Abbeel Lab – Summary of Main Research Efforts over Past 12 Months

We have made progress on the following 10 themes, and will continue to work on each of these themes.

1. Core Advances in Deep RL Algorithms

**Asymmetric Actor Critic for Image-Based Robot Learning,**
Lerrel Pinto, Marcin Andrychowicz, Peter Welinder, Wojciech Zaremba, Pieter Abbeel.
*arXiv 1710.06542, videos*

**Overcoming Exploration in Reinforcement Learning with Demonstrations,**
Ashvin Nair, Bob McGrew, Marcin Andrychowicz, Wojciech Zaremba, Pieter Abbeel.
*arXiv 1709.10089*

**Learning Generalized Reactive Policies using Deep Neural Networks,**
Edward Groshev, Aviv Tamar, Siddharth Srivastava, Pieter Abbeel.
*arXiv 1708.07280*

**Parameter Space Noise for Exploration,**
*arXiv 1706.01905*

**UCB and InfoGain Exploration via Q-Ensembles,**
Richard Y. Chen, Szymon Sidor, Pieter Abbeel, John Schulman.
*arXiv 1706.01502*

**Equivalence Between Policy Gradients and Soft Q-Learning,**
John Schulman, Xi (Peter) Chen, Pieter Abbeel.
*arXiv 1704.06440*

**Hindsight Experience Replay,**
Marcin Andrychowicz, Filip Wolski, Alex Ray, Jonas Schneider, Rachel Fong, Peter Welinder, Bob McGrew, Josh Tobin, Pieter Abbeel, Wojciech Zaremba.

**Reinforcement Learning with Deep Energy-Based Policies,**
In the proceedings of the *International Conference on Machine Learning (ICML)*, Sydney, Australia, August 2017. (*arXiv 1702.08165*)

**Learning Visual Servoing with Deep Features and Fitted Q-Iteration,**
Alex X. Lee, Sergey Levine, Pieter Abbeel.
In the proceedings of the *International Conference on Learning Representations (ICLR)*, Toulon, France, April 2017. (*arXiv 1703.11000, videos, code, benchmark*)

2. Transfer

**Sim-to-Real Transfer of Robotic Control with Dynamics Randomization,**
Xue Bin (Jason) Peng, Marcin Andrychowicz, Wojciech Zaremba, Pieter Abbeel.
*arXiv 1710.064537, video*
Domain Randomization and Generative Models for Robotic Grasping,
Joshua Tobin, Wojciech Zaremba, Pieter Abbeel.
arXiv 1710.06425

Deep Object-Centric Representations for Generalizable Robot Learning,
Coline Devin, Pieter Abbeel, Trevor Darrell, Sergey Levine.
arXiv 1708.04225

Imitation from Observation: Learning to Imitate Behaviors from Raw Video via Context Translation,
arXiv 1707.03374

Mutual Alignment Transfer Learning,
Markus Wulfmeier, Ingmar Posner, Pieter Abbeel.
In the proceedings of the 1st Annual Conference on Robot Learning (CoRL), Mountain View, CA, November 2017. (arXiv 1707.07907)

Domain Randomization for Transferring Deep Neural Networks from Simulation to the Real World
Josh Tobin, Rachel Fong, Alex Ray, Jonas Schneider, Wojciech Zaremba, Pieter Abbeel.
In the proceedings of the 30th IEEE/RSJ International Conference on Intelligent RObots and Systems (IROS), Vancouver, Canada, October 2017. (arXiv 1703.06907)

Policy Transfer via Modularity
Ignasi Clavera, David Held, Pieter Abbeel.
In the proceedings of the 30th IEEE/RSJ International Conference on Intelligent RObots and Systems (IROS), Vancouver, Canada, October 2017. (pdf)

Learning Invariant Feature Spaces to Transfer Skills with Reinforcement Learning,
Abhishek Gupta*, Coline Devin*, YuXuan (Andrew) Liu, Pieter Abbeel, Sergey Levine.
In the proceedings of the International Conference on Learning Representations (ICLR), Toulon, France, April 2017. (arXiv 1703.02949)

3. Hierarchical RL

Meta Learning Shared Hierarchies,
Kevin Frans, Jonathan Ho, Xi Chen, Pieter Abbeel, John Schulman.
arXiv 1710.09767

Stochastic Neural Networks for Hierarchical Reinforcement Learning,
Carlos Florensa Campo, Yan (Rocky) Duan, Pieter Abbeel.
In the proceedings of the International Conference on Learning Representations (ICLR), Toulon, France, April 2017. (arXiv 1704.03012, videos, code)

4. Meta-Learning / Learning-to-Learn

Meta-Learning with Temporal Convolutions,
Nikhil Mishra*, Mostafa Rohaninejad*, Xi (Peter) Chen, Pieter Abbeel.
arXiv 1707.03141

