An Analysis of Near-Earth Asteroids

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W18 Intro to Python for Data Science
August 10, 2020

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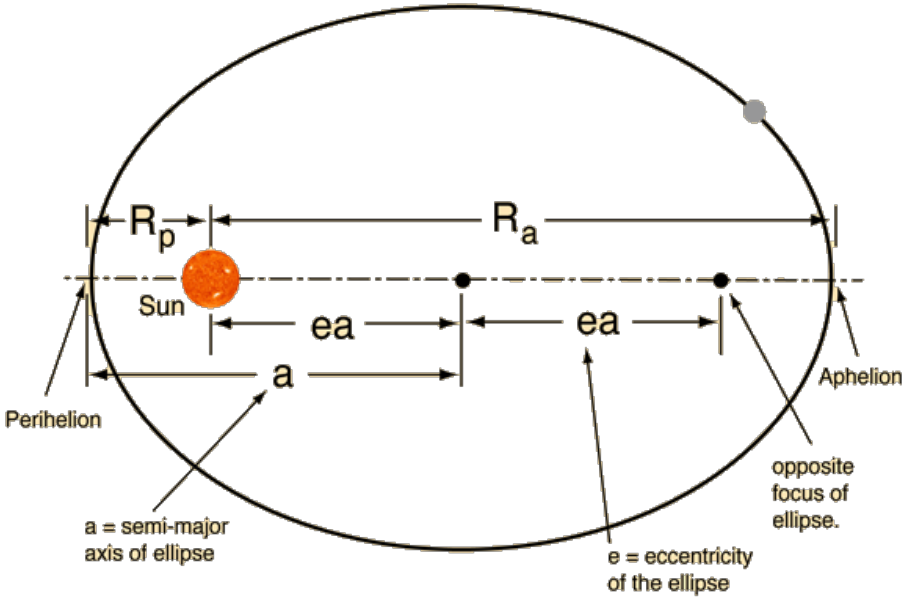
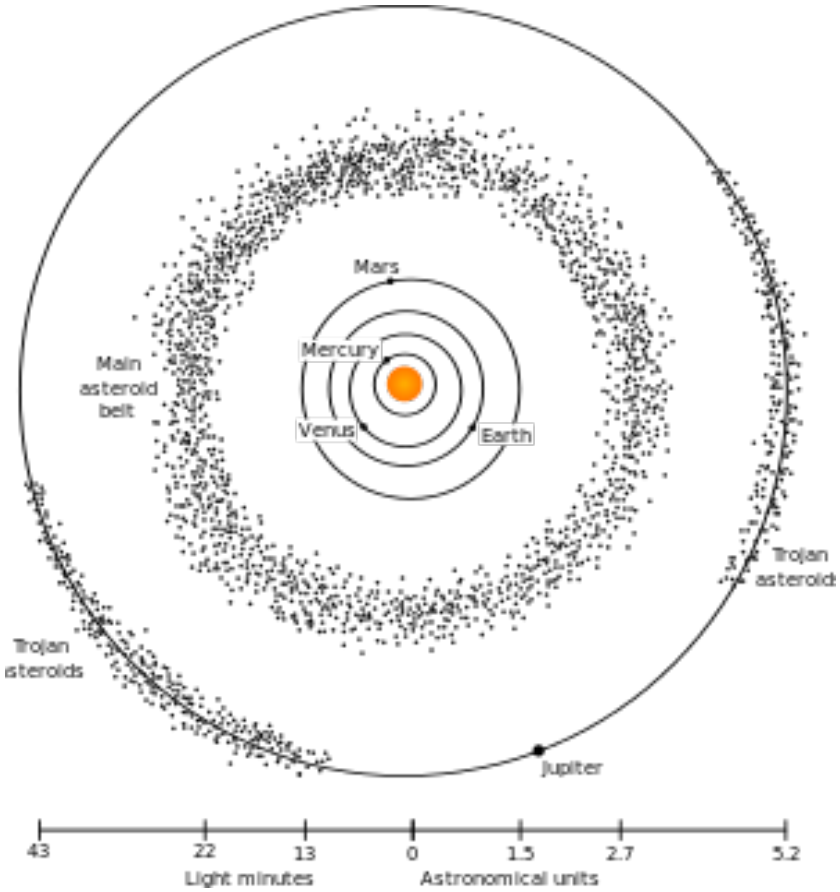
Concepts Explored:

- Confirmation that the further an asteroid is from Sun, longer its orbit takes
- Size of asteroid based on location
- Spectral type (composition)
- Influence of eccentricity, inclination, semi-major axis

