

Matlab Course: day 2

Generating plots in Matlab

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Our first plot: simple 2D plot

♣ Let's define two vectors and plot them

$$time = \begin{pmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \end{pmatrix}, param1 = \begin{pmatrix} 30 \\ 34 \\ 80 \\ 75 \\ 91 \\ 10 \\ 5 \end{pmatrix}$$

♣ `plot(time,param1)`

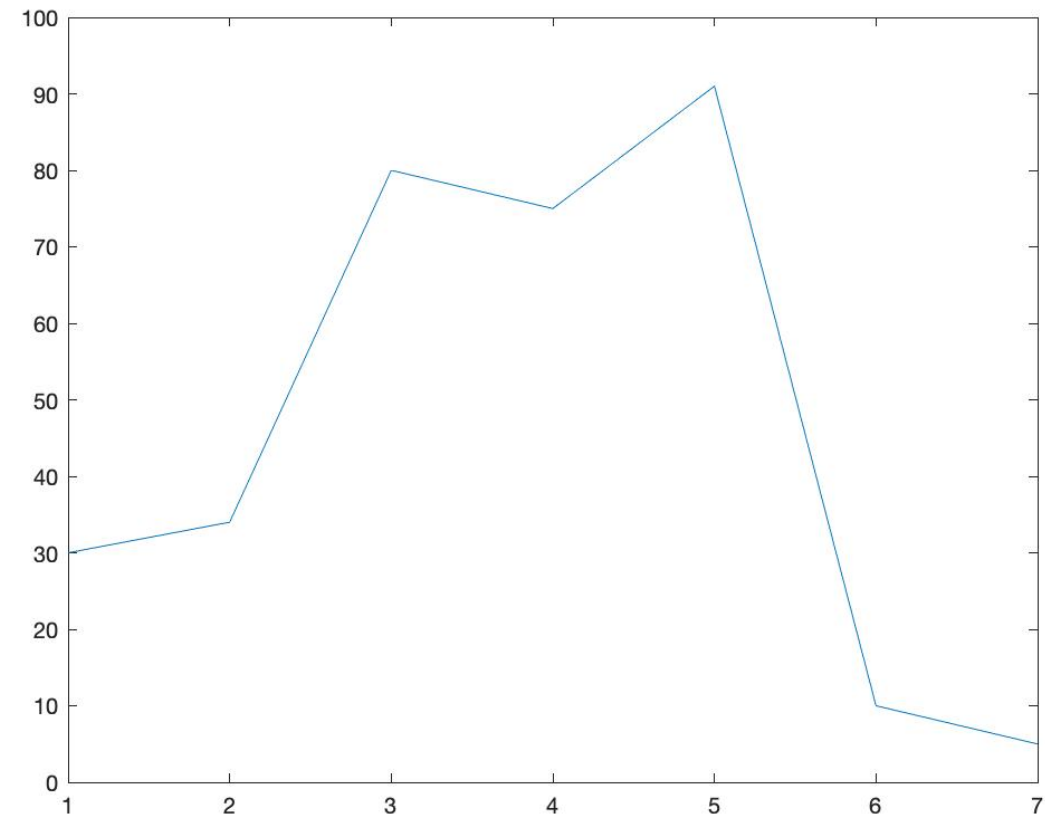


Our first plot: simple 2D plot

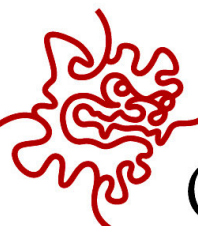
❖ Let's define two vectors and plot them

$$time = \begin{pmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \end{pmatrix}, param1 = \begin{pmatrix} 30 \\ 34 \\ 80 \\ 75 \\ 91 \\ 10 \\ 5 \end{pmatrix}$$

❖ `plot(time,param1)` 

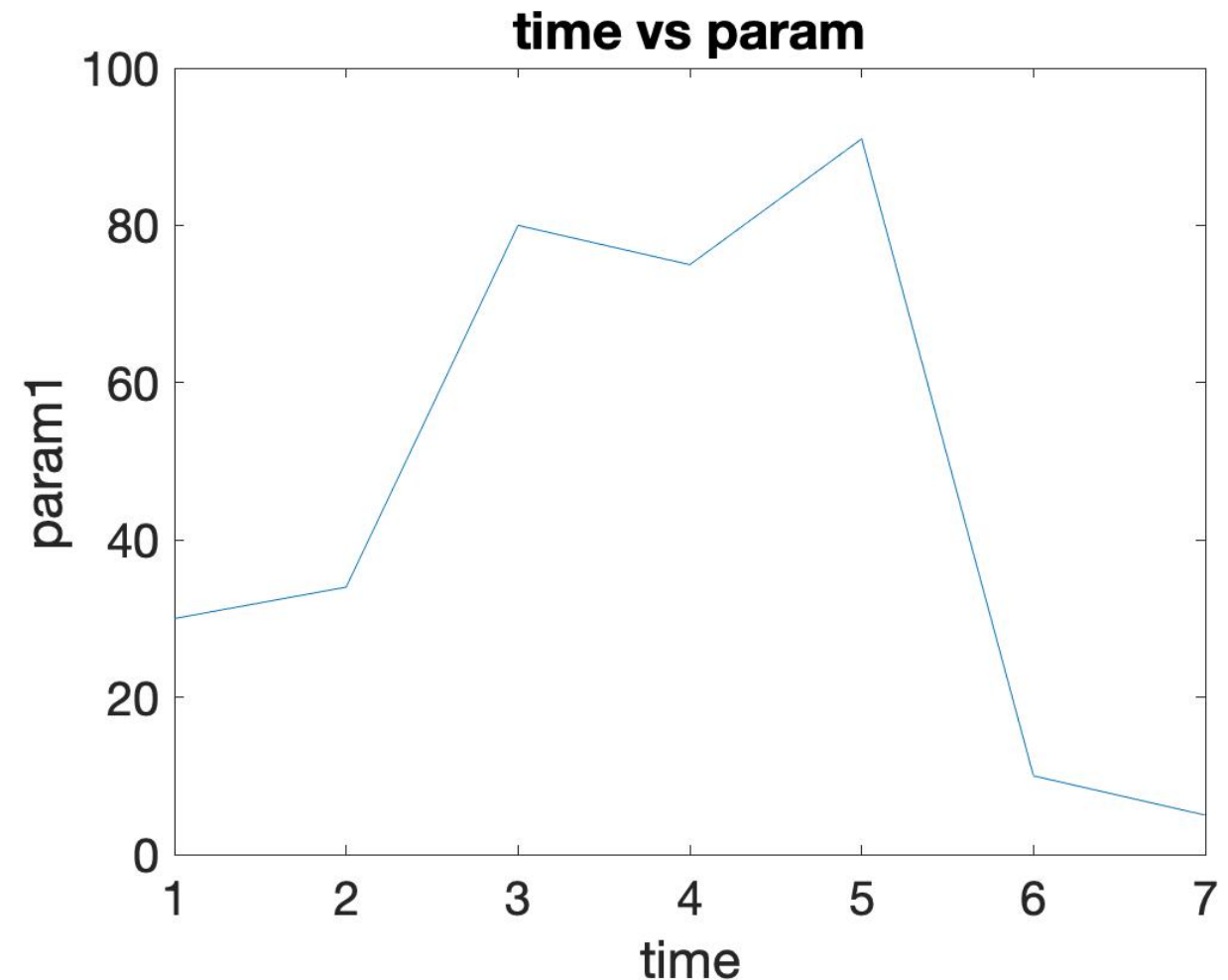


Looks horrible! Can't read the axis, no title, no labels

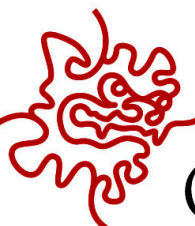


Title, labels and size

- Title command:
`title('time vs param');`
- Labeling the x and y axis:
`xlabel('time');`
`ylabel('param1')`
- Change the size of the labels, title and axes
`set(gca,'FontSize',20)`

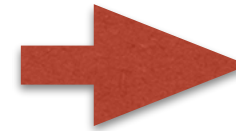


Better but not there yet!



Changing the line width and line color

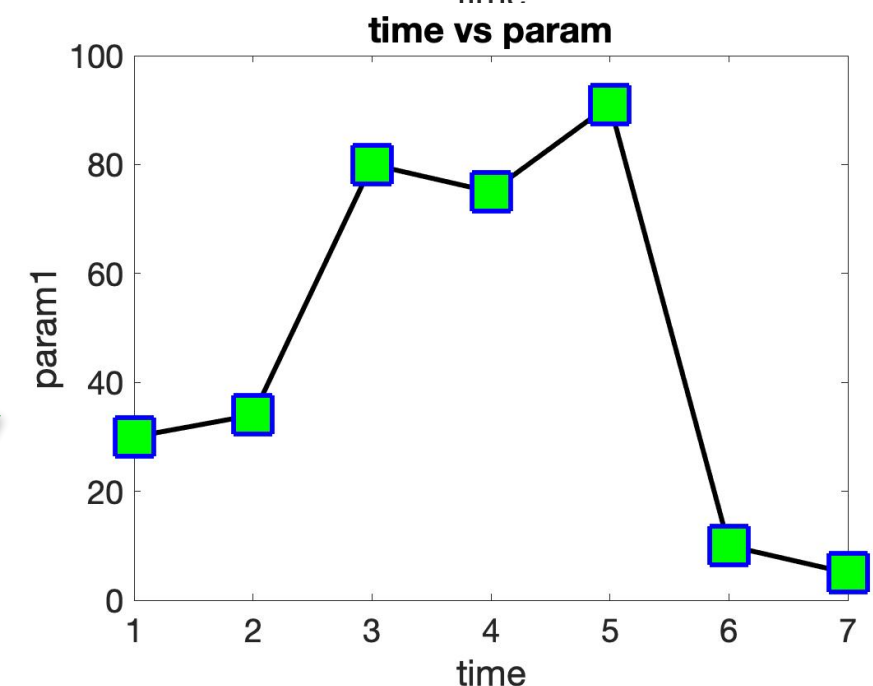
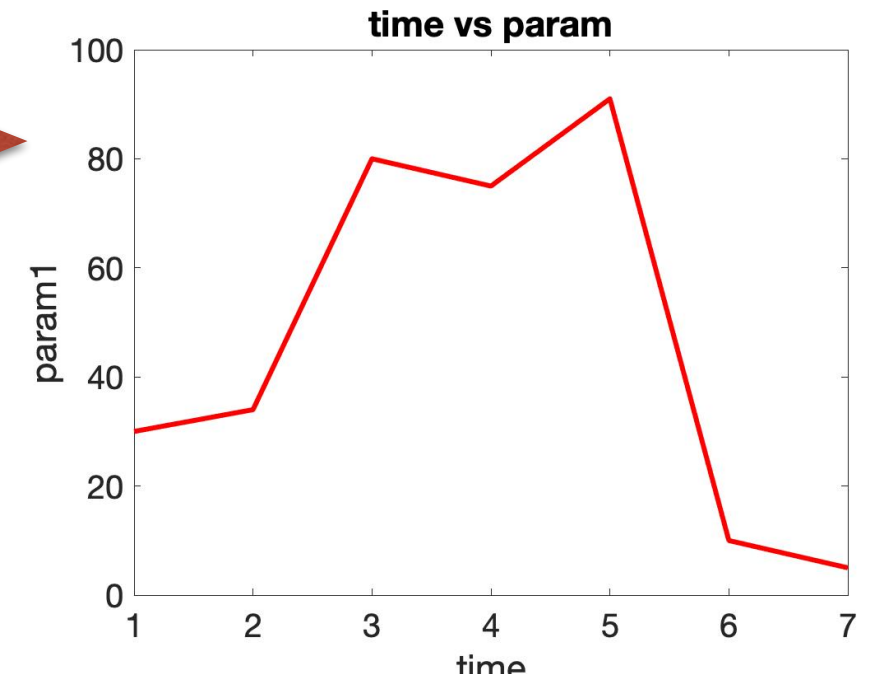
```
plot(time,param1,'LineWidth',3,'Color','r');
```



