

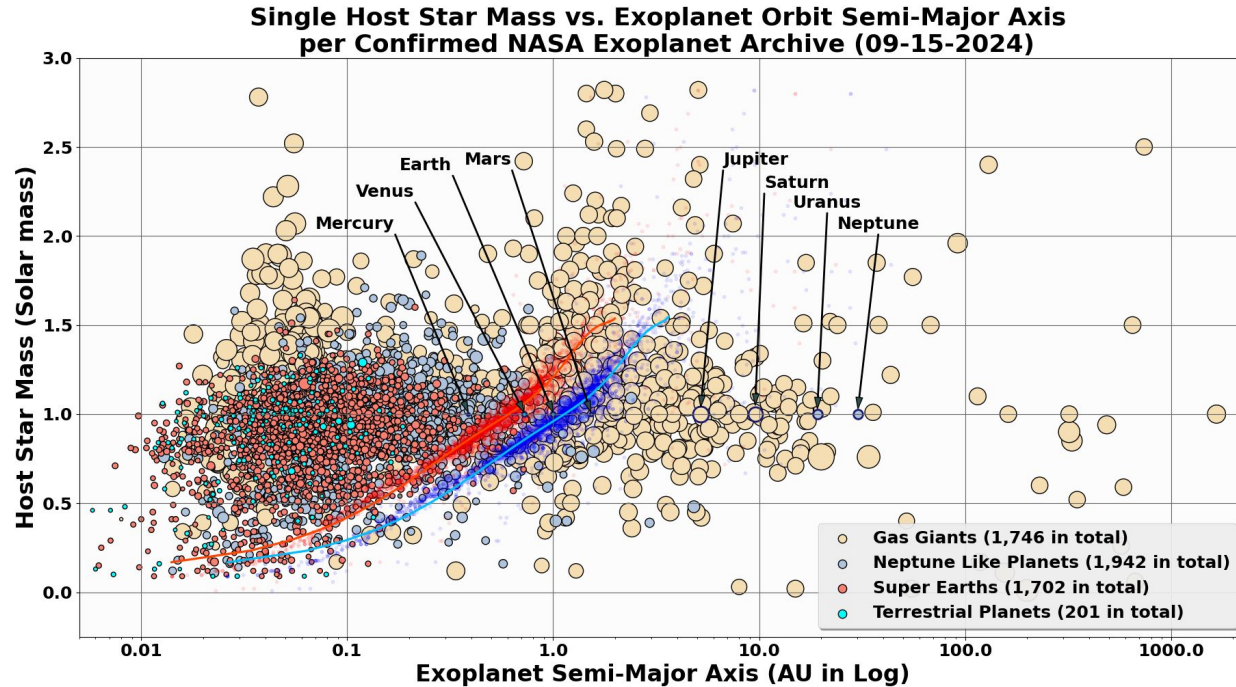
january 18th, 2025

exoplanet classification

Agenda

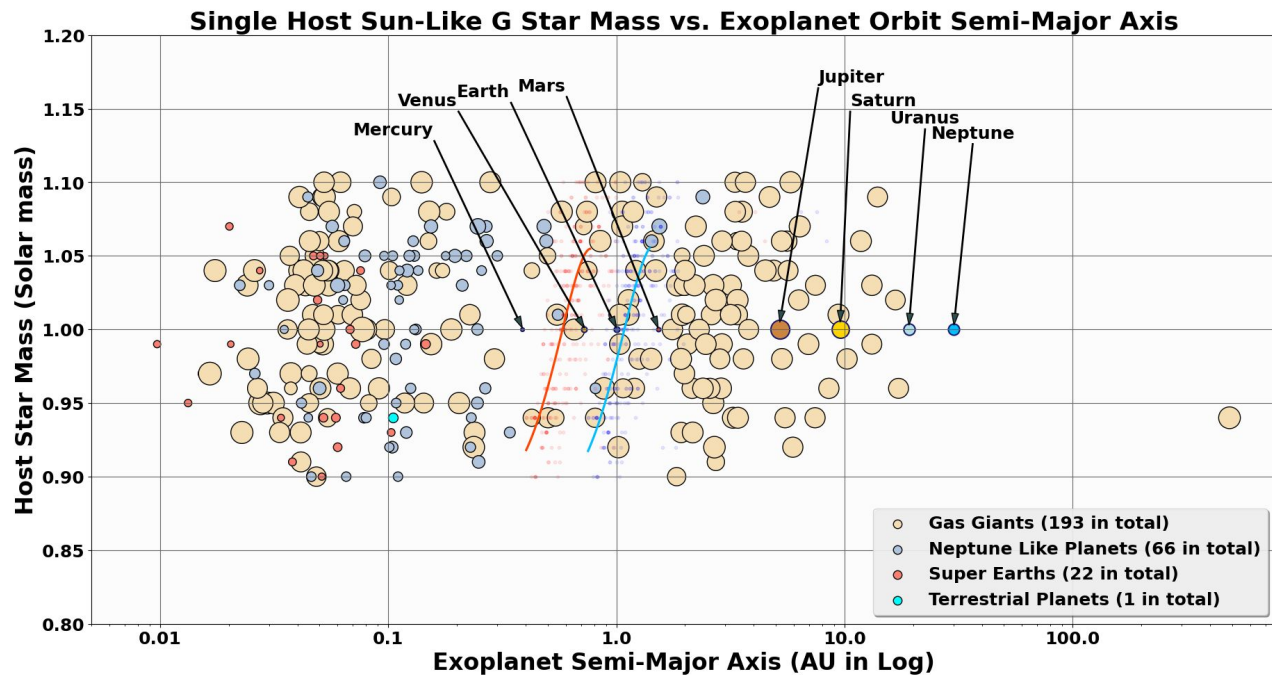
- single host star mass vs planet orbit graph
- single host sun-like G star mass vs planet orbit graph
- simple stellar system classes based on member planet types
- star mass vs planet orbit graphs per stellar system class

single host star mass vs planet orbit semi-major axis



- single host stars only.
