**DEPARTMENT:** BIOS

**COURSE NUMBER:** 534  **SECTION NUMBER:**

**CREDIT HOURS:** 3  **SEMESTER:** Spring 2020

**COURSE TITLE:** Machine Learning

**CLASS HOURS AND LOCATION:**

Tuesday and Thursday, 4:00-5:20pm

CNR Auditorium

# INSTRUCTOR: Zhaohui “Steve” Qin, Tianwei Yu, Steve Pittard

# TEACHING ASSISTANTS: Yanting Huang, Sohail Nizam

# INSTRUCTOR CONTACT INFORMATION

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# OFFICE HOURS

By appointment.

# COURSE DESCRIPTION

This course covers fundamental machine learning theory, method, algorithms and techniques. The topics include basic theory, classification methods, model generalization, clustering, and dimension reduction. The material will be conveyed by a series of lectures and homeworks/projects.

# MPH/MSPH FOUNDATIONAL COMPETENCIES:

* Analyze quantitative and qualitative data using biostatistics, informatics, computer-based  programming and software, as appropriate
* Select communication strategies for different audiences and sectors

# CONCENTRATION COMPETENCIES:

* Use statistical software for data management and exploratory data analysis.
* Communicate the results of statistical analyses to a broad audience.

# Github site:

<https://github.com/steviep42/bios534_spring_2020/>

# EVALUATION

The grade assignment will be based on:

Participation in class and discussions (10%);

Midterm exam (30%)

Three homeworks (20% each).

# COURSE STRUCTURE

The course will be organized into weekly lectures consisting of a combination of electronic slides, whiteboard problem solving, and computational demonstrations. Students are expected to ask and answer questions in class.

|  |  |
| --- | --- |
| **MPH/MSPH Foundational Competency assessed** | **Representative Assignment** |
| Use statistical software for data management and exploratory data analysis. | Project assignments will involve the exploratory analysis of real data sets. |
| Select communication strategies for different audiences and sectors | Project assignments require students to interpret machine learning techniques to applied researchers with no statistics/machine learning background. |
| **BIOS Concentration Competencies assessed** | **Representative Assignment** |
| Use statistical software for data management and exploratory data analysis. | Project assignments will require programming in Python and exploratory analysis of real data sets. |
| Communicate the results of statistical analyses to a broad audience. | Project assignments will require interpreting the results. |

# COURSE POLICIES

Students are expected to attend lectures and ask questions during class. After taking the course, the students are expected to have working knowledge the following areas:

(1) Recognize the scope of machine learning methods and where to apply them. (2) Have working knowledge in the areas of classification, clustering and dimension reduction. (3) Understand and be able to judge the performance of machine learning algorithms. (4) Understand model generalization, including variance, bias, and their trade off, and the issue of over-fitting.

**Textbook:**

**The elements of statistical learning.** Hastie, Tibshirani & Friedman.

**Python Machine Learning.** Raschka & Mirjalili

**Other references:**

**Pattern classification.** Duda, Hart & Stork.

**Data clustering: theory, algorithms and application.** Gan, Ma & Wu.

**An introduction to Statistical Learning: with Applications in R.** James, Witten, Hastie, Tibshirani.

As the instructor of this course I endeavor to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me and the Office for Equity and Inclusion, 404-727-9877.

# RSPH POLICIES

# Accessibility and Accommodations

Accessibility Services works with students who have disabilities to provide reasonable accommodations. In order to receive consideration for reasonable accommodations, you must contact the Office of Accessibility Services (OAS). It is the responsibility of the student to register with OAS. Please note that accommodations are not retroactive and that disability accommodations are not provided until an accommodation letter has been processed.

Students who registered with OAS and have a letter outlining their academic accommodations are strongly encouraged to coordinate a meeting time with me to discuss a protocol to implement the accommodations as needed throughout the semester. This meeting should occur as early in the semester as possible.

Contact Accessibility Services for more information at (404) 727-9877 or [accessibility@emory.edu](mailto:accessibility@emory.edu). Additional information is available at the OAS website at <http://equityandinclusion.emory.edu/access/students/index.html>

# Honor Code

**You are bound by Emory University’s Student Honor and Conduct Code.** RSPH requires that all material submitted by a student fulfilling his or her academic course of study must be the original work of the student. Violations of academic honor include any action by a student indicating dishonesty or a lack of integrity in academic ethics. *Academic dishonesty refers to cheating, plagiarizing, assisting other students without authorization, lying, tampering, or stealing in performing any academic work, and will not be tolerated under any circumstances.*

The RSPH Honor Code states: “Plagiarism is the act of presenting as one’s own work the expression, words, or ideas of another person whether published or unpublished (including the work of another student). A writer’s work should be regarded as his/her own property.” (<http://www.sph.emory.edu/cms/current_students/enrollment_services/honor_code.html>)

# COURSE CALENDAR AND OUTLINE

Topics and dates are subject to change as the semester progresses.

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| Lecture 1 | Introduction |
| Lecture 2 | Bayesian Decision Theory |
| Lecture 3 | Density Estimation and KNN |
| Lecture 4 | Basis Expansion |
| Lecture 5 | Generalized Additive Model and MARS |
| Lecture 6 | Linear Machine |
| Lecture 7 | Support Vector Machine 1 |
| Lecture 8 | Support Vector Machine 2 |
| Lecture 9 | Decision Tree and Bagged Trees |
| Lecture 10 | Random Forest and Adaboost |
| Lecture 11 | Boosting Trees |
| Lecture 12 | Neural Networks 1 |
| Lecture 13 | Neural Networks 2 |
| Lecture 14 | Neural Networks 3 |
| Lecture 15 | Midterm exam |
| Lecture 16 | Python tutorial |
| Lecture 17 | R and caret tutorial |
| Lecture 18 | Lab: Data wrangling |
| Lecture 19 | Performance metrics |
| Lecture 20 | Lab: Build NN from scratch |
| Lecture 21 | Guest lecture |
| Lecture 22 | Clustering |
| Lecture 23 | Clustering |
| Lecture 24 | Dimension reduction |
| Lecture 25 | Lab: clustering, dimension reduction |
| Lecture 26 | Guest lecture |
| Lecture 27 | Lab: ensemble methods |
| Lecture 28 | Special lecture TBD |