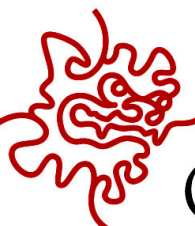
Play by adding any property you want:

1. Type of line:
 - ❖ '-' dashed dot
 - ❖ '--' dashed
 - ❖ ':' dotted
2. Colors: 'r','b','c','m','y','k','w'
3. Markers:
 - ❖ 'o' circle
 - ❖ 'x' x-mark
 - ❖ '*' star
 - ❖ 's' square
 - ❖ 'd' diamond

Full list of
options:
help plot



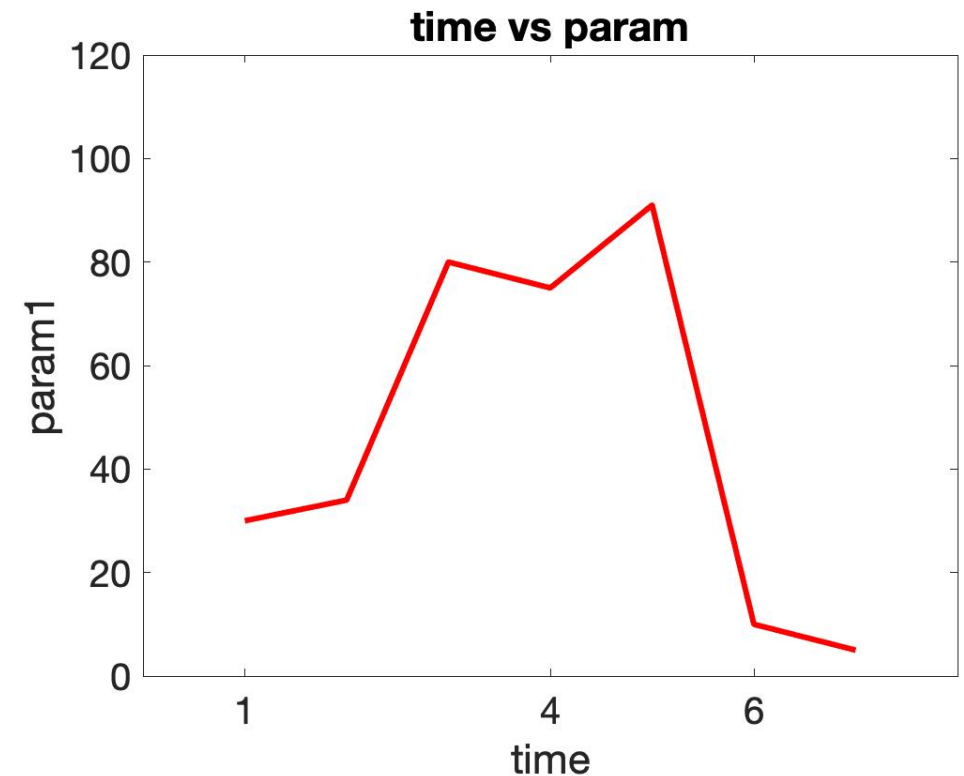
```
plot(time,param1,'LineWidth',3,'Color','k','Marker','s','MarkerSize',30,'MarkerEdgeColor','b',  
      'MarkerFaceColor','g');
```



Set limits and ticks

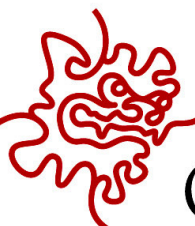
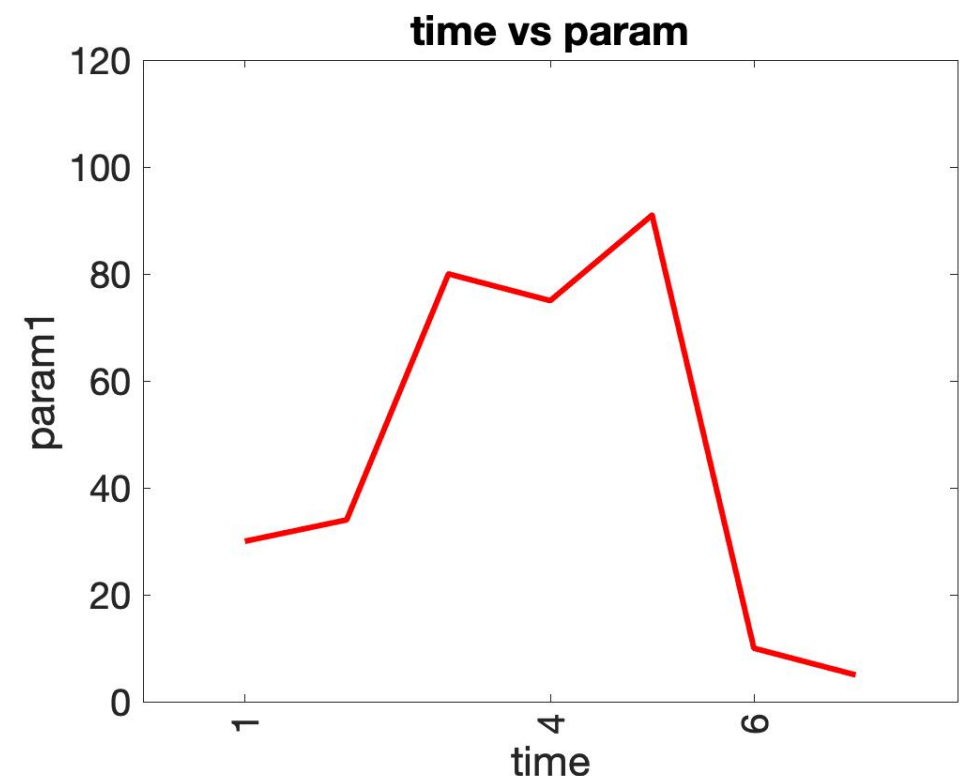
Set the axis limits as you want:

- `xlim([0,8]);`
- `ylim([0,120]);`
- `xticks([1 4 6]);`



Other useful commands:

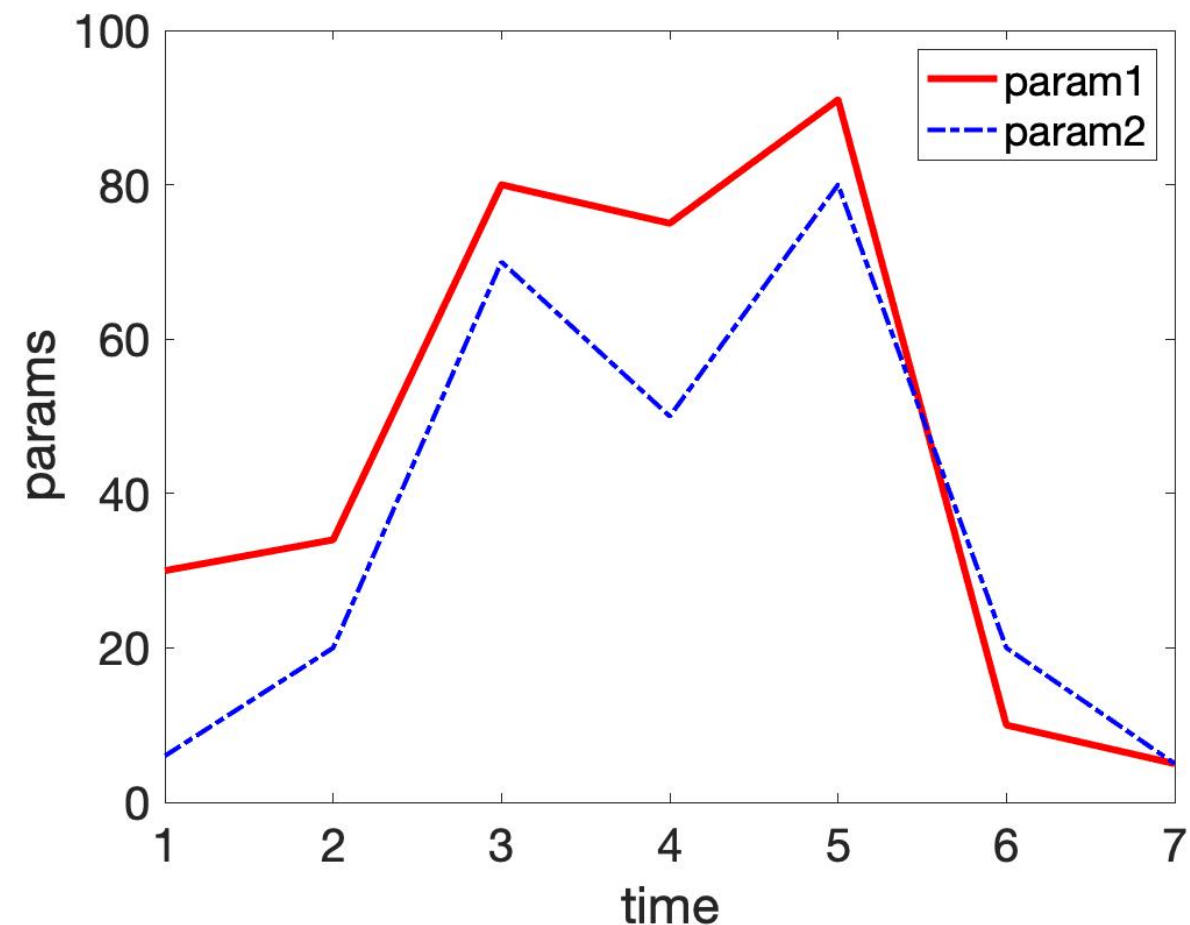
- `xtickangle(90);`
- `xticklabels({'label' ,
'label2' , 'label3'})`



Hold on plots and legends

♣ Let's define one more vector:

$$param2 = \begin{pmatrix} 6 \\ 20 \\ 70 \\ 50 \\ 80 \\ 20 \\ 5 \end{pmatrix}$$



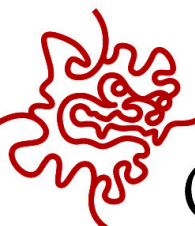
♣ Plot them on the same figure

```
plot(time,param1,'LineWidth',3,'Color','r')
```

hold on

```
plot(time,param2,'-.','LineWidth',2,'Color','b')
```

```
legend('param1','param2')
```

