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Final Project Report

In our project we decided to take NASA's exoplanet archive and filter for planets that are possibly habitable. We decided on this project because we are both interested in exoplanets and thought that using our Python knowledge to filter for habitable worlds would be good practice for a possible real-world application of what we learned in this class. We used astropy for pretty much everything in the project as it was the simplest thing to use for the data we were given and worked very well once we learned a few key commands. We used "for" and "if" statements at the very end of our code in order to print out the exact exoplanets that matched our criteria and we got 7. We are quite happy with our results and believe that this project reflects our current understanding of using Python in real astrophysical situations.

We wanted to find exoplanets that are similar to Earth but that proved more challenging than we thought. Originally we were trying to find exoplanets with a 10-15% error of Earth with data about number of stars in the system, semi-major axis, solar mass, solar radius, solar temperature, planet equilibrium temperature, planet orbital period, planet radius and mass in Earths. This gave us nothing. It turned out that none of the exoplanets in the data we had exactly fit Earth's criteria even to a degree of 25% which we upped the error to. We realized that we weren't going to find any exoplanets exactly like Earth, so we decided to dramatically remove many of our filters to only keep the ones we thought were essential to a planet's possible habitability. We filtered it and ended up only using the number of stars in the system, planet equilibrium temperature, planet radius and we ended up with 7 exoplanets: K2-18 b, Kepler-1654

b, Kepler-22 b, Kepler-62 e, Kepler-62 f, LHS 1140 b, and TOI-4600 c. There was no exoplanet within our expected range with the original data set, so we filtered the data to fewer similar qualities and made our new error greater than 0.5 but less than 10 earth radii and planet equilibrium temperature greater than 175 but less than 270. We believe there to be more exoplanets that are similar to Earth but there was missing data from the NASA Exoplanet Archive and our data set was more simple than NASA's.

We have two conclusions from this project. The first is that Earth is really, really special. We were given 35,921 different data points to filter and not one of them exactly fit all the original Earth-like criteria we gave it. That definitely made us pause for a second because we realized just how special Earth is and how the conditions that happened here must be extremely rare throughout the cosmos. The second conclusion we came to is that filtering for habitability is not as straightforward as we thought it would be. You can't try to find planets that are exactly like Earth because they're extremely rare (as said before), but you also can't make the search criteria too loose because then you get planets that might not actually be habitable. NASA claims to have found potentially 59 habitable exoplanets, which is 52 more than we found with our code, which means that NASA's criteria must be incredibly fine-tuned and much more complicated than we originally thought. Go NASA!