Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for M. Sc. In Human Computing & Artificial Intelligence
(Effective for Academic Session 2019-2020)

Semester II

Paper: ADVANCED STATISTICS
Code: AST 201
Contacts Hours / Week: 4T
Credits: 4

Objectives

Create understanding for the student on **statistical** concepts to include measurements of location and dispersion, probability, probability distributions, sampling, estimation, hypothesis testing, regression, and correlation analysis, multiple regression and Variance

Units	Course Content
1	Inference for two means (independent and paired); Inference for variances; Multiple regression techniques
2	One-way analysis of variance and its extensions; Analysis of covariance and its extensions
3	Multivariate analysis of variance and covariance; Discriminate analysis
4	Inference for proportions and comparison of proportions; Chi-square goodness of fit and tests of independence

Reference Books

1. Apostol, T. M. (1975) Mathematical Analysis : A Modern Approach to Advanced Calculus. (Addison - Wesley)
2. Bartle, R. G. (1976) Elements of Real Analysis (Wiley)
3. R. Agor (2015) Elements of Mathematical Analysis (Khanna Publications)
4. Rudin, W. (1985) Principles of Mathematical Analysis (McGraw - Hill)

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Paper: ADVANCED DATA STRUCTURE
Code: ADS 202
Contacts Hours / Week: 4T
Credits: 4

Objectives

The **course** is intended to provide the practical implementation and usage of **Algorithms** and **Data Structures**

Units	Course Content
1	Basic Concepts of OOPs – Templates Function and class templates – Algorithms: performance analysis: time complexity and space complexity– ADT – List (Singly–Doubly and Circular) Implementation – Array – Pointer – Cursor Implementation
2	Stacks and Queues – ADT– Implementation and Applications – Trees – General–Binary – Binary Search – Expression Search – AVL – Introduction to Red Black trees and Splay tree – B Trees – Implementations – Tree Traversals
3	Set – Implementation – Basic Operations on Set – Priority Queue – Implementation – Graphs – Directed Graphs – Shortest Path Problem – Undirected Graph – Spanning Trees – Graph Traversals:hash table representation: hash functions: collision resolution:separate chaining: open addressing:linear probing: quadratic probing: double hashing: rehashing
4	Issues – Managing Equal Sized Blocks – Garbage Collection Algorithms for Equal Sized Blocks – Storage Allocation for Objects with Mixed Sizes – Buddy Systems – Storage Compaction Searching Techniques – Sorting – Internal Sorting – Bubble Sort – Insertion Sort – Quick Sort – Heap Sort – Bin Sort – Radix Sort – External Sorting – Merge Sort – Multiway Merge Sort – Polyphase Sorting – Design Techniques – Divide and Conquer – Dynamic Programming – Greedy Algorithm – Backtracking – Local Search Algorithms

References Books:

1. Mark Allen Weiss, ―Data Structures and Algorithm Analysis in C++‖, Pearson Education, 2002.

2. Aho Hopcroft Ullman, ―Data Structures and Algorithms‖, Pearson Education, 2002.

3. Horowitz Sahni, Rajasekaran, ―Computer Algorithms‖, Galgotia, 2000.

4. Tanenbaum A.S, Langram Y, Augestien M.J., ‖Data Structures using C & C++‖, Prentice Hall of India, 2002.

5. Data structures, Algorithms and Applications in C++, S.Sahni, University Press (India) Pvt.Ltd, 2nd edition, Universities Press Orient Longman Pvt. Ltd.

6. Data structures and Algorithms in C++, Michael T.Goodrich, R.Tamassia and Mount, Wiley student edition, John Wiley and Sons.

7. Data structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.

8. Expert Data Structures with C++, R.B. Patel, Khanna Publishing House

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Paper: ROBOT MOTION PLANNING
Code: NWF 203
Contacts Hours / Week: 4T
Credits: 4

Objectives

The student will learn key concepts of robot motion generation: planning a motion for a robot in the presence of obstacles, and real-time feedback control to track the planned motion.

Units	Course Content
1	• Introduce basic robotic motion planning problems. • Provide students with a basic review of classical motion planning theory and an intro- duction to the most widely used classical motion planning algorithms. •Introduce sufficient terminology and concepts so that interested students can indepen- dently read the robotic motion planning research literature.
2	• Introduce the basic concepts behind sensor-based motion planning algorithms. • Expose students practical issues involved in implementing a planner via laboratories involving small mobile robots. •Extend the review of sensor-based planning algorithms studied in ME/CS 132.
3	• Review some of the basic sensor-processing issues and algorithms needed to process the outputs of typical robotic sensors. • Enable students to implement sensor-based planning algorithms on a mobile robot.
4	• Introduce and review the basic problems in robotic localization and mapping. • Review conventional estimation techniques (Kalman filter and Particle Filter) that un- derly localization and mapping algorithms. • Review estimation-based localizaton and mapping techniques. • Allow students to implement a significant robot motion planning project.

