CCNY PHYS 45400 Sp 2025

Homework 2

Looking up

1. 1610 was an exciting year

Look up the positions of Jupiter's 4 major moons at the time when Galileo observed them and compare them to his original drawings in the Sidereus Nuncius. Pick 1 day from his original drawings besides the first day!) and try to reproduce it using the historical data from the ephemeris tables. Include the original drawing and your plot in the submission. Comment on your comparison. Are they similar? Any differences?

Text of Siderius Nuncius: Starry Messenger

The year was 1610, and the dates are indicated in the text.

Some tips

- Galileo did the experiments in Padua Italy. The latitude/longitude there is: 45.4064° N, 11.8768° E
- When he says in the 6th hour, that means the sixth hour after sunset (which was probably around 5pm but you will need to looks that up and explain how you did it.)
- His drawings are in the azimuthal/elevation system
- All the objects should occupy a very small portion of the total sky - meaning the range of the axis in your plots should be quite small (< 1 degree for sure.)

2. Prove Kepler's second law (numerically)

a. Use JPL Horizons Web app (https://ssd.jpl.nasa.gov/horizons/app.html#/) to retrieve some position data about an object orbiting the sun. Try to show Kepler's 2nd law by numerically estimating the area swept out by the orbit during a short time duration and comparing that area to an equal time duration at another location along the orbit.

You can pick your own object *Just don't do Halley's Comet - that's been done enough times* but it needs to have an eccentricity value greater than 0.1 (and less than 1.0 - Many other comets are in this range)

You'll want to pick the right output values in your JPL Horizons query. The Observer range & range-rate and True Anomaly Angle are your best bets here. (Though you could do it with several others as well.) Read the documentation about the output table entries: Definition of Observer Table Quantities.

Explain your process and the geometry you did.

b. Make a plot showing the orbit of the object you chose as well as the orbit of the Earth around the sun for a comparison/reference.

For all

- Include your sources and a table of the raw data you used. (This ideally would be a link to your data file online somewhere, like a github repository or google drive link. Make sure sharing is set properly so that with a single click, it can be viewed.)

- Make sure all plots are formatted nicely and have labeled axes.

Due Date: Monday, March 3, start of class. (via ~~blackboard~~ brightspace.)

Prepare your work in a typed (no handwritten math or drawn diagrams), document (pdf) with plots and any citations for any references you used, and links to any extensive code you wrote that was used.

If you used any AI to help with code, please cite that. Under no circumstances do I want to read any AI generated text though.