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Course Title: Deep Learning

Course Code: IS-662

Department: Information Systems

**HSM Vision**

HSM envisions its success in the sustainable contribution that it will make to the industry, academia and research in public and private sector. HSM will lead by providing professionally competent and ethically conscious human resources engaged in the global and local context to foster socio-economic growth and sustainability for the society.HSM envisages having faculty with high research potential and a deep desire for cutting edge research including collaboration with national and international partners.

**HSM Mission**

Being a research-oriented and student-centric business school, we emphasize research publications in impact journals as well as state-of -the-art learning methodologies.  We will prepare our students to become the future ethical business leaders and the guiding post for the society, while equipping them with the knowledge and skills required by world-class professionals.  We will be the leading choice for organizations seeking highly talented human resource. HSM will foster internationalization with key stakeholders and actively work to exchange best practices with business schools across Pakistan through collaborations, workshops, conferences and other means.

**Course Objectives**

This course is an introduction to deep learning, a branch of machine learning concerned with the development and application of modern neural networks. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. The course will cover a range of topics from basic neural networks, convolution and recurrent network structures, deep unsupervised and reinforcement learning, and application to problem domain like speech recognition and computer vision.

**Learning Objectives**

In this course, the participants will be taken through a process of developing, training and optimizing basic neural networks, convolution nueral networks and long short-term memory networks. Complete learning systems in TensorFlow will be introduced via projects and assignments.

**Teaching Methodology (List methodologies used –example are given below)**

Participants are expected to not only attend all classes but also fully participate in discussions in a meaningful and productive manner. This will only be possible when you come to the class well prepared. The class participation should reflect maturity of ideas, creative zest, intrusive urge for knowledge and incessant attempts to relate theory with the practice. It is a practice intensified course where time constrained activities will be used frequently. Students are expected to follow the tight deadline, and come through with convincing results.

**STUDENTS ARE REQUIRED TO READ AND UNDERSTAND ALL ITEMS OUTLINED IN THE PARTICIPANT HANDBOOK**

**Class Policy:-**

* Be On Time

You need to be at class at the assigned time. After 10 minutes past the assigned time, you will be marked absent.

* Mobile Policy

**TURN OFF YOUR MOBILE PHONE!**It is unprofessional to be texting or otherwise.

* Email Policy

**READ YOUR EMAILS!** You are responsible if you miss a deadline because you did not read your email.

Participants should regularly check their university emails accounts regularly and respond accordingly.

* Class Attendance Policy

A minimum of 80% attendance is required for a participant to be eligible to sit in the final examination. Being sick and going to weddingsare absences and will not be counted as present. You have the opportunity to use 6 absences out of 30 classes. Participants with less than 80% of attendance in a course will be given grade ‘F’ (Fail) and will not be allowed to take end term exams. International students who will be leaving for visa during semester should not use any days off except for visa trip. Otherwise they could reach short attendance.

* Withdraw Policy

Students may withdraw from a course till the end of the 12th week of the semester. Consequently, grade W will be awarded to the student which shall have no impact on the calculation of the GPA of the student.A Student withdrawing after the 12th week shall be automatically awarded “F” grade which shall count in the GPA.

* Moodle

UMT –LMS (Moodle) is an Open Source Course Management System (CMS), also known as a learning Management System (LMS). Participants should regularly visit the course website on MOODLE Course Management system, and fully benefit from its capabilities. If you are facing any problem using moodle, visit <http://oit.umt.edu.pk/moodle>. For further query send your queries to [moodle@umt.edu.pk](mailto:moodle@umt.edu.pk)

* Harassment Policy

Sexual or any other harassment is prohibited and is constituted as punishable offence. Sexual or any other harassment of any participant will not be tolerated. All actions categorized as sexual or any other harassment when done physically or verbally would also be considered as sexual harassment when done using electronic media such as computers, mobiles, internet, emails etc.

* Use of Unfair Means/Honesty Policy

Any participant found using unfair means or assisting another participant during a class test/quiz, assignments or examination would be liable to disciplinary action.

