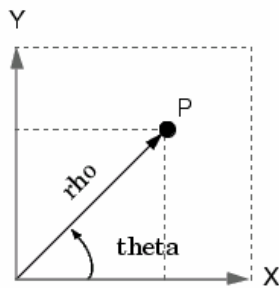
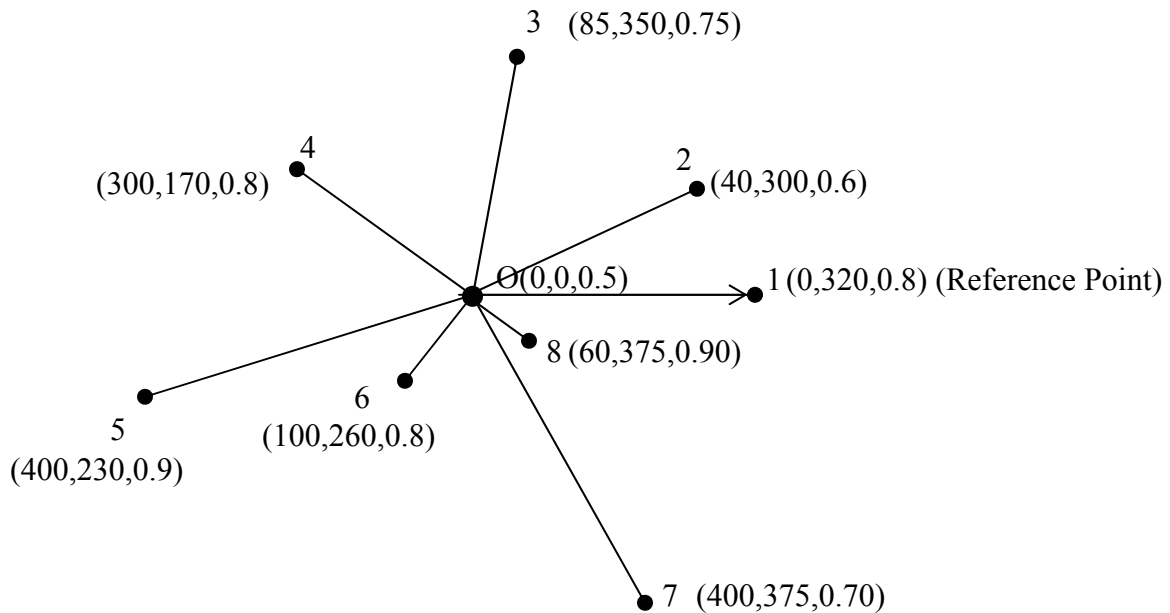
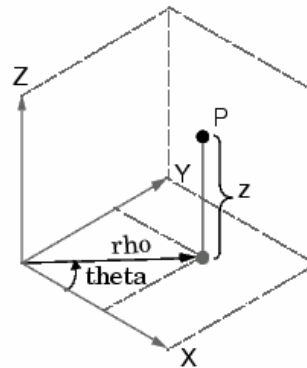


## Surface and Contour Plot Tutorial

Coordinates of 9 nodes are given below in the form of  $(\theta, r, z)$  where  $r$  is distance from the origin in meters,  $\theta$  is the horizontal angle in gradians and  $z$  is the elevation.



Two-Dimensional Mapping



Three-Dimensional Mapping

Let us start by organizing the data into arrays.

```
r = [0 0 300 350 300 400 100 400 60]
```

```
theta_g = [0 320 40 85 170 230 260 340 375]
```

```
z = [0.5 0.8 0.6 0.75 0.8 0.9 0.8 0.7 0.90]
```

Matlab works with radians by default. Therefore, it maybe useful to convert the gradians to radians.

```
theta_r = theta_g.*pi/200
```

Matlab has excellent tools for plotting surfaces and contour maps but these tools work with Cartesian coordinates. At this point, the coordinate data (theta\_r,r,z) will be converted into cartesian coordinates by `pol2cart` function.

```
[X, Y, Z] = pol2cart(theta_r,r,z)
```

Matlab functions `surf`, `contour` and `surfz` can be used to generate the surface and contour map plots of existing geographical data. However, there is a need to create a grid and interpolate the existing data to obtain the intermediate values.

