<u>Tentative</u> Syllabus ISE 5194
Introduction to Operations Analytics (3 credit hours)

Wk	Topic	Code
1	Introductory Statistics; Continuous & Discrete; Supervised & Unsupervised; Human-In-Loop & Autonomous; Optimization (Chp1)	Colab Anaconda/Spider *Cyber Vulnerability
2	Supervised: Evaluating Models; Cross Validation; ROC; Imbal. Data (Chp2)	Handwriting in R
3	Supervised: Linear Regression and *DOE; Variance & Bias (Chp3)	JMP
4	Supervised: Logistic Regression; *Kriging; *Efficient Global Optim. (Chp4)	Handwriting in R
5	Supervised: (Decision Trees; Boosting & Learners) *Optimal Trees (Chp5)	*Cyber Authent. (R)
6	*Scraping: Twitter API & Websites Neural Nets, LSTM (Ch6)	Intro. to Python
7	Review & **Quiz 1** (2-20)	Cyber Authentication (P)
8	Supervised: Feature Selection & *Hyper Parameter Optimization (*DOE)	C. A. in Python
9	Markov Decision Processes	Tiger in R
10	No Class – Break	No Class – Break
11	Markov Decision Processes & Q-Learning (Heuristic, Ch9)	*Cyber M. in R
12	Partially Observable Markov Decision Processes (Ch10)	POMDP Code in R
13	*Model-Based Bayesian Reinforcement Learning (Ch11)	Python, Project
14	Projects	TBD
15	Review & **Quiz 2** (4-16)	TBD
	No Final – Possible Make Up Only	*Unique or special features.

Course Description

Learn skills and concepts associated with analytics related optimization and decision-making.

Prerequisites

STAT 3470, STAT 6450, equivalent, or permission of instructor.

Instructor

Ted Allen has office hours in 284 Baker including by appointment (allen.515@osu.edu).

Teaching Assistant

None

Grading

30% in class (can drop lowest third), 30% quizzes, project 40%

Course goals include that students:

1. Know which nonlinear programming (NLP) methods are relevant for small and big data analytics?
2. Understand least squares estimation (LSE), maximum likelihood estimation (MLE), and Bayesian estimation (BE) as illustrated using regression and studied with simulation and ground truth models?
3. Can apply logistic regression models and interpret the results?
4. Can apply artificial neural nets and understand their limitations?
5. Can apply trees models and understand their limitations?
6. Can apply Python and R programming and understand their limitations?
7. Can model a system and offer optimal policies using Markov decision processes?
8. Can model a system and offer optimal policies using Q-Learning?
9. Can model a system and offer optimal policies using partially observed MDPs?
10. Contribute to model development and/or state-of-the-art applications through project work.

Materials: Course notes. **Other references:** Cornell notes: https://courses.cis.cornell.edu/cs4780/2017sp/ Python Book: "Hands on Machine Learning…": https://www.oreilly.com/library/view/hands-on-machine-learning/9781491962282/. The "caret" package: http://topepo.github.io/caret/index.html.

Honor Policy

Work closely with others but make sure you understand what you write completely and that none of the work is copied and you avoid even the appearance of cheating.

Draft List of Projects January 9, 2020

1. Old cyber vulnerability data – Enhao Liu (modeling, MDP prioritize, visualize for sharing)
2. New social media cyber data (maybe NLP/sentiment, interface) – Enhao Liu (modeling, MDP prioritize, visualize for sharing)
3. Data from Honda for MDP – Tengmu Megan (policies to throw away…)
4. Additive faster – Long Wang (faster, fewer defects or intentional defects)
5. Babies on plates (augment?) – Mehdi (better diagnoses, fewer MRIs)
6. New data and control at factSpread – Tengmu (control targeting, learning)
7. Autonomous vehicles and/or smart manuf. – Ted/Vimal (support policies)
8. (maybe) Thermography for nuclear inspection – Ed H. (cheaper inspection)
9. (maybe) Authentication data for OSU – Chris H. (suspend accounts)
10. Cyber game design with/teaching adversarial methods – Alomair, Olivia
11. Simulation optimization and other methods for planning voting machine allocation – Ted BOEs (allocate voting machines to achieve equal access)
12. Your dataset and your ideas.