MTH4092 (2 units) Special Topics: Mathematics of Machine Learning
TTh 8:30-9:25

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Textbook: *An Introduction to Statistical Learning with Applications in R by James, Witten, Hastie and Tibshirani ISBN*: 978-1-4614-7138-7

Other Materials: R and RStudio.

Course Description
Study of an area of mathematics not otherwise included in the curriculum. The needs and interests of students and faculty involved determine the topics. May be repeated for a total of six units.

Prerequisites: Consent of instructor.

Course Learning Outcomes
- Students will be able to apply their mathematical knowledge to solve problems.
- Students will be able to use technology to solve problems.
- Students will collaborate effectively in teams.
- Students will be able to understand and create arguments supported by quantitative evidence, and they can clearly communicate those arguments in a variety of formats.

Course Portfolio
Throughout this course you will be compiling a document consisting of a brief explanation of the tools we have learned, what to watch for when using them and the implementation of the tool with thorough documentation of the implementation. Each week in the homework, I will identify questions that should be answered in your portfolio. The portfolio will be collected twice for a grade, however you should be adding to it as we go. Weeks we have labs and ML in practice literature reviews will have extra time to compile this document.

Homework and Labs
Homework will be assigned weekly and is due Thursday the week following class discussion. Some of the textbook sections are labs in R and you will be responsible for completing the code included in those sections.

Machine Learning in Practice Literature Reviews
You will be asked to find an article on how the topics we have been learning in class are currently being used and to give a short presentation on the use.

Grading Policies

Final Portfolio (2 submissions)	40%
Literature Reviews (3)	20%
Homework and Labs	40%
Total	100%

Using the weightings above overall course grades will be computed using the approximate scale below.

Grading Scale in Percentages					
	A	B	C	D	F
+		[87.5, 90)	[77.5, 80)	[67.5, 70)	
	[92.5, 100]	[82.5, 87.5)	[72.5, 77.5)	[62.5, 67.5)	[0,60)
–	[90, 92.5)	[80, 82.5)	[70, 72.5)	[60, 62.5)	

Late work. A written assignment or computer assignment is late if it is not received at the beginning of class on the due date. Late work will not be accepted. Make-up tests will be given only by arrangement with the instructor for reasons of documented emergency.

Attendance Policy

Attendance is expected at each class session. In the event of an absence you are responsible for the material covered in class and the assignments given that day. Here is the university's stated policy on attendance:

Regular and punctual attendance at all classes is considered essential to optimum academic achievement. If the student is absent from more than 10 percent of class meetings, the faculty member can file a written report which may result in de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university drop date or, after that date, receive the appropriate grade for their work and participation. See https://catalog.pointloma.edu/content.php?catoid=35&navoid=2136#Class_Attendance in the Undergraduate Academic Catalog.

If you miss 10% of the class, you will receive a warning. If you miss 20% of the class, you will be automatically de-enrolled.

Class Enrollment:

It is the student's responsibility to maintain his/her class schedule. Should the need arise to drop this course (personal emergencies, poor performance, etc.), the student has the responsibility to follow through (provided the drop date meets the stated calendar deadline established by the university), not the instructor. Simply ceasing to attend this course or failing to follow through to arrange for a change of registration (drop/add) may easily result in a grade of F on the official transcript.

Academic Accommodations:

While all students are expected to meet the minimum standards for completion of this course as established by the instructor, students with disabilities may require academic adjustments, modifications or auxiliary aids/services. At Point Loma Nazarene University (PLNU), these students are requested to register with the Disability Resource Center (DRC), located in the Bond Academic Center. (DRC@pointloma.edu or 619-849-2486). The DRC's policies and procedures

for assisting such students in the development of an appropriate academic adjustment plan (AP) allows PLNU to comply with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act. Section 504 (a) prohibits discrimination against students with special needs and guarantees all qualified students equal access to and benefits of PLNU programs and activities. After the student files the required documentation, the DRC, in conjunction with the student, will develop an AP to meet that student's specific learning needs. The DRC will thereafter email the student's AP to all faculty who teach courses in which the student is enrolled each semester. The AP must be implemented in all such courses.

If students do not wish to avail themselves of some or all of the elements of their AP in a particular course, it is the responsibility of those students to notify their professor in that course. PLNU highly recommends that DRC students speak with their professors during the first two weeks of each semester about the applicability of their AP in that particular course and/or if they do not desire to take advantage of some or all of the elements of their AP in that course.