Spatial Understanding



$R_a = a(1+e)$ $R_p = a(1- e)$



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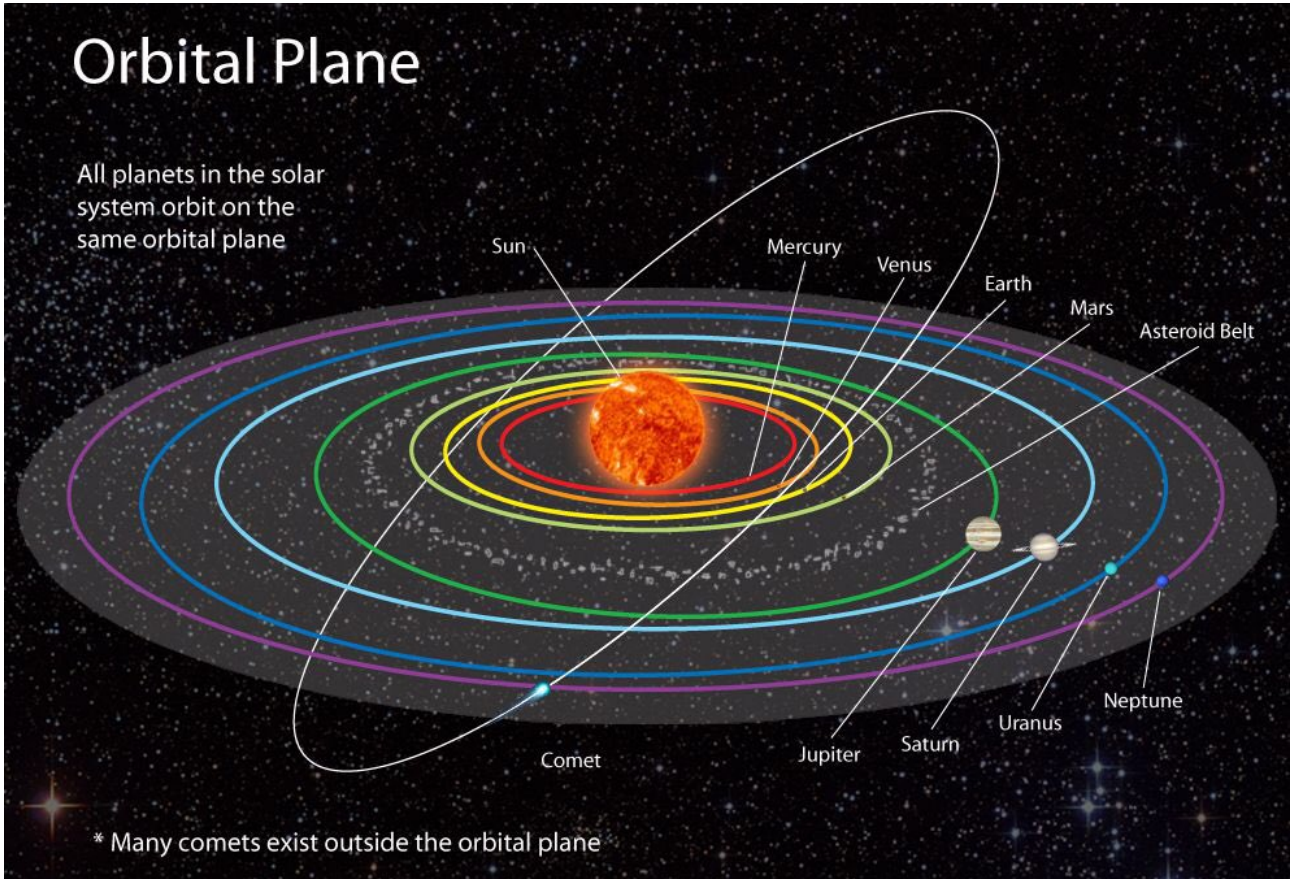
