Galaxies (Structure, Dynamics and Evolution)
Programming Assignment - 2

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Submitted by

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A Map of the Sellar Component of our Galaxy & Extragalactic Neighbours

(a) Code

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#importing relevant libraries

import numpy as np
import matplotlib.pyplot as plt
from matplotlib.patches import Ellipse
from astropy.io import ascii
from astropy.coordinates import SkyCoord  # High-level coordinates
from astropy.coordinates import ICRS, Galactic, FK4, FK5  # Low-level frames
from astropy.coordinates import Angle, Latitude, Longitude  # Angles
import astropy.units as u

# reading the data containing bright stars data
# converting the data to SkyCoord for plotting

data =
ascii.read("https://raw.githubusercontent.com/abrahammathews2000/Dataset_for_Gcolab/main/Galaxy_Asg_2/download_Data_1.tsv")
GLON = np.array(data["GLON(deg)"])
GLAT = np.array(data["GLAT(deg)"])
OBcoord = SkyCoord(frame= "galactic",l = GLON,b = GLAT,unit=(u.deg, u.deg))

# Coordinates of LMC SMC and Andromeda galaxies

LMCcoord = SkyCoord(frame= "galactic",l = 280.4652,b = -32.8884,unit=(u.deg, u.deg))
SMCcoord = SkyCoord(frame= "galactic",l = 302.8084,b = -44.3277,unit=(u.deg, u.deg))
ANDROcoord = SkyCoord(frame= "galactic",l = 121.174329,b = -21.573309,unit=(u.deg, u.deg))

# Setting up the plot

plt.figure(figsize=(25,20))
plt.subplot(projection="aitoff")
ax = plt.axes()
ax.set_facecolor('tab:blue')
plt.title("A Map of the Sellar Component of our Galaxy & Extragalactic Neighbours")
plt.grid(True)

# Plotting of OB stars

plt.scatter(OBcoord.l.wrap_at('180d').radian,OBcoord.b.radian,label="OB Stars",color =
"tab:orange")
```

```
# reading the Local Group Galaxies data
# converting the data to SkyCoord for plotting

locGal =
ascii.read("https://raw.githubusercontent.com/abrahammathews2000/Dataset_for_Gcolab/main/Galaxy_Asg_2/Table_2_analysis_Gal_Asg_2%20-%20v2.csv")
locGalNAME = np.array(locGal["Galaxy"])
locGalLON = np.array(locGal["l"])
locGalLAT = np.array(locGal["b"])
locGalcoord = SkyCoord(frame= "galactic",l = locGalLON,b = locGalLAT,unit=(u.deg, u.deg))

# Plotting the Ellipses for Dwarf Galaxies
# And labeling their names

i = 0
for i in np.arange(len(locGalLON)):
  if (i == 1):
    tempLocalGal = Ellipse((locGalcoord[i].l.wrap_at('180d').radian,locGalcoord[i].b.radian),width =
0.15,height=0.15,facecolor="darkviolet",edgecolor='black',label="Local Group Dwarf Galaxies")
  else:
    tempLocalGal = Ellipse((locGalcoord[i].l.wrap_at('180d').radian,locGalcoord[i].b.radian),width =
0.15,height=0.15,facecolor="darkviolet",edgecolor='black')
  plt.gca().add_patch(tempLocalGal)
  if(locGalNAME[i] == "LMC" or locGalNAME[i] == "SMC" or locGalNAME[i] == "Andromeda"):
    plt.text(locGalcoord[i].l.wrap_at('180d').radian, locGalcoord[i].b.radian, f'{locGalNAME[i]}',
fontsize = 20.3,color='black',fontweight = "black")
  else:
    plt.text(locGalcoord[i].l.wrap_at('180d').radian, locGalcoord[i].b.radian, f'{locGalNAME[i]}',
fontsize = 10,color='black')
i = 0
for i in np.arange(len(locGalLON)):
  if(locGalNAME[i] == "LMC" or locGalNAME[i] == "SMC" or locGalNAME[i] == "Andromeda"):
    plt.text(locGalcoord[i].l.wrap_at('180d').radian, locGalcoord[i].b.radian, f'{locGalNAME[i]}',
fontsize = 20,color='white',fontweight = "black")

# Plotting the Ellipses for LMC, SMC, and Andromeda galaxies

LMCellipse = Ellipse((LMCcoord.l.wrap_at('180d').radian,LMCcoord.b.radian),width =
0.2,height=0.15,label="LMC",facecolor = "blue",edgecolor='black')
SMCellipse = Ellipse((SMCcoord.l.wrap_at('180d').radian,SMCcoord.b.radian),width =
0.2,height=0.15,label="SMC",facecolor = "green",edgecolor='black')
ANDROellipse = Ellipse((ANDROcoord.l.wrap_at('180d').radian,ANDROcoord.b.radian),width =
0.3,height=0.2,label="Andromeda",facecolor = "tab:red",edgecolor='black')
plt.gca().add_patch(LMCellipse)
plt.gca().add_patch(SMCellipse)
plt.gca().add_patch(ANDROellipse)
```

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```
# Plotting the Ecliptic

eclipticLong = np.linspace(-180,180,361)
eclipticLat = np.zeros(len(eclipticLong))
eclipticCoord = SkyCoord(eclipticLong,eclipticLat, unit=u.deg,frame='barycentricmeanecliptic')
eclipticCoord_gal = eclipticCoord.transform_to('galactic')
plt.scatter(-eclipticCoord_gal.l.wrap_at('180d').radian,eclipticCoord_gal.b.radian,label="Ecliptic",col
or = "white",edgecolors='black')
plt.xlabel("longitude [deg]")
plt.ylabel("latitude [deg]")
plt.legend(bbox_to_anchor=(1.05, 1.0),loc='upper right')
plt.show()
```

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(b) Map