CS208	Artificial Intelligence	L	T	P
		3	1	0

Introduction: Definitions and Approaches, History of AI, Philosophical Foundations of AI, Turing's Test, Searle's Chinese Room, Symbolic and Connectionist AI, Concept of Intelligent Agents.

AI Problem Solving: Problem solving as state space search, production system, control strategies and problem characteristics; Search techniques: Breadth First and Depth-first, Hill-climbing, Heuristics, Best-First Search, A* algorithm, Problem reduction and AO* algorithm, Constraints satisfaction, Means Ends Analysis, Game Playing.

Knowledge Representation and Reasoning: Predicate and prepositional logic, Resolution, Unification, Deduction and theorem proving, Question answering; Forward versus backward reasoning, Matching, Indexing, Semantic Net, Frames, Conceptual Dependencies and Scripts.

Applications: Introduction to Natural Language Processing, Expert System.

Suggested Readings:

1. S. Russel, P. Norvig, Artificial Intelligence: A Modern Approach, Pearson.
2. E. Rich, K. Knight, Artificial Intelligence, Tata McGraw Hill.
3. N. J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann.

CS203	**Design and Analysis of Algorithms**	L	T	P
		3	0	1

Introduction to Algorithms: Time and space complexity, average and worst-case analysis, asymptotic notation, recurrence equations and their solution.

Algorithmic Techniques: Search techniques (backtracking and bounding), Search Trees, Sorting algorithms – heapsort, quick sort, sorting in linear time (counting sort, radix sort, bucket sort), Greedy algorithms (Activity-selection problem, Huffman coding, knapsack, shortest path and minimum spanning tree in graphs), Divide and conquer – Merge Sort, Integer Multiplication, Solving Recurrence-substitution method and recursion-tree, master theorem; Dynamic programming (0/1 knapsack, Traveling salesman problem, matrix multiplication, all-pairs shortest paths, longest common subsequence, optimal binary search trees).

Computational complexity: Problem classes: P, NP, NP-complete, NP-hard. Reduction. Examples of NP-complete problems.

Suggested Readings:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest , C. Stein, Introduction to Algorithms, PHI.
2. M. A. Weiss, Data Structures and Problem Solving Using Java, Addison Wesley.
3. A. Aho, V. Alfred, J. Hopcroft, J. D. Ullman, The Design and Analysis of Computer Algorithms, Addison Wesley.

CS341	**Image Processing**	L	T	P
		2	1	1

Digital Image Fundamental: Elements of Visual Perception- Structure of the human eye, Image formation in the eye, brightness adaptation and discrimination; light and electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, basic relationships between pixels, linear and nonlinear operations.

Image Enhancement:Point processing: Contrast stretching, power-law and gamma transformation. Histogram processing: histogram equalization and matching.

Filtering and Restoration:Degradation function and Noise Models, Spatial Domain Filtering: Correlation and Convolution, Smoothing Linear and Nonlinear Filters: Mean and Median Filters, Adaptive Filtering, Sharpening Linear and Nonlinear Filters: Derivative, Laplacian, Unsharp Masking, High-boost Filtering. Frequency Domain Filtering: Filtering: Low-pass (Smoothing) & High-Pass (Sharpening) Ideal, Butterworth and Gaussian Filtering, Unsharp Masking and High-Boost Filtering, Homomorphic Filtering, Periodic Noise Reduction and Inverse Filtering & Wiener Filtering.

Image Reconstruction from Projections: Transmission tomography, reflection tomography, emission tomography, magnetic resonance imaging, and projection based image processing. Radon transform, back projection operator, projection theorem, inverse radon transform, convolution filter back projection, reconstruction from blurred noisy projections, Fourier reconstruction, fan-beam reconstruction, algebraic methods and three dimensional tomography.

Image Compression: Introduction, Error criterion- objective and subjective criterion; Lossy compression- transform domain compression, JPEG compression, block truncation compression, vector quantization compression; Lossless compression- Huffman coding, arithmetic coding, transformed coding, run-length coding, block coding, quad tree coding, and contour coding.

Suggested Readings:

1. A. K. Jain, Fundamentals of Digital Image Processing, Pearson Education India, 2015.
2. Rafael Gonzalez, Richard Woods, Digital Image Processing, Pearson Education India, 2017.
3. R. H. Vollmerhausen, R.G. Driggers, Analysis of Sampled Imaging Systems, SPIE Press, 2001.
4. B. Chanda, D. D. Majumder, Digital Image Processing and Analysis, PHI, 2011.
5. A. C. Bovik, Handbook of Image and Video Processing (Communications, Networking & Multimedia). Academic Press, 2005.
6. J. S. Lim, Two Dimensional Signal and Image Processing, Prentice-Hall, Englewood Cliffs, New Jersey, 1989.
7. D. E. Dudgeon, Russell M. Mersereau, Multidimensional Signal Processing, Prentice Hall, 1983.
8. S. G. Wilson, Digital Modulation and Coding, Pearson Education, 2003.

CS322	Deep Learning	L	T	P
		2	1	1

Linear Algebra Review: Brief review of concepts from Linear Algebra.

Optimization: Types of errors, bias-variance tradeoff, overfitting-underfitting, a brief review of concepts from Vector Calculus and optimization, variants of gradient descent, momentum.

Logistic Regression: Basic concepts of regression and classification problems, linear models addressing regression and classification, maximum likelihood, logistic regression classifiers.

Neural Networks: Basic concepts of artificial neurons, single and multilayer perceptrons, perceptron learning algorithm, its convergence proof, different activation functions, softmax cross-entropy loss function.

Recurrent Neural Networks: Discussion on Recurrent Neural Networks (RNNs), Long- Short, Term Memory (LSTM) architectures, and basics of word embedding.

Deep Reinforcement Learning, Autoencoders (standard, denoising, contractive, etc).

ConvNets: Basic concepts of Convolutional Neural Networks starting from filetering. Convolution and pooling operation and arithmetics of these.

ConvNet Architectures: Discussions on famous convnet architectures - AlexNet, ZFNet, VGG, C3D, GoogLeNet, ResNet, MobileNet-v1.

Suggested Readings:

1. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016. (http://www.deeplearningbook.org)
2. M. A. Nielsen, Neural networks and deep learning. Vol. 2018, Determination press, 2015.,Determination press San Francisco, CA.
3. F. Chollet. Deep Learning with Python, Manning, 20117.
4. H. Jones, Deep Learning: An Essential Guide to Deep Learning for Beginners Who Want to Understand How Deep Neural Networks Work and Related to Machine Learning and Artificial Intelligence, Createspace Independent Publishing, 2018.