

Review: Review of Basic Sorting and Searching Algorithms, Greedy Algorithms Divide & Conquer and Dynamic Programming.

Augmentation: Maximum Flow and Min Cut Problems, Matching in bipartite graphs, Minimum weight matching.

String Processing: Finite Automata method, KMP.

Randomized algorithms: Introduction to Random numbers, randomized Qsort, randomized selection, randomly built BST, randomized min-cut.

Parallel Algorithms: Shared Memory Model, Distributed Memory Model, Speedup. Searching, sorting, selection, matrix-vector multiplication, prefix-sum.

Linear Programming: Formulating an LP, Feasible region and Convex Polyhedron, Simplex Algorithm, LP-rounding to obtain integral solutions, Primal-Dual Algorithm.

Introduction to Complexity Classes: Classes P, NP - Verifiability, NP-Hard - Reducibility, NP Complete.

Introduction to Approximation Algorithms.

Readings

1. J. Kleinberg and E.Tardos, "Algorithm Design", 1st Edition 2013., Pearson Education India,
2. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, "Algorithms", 1st Edition, 2017, Tata McGraw Hill.
3. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, "Introduction to Algorithms", 3rd Edition, 2010, Prentice-Hall of India Learning Pvt. Ltd.
4. Vijay V. Vazirani, "Approximation Algorithms", 2013, Springer.
5. Bernhard Korte and Jens Vygen, "Combinatorial Optimization: Theory and Algorithms (Algorithms and Combinatorics)", 6th edition, 2018, Springer.
6. Rajeev Motvani and Prabhat Raghavan, 2004, Cambridge University Press.

MCSC102: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING [3-0-1]

Course Objectives: Beginning with a comprehensive overview of the AI techniques, the course introduces the supervised and unsupervised ML techniques, alongwith their applications in solving real-world problems. The course also covers evaluation and validation methods for ML models.

Course Learning Outcomes:

On successful completion of this course, the student will be able to:

CO1: discuss Turing Test, and various methods of knowledge representation as applicable to a given context.

CO2: design and implement supervised and unsupervised machine learning algorithms for real-world applications while understanding the strengths and weaknesses.

CO3: analyse the computational complexity of various machine learning algorithms.

CO4: fine tune machine learning algorithms and evaluate models generated from data.

Syllabus:

Unit-I Introduction to Artificial Intelligence: Evolution of AI as a discipline, Definitions and approaches, Subject matter of AI, Foundations of AI, Philosophical issues, AI for all, Ethical Issues and Responsible AI.

Unit-II Introduction to Machine Learning: Hypothesis and target class, bias-variance tradeoff, Occam's razor, Approximation and estimation errors, Curse of dimensionality, dimensionality reduction, feature scaling, feature selection methods.

Unit-III Regression: Linear regression with one variable, Linear regression with multiple variables, Gradient Descent, Logistic Regression, Polynomial regression, over-fitting, regularization. performance evaluation metrics, validation methods.

Unit-IV Classification: Decision trees, Naive Bayes classifier, Perceptron, multilayer perceptron, Neural network, back-propagation Algorithm, Support Vector Machine, Kernel functions.

Unit V Evaluation: Performance evaluation metrics, ROC Curves, Validation methods, Bias-variance decomposition, Model complexity.

Unit-VI Unsupervised Learning: Clustering, distance metrics, Mixture models, Expectation Maximization, Cluster validation methods.

Readings:

1. Alpaydin, Ethem, **Introduction to machine learning**, MIT press, 2014.
2. T. M. Mitchell, Machine Learning, McGraw Hill Education, 2017.
3. Christopher, M. Bishop, **Pattern Recognition And Machine Learning**, Springer-Verlag, 2016.
4. Shai Shalev-Shwartz, Shai Ben-David, **Understanding Machine Learning: From Theory to Algorithms**, Cambridge Press, 2014.
5. Michalski, Ryszard S., Jaime G. Carbonell, and Tom M. Mitchell, eds. **Machine learning: An artificial intelligence approach**, Springer Science & Business Media, 2013.

MCSC103: INFORMATION SECURITY [3-0-1]

Course Objectives: The course aims to train the students to maintain the confidentiality, integrity and availability of data. The student learns various data encryption protocols for transmitting data over unsecured channels in a network.

Course Learning Outcomes: