S.T.A.C
IIT Mandi

Utkarsh

2/26/2021

Starts: Feb 26th, 5 P.M.

Ends: Feb 27th, 2 P.M.

Total Questions: 5

Total Tokens: 60

THE DANCE OF THE COSMOS

1.

Consider a hypothetical planet, of mass equal to that of Mercury, rotating around a star of 100 solar masses. The aphelion and perihelion of this orbit are also the same as those of Mercury's orbit around the Sun. Consider this binary system to be isolated from the rest of the universe. Write a program to simulate (make an animation of) the orbital motion of that hypothetical planet around the star for 5 revolutions, starting from the aphelion, considering general relativistic effects. The coordinate system should have the center of mass as the origin.

Details: The time scale of the animation should be constant, i.e., time should be uniform in your animation. (That means 1s in animation time = some constant in real world time, throughout the animation.)

The radii of the objects do not need to be to scale, but the orbit path should be to scale. And, make sure the locations of the objects are clearly identifiable at any given instant of the animation. Also, the path traversed by the bodies should be shown.

The runtime of your code should not exceed 10 minutes, and the size of your animation file should not exceed 15MB.

It is recommended, but not necessary to save the output in any video format (like mp4, mkv or mov), and not as a gif. In case of a gif, it should not exceed 2 mins.

[20 tokens]

2.

Find the approximate energy lost by the system in those 5 revolutions of the above problem, and the approximate frequency of the gravitational waves formed, at a distance of 15Mpc.

[2.5 tokens]

3.

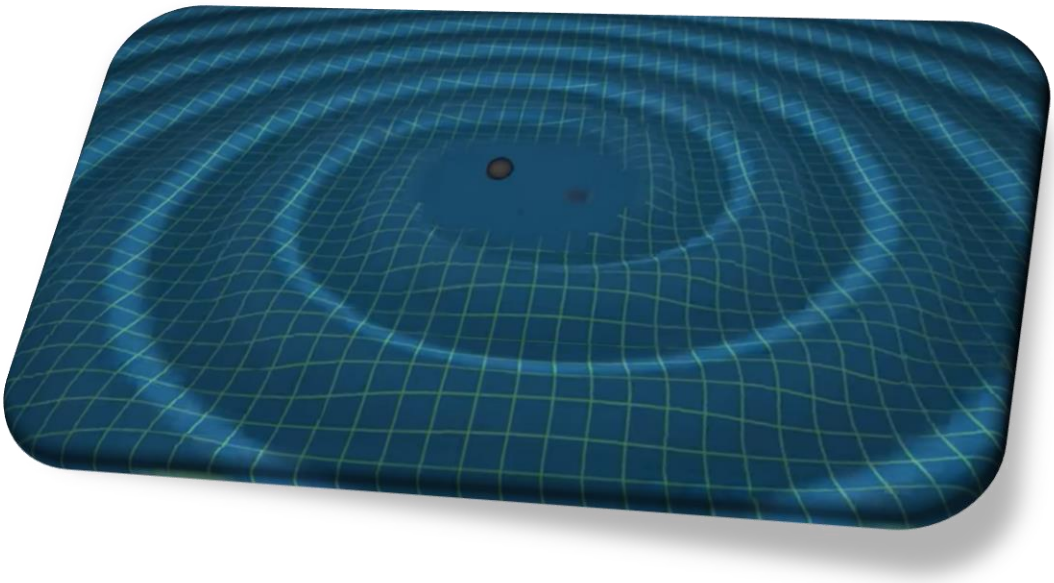
Now, consider 2 neutron stars, one of which has a mass of 1.387 solar masses and the total mass of the system is 2.828 solar masses. The semi-major axis and eccentricity of the orbit of one neutron star (relative to the other neutron star) is 1.9501e6 km and 0.6171334 respectively. Again, consider this binary system to be isolated from the rest of the universe. Write a program to simulate the motion of such a binary system, considering general relativistic effects, for 15 revolutions. The coordinate system should have the center of mass as the origin.

