Jaskirat Singh | Academic CV

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Jaskirat Singh

Research Interests

Computer Vision, Deep Reinforcement Learning, Robotics, Vision and Language Navigation.

Education

- **The Australian National University** **GPA: 7/7**
  Master of Machine Learning and Computer Vision *Jul' 19–Present*
- **Indian Institute of Technology, Delhi** **GPA: 9.3/10**
  Bachelor of Technology (B.Tech), Electrical Engineering *2013–2017*
  Specialization in Intelligent and Cognitive systems

Publications

[1] **2020a J. Singh** and L. Zheng. "Combining Semantic Guidance and Deep Reinforcement Learning for Generating Human Level Paintings". In: *Submitted [Under Review]*. URL: https://arxiv.org/abs/2011.12589.

[2] **2020b J. Singh** and L. Zheng. "Dynamic Value Estimation for Single-Task Multi-Scene Reinforcement Learning". In: *Submitted [Under Review]*. URL: https://arxiv.org/abs/2005.12254.

[3] **2020c J. Singh** and L. Zheng. "Enhanced Scene-Specificity with Sparse Dynamic Value Estimation". In: *Submitted [Under Review]*. URL: https://arxiv.org/abs/2011.12574.

Research/Teaching Experience

- **The Australian National University** **Canberra**
  Research Scholar: ANU Computer Science Summer Research Projects *Nov' 20 – Present*

- **The Australian National University** **Canberra**
  Teaching Assistant: Introduction to Machine Learning (COMP6670) *Jul' 20 – Nov' 20*

- **Yahoo Japan** **Tokyo**
  Machine Learning Research Engineer *Oct' 17– Sept '18*
  - Developed an Ad image-based CTR (click through rate) prediction model using **parameterized CNNs and unsupervised clustering**. Our model **improved the CTR prediction accuracy by 2.3 %** over past methods.
  - Proposed a **novel pricing strategy** to deal with the problem of *unfairness* and attain **Nash Equilibrium** in **online advertising auctions**.
  - Designed an **end to end deep learning pipeline for automated "user target setting" selection** in order to maximize the number of clicks for online Ads.

Other Research Projects

- **Domain-Aware Adversarial Level Selection for Multi-Scene RL**
  Supervisor: Prof. Liang Zheng *Jul 2020–Present*
  - Developed an adversarial level selection strategy for achieving **better sample complexity and episode rewards** on multi-scene environments like OpenAI ProcGen and AI2THOR based visual navigation task.
  - **Reduced the source to domain gap** by using a perpetual RL model for minimizing the KL divergence between sample distributions for the training and validation game level trajectories.

- **Exploring Semantic and Depth Penalties for Sketch Generation**
  Research Project in Advanced Computer Vision with Dr. Dylan Campbell *Jul 2020–Nov 2020*
  - Used model-based RL with a novel depth variance penalty to **enhance depth perception** in generated sketches.
  - Designed a semantic entropy reward function to discourage brush strokes traversing multiple object boundaries.

- **Connected Stories of Australia: Project with National Museum of Australia**
  Supervisor: Prof. Emmaline Lear *Jul 2019–Nov 2019*
  - Developed a machine learning and design thinking based solution for improving organisation of historic artifacts within NMA's database and increase the outreach of their public API.
  - The final prototype poses as an online interactive treasure hunt, with an NLP based backend for learning sparse concept associations.

- **Finetuning CNNs using Neural Activation Data**
  Independent Study: IIT Delhi *Jul' 16–Jun '17 & Jan' 19–May' 19*
  - Demonstrated significant correlation between **representational dissimilarity matrices (RDM)** for **IT cortex activations** and higher-order CNN features.
  - Showed the importance of inter-class correlations between model features for popular CNN architectures.
  - **Improved the linear SVM accuracy** for penultimate layer features from the Squeezenet model by **9.86 %** on the Cadieu dataset using a novel RDM loss finetuning approach.

- **Face Detection and Recognition**
  Undergraduate Thesis: IIT Delhi *Jul 2016–May 2017*
  - Proposed a novel face recognition approach which uses **Spatial Transformer Networks** along with traditional Facenet pipeline in order to introduce translational and rotational invariance for input images. This resulted in an **improvement of 1.37%** in accuracy over the Facenet model.
  - Came up with a unique approach to **combine 3D facial reconstruction and face recognition** in an end to end pipeline, in order to account for the variations in 3D structure and facial pose.

Honors and Achievements

- Awarded **ANU Computer Science Summer Research Grant** ($5k).
- **Invited for delivering a tutorial** on "Applying deep reinforcement learning for computer vision research" by the **Australian Centre for Robotic Vision (ACRV)** group.
- Our project "Connected Stories of Australia" has been awarded as the **best innovative design project** by the **National Museum of Australia**.
- **Won national hackday at Yahoo Japan**, among 54 competing teams from all across Japan, for developing a real-time application for **facial attribute modification using reversible GANs**.
- Received **IIT Delhi Merit Award & Scholarship** for outstanding academic performance.
- Secured **All India Rank 128 in IIT-JEE** among 1.4 million aspirants appearing for the exam.
- Won the **2nd prize at a National-level FIDE Rated Chess Tournament.**

Open Source RL Implementations

- **Quadcopter Flight Control:** Trained a quadcopter to fly using **Actor-Critic** based **Deep Deterministic Policy Gradients (DDPG)** algorithm with prioritized experience replay.
- **Multi-Agent Competition:** Trained a pair of RL agents to play tennis using **Multi-Agent DDPG algorithm**, which leads to robust policies for competitive/cooperative play.
- **Navigation:** Trained a Deep Reinforcement Learning Agent to navigate an artificial world simulated in the **Unity Environment**. The underlying model is a **Dueling Double Deep Q Network with prioritized experience replay**.
- **Robotic Arm Control:** Trained a robotic arm to reach target locations using **Proximal Policy Optimization (PPO)** algorithm, with multiple (non-interacting, parallel) copies of the same agent

to distribute the task of gathering experience.

- **Alphazero for Tictactoe:** Implemented the alphazero algorithm for the game of Tictactoe. Extended the solution to a much more complex 6-6-4 tictactoe.

Relevant Courses

- Advanced Topics in Machine Learning (Convex & differentiable optimization)
- Statistical Machine Learning (Class Rank 1)
- Advanced Topics in Computer Vision (Research oriented course)
- Advanced Topics in Mechatronics (Computer Vision and Deep Learning)

Technical Skills

- **Programming Languages and Tools:** Python, Java, C++, LaTeX
- **Deep Learning Frameworks:** Pytorch, Tensorflow, Caffe, Caffe2
- **Big Data:** Hadoop, Hive, SQL, Teradata
- **Web Development:** HTML5, CSS, Javascript