19ECS773: DEEP LEARNING

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In Machine Learning tasks such as speech recognition and computer vision, the mapping of raw data to the output is often a complicated function with many factors of variation. Deep Learning focuses to learn feature hierarchies with features at higher levels in the hierarchy formed by the composition of lower level features.This course aims to cover the basics of Deep Learning and some of the underlying theory with a particular focus on supervised Deep Learning along with a good coverage of unsupervised methods.

Course Objectives

- Recall neural networks and learn dropout regularization and its role in improving the efficiency.
- Learn various architectures and visualization of Convolution Neural Networks.
- Learn deep recurrent architectures and its effectiveness.
- Learn various encoders of deep unsupervised leaning.
- Apply deep learning mechanisms to various learning problems

Unit I **8L**

Introduction: Feed forward neural networks (FFNN). Gradient descent and the back propagation algorithm. Unit saturation, aka the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima. Heuristics for faster training. Regularization. Dropout.

Learning Outcomes:

After completion of this unit the student will be able to

- recall gradient descent and back propagation algorithms of FFNN(L1)
- examine relu function and its importance(L4)
- assess dropout regularization of neural networks(L5)

Unit II **9L**

Convolution Neural Network: Architectures, convolution / pooling layers, Visualizing Convolution Networks, Python/NumPy Tutorial

Learning Outcomes:

After completion of this unit the student will be able to

- explain the underlying mechanism of CNN(L2)
- analyze the working principle of pooling layers(L4)
- contrast variants of CNN(L4)

Unit III **9L**

Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures, Reservoir

Computing (basic idea), The Unreasonable Effectiveness of Recurrent Neural Networks

Learning Outcomes:

After completion of this unit the student will be able to

- explain the encoder and decoders of RNN architectures(L2)
- illustrate reservoir computing and its usage(L2)
- inspect the effectiveness of RNN(L4)

Unit IV **8L**

Deep Unsupervised Learning: Auto encoders (standard, sparse, denoising, contractive, etc), Variational Auto encoders, Adversarial Generative Networks, Auto encoder and DBM.

Learning Outcomes:

After completion of this unit the student will be able to

- outline various encoders of unsupervised learning(L2)
- analyze adversarial networks and variational encoders(L4)
- examine DBM(L4)

Unit V **8L**

Applications of Deep Learning: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, and video to text with LSTM models.

Learning Outcomes:

After completion of this unit the student will be able to

- build a NN for automatic image captioning(L6)
- improve the efficiency of NN(L6)
- elaborate Generative networks for image generation(L6)

Text Bbook(s):

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press,2015.
3. Francois Chollet, Deep Learning with Python, 1/e, Manning Publications Company,2017

Course Outcomes:

After completion of this course, the student will be able to

- explain the basics of deep learning and relu function (L2).
- define dropout regularization and its importance in improving the efficiency (L1).
- construct the architectures of CNN and their usage (L3).
- outline variations of RNN and their implementations (L2).
- elaborate the underlying unsupervised techniques in deep learning (L6).
- analyze and build CNN for various real time applications (L4).