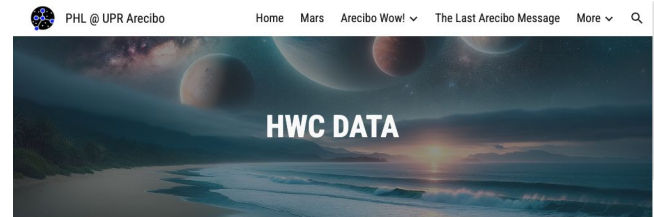# february 8th, 2025

exoplanet classification

Agenda

- join NASA exoplanet archive data with HWC, PHL @ UPR Arecibo
- analysis on the single-host stellar systems that contain conservative & optimistic habitable exoplanets
- star mass vs planet orbit graphs per stellar system class - conservative habitable
- star mass vs planet orbit graphs per stellar system class - optimistic habitable

joining NASA Exoplanet Archive with HWC, PHL

- join the NASA Exoplanet Archive data with [Hibitable World Catalog (HWC)](#) data from PHL @ UPR Arecibo

- HWC data contains a *P_HABITABLE* data field:
  - *P_HABITABLE = 1*: more likely to be rocky planets capable of surface liquid water
  - *P_HABITABLE = 2*: might include water worlds or mini-Neptunes, with less likelihoods of habitable conditions
  - *P_HABITABLE = 0*: non-habitable exoplanets

stellar system classes - recap

- 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

stellar spectral types (single host)

Number of Stellar Systems (Single Host) by Stellar Spectral Type
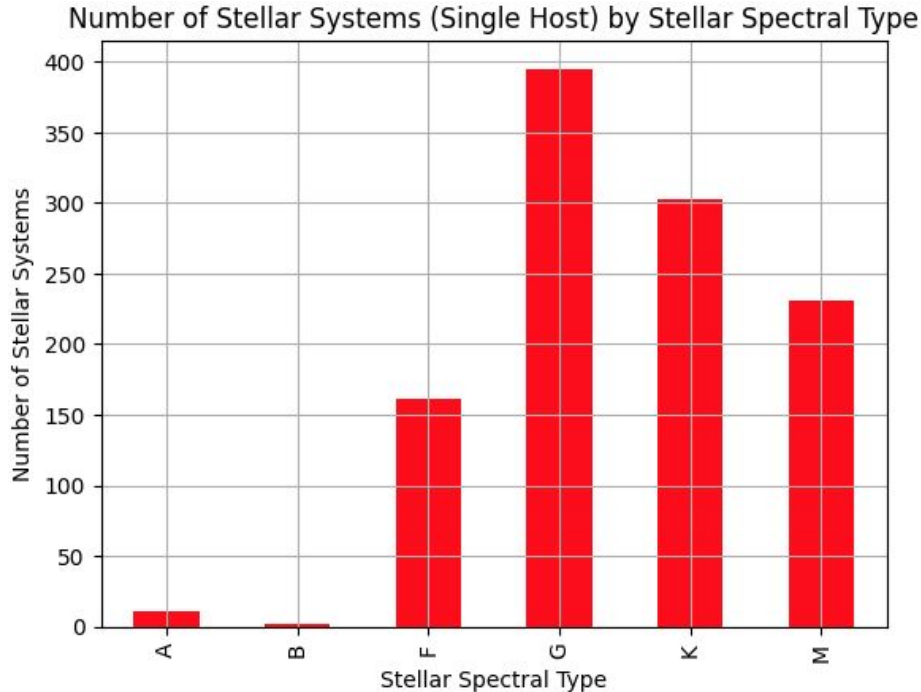
Notes:

- lots of stellar hosts in the NASA exoplanet archive data set miss spectral types
- data points with stellar spectral types other than OBAFGKM are dropped

st_spectype_short	
G	395
K	303
M	231
F	161
A	11

stellar system classes (single host)

Number of Stellar Systems (Single Host) by Stellar System Class
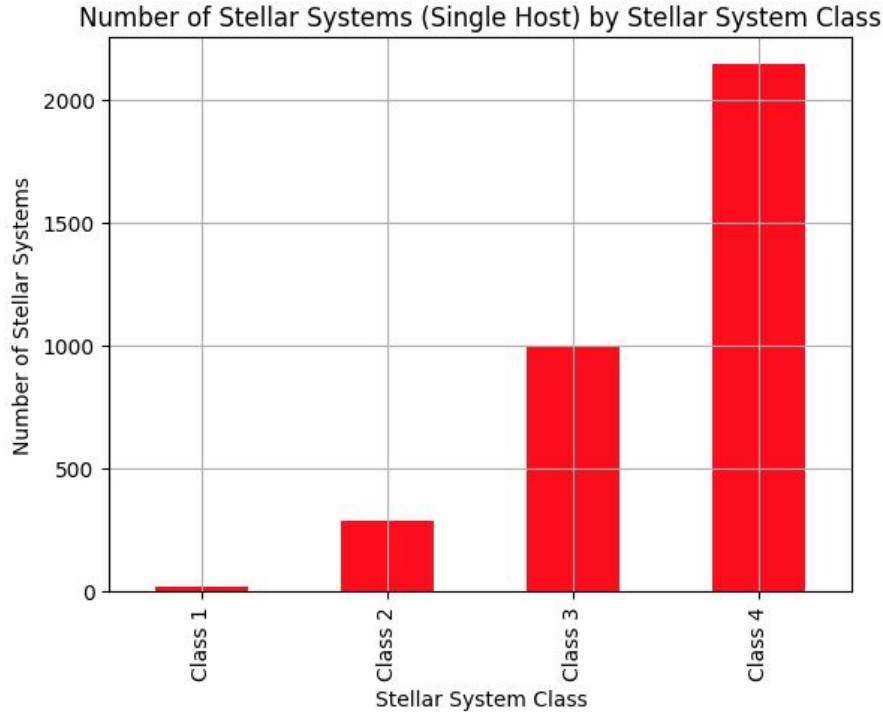

st_system_class	count
Class 1	18
Class 2	286
Class 3	997
Class 4	2144

simple stellar system classes:

- **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
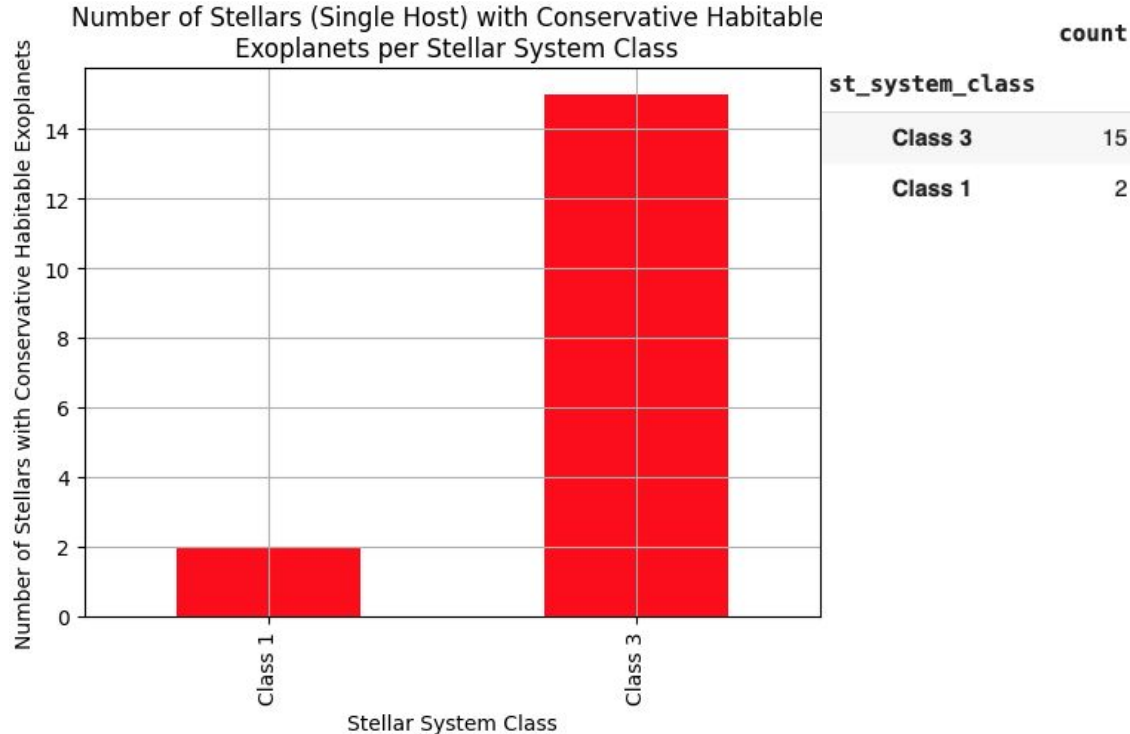- **class 4**: only Neptune-Like or Gas-Giant

stellar spectral types (single host) - with conservative habitable exoplanets

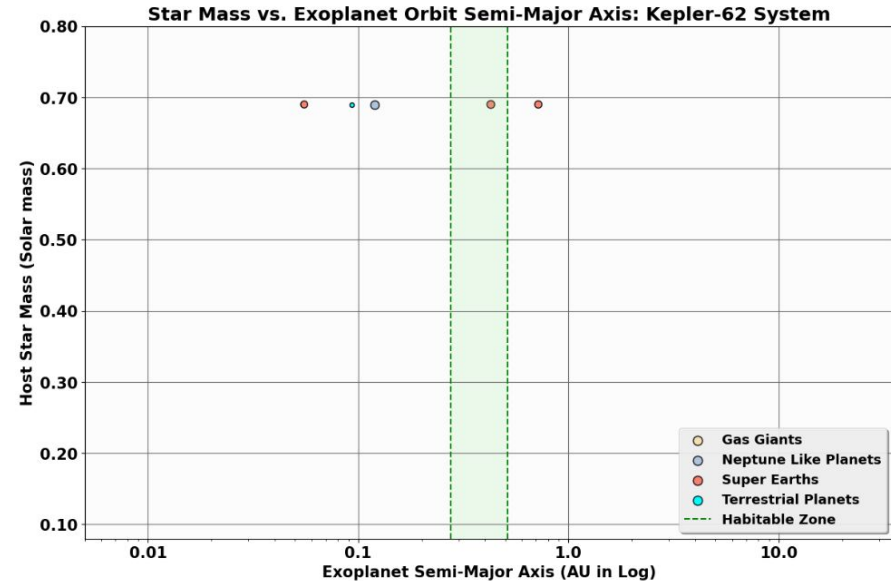Number of Stellars (Single Host) with Conservative Habitable Exoplanets per Stellar Spectral Type
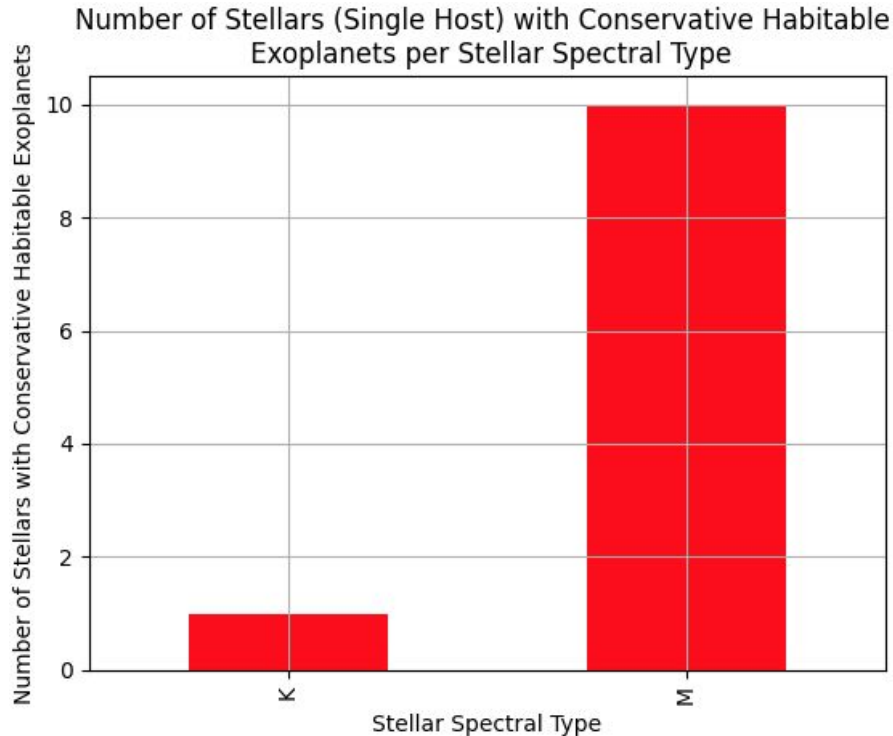
st_spectype_short	count
M	10
K	1

