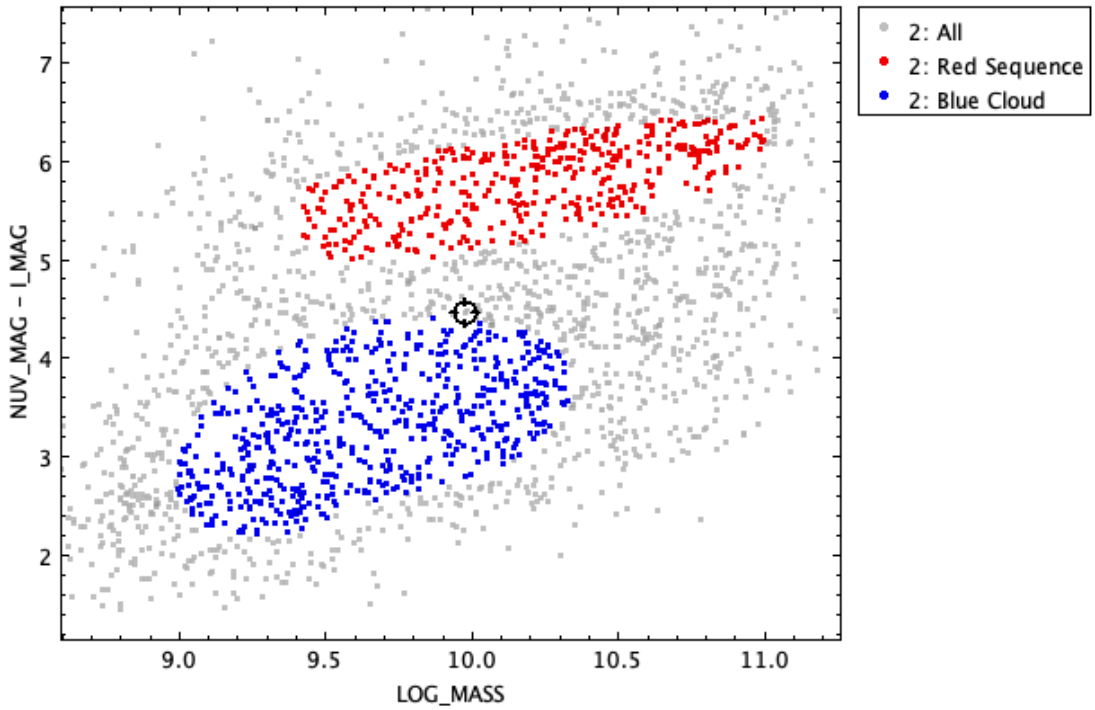
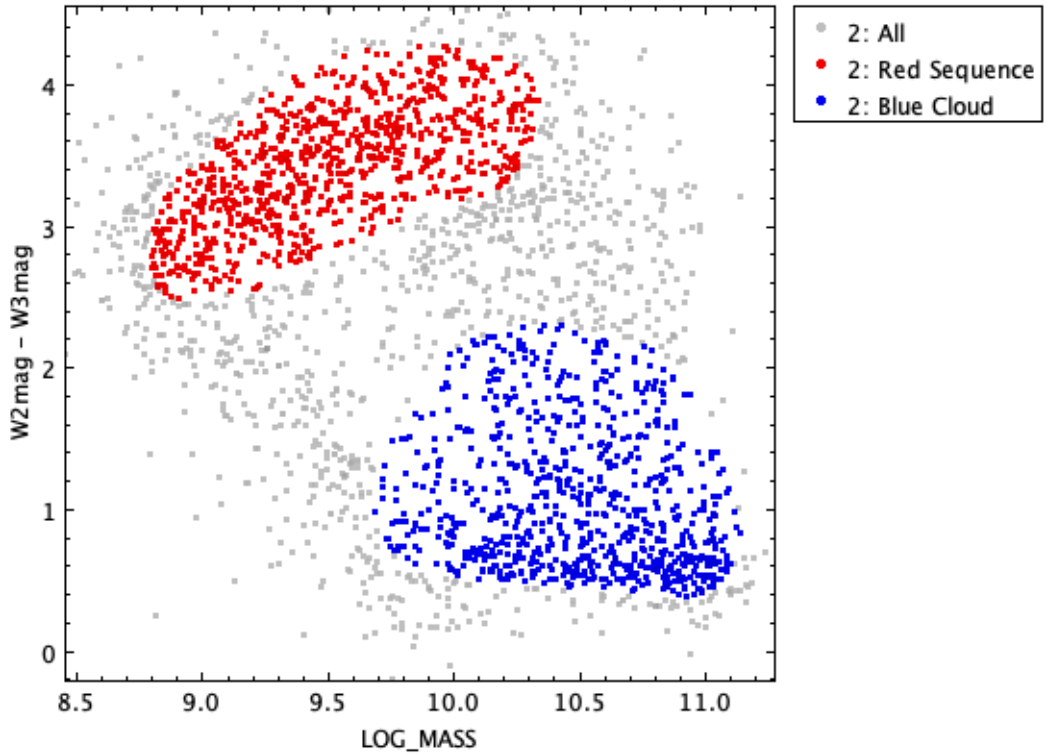
Riya Kore
Astronomy 330

