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](mailto:sroy@am.iitd.ac.in)), Office - Block IV, Room 243, webpage: <https://sites.google.com/view/sitilab-iitd/>

Contents:

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| **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