hostname	st_spectype_short
GJ 1002	M
GJ 1061	M
TOI-700	M
Teegarden's Star	M
GJ 273	M
K2-3	M
Kepler-62	K
LP 890-9	M
Ross 128	M
TOI-715	M
Wolf 1069	M

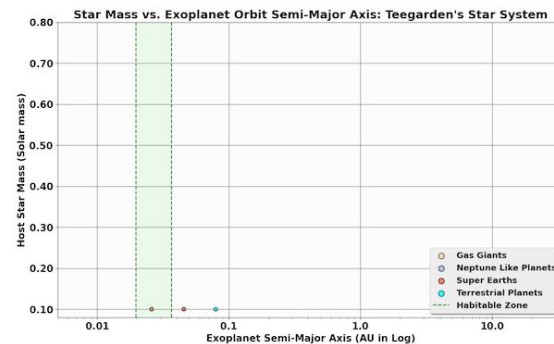# stellar system classes (single host) - with conservative habitable exoplanets
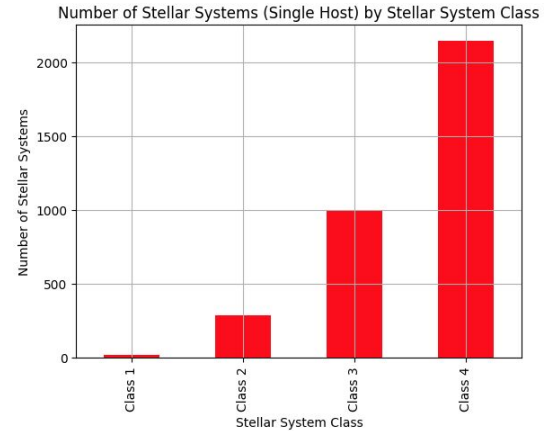
star mass vs. exoplanet orbit:
stellar systems with conservative habitable exoplanets - class 1
