Undergrad Project Ideas

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1   Research in artificial intelligence and deep learning

In the last few years, deep learning has lead to breakthroughs in computer vision, natural language processing (speech recognition), reinforcement learning (robotics, game playing), and several other areas. Deep learning, and more broadly machine learning, is viewed by several researchers as a promising path towards artificial intelligence.

There will be several research projects in Dr. Dobriban's group related to AI and deep learning. Some possible topics are listed below, however students are encouraged to suggest their own ideas, and those can be pursued as well.

1. Curiosity driven reinforcement learning: In classical reinforcement learning, the agent learns based on the rewards it obtains. However, in real problems rewards are sparse and unreliable. In this project we will explore the design of intrinsically curious agents, such as those from the well-known OpenAI project https://pathak22.github.io/large-scale-curiosity/. This can be viewed as an important step towards the more general applicability of AI.

2. Scalable deep learning: Deep learning is well known to be very resource intensive. Therefore, it is important to develop scalable deep learning methods, which can enable deep learning to scale up to truly massive datasets, or make it be fast enough to be run on edge devices such as cellphones. In this project, we will study and design scalable deep learning algorithms.

3. Other possible directions: Bandits and sequential decision-making, Data augmentation for deep learning and beyond, Uncertainty quantification, Adversarial examples, Generative models (GAN), Applications (eg visual question-answering systems), etc.

Qualifications: These projects require a full time commitment over the summer.

A minimal set of prerequisites includes (1) familiarity with probability, statistics, and machine learning at the advanced undergraduate level, as demonstrated by excellent coursework performance in the area (2) knowledge of the Python programming language, (3) excellent communication and teamwork abilities, (4) strong independence and motivation to learn new areas.

Desired qualifications include (A) some familiarity with deep learning (for instance through online courses, or Dr. Dobriban's course STAT 991) and associated software (Pytorch), (B) cloud computing (Amazon AWS, Google Cloud), (C) the LaTeX typesetting system, (D) some research

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experience through course projects or with other faculty as well as (E) familiarity with the target area of application, if one exists.

The successful candidate may work in a team with other undergraduate or graduate students in Dr. Dobriban's group. There may also be an opportunity to be hired as a Research Assistant and continue the research project through the academic year, until completion.