- added solar system planets for references.
- exponent types fetched from [NASA Exoplanet Catalog](#)
 - Terrestrial
 - Super-Earth
 - Neptune-Like
 - Gas-Giant
- HZ inner and outer boundaries are calculated according to our [paper](#).

single host sun-like G star mass vs. exoplanet orbit



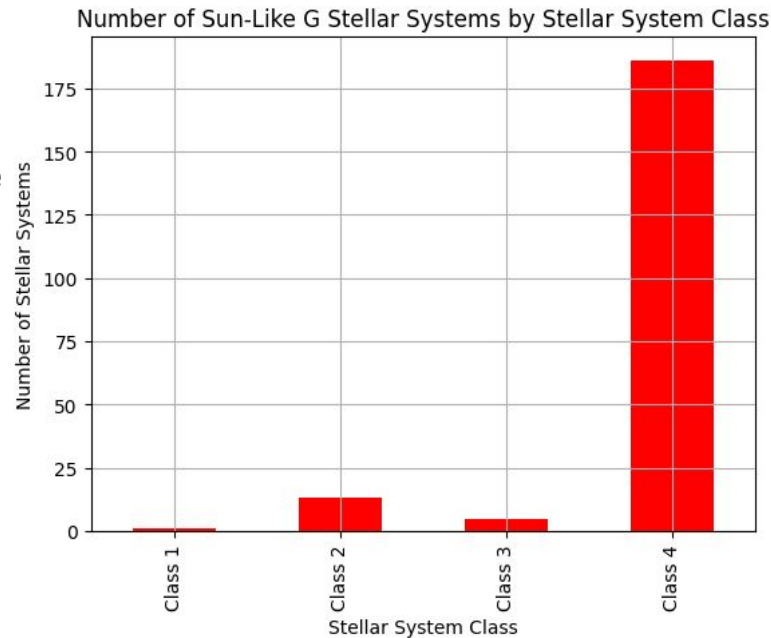
selection criteria:

- single host
- $0.9 \text{ solar_mass} \leq \text{star_mass} \leq 1.1 \text{ solar_mass}$

in total 205 G stars.

