Course Structure

Department of Applied Mechanics, IIT Delhi

APL 745: Deep Learning for Mechanics

Course slot – M, Credit: 3-0-2

Instructor: Prof. Sitikantha Roy (sroy@am.iitd.ac.in), Office - Block IV, Room 243, webpage: https://sites.google.com/view/sitilab-iitd/

Contents:

Week Number	Lecture Topic	Hands-On Topic
Week 1	Introduction to ML and Deep Learning, Review of ML Basics (Supervised, Unsupervised learning, Fully Connected Deep Neural Networks)	Installation and quick setup of Jupyter/Colab. Introduction to Python & other modules (DH)
Week 2	Linear Regression and Classification, Logistic regression, binary and multi class classification.	Linear Regression (SG) and Classification (SoftMax) (AA)
Week 3	Optimization algorithms in DL, Backpropagation, Automatic Differentiation	Neural network (DH) (without using any package)
Week 4	Regularization, bias and variance - overfitting, underfitting: Generalization	Intro to PyTorch, Solve earlier NN problem with PyTorch (SG)
Week 5	Introduction to CNN	CNN (Image Classification) (RK + AA)
Week 6	Sequence Learning, Recurrent Neural net for Transient problems	RNN (AH)
Week 7	Introduction to PINN, Types of PINNs Physics Informed DeepONet for PDEs	PINN (AH)
Week 8	Operator Learning (DeepONet to solve Mechanics problems)	DeepONet (SM, AA) PI-DeepONet (SM, AA)
Week 9		
Week 10		
Week 11		
Week 12	Advanced topics in operator learning (FNO, GNO etc.)	FNO (RK), GNN (AA, AH)
Week 13	Advanced application of DL in computational mechanics	
Week 14		

Grading Scheme:

Minor + Major = 50% weightage

Lab evaluation exam (Assignments/Projects) = 50% weightage

Attendance - 75% (min)

Audit policy: Attendance 75% (min) + Major & Minor exam + Assignments + min B- grade

Reference Books:

- Bishop Christopher, M., 2006. Pattern recognition and machine learning. *Information science and statistics, New York: Springer*.
- Chollet, F., 2021. *Deep learning with Python*. Simon and Schuster.
- PyTorch documentation (https://pytorch.org/docs/stable/index.html) (visited on 23.12.2021)
- CS229, Machine Learning, Andrew NG class note.
- Tom M Mitchel, Machine Learning, McGraw-Hill, 1997
- R. Duda, P. Hart & D. Stork, Pattern Classification (2nd ed.), Wiley