Class 10 Exercise

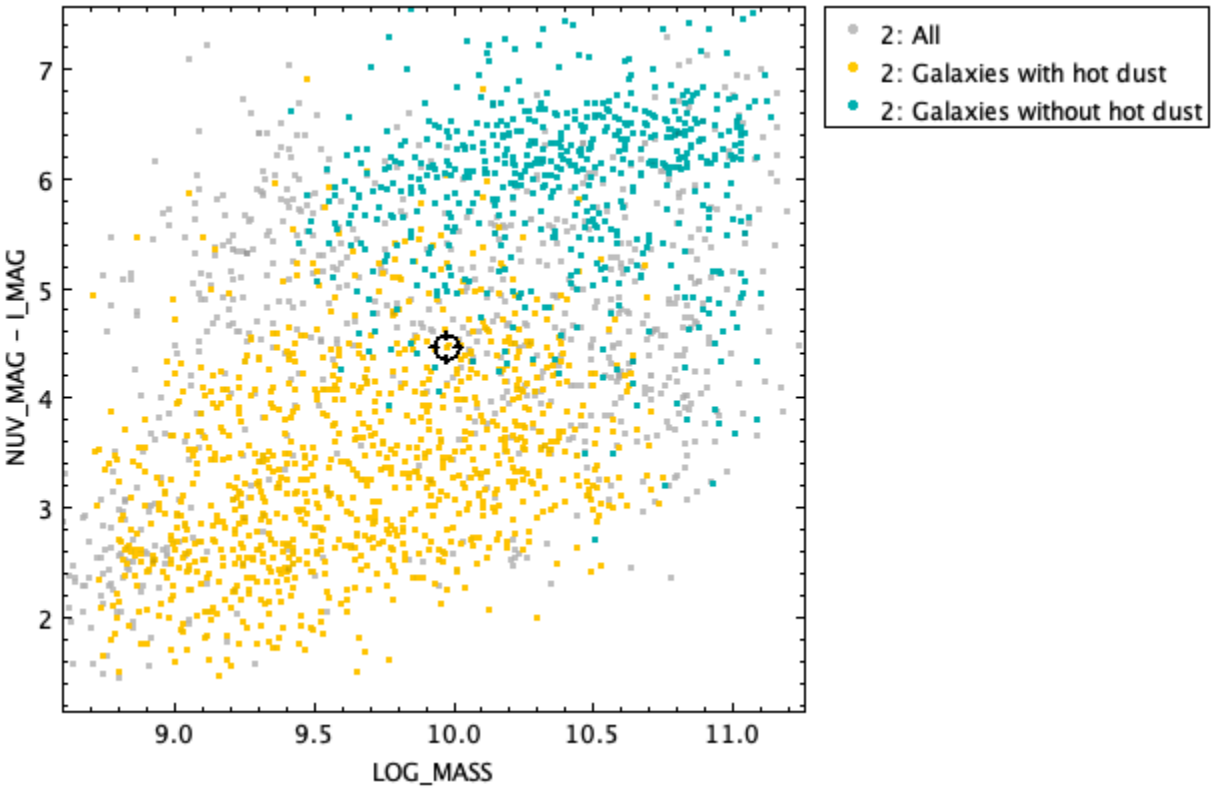
1. Plot of NUV-i vs. log(MASS), showing red sequence and blue cloud subsets.



2. Plot of W2-W3 vs. log(MASS), showing red sequence and blue cloud subsets.



3. Plot of NUV-i vs. log(MASS), showing hot-dusty and no-hot-dust subsets.



4. Answers to question 9:
    a. Galaxies that have hot dust are generally those undergoing active star formation, often found in the “blue cloud”. These galaxies contain young, massive stars that emit strong ultraviolet light, heating the surrounding dust and causing prominent infrared emission. Additionally, some galaxies with active galactic nuclei (AGN) can show elevated W2–W3 values because the central supermassive black hole’s accretion disk radiates enough energy to warm the dust, even if there is not much ongoing star formation.

    b. There are indeed red sequence galaxies whose W2–W3 colors indicate significant hot dust. Often, these galaxies host an AGN or have low-level star formation that heats dust even within an older stellar population. By examining their SDSS images, one may notice bright, compact nuclei suggestive of AGN activity, or subtle dust lanes in otherwise early-type or lenticular galaxies. These characteristics differentiate them from the typical red sequence galaxies, which generally lack strong mid-infrared emission.

    c. Galaxies without hot dust are not strictly confined to the red sequence, although many red-sequence galaxies do indeed have low W2–W3 values. Some galaxies in the blue cloud also show minimal dust signatures. These exceptions often have low dust content or metallicity, which keeps mid-infrared emission weak even when young, bright stars are present. Sometimes, stellar winds or supernova events can blow out what little dust exists, or star formation may be so

diffuse that it doesn't heat dust significantly. When looking at their SDSS images, these galaxies might appear small, faint, or irregular in shape, lacking clear dust lanes or obvious signs of intense star formation. This suggests that a galaxy can be both blue in NUV–i color and relatively free of hot dust, provided it either doesn't have much dust to begin with or has lost its dust through various feedback processes.

d. A galaxy may appear bright in the near-UV for several reasons, even if its other properties suggest an older or less active system. One possibility is a recent burst of star formation, where even a relatively small population of newly formed stars emits strongly in the UV. Another explanation is the "UV upturn" phenomenon in some elliptical galaxies, driven by specific evolutionary stages of low-mass stars that contribute significantly to UV light. Low dust extinction can preserve near-UV brightness by preventing the absorption and re-radiation of UV photons in longer infrared wavelengths, thereby making such galaxies appear unexpectedly UV-luminous.