Mayank Kumar Pal

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Education

- **Master** of Technology in Electronics and Communication Engineering,
  Indraprastha Institute of Information Technology (IIIT), New Delhi, India Aug 2019 - May 2020 (Expected)
  - Dual Degree
  - **Thesis advisor**: Prof. Sanjit K. Kaul
- **Bachelor** of Technology in Electronics and Communication Engineering,
  Indraprastha Institute of Information Technology (IIIT), New Delhi, India Aug 2015 - May 2019
  - **Thesis Title** : A Reinforcement Learning Approach to Jointly Adapt Vehicular Communications and Planning for Optimized driving. [Slides], [Video]
  - **Supervisor** : Prof. Sanjit K. Kaul co-advised by Prof. Saket Anand.

Research Interests

1. **Reinforcement Learning and Deep Reinforcement Learning**
   - Relevant Coursework
     (a) Reinforcement Learning (Markov decision process, Policy & Value iteration, Monte carlo and TD difference learning, Policy gradients, Deep-Q networks)
2. **Deep Learning and Machine Learning**
   - Relevant Coursework
     (a) Machine Learning (Regression, Support Vectors Machine, Perceptron, Deep neural networks)
     (b) Machine Learning Techniques for Real-time Control (Robot Fundamentals, Lyapunov Stability Analysis, Adaptive neural network based control)
3. **Heterogeneous Computing**
   - Relevant Coursework
     (a) Intelligent Applications Implementation on Heterogeneous Platforms (Implemented Convolutional and Recurrent neural networks architectures on GPU and FPGA using OpenCL)

Work Experience

1. Undergraduate Researcher at **Cyber-Physical Systems Laboratory** Aug 2017 - Apr 2019
   Indraprastha Institute of Information Technology, New Delhi, India
   - Developed a simulation platform to model Vehicle-to-Infrastructure (V2I) conditions for Autonomous Driving. Implemented occupancy grids, Intelligent driver model, Multiple lanes. [Source Code]
   - Integrated simulator with rllib library to train and evaluate planning and querying policies learned using Reinforcement Learning. [Trained Policy]
2. Machine Learning intern at **Philips Innovation Campus**, May 2018 - Jul 2018
   Manyata Tech Park, Bengaluru, India
   - Intent Classification - Built prediction models to classify the intent of the user query. Same models were then used to suggest alternative sentences based on the similarity score of the query. [Report]
   - Named Entity Recognition - Identifying/Extracting named entities like name, locations, organization, quantities etc. from the unstructured text.

Projects

1. **Understanding Deep Learning Optimization Algorithms using visualizations**. [Video]
   - Visualization of various deep learning optimization algorithms implemented using PyTorch's automatic differentiation tool and optimizers.
   - It demonstrates how the iterative methods approaches to the minimum in the case of convex, non-convex surfaces and surfaces with saddle point.
2. **Recurrent Deep-Q Learning**
   - In Partially Observable Markov Decision process (POMDPs), agent can't directly observe the underlying state, which violates the major assumption of most of the Reinforcement Learning algorithm i.e. state is Markovian. [POMDP Environment]
   - Recurrent networks can learn the latent representation which encodes the useful information of what agent has seen in the past. [Trained Policy]
   - Latent representation is then used as the state input to learn control policies. [Results]
3. **A Deep Reinforcement Learning Framework** [Demo]
   - This framework implements the various state of the art Value based Deep Reinforcement Learning algorithms, supports OpenAI gym environments out of the box.
   - Implementation include Deep-Q learning, Deep-Q learning with target freezing, Prioritized experience replay, Double Q-learning.
4. **Asynchronous Actor-Critic** (A3C) - **Policy Gradients Methods**
   - High quality implementation of A3C algorithm with Generalized Advantage Estimation. Supports different neural network based policies out of the box. [Source Code]
   - Performance of the algorithm scales linearly with the number of cores. [Trained Policies]
5. **Accelerating Convolutional and Recurrent neural networks Inference on GPU and FPGA using OpenCL**
   - Accelerated VGG19, a Deep neural networks for vision tasks, inference on GPU using OpenCL. [Source Code], [Report].
   - Implemented a Recurrent neural network to accelerate text deciphering inference on FPGA using OpenCL. Xillinx ZC706 platform was used for the implementation. [Source Code], [Report]

Publications

1. **A Reinforcement Learning Approach to Jointly Adapt Vehicular Communications and Planning for Optimized Driving**. *Mayank K. Pal, Rupali Bhati, Anil Sharma, Sanjit K. Kaul, Saket Anand, P.B. Sujit*, IEEE International Conference on Intelligent Transportation Systems (IEEE-ITSC), November 2018. [Paper], [Video]

Work in Progress

1. **Autonomous Driving Using Age Optimal Updates**, *Mayank K. Pal, Shivangi Agarwal, Sanjit K. Kaul, Saket Anand and P. B. Sujit* [Paper]

Tools and Technologies

1. **Programming Languages** - Python (Expert), C/C++(Expert), MATLAB (Intermediate Level)
2. **Deep Learning Frameworks** - PyTorch, Keras, TensorFlow
3. **Machine Learning Frameworks/Tools** - scikit-learn, numpy, pandas, matplotlib
4. **Reinforcement Learning Frameworks/Tools** - ray, rllib, OpenAI gym, MoJoCo
5. **Technologies** - Google Cloud Platform, Kubernetes, Docker, Git

Teaching

1. Teaching Assistant for **Reinforcement Learning** course taught by Prof. Sanjit Kaul at IIIT-Delhi (Winter Semester 2018 & Monsoon Semester 2019)

2. Teaching Assistant for **Intelligent Applications Implementation on Heterogeneous Platforms** course taught by Prof. Sumit Mediratta at IIIT-Delhi (Monsoon Semester 2019)

Talks/Tutorials

1. Recurrent Neural Networks for Deep Reinforcement Learning to handle Partial Observability in states, [Slides] — June 2018

2. Value based Reinforcement Learning - RL Thursdays, [Slides] — Jan 2019

3. A Hands-On Tutorial on implementing [Q-Learning] (Off-Policy), [SARSA](On-Policy) and Policy Gradients algorithms at **AI-Winter School**, IIIT-Delhi, India — Jan 2019

4. A Hands-On tutorial on implementing algorithms for Heterogeneous Devices using Open Compute Language (OpenCL). [Slides] — Aug 2019