AIET Program - Schedule

- Class Timings : 9:30 -11; 11:15-12:45; 2:15-3:45; 4-5:30
- Morning Theory and Afternoon Lab unless specified
- Venue : Auditorium, Block A except on May 29 (A LH 1, Block A)
- Weekly Exams on Monday afternoon from 4 PM - 6 PM (Quiz covering previous weeks syllabus, mostly
- MCQs through TS LMS), programming assignment can also be given after the exam
- On Mondays 2 hour lab sessions starting early from 1:45PM to 3:45 PM

Week 1	May 27 : Orientation (Morning) Python programming (Afternoon)	Talent Sprint Research Scholar (Ravi, Samujjwal)
	May 28 : Overview of Machine Learning	Vineeth N Balasubramanian
	May 29 : Probability	Srijith P. K.
	May 30 Linear Algebra	Aditya Siripuram
	May 31: Dimensionality Reduction	Aditya Siripuram
	June 1: Linear regression, k-NN	Aditya Siripuram
Week 2	June 3 : Naive Bayes, logistic regression, Decision trees Quiz 1 (4 PM - 6 PM)	Vineeth N Balasubramanian
	June 4 : Support Vector Machines	Vineeth N Balasubramanian
	June 5 : Holiday	
	June 6 : Clustering Methods: k-Means, DBSCAN, Variants	Manish Singh
	June 7 : Data/web mining (Morning) Ensemble Methods: Boosting, Bagging (Afternoon)	Manish Singh Srijith P K
	June 8 : GMM and latent variable models	K Sriramamurthy
Week 3	June 10: Neural Networks, Backpropagation Quiz 2 (4 PM - 6PM)	Sumohana
	June 11 : Convolutional Neural Networks	Sumohana
	June 12 : Sequence Models, RNNs and LSTMs	K Sriramamurthy
	June 13: Speech Processing	K Sriramamurthy

	June 14 : Computer Vision	Sumohana/C Krishna Mohan
Week 4	June 17 : Computer Vision Quiz 3 (4 PM - 6 PM)	Sumohana/C Krishna Mohan
	June 18 : text processing	Maunendra Desarkar
	June 19 : text processing	Maunendra Desarkar
	June 20: Internet of Things	Antony Franklin
	June 21 : Internet of Things	Rajalekshmy
	June 22 : Quantum computing (Morning)	M V Panduranga Rao
Week 5	June 24 : Block chains Quiz 4 (4 PM - 6PM)	Sathya Peri
	Capstone Projects	Handled by TalentSprint
	June 28 - 29 : Project Presentations	

DETAILED SYLLABUS

Week 1

May 27: Python Programming

Instructors: Ravi, Samujjwal

May 28: Overview of Machine Learning

Instructor: Dr. Vineeth

Lead TA: Joseph K J

Theory:
Introduction to Machine Learning; Paradigms - Supervised, Unsupervised; Tasks - Classification, Regression, Clustering, Dimensionality Reduction; Other - Ranking, Reinforcement Learning; Example applications; Performance Evaluation

Lab:
Introduction to scikitlearn, Numpy, Scipy, Matplotlib

Pre-reading:
- Part 1 of Deep Learning book: http://www.deeplearningbook.org/
- Essence of linear algebra: http://youtu.be/kjBOesZCoqc
- Essence of calculus: https://goo.gl/Hnk1jA

References:
- Chapter 1, Introduction to Machine Learning, Ethem Alpaydin, https://www.cmpe.boun.edu.tr/~ethem/i2ml/
- Other references will be provided during the lecture

May 29-30 Mathematical Foundations: Probability, Linear Algebra

Instructors: Dr. Srijith, Dr. Aditya

TA: Srinivasa Anumasa

Theory:
- Probability, Sample space, and events, independence, conditional probability, Bayes theorem, random variables, expectations, continuous and discrete distributions, central limit theorem
- Modelling using matrices, matrix spaces and rank, eigen value and singular value decomposition, pseudoinverse, positive definite matrices
- Introduction to estimation

Tutorials:
Covering the topics above

References:

- Sheldon Ross, Introduction to Probability Models, 11th Edition
- D. Bertsekas, Introduction to Probability
- S. Boyd and L.Vandenberge; Introduction to vectors, matrices and least squares C.D.Meyer, Matrix analysis and applied linear algebra

