SARDAR PATEL UNIVERSITY

M Sc – Artificial Intelligence & Machine Learning

w.e.f. June 2024
3 Lectures & 1 Seminar/Tutorial per week
Total Marks: 100

PT02FAIM51: Systems Analysis, Design, and Software Engineering

Unit 1   System Analysis and Design -1
- The concept of a System, Basic Components
- Open and close systems
- Examples and categories of the systems such as TPS, MIS, DSS, etc.
- Phases of the Classical Systems Development Life Cycle (SDLC) Method

Unit 2   System Analysis and Design -2
- The Prototype methods
- The structured development approach using Functional Decomposition Diagram (FDD), Data Flow Diagram (DFD)
- Introduction to the Modern Approaches of Systems Development

Unit 3   Software Engineering - 1
- Software – meaning, general characteristics and applications
- Software Engineering – meaning, goal and needs
- Software Development Process Models – Waterfall, Iterative, Spiral, etc.

Unit 4   Software Testing
- Testing – meaning, importance and process
- Testing fundamentals – error, fault, bug, failure, test oracles, test
- cases and test criteria
- Introduction to Black-box (functional) testing and White-box (structural) testing
- Alpha testing and Beta testing
- Special system tests

MAIN REFERENCE BOOKS:
1. Jalote Pankaj : Integrated Approach to Software Engineering, 3rd Edition, Narosa Publishing House, 2005 (ISBN 978-81-7319-702-4).
2. Rojerer S. Pressman : Software Engineering, A Practice Approach, 6th Edition, McGraw Hill International Edition, Fifth Reprint 2012.
3. Sajja, P.S. "Essence of Systems Analysis and Design: A Workbook Approach", Springer International Publishing, Singapore, 2017.
4. Rajib Mall : Fundamentals of Software Engineering, 2nd Edition, Prentice-Hall of India, 2006.

M Sc – Artificial Intelligence & Machine Learning

PT02CAIM52: Machine Learning

Unt 1   **Introduction**
- Introduction and motivation for machine learning;
- Examples of machine learning applications
- Types of machine learning techniques
- Working with Datasets
- Data pre-processing techniques
- Feature Engineering

Unit 2   **Regression Models**
- Linear Regression
- Logistic Regression
- Support Vector Regression
- Decision Trees
- Fitting datasets and evaluating their performance set
- Making predictions on new data

Unit 3   **Supervised Machine Learning (Classification Techniques)**
- K-Nearest Neighbor
- Support Vector Machine
- Decision tree Classification
- Train/test split, Confusion matrix for evaluation
- Class probabilities and class predictions, ROC Curve: Plot and Interpret

Unit 4   **Unsupervised Machine Learning (Clustering and other applications)**
- K-means clustering
- Hierarchical and Density Based Clustering (DB Scan)
- Fuzzy c means clustering
- Dimensionality Reduction and PCA

MAIN REFERENCE BOOKS:

1. Rajendra Akerkar, Priti Srinivas Sajja, Intelligent Techniques for Data Science, Springer International Publishing, 2016
2. Burkov, A. (2019). The hundred-page machine learning book (Vol. 1, p. 32). Quebec City, QC, Canada: Andriy Burkov.
3. Gollapudi, S. (2016). Practical machine learning. Packt Publishing Ltd.
4. Bonaccorso, G. (2017). Machine learning algorithms. Packt Publishing Ltd.
5. Raschka, S., & Mirjalili, V. (2019). Python machine learning: Machine learning and deep learning with Python, scikit-learn, and TensorFlow 2. Packt Publishing Ltd.

M Sc – Artificial Intelligence & Machine Learning

PT02CAIM53: Python Programming - 2

Unit 1 **Python Programming**
- The Zen of Python
- Common idioms
- Lambda functions
- List comprehensions
- Generator expressions

Unit 2 **Meta Programming and Analysis**
- Implicit properties
- globals() and locals() and Attributes
- The inspect module
- Decorators
- Monkey patching
- Analyzing programs Using pylint and unittest
- Testing and Debugging

Unit 3 **Database access using python**
- The DB API
- Available Interfaces
- Connecting to a server
- Creating and executing a cursor
- Fetching data
- Parameterized statements
- Metadata
- Transaction control

Unit 4 **Advance python application in deep learning and neural network**
- Implementation of forward propagation algorithm.
- Coding of various activation functions like linear, triangular, trapezoidal etc
- Coding of deep learning network with suitable examples.
- Implementing supervised and un-supervised neural networks using python.

MAIN REFERENCE BOOKS:

1. Python: The Complete Reference by Martin C. Brown, McGraw Hill Education; Forth edition, 2018
2. Python Machine Learning By Example by Yuxi (Hayden) Liu, Packt Publishing Limited, 2017.
3. Python Cookbook, Third edition by David Beazley and Brian K. Jones, O'REILLY publication, 2013
4. Data Structure and Algorithmic Thinking with Python by NarasimhaKarumanchi, Careermonk Publications, 2015.

M Sc – Artificial Intelligence & Machine Learning

PT02CAIM54: R Programming

Unit 1 Introduction
- Introduction to R and RStudio. Using the help facility.
- Data structures: vectors, matrices, lists and data frames.
- Reading data into R from various data sources.
- Merging data across data sources.
- Exploratory data analysis and graphical displays.

