Course Number : AR509
Course Name : Deep Learning for Robotics
Credit Distribution : 3-0-2-4
Intended for : PG and PhD
Prerequisite : Consent of faculty advisor
Mutual Exclusion **:** None

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1. Preamble:

Robotic platforms now deliver vast amounts of sensor data from large unstructured environments. In attempting to process and interpret this data there are many unique challenges in bridging the gap between pre-recorded datasets and the field. Deep learning has pushed success in many computer vision tasks through the use of standardized datasets. Beginning with understanding simple neural networks to explore long short-term memory (LSTM) and reinforcement learning, these modules will provide the foundations for using deep learning algorithms in many robotics workloads. This course will provide practical knowledge to apply supervised learning, derive backpropagation and use dropout and normalization to train the robot model, use reinforcement learning to let a robot learn from simulations, and build many types of deep learning systems.

2. Course Modules with quantitative lecture hours:

Introduction to Deep Learning for Robotics: Supervised learning for robotics applications, Backpropagation to train neural networks, Overfitting, and Neural network architecture for several robot functions. **(6 hours)**

Neural networks for robot motion control: Neural networks for inverse kinematic motion calculation, Training with techniques such as dropout and regularization, Solving high-dimensional problems by dimension reduction with principal component analysis (PCA). **(10 hours)**

Reinforcement Learning: Write a reinforcement learning agent with PyTorch, Overview of Reinforcement Learning Coach - a state-of-the-art reinforcement learning framework. **(10 hours)**

Temporal data and neural networks: Backpropagation through time and vanishing or exploding gradients, Variations of recurrent neural networks (RNN), and LSTMs to implement them in PyTorch. **(10 hours)**

Laboratory/practical/tutorial Modules:

Neural networks for robot motion control, Reinforcement Learning, Temporal data and neural networks. **(6 hours)**

3. Textbooks:

1. Iosifidis A. and Tefas A., *Deep Learning for Robot Perception and Cognition*, Elsevier.
2. Arana-Daniel N., Alanis A. Y., Lopez-Franco C., *Neural Networks for Robotics: An Engineering Perspective*, CRC Press.
3. Nath V. and Levinson S. E., *Autonomous Robotics and Deep Learning*, Springer.

4. References:

1. Sutton R. and Barto A., *Reinforcement Learning: An Introduction*, MIT Press.
2. Russell S. and Norvig P., *Artificial Intelligence: A Modern Approach*, Prentice Hall.

5. Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.		None	None	None

6. Justification of new course proposal if cumulative similarity content is >30%: None