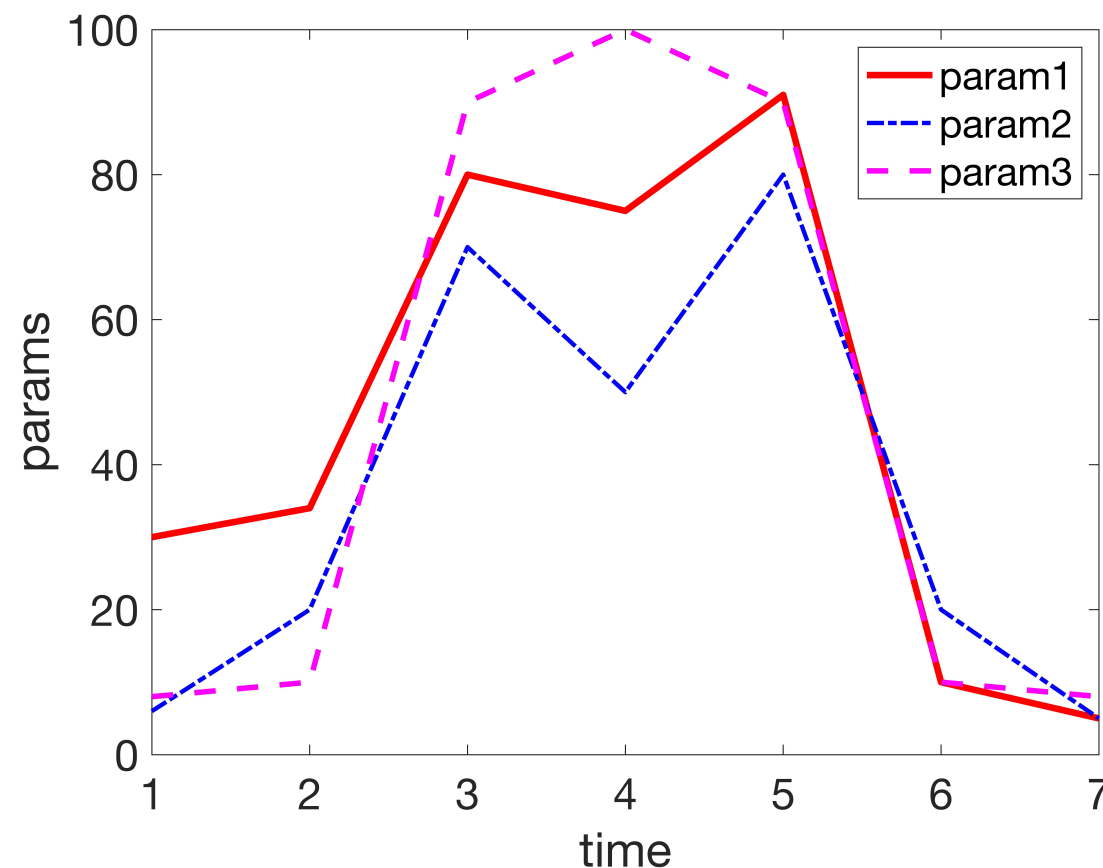
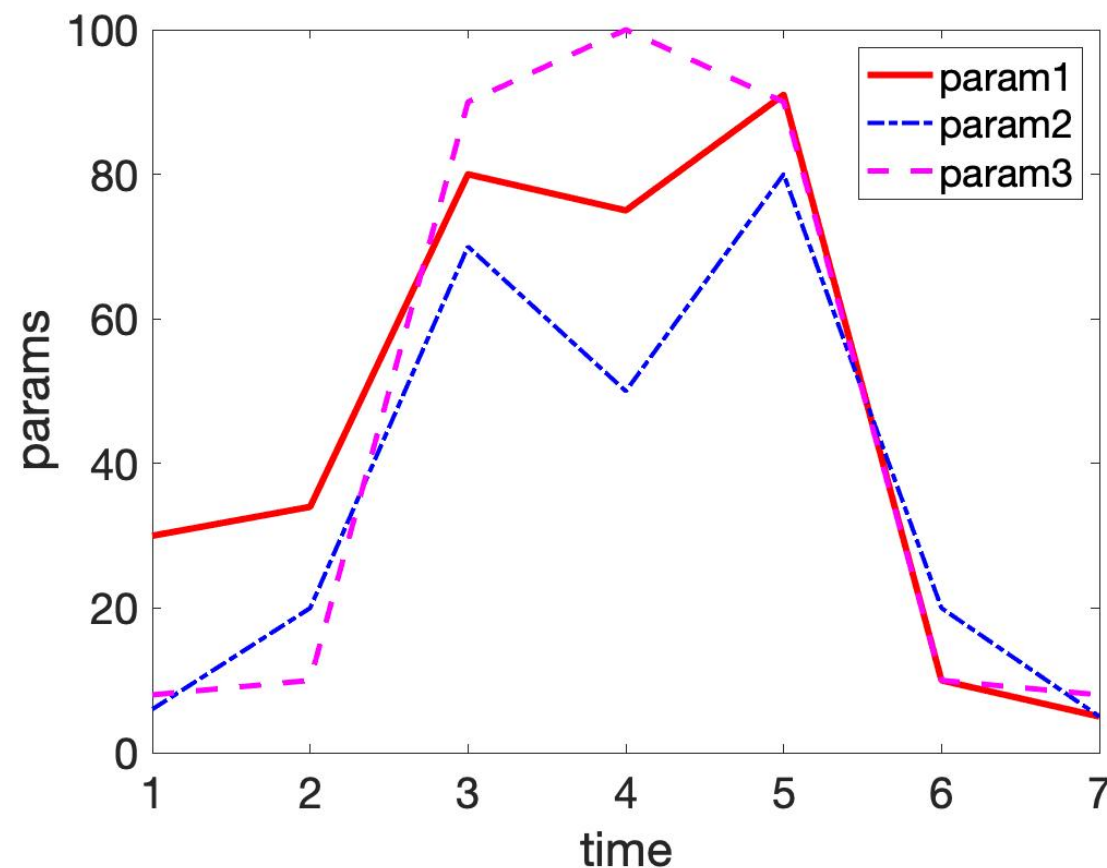


Saving figures and improving resolution

- Basic way:
Figure — Save as - choose format
- For publications: **INCREASE RESOLUTION!!**

```
hgexport(gcf, 'Name_of_figure', hgexport('factorystyle')  
'Format', 'jpeg', 'Resolution', '500')
```

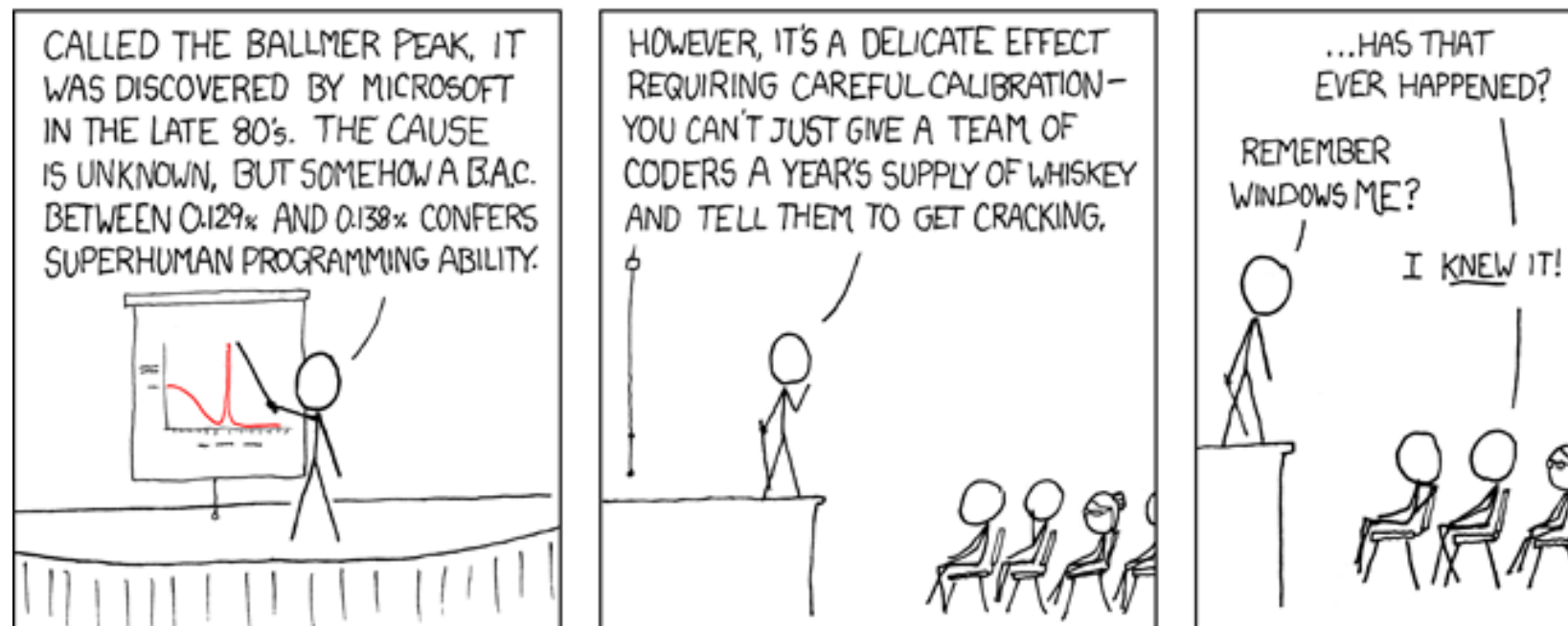
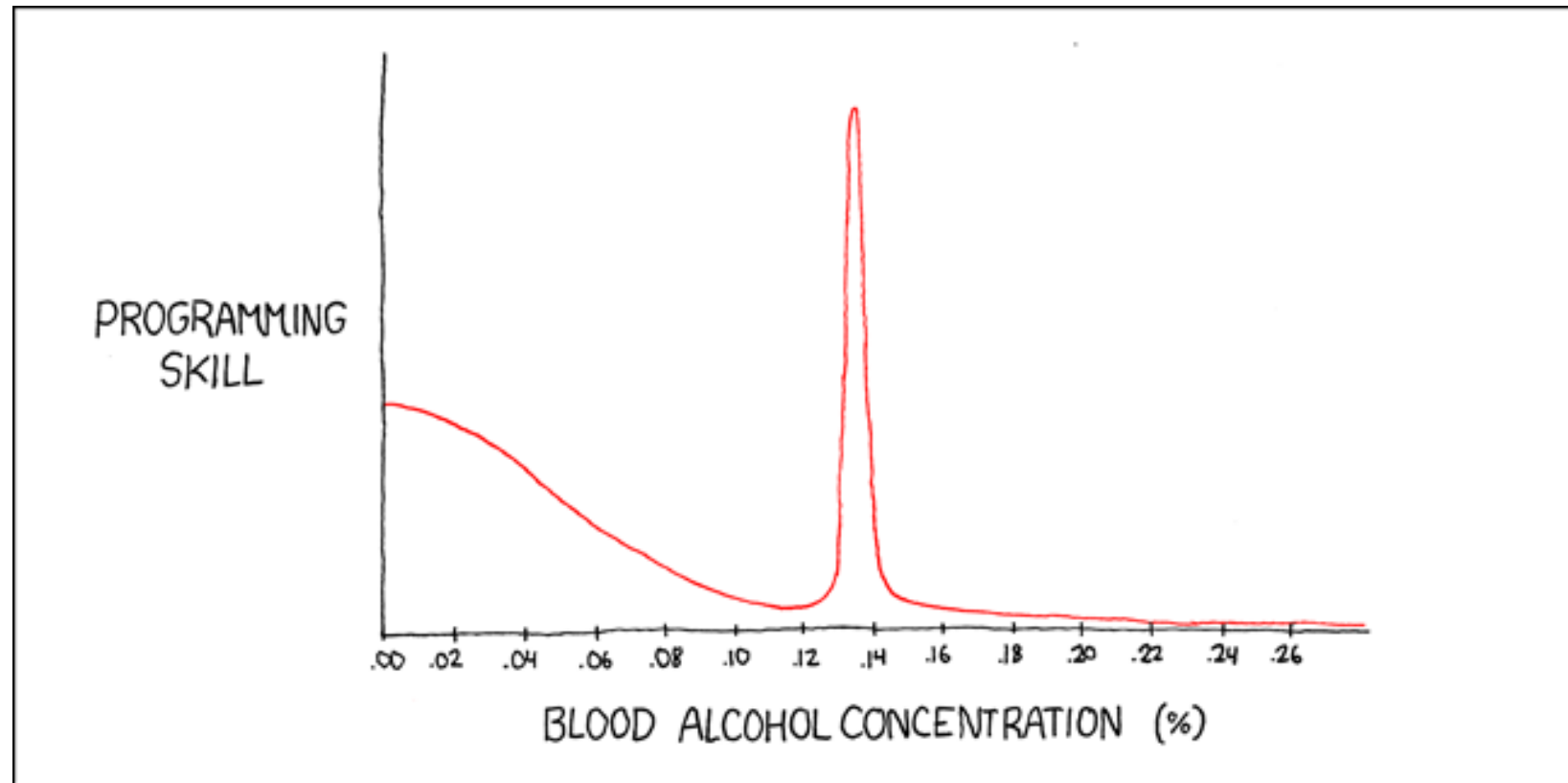
Eps
Pdf
Jpeg
Png



**Let's
zoom in
and see
the
difference**

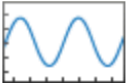
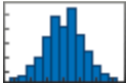



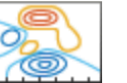
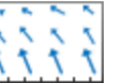
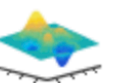

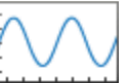


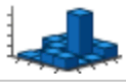
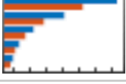
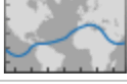