(Details same as Problem 1)

[15 tokens]

4.

Now, find the approximate energy loss and approximate absolute decrease in orbital time period for the above problem.



[2.5 tokens]

Note

You can ignore orbital decay for the first problem, but not for any other problem.

By approximate, we mean REASONABLY approximate!!

Factors like good aesthetics and showing extra parameters (like instantaneous velocity and position) in the animation may be considered in case of score ties.

DEBLURRING ASTRONOMY

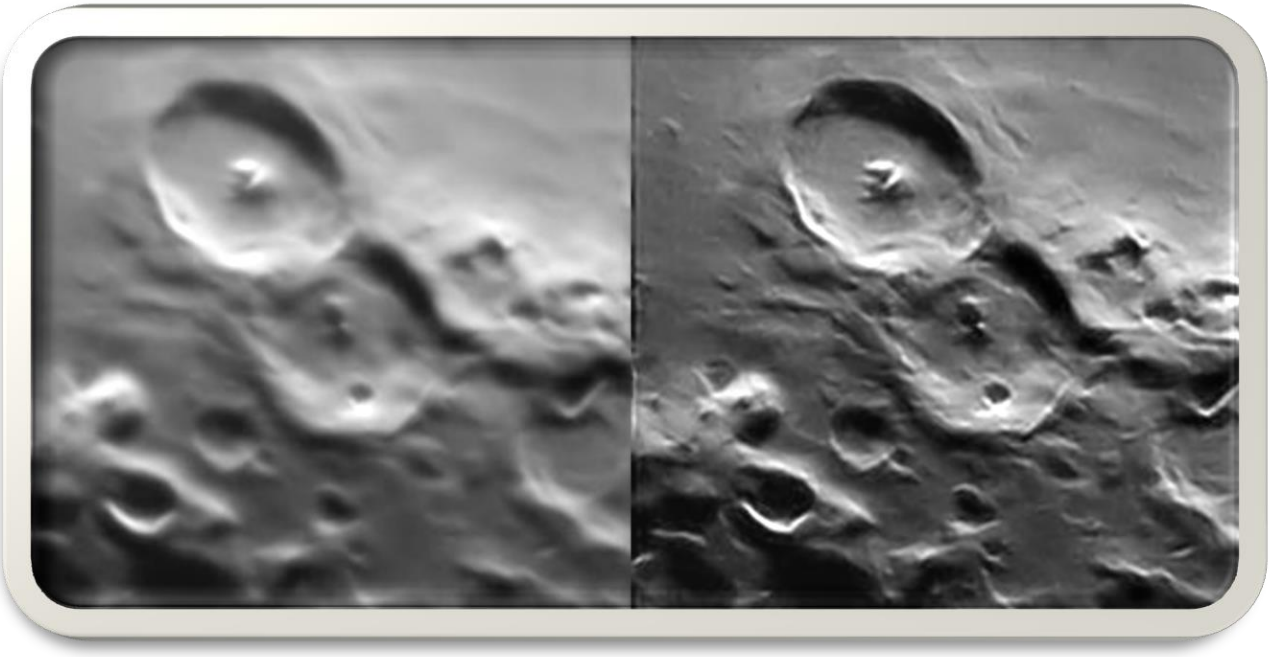
5.

In the field of astronomy, we often require clear images of celestial bodies like stars, galaxies, nebula etc. so as to study them properly. But due to the limitations of our telescopes, we usually get poor quality and blurry images. Hence, deblurring astronomical images is of critical importance and deep learning can play a vital role in this. So, in this hackathon, your task is to enhance the quality of galaxy images which are present in **Class 1** from the given dataset link.

Dataset which you have to deblur can be accessed in this link.

Mode of submission: -

1. You have to share a drive link which contains the deblurred images of the dataset as mentioned above.
2. Share a Google-collab notebook with the code used for deblurring.
3. Prepare a short report describing your method.



[20 tokens]