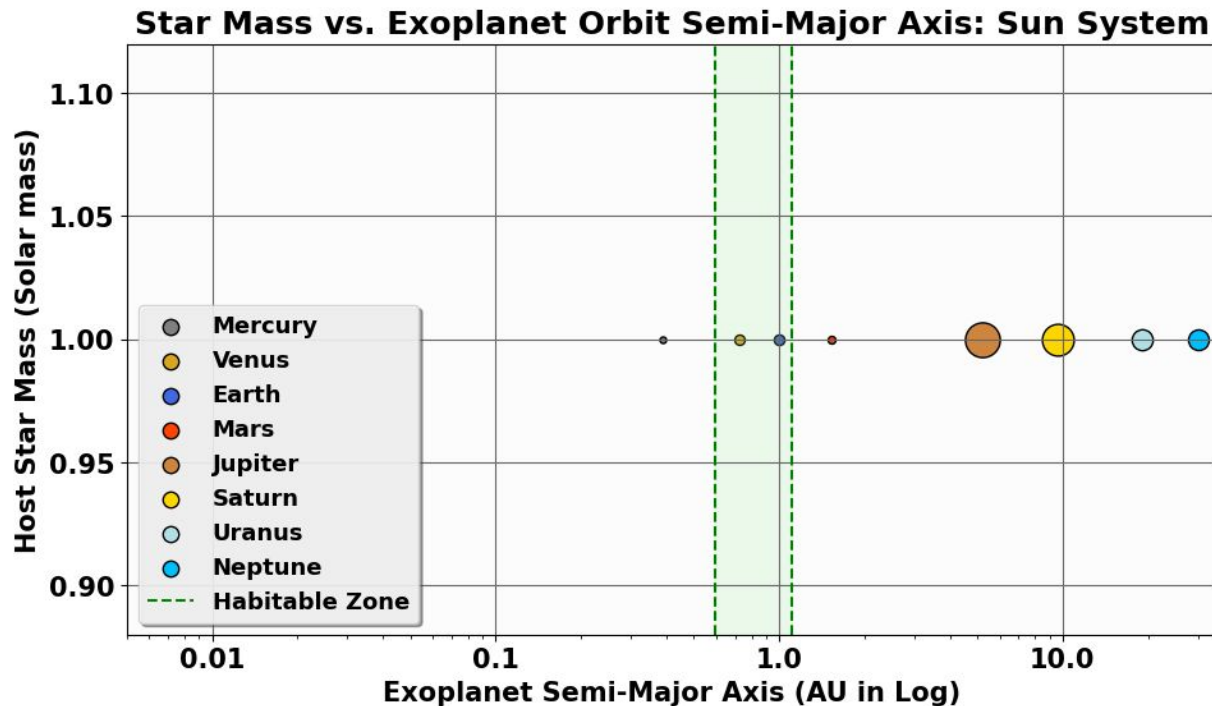
stellar system classes

- create simple stellar system classes based on member planet types:
 - **class 1:** at least one Terrestrial + at least one Neptune-Like or Gas-Giant
 - **class 2:** at least one Super-Earth + at least one Neptune-Like or Gas-Giant
 - **class 3:** only Terrestrial or Super-Earth
 - **class 4:** only Neptune-Like or Gas-Giant



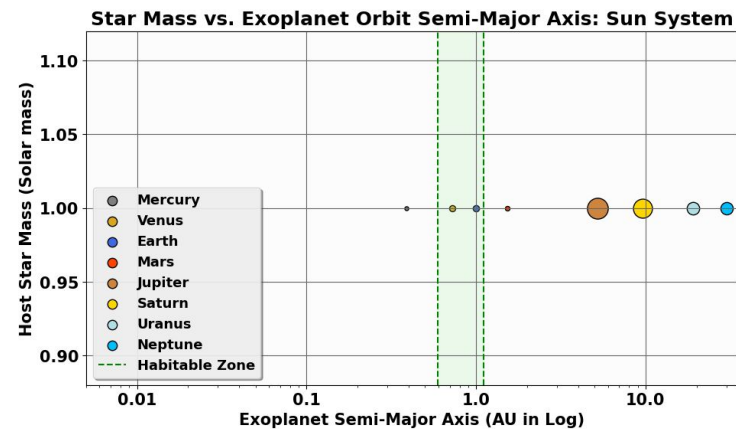
st_system_class	
Class 1	1
Class 2	13
Class 3	5
Class 4	186

