Course Instructor **Mohammad A. Khan (AzK)**

Course Number and Title: **CSE465** (Pattern Recognition & Neural Networks)

Credits: 3 Credits

Type: Optional

Prerequisites:

Contact Hours: Lecture – 3 Hours/Week

**Course Description:**

Introduction to pattern matching algorithms. In this course, we will focus on neural network based methods of pattern recognition only. We will start with deep feedforward neural networks. Then we will explore how we can customize neural networks for different kidn of problem solving: for image/video based problems, for time series, for natural language processing, etc.

**Course Outcomes (COs):**

Upon successful completion of this course, students will,

CO1: Gain mathematical and judgmental insights into the deep learning algorithms; (Quiz/Mid/Final)

CO2: Be able to pick the most appropriate algorithm for a problem (Final)

CO3: Be able to use a tensor-based framework to implement DL projects (Project)

**Tentative week plan (may change later):**

Power point presentation will be distributed for each topic

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| Week | Lecture ID | Topics |
| 1 | Lecture 1 | General introduction to Neural Networks |
| 2 | Lecture 2 | Python Introduction |
| 3 | Lecture 3 | Deep Feedforward Neural Network – I |
| 4 | Lecture 4 | Deep Feedforward Neural Network – II |
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| 5 | Exam | Project idea |
| 6 | Exam | Project idea |
| 7 | Lecture 5  Exam | Convolutional Neural Network – I / Quiz 1 |
| 8 | Lecture 6 | Convolutional Neural Network – II |
| 9 | Lecture 7 | Example CNN Networks |
| 10 | Lecture 8 | Deep Learning Project – Working Process |
| 11 | Lecture 9  Exam | Transfer Learning / Quiz 2 |
| 12 | Lecture 10 | Regularization Techniques |
| 13 | Exam | Midterm |
| 14 | Lecture 11 | Object recognition & Semantic Segmentation |
| 15 | Lecture 12 | Optimizing Gradient Descent-I |
| 16 | Lecture 13 | Optimizing Gradient Descent-II |
| 17 | Exam | Project mid (presentation) |
| 18 | Lecture 14 | Hands on neural network projects (Pytorch) |
| 19 | Lecture 15  Exam | Sequence Models / Quiz 3 |
| 20 | Lecture 16 | Transformers & Attention |
| 21 | Lecture 17 | Auto encoders and Variational auto encoders |
| 22 | Lecture 18 | GAN |
| 23 | Exam | Project Final (presentation) |
| 24 | Exam | Project final (presentation) |

**Book List:**

Deep Learning by **Ian Goodfellow**

**Optional:**

Deep Learning with PyTorch: Build, train, and tune neural networks using Python tools (1st Edition) by Eli Stevens, Luca Antiga, Thomas Viehmann

**Grading points distribution:**

1. Attendance - 5%
2. Class test – 15%
   1. Best 2 out of 3
3. Project - 20% (Individual)
   1. Problem formulation - 5%
   2. Presentation - 10%
   3. Report - 5%
4. Midterm - 30%
5. Final - 30%

**Syllabus**:

1. Quiz 1
   1. Deep Feedforward Neural Network (Lecture 3, Lecture 4)
2. Quiz 2
   1. Convolutional Neural Network (Lecture 5, Lecture 6)
3. Quiz 3
   1. Optimizing Gradient Descent (Lecture 12, Lecture 12)
4. MidTerm
   1. Convolutional Neural Network (Lecture 5, Lecture 6)
   2. Example CNN Networks (Lecture 7)
   3. Transfer Learning (Lecture 9)
   4. Regularization Techniques (Lecture 10)
5. Final
   1. Object recognition & Semantic Segmentation (Lecture 11)
   2. Sequence Models (Lecture 15)
   3. Transformers & Attention (Lecture 16)
   4. Auto encoders and Variational auto encoders (Lecture 17)
   5. GAN (Lecture 18)

Project:

1. One person group (two at max)
2. Fill up the project and group form
   1. Link will be posted on Google classroom.
3. Report format: <https://drive.google.com/drive/folders/1P0KVQMOrIzhLC7I90n44wH8xC1z_zBT8?usp=sharing>
4. Use of GIT is recommended.

**Grading points to letter grade:**

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| --- | --- | --- |
| **Numerical**  **Scores** | **Letter Grade** | **Grade Points**  **Per Credit** |
| 93+ | A | 4.0 |
| 90 - 92 | A- | 3.7 |
| 87 - 89 | B+ | 3.3 |
| 83-86 | B | 3.0 |
| 80 - 82 | B- | 2.7 |
| 77 - 79 | C+ | 2.3 |
| 73 - 76 | C | 2.0 |
| 70 - 72 | C- | 1.7 |
| 67 - 69 | D+ | 1.3 |
| 60 - 66 | D | 1.0 |
| 0 - 59 | F\* | 0.0 |
|  | I\*\* Incomplete | 0.0 |
|  | W\*\* Withdrawal | 0.0 |
|  | R\*\* Retaken | 0.0 |

**Policy:**

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| **Exams and Quizzes:** Exams and quizzes will be closed book and closed notes. No electronic devices except non-programmable calculators will be allowed during exams. Calculators cannot be shared with friends. **There will be no makeup quizzes or exams.** If you miss a quiz or exam, you will get zero for that. The final exam will be comprehensive. |
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| **Assignments:** There will be two home works/ Assignments throughout the semester. **No late submission will be accepted.** To be successful in the exam, you should solve homework problems independently, although you may discuss with your friends to understand a more comprehensive picture of the problems. |
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| **Class etiquette:** Distracting others in class is violating other's rights to be attentive. **So, laptops, tablets, cell phones or any other devices cannot be turned on during the class time.** You have to share any talk with the whole class. Attendance will be counted at the beginning of the class and if you are late then **no late attendance will be counted.** |
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| **Grade dispute:** If you dispute your grade on any homework, quiz or exam, you have one week time from the date that the graded paper was returned to you to request a change in the grade. After this time, no further change in grade will be considered. |
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| **General course administration:** The class presentations will be interactive lectures. The instructor will provide lecture slides after the lecture sessions. |
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| **Academic Honesty:** Any means of unauthorized assistance in preparing materials which a student submits as original work is deemed to be cheating and constitutes grounds for disciplinary action. Instructors are expected to use reasonably practical means of preventing and detecting cheating. Any student judged to have engaged in cheating might receive a reduced grade for the work in question, a failing grade in the course, or such other lesser penalty, as the instructor deems appropriate. Serious instances may be referred to the Disciplinary Committee in the Office of the Vice-Chancellor. |