Online Course on Foundations of Machine Learning and Deep Learning

Conducted by

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Instructor's Overview

Anupam Borthakur
Ph.D. Candidate, IIT Kharagpur
Area of Research: Privacy, Deep Learning, Machine
Learning
Know more at:
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Sista Raviteja
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Course Overview

Weeks	Broad Topic	Delivery	Mode
Module 1	Introduction to Machine Learning		
Module 2	Introduction to Deep learning		
Module 3	Introduction to Convolution Neural Networks	Theory + Hands on	Online
Module 4	Complexity Analysis of Deep Neural Networks		
Module 5	Selecting a deep Neural Network		

Course Contents

Weeks	Date	Day	Time	Broad Topic	Topic	Description
Week 1	3/18/2024	Monday	1 Hour	Introduction to Machine Learning	Intution to Learning	0. Course overview
						1. Learning
						2. Human Vs Machine perspectives
						3. Formulation
						4. Relation to AI/ML
	3/19/2024	Tuesday	2 Hours		Basics of Learning-1 (pipeline overview)	1. Inputs, W/B Box, Outputs
						2. Types of inputs
						3. Types of W/B Boxes
	3/20/2024	Wednesday				4. Type of Outputs
						5. Relation to Learning
	3/21/2024	Thursday	2 Hours		Basics of Learning -2 (types of learning)	1. Supervised
						2. Unsupervised
	3/22/2024	Friday				3. Semi-supervised
						4. Self Supervised
	3/23/2024	Saturday	2 Hours		Hands on basics 1	Hands on implentation of Basics of L1
					Hands on basics 2	Hands on implentation of Basics of L2

Module 1

Course Contents

3/26/2024	Tuesday	1 Hour	Introduction to Deep learning	Introduction to DL	Introduction to DL
3/27/2024	Wednesday	2 Hours		Perceptron Theory and Working	1. Perceptron - neurons
					2. Perceptron I/o Relations
3/28/2024	Thursday				3. Perceptron working (with backpropagation)
					4. Non-linearity (touch up)
3/30/2024	Saturday	2 Hours	Introduction to Deep learning	Hands on	Introduction to Pytorch Framework
4/1/2024	Monday	2 Hours		Non-linearity	1. Need for nonlinearity
					2. Types of nonlinearities
4/2/2024	Tuesday				3. NN as a non linear system proof
4/3/2024	Wednesday	1 Hour		MLP	1. Introduction to MLP
					2. Flow on information in MLP
					4. Weight update equations
					3. Applications of MLP
4/4/2024	Thursday	1 Hour		Hands on	MLP tutorial

Module 2

Course Contents

4/5/2024	Friday	1 Hour	Introduction to Convolution Neural Networks	Drawbacks of MLP	0. Types of variations in input data (in var, eq, ..)
					1. Translation variant
					2. not robust to rotational variations
4/6/2024	Saturday	2 Hours		Working of CNN	1. Convolution
					2. 2D Convolution
4/8/2024	Monday	1 Hour		Advantages of CNN	1. Proof of invariance and equivaraiance of conv kernels
					2. parameter sharing
4/10/2024	Wednesday	2 Hours		Hands on	1D conv Hands on
4/11/2024	Thursday			Hands on	2D conv Hands on

Module 3

4/12/2024	Friday	1 Hour	Complexity Analysis of Deep Neural Networks	Linear Layers	1. Space and Compute Complexity derivations
4/13/2024	Saturday	2 Hours		Convolution Layers	1. Space and Compute Complexity derivations
				Activation and Pooling Functions	1. Space and Compute Complexity derivations
4/15/2024	Monday	2 Hours		Hands on	Hands on example for proving space and compute complexity (FC)
4/16/2024	Tuesday			Hands on	1. Hands on example for proving space and compute complexity (CNN)

Module 4

Course Contents

4/18/2024	Thursday	1 Hour	Selecting a Deep Neural Network	Network Complexity	1. space and compute complexity b/w 2 sample networks
4/19/2024	Friday	1 Hour		Performance	1. performance metrics
					2. train-validation curves
					3. bias-variance trade off
4/20/2024	Saturday	2 Hours		Hyperparameters	1. Hyperparameters
					2. Choosing the right hyperparameters
					3. Impact of hyperparameters
4/21/2024	Sunday	2 Hours		Hands on	popular networks space and compute complexity
				Hands on	performance metrics and hyperparameters

Module 5

General Instructions

Class Streaming:
- Google Meet (Primary)

Slides and Tutorials :
- GitHub: *Link will be updated*

Attendance*
- Google form attendance Link

✓ Students can communication via email
  - anupamborthakur@kgpian.iitkgp.ac.in
  - sista.raviteja@kgpian.iitkgp.ac.in

✓ Students can communication via WhatsApp /group*

Coding Instructions

Software and platforms
- PyTorch
- Anaconda
- Collaboratory
- Always use comment at appropriate places

Thank You

For your Attention!

Any Questions?