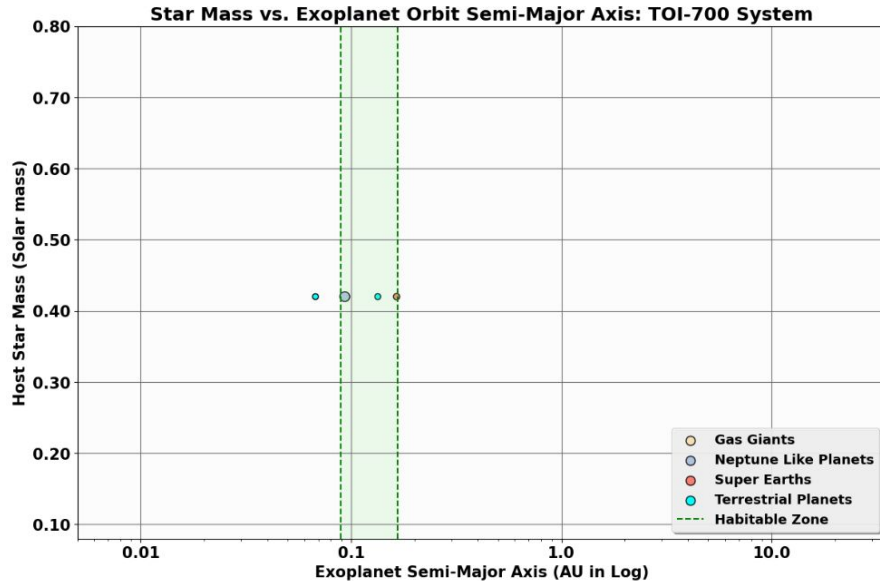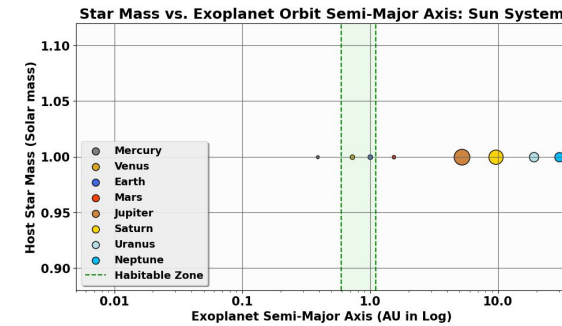
star mass vs. exoplanet orbit:
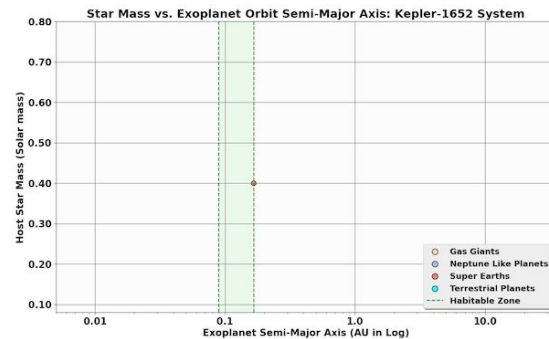# stellar systems with conservative habitable exoplanets - class 3
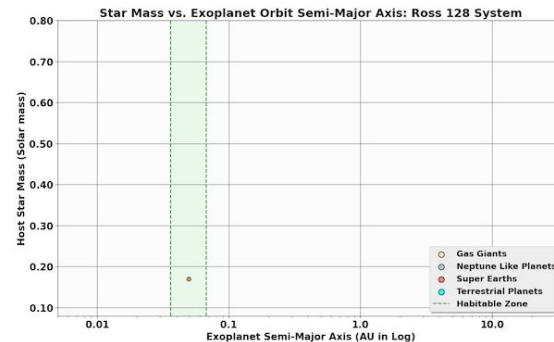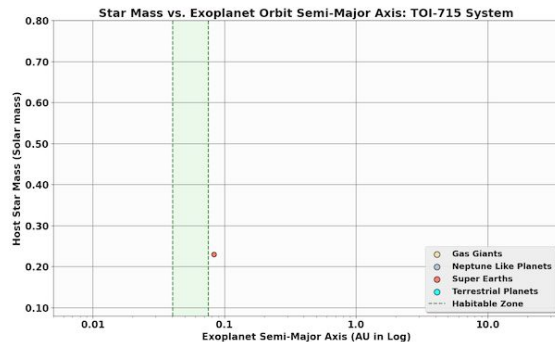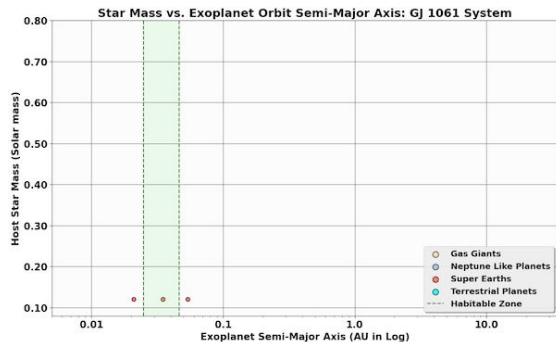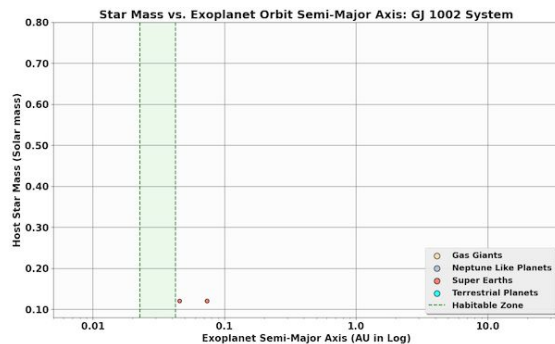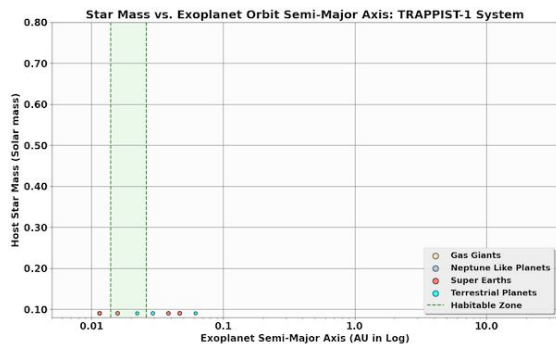