

A person stands on a dark, rocky outcrop under a vast, star-filled night sky. A bright, glowing light source, possibly a star or a distant galaxy, is visible in the upper right quadrant of the sky, casting a soft glow. The foreground shows the silhouettes of rocks and some sparse vegetation. The overall mood is contemplative and awe-inspiring.


STELLAR CLASSIFICATION

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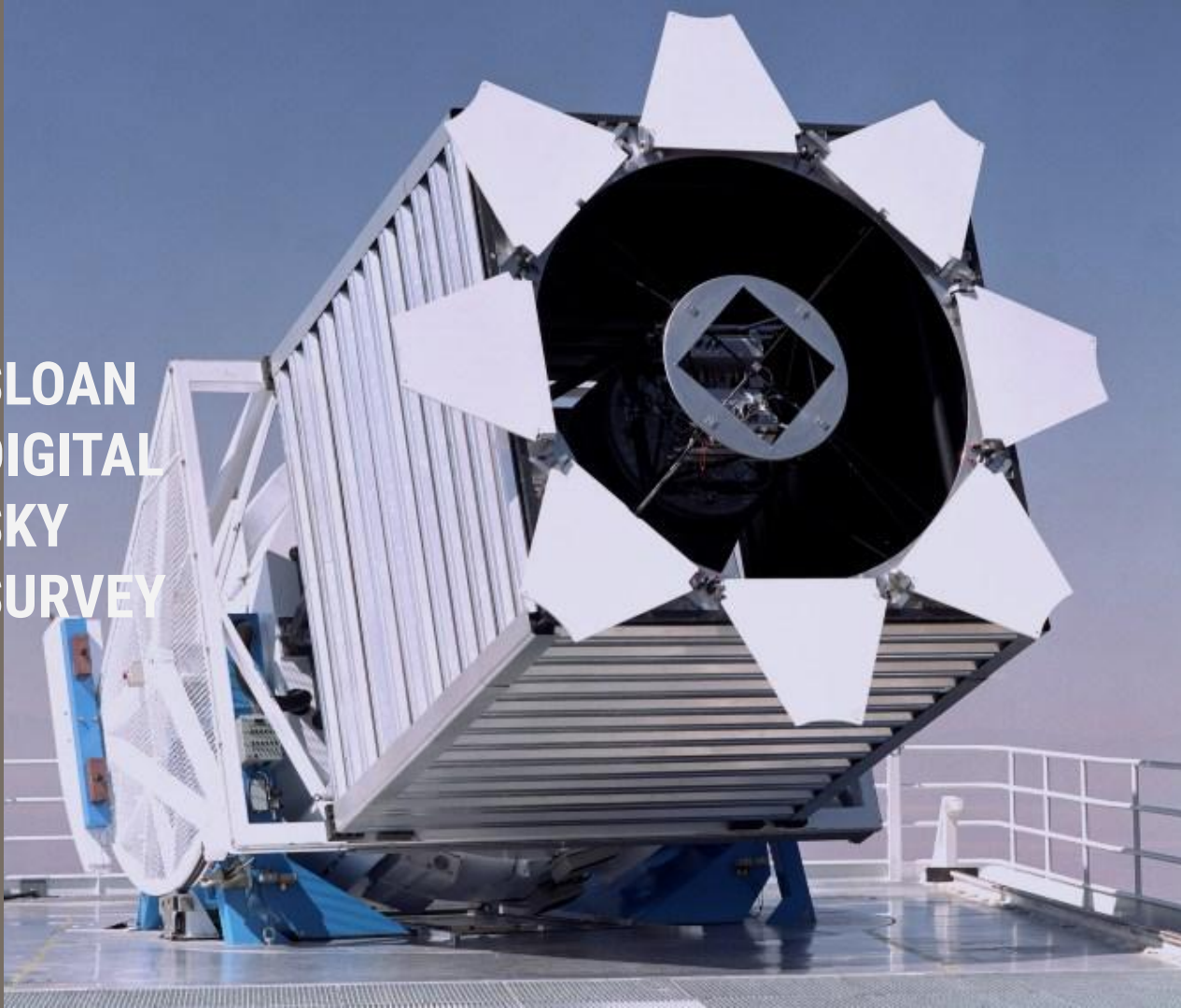
FOR SCIENCE!

With this project I hope to educate
myself, and hopefully a few others a
little bit more on the world of
astronomy and some of the science
behind it



What is Stellar Classification?

