Deep Learning in Life Sciences

Semester No	Code	Credit Hours
7-8	BI – 430	3 – 0

Course Description

This course introduces foundations and state-of-the-art machine learning challenges in genomics and the life sciences. We introduce deep learning approaches to key problems, comparing and contrasting their power and limitations. We seek to enable students to evaluate various solutions to crucial problems we face in this rapidly developing field and to execute new enabling solutions that can have a large impact.

Text And Material

1. Dive Into Deep Learning, A. Zhang, Z.C. Lipton, M. Li, A. Smola.
2. Deep Learning" by Goodfellow, Bengio, and Courville

Course Learning Outcomes:

After completing this course, a student will be able to:

1. Knowledgeable about deep learning methods in life sciences, especially in tasks like sequence and structure analysis and evolution, biological networks
2. Able to understand the key algorithms for the main tasks
3. Able to implement and apply the techniques to real-world datasets

Assessment System

Quizzes	10-15%
Assignments	5-10%
Midterms	30-40%
ESE	40-50%

Week wise Lecture Plan:

Week No	Description	Quizzes	Assignment
1	Overview of the Course/ ML Review		

2	Neural Networks (CNN (review) & Deconvolutional Networks)	01	01
3	Neural Networks (RNN & GNN)		
4	Introduction to GANs		
5	Understanding Transformers		
6	Interpretability, Dimensionality Reduction Relevance Propagation, Convolution Arithmetic	02	
7	Maximum entropy methods Discriminative Localisation		02
8	Introduction of autoencoders		
9	**MIDTERMS**		
10 -11	Interpreting ML Models: visualise Filters, Measure Gradients, Perturb inputs.	03	03
12	Tensor Flow Introduction		
13	Deep Learning Problems and compute solutions; Genomic regulatory codes	04	
14	Deep Learning Problems and compute solutions; Gene regulation - Single Cell RNA-seq		
14	Deep Learning Problems and compute solutions; Genetic Variations & Diseases		
15 - 16	Graphs & Proteins • Protein structure prediction • Functional classifications		04
17	Biomedical imaging • Video Processing, structure determination	05	
18	**END SEMESTER EXAMINATION**		