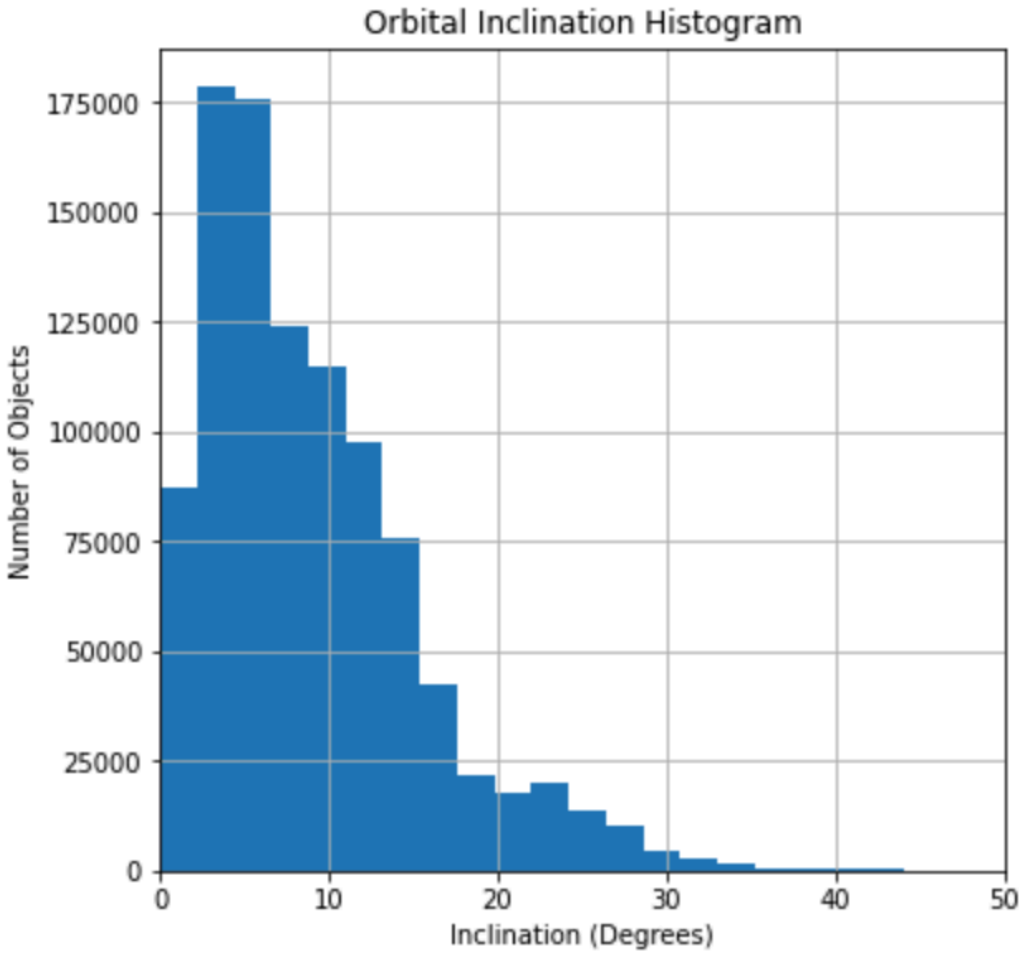
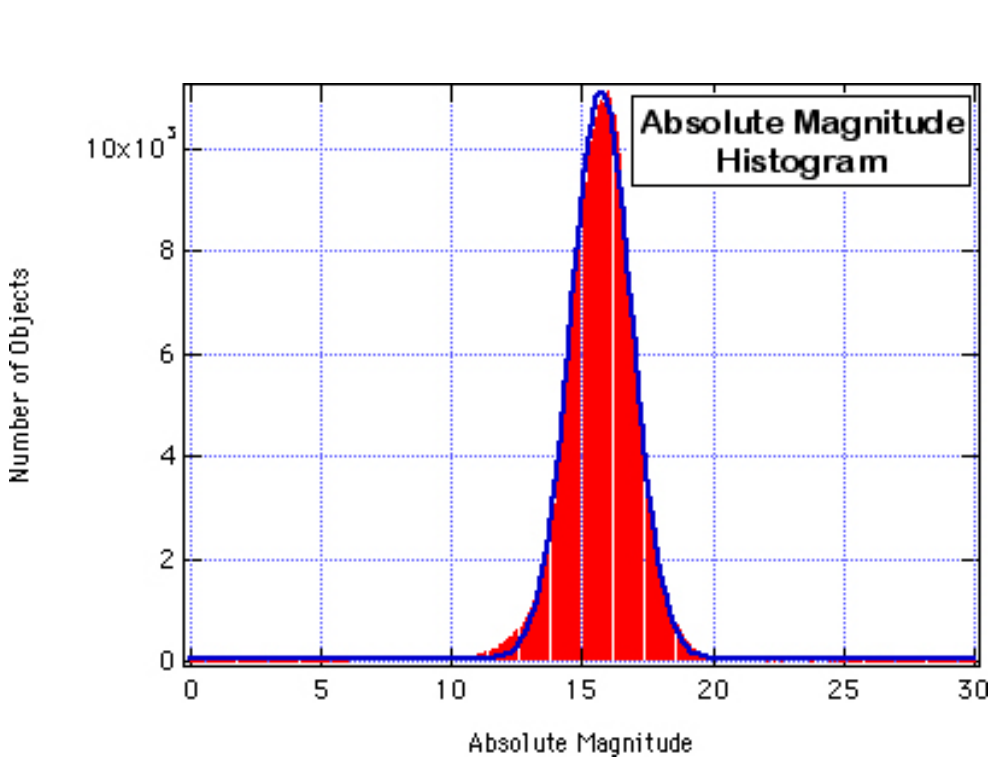
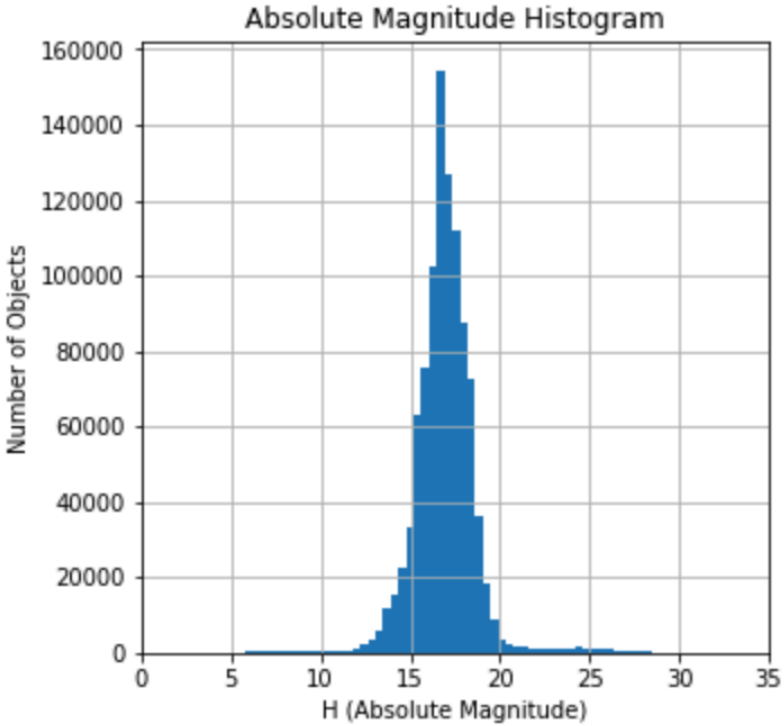
Spatial Understanding

