VEER MADHO SINGH BHANDARI
UTTARAKHAND TECHNICAL UNIVERSITY DEHRADUN

Specialization/Minor

in

Artificial Intelligence & Machine Learning

EFFECTIVE FOR 2021-22 BATCH

2ND YEAR TO 4TH YEAR

Eligible Branches to adopt as Specialization

1. B.Tech.- Computer Science & Engineering

2. B.Tech.- Electronics and Communication Engineering

3. B.Tech.- Electronics Engineering

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Evaluation Schemes for Specializations/minor in B.Tech.

Specialization in Artificial Intelligence & Machine Learning										
SN	Code	Sem	Subject	Periods			Evaluation Scheme		Total Marks	Credits
				L	T	P	Internal	External		
1.	SAI301	3rd	Machine Learning and Pattern Recognition	3	0	0	50	100	150	3
2.	SAI401	4th	Deep Machine Learning With Visual Computing	3	0	0	50	100	150	3
3.	SAI501	5th	Principles of Deep Learning	3	0	0	50	100	150	3
4.	SAI601	6th	Neuro-Fuzzy Techniques	3	0	0	50	100	150	3
5.	SAI701	7th	Information Retrieval	3	0	0	50	100	150	3
6.	SAI801	8th	Computer Vision	3	0	0	50	100	150	3
			Total	**18**	**0**	**0**	**300**	**600**	**900**	**18**

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SAI301	MACHINE LEARNING AND PATTERN RECOGNITION	L	T	P	C
		3	0	0	3

Contents		Hours
Unit 1	Foundation of Artificial Intelligence and machine learning, intelligent autonomous system,Learning problem characterization, Decision tree, Bayes belief network, Artificial neural network.	8
Unit 2	Genetic algorithm, logic programming, Symbolic representation of weak theories, Explanation based learning, Reinforcement learning, Case-based reasoning, Support vector machine, Principle Component Analysis (PCA).	8
Unit 3	Introduction to pattern recognition, Structure of typical pattern recognition system, Decision functions and their implementation, Feature vector and feature space, Method of feature selection and extraction, Clustering techniques.	8
Unit 4	Distance function for pattern classification, C-means iterative algorithm, Pattern classification by statistical function, Fuzzy classifier, Neural classifier, Applications of pattern recognition.	8

Suggested Readings :

1.   **Artificial Intelligence and Machine Learning, By Vinod Chandra S.S., Anand Hareendran S.**
2.   **Basics of Artificial Intelligence & Machine Learning, by Dr Dheeraj Mehrotra.**
3.   **Artificial Intelligence, By Rajiv Chopra**

SAI401	DEEP MACHINE LEARNING WITH VISUAL COMPUTING	L	T	P	C
		3	0	0	3

Contents		Hours
Unit 1	Introduction to Tensorflow and machine learning, Cost function, Gradient descent, Variations of gradient descent, Model selection and evaluation, Introduction to tensor, Building data pipelines for Tensorflow, Text processing with Tensorflow, Classify images, Underfitting and overfitting.	8
Unit 2	Convolution neural network, Transfer learning with pertained CNN. Recurrent Neural Network,Text Generation with RNN, Tensorflow customization, Tensorflow distributed training.	10
Unit 3	Introduction of visual computing, Feature extraction for visual computing, Neural network, classification with perceptron model, Deep learning with neural network, classification with multilayer perceptron, Autoencoder, MNIST handwritten digits classification using autoencoders,Stacked autoencoders, denoising and sparse autoencoders, classification cost function, SGD and ADAM learning rules, convolutional neural network building block.	8
Unit 4	LeNET, AlexNet model,VGGNet model, Revisiting AlexNet and VGGNet for computational complexity, ResNet, DenseNet, GoogleNet, Space and computational complexity in DNN, Transfer learning a GoogleNet, Transfer learning a ResNet, Activation pooling for object detection.	10
Unit 5	Region Proposal Networks, Semantic segmentation with CNN, Adversarial autoencoder for classification.	9

Suggested Readings :
1. **Deep Learning and Artificial Intelligence: A Beginners' Guide to Neural Networks and Deep Learning, By John Slavio**
2. **Introduction to Deep Learning: From Logical Calculus to Artificial Intelligence By Sandro Skansi.**
3. **MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial,   By Phil Kim**

