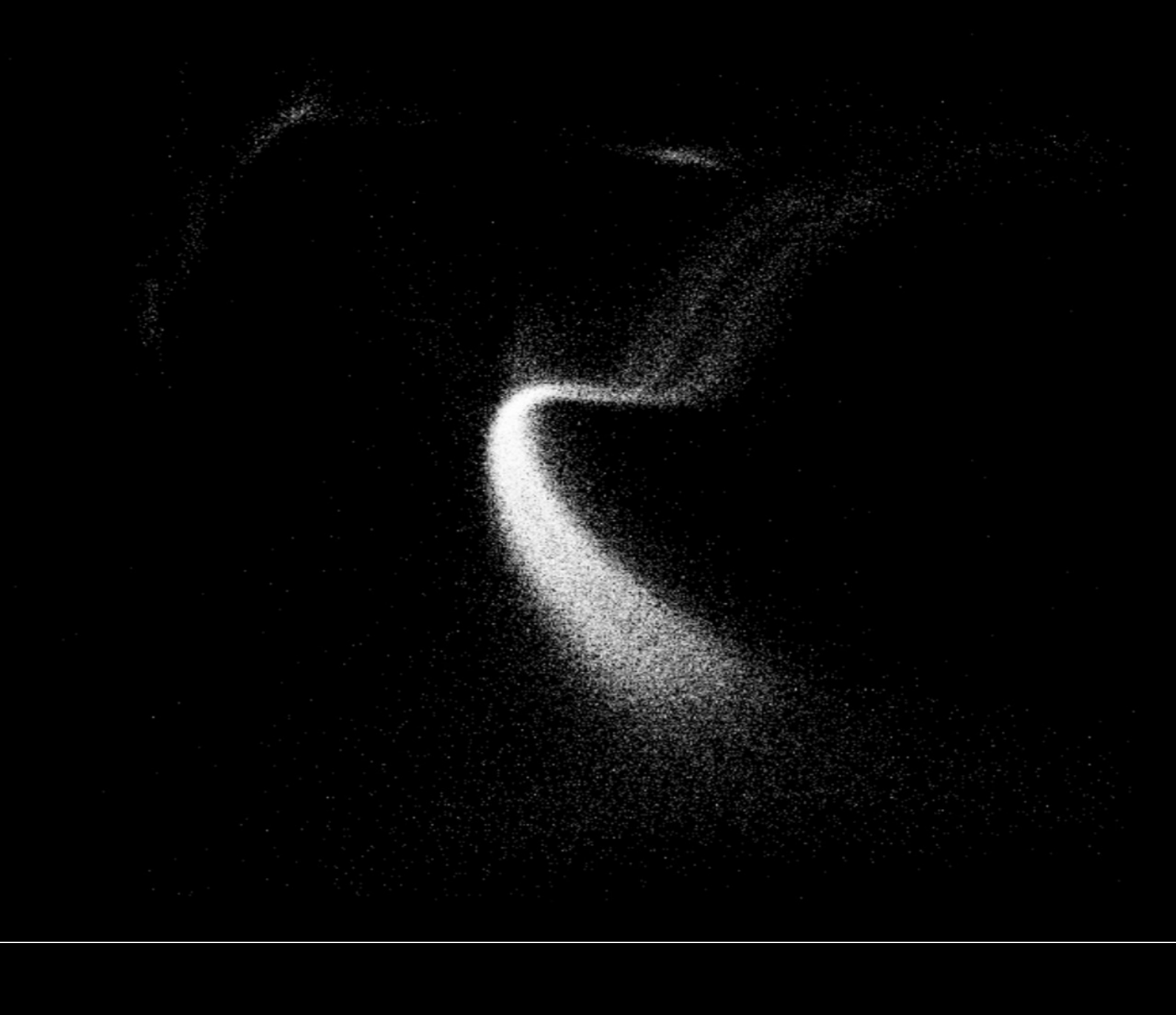

Exploring HR Diagrams

Computational Astronomy Bootcamp 2022

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Chapter 1 Introduction

This Project will focus on understanding Stellar Classication and Stellar Evolution using observational data. For this we will need to know the following:

- Working Knowledge in Python, Numpy and Matplotlib, especially array manipulation.
- Some amount of Statistical Physics will also be required, but what is required can be learnt on the fly.

The project is intended to be 6 weeks long, with about 5 hours of work per week. This includes the time to become familiar with Python and the packages Numpy and Matplotlib.

To keep the pace of the Reading and the Programming, we have made a few checkpoints (Section 2), for each week, that must be kept to in case you want to finish on time. It is encouraged to keep contact with the mentors for the Project, especially if you face any difficulty. Documentation and communication should be the most important skills you take away from this project.

There will be the report (and documentation) submission and presentation, which will happen sometime at the end of the project tenure. It is expected that all members of the project combine ,compare, and contrast their work in the report and give the presentation together. The documentation, however, will be for individual participants and should essentially be a log of the work that you have done for the project, including any resources you used, any difficulties and challenges you faced (and how you overcame them).

As a final note, we hope that you enjoy this project and are motivated to go further into research.

1.1 Mentors

The mentors for this project will be:

- Shreya JVS (jvsshreya@gmail.com)
- Manan Seth (manan.seth@iitb.ac.in)

Chapter 2 Checkpoints

2.1 Programming

Week 1 Load the data file for NGC2808 from HUGS (use the meth01 file) using any of (`numpy.loadtxt`, `numpy.genfromtxt`, `pandas.read csv` or `astropy.io.ascii`). Make a colour magnitude diagram from this data. Compare this diagram with the one given by the archive, and discuss why they don't look the same.

Week 2 Use the Probability Column (how is this calculated, you may ask) and only plot the stars with more than 90% probability. Now is the time to start customising your plots; invert the Y-axis (why?), try to also reconstruct an image of the cluster using the positions and magnitudes of the stars. Discuss the theory used here.

Week 3 Make your code independent of inputs apart from the data-file. This includes the limits on the axes of the graphs, the probability and error cuts, and anything else that has been hard-coded.

Week 4 Week to catch up on anything you may have missed. If you are on track so far, nice work! Continue on to the next checkpoints a week in advance.

Week 5 Find the ratio of distances to 2 clusters by matching the Main Sequence. Keeping any one cluster as a reference, find the distances to all the other clusters.

Week 6 Quantify the 'matching of Main Sequence' as an algorithm and implement it. Or alternatively, use isochrone fitting to find the age of a Globular Cluster.

2.2 Reading

Week 1 Magnitude Systems in Astronomy, Colour Indices and their relation to temperature of a black-body

Week 2 Figure out a way to see how stars differ from Black-Bodies given the magnitudes of a lot of stars in different filters. (for some context, see the HUGS data files).

Week 3 Spectral Classification of stars using Spectral Lines of Hydrogen. (As a side note, find out how spectra are made for stars. Try to find spectra for each spectral type and see the differences in absorption lines)

Week 4 Week to catch up on anything you may have missed. If you are on track so far, nice work! Continue on to the next checkpoints a week in advance.

Week 5 Theoretical backing for spectral classification. Find out how the spectral class is basically determined by temperature of the star. (This provides the Theoretical Reason why we can substitute an HR diagram with a Colour-Magnitude Diagram)

Week 6 Basic overview of the stages in the evolution of stars. Try to find each stage in an observational HR diagram