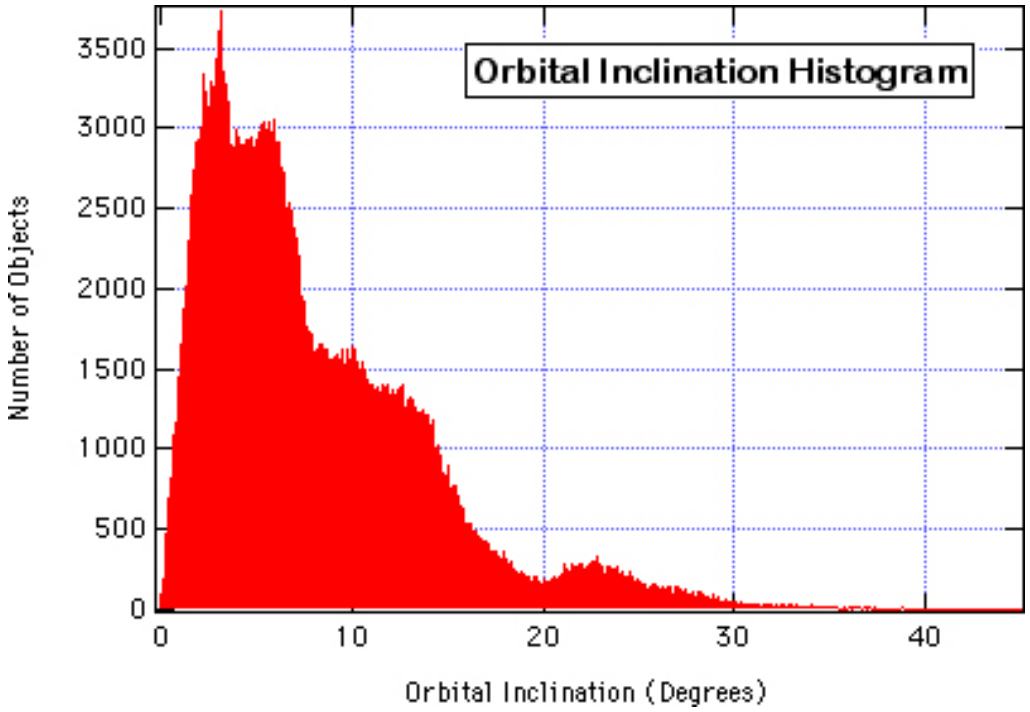


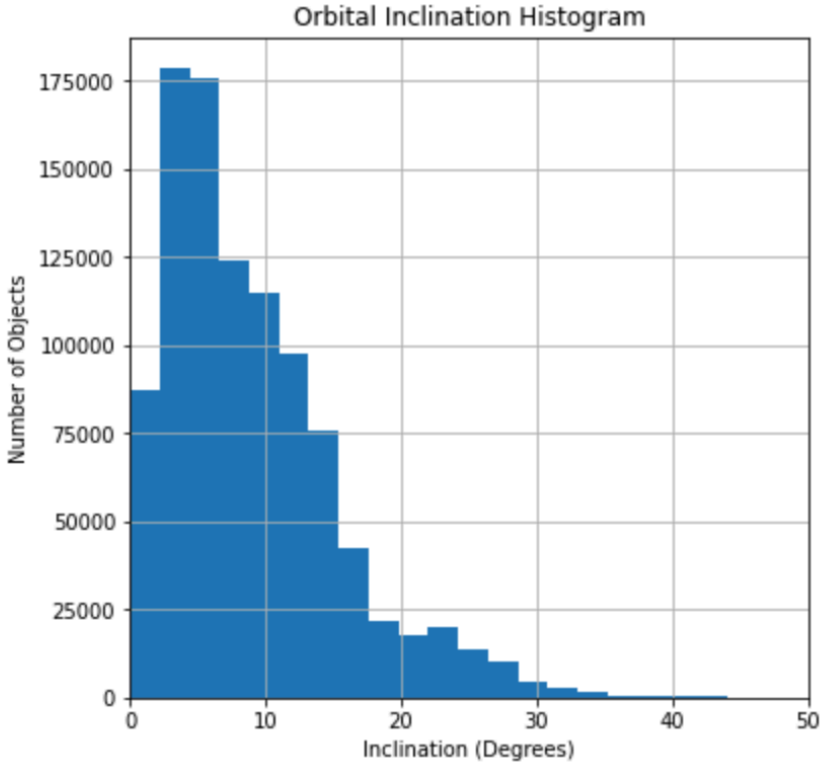
Histograms


Orbital Inclination Histogram
Number of Objects
175000
150000
125000
100000
75000
50000
25000
0
0
10
20
30
40
50
Inclination (Degrees)


Absolute Magnitude Histogram
10x10^3
Number of Objects
0
2
4
6
8
0
5
10
15
20
25
30
Absolute Magnitude


Absolute Magnitude Histogram
Number of Objects
0
20000
40000
60000
80000
100000
120000
140000
160000
0
5
10
15
20
25
30
35
H (Absolute Magnitude)





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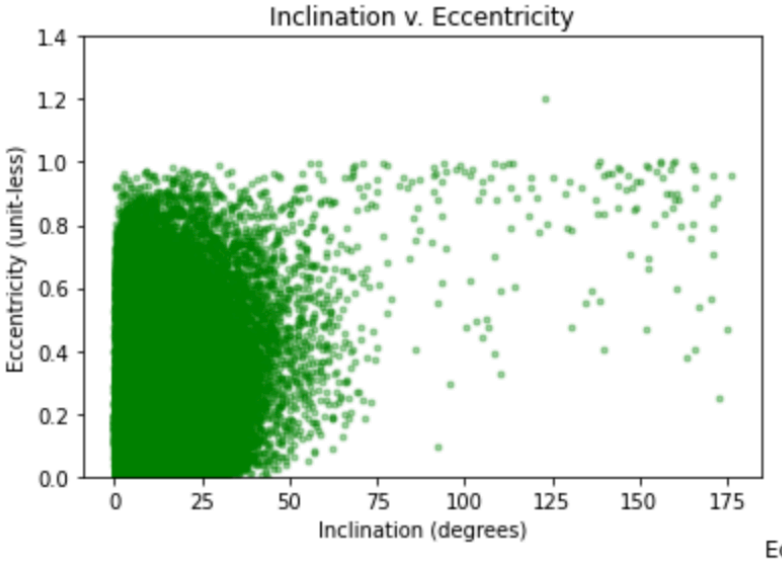
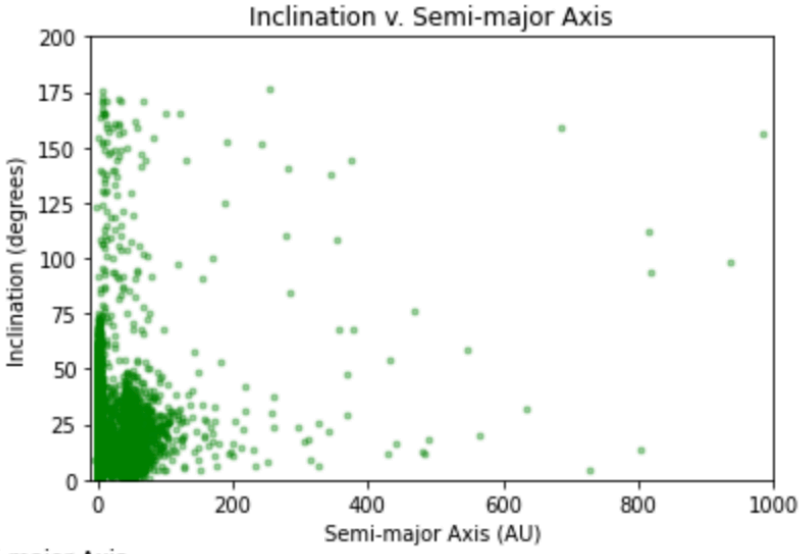
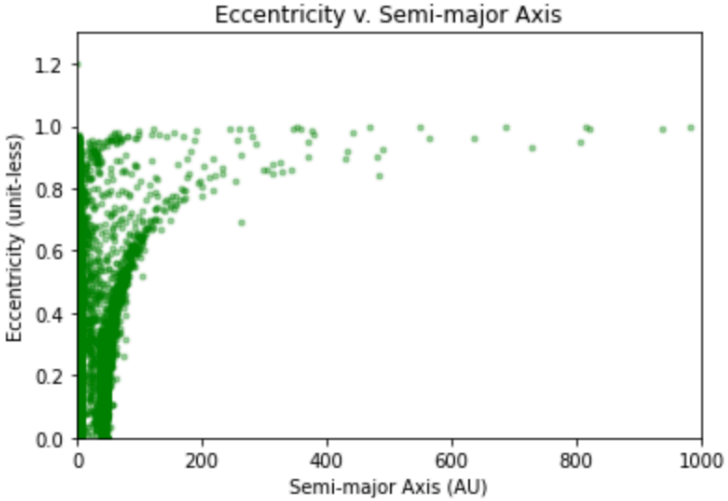
Eccentricity, Inclination, & Semi-major Axis







