# Stars with Exoplanets

By Camdin and Jordan!

# Guiding Question

Is there a discernible relationship between the location of stars on the HR diagram and the presence of exoplanets, as well as how many exoplanets they may possess?

# An Interesting Combination

HR Diagrams:

- Intuitive and cool
- Exoplanets are something we haven’t looked at yet

# Python Libraries

Matplotlib - Visualization tools

Pandas - Dataframe tools

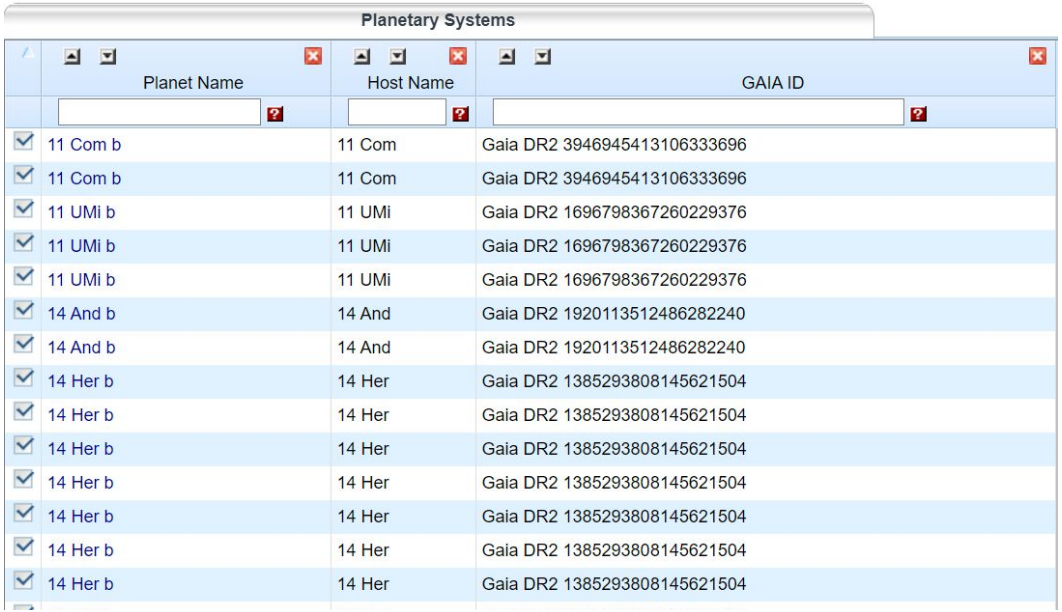
Numpy - Math

# Our Data

Nasa Exoplanet Archive(TESS Satellite)