Unit 2 Descriptive Statistics & Intro to Probability
- Samples, measures of center and spread, percentiles, odds ratio.
- Outliers and robustness.
- Independence, conditional probability, Bays formula.
- Distributions, population mean and population variance, Binomial, Poisson, and Normal distribution.
- Central Limit theorem and the Law of large numbers.
- Continuity correction.
- Sampling with and without replacement.
- Correction for finite population size

Unit 3 R: Statistical Inference
- Significance and confidence level, p-value.
- One-sided and two-sided tests and confidence intervals.
- Sampling distribution, estimators, standard error.
- Normal probabilities in application to p-value.
- One-sample and two-sample tests for independent and matched samples
- The case of unknown variance and Student t-distribution, assumption of normality.
- Pooled variance and equal variances assumption.
- Estimation of variance.
- Fisher test for variance equality.
- Chi-square test for goodness of fit, chi-square test for independence.
- Sample size estimation.
- The concept of hypothesis testing, type I and type II error, false discovery rate.
- Iterating with simulation

Unit 4 Statistical and Data Mining techniques using R
- Simple linear regression model, residuals, degrees of freedom, least squares method, correlation coefficient, variance decomposition, determination coefficient
- Interpretation of the slope, correlation, and determination

coefficients
- Standard error and statistical inference in simple linear regression model
- Analysis of variance (ANOVA). One-way and two-way ANOVA
- Beyond simple regression models: multiple regression, logistic regression
- Correction for multiple testing, Family-wise error rate distribution, Test of Hypothesis of Small and Large Samples- Standard Normal distribution, Chi-square distribution, Student's t distribution, F distribution, Analysis of Variance
- Applications in data mining and case studies

MAIN REFERENCE BOOKS:

1. Biostatistics (9 Ed.) by Wayne W. Daniel, Wiley 2004.
2. Schaum's Outlines - Introduction to Probability and Statistics by Seymour Lipschutz and John Schiller., TATA McGraw-Hill edition. 1998.
3. Statistical Methods by N. G. Das, Vol: I and II., The McGraw-Hill Companies. 2009.
4. Fundamentals of Biostatistics (6th Ed.), Bernard Rosner., Thomson Brooks/Cole. 2006.
5. Colin Gillespie, Robin Lovelace, Efficient R Programming: A Practical Guide to Smarter Programming, O'reilly Media, Inc, 2016

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PT02CAIM55: Practicals based on theory subjects

M Sc – Artificial Intelligence & Machine Learning

PT02EAIM56: Web Technology

Unit 1 HTML and CSS (Cascading Style Sheet)
- Introduction of HTML, HTML Tags
- Heading, linking, Images
- Special character and Horizontal Rules, Lists, Internal Linking, Meta Elements
- Designing HTML Tables, Forms and Webpage layout
- Introduction to CSS, Features of CSS
- CSS Selectors
- Attributes of CSS: Font attributes, Color and Background attributes, Text attributes, Border attributes, Margin attributes, Padding attributes, Font attributes, List attributes, Table attributes

Unit 2 JavaScript
- Introduction, Writing JavaScript into HTML, Data Types and Literal, Type Casting, Creating Variable, Incorporating Variables in a JavaScript, JavaScript Array, Operators and Expressions in JavaScript, Special Operators, Constructor, Condition Checking, Endless Loop.
- Functions and Dialog: Functions in JavaScript, User Define Function, Dialog Boxes, Document Object Model, Built in objects in JavaScript.
- Events of JavaScript.
- Browser Object Model: Windows, Location, History, Screen, Navigator
- Built in Function: String built in functions, Date Built in functions, Mathematical Built in functions.

Unit 3 Servlet Programming
- Introduction of Web Application: Web Client and Web Server
- HTTP protocol basics
- Tomcat as a Web Container
- Web application project structure
- Servlets basics
- Servlet Life Cycle
- Steps to create a servlet in Tomcat
- HTTP Methods
- Servlet Collaboration and Configuration:
- Request Dispatcher
- Send Redirect
- Servlet Config
- Servlet Context
- Working with attributes

- Session Management

Unit 4   Java Server Pages (JSP)
- Life cycle of JSP
- JSP API
- Scriptlet tag
- Expression tag
- Declaration tag
- JSP objects and Directives
- Implicit Objects
- Directive Elements
- Action Elements

Reference Books:
1. JavaScript Bible by Danny Goodman, Michael Morrison, Paul Novitski, Tia Gustaff'Rayi, WILEY Publication
2. Web Enabled Commercial Application Development Using Html, Javascsript, Dhtml & Php by Ivan Bayross
3. Java Servlet Programming by Jason Hunter, William Crawford, O'reily Publication
4. Head First Servlet and JSP by Bryan Basham, Kathy Sierra, Bert Bates. O'reily Publication
5. HTML5 and CSS3 Made Simple by Ivan Bayross BPB Publication.

M Sc – Artificial Intelligence & Machine Learning

PT02EAIM57: Natural Language Processing

Unit 1   **Introduction to Natural Language Processing**
- Natural Language Processing - Problems and perspectives
- Human languages, models, ambiguity, processing paradigms; Phases in natural language processing
- Applications.

Unit 2   **Linguistics resources and Processing of Text**
- Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc., Management of linguistic data with the help of NLTK.
- Regular expressions, Finite State Automata, word recognition, lexicon. Morphology, acquisition models, Finite State Transducer, N-grams, smoothing, entropy, HMM, ME, SVM, CRF.

Unit 3   **Part of Speech tagging and Parsing**
- Stochastic POS tagging, HMM
- Transformation based tagging (TBL)
- Handling of unknown words, named entities, multi-word expressions
- Parsing- Unification, probabilistic parsing, TreeBank.

Unit 4   **Semantics and Discourse**
- Semantics- Meaning representation, semantic analysis, lexical semantics, WordNet**,** Word Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary-based approaches.
- Discourse- Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure.

MAIN REFERENCE BOOKS:
1. Daniel and Martin J. H., "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2009.
2. Manning C. D. and Schutze H., "Foundations of Statistical Natural Language processing", First Edition, MIT Press, 1999
3. Allen J., "Natural Language Understanding", Second Edition, Pearson Education, 2003.