* Plagiarism Policy  
    
  All students are required to attach a “Turnitin” report on every assignment, big or small. Any student who attempts to bypass “Turnitin” will receive “F” grade which will count towards the CGPA. The participants submit the plagiarism report to the resource person with every assignment, report, project, thesis etc. If student attempts to cheat “Turnitin”, he/she will receive a second “F” that will count towards the CGPA. There are special rules on plagiarism for final reports etc. all outlined in your handbook.
* Communication of Results

The results of quizzes, midterms and assignments are communicated to the participants during the semester and answer books are returned to them. It is the responsibility of the course instructor to keep the participants informed about his/her progress during the semester. The course instructor will inform a participant at least one week before the final examination related to his or her performance in the course.

**Course Outline**

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| --- | --- |
| Program | Graduate |
| Credit Hours | 3 |
| Duration | 15 weeks |
| Prerequisites (If any) | A strong mathematical background in calculus, linear algebra, and probability & statistics, as well as programming in Python and R. |
| Resource Person  Name and Email |  |
| Counseling Timing  (Room# ) | By appointment through email and mobile number |
| Contact no. |  |
| Web Links:- (Face book, Linked In, Google Groups, Other platforms) |  |

**Chairman/Director Programme signature………………………………….Date……………………..**

**Dean’s signature…………………………… ………………….Date………………………………………….**

**Grade Evaluation Criteria**

Following is the criteria for the distribution of marks to evaluate final grade in a semester.

**Marks Evaluation Marks in percentage**

Quizzes 10 %

Assignments 20 %

Project (including all components) 40 %

Exam 25 %

Class Participation 05 %

**Total 100 %**

**Recommended Text Books:**

The required textbook for the course is

* Ian Goodfellow, Yoshua Bengio, Aaron Courville. Deep Learning.
* Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Interscience. 2nd Edition. 2001.
* Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4​. Academic Press, 2008.
* Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence. 2003.

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| **W** | **Topics to be**  **covered in the course** | **Learning Objective**  **of this topic** | **Expected Outcomes from Students** | **Teaching Method** | **Assessment Criteria** | **Deadlines and Homework** |
| 1 | Course overview  Math review |  | What is deep learning? DL successes; syllabus & course logistics; what is on the mandatory pre-quiz?  Gradient descent, logistic regression.  Probability, continuous and discrete distributions; maximum likelihood. | Lecture | Quiz | In Class |
| 2 | Intro to neural networks |  | Training data; maximum likelihood based cost, cross entropy, MSE cost; feed-forward networks; MLP, sigmoid units; neuroscience inspiration;  Output vs hidden layers; linear vs nonlinear networks; | Lecture |  | In Class |
| 3 | Backpropagation |  | Learning via gradient descent; recursive chain rule (backpropagation) | Lecture and Activity | Activity | In Class |
| 4 | Deep learning strategies I |  | GPU training, regularization etc; project proposals | Lecture and Activity | Activity 2 | In Class |
| 5 | Deep learning strategies II |  | RLUs | Lecture and Activity |  |  |
| 6 | SCC/TensorFlow overview |  | How to use the SCC cluster; introduction to Tensorflow. | Lecture and Discussion | **Project Update Discussion** | In Class |
| 7 | CNNs |  | Convolutional neural networks |  | Project Part 1 Progress Update and Discussion | In Class |
| 8 | Project Presentation |  |  | Project | Project Part 1 Due and Viva | In Class |
| 9 | Deep Belief Nets |  | probabilistic methods | Lecture and Activity | **Quiz** | In Class |
| 10 | Deep Belief Nets II |  |  | Lecture and Activity | Activity 3 | In Class |
| 9 | RNNs I |  | Recurrent neural networks | Lecture |  | In Class |
| 10 | RNNs II |  |  | Lecture | Discussion | In Class |
| 11 | Neural Turing Machines |  | For eample: attention, memory networks, etc.) | Lecture and Activity | Activity 4: | In Class |
| 12 | Unsupervised deep learning I |  | autoencoders | Lecture and Activity | Discussion | In Class |
| 13 | Unsupervised deep learning II |  | (e.g. deep generative models etc.) | Lecture and Quiz | Quiz | In Class |
| 14 & 15 | Deep reinforcement learning |  | Vision + NLP applications | Lecutre, Activity, Project | Activity 5, Project Discussion | In Class |