In Astronomy, stellar classification is the classification of stellar bodies based on their spectral characteristics. The classification scheme of galaxies, quasars, and stars is one of the most fundamental in astronomy. The early cataloguing of stars and their distribution in the sky has led to the understanding that they make up our own galaxy and, following the distinction that Andromeda was a separate galaxy to our own, numerous galaxies begun to be surveyed as more powerful telescopes were built. This project aims to classify stars, galaxies, and quasars based on their spectral characteristics

A photograph of the Sloan Digital Sky Survey (SDSS) telescope, a large white structure with a prominent circular aperture and a complex internal lens system, mounted on a blue base. The telescope is positioned on a rooftop platform with a metal railing. The sky is clear and blue.

SLOAN DIGITAL SKY SURVEY

This dataset consists of 100,000 observations of space taken by the SDSS (Sloan Digital Sky Survey). Every observation in this dataset is described by 17 feature columns and 1 class column which identifies it to be either a star, galaxy, or quasar



UNDERSTANDING

Angular Positions

Right ascension angles(alpha), Declination angles(delta)

Spectral Characteristics

Ultraviolet(u), Infrared(z), Near Infrared(i)

Ultraviolet(u), Green(g), red(r) Near Infrared(i), Infrared(z)

Observational Identifying Information

Julian Dates(MJD), SDSS plate ID's(plate), Object Identifiers(obj_ID)

Optical Spectroscopic ID's(spec_obj_ID),

CLASS

Galaxies, Stars, Quasars



ANGULAR FEATURES

Alpha: Right Ascension Angle

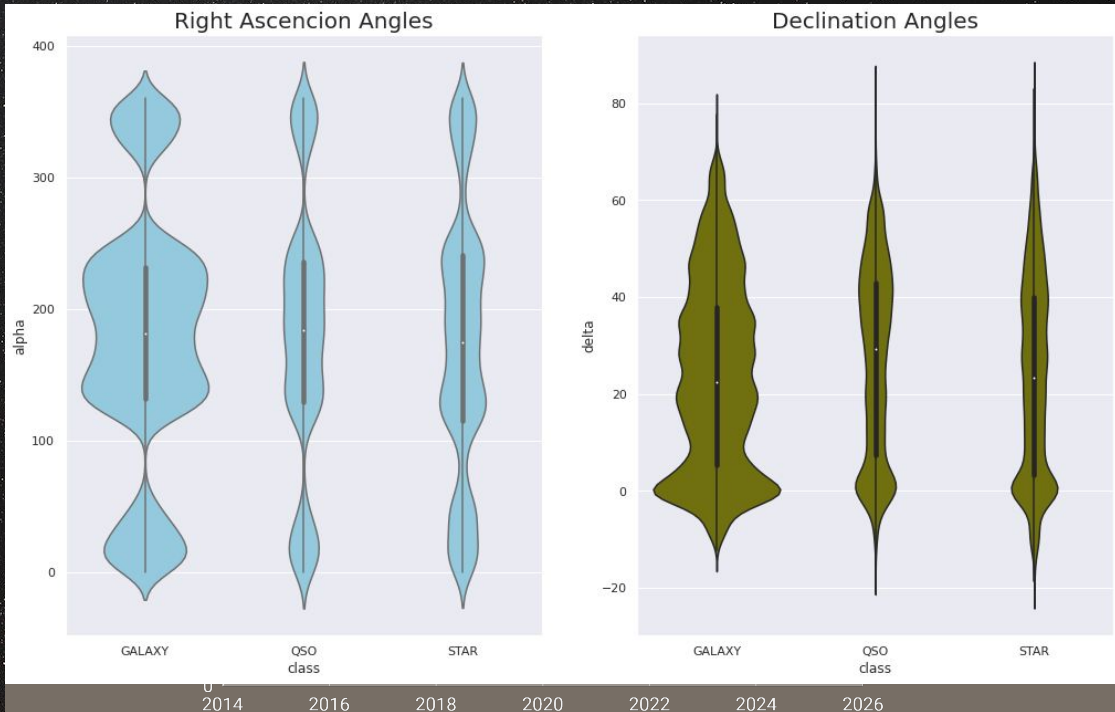
Right Ascension is the astronomical equivalent of longitude. Right Ascension measures the positions of celestial objects in an east-west direction from the first point of Aries, like longitude, but unlike longitude right ascension is a time-based coordinate.

Delta: Declination Angle

Declination is the astronomical equivalent of latitude. Declination is an angular distance of a point north or south of the Celestial Equator, essentially a projection of the Earth's equator into space

[Detailed Explanationn](#)

They contribute
to locating an
existing
celestial object,
but not to
predicting its
stellar
classification.