May 31: Dimensionality Reduction

Instructor: Dr. Aditya

TAs : Charantej P, Subbareddy B

Theory:
Introduction and motivation, principal component analysis, SVD, Kernel PCA and other PCA variants, locally linear embeddings, Isomap; Other techniques based on CUR, NMF and LDA

Lab:
Based on the topics above

References:

- K Murphy, Machine learning: A Probabilistic approach

June 1: Linear regression, k-NN

Instructor: Dr. Aditya

TAs : Charantej P, Subbareddy B

Theory:
Motivation, least squares and pseudoinverse, weighted and generalized least squares; Maximum likelihood estimation; ridge regression, lasso and LAR; Gradient descent; Nearest neighbour methods; bias -variance tradeoff

Lab:
Based on the topics above

References:

- S.Boyd and L.Vandenberge; Introduction to vectors, matrices and least squares K Murphy, Machine learning: A Probabilistic approach
- T.Hastie, R. Tibshirani and J.Friedman; The elements of statistical learning
- Bishop, Pattern recognition and machine learning

Week 2

June 3: Naive Bayes, Decision trees, Logistic regression

Instructor: Dr Vineeth

Lead TA: Joseph K J

Theory:
Naive Bayes Classifier, Decision Trees, Logistic Regression: Theory, Variants and Applications

Lab:
Hands-on exercises in scikitlearn (Python) on Naive Bayes Classifier, Decision Trees, Logistic Regression

References:

- Chapters 3,4,9,10 -Introduction to Machine Learning, Ethem Alpaydin, https://www.cmpe.boun.edu.tr/~ethem/i2ml/
- Chapters 2,3,4,7 - Pattern Recognition and Machine Learning, Christopher Bishop, https://www.springer.com/in/book/9780387310732

June 4: Support Vector Machines

Instructor: Dr Vineeth

Lead TA: Joseph K J

Theory:
Support Vector Machines: Intuition, Formulation and Derivation; Variants (One-class, Multi-class); Kernel Methods and Non-linear SVM

Lab:
Hands-on exercises in scikitlearn (Python) on SVMs and Kernel Methods

Pre-reading:

- Basics of optimization: Lagrangian, KKT conditions (http://www.onmyphd.com/?p=lagrange.multipliers, http://www.onmyphd.com/?p=kkt.karush.kuhn.tucker)

References:

- Chapters 3,4,9,10 -Introduction to Machine Learning, Ethem Alpaydin, https://www.cmpe.boun.edu.tr/~ethem/i2ml/
- Chapters 2,3,4,7 - Pattern Recognition and Machine Learning, Christopher Bishop, https://www.springer.com/in/book/9780387310732

June 5: Holiday

June 6: Clustering Methods: k-Means, DBSCAN, Variants

Instructor: Dr Manish

TA: Rohan Banerjee

Theory:
Partitioning, Hierarchical and Density based clustering algorithms; Evaluation of clustering

Lab:
TBD

References:

- Jiawei Han, Data Mining: Concepts and Techniques, 3rd edition 2011

June 7: Data/web mining

Instructor: Dr Manish

TA: Sailaja Rajanala

Theory:
Content based, collaborative and latent factor based recommendation systems; Evaluating recommendation systems

Lab:
TBD

References:

- Jure Leskovec, Anand Rajaraman, and Jeff Ullman, Mining of Massive Datasets, 2nd edition 2014

Ensemble Methods: Boosting, Bagging

Instructor: Dr Srijith

TA : Srinivas

Theory:
Bagging, Boosting, Random Forests, Gradient boosting

Lab:
TBD

References:

- Kevin Murphy : Probabilistic Machine learning
- Christopher Bishop : Pattern recognition and machine learning

June 8: GMM and latent variable models

Instructor: Dr KSRM

TA: Mr. Gowri Prasad

Topics:
Mixture of Gaussians, Maximum likelihood, EM for Gaussian mixtures, relation to K-means.

Theory:
Probability density estimation using GMMs and its applications will be discussed

Lab:
Sampling data from a 2-D multinomial Gaussiam distribution, estimating the parameters of the GMM from the sampled data and comparing them with the actual ones, understanding practical issues in training GMMs, and any one application of GMMsn.

