Kodak moments

3-D Visualization and Color

CS112 Scientific Computation
Department of Computer Science
Wellesley College

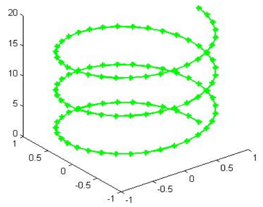
3-D line and scatter plots

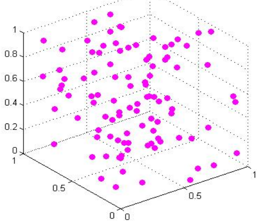
Create plots of 3-D curves and points using

plot3(x, y, z, …)

scatter3(x, y, z, …)

```
>> angles = linspace(0, 6*pi, 100);
>> plot3(cos(angles), sin(angles), angles, 'g-*', 'Linewidth', 2);
>> scatter3(rand(1,100), rand(1,100), rand(1,100), 40, 'm', 'filled');
```





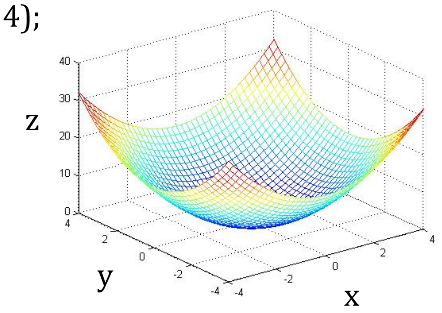
Graph a 3-D function of two variables

Suppose we want to graph the function

$z = x^2 + y^2 \quad -4 \leq x,y \leq +4$

We can get there in three steps:

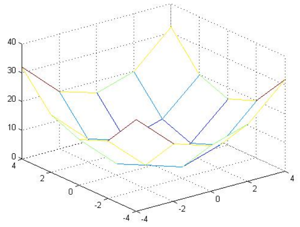
```
>> [x  y] = meshgrid(-4:0.2:4);
>> z = x.^2  + y.^2;
>> mesh(x, y, z);
```



Use meshgrid to create 2-D coordinates

meshgrid creates 2-D matrices of coordinates, given an input vector that specifies the values for each coordinate

```
>> [x  y] = meshgrid(-4:2:4);
>> z = x.^2 + y.^2;
>> mesh(x, y, z);
```

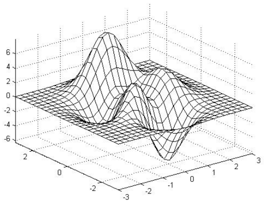


```
x =                         y =                             z =
  -4   -2   0   2   4         -4   -4   -4   -4   -4         32   20   16   20   32
  -4   -2   0   2   4         -2   -2   -2   -2   -2         20    8    4    8   20
  -4   -2   0   2   4          0    0    0    0    0         16    4    0    4   16
  -4   -2   0   2   4          2    2    2    2    2         20    8    4    8   20
  -4   -2   0   2   4          4    4    4    4    4         32   20   16   20   32
```

So, what can I do with my plot?

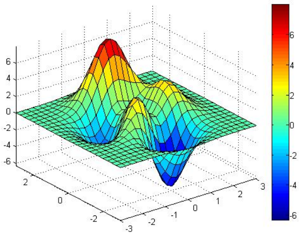
Let’s begin with something a little more interesting:

```
>> [x  y  z] = peaks(25);
>> mesh(x, y, z, 'EdgeColor', 'k');
>> axis tight
```



Display a surface,
    and add a colorbar:

```
>> surf(x, y, z);
>> colorbar
```



Colormaps

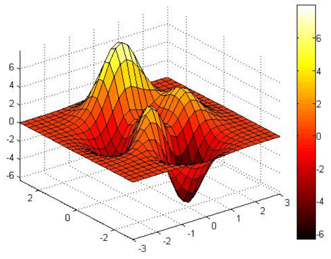
```
>> cmap = colormap
 cmap =
               0         0    0.5625
               0         0    0.6250
               0         0    0.6875    steadily
               0         0    0.7500    increase
               0         0    0.8125      blue
               0         0    0.8750
               0         0    0.9375
               0         0    1.0000
               0    0.0625    1.0000     add in
               0    0.1250    1.0000     green
               0    0.1875    1.0000
             ...       ...       ...
          0.6250         0         0    pure red
          0.5625         0         0   at the end
          0.5000         0         0

           red      green      blue
```

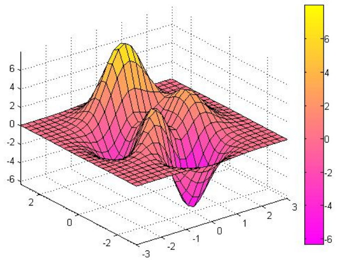
Named colormaps

MATLAB has named colormaps that can be set with colormap

colormap(hot)



colormap(spring)



View the colormaps by searching for colormap in Help facility

Don’t like the colors? Make your own!

