

TANMAY SHANKAR

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RESEARCH INTERESTS

I am interested in enabling robots to learn and reason about skills and abstractions, and how to use them to solve complex tasks. To that end, I am interested in discovering insights that bridge unsupervised machine learning, reinforcement and imitation learning and classical robotics.

EDUCATION

Carnegie Mellon University, Pittsburgh, USA. 2020 - Present
Ph.D. in Robotics, Robotics Institute.
Thesis Advisor: Jean Oh, Robotics Institute.

Carnegie Mellon University, Pittsburgh, USA. 2016 - 2018
Masters in Robotics, Robotics Institute.
Thesis Advisors: Katharina Muelling & Kris Kitani, Robotics Institute.

Indian Institute of Technology Guwahati, Guwahati, India. 2012 - 2016
B. Tech., Mechanical Engineering, minor in Electronics and Communication Engineering

WORK EXPERIENCE

Facebook AI Research, Pittsburgh, USA 2018 - 2020
Research Engineer, working with Abhinav Gupta and Shubham Tulsiani.

Facebook AI Research, Pittsburgh, USA 2022 - 2022
Research Intern, working with Stuart Anderson, Aravind Rajeswaran, Vikash Kumar.

RESEARCH EXPERIENCE

Learning Unsupervised Skill Correspondences Across Robots [Website]
Ph.D. Research Project, CMU *Advisor:* Jean Oh
Translating Robot Skills via Unsupervised Representation Alignment

- Formulated unsupervised approach to translate skills across different morphological robots, inspired by unsupervised machine translation.
- Transferred skills and task-strategies across robots using unsupervised translation.

Learning Robot Skills with Temporal Variational Inference [Website]
Research Project, FAIR *Advisor:* Abhinav Gupta
Unsupervised Hierarchical Policy Learning from Demonstrations

- Formulated an unsupervised temporal variational inference to learn hierarchical policies (options, represented as latent variables) from demonstrations, using ideas of consistency.
- Applied our unsupervised objective to learn continuous spaces of options on 4 robotic datasets.

Discovering Motor Programs by Recomposing Demonstrations [Website]
Research Project, FAIR *Advisors:* Shubham Tulsiani & Abhinav Gupta
Unsupervised Skill Discovery from Robot Demonstrations by Recomposition

- Formulated an unsupervised loss to discover the space of motor primitives of a set of robot demonstrations, using ideas of recombination, simplicity, parsimony, and plannability.
- Showed efficacy of primitives to accelerate downstream task learning on a Baxter robot.

Learning Neural Parsers via Deterministic Differentiable Imitation Learning [Website]
Graduate Research Thesis, CMU *Advisors:* Katharina Muelling & Kris Kitani
Learning to Parse via hybrid Imitation-Reinforcement Learning

- Introduced a novel Deterministic Policy Gradient DRAG, for the hybrid IL-RL setting, as a deterministic actor-critic variant of AggreVaTeD, or an imitation learning variant of DDPG.
- Applied DRAG to learn a neural parser by imitating an information-gain maximizing oracle.

Reinforcement Learning via Recurrent Convolutional Neural Networks [\[Website\]](#)
Bachelor's Thesis, IIT Guwahati *Advisors:* S. K. Dwivedy & Prithwjit Guha
Reinforcement Learning Networks - Fusing Learning and Planning

- Introduced a neural approximation to value iteration, by representing the expectation of the Bellman backup as convolutions, and iterations as temporal recurrence.
- Introduced the *QMDP-RCNN*, a learnable approximation to partially observable planning.

PUBLICATIONS **T. Shankar**, A. Gupta, *“Learning Robot Skills with Temporal Variational Inference”*, International Conference on Machine Learning, ICML 2020. [\[PDF\]](#) [\[Code\]](#)

T. Shankar, S. Tulsiani, L. Pinto, A. Gupta, *“Discovering Motor Programs by Recomposing Demonstrations”*, International Conference on Learning Representations, ICLR 2020. [\[PDF\]](#)

T. Shankar, N. Rhinehart, K. Muelling, K. Kitani, *“Learning Neural Parsers with Deterministic Differentiable Imitation Learning”*, Conference on Robot Learning, CoRL 2018. [\[PDF\]](#)

T. Shankar, S.K. Dwivedy, P. Guha, *“Reinforcement Learning via Recurrent Convolutional Neural Networks”*, International Conference on Pattern Recognition, ICPR 2016. [\[PDF\]](#)

T. Shankar, S.K. Dwivedy, *“A Hybrid Assistive Wheelchair Exoskeleton”*, International Convention on Rehabilitation Engineering and Assistive Technology, i-CREATE 2015. [\[PDF\]](#)

T. Shankar, A. Biswas, V. Arun, *“Development of an Assistive Stereo Vision System”*, International Convention on Rehabilitation Engineering and Assistive Technology, i-CREATE 2015. [\[PDF\]](#)

PAPERS UNDER REVIEW **T. Shankar**, Y. Lin, A. Rajeswaran, V. Kumar, S. Anderson, J. Oh, *“Translating Robot Skills: Learning Unsupervised Skill Correspondences Across Robots”*, under review at International Conference on Machine Learning, ICML 2022.

SERVICE & LEADERSHIP Reviewer for ICML 2022, ICLR 2020 & CVPR 2019. 2019 - 2022
 Founded an AI and Robotics Research mentoring program for IITG Undergraduates. 2015 - 2016
 Mentor for CMU Undergrad from underrepresented groups getting into AI Research. 2020

AWARDS Samsung Innovation Award, for excellence in research, IIT Guwahati. 2015
 Master R. Balakrishnan Memorial Award, Best All Rounder Student. 2011
 Dr. Lt. Col. T S Kalyanam Award, for the Best Outgoing Student. 2011

TEACHING EXPERIENCE **Teaching Assistant, Deep Reinforcement Learning, CMU** 2018
Instructor: Dr. Ruslan Salakhutdinov, Machine Learning Department

OPEN SOURCE github.com/facebookresearch/CausalSkillLearning, github.com/tanmayshankar/RCNN_MDP

TECHNICAL SKILLS *Languages Known:* Python, Familiar with C / C++, Matlab.
Software Packages: TensorFlow, PyTorch, OpenCV, PCL, MATLAB, L^AT_EX, Rviz, Gazebo, ROS
Hardware: Rethink Baxter & Sawyer, Odroid XU3, Pixhawk Autopilot.

GRADUATE COURSEWORK *Deep Learning* *Language Grounding to Vision and Control*
Deep Reinforcement Learning *Machine Learning*
Computer Vision *Math Fundamentals for Robotics*
Kinematics Dynamics and Controls *Probabilistic Graphical Models*