RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Information Technology, VIII- semester

Departmental Elective IT 802 (A) Machine Learning

Course Objectives:
To familiarize students with the knowledge of machine learning and enable them to apply suitable machine learning techniques for data handling and to gain knowledge from it. Evaluate the performance of algorithms and to provide solution for various real-world applications.

Unit I Introduction:
Introduction, Examples of various Learning Paradigms, Perspectives and Issues, Concept Learning, Version Spaces, Finite and Infinite Hypothesis Spaces, PAC Learning, VC Dimension

Unit II Supervised Learning Algorithms:
Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Decision Trees: ID3, Classification and Regression Trees (CART), Regression: Linear Regression, Multiple Linear Regression, Logistic Regression, Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and NonLinear, Kernel Functions, K-Nearest Neighbors

Unit III Ensemble Learning:
Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking

Unit IV Unsupervised Learning:
Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional: K-means clustering, K-Mode Clustering, Self-Organizing Map, Expectation Maximization, Gaussian Mixture Models, Principal Component Analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis

Unit V Probabilistic Learning:
Bayesian Learning, Bayes Optimal Classifier, Naïve Bayes Classifier, Bayesian Belief Networks, Mining Frequent Patterns

References:

1. EthemAlpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.
2. MehryarMohri, AfshinRostamizadeh, AmeetTalwalkar "Foundations of Machine Learning", MIT Press, 2012.
3. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.
4. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014.

5. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, 2nd Edition, CRC Press, 2015.
6. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012
7. Jiawei Han and MichelineKambers and Jian Pei, “Data Mining –Concepts and Techniques”, 3rd Edition,Morgan Kaufman Publications, 2012.
8. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, “Mathematics for Machine Learning”, Cambridge University Press, 2019.

Course Outcomes:

After the completion of this course, the students will be able to:

1. Recognize the characteristics of machine learning strategies.
2. Apply various supervised learning methods to appropriate problems.
3. Identify and integrate more than one technique to enhance the performance of learning.
4. Create probabilistic and unsupervised learning models for handling unknown pattern.
5. Analyze the co-occurrence of data to find interesting frequent patterns and Preprocess the data before applying to any real-world problem and can evaluate its performance

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Information Technology, VIII- semester

Departmental Elective IT 802 (B) Natural Language Processing

Course Objectives:
To provide a broad introduction to NLP with a particular emphasis on core algorithms, data structures, and machine learning for NLP.

Unit I

Introduction to various levels of natural language processing, Ambiguities and computational challenges in processing various natural languages. Introduction to Real life applications of NLP such as spell and grammar checkers, information extraction, question answering, and machine translation

Unit II

Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis

Unit III

Inflectional and Derivation Morphology, Morphological Analysis and Generation using finite state transducers

Introduction to word types, POS Tagging, Maximum Entropy Models for POS tagging, Multi-word Expressions.

Unit IV

The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models.

Introduction to phrases, clauses and sentence structure, Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, Word Sense Disambiguation, WordNet, Thematic Roles, Semantic Role Labelling with CRFs.

Unit V

NL Interfaces, Text Summarization, Sentiment Analysis, Machine Translation, Question answering, Recent Trends in NLP

References:
1. J. H. Speech and Language Processing, Jurafsky, D. and Martin, Prentice Hall, 2nd Edition, 2014

2. C. D. and H. Schütze: Foundations of Statistical Natural Language Processing, Manning, The MIT Press

Course Outcomes:
After the completion of this course, the students will be able to:

1. Identify and discuss the characteristics of different NLP techniques
2. Understand the fundamental mathematical models and algorithms in the field of NLP and apply these mathematical models and algorithms in applications in software design and implementation for NLP
3. Understand the complexity of speech and the challenges facing speech engineers
4. Understand approaches to syntax and semantics in NLP
5. Understand approaches to discourse, generation, dialogue and summarization within NLP

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New Scheme Based On AICTE Flexible Curricula

Information Technology, VIII- semester

Departmental Elective IT 802 (C) Robotics

Course Objectives:
The objective of this course is to impart knowledge about industrial robots for their control and design.

