Introduction to Cross-Domain Heterogeneity in Machine Learning

Objective: The content of this module is focused on developing a fundamental understanding of machine learning algorithms, and a strong emphasis on dealing with cross-domain heterogeneity. Over the period of time, the students are expected to improve both the theoretical aspects of cross-domain heterogeneity as well as the implementational aspect. Further, this module is designed to explore the research questions on cross-modal heterogeneity.

Prerequisite: Python, Jupyter notebook, Google Colab, GitHub

Timeline (Week)	Topics	Material	Programming Assignment
1	Introduction to machine learning and different types of ML task - classification and regression	Online Resource: Medium, Towards Data Science, GeeksforGeeks	Visualization - Bar, Group, Scatter
2	Statistical feature and feature selection strategies, Linear and non-linear mapping	Book: An Introduction to Statistical Learning, Chapter - 2, 3, 4	Consider a dataset and extract statistical features, Visualization - Confusion matrix
3	Traditional algorithms - Random Forest, Multi-linear perceptron and clustering, Validation approach - LOSO, Train-Test Split	Online Resource	Sci-py library to apply algorithms
4, 5	Convolutional neural network, Fully connected layers, Softmax layers, Deep learning techniques - Backpropagation, Dropout, batch normalization, soft labeling	Paper - Deep Learning	PyTorch Sample Examples
6	Transfer learning, Study - VGGNet, ResNet	Paper - https://arxiv.org/abs/1411.1792, Stanford - CS231	Kaggle Competition: Cats vs Dogs

7	Domain adaptation, Assumptions, Types of domain adaptation, Distribution alignment metrics - MMD, JSD, KL-D	Survey Paper - http://proceedings.mlr.press/v37/ganin15.html	t-SNE, PCA
8, 9	Popular Architecture - Encoder-decoder, Adversarial Network, Generative Adversarial Network, Feature alignment, Feature fusion techniques, Topic Related - Paper Survey	RevGrad - http://proceedings.mlr.press/v37/ganin15.html, GAN Paper - https://dl.acm.org/doi/pdf/10.1145/3422622	Encoder-decoder, Adversarial Network
10	Research Idea	Google Scholar, GitHub	