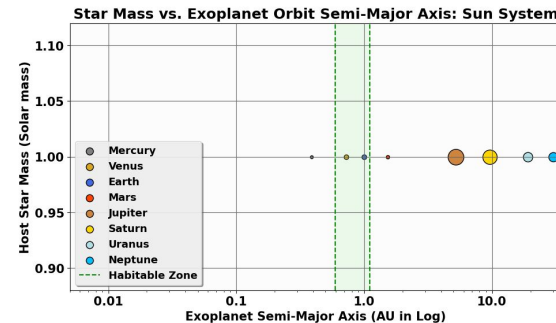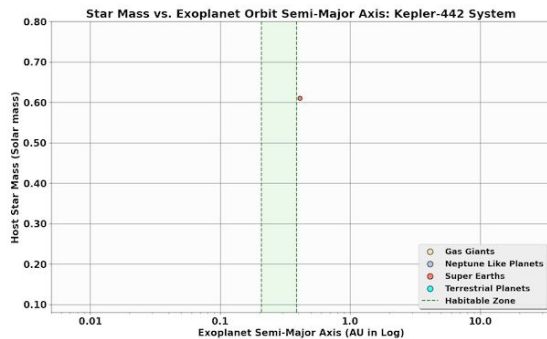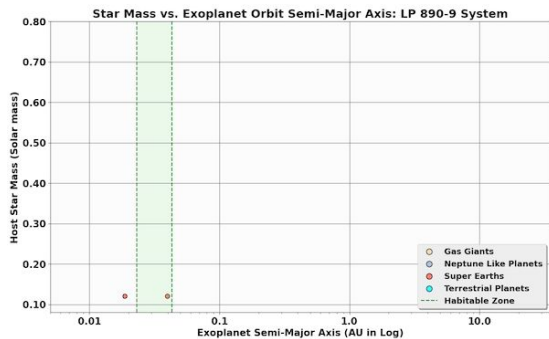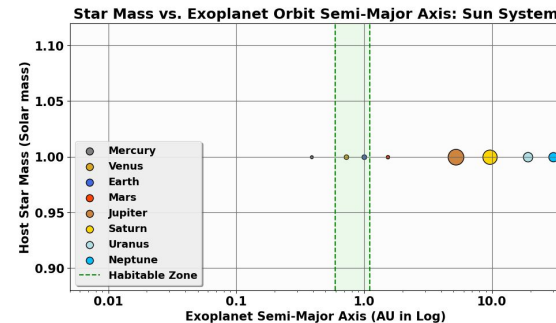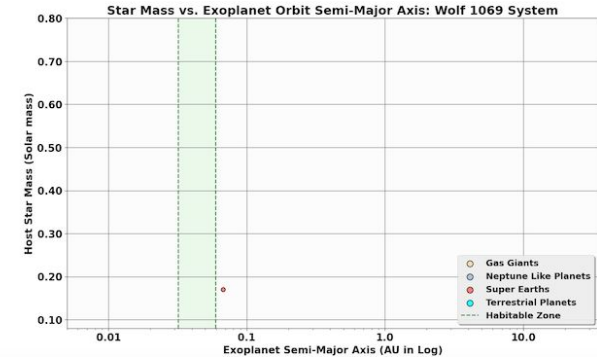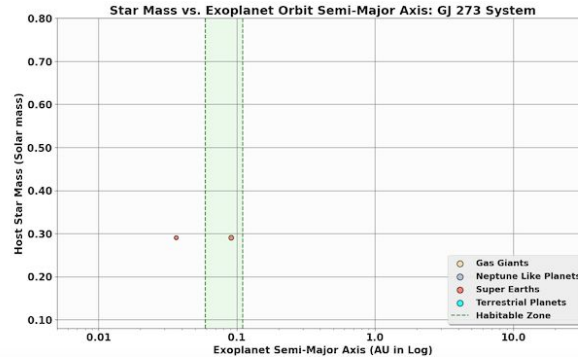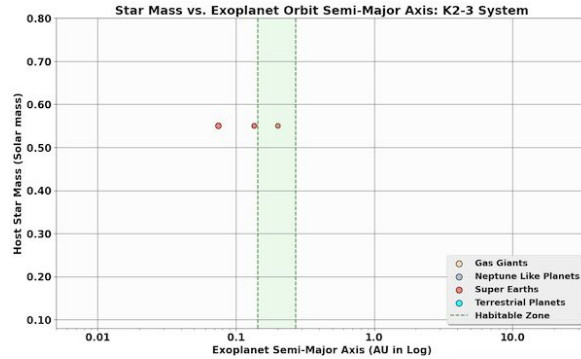
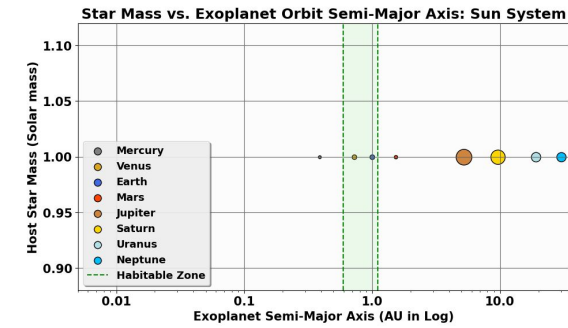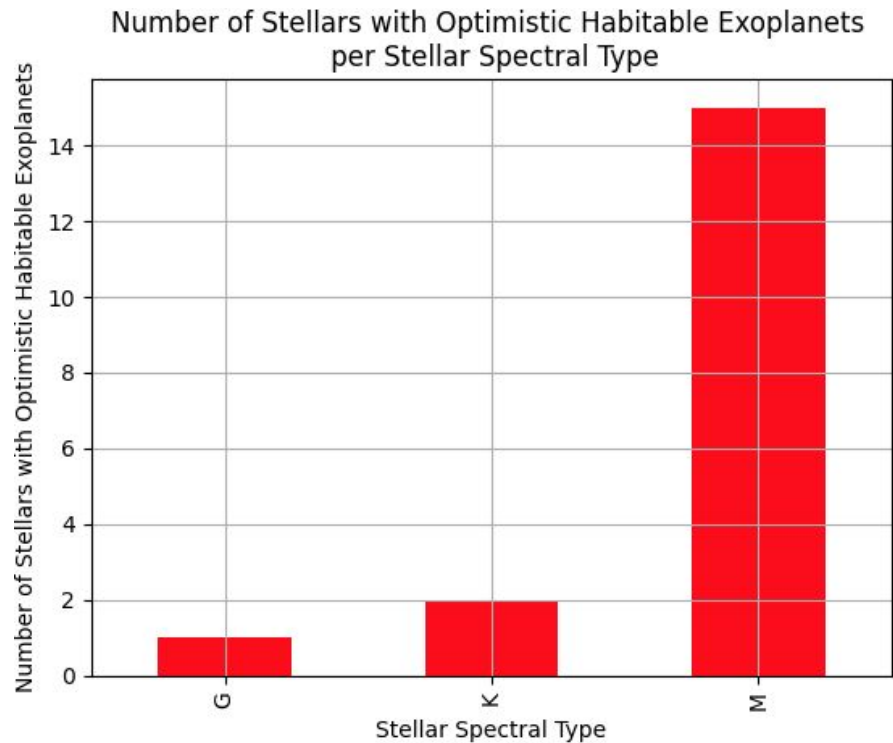# star mass vs. exoplanet orbit: stellar systems with conservative habitable exoplanets - class 3 (cont.)
