Jaskirat Singh | Academic CV

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Jaskirat Singh

Research Interests

Interactive Image Synthesis and Editing, Artistic Content Generation, Deep Reinforcement Learning.

Education

- **The Australian National University** — **Expected**
  Ph.D. in Computer Science — *Sep' 21–Present*
  Supervisors: Prof. Liang Zheng and Prof. Stephen Gould

- **The Australian National University** — **GPA: 7/7**
  Master of Machine Learning and Computer Vision — *Jul' 19–Jul' 21*
  Awarded University Medal for Exceptional Academic Excellence

- **Indian Institute of Technology, Delhi** — **GPA: 9.3/10**
  Bachelor of Technology (B.Tech), Electrical Engineering — *2013–2017*
  Specialization in Intelligent and Cognitive systems

Research/Teaching Experience

- **Adobe Research** — **San Jose, California**
  Research Intern: Computer Vision, Imaging & Video — *Jun' 21 – Dec' 21*

- **The Australian National University** — **Canberra**
  Summer Research Scholar: Computer Vision Lab with Prof. Liang Zheng — *Dec' 20 – Feb' 21*

- **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.

Publications

1. Paint2Pix: Interactive Painting based Progressive Image Synthesis and Editing
   Jaskirat Singh, Cameron Smith, Jose Echevarria, and Liang Zheng.
   ECCV 2022

2. Intelli-Paint: Towards Developing Human-like Painting Agents
   Jaskirat Singh, Cameron Smith, Jose Echevarria, and Liang Zheng.
   ECCV 2022, US Research Patent

3. Combining Semantic Guidance and Deep Reinforcement Learning For Generating Human-Level Paintings
Jaskirat Singh, and Liang Zheng.
CVPR 2021

4. Sparse Attention Guided Dynamic Value Estimation for Single-Task Multi-Scene Reinforcement Learning
Jaskirat Singh, and Liang Zheng.
arXiv 2021

Honors and Achievements

- **Awarded University Medal** for exceptional academic excellence at the Australian National University.
- 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 **Silver Medal at National FIDE Rated Chess Tournament.**

Other Research Projects

- **Domain-Aware Adversarial Level Selection for Multi-Scene RL**
Supervisor: Prof. Liang Zheng *Jul' 20–Nov' 20*
  - 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 with Dr. Dylan Campbell *Jul' 20–Nov' 20*
  - 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' 19–Nov' 19*
  - 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' 16–May' 17*
  - 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.

Relevant Courses

- Advanced Topics in Machine Learning (Convex & Differentiable Optimization) Class rank: 1
- Statistical Machine Learning (Bayesian Neural Networks) Class rank: 1
- Advanced Topics in Computer Vision (Research Oriented Course) Class rank: 1
- Advanced Topics in Mechatronics (Computer Vision and Deep Learning)

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.

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