**20IT7301-DEEP LEARNING**

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| **Course Category:** | | Program Core | | | | | | | | **Credits:** | | | | | | | 3 | |
| **Course Type:** | | Theory | | | | | | | | **Lecture-Tutorial-Practice:** | | | | | | | 2-0-2 | |
| **Prerequisites:** | | 20IT6302-Machine Learning | | | | | | | | **Continuous Evaluation:** | | | | | | | 30 | |
|  | | | | | | | | | | **Semester end Evaluation:** | | | | | | | 70 | |
| **Total Marks:** | | | | | | | 100 | |
| **Course Outcomes** | Upon successful completion of the course, the student will be able to: | | | | | | | | | | | | | | | | | |
| CO1 | | Analyze the performance of feed forward neural networks with different hyper parameters | | | | | | | | | | | | | | | |
| CO2 | | Apply CNN, Auto encoders, Attention mechanisms and GANs on image processing applications | | | | | | | | | | | | | | | |
| CO3 | | Design a suitable RNN model for time series applications | | | | | | | | | | | | | | | |
|  | CO4 | | Create a suitable  intelligent model for the given application | | | | | | | | | | | | | | | |
| **Contribution of Course Outcomes towards achievement of Program Outcomes**  **1-Low, 2- Medium, 3- High)** |  | | PO1 | PO2 | PO3 | PO 4 | PO 5 | PO 6 | PO 7 | | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | | PSO2 |
| CO1 | | 1 | 1 |  | 2 |  |  |  | | 1 | 1 |  |  | 1 | 1 | | 1 |
| CO2 | | 2 | 2 |  |  | 2 |  |  | | 1 | 1 |  |  | 1 | 2 | | 2 |
| CO3 | | 2 | 2 | 3 |  | 2 |  |  | | 2 | 2 |  |  | 2 | 2 | | 2 |
| CO4 | | 3 | 2 | 3 | 2 | 3 |  |  | | 2 | 2 |  |  | 3 | 3 | | 3 |
| **Course Content** | **UNIT I:**  **The Neural Network**: Building Intelligent Machines, The Limits of Traditional Computer Programs, The Mechanics of Machine Learning, The Neuron, Expressing Linear Perceptrons as Neuron, Feed-Forward Neural Networks, Linear Neurons and Their Limitations, Sigmoid, Tanh, and ReLU, Softmax Output Layers  **Training Feed-Forward Neural Network**: Gradient Descent, The Delta Rule and Learning Rates, Gradient Descent with Sigmoidal Neurons, The Backpropagation Algorithm, Stochastic and Minibatch Gradient Descent, Test Sets, Validation Sets, and Overfitting, Preventing Overfitting in Deep Neural Networks | | | | | | | | | | | | | | | | | |
| **UNIT II:**  **Convolutional Neural Networks**: Neurons in Human Vision, The Shortcomings of Feature Selection, Filters and Feature Maps, Convolutional Layer, Max Pooling, Full Architectural Description of Convolution Networks, Image Preprocessing pipelines, Accelerating training with batch normalization  **Embedding and Representation Learning**: Learning Lower-Dimensional Representations,Principal Component Analysis, Motivating the Autoencoder Architecture, Denoising to Force Robust Representations, Sparsity in Autoencoders | | | | | | | | | | | | | | | | | |
| **UNIT III:**  **Sequence Modeling**: **Recurrent and Recursive nets:** Unfolding Computational Graphs, Recurrent neural networks, Bidirectional RNNS, Encoder-Decoder sequence-to –sequence architectures, Deep Recurrent networks, Recursive neural networks.  **The Challenge of Long-Term Dependencies:** Echo State Networks, Leaky Units &Other strategies for multiple timescales, The Long Short-Term memory | | | | | | | | | | | | | | | | | |
| **UNIT IV:**  **Advanced Topics in Deep Learning:** Introduction, Attention Mechanisms, Recurrent Models of Visual Attention, Attention Mechanisms for Machine Translation, Neural Networks with External Memory-Neural Turing Machine  **Generative Adversarial Networks:** Training a Generative Adversarial Network, Using GANs for Generating Image Data, Conditional Generative Adversarial Networks, Competitive Learning, Limitations of Neural Networks | | | | | | | | | | | | | | | | | |
|  | **Content Beyond:** The Transformer Neural Network | | | | | | | | | | | | | | | | | |
| **Text books and Reference books** | **Text Book(s):**   1. Nikhil Buduma, Nicholas Locascio, “Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms”, O'Reilly Media, 2017 2. Ian Goodfellow, YoshuaBengio, Aaron Courville, ”Deep Learning(Adaptive Computation and Machine Learning series”,MIT Press, 2017 3. Charu C. Aggarwal, Neural Networks and Deep Learning, c Springer International Publishing AG, part of Springer Nature 2018, ISBN 978-3-319-94462-3 ISBN 978-3-319-94463-0 (eBook)   **Reference (Book)s:**   * 1. Li Deng and Dong Yu, “Deep learning Methods and Applications”, Now publishers, 2013   2. Michael Nielsen,“Neural Networks and Deep Learning”, Determination Press 2015   3. Vaswani A, Shazeer N, Parmar N, Uszkoreit J, Jones L, Gomez AN, Kaiser Ł, Polosukhin I. Attention is all you need. Advances in neural information processing systems. 2017; 30. | | | | | | | | | | | | | | | | | |
| **E-resources and other digital material** | 1. MiteshKhapra, “Deep Learning”, Sep 20, 2018, https://www.youtube.com/ watch?v=4TC5s\_xNKSs&list=PLH- xYrxjfO2VsvyQXfBvsQsufAzvlqdg9  AfshineAmidi and ShervineAmidi ,”Deep Learning cheat sheets for Stanford's CS 230”, 2018, <https://github.com/afshinea/stanford-cs-230-deep-learning>YoshuaBengio, Deep learning: “Theoretical Motivations, Canadian Institute for Advanced Research”, 2015 <http://videolectures.net/deeplearning2015_bengio_theoretical_motivations/>  1. Geoffrey Hinton’s [GoogleTech Talk](http://www.youtube.com/watch?v=VdIURAu1-aU),”Recent developments on Deep Learning” March 2010, <https://www.youtube.com/watch?v=VdIURAu1-aU> | | | | | | | | | | | | | | | | | |