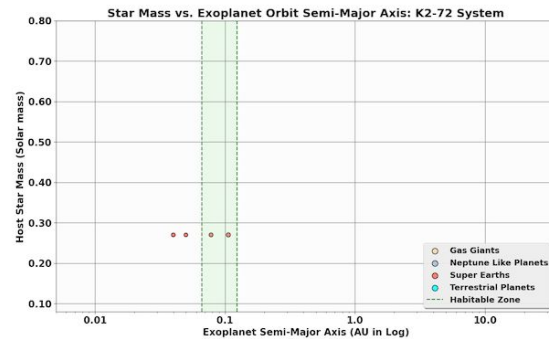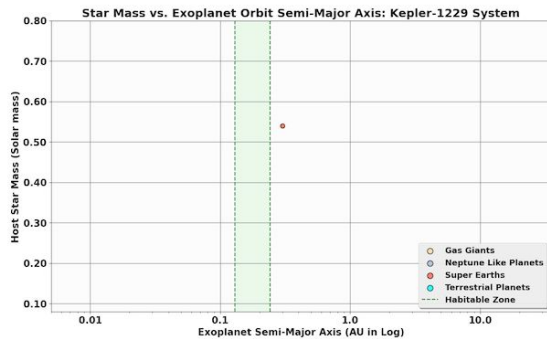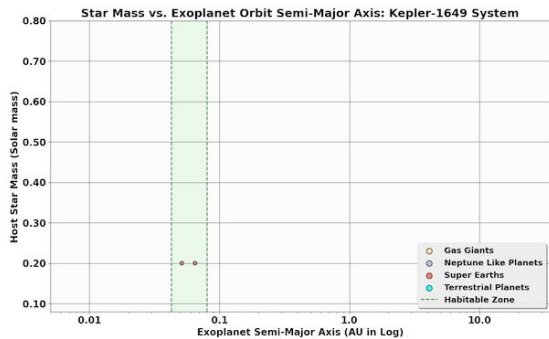
star mass vs. exoplanet orbit: stellar systems with conservative habitable exoplanets - class 3 (cont.)
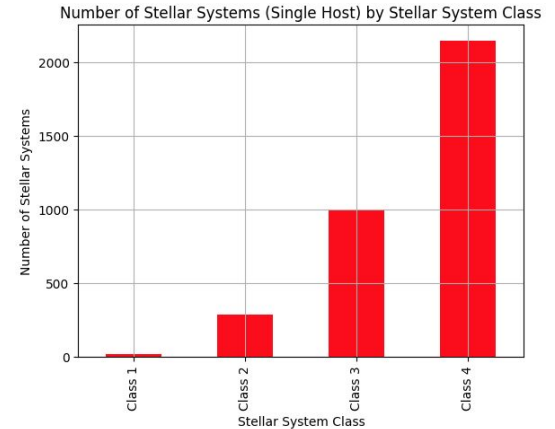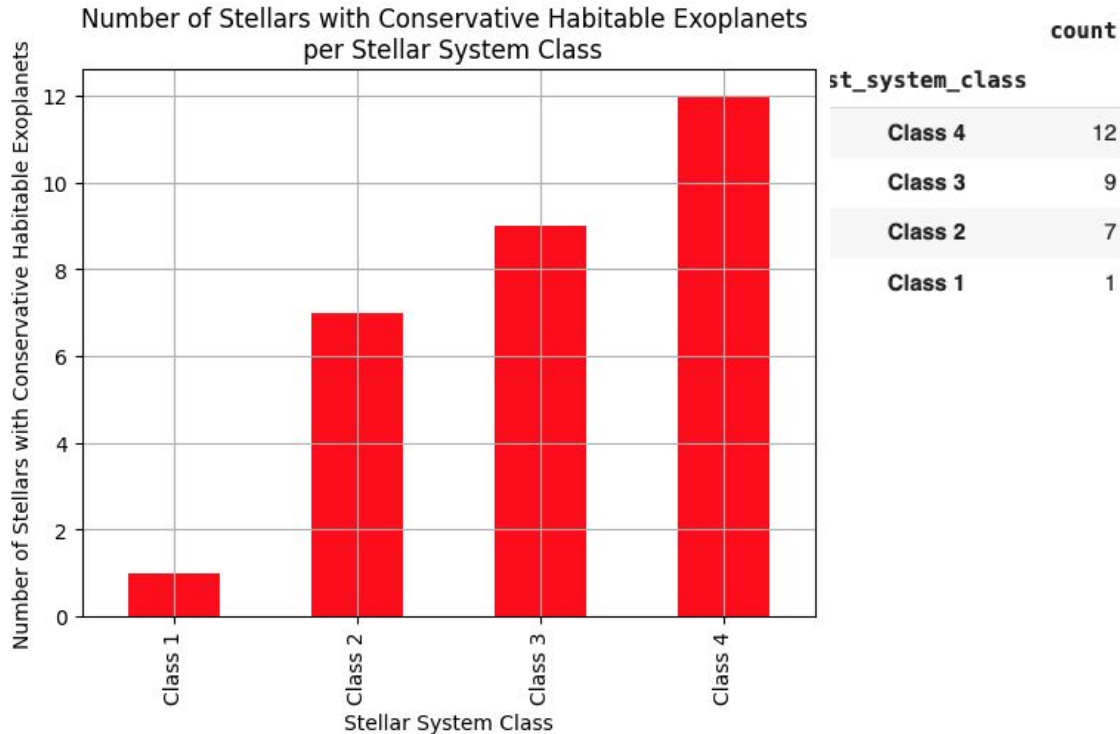
# stellar spectral types (single host) - with optimistic habitable exoplanets

