics and Biomedical Data Science

(Spring 2023)

SYLLABUS

Instructor: Xinghua Mindy Shi	Email: mindyshi@temple.edu
Lecture Time:	Lecture Venue: TTLMAN, 00302
Office Hours:	TBD

A.) COURSE DESCRIPTIONS

Bioinformatics and biomedical data science have emerged as analytics frontiers in reaping the benefits of machine learning toward advanced modeling of massive biological and medical data. This course introduces classical and state-of-the-art methodology development in machine learning applied to bioinformatics and biomedical data science. Topics include classical statistical and machine learning algorithms that are particularly useful in bioinformatics and biomedical analytics. By the end of the class, students will have gained the knowledge of diverse machine learning methods and evaluate relevant scientific publications, as well as the capability of developing open-source programs to analyze and interpret biological and biomedical data.

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B.) PREREQUISITES

MATH 1041 (or MATH 1941), MATH 1042 (or MATH 1942), CIS 2033 and CIS 2168 (or equivalents).

C.) LEARNING OBJECTIVES

Having successfully completed this course, the student will be able to: 1.) Understand concepts and methodology of machine learning with application to bioinformatics and biomedical data science. 2.) Gain the ability to analyze large-scale biomedical data and write well-documented, well-organized programs utilizing machine learning algorithms.

D.) TEXTBOOKS

No textbook is required. Reading lists will be provided with links/pdfs of corresponding papers.

E.) TOPICS COVERED

1. **Optimization algorithms and machine learning methods for sequence analysis**
   a. DNA sequence analysis
   b. RNA sequence analysis
   c. Functional genomic data analysis
   d. Protein structural prediction

2. **Statistical and machine learning methods for association studies and predictive modeling**
   a. Linkage analysis
   b. Genome wide association studies
   c. Quantitative trait locus mapping
   d. Predictive models

3. Time series and survival analysis

a. Time series analysis
b. Survival models

4. Biological network analysis

a. Complex network analysis
b. Network dynamics

5. Privacy and security in biomedicine

a. Infringement of privacy and security leakage
b. Algorithms for privacy protection and defense against adversarial attacks
c. Secure and trustworthy machine learning

F.) GRADING

Students will be evaluated on their ability to answer questions regarding material presented in the class and assigned texts. Assignments will be given during the semester as a practice of machine learning. A team project (2-3 students per team) will be demonstrated and presented in the class.

Grading: 50% team project (10% project proposal presentation and report, 20% mid-term presentation and report, 20% final presentation and report); 20% assignments; 20% exams (10% midterm and 10% final exam); 10% participation (in class quizzes will be counted toward participation).

Rubrics for course projects:

Project Proposal (10 in total; 5 for presentation, 5 for report):

Background, significance, and literature review 1.5
Novelty and contribution 1
Methods 2
Expected Results 1.5

Project Midterm Report (20 in total; 10 for presentation, 10 for report):

Background, significance, and literature review 2
Novelty and contribution 1.5
Methods 3.5
Results 3

Project Final Report (20 in total; 10 for presentation, 10 for report):

Background, significance, and literature review 1.5
Novelty and contribution 1.5
Methods 3
Results 4

G.) POLICIES AND PROCEDURES

a. ATTENDANCE

Attendance is required for the class, with in-class quizzes count as attendance towards the final score.

b. ACADEMIC INTEGRITY

According to the University Student Code of Conduct, students must not commit, attempt to commit, aid, encourage, facilitate, or solicit the commission of academic dishonesty and impropriety including plagiarism, academic cheating, and selling lecture notes or other information provided by an instructor without the instructor's authorization. Violations may result in failing the assignment and/or failing the course, and/or other sanctions as enumerated in the University Code of Conduct.

c. Disability Disclosure

Any student who has a need for accommodation based on the impact of a documented disability should contact Disability Resources and Services (DRS), Ritter Annex 100, (215) 204-1280 or 215-204-1786 (TTY) or drs@temple.edu, to make arrangements. Students requesting accommodations should meet with the instructor as soon as possible

after the start of classes to discuss their needs and to provide documentation from DRS. Accommodations are not retroactive.

d. Technical Support

For a listing of technical support services available to Temple University students, see the Academic and Support Services Page.

e. Counseling Services

As a student, you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation. These concerns or stressful events may lead to diminished academic performance and ability to participate in daily activities. Counseling services are available to assist you. Please contact the Tuttleman Counseling Center.

f. Continuity of Instruction in Event of Emergency

Students are to register for the TUAlert System to be made aware of University closures due to weather or other emergency situations and follow all additional university-wide emergency instruction. Students can register for this system on the Campus Safety Services website. In the event of an emergency, class materials/instructions will be provided in a web-based format via Canvas or Zoom. Students registered for the class will be alerted to any alternate testing procedures and submission of assignment requirements from the instructor via email.