One-Shot Imitation Learning,
Yan (Rocky) Duan, Marcin Andrychowicz, Bradly Stadie, Jonathan Ho, Jonas Schneider, Ilya Sutskever, Pieter Abbeel, Wojciech Zaremba.
In Neural Information Processing Systems (NIPS), Long Beach, CA, December 2017. (arXiv 1703.07326, videos)
One-Shot Visual Imitation Learning via Meta-Learning,
Chelsea Finn*, Tianhe (Kevin) Yu*, Tianhao Zhang, Pieter Abbeel, Sergey Levine.
In the proceedings of the 1st Annual Conference on Robot Learning (CoRL), Mountain View, CA, November 2017. (arXiv 1709.04905, videos)

Model-Agnostic Meta-Learning for Fast Adaptation of Deep Networks,
Chelsea Finn, Pieter Abbeel, Sergey Levine.
In the proceedings of the International Conference on Machine Learning (ICML), Sydney, Australia, August 2017. (arXiv 1703.03400)

5. Communication / Multi-Agent Systems

Continuous Adaptation via Meta-Learning in Nonstationary and Competitive Environments,
arXiv 1710.03641, videos

Learning with Opponent-Learning Awareness,
arXiv 1709.04326

Emergence of Grounded Compositional Language in Multi-Agent Populations,
Igor Mordatch, Pieter Abbeel.
In The Thirty-Second AAAI Conference on Artificial Intelligence (AAAI 2018), New Orleans, Louisiana, February 2018. arXiv 1703.04908

Multi-Agent Actor-Critic for Mixed Cooperative-Competitive Environments,
Ryan Lowe, Yi Wu, Aviv Tamar, Jean Harb, Pieter Abbeel, Igor Mordatch.

6. Model-based RL

Self-supervised Deep Reinforcement Learning with Generalized Computation Graphs for Robot Navigation,
Gregory Kahn, Adam Villaflor, Bosen Ding, Pieter Abbeel, Sergey Levine.
arXiv 1709.10489

Prediction and Control with Temporal Segment Models,
Nikhil Mishra, Pieter Abbeel, Igor Mordatch.
In the proceedings of the International Conference on Machine Learning (ICML), Sydney, Australia, August 2017. (arXiv 1703.04070)

7. Curriculum Generation

Automatic Goal Generation for Reinforcement Learning Agents,
David Held, Xinyang Geng, Carlos Florensa, Pieter Abbeel.
arXiv 1705.06366

Reverse Curriculum Generation for Reinforcement Learning,
Carlos Florensa, David Held, Markus Wulfmeier, Pieter Abbeel.
In the proceedings of the 1st Annual Conference on Robot Learning (CoRL), Mountain View, CA, November 2017. (arXiv 1707.05300)
8. Human Compatible AI / Safety

Interpretable and Pedagogical Examples, Smitha Milli, Pieter Abbeel, Igor Mordatch. 
arXiv 1711.00694

Adversarial Attacks on Neural Network Policies, Sandy H. Huang, Nicolas Papernot, Ian Goodfellow, Yan Duan, Pieter Abbeel. 
arXiv 1702.02284, videos

Uncertainty-Aware Reinforcement Learning for Collision Avoidance, Gregory Kahn, Adam Villaflor, Vitchyr Pong, Pieter Abbeel, Sergey Levine. 
arXiv 1702.01182, videos

Inverse Reward Design, Dylan Hadfield-Menell et al. 
In Neural Information Processing Systems (NIPS), Long Beach, CA, December 2017. (arXiv 1711.02827)

Constrained Policy Optimization, Josh Achiam, David Held, Aviv Tamar, Pieter Abbeel. 
In the proceedings of the International Conference on Machine Learning (ICML), Sydney, Australia, August 2017. (arXiv 1705.10528)

Enabling Robots to Communicate their Objectives, Sandy H. Huang, David Held, Pieter Abbeel, Anca D. Dragan. 
In the proceedings of Robotics Science and Systems, Cambridge, MA, July 2017. (arXiv 1702.03465)

9. Imitation Learning

Deep Imitation Learning for Complex Manipulation Tasks from Virtual Reality Teleoperation, Tianhao Zhang, Zoe McCarthy, Owen Jow, Dennis Lee, Ken Goldberg, Pieter Abbeel. 
arXiv 1710.04615, videos

Third Person Imitation Learning, Bradly Stadie, Pieter Abbeel, Ilya Sutskever. 
In the proceedings of the International Conference on Learning Representations (ICLR), Toulon, France, April 2017. (arXiv 1703.01703)

10. Scaling Up

Synkhronos: a Multi-GPU Theano Extension for Data Parallelism, Adam Stooke and Pieter Abbeel. 
arXiv 1710.04162