These features together essentially represent the stellar coordinates of celestial objects from our POV on Earth. While useful in coordinating the location of a given object, they do not contribute to its stellar classification. This is supported by the violin plots above as the shape of distribution is very similar across all 3 classes in both plots.

SPECTRAL FEATURES

U

Ultraviolet filter in the photometric system.

g

Green filter in the photometric system.

r

Red filter in the photometric system.

i

Near Infrared in the photometric system.

z

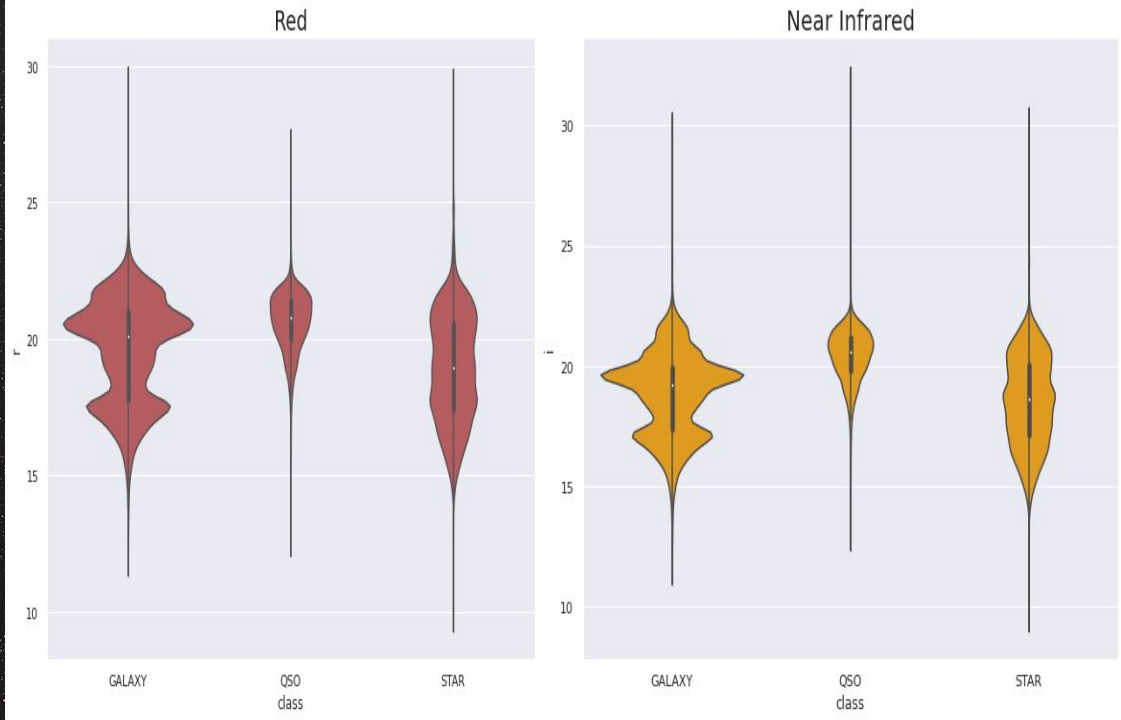
Infrared filter in the photometric system.



About Spectral Characteristics

Spectral characteristics are the most significant factor in classifying a stellar object. This is done through analyzing electromagnetic radiation from a stellar object by splitting it with a prism into a spectrum exhibiting the rainbow of colors interspersed with spectral lines. The strength of different spectral lines vary mainly due to the temperature of the given objects photosphere. Based on this method and more, stellar objects can be classified into their separate classes.

**These features
are essential in
classifying
stellar bodies.**



As you can see from the violin plots of these 2 spectral features, The shape of distribution is quite unique to each class. This is a strong indication that these features will directly contribute to the classification of each of these objects

OBSERVATIONAL IDENTIFYING INFORMATION

MJD

Modified Julian Date. Used to indicate when a given piece of SDSS data was taken.

Spec obj_ID

Unique ID used for optical spectroscopic objects.

Run_ID

Run number used to identify the specific scan.

Fiber_ID

Fiber ID that identifies the fiber that pointed the light at the focal plane in each observation

Plate

Plate ID identifies each plate in SDSS

CLASSIFICATION



K Nearest neighbors w/
PCA & GridSearch CV

- 97% Accuracy
- Better at at classifying true positives

RECOMMENDED



Logistic Regression w/
PCA & GridSearchCV

- 95% Accuracy
- Made more mistakes predicting galaxies

NOT RECOMMENDED

**MACHINE
LEARNING**



THANKS!

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Email
Linked In
Github

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