Machine Learning (CS 770)
Summer 2024

Dr. Shruti Kshirsagar

Office Hours

Dr. Shruti Kshirsagar Ph.D.

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Office Location:

Dr. Shruti kshirsagar: Room 210, Jabara Hall

Office Hours:

Dr. Shruti kshirsagar: Tuesday- 3-5 pm

Classroom Day/Time:

Monday (3-4.15 pm)

Wednesday (3-4.15 pm)

WSU

- I am currently working as a assistant Teaching Professor in school of Computing department.
- I am teaching Machine Learning, Deep Learning and Spoken Language Processing course.
- I also have research group focusing on deep learning, machine learning, Speech/Audio, Audio event detection topic, brain tumour segmentation, Speech emotion recognition.
- I am also working as a Graduate Coordinator for MS in data science program.

Research Experience

Research Experience

- Audio R&D scientist | EERS Global Inc | Montreal, Canada, (June 2022- April 2023)
- Machine Learning for Audio Analytics Intern | Robert Bosch Inc, Mississauga, Ontario, Canada (June 2021-October 2021)
- PhD Graduate Researcher | National Institute of Scientific Research, Montreal Canada, (January 2018-September 2022)
- MITACS Accelerate Research Intern | Lisnen Canada, Toronto, Ontario (August 2020-December 2020)
- MITACS Accelerate Research Intern | Thales Canada, Quebec (May 2018 – September 2018)
- Research Assistant | Nanyang Technological University, Singapore (May 2017 - Aug 2017)
- Masters Dissertation Thesis | Indian Institute of Technology Bombay, India (Aug 2015 - June 2016)

Research Students and topics

- Supervising the following Master in engineering students at Wichita State University, School of Computing department: (September 2023 - present)
  - Fatemeh Karji - Brain Tumour segmentation, Fall 2023 - Summer 2024
  - Sriram Srinivasan - Speech emotion recognition, Fall 2023 - Summer 2024
  - Parupati, Bharath Chandra Reddy - Audio Event detetction, Fall 2023 - Fall 2024
- Current PhD students at Wichita State University, School of Computing department: (Spring 2024 - present)
  - Leonidah Chepkoech - Medical Image segmentation using deep learning, Spring 2024 - present
  - Mark Angelo Ronaldo - Medical Image segmentation using deep learning, Spring 2024 - present
  - Salari Elmira - Large Language Modelling using deep learning, Spring 2024 - present

Prerequisites

- Basic knowledge of Probability Theory/statistics (STAT761 Statistics), calculus (MATH 242) and linear algebra (MATH011 ,MATH012, Mathematics) is required.
- The course is intended for hard-working, highly motivated students.
- Participants will be expected to display initiative, creativity, scientific rigour, critical thinking, and good communication skills.
- Basic knowledge of python language: Tutorials will be given on python basics and required softwares

Online Tutorial Links

- Python Tutorial:

http://web.stanford.edu/class/cs224n/readings/cs224n-python-review.pdf

Pytorch tutorial: https://colab.research.google.com/drive/13HGy3-uIly1KD_WFhG4nVrxJC-3nUUkP?usp=sharing

https://pytorch.org/tutorials/beginner/basics/intro.html

- Tensorflow & Keras : Google Co-lab Introduction Video

Useful Online Courses covering the Prerequisites

- Prof. Gilbert Strang's video lectures on linear algebra.
- Prof. John Tsitsiklis's video lectures on Applied Probability.
- Prof. Krishna Jagannathan's video lectures on Probability Theory.
- Prof. Deepak Khemani's video lectures on Artificial Intelligence.

Course description

- Machine Learning course is designed to provide a comprehensive and practical understanding of the fundamentals and recent advances in the area of machine learning.
- The course introduces fundamental algorithms in supervised learning and unsupervised learning including regression, classification, clustering, dimensionality reduction, deep neural network to solve real world problems.
- The course introduces various python based Machine Learning libraries (such as scikit learn, tensorflow etc.)