star mass vs. exoplanet orbit: our solar system



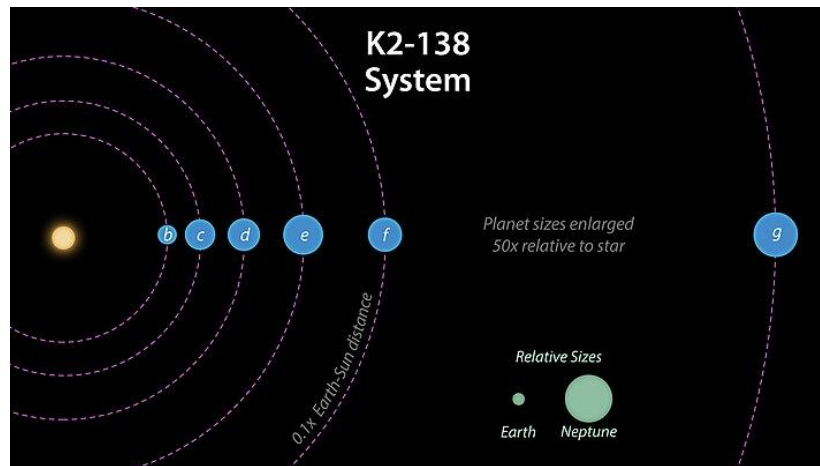
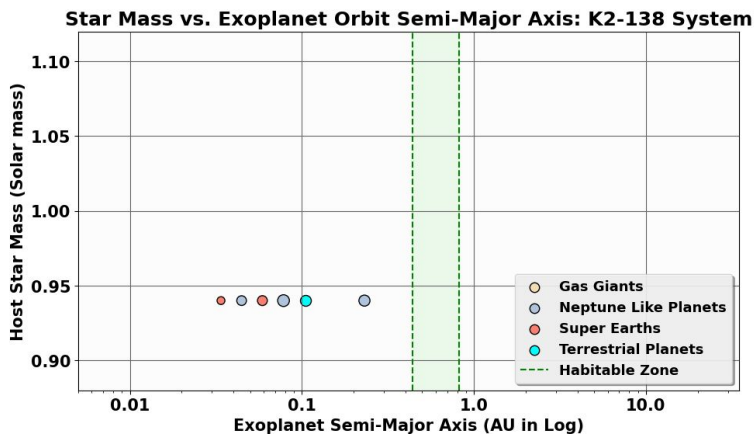
HZ inner and outer boundaries are calculated according to our [paper](#).

star mass vs. exoplanet orbit: class 1 stellar systems



[K2-138 overview at NASA exponent archive](#)