Unit I Introduction to Robotics:
Types and components of a robot, Classification of robots, closed-loop and open-loop control systems;
Kinematics systems: Definition of mechanisms and manipulators, Social issues and safety

Unit II Robot Kinematics and Dynamics:
Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Jacobian, Singularity, and Statics;
Dynamic Modelling: Equations of motion: Euler-Lagrange formulation

Unit III Sensors and Vision System:
Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc.
Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations, Vision applications in robotics.

Unit IV Robot Control:
Basics of control: Transfer functions, Control laws: P, PD, PID, Non-linear and advanced controls
Robot Actuation Systems: Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.

Unit V Control Hardware and Interfacing:
Embedded systems: Architecture and integration with sensors, actuators, components, Programming for Robot Applications

References:

1. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.
2. Ghosal, A., "Robotics", Oxford, New Delhi, 2006.
3. Niku Saeed B., "Introduction to Robotics: Analysis, Systems, Applications", PHI, New Delhi.
4. Mittal R.K. and Nagrath I.J., "Robotics and Control", Tata McGraw Hill.
5. Mukherjee S., "Robotics and Automation", Khanna Publishing House, Delhi.
6. Craig, J.J., "Introduction to Robotics: Mechanics and Control", Pearson, New Delhi, 2009
7. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, "Robot Modelling and Control", John Wiley and Sons Inc, 2005
8. Steve Heath, "Embedded System Design", 2nd Edition, Newnes, Burlington, 2003

9. Merzouki R., Samantaray A.K., Phathak P.M. and Bouamama B. Ould, “Intelligent Mechatronic System: Modeling, Control and Diagnosis”, Springer.

Course Outcomes:

After the completion of this course, the students will be able to:

1. Understand robot mechanism
2. Perform kinematic and dynamic analyses with simulation
3. Design control laws for a robot
4. Integrate mechanical and electrical hardware for a real prototype of robotic device
5. Select a robotic system for given application

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New Scheme Based On AICTE Flexible Curricula

Information Technology, VIII- semester

Departmental Elective IT 802 (D) Quantum Computing

Course Objectives:
The objective of this course is to impart necessary knowledge to the learner so that he/she can develop and implement algorithm and write programs using these algorithm

Unit I
Motivation for studying Quantum Computing , Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.), Origin of Quantum Computing
Overview of major concepts in Quantum Computing: Qubits and multi-qubits states, Braket notation, Bloch Sphere representation, Quantum Superposition, Quantum Entanglement

Unit II
Math Foundation for Quantum Computing: Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors

Unit III
Building Blocks for Quantum Program: Architecture of a Quantum Computing platform,
Details of q-bit system of information representation: Block Sphere, Multi-qubits States, Quantum superposition of qubits (valid and invalid superposition), Quantum Entanglement, Useful states from quantum algorithmic perceptive e.g. Bell State, Operation on qubits: Measuring and transforming using gates.
Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlled gates, Ising, Deutsch, swap etc.

Unit IV
Programming model for a Quantum Computing Program: Steps performed on classical computer, Steps performed on Quantum Computer, Moving data between bits and qubits.
Basic techniques exploited by quantum algorithms, Amplitude amplification, Quantum Fourier Transform, Phase Kick-back, Quantum Phase estimation, Quantum Walks

Unit V
Major Algorithms: Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch -Jozsa Algorithm OSS Toolkits for implementing Quantum program: IBM quantum experience, Microsoft Q, Rigetti PyQuil (QPU/QVM)

References:

1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.
2. David McMahon, "Quantum Computing Explained", Wiley

Course Outcomes:

After the completion of this course, the students will be able to:

1. Understand major concepts in Quantum Computing
2. Explain the working of a Quantum Computing program, its architecture and program model
3. Develop quantum logic gate circuits
4. Develop quantum algorithm
5. Program quantum algorithm on major toolkits