

EE 599 – Machine Learning for Medical Applications

Units: 3

Term—Day—Time: Spring 2017, MW 3:30 to 4:50 PM

Location: VKC 151

Instructor: Prof. Cauligi Raghavendra

Office: EEB 216

Office Hours: MW 2 to 3 PM and by appointment

Contact Info: raghu@usc.edu, (213) 740-9133

Course Description

Application of machine learning models and algorithms to medical applications, learning from data and classification of disorders. Overview of health data, collection with sensors, body area networks, brain image data and other publicly available medical applications data. Issues and methods for handling real world data with respect to missing and inconsistent data. Application of existing machine learning techniques to brain image data to classify various mental disorders, including Alzheimer's, Autism, TBI and PTSD, etc. Brain image data to include MRI, fMRI, and SPECT data. Students will learn about machine learning applications to real world medical data through examples and reading papers. Students are expected to work on a team project with real world data and write a paper.

Learning Objectives

Students will learn about issues with real world data and how to deal with them in analyzing data;
Students will learn about methodologies for applying machine learning to medical applications and for real world data
Doing literature search, conduct research and working on a team project

Prerequisite(s): Knowledge of machine learning algorithms and software tools

Concurrent Enrolment: None

Recommended Preparation: EE 660 or CSCI 567 or other machine learning course

Co-Requisites: None

Course Notes

Materials will be from papers and slides used in class. There will be guest lectures.

Technological Proficiency and Hardware/Software Required

Students are required to have familiarity with Matlab, Scikit learn, or other ML tools, and coding language of their choice. Access to Matlab is provided on campus. ML tools are publicly available. Students can use their own machines or use machines provided on campus.

Required Readings and Supplementary Materials

Required readings and supplementary materials are published journal and conference papers. Papers will be drawn on practical uses of machine learning, and publications in medical journals. A list of papers is made available at the beginning of each semester.

Description and Assessment of Assignments

This is a research and project oriented course. Students are required to choose a medical application problem of their interest early in the semester, do literature survey, learn and acquire data from public sources, design and apply machine learning to that problem, and write a term paper. Students are expected to participate in class discussions, make short presentations during the semester, and a final presentation on their project at the end of semester. Each team will make a presentation of their project towards the end of the semester.

Grading Breakdown

How will students be graded overall, including the assignments detailed above. Participation should be no more than 15%, unless justified for a higher amount. All must total 100%.

Assignment	Points	% of Grade
Summary writeup 1	10	
Summary writeup 2	10	
Participation	10	
Short Class presentations	10	
Home Work	10	
Project and report	30	
Final Presentation	20	
TOTAL	100	0

Assignment Submission Policy

Assignments are assigned in class and it is written summary of papers read related to the project. Assignments are written reports

Additional Policies

In team projects, each member should contribute to the success of the project. Responsibility of each member to be documented in the report. Expectation is for the project to be a publishable work.

Course Schedule: A Weekly Breakdown

Note: This is a very tentative outline and is in draft form, to give you an idea of course topics to be covered. Since there will be several guest lectures the exact schedule will change and finalized at the beginning of Spring semester. Number of lectures per topic is approximate. Student presentation times to be finalized.

	Topics/Daily Activities	Readings and Homework	Deliverable/ Due Dates
Week 1 Dates	Introduction and overview of course Basics of Machine learning, data, and tools to use	Papers 1,2	Class discussion
Week 2 Dates	Machine Learning basics Guest Lecture	Papers 2, 3	Class discussion

Week 3 Dates	Health data, Sensors, Body area networks Guest lecture	Paper 3	Class discussion
Week 4 Dates	Medical applications data Guest Lecture	Paper 4	Choose topic and identify team Select papers on topic
Week 5 Dates	Useful things to know about Machine Learning	Papers 5	Short write up on literature Home Work on applying Machine Learning to a public dataset
Week 6 Dates	Short presentations by Student teams	Papers 6	Short write up on project proposal and plan
Week 7 Dates	Data preparation, feature selection and evaluation	Papers 7, 8	
Week 8 Dates	Heart imaging, heart attack prediction	Papers 9, 10	
Week 9 Dates	Short presentations by student teams	Paper 10	Short write up on papers
Week 10 Dates	Machine learning for mental disorders	Papers 10,11	Class discussion
Week 11 Dates	Mental disorders continued Autism, TBI, PTSD	Papers 11,12	Class discussion
Week 12 Dates	Cancer, tumor detection, brain networks	Papers 13,14	Class discussion
Week 13 Dates	Project Presentations		Each student team to make a presentation on their project
Week 14 Dates	Project Presentations		Each student team to make a presentation on their project
Week 15 Dates	Project Presentations		Final Project Report Due
FINAL Date			Date: For the date and time of the final for this class, consult the USC <i>Schedule of Classes</i> at www.usc.edu/soc .

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* <https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* <http://equity.usc.edu> or to the *Department of Public Safety* <http://adminopsnet.usc.edu/department/departement-public-safety>. This is important for the safety of the whole USC community. Another member of the

university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage <http://sarc.usc.edu> describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/alj>, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.