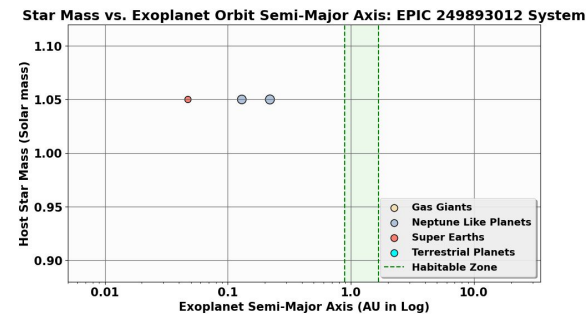
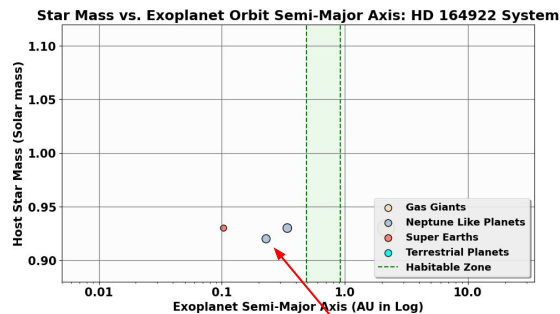
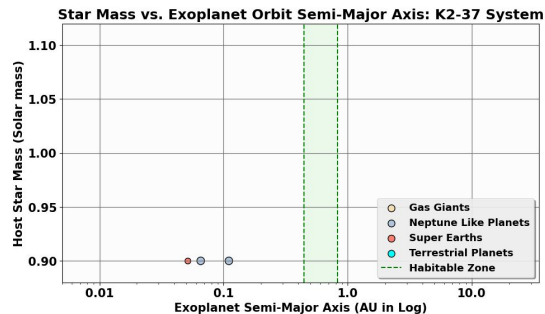
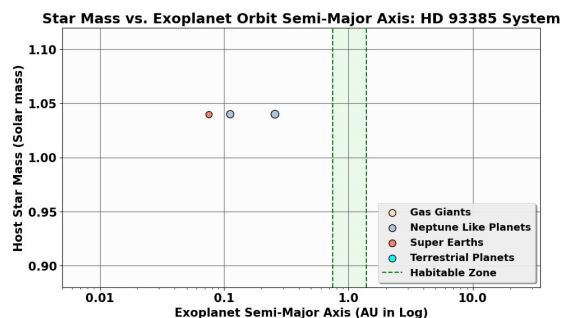
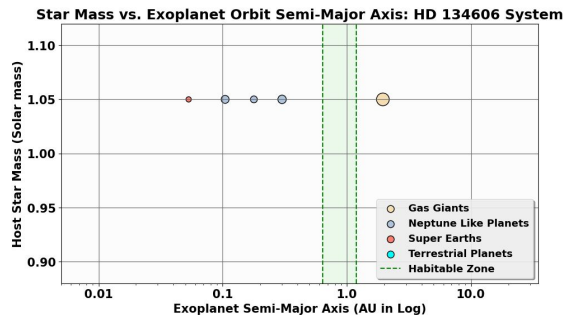
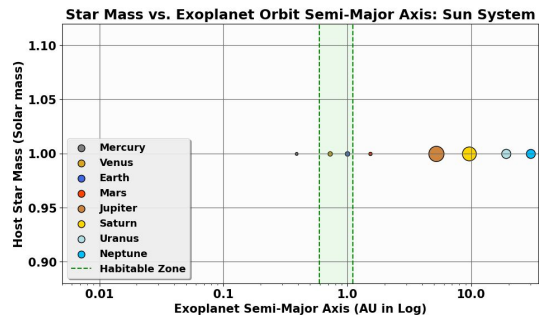
[K2-138 at wikipedia](#)



the above image comes from [wikipedia](#)

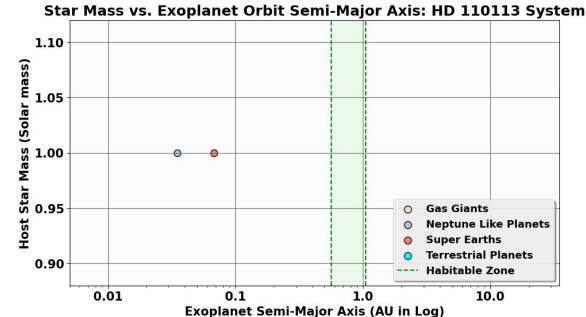
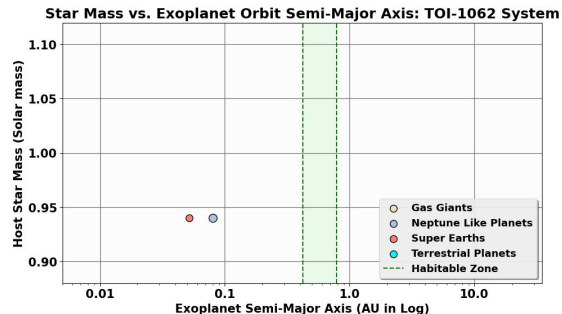
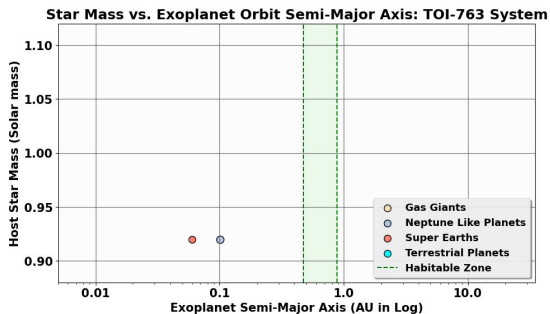
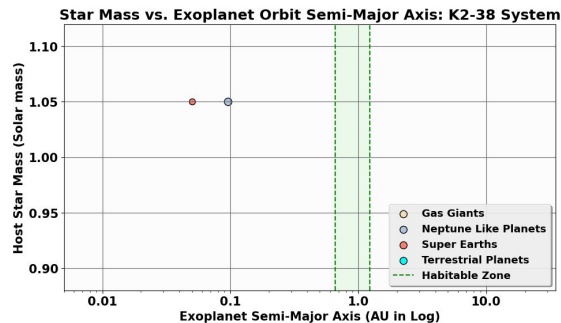
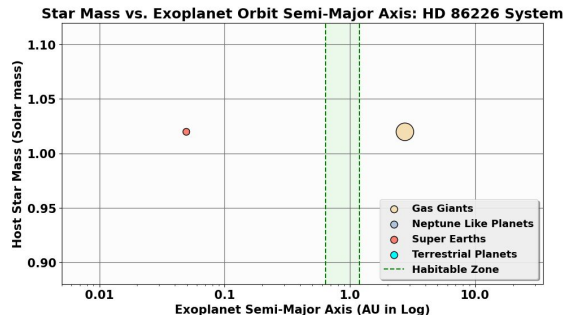
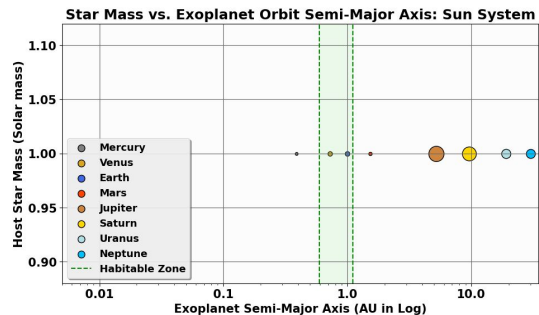
star mass vs. exoplanet orbit: class 2 stellar systems