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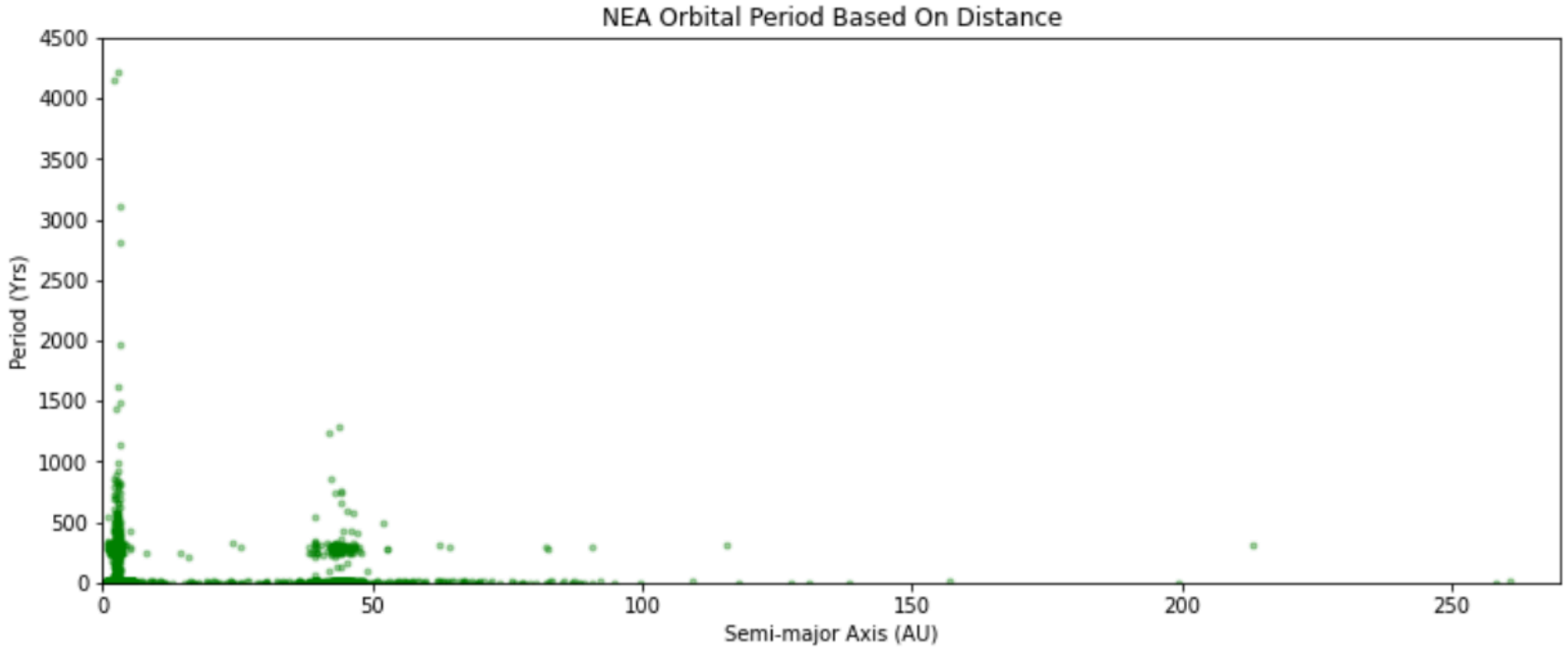
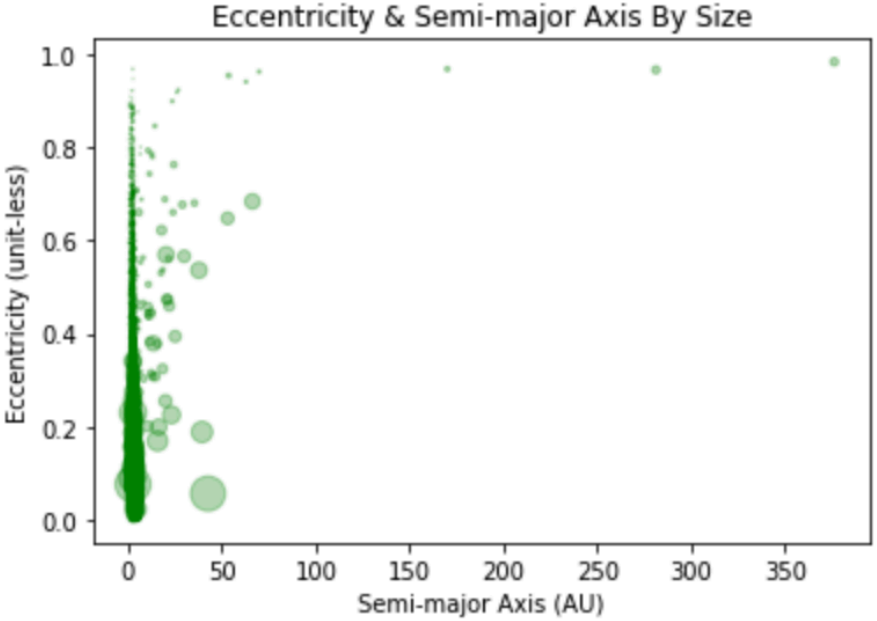
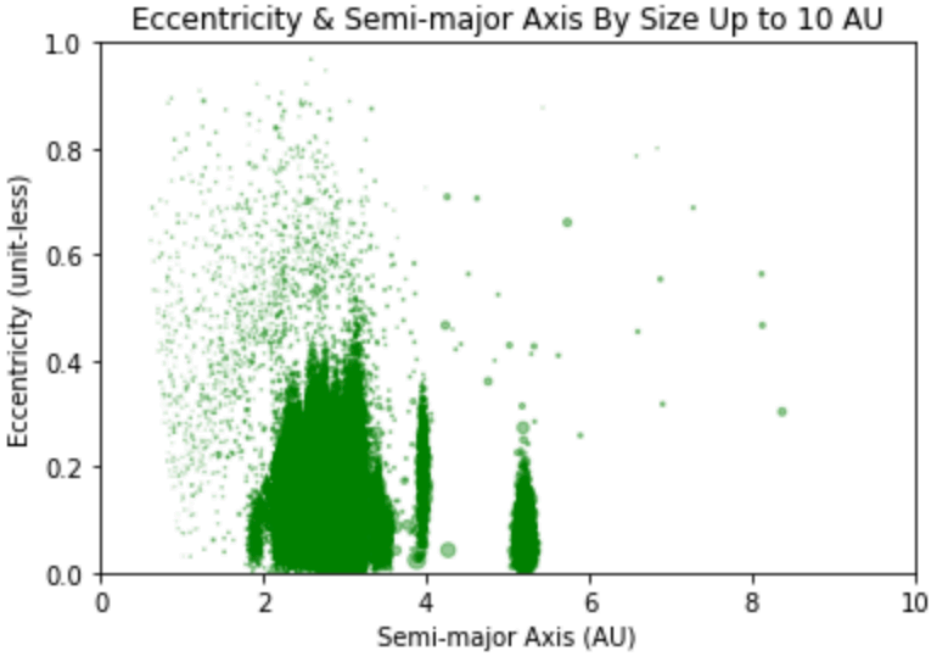
Orbital Period & Semi-major Axis



