Snowmass 21 Computational Frontier
Topical group on ML

June 11, 2020

- Physics-specific ML
  - Enforcing symmetries, limits, boundary conditions
  - Data on manifolds or graphs
  - Uncertainty-aware models
  - Heterogeneous data structures
- Interpretability and validation
  - Quantifying systematic uncertainties
  - Uncertainty measures
  - Exactness proofs
  - ML for data reconstruction
- Community tools and standards
  - Software
  - Data structures
  - Protocols for building and/or adapting from industry or wider community
- Resource needs and management
  - Co-processors e.g., FPGA, GPU
  - Real-time ML
  - Cloud processing, needs of small and large groups
  - Centralized vs. distributed computing and data storage resource
  - Distributed computing
  - Scalability to exascale and beyond
- Education and engagement
  - Physics-ML specific courses, schools, degrees, workshops

    - Outreach and community building beyond HEP (e.g. CS)
    - Curation of open data sets for open science
    - Ethics and safety of AI

- Case studies: the role of ML in HEP. These are meant to be examples that highlight the role of ML in HEP, not an exhaustive list.
    - Expt Trigger example: LHCb trigger (https://arxiv.org/abs/1510.00572)
    - Expt Analysis example: ATLAS Dijet resonance search with weak supervision (https://arxiv.org/abs/2005.029
    - Expt examples: Track reconstruction (https://arxiv.org/abs/2003.11603)
    - Theory example: Gauge field generation in lattice field theory with exact algorithms based on generative flow models (https://arxiv.org/abs/2003.06413)