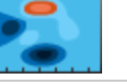
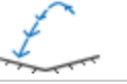
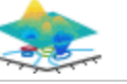
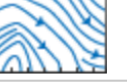

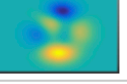
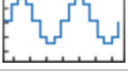






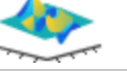
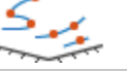

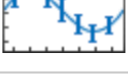



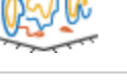






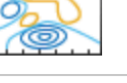



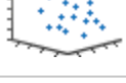

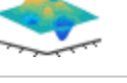
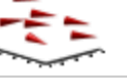


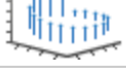
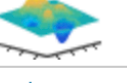

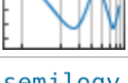



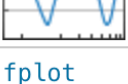


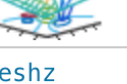
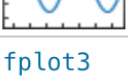








Reproduce Ballmer peak's plot

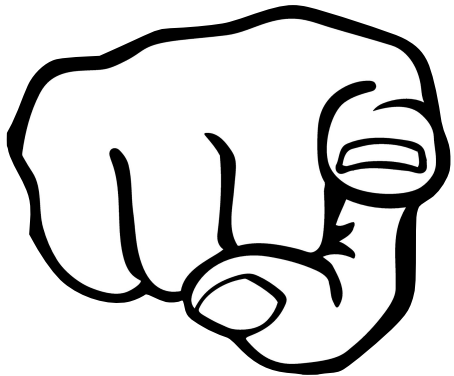


data is in ballmer.mat

Plotting your data in Matlab

Line plot	Data distribution plot	Discrete data plot	Geographic plot	Polar coordinate plot	Contour map	Vector field	Surface plot and mesh plot	Visualization of volume data	animation	image
plot 	histogram 	bar 	geobubble 	polarplot 	contour 	quiver 	surf 	streamline 	animatedline 	image 
plot3 	histogram2 	barh 	geoplot 	polarhistogram 	contourf 	quiver3 	surfc 	streamslice 	comet 	imagesc 
stairs 	pie 	bar3 	geoscatter 	polarscatter 	contour3 	feather 	surfl 	streamparticles 	comet3 	
errorbar 	pie3 	bar3h 		compass 	contourslice 		ribbon 	streamribbon 		
area 	scatter 	pareto 		ezpolar 	fcontour 		pcolor 	streamtube 		
stackedplot 	scatter3 	stem 					fsurf 	coneplot 		
loglog 	scatterhistogram 	stem3 					fimplicit3 	slice 		
semilogx 	spy 	scatter 					mesh 			
semilogy 	plotmatrix 	scatter3 					meshc 			
fplot 	heatmap 	stairs 					meshz 			
fplot3 	wordcloud 						waterfall 	https://jp.mathworks.com/help/matlab/creating_plots/types-of-matlab-plots.html		

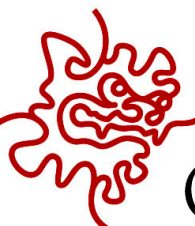
First bar plot



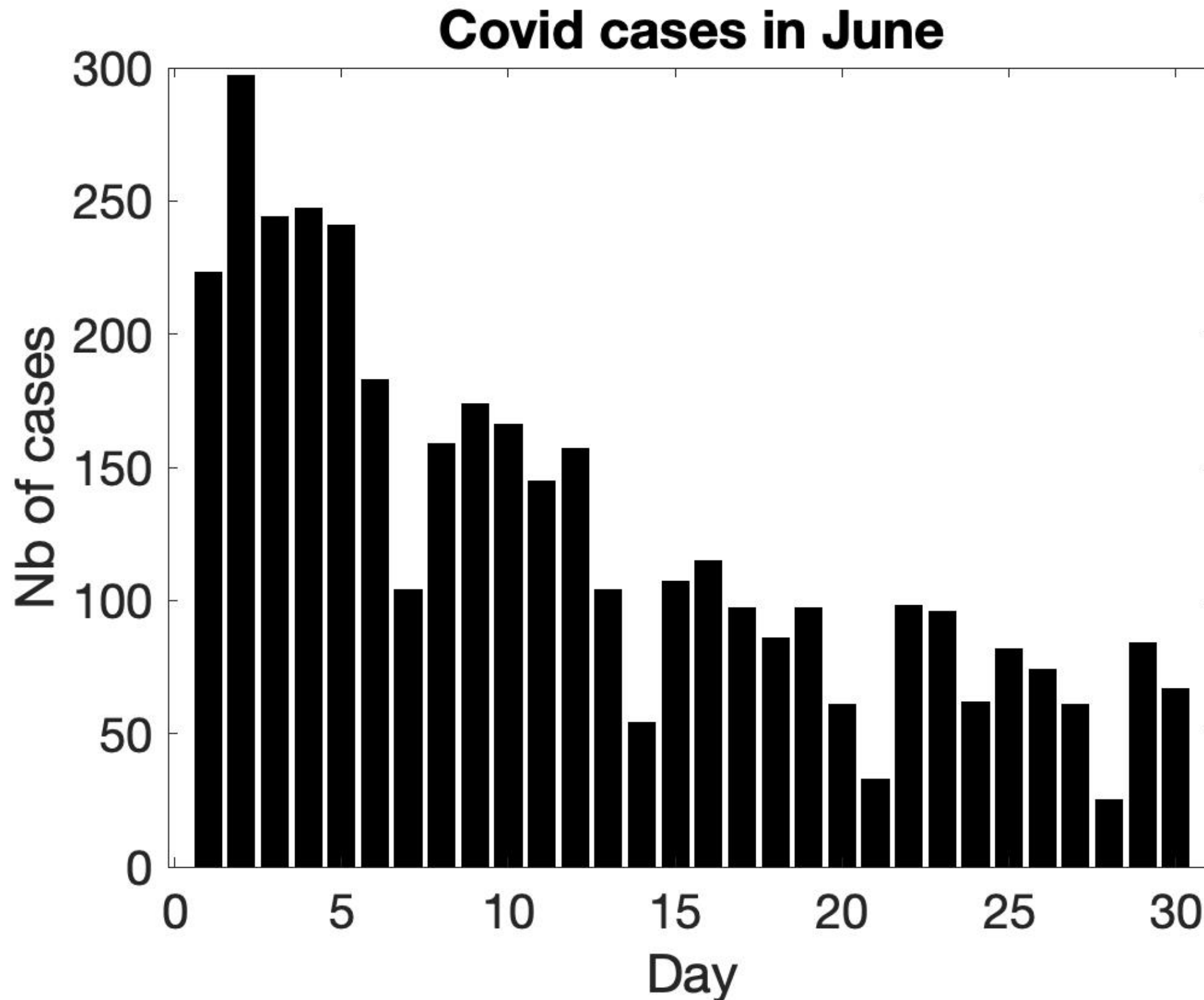
task 2



- Make a bar plot of the Covid cases in Okinawa for June
- load **Cov_june.mat** in the Task2 folder
- Generate a bar plot - in black
- Add a title
- Label the axis
- Set the FontSize to 20



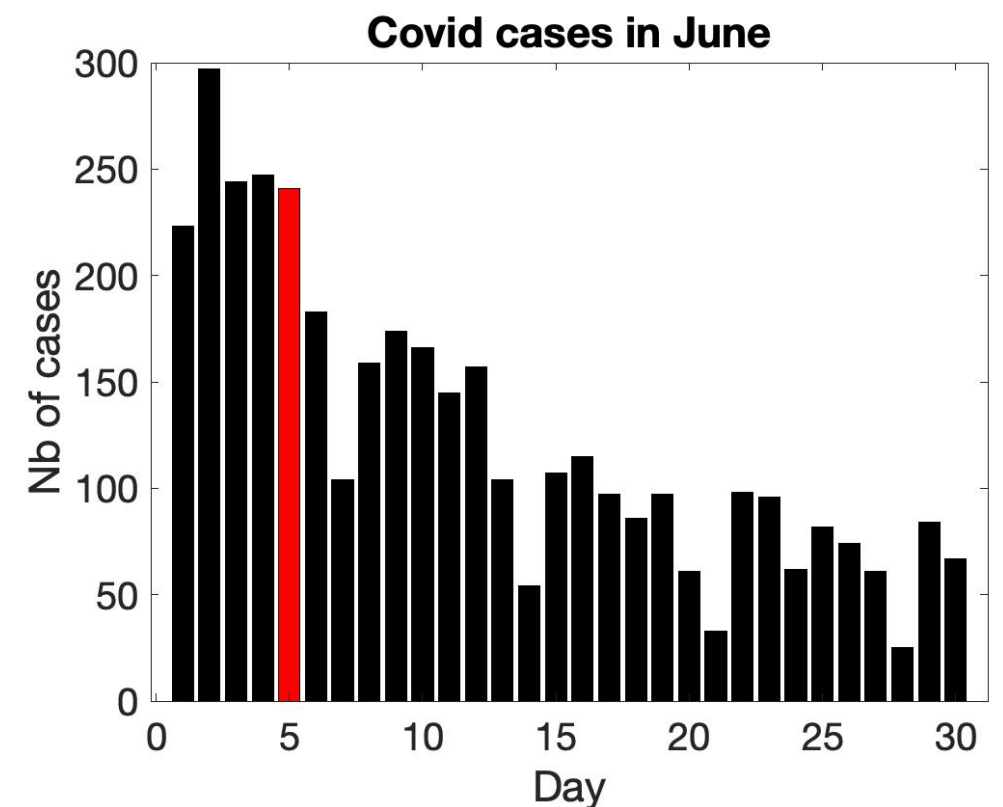
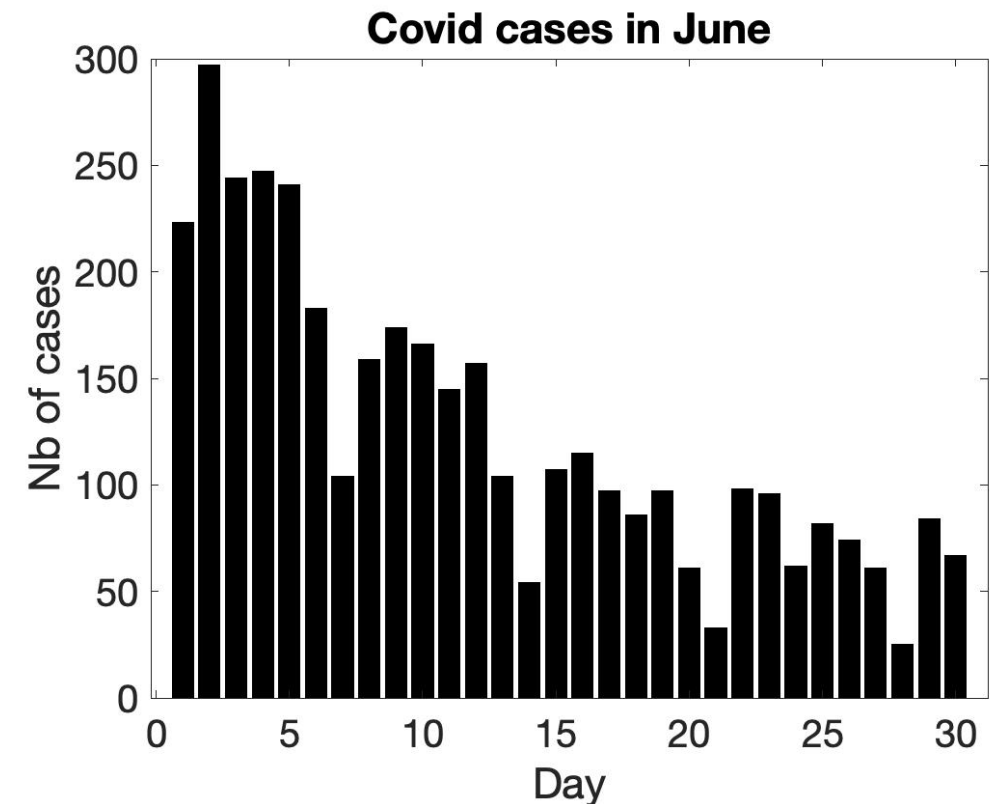
Covid Bar Plot



