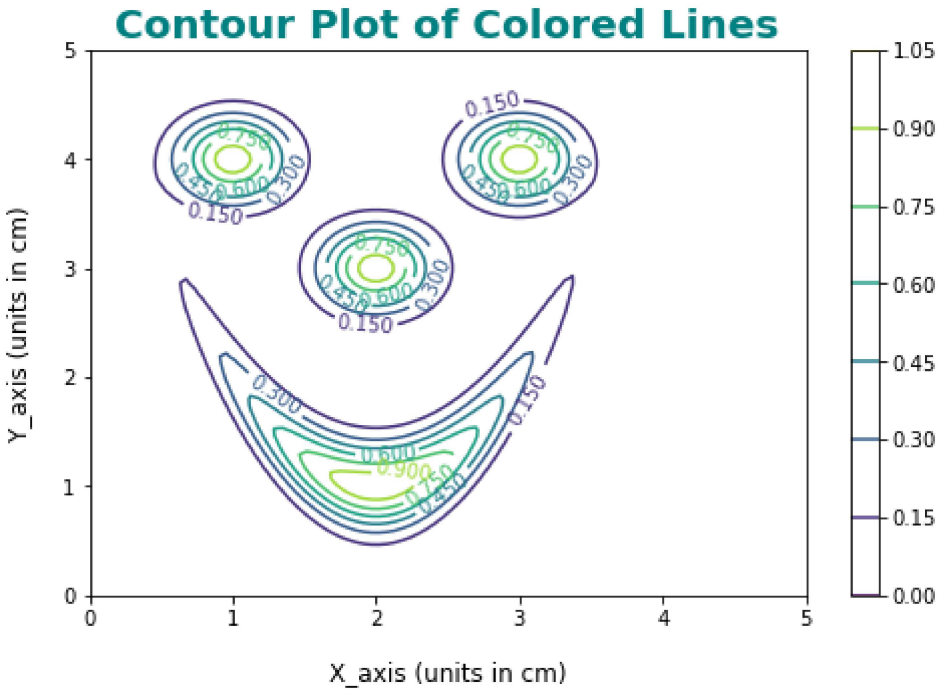
Assignment 3: 3D Plots

1. Contour plot

```
1) Make a contour plot. Make sure to add labels in the plot or a legend for
colors on the contours. You can choose either a filled contour plot or colored
lines, your choice.
```

In [1]:

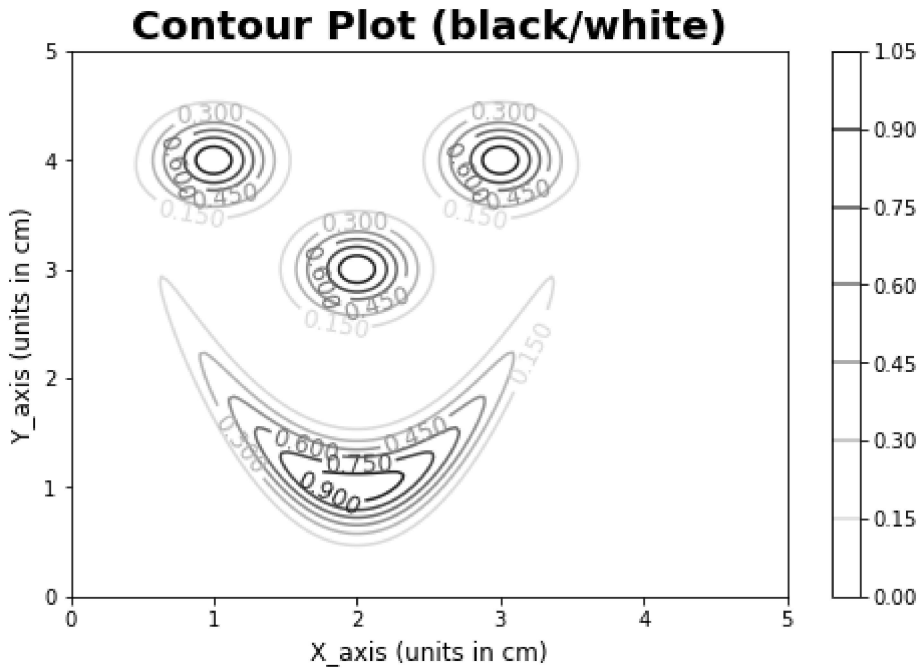
```
import numpy as np
import matplotlib.pyplot as plot
from matplotlib import cm
import matplotlib.mlab as mlab

x_axis = np.linspace(0,5,90)
y_axis = np.linspace(0,5,90)
X, Y = np.meshgrid(x_axis,y_axis)
Z = np.exp(-((X-1)**2+(Y-4)**2)/0.15) + \
    np.exp(-((X-3)**2+(Y-4)**2)/0.15) + \
    np.exp(-((X-2)**2+(Y-3)**2)/0.15) + \
    np.exp(-(X-2)**2) * np.exp(-(Y - ((X-2)**2+1))**2/0.15)


plot.figure(figsize =[8, 5])
contour_plot = plot.contour(X, Y, Z,cmap=cm.viridis)

plot.clabel(contour_plot, inline=True, fontsize=10)

plot.title('Contour Plot of Colored Lines',fontsize=20,
           color='Teal',weight='bold')
plot.xlabel('X_axis (units in cm)',fontsize=12,labelpad=15)
plot.ylabel('Y_axis (units in cm)',fontsize=12,labelpad=15)
plot.colorbar()
plot.show()
```



2) Do this for an additional color mapping: e.g. hot/cold or black/white.

In [2]:

```
import numpy as np
import matplotlib.pyplot as plot
from matplotlib import cm
import matplotlib.mlab as mlab

x_axis = np.linspace(0,5,150)
y_axis = np.linspace(0,5,150)
X, Y = np.meshgrid(x_axis,y_axis)
Z = np.exp(-((X-1)**2+(Y-4)**2)/0.15) + \
    np.exp(-((X-3)**2+(Y-4)**2)/0.15) + \
    np.exp(-((X-2)**2+(Y-3)**2)/0.15) + \
    np.exp(-(X-2)**2) * np.exp(-(Y - ((X-2)**2+1))**2/0.15)


plot.figure(figsize =[8, 5])


contour_plot = plot.contour(X,Y,Z,cmap=cm.binary)
plot.clabel(contour_plot,inline=7, fontsize=12)
plot.title('Contour Plot (black/white)',fontsize=20,
           color='Black',weight='bold')
plot.xlabel('X_axis (units in cm)',fontsize=12)
plot.ylabel('Y_axis (units in cm)',fontsize=12)
plot.colorbar()
plot.show()
```

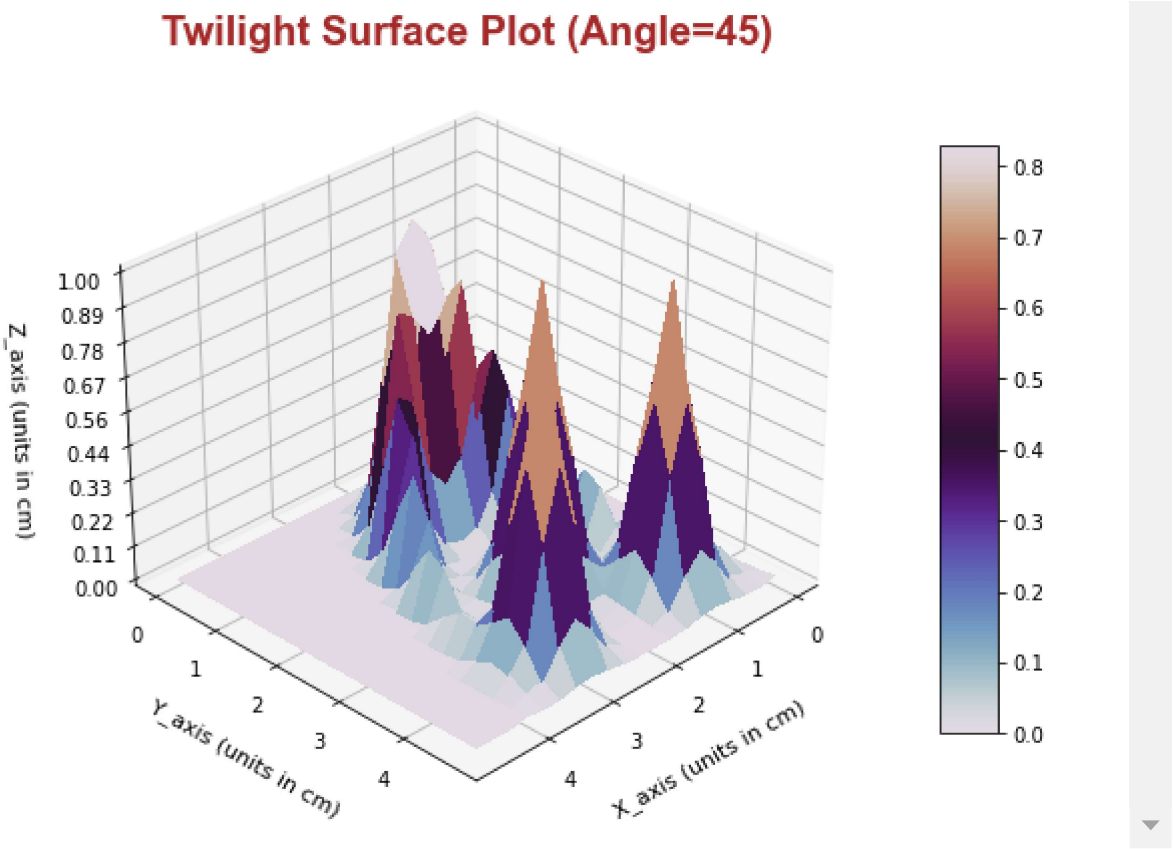


2. Surface plots (or mesh plots)

1). Using the same data set as before, create a surface plot. Also be sure to choose an appropriate color mapping to help in interpretation. If you can’t make a surface plot, a mesh plot (where the surface is not filled in) will suffice.

In [3]:

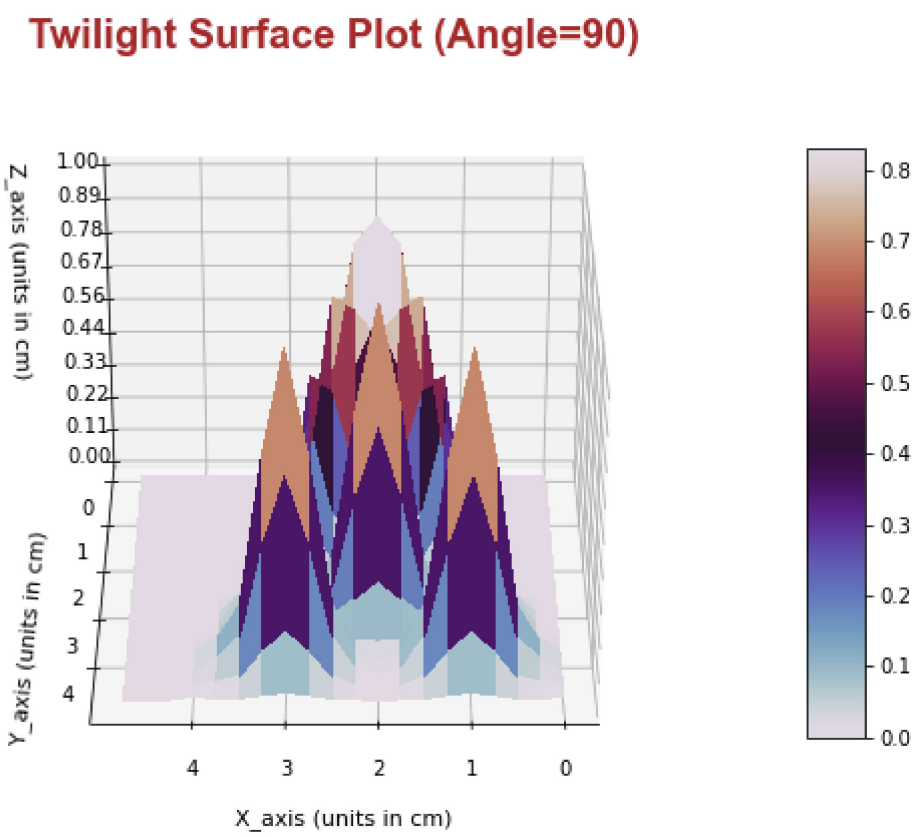
