



Khawaja Fareed University of Engineering & IT Rahim Yar Khan

Tentative Course Plan **Department of Computer Science**

Class:

Semester:

Session:

Instructor:	Mr. Shahzad Hussain	Email: shahzad.hussain@kfueit.edu.pk
Course Title:	Deep Learning and Applications	Program: BSCS
Course Number:	COSC-4121	Credit Hours: 3

Lecture Time:	
<u>Course Objective & Outcomes:</u> 1. Deep learning from first principles 2. Setting up your own deep-learning environment 3. Image-classification models 4. Deep learning for text and sequences 5. Neural style transfer, text generation and image generation	
<u>Methods of Teaching:</u> • Class participation is very important and will be evaluated on the bases of class attendance, punctuality, ability to contribute in class discussions, participation in answer questions session and preparation level with assigned readings. All students are expected to prepare for and participate in class. • The methodology of Direct / Live teaching at class room as per Lecture schedule where student have the freedom to interact and ask any question to teacher regarding the current Lecture topic. • Student would also have option to contact with teacher at specific office hours (may change according to summer and winter season) regarding the course related queries.	
Resource Material	1. Reference Book
	i Deep Learning with Python, Francois Chollet, ISBN-10: 9781617294433
	ii Deep Learning (Adaptive Computation and Machine Learning series) ISBN-10: 0262035618
	2. Web Resources
	i. https://sebastianraschka.com/resources/dl-lectures.html
	ii. https://deeplearning.mit.edu/
Office Help Hours	During Official Hours

SEQUENCE OF TOPICS TO BE COVERED		
Week	Topics (outline of main topics and sub topics)	Book / Tutorial
1	What is deep learning? Artificial Intelligence, Machine learning, and Deep Learning; Learning representation from data; the “deep” in deep learning; what machine learning achieved so far; don’t believe the short-term hype; the promise of AI	Chapter No. 1
2	Before we begin: the mathematical building blocks of neural networks A first at Neural Network; Data Representation for neural network; Scalars (0D tensors); Vectors (1D tensors); Matrices (2D tensors); 3D tensors and higher-Dimensional tensors; Times series data and sequence data; Image data and Video data	Chapter No. 2
3	The gears of neural networks: tensor operations Element-wise operations; broadcasting; tensor dot; tensor reshaping; Geometric interpretation of tensor operations; A geometric interpretation of deep learning The engine of neural networks: gradient-based optimization What’s derivative? Derivative of a tensor operations; the gradient; Stochastic gradient descent; chaining derivatives; the backpropagation algorithms.	Chapter No. 2
4	Getting started with neural networks Looking at first example; Anatomy of a neural network Layers; the building blocks of deep learning; Models: networks of layers; Loss functions and optimizers: key to configuring the learning process.	Chapter No. 3
5	Introduction to Keras Keras; Tensorflow, Theano, and CNTK; Developing with Keras Setting up a deep-learning workstation; Jupyter notebooks: the preferred way to run deep-learning experiments; getting Keras running: two options Classifying movie reviews: a binary classification example	Chapter No. 3
6	Classifying newswires: a multiclass classification example The Reuters dataset; preparing the data; building the network; validating the approach; generating predictions on new data; a different way to handle the labels and the loss; the importance of having sufficiently large intermediate layers; further experiments Predicting house prices: a regression example The Boston Housing Price dataset; Preparing the data; building the network; validating your approach using k-fold validation	Chapter No. 3
7	Fundamentals of machine learning Four branching of machine learning; Evaluating machine-learning models; Data preprocessing, feature engineering, and feature	Chapter No. 3

8	Deep learning for computer vision Introduction to convnets; the convolution operations; the max-pooling operations; Training a convnets from scratch on a small dataset. The relevance of deep learning for small-data problems; download the data; building your network; data preprocessing; using data augmentation	Chapter No. 5
Mid Exam		
9	Using pretrained convnet: Feature extraction; Fine-tuning; wrapping up Visualizing what convnets learn Visualizing intermediate activations; Visualizing convnet filters; Visualization heatmaps of class activation.	Chapter No. 5
10	Working with text and sequences Working with text data One-hot encoding of words and characters; Using word embedding; putting it all together; from raw text to word embedding Understanding recurrent neural networks A recurrent layer in Keras; Understanding the LSTM and GRU layers; A concrete LSTM example in Keras	Chapter No. 6
11	Advance use of Recurrent Neural Networks A temperature-forecasting problem; Preparing the data; A common-sense, non-machine learning baseline; a basic machine learning approach; a first recurrent baseline; Using recurrent dropout to fight overfitting; stacking recurrent layers; Using bidirecting RNNs	Chapter No. 6
12	Generative deep learning: Text generative with LSTM A brief history of generative recurrent networks; how do you generative sequence data? The importance of the sampling strategy; Implementing character-level LSTM text generative Deep Dream Implementing DeepDream in Keras	Chapter No. 8
13	Neural style transfer The content loss; The style loss; Neural style transfer in Keras Generating images with variational autoencoders Sampling from latent spaces of images; Concept vectors for image editing; Variational autoencoders	Chapter No. 8
14	Introduction to Generative Adversarial Networks (GAN) A schematic GAN implementation; A bag of tricks; The generator; The discriminator; The adversarial network; How to train your DCGAN	Chapter No. 8
15	Advanced deep-learning best practices Going beyond the Sequence model the Keras functional API Inspecting and monitoring deep-learning models using Keras callbacks and TensorBoard	Chapter No. 7

16	The limitation of deep learning The risk of anthropomorphizing machine-learning models; Local generalization vs. extreme generalization	Chapter No. 9
	Final Term Exam	

Student Evaluation criteria:

Workshop / Assignments/Case study	5%
Surprise Test/Sudden Test , Quizzes	5%
Semester Project	10%
Mid Term Paper	30%
Final Term paper	50%
Total	100%

Student Responsibilities:

Students must attend class. Failure to attend class may result in failure in the course. Students must also arrive on time and remain in class for the entire period. Cellular Phones and Beepers must be Turned off (Proper classroom decorum [behavior] adopted. Course outlines and calendars explain requirements and assignments, students are responsible for knowing what they say. Students are also responsible for doing all assigned work on time. Excessive absences (more than 03) will result in “F Grade”. Students may prepare Sketchbook for taking notes and for references.

Instructor/Tutor

Approved by:

Chairman/ HOD/ Subject Specialist