Microsoft

AI for Earth Grantee Profile

David Dao

GainForest

Summary

Deforestation is one of the significant contributors of greenhouse gases and drivers of climate change. Much of that deforestation comes from local farmers trying to make their living, which presents the possibility of combating it by offering financial incentives to preserve the trees. In many areas, such as the Amazon forest, it would be too time-consuming and difficult to determine who has the legal claim to be the caretaker for a particular section of forest. AI researcher David Dao and his team came up with an innovative alternative: help make everyone a caretaker of the forest by letting anyone put a financial stake in its well-being and earning a higher repayment when it is conserved. Through AI technologies on Microsoft Azure, including machine learning and blockchain-enabled smart contracts, Dao was able to make this concept, GainForest, a reality.

Fighting deforestation with deep learning and smart contracts

Although forests pull carbon dioxide out of the atmosphere, helping to maintain the global temperature and mitigate climate change, the converse is also true. Deforestation does not just reduce that capacity for carbon storage, it also adds that carbon back into the atmosphere. As the World Wildlife Fund (WWF) documents, deforestation and forest degradation are responsible for 15 percent of all greenhouse gas emissions.

> Deforestation and forest degradation are responsible for 15 percent of all greenhouse gas emissions and must be reduced to avoid calamitous climate change.

Many of the critically endangered areas are tropical rainforests with high biodiversity, such as the Amazon, which has lost 17 percent of its forest in the past 50 years. Most of that loss (around 80 percent) is due to local farmers clearing the forest for cattle ranching or crops. This process not only reduces the forest but also exhausts the soil after providing only a short-term burst of fertility, perpetuating the demand for more forest clearing. As deforestation continues, it drives further calamitous climate change—in addition to reducing biodiversity, changing water cycles, increasing erosion, and disrupting societies.

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Because much of the deforestation comes from local people just trying to make a living, one possible approach to curtailing deforestation is to offer financial incentives: simply pay people to not cut down forests. The United Nations launched its Reducing Emissions from Deforestation and Forest Degradation (REDD+) program in 2008 on that concept at a national level. REDD+ offers financial incentives to developing countries to reduce their emissions from forested lands and engage in conservation and sustainable management.

A study of one project in Uganda (as reported in *Nature*) showed that when villagers were contracted to preserve hectares of forest and paid equivalently to what they might have earned for cutting down the trees, significantly more of the forest was maintained—and at a total project cost of less than half the estimated cost if the trees' carbon had been released. However, in many areas such as the Amazon, it's often a huge, time-consuming challenge to determine who are the direct caretakers for any given part of the forest.

Turning everyone into forest caretakers

At the UN Climate Change Conference in 2017 (COP23), AI researcher David Dao came up with a potential solution. Dao's team participated in the #hack4climate challenge, a program to drive innovative technology solutions that can help make significant advances toward achieving the climate action goals of the Paris Agreement. Dao says, "The United Nations' REDD program is discouraging deforestation by offering financial incentives and education programs to local farmers. We wanted to help the UN come up with a new way of making the distribution of their funds more performance oriented."

> "We wanted to help the UN come up with a new way of making the distribution of their funds more performance oriented."—David Dao

The team's concept had a simple basis: instead of trying to determine the specific people to give incentives as forest caretakers, they would build a system that could enable anyone to have a financial stake in forest conservation, turning everyone into caretakers. With this system, people would invest funds in protecting sections of the forest in hopes of gaining a return. After a certain period of time, the changes would be assessed, and where a section was deforested, those investors would lose their stake, with those funds redistributed to reward investors in sections that were preserved. Through this method, anyone from local tribes and landowners to squatters, NGOs, local governments, and others would have an incentive to participate in actively fighting deforestation, regardless of their legal ties to the land.

Using AI technology to support the stakeholder system

Making this method work are three technology-enabled parts. First, combining satellite photography with AI image analysis enables automated monitoring of the forests, to easily determine where the trees are being preserved and where they are being removed.

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Second, a machine learning algorithm can be trained to predict which areas of a forest are at risk of deforestation, and how great that risk is. This part helps set the rewards for investing in the forest—the higher the risk for a section to be removed, the greater the reward if it's preserved.

Third, smart contracts using blockchain technology enable the efficient, transparent, and highly secure transfer of funds based on the AI-verified status of the forest. People may also choose to be donors to support the forest conservation, without receiving a financial return, and in this case the system again provides verification of its success. Following the COP23 hackathon, Dao and his team developed their concept and these parts into the GainForest initiative.

Thanks to a Microsoft AI for Earth grant, the GainForest team gained access to advanced cloud computing resources, including the AI and machine learning tools they needed to succeed. Dao explains, "Having access to Microsoft's Azure platform has been a game-changer for us. Beforehand, we didn't physically have the computing power to analyze the vast amounts of data we generated. Now, with Azure, we can train our algorithms to predict and monitor deforestation faster than ever before." The deep neural network learned to identify the systematic spread of deforestation and even detect human-caused deforestation structures such as fishbone roads. Azure was particularly useful for helping the team to integrate local IoT sensors with satellite images to build a more accurate forecast model.

Going forward

Currently, GainForest is working with UN-REDD+ and the government of Chile on a pilot project for sections of the Amazon and Valdivian forests in that nation. Later this year, Dao and his team plan to present GainForest to delegates at the COP25 UN Climate Change Conference, to show the potential this kind of technology has in helping to protect our planet.

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About David Dao

David Dao is a PhD candidate at ETH Zurich DS3Lab and researcher at Stanford University (re)inventing future machine learning systems. His research uses blockchain-based incentives and AI to realize new types of privacy-preserving data systems for sustainability, medicine, and ethics. He is a co-founder of GainForest, an award-winning non-profit that provides AI-powered conservation tools to prevent deforestation. He was an engineer in Silicon Valley and a research fellow at Berkeley AI Research (BAIR) and Broad Institute of MIT and Harvard. A Global Shaper at World Economic Forum, Dao organized several large conferences in Germany, Silicon Valley, and at Harvard. His work was featured in *MIT Technology Review*, *The Scientist*, *The New York Times* and at the United Nation's Climate Change conference.

Resources

Websites

GainForest site
David Dao's site
UN-REDD Program site
AI for Earth

Documentation

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