CLARIPHY - NSF AI Institute Proposal Overview

The U.S. National Science Foundation (NSF) currently has an open call for proposals[1] to establish National Artificial Intelligence (AI) Institutes. Building on decades of research investment in AI in the U.S., the aim of these Institutes is to accelerate research, transform society and grow a technologically sophisticated workforce. The call includes both core AI research themes, as well as some domain-side themes including "AI Discovery for Physics".

We propose to estabilish the Community Laboratory for AI Research at the Intersection with Physics (CLARIPHY) to advance discovery through a partnership between AI researchers and physicists. It aims to leverage very broadly particle, nuclear and astro-particle data challenges in the coming decade to inform AI research. CLARIPHY involves Physics and AI researchers from Princeton, U. Cincinnati, Columbia, U.California-Irvine, Davidson College, U. Washington, Notre Dame, Rice, Rutgers, Stanford, and U. Wisconsin-Madison. The proposal will fund a large number of undergraduates, graduate students and postdoctoral researchers from both the AI and Physics domains to engage together in AI/ML-related joint research projects, as well as a number of elements aimed at enabling the larger research communities through workshops, training, etc. In particular, CLARIPHY personnel will engage in ML-related physics research topics like those described in the "Roadmap for HEP Software and Computing R&D for the 2020s", and related documents developed by the HEP Software Foundation, as use-inspired drivers for AI research. The institute will also serve as a nexus for community activities at the intersection of these research areas and bring together physicists and AI researchers.

CLARIPHY will advance discovery in Physics by "improving and optimizing operations, real-time event selection, classification, feature extraction, reconstruction, and analysis at dataflow-intensive facilities" including experiments the Large Hadron Collider at CERN, planned neutrino experiments such as the Deep Underground Neutrino Experiment in the U.S., the IceCube neutrino observatory at the South Pole, the Facility for Rare Isotope Beams (FRIB) at Michigan State University, the planned Electron Ion Collider (EIC) at Brookhaven National Lab and direct dark matter detection experiments such as XENONnT in Italy. Each of these projects faces significant computational and data volume challenges in the 2020s, as well as a desire to maximize the physics obtainable for the investments in these cutting-edge facilities.

"An AI Institute in Physics will incorporate novel techniques to accelerate discovery and extend the frontier in AI by addressing domain-specific challenges in Physics. Realizing the full potential of AI for Discovery in Physics will improve the operations and exploitation of (NSF) Division of Physics facilities, promote the integration and interpretation of heterogenous datasets, accelerate model-building and quantification of uncertainties, and enable novel ways to interrogate high-dimensional features of complex data sets."

We are looking for potential collaborators both on the planned research activities as well as eventual joint organization and/or hosting of community activities such as topical workshops, training of students and postdocs on ML-related methods and technologies and eventual data challenges to engage the larger AI research community.

[1] `https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505686`