

Week 1

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Reading

We will start with a bit of a revision of sorts, of a few core concepts that will be necessary for us to proceed in the project. They are the following:

1. Solution of the 2-Body Problem in Newtonian gravity.
2. Doppler shift and how it can be used to measure velocities. The derivation of this formula uses special relativity, so if you have not done that before, skip it.

Recommended Resource: [Astronomical Files](#) from the Black Oak Observatory

Additional Reading: [Binary Stars: A cheat sheet](#) and [Celestial Mechanics](#) (you might also find relevant the sections on Binary Stars and Orbital Elements)

Fun Activity: If you have access to a pair of binoculars (or a telescope), try to look up some famous binary stars/visual binaries (these are simply along the line of sight). A few to get started with (easier ones to resolve): Algieba (Visual Binary) in Leo, Alcor-Mizar (2+1 systems) in Ursa Major, ϵ Lyri in Lyra (this is a famous Double Double).

To begin with, do this assignment

1. Consider the following system: two stars of masses m_1 and m_2 , in circular orbit around each other. Consider plane of the system to be perpendicular the plane of the sky (this is the system from the assignment). Find an expression for the line-of-sight velocity of the two objects with time. (*Hint:* Will you need more information do you need to do this? Assume a reasonable value)

Programming

We will be using quite a bit of programming in Python. Since everybody should ideally have the same versions of Python, and the packages etc, it is highly encouraged that you use virtual environments. The easiest way to do this is to use `conda` from either Miniconda3 or Anaconda3. I use Miniconda, and install packages myself. The steps to set up are:

```
conda activate base
conda update conda
conda env create -f environment.yml
```

You will need to use the `environment.yml` file, which will be shared on Slack (ideally this should be GitHub, and once the project is underway, all future collaboration will be based on GitHub) For now, you must do the following:

1. Familiarize yourself with GitHub (and Git). Make a test repository, and add in a dummy file. Make sure you understand what a commit is, how to make branches, and how to push your local changes to a branch on GitHub.
2. Create the conda environment.
3. Using the results from the Reading, make a Velocity vs Time plot for a system. Make a function that will take an array of times, and parameters about the system, and return the velocity curve