```
from mpl_toolkits.mplot3d import Axes3D
import matplotlib.pyplot as plt
from matplotlib import cm
from matplotlib.ticker import LinearLocator, FormatStrFormatter
import numpy as np

f = plt.figure(figsize=(8,6))
graph = f.gca(projection='3d')

graph.view_init(azim=45)

X = np.arange(0, 5,0.25)
Y = np.arange(0, 5,0.25)
X, Y = np.meshgrid(X, Y)

Z = np.exp(-((X-1)**2+(Y-4)**2)/0.15) + \
    np.exp(-((X-3)**2+(Y-4)**2)/0.15) + \
    np.exp(-((X-2)**2+(Y-3)**2)/0.15) + \
    np.exp(-(X-2)**2) * np.exp(-(Y - ((X-2)**2+1))**2/0.15)

surface_plot = graph.plot_surface(X, Y, Z,
            cmap=cm.twilight,linewidth=0, antialiased=False)


graph.set_zlim(0, 1)

graph.zaxis.set_major_locator(LinearLocator(10))

graph.zaxis.set_major_formatter(FormatStrFormatter('%.02f'))

f.set_size_inches(9,9)
f.colorbar(surface_plot,shrink=0.6,aspect =10,pad=0.09)

graph.set_xlabel('X_axis (units in cm)',fontsize=11,labelpad=10)
graph.set_ylabel('Y_axis (units in cm)',fontsize=11,labelpad=10)
graph.set_zlabel('Z_axis (units in cm)',fontsize=11,labelpad=10)
graph.set_title('Twilight Surface Plot (Angle=45)',fontsize=20,
                color='Brown',weight='bold',fontfamily='Arial')
plt.show()
```