Asteroid Size Based on Distance





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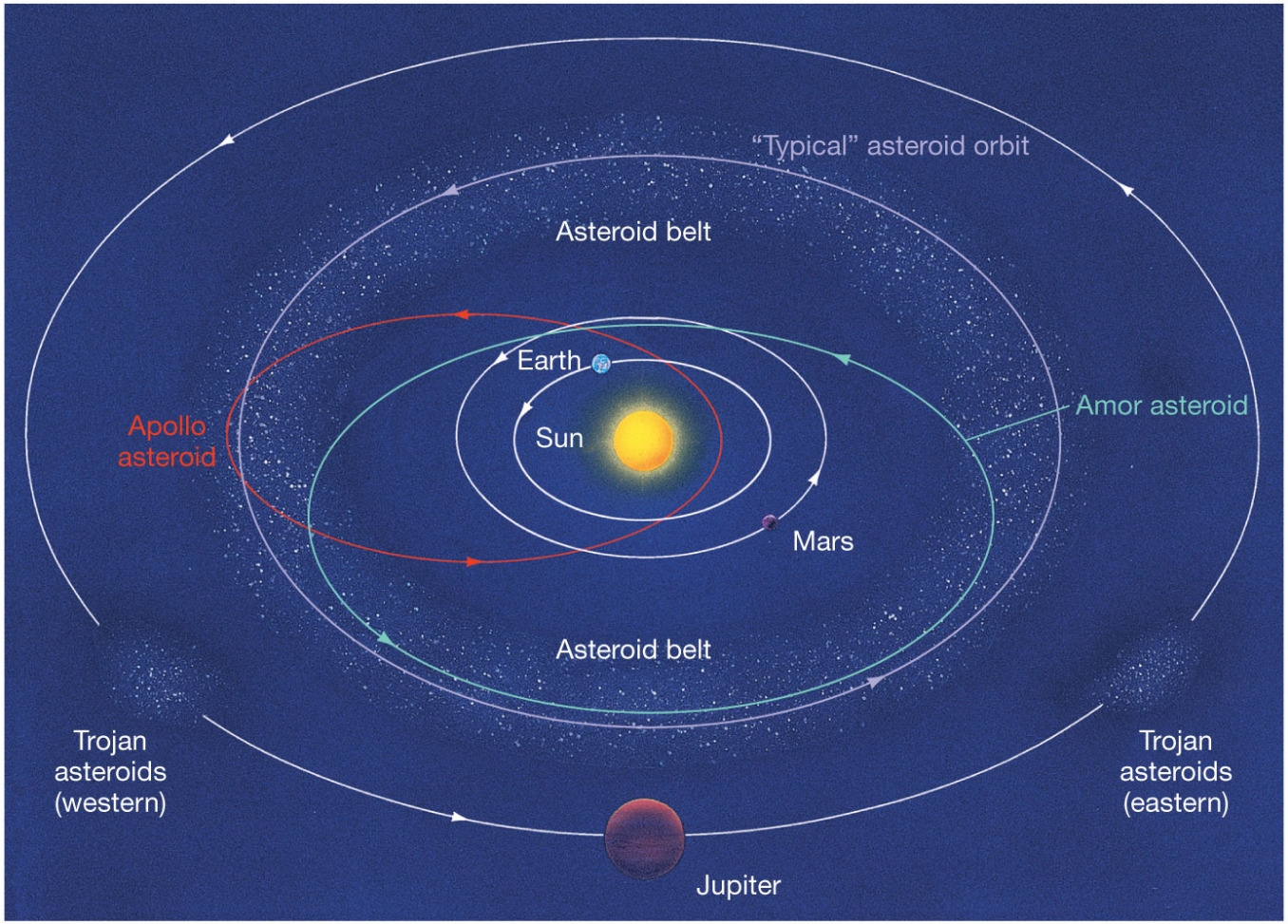
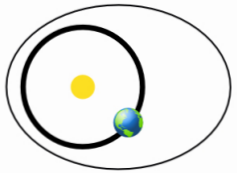

