

Assignment 4

Astronomy and Space Sciences

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Can AI be used to understand facts about the topic and bring that topics from "pseudoscience" to "science".

In our efforts to understand the Universe, we're getting greedy, making more observations than we know what to do with. Satellites beam down hundreds of terabytes of information each year, and one telescope under construction in Chile will produce 15 terabytes of pictures of space every night. It's impossible for humans to sift through it all. As astronomer Carlo Enrico Petrillo told The Verge: "Looking at images of galaxies is the most romantic part of our job. The problem is staying focused." That's why Petrillo trained an AI program to do the looking for him.

Petrillo and his colleagues were searching for a phenomenon that's basically a space telescope. When a massive object (a galaxy or a black hole) comes between a distant light source and an observer on Earth, it bends the space and light around it, creating a lens that gives astronomers a closer look at incredibly old, distant parts of the Universe that should be blocked from view. This is called a gravitational lens, and these lenses are key to understanding what the Universe is made of. So far, though, finding them has been slow and tedious work.

That's where artificial intelligence comes in — and finding gravitational lenses is just the start. As Stanford professor Andrew Ng once put it, the capacity of AI is being able to automate anything "a typical person can do with less than one second of thought." Less than a second doesn't sound like much room for thinking, but when it comes to sifting through the vast amounts of data created by contemporary astronomy, it's a godsend.

Some of the biggest challenges of the next generation of astronomy lie in studying all the data. To take on the challenges, astronomers are turning to machine learning and artificial intelligence (AI) to build new tools to rapidly search for the next big breakthroughs.

Here are the four ways in which AI is helping astronomers.

1-Planet hunting: There are a few ways to find a planet but the most successful has been by studying transits. When an exoplanet passes in front of its parent star, it blocks some of the light which the humans can see. AI's time-series analysis techniques, which analyse data as a sequential sequence with time have been combined with a type of AI to successfully identify the signals of exoplanets with up to 96 per cent accuracy.

2- Gravitational waves: Time-series models aren't just great for finding exoplanets, they are also perfect for finding the signals of the most catastrophic events in the universe. By training models on simulated data of black hole mergers, we can identify potential events within moments of them happening and send out alerts to astronomers around the world to turn their telescopes in the right direction.

3-The changing sky: When the Vera Rubin Observatory, currently being built in Chile, comes online, it will survey the entire night sky every night - collecting over 80 terabytes of images in one go - to see how the stars and galaxies in the universe vary with time. One terabyte is 8,000,000,000,000 bits.

4-Gravitational lenses: One celestial phenomenon that excites many astronomers is strong gravitational lenses. This is what happens when two galaxies line up along our line of sight and the closest galaxy's gravity acts as a lens and magnifies the more distant object, creating rings, crosses and double images. In 2018, astronomers from around the world took part in the Strong Gravitational Lens Finding Challenge where they competed to see who could make the best algorithm for finding these lenses automatically. The winner of this challenge used a model called a convolutional neural network, which learns to break down images using different filters until it can classify them as containing a lens or not.