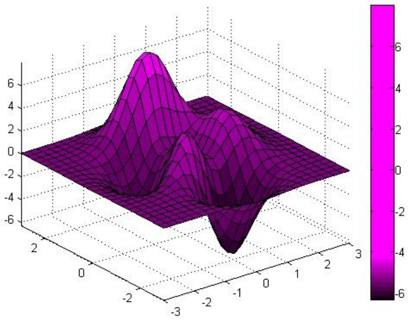
Exercise: Create a matrix named purples that stores RGB values for 10 shades of purple, to use as a colormap

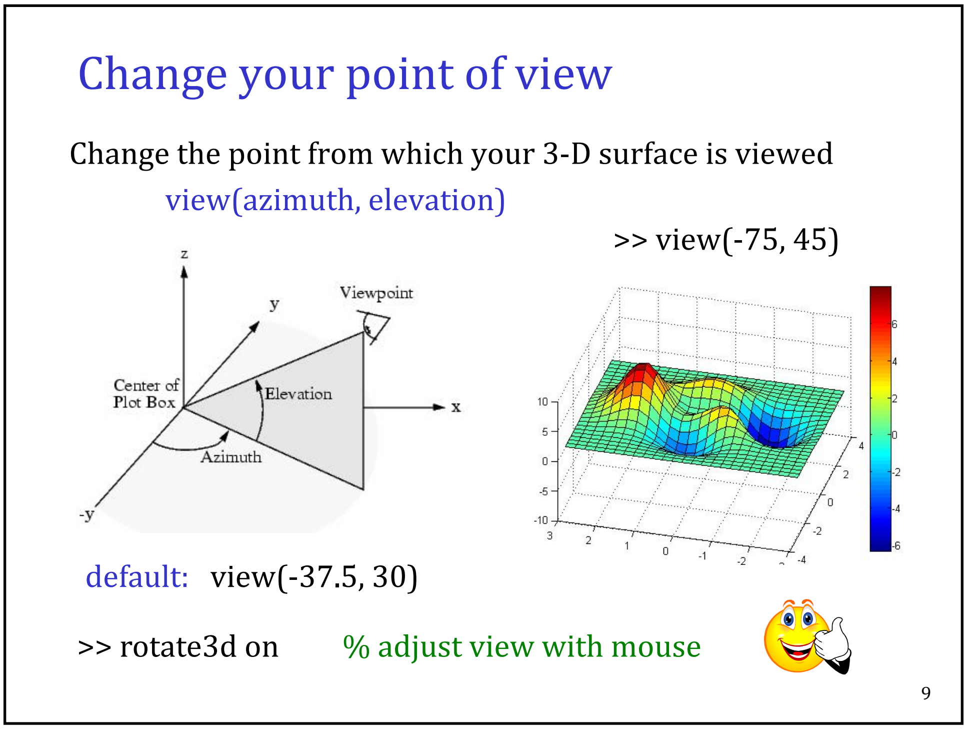
Hint: purple has equal amounts of red and blue

```
>> purples = zeros(?, ?);

???

>> colormap(purples);
```





Change your point of view

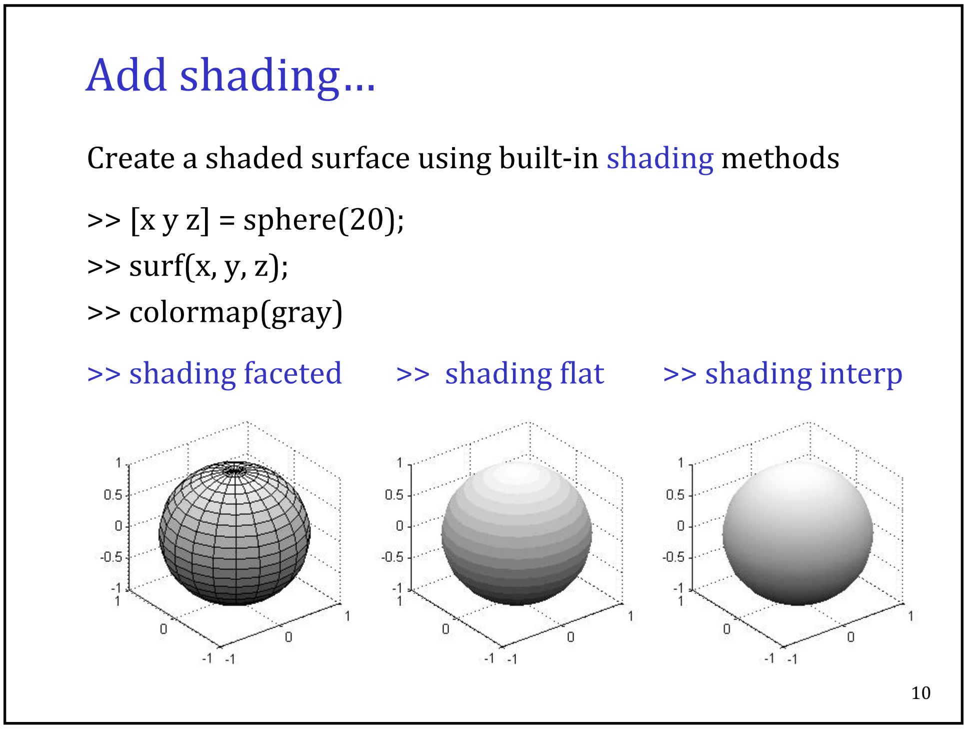
Change the point from which your 3-D surface is viewed