2). Generate at least one additional viewpoint of the surface that may also be helpful in providing insights.

In [4]:

```
from mpl_toolkits.mplot3d import Axes3D
import matplotlib.pyplot as plot
from matplotlib import cm
from matplotlib.ticker import LinearLocator, FormatStrFormatter
import numpy as np

f = plot.figure(figsize=(8,6))
graph = f.gca(projection='3d')

graph.view_init(azim=90)

X = np.arange(0, 5,0.25)
Y = np.arange(0, 5,0.25)
X, Y = np.meshgrid(X, Y)

Z = np.exp(-((X-1)**2+(Y-4)**2)/0.15) + \
    np.exp(-((X-3)**2+(Y-4)**2)/0.15) + \
    np.exp(-((X-2)**2+(Y-3)**2)/0.15) + \
    np.exp(-(X-2)**2) * np.exp(-(Y - ((X-2)**2+1))**2/0.15)

surface_plot = graph.plot_surface(X, Y, Z, cmap=cm.twilight,
                    linewidth=0, antialiased=False)


graph.set_zlim(0, 1)

graph.zaxis.set_major_locator(LinearLocator(10))

graph.zaxis.set_major_formatter(FormatStrFormatter('%.02f'))

f.set_size_inches(9,9)
f.colorbar(surface_plot,shrink=0.6,aspect =10,pad=0.09)

graph.set_xlabel('X_axis (units in cm)',fontsize=11,labelpad=10)
graph.set_ylabel('Y_axis (units in cm)',fontsize=11,labelpad=10)
graph.set_zlabel('Z_axis (units in cm)',fontsize=11,labelpad=20)
graph.set_title('Twilight Surface Plot (Angle=90)',fontsize=20,
                color='Brown',weight='bold',fontfamily='Arial')
plt.show()
```


Twilight Surface Plot (Angle=90)
Z_axis (units in cm)
1.00
0.89
0.78
0.67
0.56
0.44
0.33
0.22
0.11
0.00
Y_axis (units in cm)
0
1
2
3
4
X_axis (units in cm)
4
3
2
1
0
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0