JOHNS HOPKINS MATHEMATICAL INSTITUTE for DATA SCIENCE

Department of Biomedical Engineering
Biomedical Data Science Lab (EN.580.477)
Fall 2019

JOHNS HOPKINS WHITING SCHOOL of ENGINEERING

Instructor	*Office Hours*	*Contact*
Prof. Benjamín Béjar	Mon 12:00pm - 01:00pm, Clark 319B	bbejar
Teaching Assistant	*Office Hours (starting on 09/08)*	
Shubhayu Bhattacharyay	Sun 03:00pm - 04:00pm, Clark 210	sbhatt15
Ali Saad-Eldin	Mon 10:00am - 11:00am, Clark 210	asaadel1
Katarina Mayer	Mon 08:00pm - 09:00pm, Clark 110	kmayer2
Pouria Tohaidi	Tue 11:00am - 12:00pm, Clark 210	ptohidi1
Gavin Mischler	Tue 12:30pm - 01:30pm, Clark 210	gmischl1
Arik Slepyan	Tue 04:00pm - 05:00pm, Clark 210	aslepya1
Ehsan Joshi	Wed 11:00am - 12:00pm, Clark 210	ejoshi1

Lab Session	Thu/Fri 09:00am - 01:00pm or 01:30pm - 05:30pm	Clark 216
Pre-lab	Online, must be submitted through Blackboard	
Evaluation	50% Lab Reports (25% × 2 labs) 15% Pre-lab (5 + 10%) 35% Final Project	

Course Material
All related course material will be posted on Blackboard and on the class webpage: http://cis.jhu.edu/∼bbejar/bmds/.

Discussion Forum
A Piazza page will be used as a discussion forum for the class. Please, visit Piazza BMDS Lab.

Reference Textbooks (relevant chapters in parenthesis)
- R. C. Gonzalez, and R. E. Woods. *"Digital Image Processing"*, Pearson, 2018 (3.4,4.4,12.7,13.5).
- C. M. Bishop, *"Pattern Recognition and Machine Learning"*, Springer-Verlag, 2006 (3,4,5,12).
- R. O. Duda, P. E. Hart, and D. G. Stork, *"Pattern Classification"*. Wiley-Interscience, 2000.
- T. Hastie, R. Tibshirani, and J. H. Friedman, *"Elements of Statistical Learning"*, Springer, 2009.

Course Overview
This course provides an introduction to data science and machine learning for applications in biomedical engineering through practical examples. The class runs in parallel to Biomedical Data Science (EN.580.475) which build the foundations of data science. The lectures cover topics in biomedical signal processing, biomedical data regression and classification, and deep learning methods applied to biomedical problems. The lab complements the lectures by providing a hands-on experience in biomedical applications such as denoising, reconstruction and classification of action potentials, and septic shock prediction in patients with sepsis. Lab sessions will include writing Python scripts to analyze both synthetic and real data.

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Course Objectives
- Master the right tools to tackle biomedical signal and data processing problems.
- Have an intuitive understanding of data science methods through practical examples.
- Learn about topics that are at the forefront of biomedical data science research.

Grading
Lab reports are due for each of the two labs for 25% of the grade each. Each lab will be preceded by a pre-lab session that will introduce the necessary tools and background material for completing the lab assignment. Pre-labs will be completed by the students on their own and are due for 5% and 10% of the grade. A final project will cover the other 35% of the grade. Lab reports and pre-labs must be submitted through Blackboard no later than 9:00 AM on Thursday morning the week after the (pre-)lab. Late lab reports will lose 50 points until 5 PM on Thursday. Lab reports will not be accepted after 5 PM. Pre-lab reports are not accepted after the due date.

Ethics
The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. In addition, the specific ethics guidelines for this course are:

(1) All assignments must be entirely done on your own. We suggest that when you work together you do not take pictures or copy anything down on paper. Discuss the problems, work through the approach on the board, and then do the assignment from scratch on your own.

(2) During lab sessions students are encouraged to work together (in pairs) and discuss methods for performing the lab assignments. However, all other assignments outside the lab session such as pre-labs and quizzes (if any) must be entirely your own.

(3) Copies of all code must be included with your lab report

Report any violations you witness to the instructor.
You can find more information about university misconduct policies on the web at these sites:

- For undergraduates: http://e-catalog.jhu.edu/undergrad-students/student-life-policies/
- For graduate students: http://e-catalog.jhu.edu/grad-students/graduate-specific-policies/

Students with Disabilities
Any student with a disability who may need accommodations in this class must obtain an accommodation letter from `Student Disability Services`, 385 Garland, (410) 516-4720.

ABET Outcomes
- Ability to apply mathematics, science and engineering principles (a).
- Ability to design and conduct experiments, analyze and interpret data (b).
- Ability to function on multidisciplinary teams (d).
- Ability to identify, formulate and solve engineering problems (e).
- Ability to communicate effectively (g).
- Ability to use the techniques, skills and modern engineering tools necessary for engineering practice (k).

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Date	(Pre-)Lab Description	Instructor	Location
Thu & Fri 08/29 08/30	No lab session		
Pre-lab I Week 09/05-09/12	Intro. to Python and Python Notebook Intro. to Google Colab Basic Signal Processing		
Lab I Thu & Fri 09/12 09/13	Signal Denoising Heart Beat Rate Estimation Mobile Health	B. Béjar	Clark 216
Pre-lab II Week 09/19-09/26	Optimization via Gradient Descent Introduction to Pytorch Overfitting and Regularization		
Lab II Thu & Fri 09/26 09/27	Action Potential Classification Linear Classifiers Two-layer Neural Network	B. Béjar	Clark 216
Final Project Thu 10/03	Final Project released: *"Prediction of the Impending Onset of Septic Shock in Patients with Sepsis"*		
Thu & Fri 10/10 10/11	Final Project Q&A session	B. Béjar	Clark 216
Thu 10/17	**Final Project deadline**		