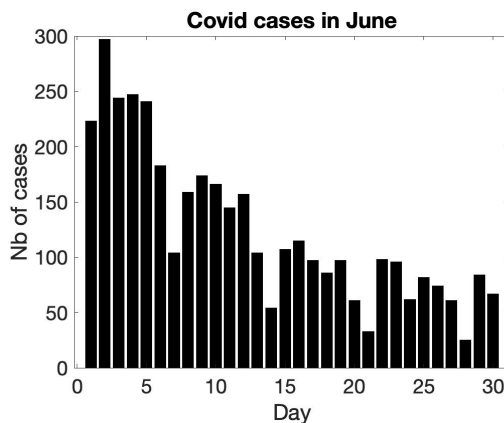
Bar Plots tricks

- Coloring certain bars in a bar plot:
`b=bar(Cov_june,'k');`
`b.FaceColor = 'flat';`
`CData(5,:)= [1 0 0];`
- Other things you can do:
modify the size, the line color, filling color, stacked bar plots, grouped bar plot, etc

Help bar

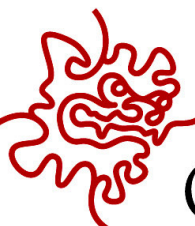


Covid Bar plot - min, max, mean



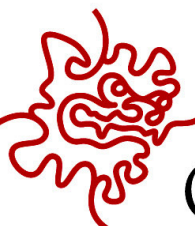
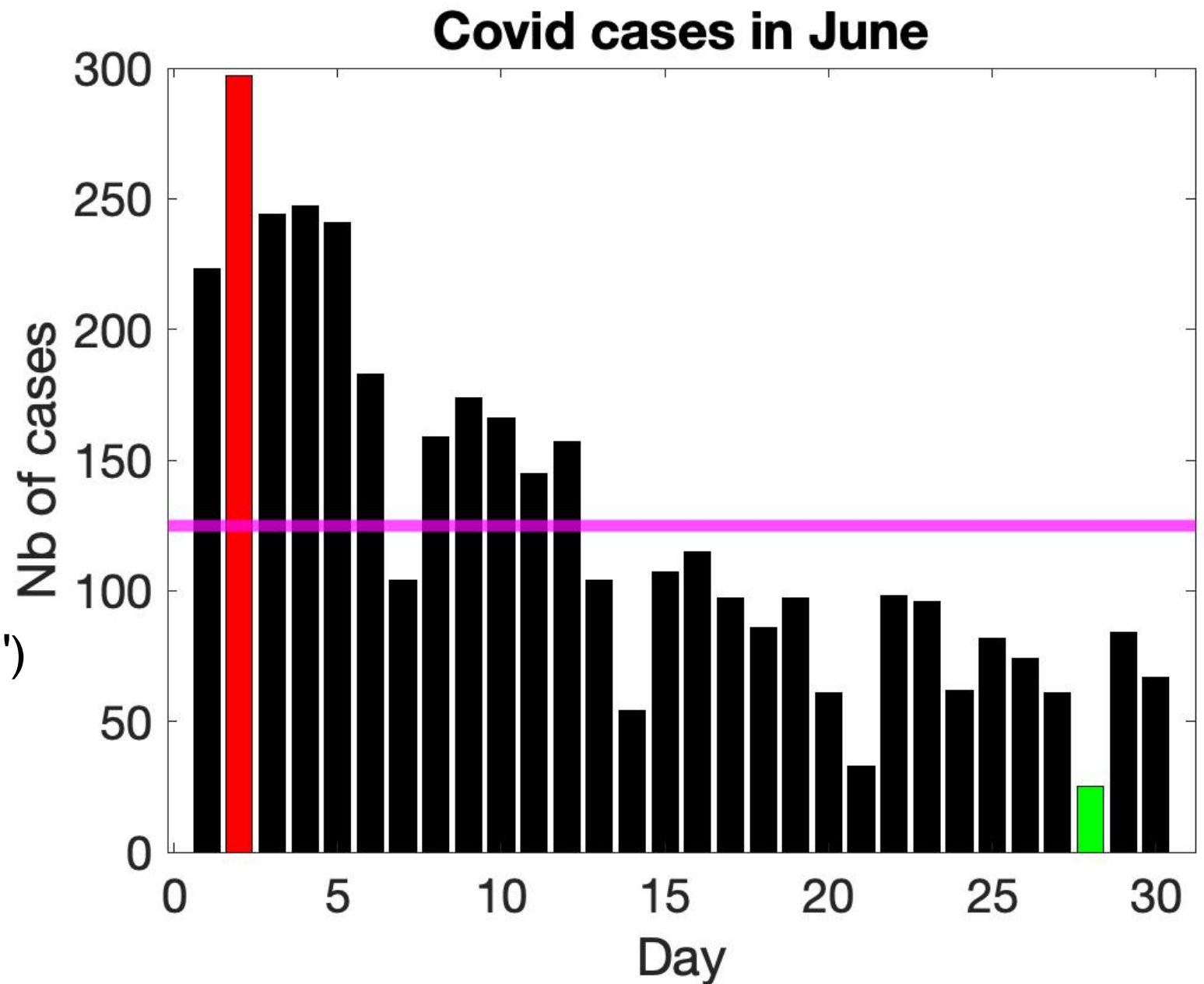
Use Matlab commands to find:

1. Which day we had the smallest number of Covid cases?
2. Which day we had the largest number of Covid cases.
3. Which is the mean value?
4. Color the **worst day** in **red**
5. Color the **best day** in **green**
6. Draw a horizontal line with the **mean value** in **magenta**.



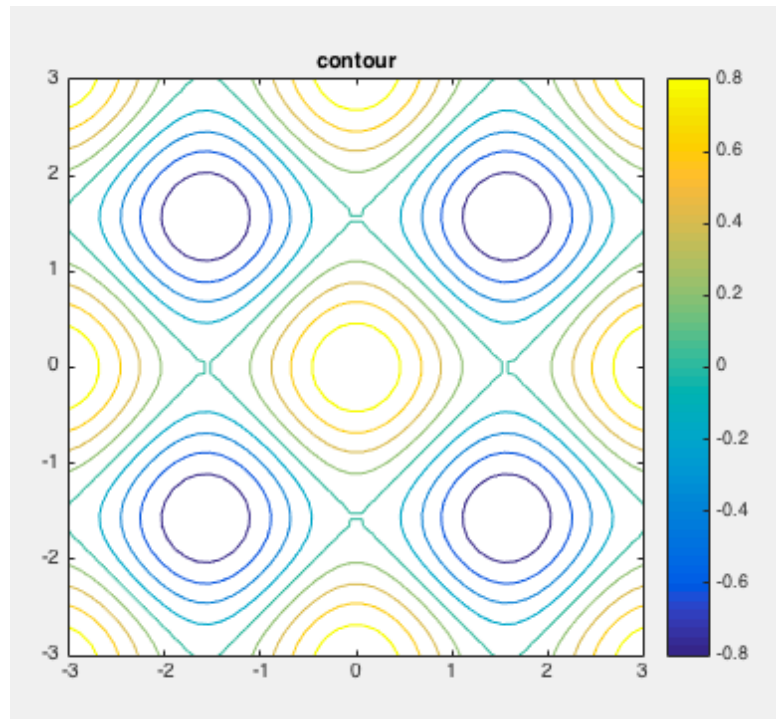
Covid Bar plot - min, max, mean

- Find minimum and maximum:
`[min1 min2] = min(Cov_june);`
`[max1 max2] = max(Cov_june);`
- Color the result:
`b.CData(min2,:) = [1 0 0];`
`b.CData(max2,:) = [0 1 0];`
- Find the mean value:
`meanv = mean(Cov_june);`
- `ylines(meanv,'LineWidth',5,'Color','m')`

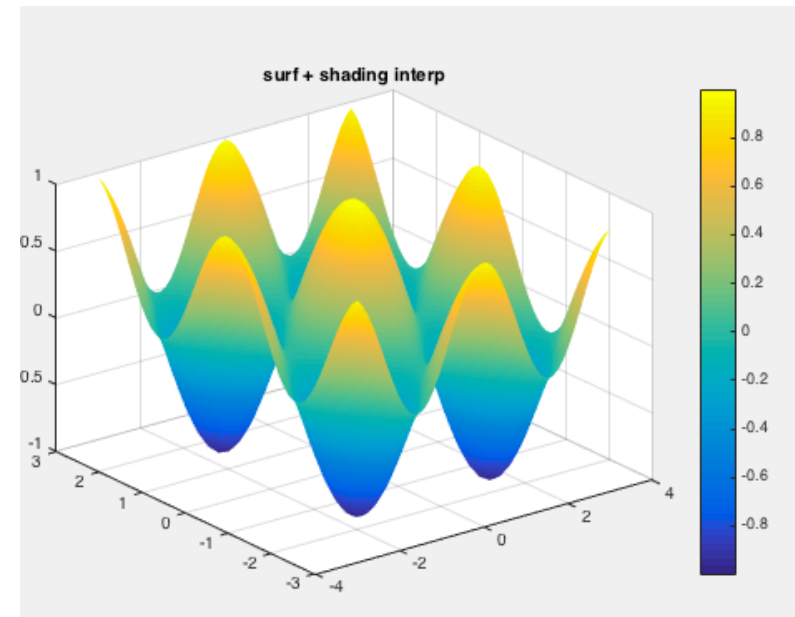


3D plots

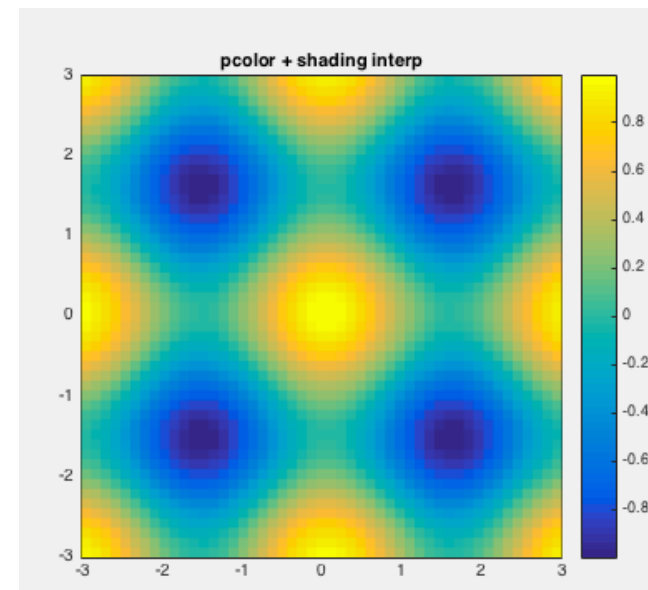
- Contour plots



- Surface plots



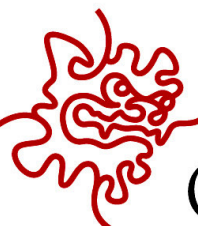
- Pseudocolor plot



Meshgrid for 3D plots

- To make 3D plots we need a **meshgrid**, a cartesian grid created from vectors:
 $[x \ y] = \text{meshgrid}(x_v, y_v)$
- We use x and y to create functions to plot

```
x_v =  
      1      2      3      4      5  
  
>> y_v = -2:2  
  
y_v =  
     -2     -1      0      1      2  
  
>> [x y] = meshgrid(x_v,y_v)  
  
x =  
      1      2      3      4      5  
      1      2      3      4      5  
      1      2      3      4      5  
      1      2      3      4      5  
      1      2      3      4      5  
  
y =  
     -2     -2     -2     -2     -2  
     -1     -1     -1     -1     -1  
      0      0      0      0      0  
      1      1      1      1      1  
      2      2      2      2      2  
  
>> z = x.*y  
  
z =  
     -2     -4     -6     -8    -10  
     -1     -2     -3     -4     -5  
      0      0      0      0      0  
      1      2      3      4      5  
      2      4      6      8     10
```