References:

- C. M. Bishop, Pattern Recognition and Machine Learning Kevin Murphy : Probabilistic Machine learning

Week 3

June 10: Neural Networks, Backpropagation

Instructor: Dr Sumohana

Lead TA: Parimala

Theory:
Motivation for neural networks, analysing a basic multilayer perceptron, back propagation algorithm for gradient computation, finding optimal weights, examples of nonlinear functions and their usage.

Lab:
Implementing a feed forward neural network, back propagation algorithm, weight update, basic classification problems.

References:

- C. M. Bishop, Pattern Recognition and Machine Learning
- T. Hastie et al., Elements of Statistical Learning

June 11: Convolutional Neural Networks

Instructor: Dr Sumohana

Lead TA: Parimala

Theory:

Notion of convolution, motivating CNNs from biological vision, understanding the building blocks of a CNN, building a CNN, error analysis, gradient update with back propagation and optimising filter weights.

Lab:
Building a CNN from scratch and implementing the back propagation algorithm for CNNs. Image classification on simple databases.

References:

- Goodfellow et al., Deep Learning, MIT Press

June 12: Sequence Models, RNNs and LSTMs

Instructor: Dr. KSRM

TA: Mr. Gowri Prasad

Topics:
Dynamic time warping, Hidden Markov models, recurrent networks, backpropagation through time, long-short term memories, gated-recurrent units, and attention mechanism.

Theory:

Motivation for processing sequential data, understanding dtw kernel for defining similarity score between two sequences, density estimation of sequences using hidden markov models, sequence processing using deep architectures.

Lab:

- Isolated digit recognition using DTW and HMM Implementation of basic character-level RNN
- Language modeling using RNN/LSTM using Keras/Pytorch.

References:

- Goodfellow et al., Deep Learning, MIT Press

June 13: Speech Processing

Instructor: Dr KSRM

TA: Mr. Gowri Prasad

Topics:
Feature extraction, Building Speech Recognition system

Theory:
Understanding acoustic theory of speech production to extract features of interest from speech signal, hybrid HMM-DNN acoustic modeling for building robust speech recognizer.

Lab:
Building a continuous speech recognizer using Kaldi toolkit

References:

- Rabiner & Juang “Fundamentals of Speech Recognition”, PHI

June 14 : Computer Vision

Instructor: Dr Sumohana/ Dr CKM

TA: TBD

Topics:
TBD

Theory:
TBD

Lab:
TBD

References:
TBD

Week 4

June 17: Computer Vision

Instructor: Dr Sumohana/ Dr CKM

Lead TA : Parimala

Theory:

- Fundamentals of image processing and computer vision - linear systems and convolution, basic filters and applications.
- Biological vision and connections to deep learning.
- Basics of colour and stereo vision. Basics of segmentation, detection and recognition.

Lab:
Implementing basic filtering operations, detection, recognition and stereo vision algorithms.

References:
R. Szeliski, Computer Vision: Algorithms and Applications

June 18: Text Processing

Instructor: Dr Maunendra

TA : TBD

Theory:
Modeling text segments and documents as vectors, document similarity and retrieval using different mathematical models

Lab:
Hands-on exercises involving crawling, content extraction and corpus building

References:
TBD

June 19: Text Processing

Instructor: Dr Maunendra

TA: TBD

Theory:
Beyond individual appearances of terms - distributed representation of terms, Document understanding using induced term-space

Lab:
Hands-on exercises involving generation of and usage of distributed representations

References:

TBD

June 20: Internet of Things

Instructor: Antony

TA :
TBD

Topics:
TBD

Theory:
TBD

June 21: Internet of Things

Instructor: Rajalekshmy

TA :
TBD

Topics:
TBD

Theory:
TBD

Lab:
TBD

References:
TBD

June 22: Quantum Computing

Instructor: MVP

TA : TBD

Topics:
TBD

Theory:
TBD

Lab:
TBD

References:
TBD

June 24: Block Chain

Instructor: Sathya

TA : TBD

Topics:
TBD

Theory:
TBD

Lab:
TBD

References:
TBD