Course Main objective

Upon successful completion of this course, students will be:

- Delve into the theoretical foundations of machine learning and gain hands-on experience in implementing machine neural networks using popular frameworks like Scikit Learn, Sklearn, TensorFlow or PyTorch.

Course Main objective:

- Understand the application, concepts, techniques, and fundamentals of various machine learning algorithms.
- Develop Machine Learning approaches/techniques to solve various problems.
- Develop, design, train and debug and evaluate machine Learning algorithms to solve various problems.
- To gain experience doing independent study and research.

Reference book

The course is based on the following references.

- [HTF] Trevor Hastie, Robert Tibshirani and Jerome Friedman. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Available free online.
- [Bishop] Christopher Bishop. Pattern Recognition and Machine Learning.
- [Mitchell] Tom Mitchell. Machine Learning.
- [TSKK] Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar. Introduction to Data Mining.
- [Rojas] Raul Rojas. Neural Networks.
- [GBC] Ian Goodfellow, Yoshua Bengio and Aaron Courville. Deep Learning. Available free online

Reference/supplemental materials: The course will be supplemented by additional reading on programming languages. This reading material will be handed out in class or will be available on blackboard. Lecture notes will be based on the above text book but will not be exclusively taken from it.

Grade Evaluation

- Your letter grade will be based on the following components:

  Assignments- 60 %

  Project- 40%
- Your final course grade will be based on the following:

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
94-100	90-93	87-89	83-86	80-82	77-79	73-76	70-72	67-69	63-66	60-62	0-59

Assignments

There will be three assignments

1. Linear Regression
2. Classification
3. Deep neural network

Important Dates

- 1st Assignment Due: Week 4-5
- 2nd Assignment Due: Week 7-8
- 3rd Assignment Due: Week 10-11

Late Assignments

- Each student will have a total of three free late (calendar) days to use for homeworks.
- Once these late days are exhausted, any assignments turned in late will be penalized.
- 5% per late day. However, no assignment will be accepted more than three days after its due date.
- Each 24 hours or part there of that a homework is late uses up one full late day.

Homework Assignment & Missed Exams

- **Homework Assignments**

Home assignments, and their due dates, will be announced in class, and posted on the course's Blackboard page.

Late assignment policy: Late Assignments will be accepted up to 3 days past the due day, with 5% late penalty.

Attendance policy

Attendance: You are required to attend each class. Proper documentation is required for all University excused absences. You are responsible for all course material presented and no make-up quizzes/tests will be administered for non-excused absences. A request for an excused or rescheduled exam or presentation must be made in person at least one week before the regularly scheduled exam/presentation date (except in unavoidable situations, such as a medical emergency) and is at the discretion of the instructor.

Disabilities

- If you have a physical, psychiatric/emotional, or learning disability that may impact on your ability to carry out assigned course work, I encourage you to contact the Office of Disability Services (DS).The office is located in Grace Wilkie, room 203, (316) 978-3309 (voice/tty) (316-854-3032 videophone).

- DS will review your concerns and determine, with you, what academic accommodations are necessary and appropriate for you. All information and documentation of your disability is confidential and will not be released by DS without your written permission.

Academic Honesty

- Violations of the Academic Honesty Policy, including but not limited to plagiarism, unauthorized distribution of course materials, possession of banned electronic devices, etc., will result in the following penalties:

  1. First offense: A zero on the assignment or exam.
  2. Second offense: An F in the course.

Tentative Schedule

1. Introduction to Machine Learning
2. Types of Machine Learning
3. Basics of data processing
4. Linear Regression
5. Overfitting, ML pipeline, cross-validation
6. Gradient Descent Algorithm
7. Regularization
8. Types of Regression
9. Evaluation Metrics

