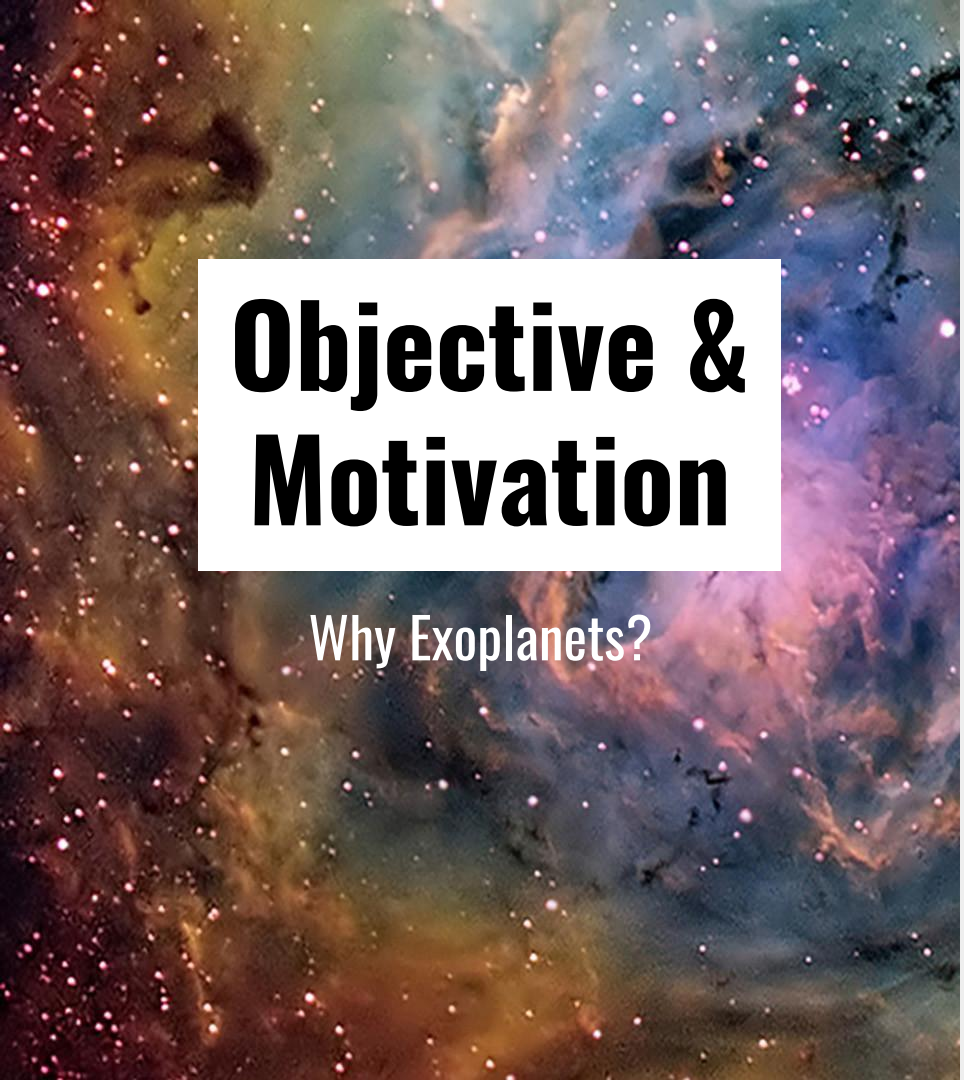
Exoplanets

Humans Escape Route

TEAM 8
Andrew Brannon
Devanshi Mathur
Jessica Bailey
Judy Xia
Yun Kim

Introduction

What is “**Exoplanet**”	An exoplanet is a planet beyond our solar system. Most exoplanets orbit other stars but there are some free floating exoplanets that are called rogue planets, that orbit the galactic center instead of a star.
Why is it important?	The study of exoplanets is important because it helps us understand planetary diversity, discover habitable environments, learn about planetary formation, test scientific theories, and explore the potential for life beyond Earth.
Could exoplanets be **Humans Escape Route**?	While exoplanets offer a vast cosmic playground to explore, the challenges of vast distances, travel times longer than human lifespans, and the need for sustainable habitats present significant hurdles.