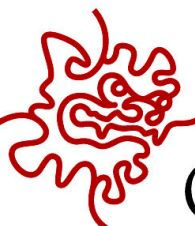
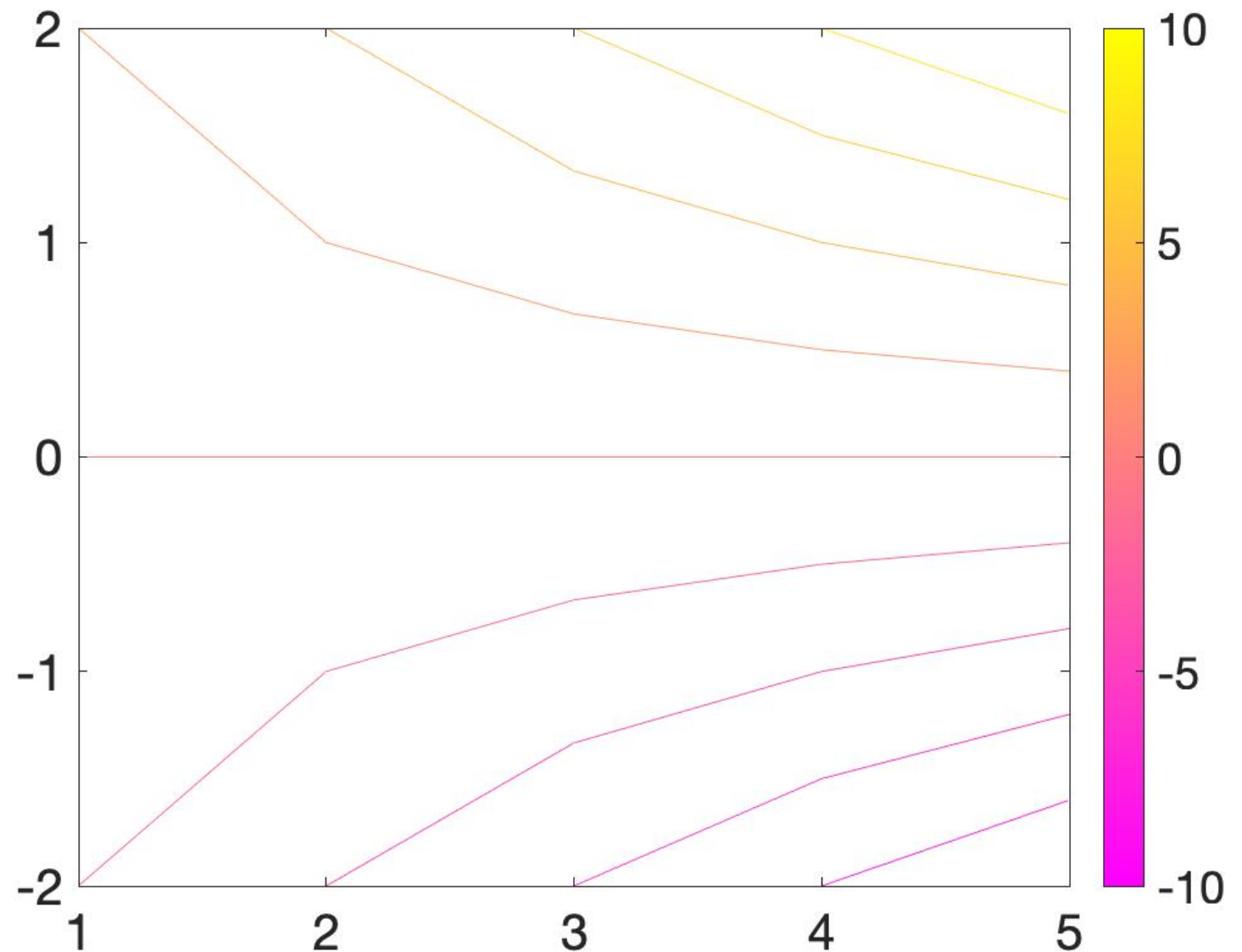


Contour plots

- Contour of $z(x,y)$: `contour(x, y, z)`
- `colorbar` to show colorbar
change colors! `colormap [jet, hot, cool, spring, winter, gray, bone, copper, pink, lines]`
or `colormapeditor`
- `caxis([cmin cmax])`: colorbar range

Contour plots

```
figure(1)
x_v= 1:5;
y_v = -2:2;
[x y] = meshgrid(x_v,y_v)
z = x.*y
contour(x,y,z)
set(gca,'FontSize',20);
colorbar
colormap spring
```



Let's make some pretty plots

- `linspace(a,b,N)` - returns a row vector of size `N`, with `N` elements in between the minimum value `a` and the maximum value `b`.

```
x_line = linspace(-3,3,50);
```

```
y_line = linspace(-3,3,50);
```

```
[x,y] = meshgrid(x_line, y_line);
```

- Define the function we want to plot:

```
z = sin(x) .* sin(y);
```

Pretty Plots

```
x_line = linspace(-3,3,50);  
y_line = linspace(-3,3,50);  
[x,y] = meshgrid(x_line, y_line);  
  
z = sin(x) .* sin(y);
```



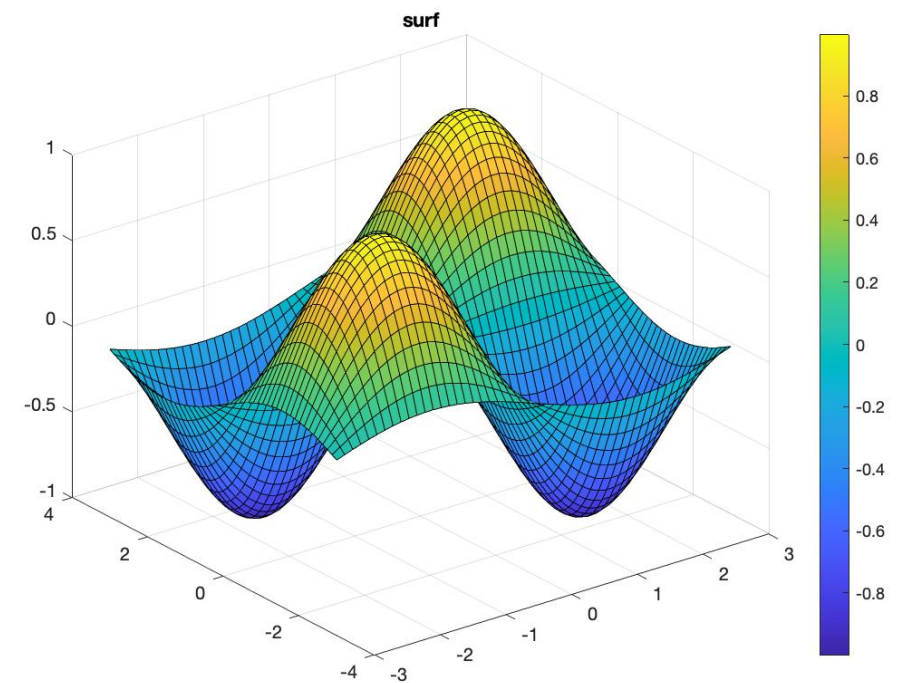
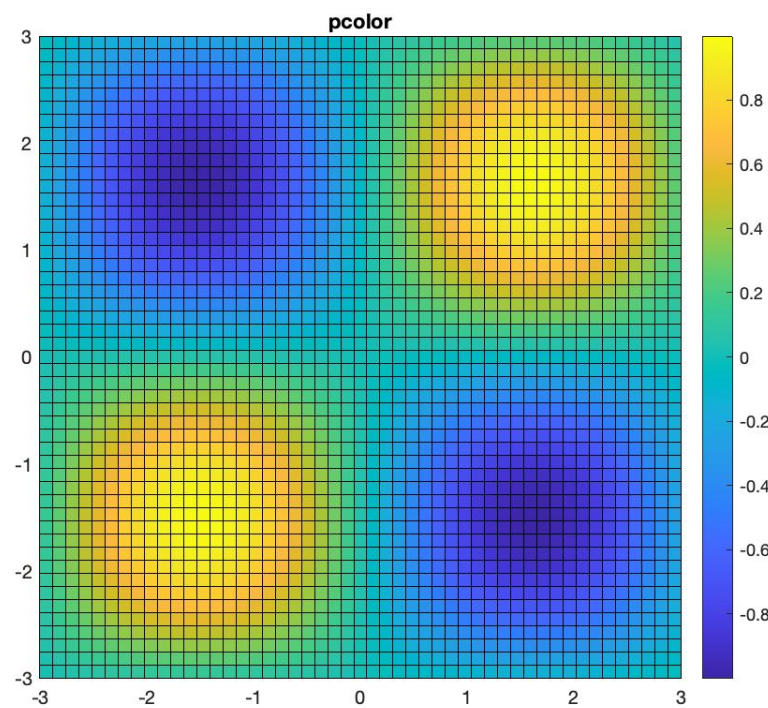
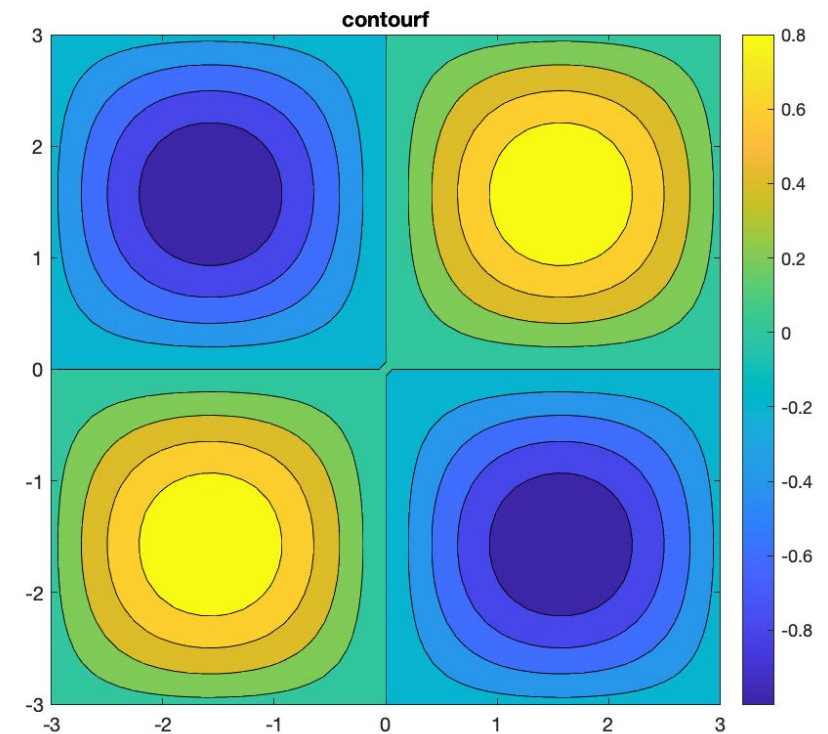
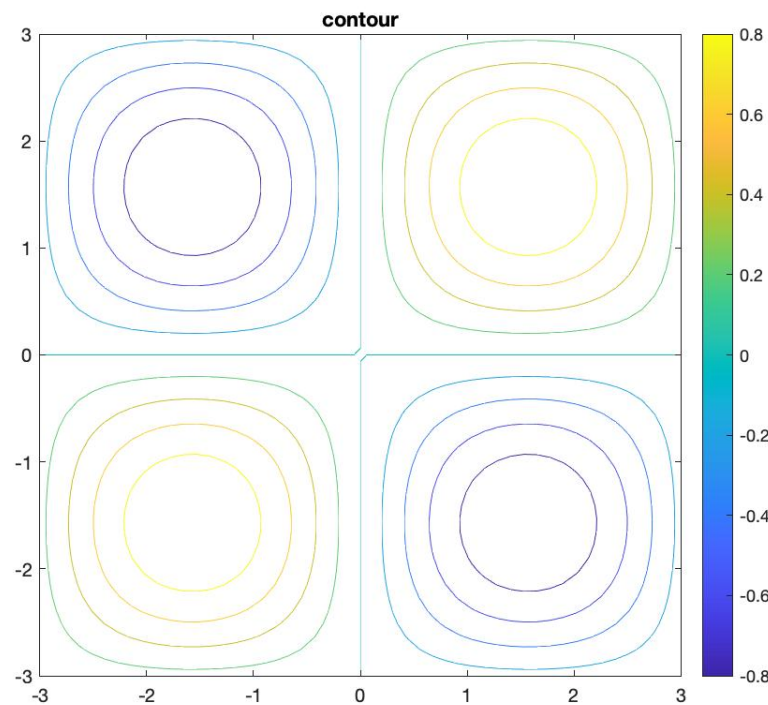
- Play with 3D plot commands:

1. contour
2. contourf
3. pcolor
4. surf

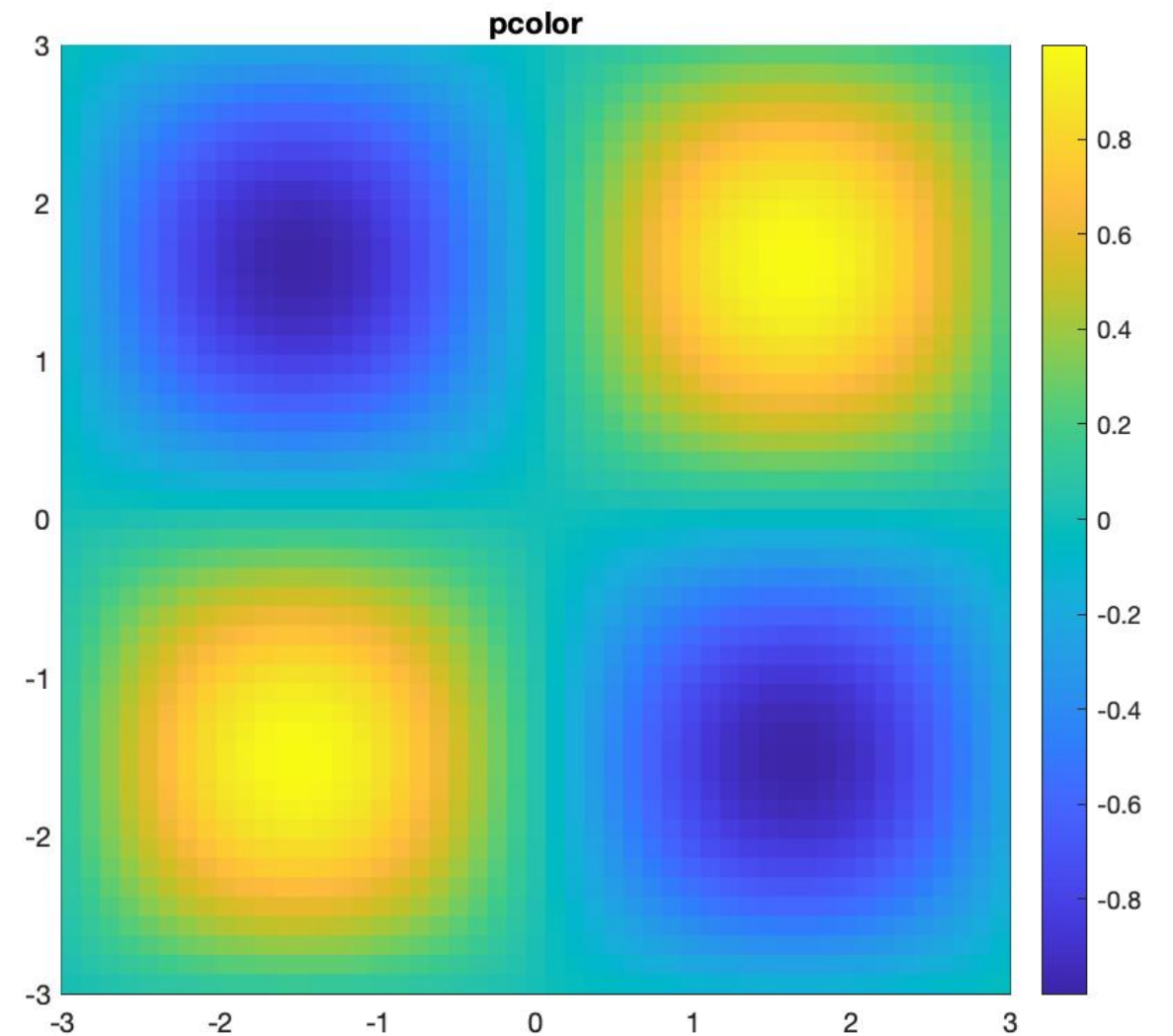
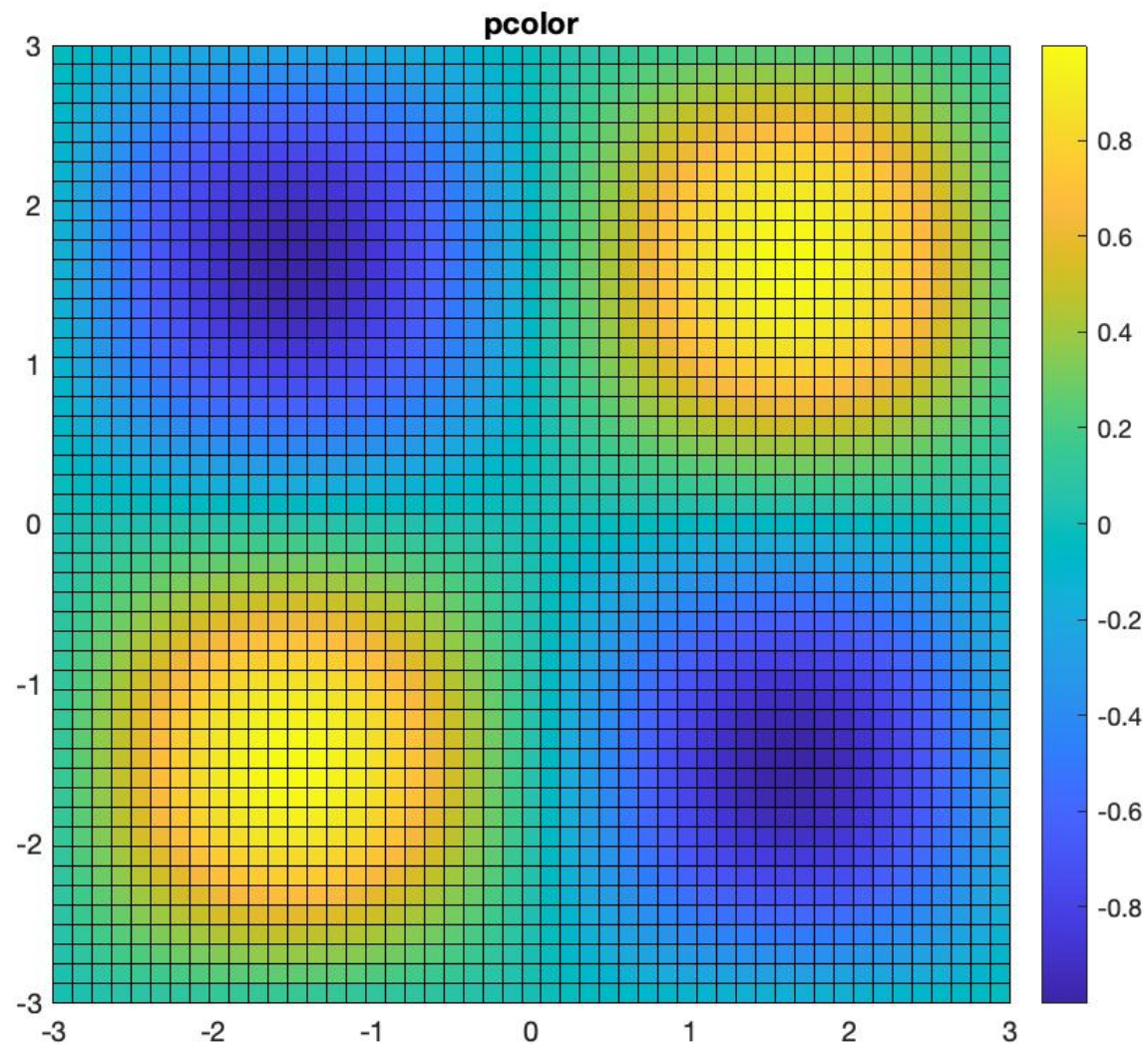
Recommendations:

- Make 4 different figures
- axis square
- Add title
- Add colors
- Try different colormap

Fancy plots!!

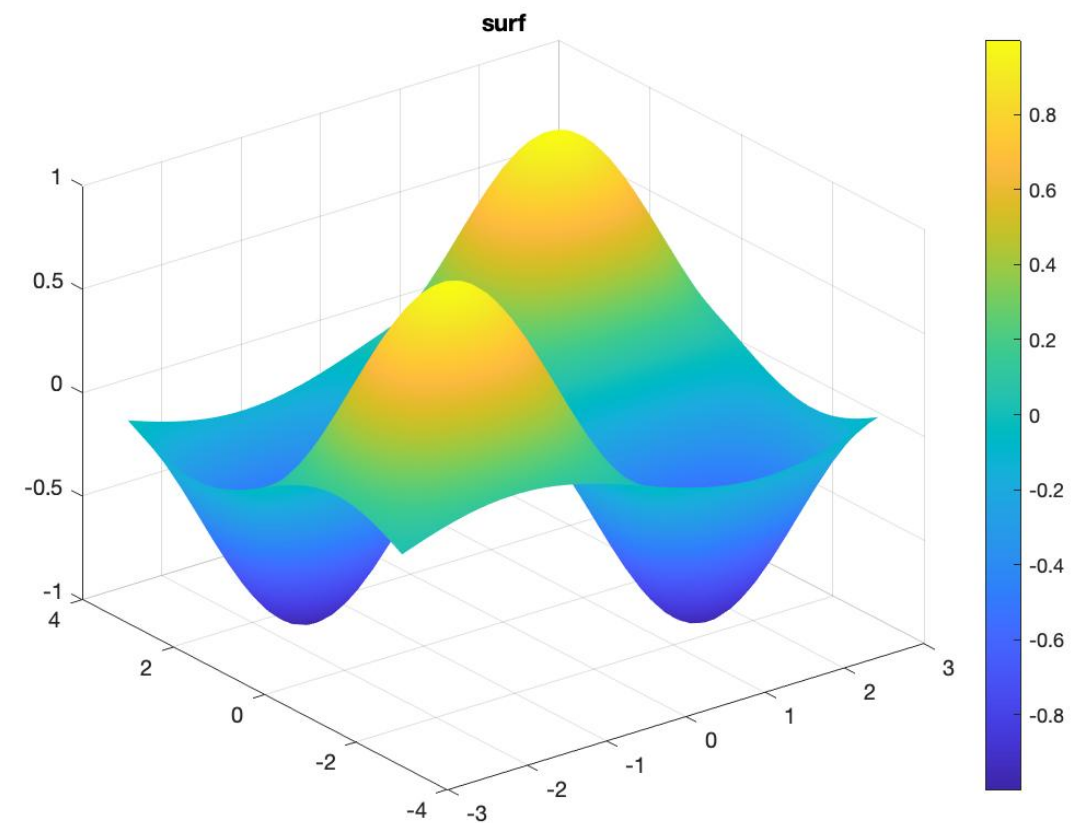
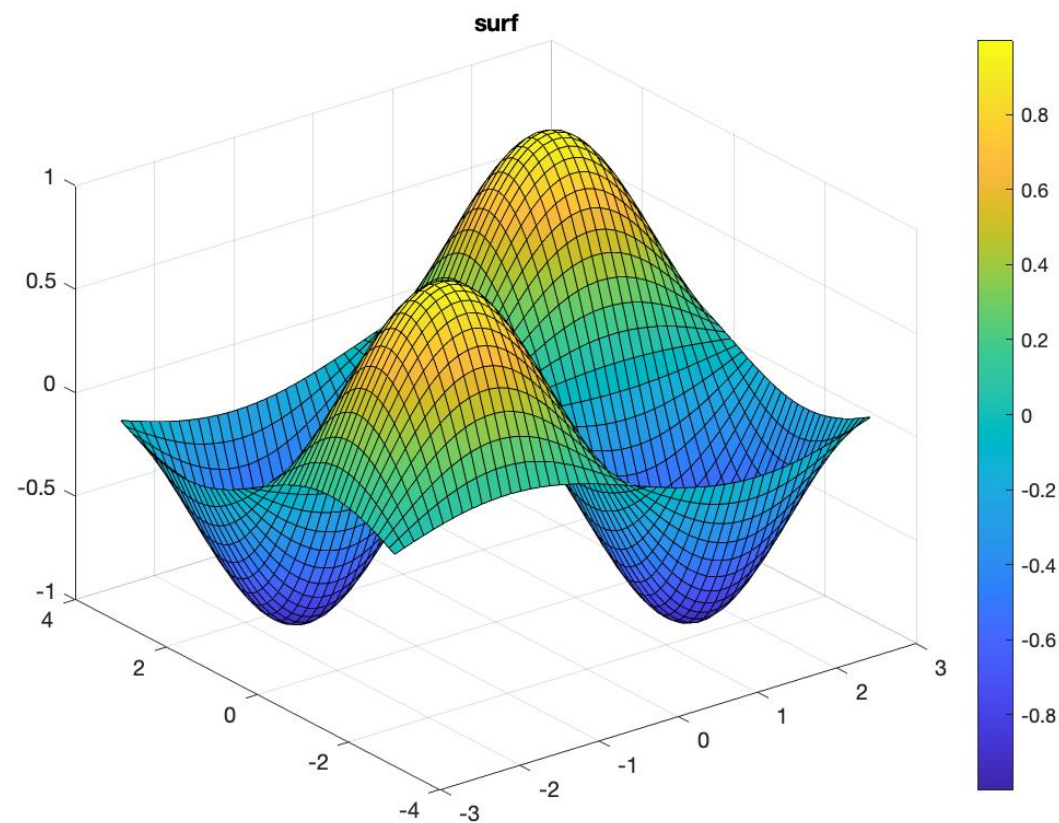