References Books:

1. Steven M. LaValle, Planning Algorithms, Cambridge University Press, 2006. 2. JeanClaude Latombe, Robot motion planning. Springer, 1990.

3. Choset, H., Lynch, K. M., Hutchinson, S., Kantor, G., Burgard, W., Kavraki, L. E., & Thrun, S. (2005). Principles of robot motion: theory, algorithms, and implementations. MIT press.

4. B. Siciliano, L. Sciavicco, L., Villani, G. Oriolo, Robotics: Modeling, Planning and Control, Springer, 2009.

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Paper: ADVANCED PROGRAMMING IN PYTHON
Code: ALD 203
Contacts Hours / Week: 3T
Credits: 3

Objectives

To enable the students to:
learn how to analyze data in Python using multi-dimensional arrays in numpy, manipulate DataFrames in pandas, use SciPy library of mathematical routines,

Units	Course Content
1	**Python Basic:** Python fundamental, working with data
2	**Importing Dataset** Domain, Dataset, Package for Data Science, Importing/Exporting Data, Insight from Dataset
3	**Cleaning and Preparing the Data** Identify and Handle Missing Values, Data Formatting, Normalisation, Binning
4	**Summarising the Data Frame** Descriptive Statstics, Grouping, ANOVA, Correlation
5	**Model Development** Linear Regression, Prediction and Decission making
6	**Data Vizualization** Introduction to Matplotlib, Basic plotting, Charts
7	**Artificial Libraries in Python** Introduction to TensorFlow, Sciket-learn and Theano

References

1. Advanced Machine Learning with Python, By John Hearty
2. Taming Python by Programming, By Jeeva Jose

Paper: BIG DATA TECHNOLOGY

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Code: ADS 204
Contacts Hours / Week: 3T
Credits: 3

Objectives

To enable the students to:
Learn about Big Data technologies and how they are useful to Artificial Intelligence.

Units	Course Content
1	**Bi Data Basic:** Data -- it's been around (even digitally) for a while. What makes data "big" and where does this big data come from?
2	**Big Data Dimensions of Scalability** You may have heard of the "Big Vs". We'll give examples and descriptions of the commonly discussed 5. But, we want to propose a 6th V and we'll ask you to practice writing Big Data questions targeting this V -- value
3	**Getting Value out of Big Data** We love science and we love computing, don't get us wrong. But the reality is we care about Big Data because it can bring value to our companies, our lives, and the world. In this module we'll introduce a 5 step process for approaching data science problems.
4	**Big Data Programming** Big Data requires new programming frameworks and systems. For this course, we don't programming knowledge or experience -- but we do want to give you a grounding in some of the key concepts.
5	**Getting Started with Hadoop** Let's look at some details of Hadoop and MapReduce. Then we'll go "hands on" and actually perform a simple MapReduce task in the Cloudera VM. Pay attention - as we'll guide you in "learning by doing" in diagramming a MapReduce task as a Peer Review.

References:

1. Big Data Fundamentals: Concepts Drivers: Concepts, Drivers and Techniques by Erl/Khattak/Buhler
2. A Simple Introduction to Data Science by Lars Nielsen and Noreen Burlingame
3. Big Data and Hadoop by V.K. Jain (Khanna Publishing House)

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Practical

Paper: Advance Python Lab
Code: ALP 291
Contacts Hours / Week: 2P
Credits: 2

Units	Course Content
1	Python fundamental, working with data, Domain, Dataset, Package for Data Science, Importing/Exporting Data, Insight from Dataset, Identify and Handle Missing Values, Data Formatting, Normalisation, Binning, Descriptive Statstics, Grouping, ANOVA, Correlation, Introduction to Matplotlib, Basic plotting, Charts, Introduction to TensorFlow, Sciket-learn and Theano

Paper: Robotics Lab
Code: ALP 292
Contacts Hours / Week: 2P
Credits: 2

Units	Course Content
1	Undertake kinematics analysis of robot manipulators Understand the importance of robot dynamics
2	Have an understanding of the functionality and limitations of robot actuators and sensors Understand and be able to apply a variety of techniques to solve problems in areas such as robot control and navigation
3	Describe different mechanical configurations of robot manipulators To be able to program a robot to perform a specified task (e.g obstacle avoidance or wall following) in a target environment.
4	Understand how simulations of robots work, where they can be useful and where they can break down. Appreciate the current state and potential for robotics in new application areas.
Reference Books: Learning Robotics Using Python Paperback – Import, 27 May 2015 by Lentin Joseph (Author)	