Tentative Schedule

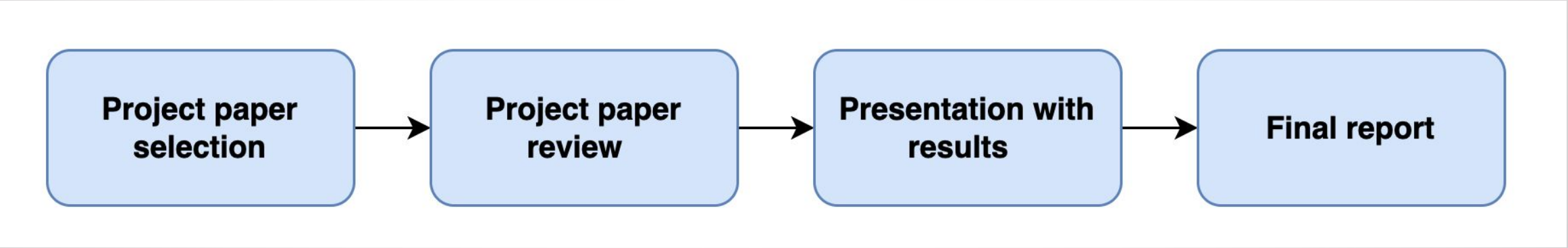
10. Bias-variance Trade-off
11. Classification: KNN
12. Logistic Regression
13. Perceptron
14. Max-margin classifier-SVM
15. Decision Tree
16. Ensemble, Random Forest

Tentative Schedule

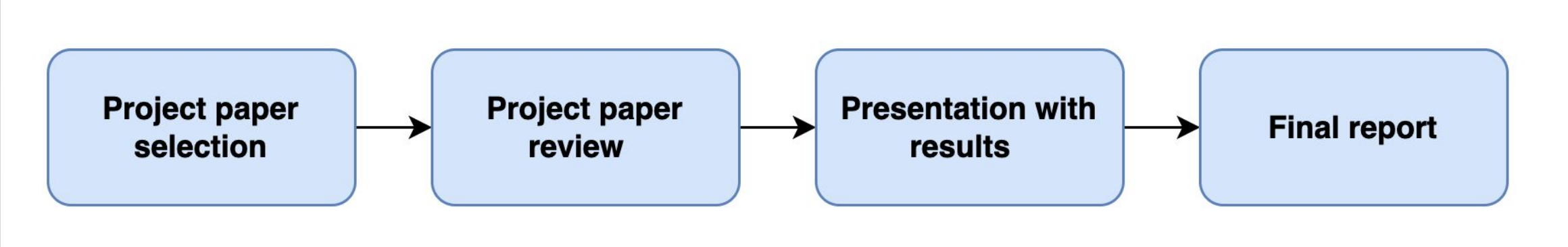
17. Bagging, Boosting, stacking
18. Unsupervised Learning-Clustering Algorithm
19. K-mean clustering
20. Dimensionality reduction-PCA
21. Neural Network, Activation, Backpropagation, loss functions
22. Deep Neural Network
23. Convolutional Neural Network
24. Transfer Learning with Pre-trained model
25. Recurrent Neural Network
26. Autoencoder
27. Frontier in ML, what's next?

Project

One of the main goals of this course is to prepare you to develop machine learning systems of practical use. If you are interested in research, this course should also leave you well-qualified to do research in machine learning and deep learning in an academic setting. The final project in this course will offer you an opportunity to do exactly this.



Project logistics



- Project paper selection- Week 3-Week 5
- Project paper review -Week 5-Week 7
- Implementation Presentation with review-Week 7- Week 13-14
- Final report-Week 15

Extra Credits

Pop quizzes (upto 5) [each 20 marks]

- Based on basics concept of Machine Learning

Future roadmap

Future Roadmap

- **We have various frameworks available as black box, so why to take this course if this framework can do so much help in directly applying models to data?**
- You will get to know what to do if something goes wrong in training & testing times
- Debugging learning algorithms requires so much of detective works, so you will understand from this course what is going on under the hood
- This is why we will derive things by hand in the class assignments
- This course will help you to understand the foundation of machine learning and deep learning models.
- At the end of this course you will learn to apply the learning algorithm to real time data (which is current focus of Industry)

Next class topic

- Introduction- Machine Learning

Questions?

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