Gaia Archive - Data Release 2

34,250 projected exoplanets



Planetary Systems

| Planet Name | Host Name | GAIA ID |
|---|---|---|
| 11 Com b | 11 Com | Gaia DR2 3946945413106333696 |
| 11 Com b | 11 Com | Gaia DR2 3946945413106333696 |
| 11 UMi b | 11 UMi | Gaia DR2 1696798367260229376 |
| 11 UMi b | 11 UMi | Gaia DR2 1696798367260229376 |
| 11 UMi b | 11 UMi | Gaia DR2 1696798367260229376 |
| 14 And b | 14 And | Gaia DR2 1920113512486282240 |
| 14 And b | 14 And | Gaia DR2 1920113512486282240 |
| 14 Her b | 14 Her | Gaia DR2 1385293808145621504 |
| 14 Her b | 14 Her | Gaia DR2 1385293808145621504 |
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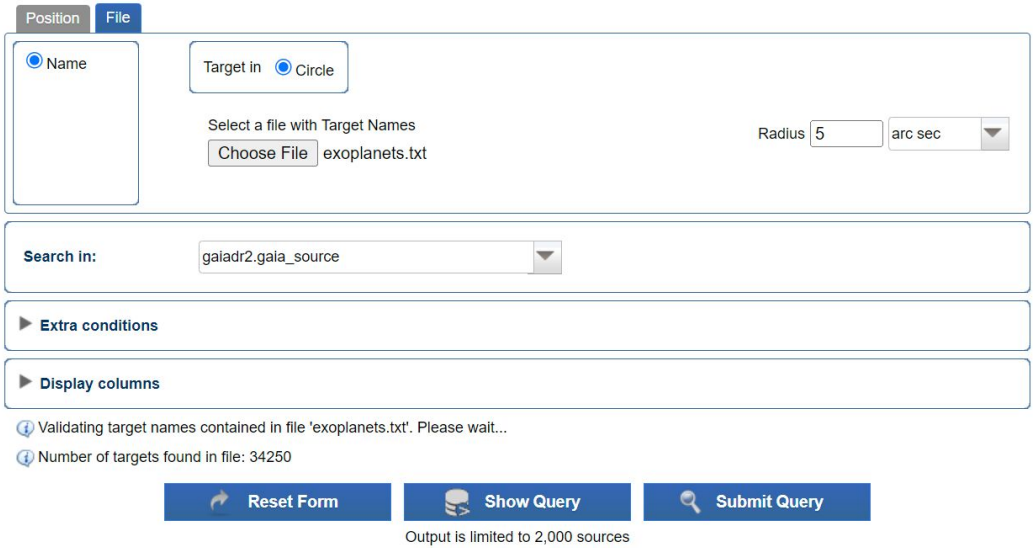
# Gaia Archive Search Tool

Put a txt file into it or search one star at a time(Star name or Gaia ID work)

```
11 Com
11 Com
11 UMi
11 UMi
11 UMi
14 And
14 And
14 Her
14 Her
14 Her
14 Her
14 Her
14 Her
14 Her
14 Her
14 Her
16 Cyg B
16 Cyg B
16 Cyg B
16 Cyg B
16 Cyg B
16 Cyg B
17 Sco
```



# Combining the two data sources

We needed to merge the star dataframe with the exoplanet dataframe

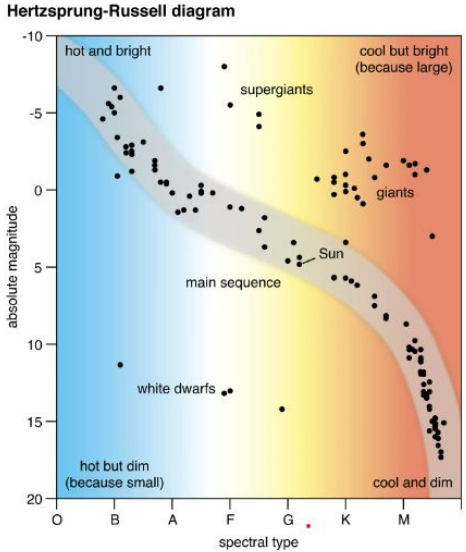
- Counted number of times each host star showed up(using a dictionary Data Structure)
- Used the python read function to write that to a .txt that could be put into the Gaia Archive(a few hurdles with the Data here)
- Took the list of stars and filtered out unnecessary columns
- 1651 stars with exoplanets*

.* Also had correct formatting in the databases

# Extracting Key resources

Once we had the data from Gaia we just needed to make HR diagrams:

- Color(B band - R band)([‘bp_rp’])
- Absolute Magnitude
- m-M = 5 * log(d/5), where M is absolute magnitude, m is perceived magnitude([‘photo_g_mean_mag’]), and d is the 1/([‘parallax’]).



