Summary of "Tackling Climate Change with Machine Learning"

Climate change is one of the greatest problems society has ever faced, with increasingly severe consequences for humanity as natural disasters multiply, sea levels rise, and ecosystems falter. In recent years, a branch of artificial intelligence called machine learning has been recognized as a broadly powerful tool for technological progress. Many experts in machine learning (ML) wish to apply their skills to tackle climate change, but are uncertain how. On the other side, many fields have begun actively seeking input from the ML community.

This paper aims to provide an overview of where machine learning can be applied with high impact in the fight against climate change, through either effective engineering or innovative research. We look at strategies both for mitigation (reducing greenhouse gas emissions) and for adaptation (preparing for unavoidable consequences), as well as meta-level tools that enable other strategies. The diversity of problems posed by climate change can be seen as an opportunity: there are many ways to have an impact.

Among the many specific opportunities we highlight for impactful work, we observe several overarching ways in which ML can be helpful. ML can enable automatic monitoring through remote sensing (e.g. by pinpointing deforestation, gathering data on buildings, and assessing damage after disasters). It can accelerate the process of scientific discovery (e.g. by suggesting new materials for batteries, construction, and carbon capture). ML can optimize systems to improve efficiency (e.g. by consolidating freight, designing carbon markets, and reducing food waste). And it can accelerate computationally expensive physical simulations through hybrid modeling (e.g. climate models and energy scheduling models). These and other themes are highlighted in more detail within the paper.

All of the opportunities we describe require collaboration across fields. Working with domain experts reduces the chance of using powerful tools when simple tools will do the job, of working on a problem that isn't actually relevant to stakeholders, of overly simplifying a complex issue, or of failing to anticipate risks. Collaboration can also help ensure that new work reaches the audience that will use it.

Applying machine learning to tackle climate change has the potential both to benefit society and to advance the field of machine learning. Many of the problems we discuss highlight cutting-edge areas of ML, such as interpretability, causality, and uncertainty quantification. Moreover, meaningful action on climate problems can lead to interdisciplinary innovations, such as better physics-constrained ML techniques.

That said, machine learning is not a silver bullet. The applications we highlight are impactful, but no one solution will "fix" climate change. There are also many areas of action where ML is inapplicable, and we omit these entirely. Furthermore, technology alone is not enough – technologies that would address climate change have been available for years, but have largely not been adopted at scale by society. While we hope that ML will be useful in reducing the costs associated with climate action, humanity also must decide to act.