Akella Ravi Tej

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Dear Uber AI team,

I am applying to the Uber AI Residency Program to pursue my research interests in reinforcement learning (RL) and robotics. I hold a bachelor's degree (B.Tech 2014-18) in *Electronics & Communication Engineering* with minors in *Computer Science* from the **Indian Institute of Technology Roorkee**.

Over time, evolution has shaped a degree of sentience which brings the efficiency at which humans operate. The possibility of AI to deliver human-level performance is inspiring and has driven my research in artificial general intelligence (AGI). A more narrow goal is to achieve better generality and transfer performance in deep RL. As a first step towards this goal, I have been pursuing independent research in RL and disentangled representation learning over the past year. I firmly believe that RL takes us a step closer to AGI, showing a promising direction to communicate the intuitive but inexplicable knowledge of our intelligence using a carefully designed reward function. During this time, I worked on the implementation of β-variational auto-encoders (β-VAE), the state-of-the-art model for unsupervised visual disentangled representation learning. This study shows promise in advancing an RL agent's transfer performance outside of the training data distribution, which is key to achieving the generalization and robustness of biological intelligence.

Presently, I am working on a joint project by Caltech (*Prof. Animashree Anandkumar's group*) and Facebook AI Research to design sample efficient RL algorithms for continuous state-action space. My role is to devise a feasible combination of Bayesian actor-critic (BAC) framework and trust region policy optimization to achieve targeted exploration with guaranteed monotonic policy improvements. The biggest obstacle for using BAC was scaling the Gaussian process (GP) regression using traditional approaches (like online sparsification as suggested in the original BAC paper) to 100,000+ data points, which is unavoidable in RL. After multiple disappointing trials and thorough research, I was able to achieve this with structured kernel interpolation framework (KISS-GP: generalized inducing points approach). Another key modification I made to the original BAC architecture was augmenting the original critic (single GP layer) with a deep neural network (feature extractor). While the upgraded critic is capable of modeling the Q-value function more accurately in complex environments, this network now had to be jointly optimized. Over time, I solved this issue with stochastic variational inference (ELBO objective) for large-scale GP regression which allows stochastic gradient descent techniques for optimizing the feature extractor network. For end-to-end training, I used the deep kernel regression module from the GPyTorch library which additionally offers GPU acceleration for rapid training using minibatches. For testing, I am using robotic locomotion experiments rendered by MuJoCo simulator.

I wish to continue my research at Uber AI for the unique opportunity of conducting fundamental machine learning research with distinguished scientists in the field. With my interests spread over the topics of deep learning, robotics, and RL, I find the collaboration-friendly environment and diversity in AI research at Uber very appealing. Having read some of the published research by earlier cohorts in my areas of interest, I see a clear fit for my skills and interests at Uber AI. For these reasons, I am confident that the Residency program will serve as a launchpad, taking me a step closer to my goals.

Sincerely,
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