"Typical" asteroid orbit
Asteroid belt
Earth
Sun
Apollo asteroid
Amor asteroid
Mars
Asteroid belt
Trojan asteroids (western)
Trojan asteroids (eastern)
Jupiter

Special Orbits

Amors

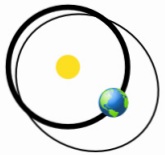
Earth-approaching NEAs with orbits exterior to Earth's but interior to Mars' (named after asteroid (1221) Amor)



$$a > 1.0 \text{ AU}$$
$$1.017 \text{ AU} < q < 1.3 \text{ AU}$$

Apollos

Earth-crossing NEAs with semi-major axes larger than Earth's (named after asteroid (1862) Apollo)



$$a > 1.0 \text{ AU}$$
$$q < 1.017 \text{ AU}$$

Atens

Earth-crossing NEAs with semi-major axes smaller than Earth's (named after asteroid (2062) Aten)

$$a < 1.0 \text{ AU}$$
$$Q > 0.983 \text{ AU}$$

Atiras

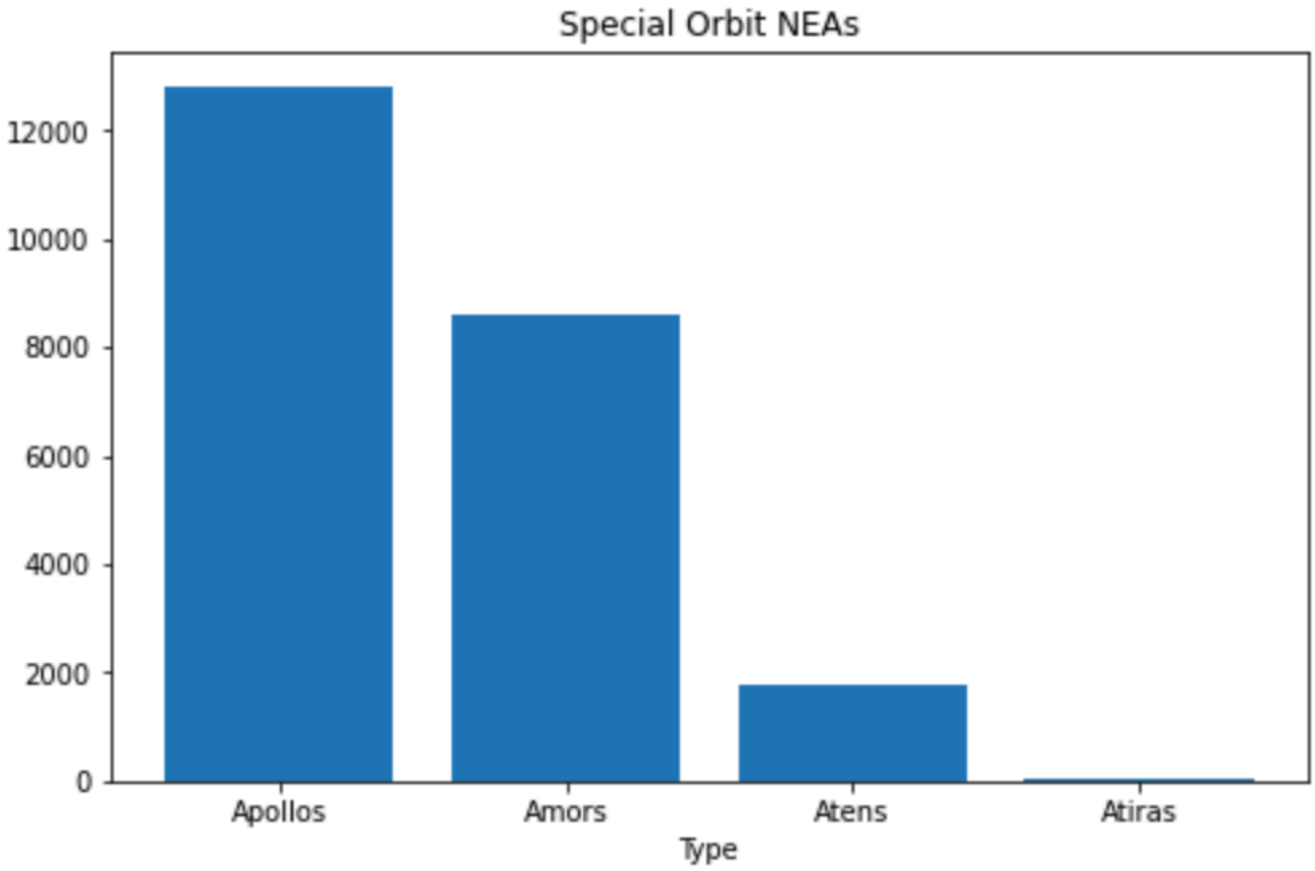
NEAs whose orbits are contained entirely within the orbit of the Earth (named after asteroid (163693) Atira)

$$a < 1.0 \text{ AU}$$
$$Q < 0.983 \text{ AU}$$

(q = perihelion distance, Q = aphelion distance, a = semi-major axis)

Special Orbits

Total
NEAs: 23,174 (2.3%)
Apollos: 12,812 (1.3%)
Amors: 8,584 (0.87%)
Atens: 1,754 (0.2%)
Atiras: 23 (0.002%)