Let us start out by creating the mesh in x and y coordinates. First we need to decide how fine the mesh is going to be. `linspace` function creates linear array between `min(x)` and `max(x)` by dividing the range into 100 equal pieces. It is possible to create a coarser or finer mesh by changing the number 100. A word of caution, you have to use the same number for x and y.

```
xlin = linspace(min(X),max(X),100);  
ylin = linspace(min(Y),max(Y),100);
```

At this point, it is possible to create the mesh using the `meshgrid` function.

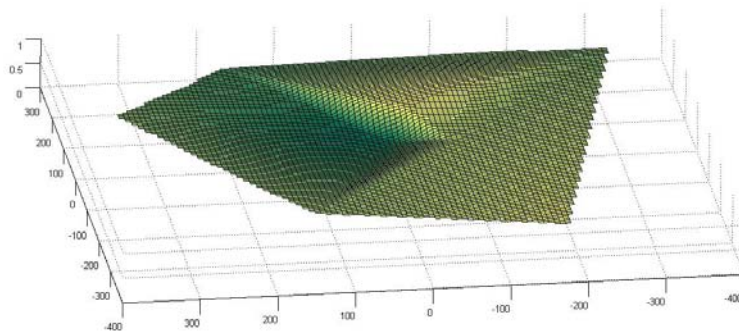
```
[XI,YI] = meshgrid(xlin,ylin);
```

After the mesh is set up in the xy plane, intermediate values of z can be generated by `griddata` function.

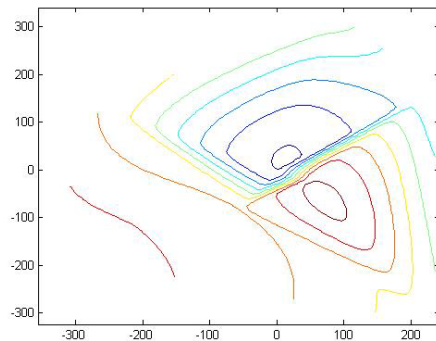
```
ZI = griddata(X,Y,Z,XI,YI,'cubic');
```

Now that all intermediate values are interpolated, it is possible to obtain the surface and contour map plots using the `surf`, `contour` and `surfz` commands.

```
surf(XI,YI,ZI)
```



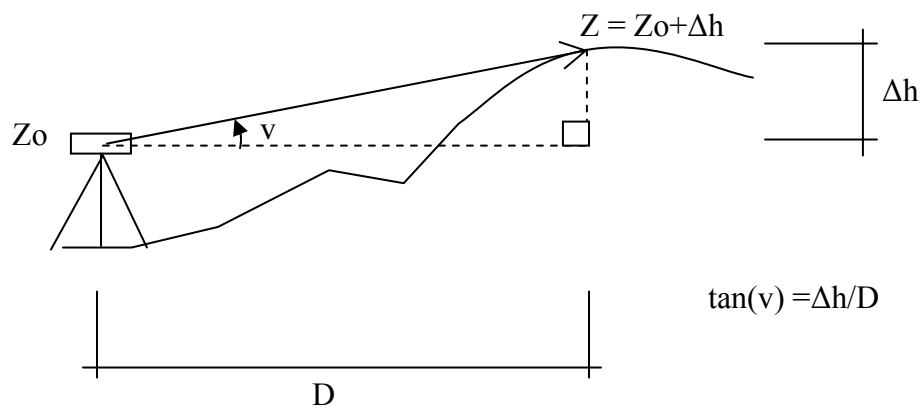
```
contour(XI, YI, ZI)
```



Once the figure is generated, use the editor to add legends, text and etc. to fine tune your output.

The coordinates in your take-home final is given in the form of  $D$ ,  $h$  and  $v$  where  $D$  is the polar distance (rho) in meters,  $h$  is the horizontal angle in grads and  $v$  is the vertical angle in grads. You will need to use the vertical angle to calculate the elevation  $Z$ . (Use the figure presented below) Therefore, you need to convert the vertical angles from grads to radians just like in the tutorial presented above. Also notice that the horizontal angles in the take home increase clockwise whereas the theta in matlab increases in the counterclockwise direction.

It would be advisable to plot the points on a blank page using your custom parameters, alpha and beta to get a feel of the topography.



For the second question in your final, you may consider using polyarea or an equivalent function to calculate the areas.