

Zenith'22

Merope : Astro-hackathon

Problem Statement

1.

Cepheid variables are a very popular class of Variable Stars (stars whose brightnesses appear to change over time), that can be used to measure distances in space due to an interesting property of theirs - their Absolute Magnitude is mathematically related to their time period of pulsation.

You have been given some csv files, with a series of brightness observations over several years, for a few Regular/Classical (Type-1) Cepheid variables. Can you estimate the periods of those stars from the data?

Link for data:
<https://drive.google.com/drive/folders/1Jax4Ed6t2s7SYEMkK2Qjkc2D8LO2DD82?usp=sharing>

Additionally, you can then also use the period to also estimate the distance to these stars, based on the property mentioned above.

Notes :

- The CSV files have been downloaded from the AAVSO database, used in professional astronomy. You can refer to this link <https://www.aavso.org/format-data-file> for its format. There are many other fields present, but just *the first 2 columns* (date of observation, magnitude) are relevant here. You can ignore the rest.
- Look up the definition of “Absolute” Magnitude/Luminosity of a star. In contrast, “relative/apparent” magnitude is its brightness as visible to us located on Earth - what we see & measure. Using these 2, you can calculate the distance to the star using a simple formula.

- The important part is finding the time period from the given data. For the distance calculation after that, an approximate value is good enough.

2.

Kushagra, a top class astronomer, lives in Betaverse, a universe parallel to ours with the same physical laws. Kushagra lives on Zirca, a planet similar to earth in Betaverse. Zirca completes one revolution around its star in 365 days. The only difference in the betaverse is that it initially was expanding like our universe, but later started to obey the steady state theory of the universe and the galaxies which were moving, started moving at the speed it was when the transition happened. Kushagra and his team find a galaxy about 3.26 million light years away. They also find some interesting properties in that galaxy and want to study it more. He also finds that the scale factor for this galaxy is 10. The size of the observable betaverse w.r.t zirca is 3.3 million light years. Find the time-period, the zircans have to know more about this galaxy.

Write a general program to find the time for any galaxy and use the given values as a test case.

Notes:

- A good starting point can be to look up Steady state theory. Scale factor basically tells you how the universe is expanding or contracting. Also pay some attention to Hubble's law and constant.
- You can solve this cosmology problem by coding from scratch by studying the theory, however using astropy will make your work a lot easier.
- Note that this question is more about the physics than the coding.
- Also note that, on using astropy, the units you may get in your final output might be wrong, However, you can ignore this, just make sure the calculations are done correctly and comments are put correctly.

General Instructions :

- As always, submit the code files you've written, along with a sample output / answer that you got while running it. You are free to use any publicly

available libraries and APIs in your code, and a programming language of your choice.

- Please also include a brief Readme file with instructions on how to run your program, and list any libraries etc that need to be installed before that.
- Create a ZIP file containing all of these, named using your team name, and email it to stac@students.iitmandi.ac.in before the deadline.

Deadline for submission : 11:55 PM, 7th Feb 2022 (Monday)

- Feel free to ask doubts, if you have any, to the organizers, and check the discussion related to this event in the #merope channel on discord - <https://discord.gg/VNPYE89f> !