[HD134606 at wikipedia](#)

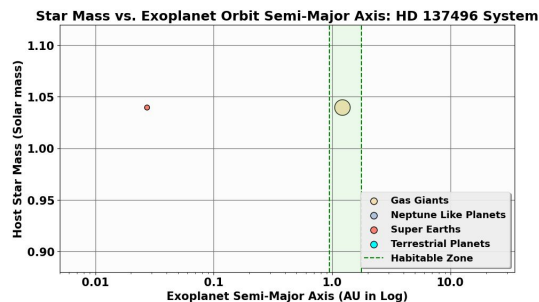
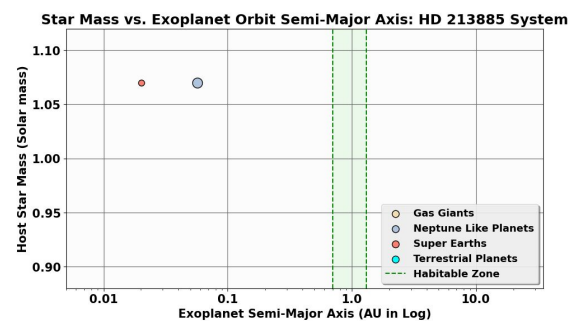
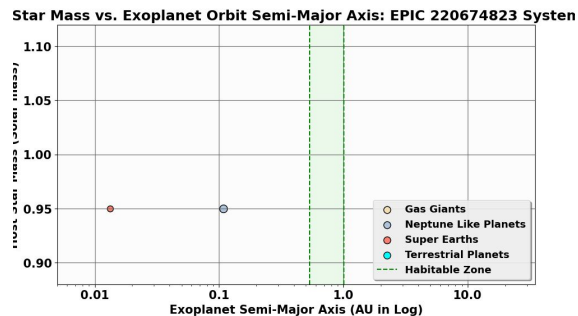
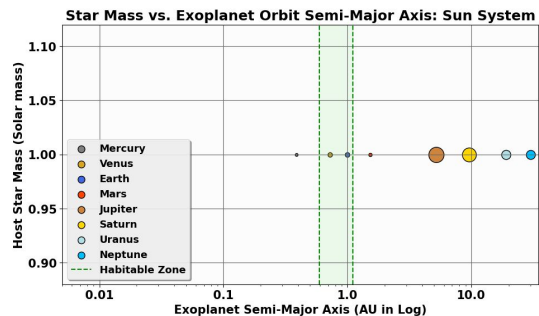


st_mass value for "HD 164922 e" is 0.92 in NASA Exoplanet Archive,
while other planets in the same system are 0.93