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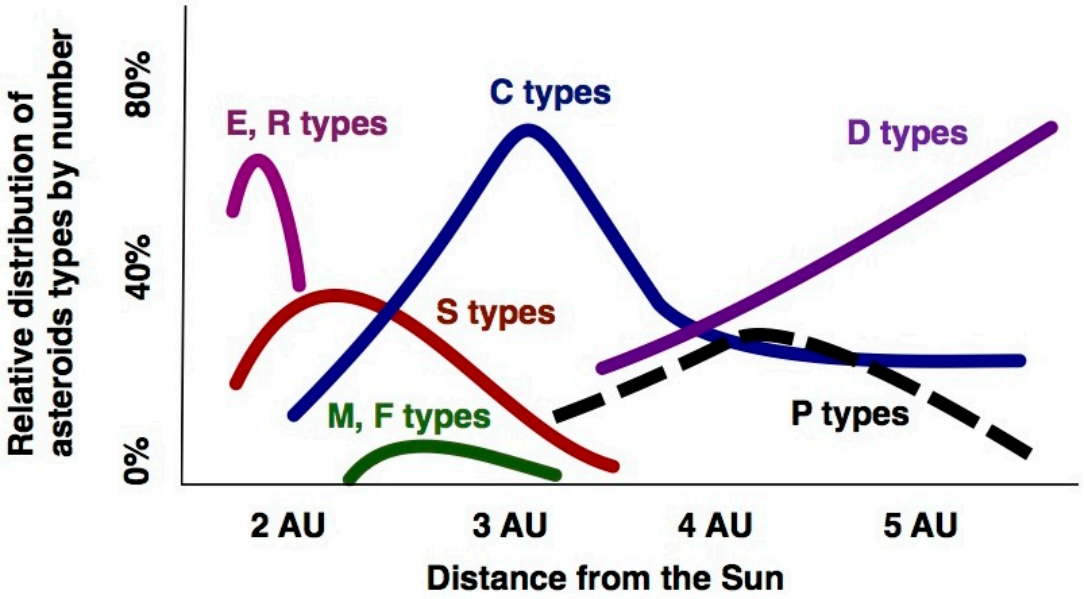
Spectral Type



- C-Type (carbonaceous):
  - ~75%
  - Found in outer Main belt
  - Very dark
  - Depleted He, H, etc.
- S-Type (silicaceous):
  - ~17%
  - Found in inner belt
  - Relatively bright
  - Fe & Mn silicates
- M-Type (metallic):
  - Found in middle of Main belt
  - Relatively bright
  - Fe

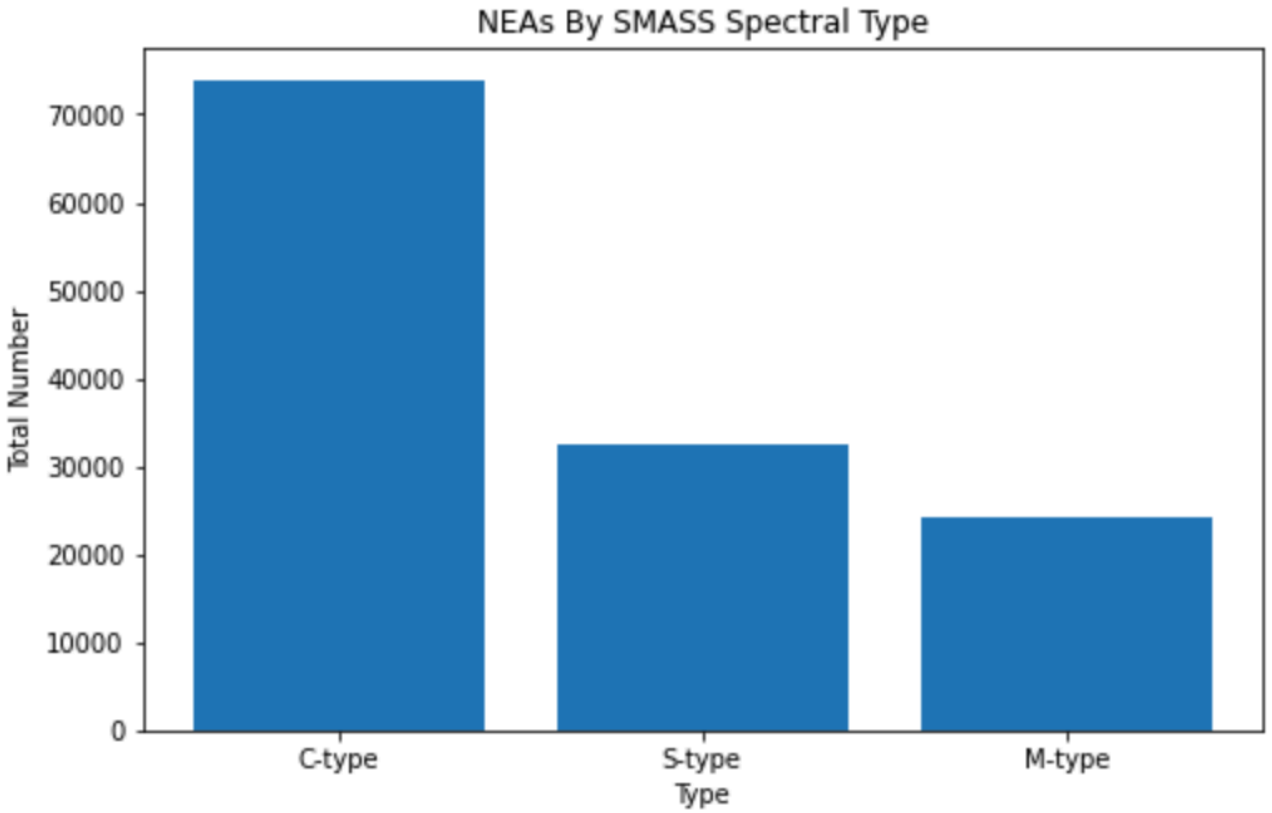
Spectral Type

C-type: Very dark with an albedo of 0.03-0.09

S-type: Relatively bright with an albedo of 0.10-0.22

M-type: Relatively bright with an albedo of 0.10-0.18

Approximate total
C-Type: 73,867
S-Type: 32,612
M-type: 24,324



Thank you

Questions?

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