THE HR DIAGRAM

JOURNEY INTO THE DEPTHS OF THE UNIVERSE

EQUINOX
The Astronomy Club

18 JUNE 1911

A MINI PS

INTRODUCTION

The Hertzsprung-Russell diagram was independently developed by Ejnar Hertzsprung (1911) and Henry Norris Russell (1913), plotting stellar luminosity against surface temperature or spectral class. This revolutionary tool revealed that stars aren't randomly distributed but follow distinct patterns, establishing the main sequence where most stars reside. It became fundamental for understanding stellar evolution, stellar classification, and the life cycles of stars from formation to death.

In the last week we studied about the Lifecycles of Stars and how the Hertzsprung-Russell Diagram classifies stars into different groups on the basis of luminosity, size, colour and many other factors. This PS is about applying your knowledge on Machine Learning realised Astronomy.

Instructions:

The PS has been divided into two parts - Theoretical & Computational. There are no optional questions and attempting all the qustions will increase your chances of getting more points.

THEORETICAL MODULE

Question 1: (10 Points)

Mass and Main Sequence How does a star's mass affect its position on the main sequence? Explain why more massive stars are brighter and hotter.

Question 2: (10 Points)

Main Sequence Stability What keeps a main sequence star stable? Describe the balance of forces that determines a star's luminosity and temperature.

Question 3: (10 Points)

Beyond the Main Sequence What happens when a star leaves the main sequence? Compare how low-mass and high-mass stars evolve differently on the H-R diagram.

COMPUTATIONAL MODULE

Question 1: (70 Points)

The H-R diagram plots the luminosity of stars against their temperature (or color). Main sequence stars follow a general trend where hotter stars are more luminous.

Use this dataset of stars with known temperature, luminosity, radius and absolute magnitudes. Apply linear regression to model the relationship for main sequence stars. You can then use this model to estimate the absolute magnitude (and thus distance) of other main sequence stars based on their color.

Tip: Use train-test split and evaluation metrics to show credibility of code