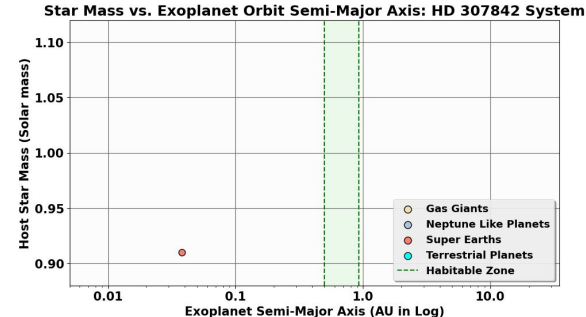
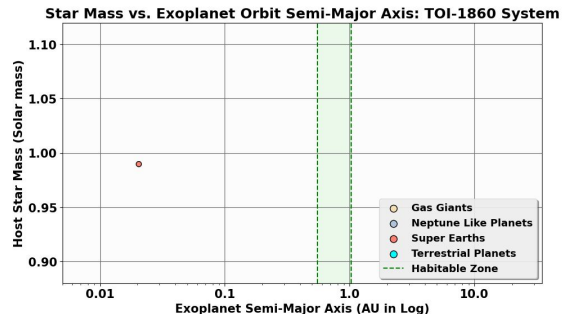
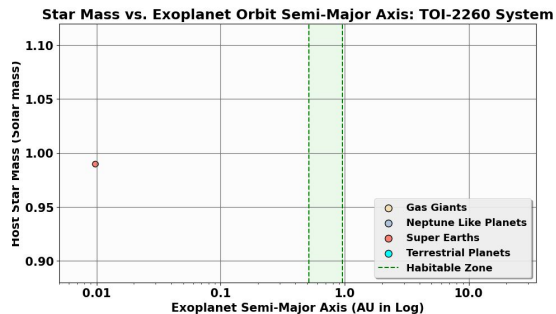
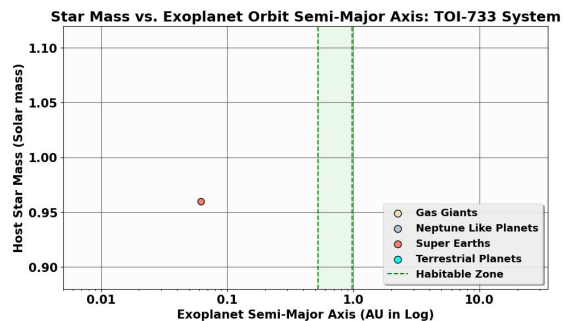
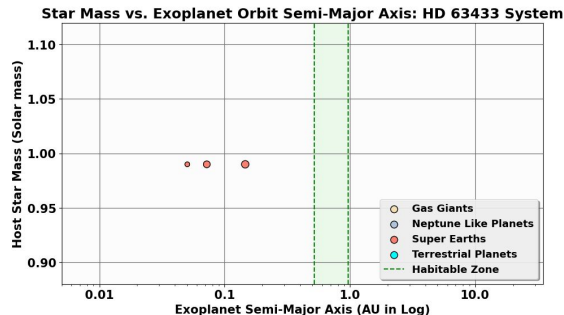
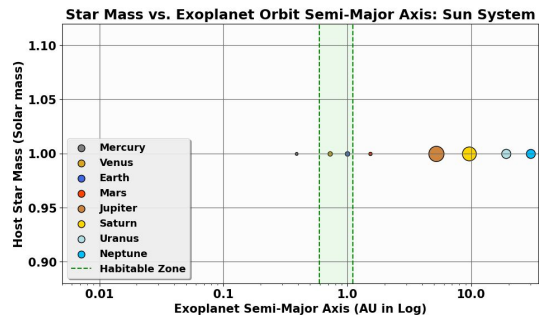
star mass vs. exoplanet orbit: class 2 stellar systems



star mass vs. exoplanet orbit: class 2 stellar systems



star mass vs. exoplanet orbit: class 3 stellar systems



future work

- try with different mass selection criteria for G stars: 0.8 ~ 1.2 solar mass
- experiment with the same for K stars: 0.6 ~ 0.8 solar mass
- maybe try with K-mean ML model to cluster stellar systems based on similarities?