# Getting the Results

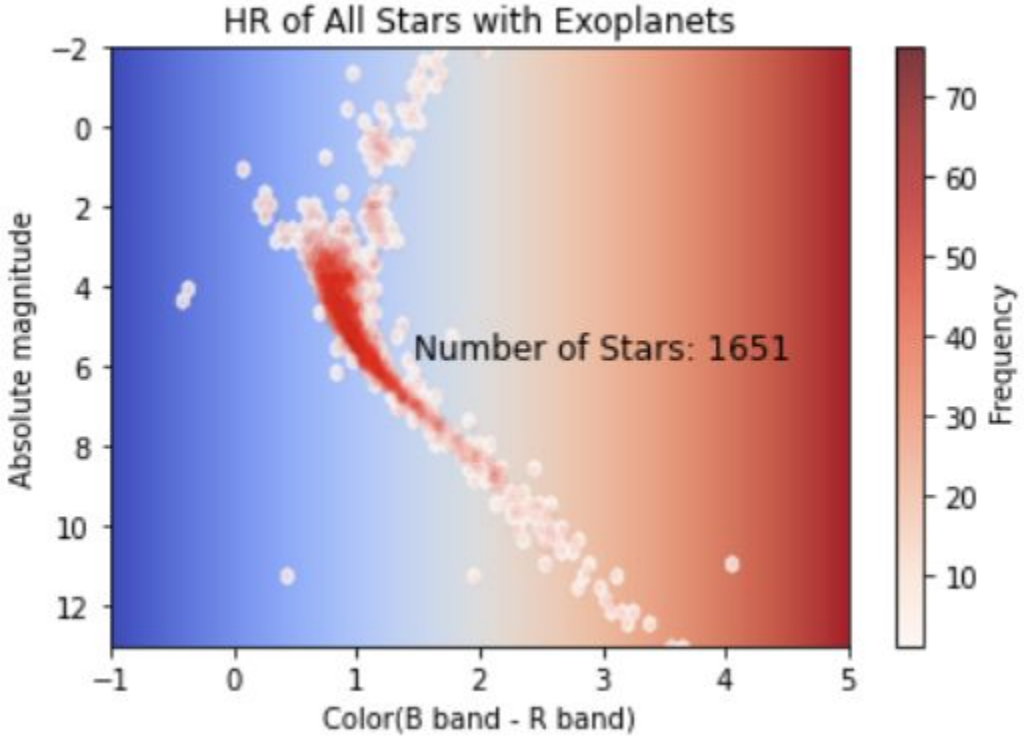
Plan

- Once we had all the data we did one initial HR diagram with all our stars
- We then split it up into several number brackets to examine different patterns

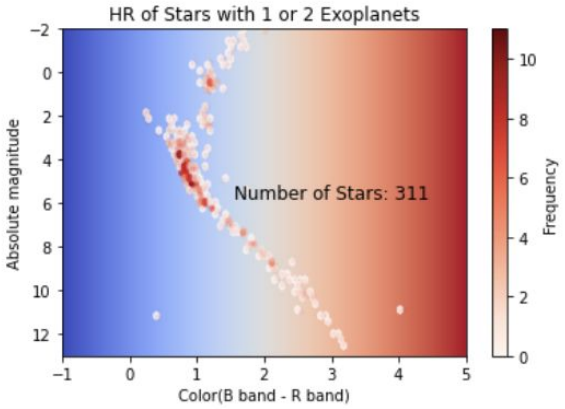
Plots

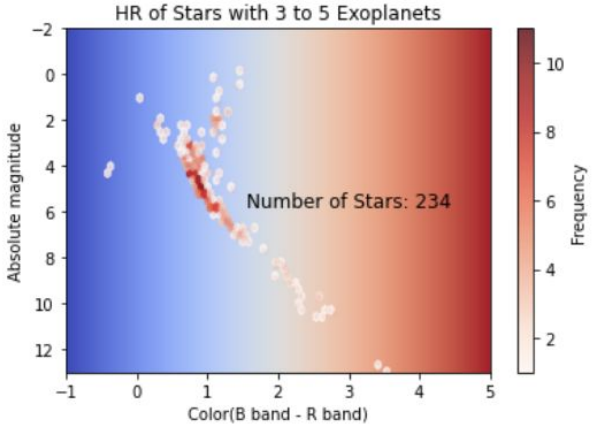
- We used the Matplotlib scatter plot to plot all the stars and we overlaid a hexbin graph on top of it to show point density.
- We used the plt.imshow() function to plot a color mesh on the background to make the proper color of the HR diagram.