Number of Stellars with Optimistic Habitable Exoplanets per Stellar Spectral Type

st_spectype_short	count
M	15
K	2
G	1

hostname	st_spectype_short
GJ 180	M
GJ 163	M
TOI-2257	M
Ross 508	M
LHS 1140	M
Kepler-62	K
Kepler-22	G
Kepler-155	M
K2-9	M
K2-18	M
HN Lib	M
HD 216520	K
GJ 682	M
GJ 514	M
GJ 433	M
GJ 357	M
GJ 3293	M
Wolf 1061	M

stellar system classes (single host) - with optimistic habitable exoplanets

Number of Stellars with Conservative Habitable Exoplanets per Stellar System Class

st_system_class	count
Class 4	12
Class 3	9
Class 2	7
Class 1	1

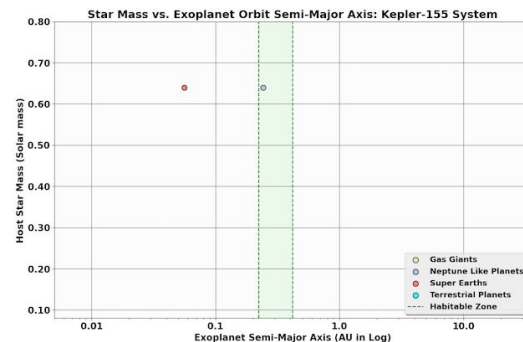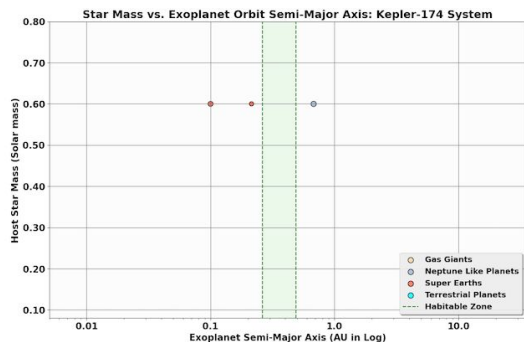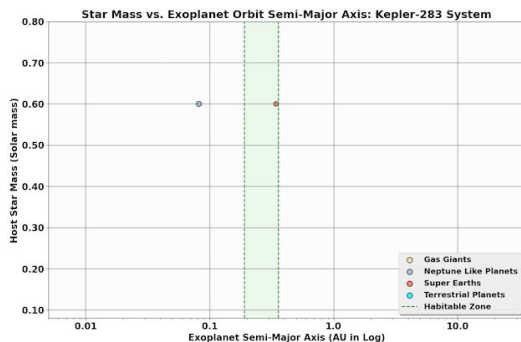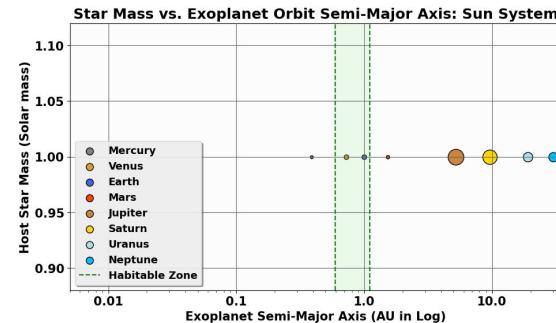Number of Stellar Systems (Single Host) by Stellar System Class

star mass vs. exoplanet orbit: stellar systems with optimistic habitable exoplanets - class 1

