TAN TAO UNIVERSITY
FROM KNOWLEDGE TO THE STARS

Tan Tao University – School of Engineering

Syllabus

Course code/name: CS434 –Neural Networks and Deep Learning
Semester: Spring 2022
Program type: Undergraduate
Credits: 3 (theory: 2, practice:1)

Instructor: Assoc. Prof. Tran Vu Khanh, PhD
Time and Date: 8:30-11:50 Monday
Office hour: appointment by email.

1. Description

This course introduces neural network and deep learning. Deep learning has gained significant attention in the industry by achieving state of the art results in computer vision and natural language processing. Students will learn the fundamentals and advances of of deep learning and modern techniques to build state of the art models such as CNN, RNN, Autoencoder, VAE, GAN, Deep-Q Learning. Students will use TensorFlow in two levels: Low Level and API Keras to build Deep Learning models and also Pytorch.

2. Prerequisites: MATH201, CS332

3. Course Objectives

Objective	Description	Outcome
OBJ1	Provide the concepts of Neural Networks, Deep Learning, Deep Reinfocement Learning	ELO6
OBJ2	Provide practical knowledge in a number of ANN, CNN, RNN, GAN, Autorendcoder, VAE, Deep-Q Learning	ELO7a, ELO7b ELO5
OBJ3	Be able to identify the type of machine learning, deep learning real-world problems and choose the right algorithms, models, tune parameters for solving problems.	ELO8

4. Learning Outcomes

At the end of this course, student has ability to

Objective	Outcome	Description	Outcome of

			Curriculum
a. Knowledge			
OBJ1	KO1	– Understand deep learning concepts and algorithms	ELO4
	KO2	– Choose the right deep learning algorithms for real-world problem solving;	ELO5
OBJ2	KO3	– Develop and write a substantial deep learning models/funtions in Python.	ELO3
	KO4	– Use TensorFlow, Keras, Pytorch to solve deep learning problems	ELO3
	KO5	– Building new architectes of Deep Learning	ELO6
b. Skill			
OBJ3	KO7	– Work in group (discussion and presentation);	ELO12
	KO8	– Search and read necessary information to solve facing problem;	ELO8

5. Text books/ Materials

There is no required textbook for this course. Several recommended books/materials will be recommended in the lectures such as:

- Bishop, Christopher. *Neural Networks for Pattern Recognition*. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.
- MacKay, David. *Information Theory, Inference, and Learning Algorithms*. Cambridge, UK: Cambridge University Press, 2003. ISBN: 9780521642989. Available on-line here.
- Charniak, Eugene. *Introduction to Deep Learning*. MIT Press, 2018. ISBN: 9780262039512.
- Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning. MIT Press. https://www.deeplearningbook.org/.
- Deep Learning Courses: MIT, Bekerly, Coursera, Edx.

6. Teaching Methods

– There is 01 lecture / week (200 minutes/ lecture), each lecture consists of theory or practice depending on the topics.

- Students are required to complete at least 4h after each lecture to complete the practice problem (*encourage to discuss with lecturer in office hours*).
- Self-study via group assignment to solve simple real application (*encourage to discuss with lecturer in office hours*).
- Students are required to make report as well as presentation for group assignment.

7. Assessment
   - Individual assignment (Individual): 40%
   - Midterm: 30% (Quizzes: 40-50 questions)
   - Final exam: 30% (combine with Group assigment)
8. Calendar
   - Reading will be assigned after each lecture.

Week no.	*Topic*
1	***Introductions and Review*** - *Introduction to the course* - *Reviews of Algebra and Derivatives, Tensorflow, Pytorch* - *Reviews of Linear models, Loss functions, Gradient descent, stochastic gradient descent, mini-batches* - *Lab*
2	***Artificial Neural Network*** *The architecture of a neural network, hidden layers, activation functions* - *Mathematics of Forward-Backward propagations, Regularization* - *Training a Neural Network, Improving and Tuning* - *Lab*
3	***Convolutional Neural Networks (CNN)*** - *Introduction to CNN* - *Building a CNN model with grid size, padding, stride, depth and pooling* - *Lab*
4	***CNN Architectures and Transfer learning*** - *CNN architectures: LeNet-5, AlexNet, VGG-16/VGG-19, Inception and ResNet* - *Transfer learning: how to apply them to an existing pretrained model, and to accelerate your training* - *Lab*
5	***CNN Advanced Techniques and Applications*** - *Data augmentation* - *Application in Computer vision* - *Lab*

6	***Recurrent Neural Networks (RNN)*** - *Introduction to RNN and their application to Natural Language Processing* - *Text Word to Vector* - *Lab*
7	***Recurrent Neural Networks (continued)*** - *RNN Architectures* - *GRU cells* - *Lab*
8	***Midterm Project Presentations***
9	***Recurrent Neural Networks (continued)*** - *LSTM cells* - *Sequence to Sequence Models* - *Lab*
10	***Autoencoders and VAE*** - *Introduction to Autoencoders* - *VAE* - *Lab*
11	***Generative adversarial networks (GAN)*** - *Introduction to GAN* - *Wasserstein GAN* - *Lab*
12	***Applications of Generative Deep Learning in*** - *Paint with lab* - *Write and Compose with lab*
13	***Introduction to Reinforcement Learning*** - *Introducton to RL* - *Q-Learning* - *Policy Gradient Methods* - *Lab*
14	***Deep Reinforcement Learning*** - *Basic Deep Q-Learning* - *Actor-Critic Methods* - *Lab*
15	***Final Project Presentations***

9. Grading guidelines

TTU percentages	Letter Grade	GPA
97-100	A+	4.0
93-96	A	4.0
90-92	A-	3.7
87-89	B+	3.3
83-86	B	3.0
80-82	B-	2.7

TTU percentages	Letter Grade	GPA
77-79	C+	2.3
73-76	C	2.0
70-72	C-	1.7
60-69	D	1.0
0-59	F	0.0

The minimal passing grade is C for all CS students.

Full name of course lecturer: Tran Vu Khanh

Signature: _____

Full name of department head: Cao Tien Dung

Signature: _____

Registrar: Nguyễn Thanh Điền

Signature: _____

Date: 28/12/2021