view(azimuth, elevation)

```
>> view(-75, 45)
```

default: view(-37.5, 30)

```
>> rotate3d on      % adjust view with mouse
```



Add shading…

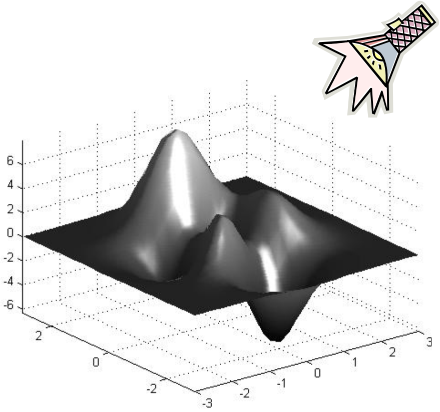
Create a shaded surface using built-in shading methods

```
>> [x y z] = sphere(20);
>> surf(x, y, z);
>> colormap(gray)
```

```
>> shading faceted      >>  shading flat      >> shading interp
```

Add a light source…

```
>> [x y z] = peaks(25);
>> surf(x, y, z);
>> axis tight
>> colormap(gray)
>> shading interp
>> light('Position', [0  -1  0])
>> lighting phong
```

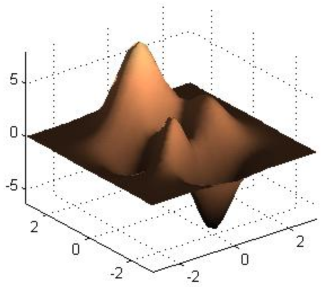


… and adjust the surface material

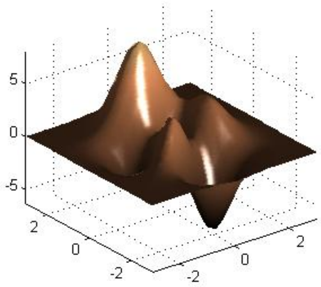
Start the same as previous slide, then…

```
>> colormap(copper)
```

>> material dull

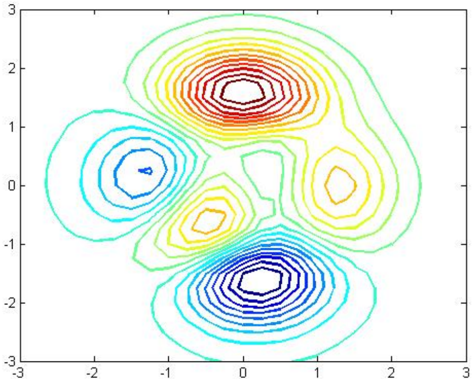


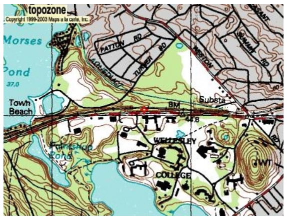
>> material shiny



Contour plots

```
>> [x y z] = peaks(25);
>> contour(x, y, z, 20, 'Linewidth', 2)
```



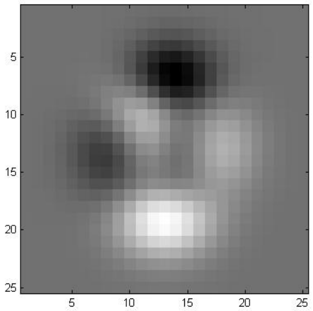


like a topographical map

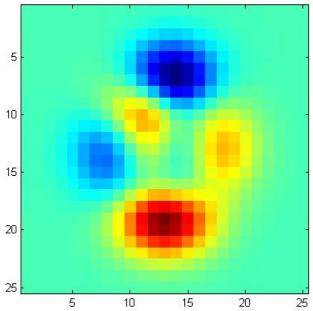
Color images

```
>> [x y z] = peaks(25);
>> imagesc(z)
```

```
>> colormap(gray)
```



```
>> colormap(hot)
```


5
10
15
20
25
5
10
15
20
25