Star Mass vs. Exoplanet Orbit Semi-Major Axis: Sun System

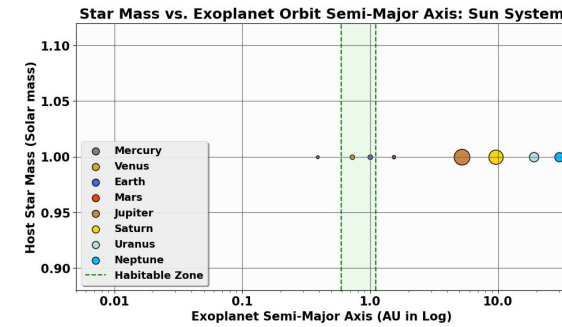Star Mass vs. Exoplanet Orbit Semi-Major Axis: Kepler-62 System
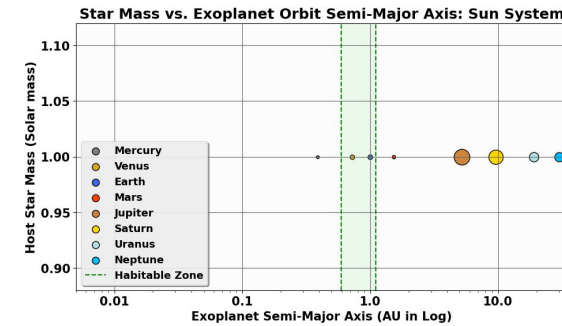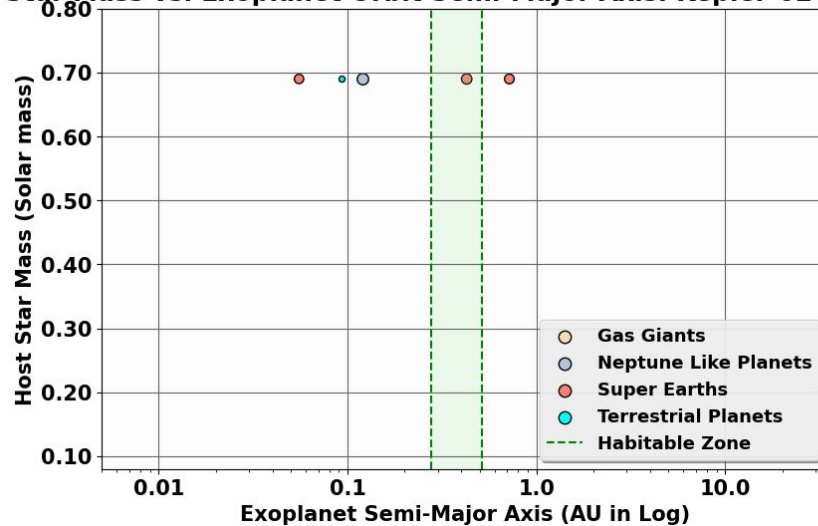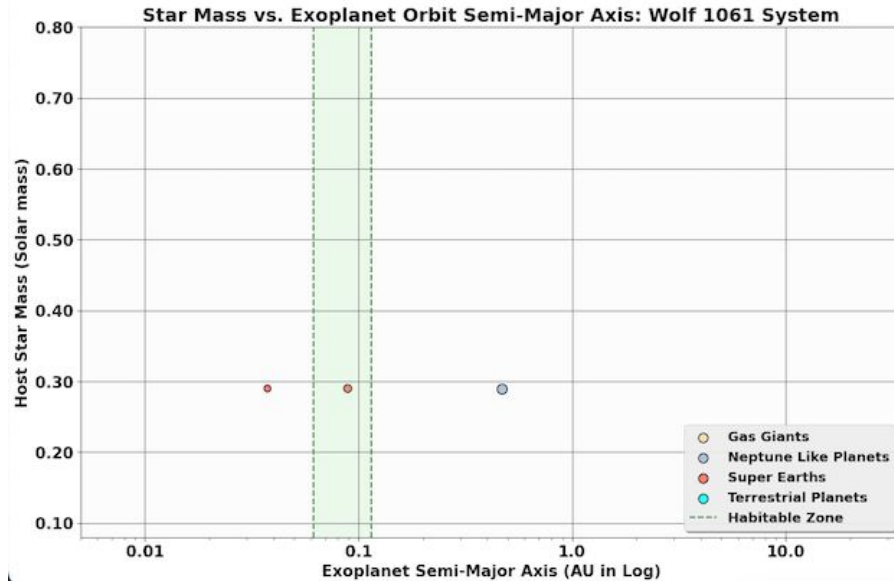
star mass vs. exoplanet orbit: stellar systems with optimistic habitable exoplanets - class 2
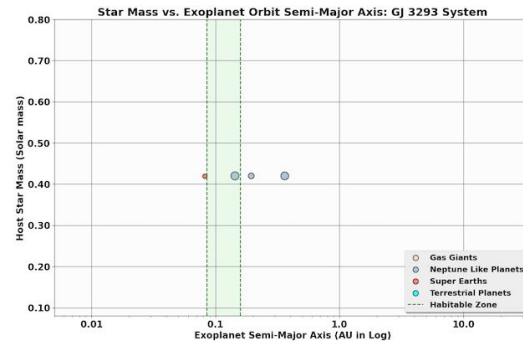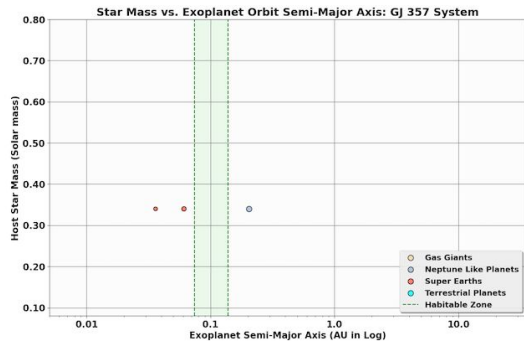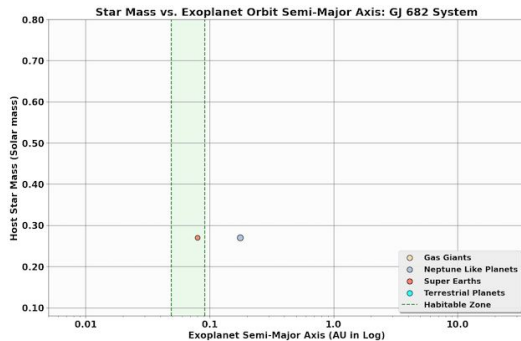
star mass vs. exoplanet orbit: stellar systems with optimistic habitable exoplanets - class 2 (cont.)

future work

- continue working on the draft of the short paper.
- try with K-mean ML model to cluster stellar systems.