

Detection and Analysis of Exoplanets using Machine Learning Techniques

Lance Dacy¹, Aurian Ghaemmghami², Aniketh Vankina³, and Jamie Vo⁴

Abstract—The Earth’s population continues to grow at a steady rate. The natural resources on Earth are in limited supply. The need to find other worlds that could contain life becomes more focused and intense in the past few years. Scientists desire to find exoplanets that have the features similar to Earth for sustaining life, not only for curiosity sake, but for potential new places for humans to thrive. The data collected over the centuries is so large that filtering the data becomes problematic. With new technologies that use a machine’s processing power, data science methods could help scientist evaluate this data and its patterns to narrow down exoplanets that could sustain life as we know it. The data needed to model these exoplanets need to be easily consumed; this project will focus on the viability of deploying cloud data stores specifically to aid in exoplanet modeling.

I. INTRODUCTION

Are we alone in the Universe? That is an age-old question that humans having been striving to answer since we first identified that our planet is simply a small part of a larger whole. Earth appears to be one of the planets in the whole Universe that has just the right ingredients to host life. Or is it? The science continues to explore that question "Are we alone?" and have developed a systematic approach of the course of centuries to help compile data that might just answer that question.

We live in a technology age where it is feasible to gather mounds of data about our Universe. Even better, we live in a technology age where computers can assist in stitching that data together to help find the patters that point us in the right direction for an answer. Our Data Science Team joins the ranks of numerous scientist to help analyze the myriad data gathered from the Universe to find the building blocks essential to host life as we know it. Given the quest for life as we know it, scientist narrow down the building blocks to a simple acronym called CHNOPS. CHNOPS stands for Carbon, Hydrogen, Oxygen, Phosphorus, and Sulfur. These are the base elements believed to provide the building blocks for living organisms. Finding a place in the Universe that contains these elements is much like finding a needle in a haystack.

Aside from the fact that the human race has a quest to find others in the Universe, there is also another need that needs to be sustained. We will eventually consume all the natural resources on this precious Earth. The Earth’s population continues to grow at a rate of 1.05% [1].

The planet’s resources are expected to cap at nearly 8 billion people. The Earth currently inhabits 7.8 billion as of July 2020. Earth’s estimated timeline to maintain complex life is anticipated to cease to exist as early as 1.5 billion

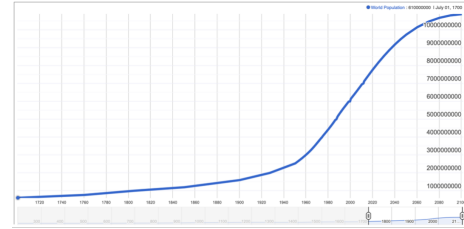


Fig. 1. World Population: Past, Present, and Future. The graph displays the population increase from the 1700’s to present day. [4]

years. Apart from discovering life at a habitable planet, space exploration allows humankind to gain a greater understanding of the cosmos and potentially answer the question of, “Is there life beyond Earth?” [2] and more importantly, could we catapult the human race to this newfound habitable planet.

As mentioned earlier, the good news is that we have mounds of data that have been collected over the last centuries. What is lacking is a good way to determine patterns in all of the data with computational cycles of the human brain. NASA has collected Kepler data that is a repository of the type of information needed to answer some of the questions of the human race. Unfortunately, as with most big data systems, the repository is data rich, but information poor. It is becoming increasingly difficult to filter the data to meaningful levels. The data contains information on image sources, light measures, and gravity among other things. In conjunction with the volume of data is the unknown requirements that confirm if a planet is habitable, analyzing the parameters pouring in to confirm a planet, and understanding the cosmic web that connects the galaxies which hold potential habitable planets.

This project’s goal is aimed at answering the following problem: Based on the myriad data available about space exploration, is it possible to provide an estimate of the number of other exoplanets in the Universe that are able to maintain life as we know it? In addition, could a repeatable hosted data center be built that allows for the community to consume and build algorithms for this specific purpose; easing the issue of data filtering? The main contributions to this paper are mentioned in the references section which supports the understanding of the science behind this data. In the early stages of the paper, the team will discuss the motivation behind the problems statement and then continue on into the methodologies considered. More focus will be aimed at the hosting and replication of the data using Amazon Web Services (AWS) than the actual algorithms

used to determine habitual planets. Nonetheless, the team will demonstrate a few algorithm techniques to prove out the hosting platform and its feasibility. The team will then explore methodologies in deep learning and machine learning that are widely used in the application of exoplanet scientific research. This will entail creating a working model to detect exoplanet feasibility based on configurable parameters set by the scientists and showcase the platform of data that will be served against those models. The team will then move on to the various milestones of the project which are the ability to collect the data, store the data in the Cloud (AWS), configure ETL processes that can be consumed, and then deploy a few machine learning models that will consume the data store.

II. MOTIVATION

III. METHODOLOGY

IV. MILSTONES-DATA COLLECTION

V. MILESTONES-DATA STORAGE IN THE CLOUD

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- Item 1
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TABLE I
DEANONYMIZE CLASSIFICATION

	client ACK	server data	server ACK	server data
detection rate	96%	94%	96%	94%
false negative	4%	6%	4%	6%
false positive	0%	0%	0%	0%

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VI. MILESTONES-ETL (EXTRACT, TRANSFORM, AND LOAD)

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dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum:

- 1) Client: a client of the Tor network is targeted to identify it.
- 2) Server: the Tor onion (hidden) service is targeted to reveal its identity or to weaken it.
- 3) Network: the broader Tor network itself is targeted, usually via multiple malicious Tor nodes.

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VII. MILSTONES-MACHINE LEARNING MODELS

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TABLE II
TRAFFIC ANALYSIS THROUGH FLOW CORRELATION

	In-Lab	Tor Relay
De-anonymized	100%	81.4%
false negative	0%	12.2%
false positive	0%	6.4%

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VIII. CONCLUSIONS

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