Objective & Motivation

Why Exoplanets?

- Find planets lying in Habitable Zone
- Create a live dashboard to show Sky Map with multiple layers showing exoplanets discovered, exoplanets in goldilock zone and exoplanets that can support life according to scientists
- Create charts to show the distance, discovery method, discovery year, planet mass, density etc

Planet-Hunting Methods

01	**Transit**	Watch a star for dips in brightness caused by a planet passing in front. Tells us planet's size, orbit, and distance. Helps discover and learn about exoplanets.
02	**Radial Velocity**	Measure a star's wobble caused by an orbiting planet's gravitational tug. Reveals planet's mass and orbit. Aids in finding and studying exoplanets.
03	**Microlensing**	Massive object's gravity magnifies light from a background star, revealing planet presence. Provides unique data on distant exoplanets.
04	**Imaging**	Astronomers can take pictures of exoplanets using techniques that remove the overwhelming glare of the stars they orbit

Goldilock Zone Calculations

The **"Goldilocks zone"** is a region around a star where a planet's distance allows for the potential of liquid water on its surface—crucial for life. It's not too hot or too cold, but just right.

The habitable zone depends on factors such as:

- -star's luminosity
- -size
- -temperature,
- -planet's atmosphere, albedo (reflectivity)
- - greenhouse effect.

These elements interact to determine the range of distances from the star where conditions might be suitable for liquid water to exist on a plane

Stage 2: Approximate the radii of the boundaries of the host star's habitable zone

$$r_i = \sqrt{\frac{L_{star}}{1.1}}$$

$$r_o = \sqrt{\frac{L_{star}}{0.53}}$$

Where:

This method approximates habitable zone radii using stellar luminosity and stellar flux following methods presented by Whitmire et al., 1996, cited below.

r_i = the inner boundary of the habitable zone in astronomical units (AU)

r_o = the outer boundary of the habitable zone in astronomical units (AU)

L_{star} is the absolute luminosity of the star

1.1 is a constant value representing stellar flux at the inner radius (based on Kasting et al., 1993, cited below; Whitmire et al., 1996, cited below)

0.53 is a constant value representing stellar flux at the outer radius (based on Kasting et al., 1993, cited below; Whitmire et al., 1996., cited below)

Workflow

01	Build Flask powered Exoplanet API to request data from SQLite DB	• Request NASA Archive API for raw data • Clean the data • Perform Goldilock Calculations • Save the CSV data as SQLite DB • Build Exoplanet API to request data from SQLite DB
02	Storing Web scraped data in MongoDB	• Scrape the NASA website to extract live values • Store the values in MongoDB
03	Create dashboard	• Using the data stored to create visualisations using HTML/CSS/Javascript • Used charts and sky map JS libraries to make webpage captivating

Insights

- We found 77 exoplanets that lie in the goldilock zone

- Out of these, 3 exoplanets are approved by scientists as they believe based on their other intrinsic properties these exoplanets can provide the suitable conditions for liquid water

Were we able to find an escape route from Earth if we had an apocalypse??
Determining if habitable exoplanets can support life is intricate. While a habitable zone is a guide, factors like atmosphere, surface conditions, chemistry, energy, and stability influence potential habitability. Our understanding is evolving, and future observations are key to unraveling this complex question.

References

- Exoplanets Counts
  - https://exoplanets.nasa.gov/
- Skymap
  - https://github.com/cds-astro/aladin-lite
- API Web Page
  - https://exoplanetarchive.ipac.caltech.edu/
- Charts
  - https://www.chartjs.org/

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