

MCAE506: ARTIFICIAL INTELLIGENCE [4-1-0]

Unit-I Introduction: Introduction to Artificial Intelligence, various definitions of AI, AI Applications and Techniques, Turing Test and Reasoning - forward & backward chaining.

Unit-III Intelligent Agents: Introduction to Intelligent Agents, Rational Agent, their structure, , reflex, model-based, goal-based, and utility-based agents, behavior and environment in which a particular agent operates.

Unit-IV Problem Solving and Search Techniques: Problem Characteristics, Production Systems, Control Strategies, Breadth First Search, Depth First Search, iterative deepening, uniform cost search, Hill climbing and its Variations, simulated annealing, genetic algorithm search. Heuristics Search Techniques: Best First Search, A* algorithm, AO* algorithm, Minmax & game trees, refining minmax, Alpha – Beta pruning, Constraint Satisfaction Problem, Means-End Analysis.

Unit-V Knowledge Representation: Introduction to First Order Predicate Calculus, Resolution Principle, Unification, Semantic Nets, Conceptual Dependencies, semantic networks, Frames system, Production Rules, Conceptual Graphs, Ontologies.

Unit-VI Planning: Basic representation for planning, symbolic-centralized vs reactive-distributed, partial order planning algorithm.

Unit-VII Reasoning with Uncertain Knowledge: Different types of uncertainty - degree of belief and degree of truth, various probability constructs - prior probability, conditional probability, probability axioms, probability distributions, and joint probability distributions, Bayes' rule, other approaches to modeling uncertainty such as Dempster-Shafer theory and fuzzy sets/logic.

Unit-VIII Understanding Natural Languages: Components and steps of communication, contrast between formal and natural languages in the context of grammar, parsing, and semantics, Parsing Techniques, Context-Free and Transformational Grammars

Readings:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 3rd edition, Pearson Education.
2. Elaine Rich and Kelvin Knight, Artificial Intelligence, 3rd edition, Tata McGraw Hill , 2017.
3. DAN.W. Patterson, Introduction to A.I. and Expert Systems – PHI, 2007.
4. Michael Wooldridge, An Introduction to MultiAgent Systems, 2nd edition, John Wiley & Sons, 2009.
5. Fabio Luigi Bellifemine, Giovanni Caire, Dominic Greenwood, Developing Multi-Agent Systems with JADE, Wiley Series in Agent Technology, John Wiley & Sons, 2007.
6. W.F. Clocksin and C.S. Mellish, Programming in PROLOG, , 5th edition, Springer, 2003.
7. Saroj Kaushik, Logic and Prolog Programming, New Age International Publisher, 2012.
8. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison-Wesley, Pearson Education, 4th edition, 2011.

MCAE505: NEURAL NETWORKS [4-1-0]

Unit-I Introduction: Neuron as basic unit of neurobiology, McCulloch-Pitts model, Hebbian Hypothesis; limitations of single-layered neural networks.

Unit-II Supervised Learning: Single-layered neural networks, perceptron rule, review of gradient descent algorithms; multi-layered neural networks: first order methods, backpropagation algorithm, second order methods, modelling sequences using recurrent neural networks, Hopfield networks, Boltzmann machines, restricted Boltzmann machines.

Unit-III Kernel methods and support vector machines: soft margin techniques.

Readings:

1. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2010.
2. Simon O. Haykin, Neural Networks and Learning Machines, Pearson Education, 2016

MCAE507: MACHINE LEARNING [4-1-0]

Unit-I Introduction: Learning theory, Hypothesis and target class, Inductive bias and bias-variance tradeoff, Occam's razor, Limitations of inference machines, Approximation and estimation errors, Curse of dimensionality, dimensionality reduction, feature scaling, feature selection methods.

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

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

Unit IV Evaluation: Performance evaluation metrics, ROC Curves, Validation methods, Biasvariance decomposition, Model complexity.

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

Readings:

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