Academic Honesty:
Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See https://catalog.pointloma.edu/content.php?catoid=35&navoid=2136#Academic_Honesty for definitions of kinds of academic dishonesty and for further policy information.

Copyright Protected Materials
Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

Credit Hour
In the interest of providing sufficient time to accomplish the stated course learning outcomes, this class meets the PLNU credit hour policy for a 2 unit class delivered over 15 weeks. Specific details about how the class meets the credit hour requirements can be provided upon request.

Component	Total Hours
Reading (14 at 1 hr. each)	14
Homework and Labs (14 at 2 hours each)	28
Zooms (15 at 1 hr. each)	15
ML in Practice Zooms (15 at 1 each)	3
Portfolio	20

(15 at 1 and 2 at 2.5)	
Total	**80**

Point Loma Nazarene University Mission
Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

Department Mission
The Mathematical, Information, and Computer Sciences department at Point Loma Nazarene University is committed to maintaining a curriculum that provides its students with the tools to be productive, the passion to continue learning, and Christian perspectives to provide a basis for making sound value judgments.

Final Exam: Tuesday Dec 1, 2020 7:30-1:00 am
The final exam date and time is set by the university at the beginning of the semester and may not be changed by the instructor. This schedule can be found on the university website and in the course calendar. No requests for early examinations will be approved. Only in the case that a student is required to take three exams during the same day of finals week, is an instructor authorized to consider changing the exam date and time for that particular student.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
8/16/20	8/17/20	8/18/20	8/19/20	8/20/20	8/21/20	8/22/20
		Intro to course 2.1 What is statistical learning?		2.2. Assessing model acc. 2.3 Lab (Not graded, but make sure you are comfortable with R)		
8/23/20	8/24/20	8/25/20	8/26/20	8/27/20	8/28/20	8/29/20
		3.1 Simple linear regression		3.2 Multiple linear regression		
8/30/20	8/31/20	9/1/20	9/2/20	9/3/20	9/4/20	9/5/20
		3.3 Other considerations		3.6 Lab: Linear Regression No Zoom		
9/6/20	9/7/20	9/8/20	9/9/20	9/10/20	9/11/20	9/12/20
		4.1 Classification Overview 4.2 Why not linear regression?		4.3 Logistic Regression		
9/13/20	9/14/20	9/15/20	9/16/20	9/17/20	9/18/20	9/19/20
		4.4 LDA		4.5 Comparing classifiers		
9/20/20	9/21/20	9/22/20	9/23/20	9/24/20	9/25/20	9/26/20
		4.6 Lab: Classifiers No Zoom		ML in Practice		
9/27/20	9/28/20	9/29/20	9/30/20	10/1/20	10/2/20	10/3/20
		5.1 Cross-validation		5.2 Bootstrap		
10/4/20	10/5/20	10/6/20	10/7/20	10/8/20	10/9/20	10/10/20
		5.3 Lab: CV and Bootstrap No Zoom		6.1 Model selection First Portfolio submission		
10/11/20	10/12/20	10/13/20	10/14/20	10/15/20	10/16/20	10/17/20
		6.2 Shrinkage methods		6.3 Dimension reduction		
10/18/20	10/19/20	10/20/20	10/21/20	10/22/20	10/23/20	10/24/20
		6.5 Lab: Subset selection No Zoom		6.7 Lab: PCR and PLS		
10/25/20	10/26/20	10/27/20	10/28/20	10/29/20	10/30/20	10/31/20
		8.1 Decision trees		ML in Practice		
11/1/20	11/2/20	11/3/20	11/4/20	11/5/20	11/6/20	11/7/20
		8.2 Bagging, random forests, boosting		8.3 Lab: Decision Trees No Zoom		
11/8/20	11/9/20	11/10/20	11/11/20	11/12/20	11/13/20	11/14/20
		10.1 Unsupervised learning 10.2 PCA		10.3 Clustering Methods		
11/15/20	11/16/20	11/17/20	11/18/20	11/19/20	11/20/20	11/21/20
		10.4 Lab: PCA No Zoom		10.5 Lab: Clustering No Zoom		
11/22/20	11/23/20	11/24/20	11/25/20	11/26/20	11/27/20	11/28/20
		ML in Practice Optional Zoom	Thanksgiving Break			
11/29/20	11/30/20	12/1/20	12/2/20	12/3/20	12/4/20	12/5/20
		Final Portfolios 7:30- 10am				