Trevor Barron

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Research Interests

Reinforcement Learning, Machine Learning, Robotic Control

Education

2016–Present **M.S. in Computer Science**. *Arizona State University*, Tempe, AZ.

2011–2014 **B.A. in Computer Science**. *Colorado College*, Colorado Springs, CO., *3.89 GPA; 3.975 Major GPA*. Distinction in Computer Science

2010 **Completed high school as homeschooled student**
Coursework included advanced biology and computer science classes at Stanford Online High School. Achieved a 5 on three Advanced Placement exams (biology, computer science, calculus).

Publications

T. Barron, H. Ben Amor, and O. Obst, "Information maximizing exploration with a latent dynamics model," *Deep Reinforcement Learning Symposium, NIPS*, 2017.

T. Barron and H. Ben Amor, "Sample-efficient reinforcement learning for robot to human handover tasks," *The Multi-disciplinary Conference on Reinforcement Learning and Decision Making*, 2017.

T. Barron, M. Whitehead, and A. Yeung, "Deep reinforcement learning in a 3-d blockworld environment," *Deep Reinforcement Learning: Frontiers and Challenges, IJCAI*, 2016.

T. Barron and M. Whitehead, "Visualizing stacked autoencoder language learning," *European Symposium on Artificial Neural Networks*, 2016.

T. Barron and M. Whitehead, "Latent semantic indexing and word vector representations," 2013. Poster presented at the 2013 Undergraduate Research Symposium in the Physical Sciences, Math, and Computer Science at the University of Chicago, October 25–26, University of Chicago, Chicago, Illinois.

Projects

- **Information Maximizing Exploration with a Latent Dynamics Model.** We modify standard information maximizing methods for exploration by fitting the probabilistic dynamics model in the features found by the final hidden layer of the neural network value function. This simplifies the learning of the Bayesian model. We observe that operating in the latent space performs comparable or better than a parallel method on the true state space. **Intrinsic motivation in RL, Bayesian modeling**

- **Optimizing trajectories for robot-human handover tasks.** We focus on sample-efficient reinforcement learning in the context of a human with a disability. An initial policy is defined by imitation, which is then adapted to someone which a particular impairment. We are able to learn efficient trajectories for object handovers from robot to human in as few as 50 trials. **Latent space policy search, dynamic motor primitives**

- **Reinforcement learning for complex tasks in a 3D environment.** I explored ways to handle 3D environments such as providing a point-cloud representation of the agent's environment or a depth map as input to the network. We found depth can accurately be inferred from 2D inputs in structured environments. **Deep-Q-Networks, RL, Caffe**
- **Visualizing natural language learning in a deep autoencoder network.** Trained a stacked autoencoder on large text dataset derived from Wikipedia and visualized learned features with t-SNE and wordcloud techniques to understand how deep networks learn on natural language data. **Lua/Torch, Caffe, Python, Data Visualization**
- **Optimized neural network implementation in CUDA.** Achieved a speed-up of up to 87x from a sequential CPU implementation to an optimized GPU implementation for a medium-sized neural network. **CUDA, C++**
- **Matrix multiplication algorithms on the CPU and GPU.** Compared the running time of the naive algorithm and Strassen's algorithm for matrix multiplication. I achieved a speedup of about 50x and 100x from CPU to GPU for the naive and Strassen's algorithms respectively. **C++, CUDA**
- **Probabilistic natural language processing and generation.** Independent research with Colorado College professor Matthew Whitehead. I experimented with the combination of various probabilistic methods. **C++, Python**
- **Text-to-speech for mathematical expressions.** Worked with Benetech during Google Summer of Code 2012 using the MathJax JavaScript library to convert MathML to an intermediary tree structure from which MathSpeak text was generated by a traversal. **JavaScript**
- **Go-playing AI based on a probabilistic Monte Carlo simulation.** Won class competition. **Java**

Accomplishments & Awards

April 2013 — **Won the Colorado College Big Idea Entrepreneurship Competition**
Mobile EEG brain monitoring application for epilepsy patients. Earned product development grant of $38,000. Assisted my partner's further development of the product.

August 2012 — **London Olympian in the 20km race walk**
Finished 26th with the fastest time ever by an American in the event; U.S. national champion in the 20km race walk, 2011 and 2012; youngest U.S. competitor at the 2011 World Track and Field Championships in Daegu, Korea, finishing 23rd of 46 entrants.

Spring 2012 — **Euclid Scholarship Recipient**
Awarded by the Colorado College Math and Computer Science department in recognition of exceptional promise in math and computer science.

Fall 2012 - Spring 2014 — **Colorado College President's Council**
Served as an ambassador for Colorado College both internally and externally.

Spring 2010 — **National Engineering Design Challenge finalist**
Member of Stanford Online High School team that qualified for national finals in Washington, D.C. Developed a device that translated the lights on the phone indicating which line is in use or ringing to a tactile format that users with visual impairment could understand.

Summer 2008 — **University of Pittsburgh Gene Team Member**
Selected through competitive application process to participate in National Science Foundation-funded biomedical summer research program.

Work Experience

8/2017– Present	**Research Assistant and Teaching Assistant under Dr. Ben Amor; Interactive Robotics Lab**. *ASU*, Tempe, AZ. Working on project to improve RL algorithms with memory-augmented policies for partially observed domains with long temporal dependencies. I was also a TA for the graduate level AI course in Fall 2017.
5/2017– 8/2017	**Summer intern at Honda Research Institute**, Mountain View, CA. Focused on RL applications to autonomous driving.
8/2016– 5/2017	**Research Assistant under Dr. Ben Amor; Interactive Robotics Lab**. *ASU*, Tempe, AZ. Worked on a Toyota-funded project to optimize human-robot handovers with applications to both manufacturing and assisting those with physical impairments.
5/2015– 5/2016	**Computer Science Research Assistant and Paraprofessional**. *Colorado College*, Colorado Springs, CO. Tutor for computer science courses and research assistant to my undergraduate adviser.
6/2014– 1/2015	**Software Engineer Associate**. *Lockheed Martin*, Colorado Springs, CO. Software engineer on the DIAMONDShield project.
5/2012– 8/2012	**Google Summer of Code Intern**. *Benetech* Implemented text-to-speech for mathematical expressions.

Personal

- Languages: English (native), Spanish (proficient)
- Athletics: I enjoy the challenges of endurance athletic events and have competed in marathons, a triathlon, a half-Ironman, and cycling events.
- Family: I have a wife who loves teeth (she is in dental school) and one hyper dog.