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SAI501	PRINCIPLES OF DEEP LEARNING	L	T	P	C
		3	0	0	3

Contents		Hours
Unit 1	Intro to neural networks cost functions, hypotheses and tasks; training data; maximum likelihood, based cost, cross entropy, MSE cost; feed-forward networks; MLP, sigmoid units; neuroscience, inspiration; Learning in neural networks output vs hidden layers; linear vs nonlinear networks.	8
Unit 2	Backpropagation learning via gradient descent; recursive chain rule (backpropagation); if time:Bias-variance tradeoff, regularization; output units: linear, soft max; hidden.	12
Unit 3	Deep learning strategies I (e.g., GPU training, regularization,etc); project proposals, Deep learning strategies II (e.g., RLUs, dropout, etc) SCC/TensorFlow overview How to use theSCC cluster; introduction to Tensorflow. CNNs I Convolution neural networks.	8
Unit 4	Deep Belief Nets I probabilistic methods RNNs I Recurrent neural networks Other DNN variants(e.g. attention, memory networks, etc.), Neural Turing Machines(Kate)	8
Unit 5	Unsupervised deep learning Unsupervised deep learningI, Unsupervised deep learning II (e.g. deep generative models etc.), Deep reinforcement learning Vision applications I NLP applications I Laboratory Exercises	9

Suggested Readings:

1. Deep Learning and Artificial Intelligence: A Beginners' Guide to Neural Networks and Deep Learning, By John Slavio
2. Introduction to Deep Learning: From Logical Calculus to Artificial Intelligence By Sandro Skansi
3. MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial,   By Phil Kim

SAI601	NEURO-FUZZY TECHNIQUES	L	T	P	C
		3	0	0	3

	Contents	Hours
Unit 1	Neural Networks: History, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms-perceptions.	10
Unit 2	Training rules, Delta, Back Propagation Algorithm, Multi-layer Perceptron Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks. Fuzzy Logic: Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overviewof Classical Sets, Membership Function, Fuzzy rule generation.	12
Unit 3	Operations onFuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations,Aggregation Operations.Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operationson Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.	10
Unit 4	Application of Fuzzy Logic: Medicine, Economics etc. Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks.Genetic Algorithm: An Overview of GA, GA operators, GA in problem solving,Implementation of GA	8

Suggested Readings :
1.   **MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial,   By Phil Kim**
2.   **Basics Of Artificial Intelligence & Machine Learning, by Dr Dheeraj Mehrotra**
3.   **Deep Learning and Artificial Intelligence: A Beginners' Guide to Neural Networks and Deep Learning, By John Slavio**

SAI701	INFORMATION RETRIEVAL	L	T	P	C
		3	0	0	3

Contents		Hours
Unit 1	Boolean retrieval, the term vocabulary and postings lists, Dictionaries and tolerant retrieval, Introduction to index-construction and index-compression.	8
Unit 2	Scoring, term weighting and the vector space model, computing scores in acomplete search system, Evaluation in information retrieval, Introduction toRelevance feedback and query expansion.	12
Unit 3	Probabilistic information retrieval, review of basic probability theory, the probability ranking principle, the binary independence modelLanguage models for information retrieval, Language modeling versus otherapproaches to IR, Text classification and Naive Bayes, Bayesian Network approaches to IR.	8
Unit 4	Vector space classification, Support vector machines and ma-chine learning on documents, flat clustering, Hierarchical clustering, Matrixdecomposition and latent semantic indexing. Introduction to Web search basics, Web crawling and indexes, Link analysis.	8

Suggested Readings :

1. Introduction to Information Retrieval - Christopher D. Manning , Prabhakar Raghavan , Hinrich Schütze
2. Introduction to Information Retrieval - Stanford NLP Group

SAI801	COMPUTER VISION	L	T	P	C
		3	0	0	3

	Contents	Hours
Unit 1	Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc.; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.	8
Unit 2	Feature Extraction:Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.	8
Unit 3	Image Segmentation Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.	8
Unit 4	Pattern Analysis Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.	8

Suggested Readings :

1. **Artificial Intelligence, By Rajiv Chopra**
2. **Artificial Intelligence and Machine Learning, By Vinod Chandra S.S., Anand Hareendran S.**
3. **Basics of Artificial Intelligence & Machine Learning, by Dr Dheeraj Mehrotra**