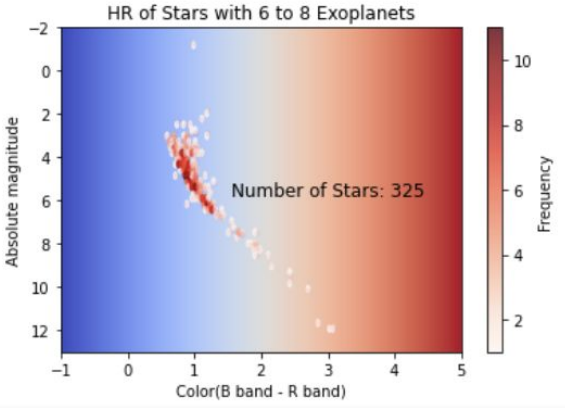
# Results - All-Stars

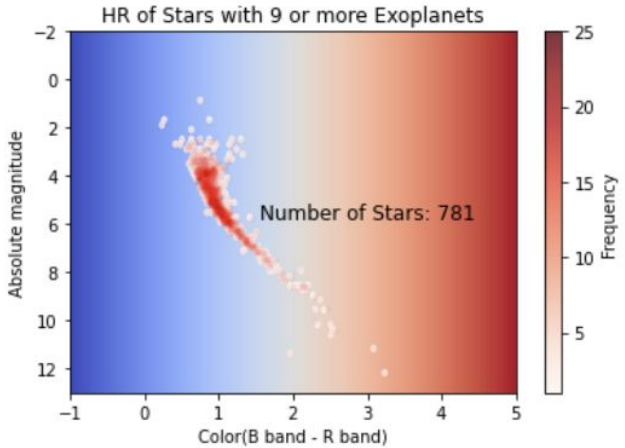


# Results - Number Brackets



# Conclusions - Missing Stars?

There aren’t any white dwarfs with exoplanets

- Post-Supernova not many would survive

For the big and bright blue stars

- Measuring problems- changes are extremely small for exoplanets - Mistaken for noise
- The stars gravity is just so strong that any matter was pulled into the star before it had the chance to form into planets.

# Key Limitation/Hurdles

Limitation

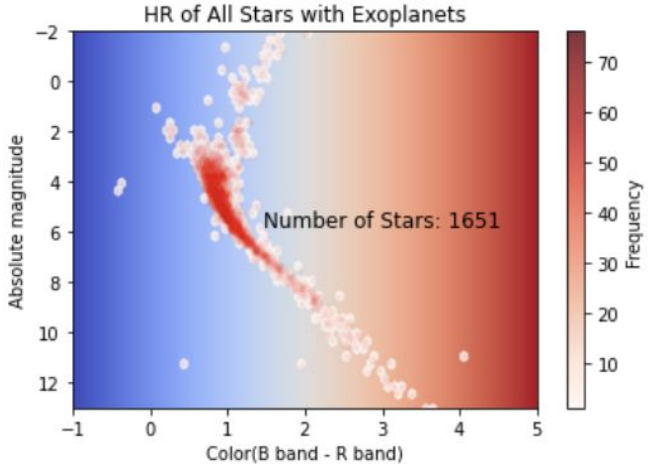
- One skew that might have happened is that bigger stars are more prominent and easier to see and measure the extremely precise measurements necessary to confirm the existence of exoplanets.
- Gaia Data Release 2 so not necessarily up to date.

Hurdles

- Dataset merging(i.e. naming differences)(Astroquery)
- Neither of us are Physics majors/hard to draw conclusions

# Further Research

- Take a look at the individual outlier stars to see what's going on.
- Do a statistical analysis on the properties of the stars other than just looking at the diagram



# Questions?