Pseudocolor plot - properties



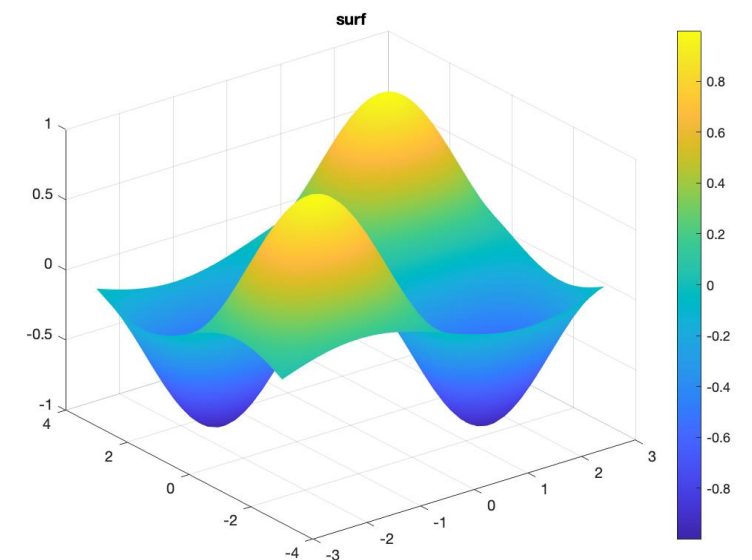
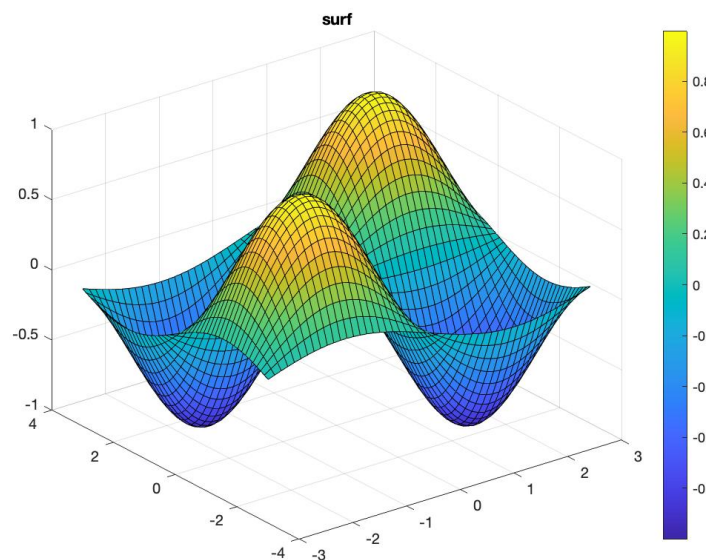
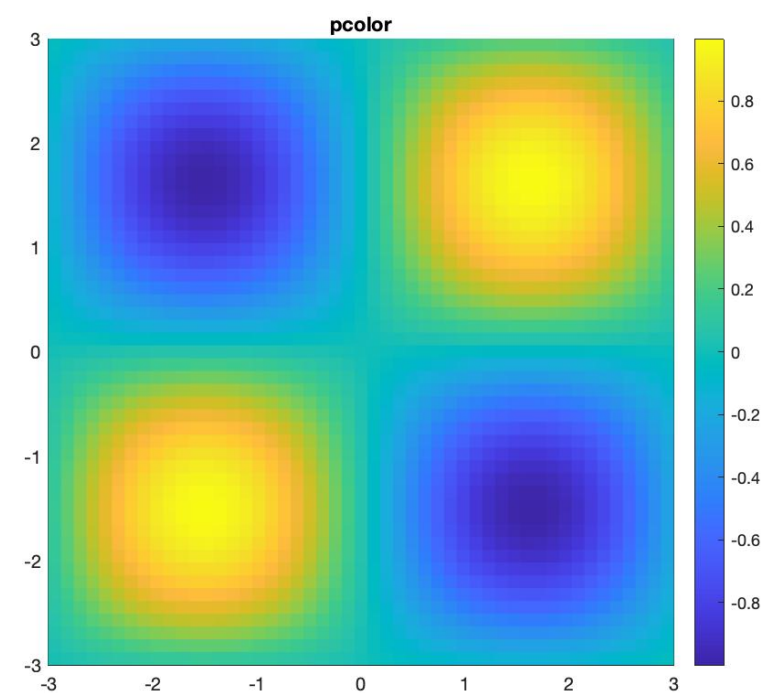
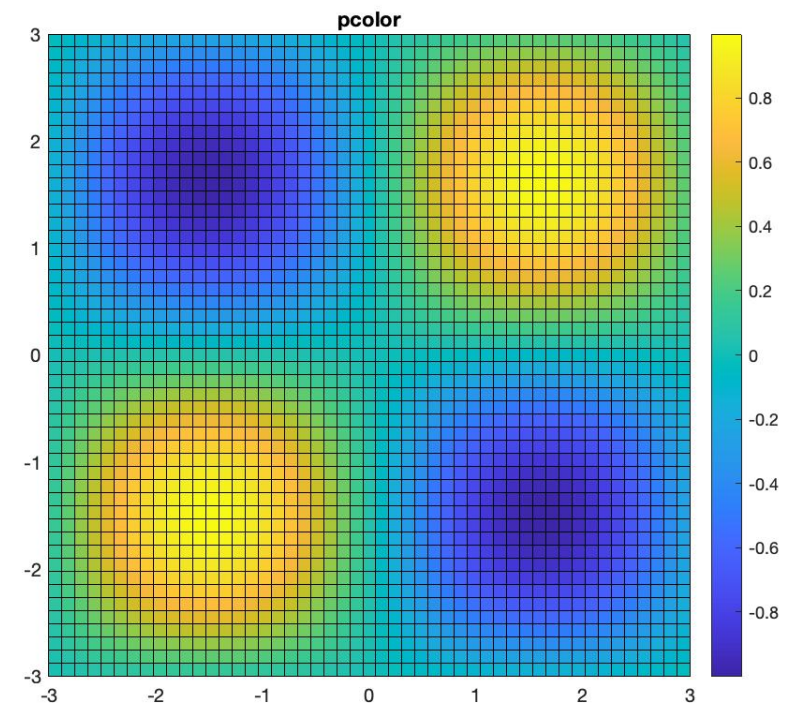
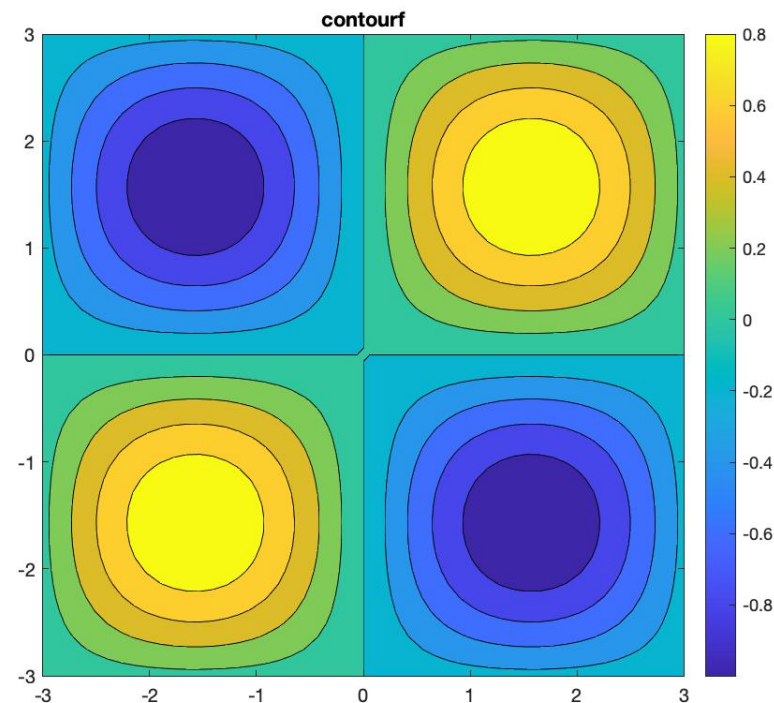
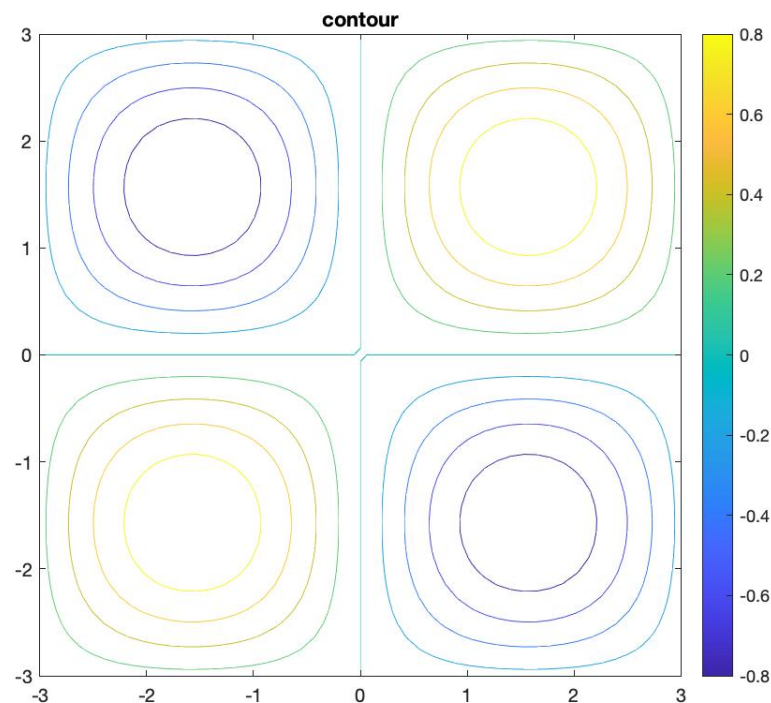
shading flat

Shape plot - properties

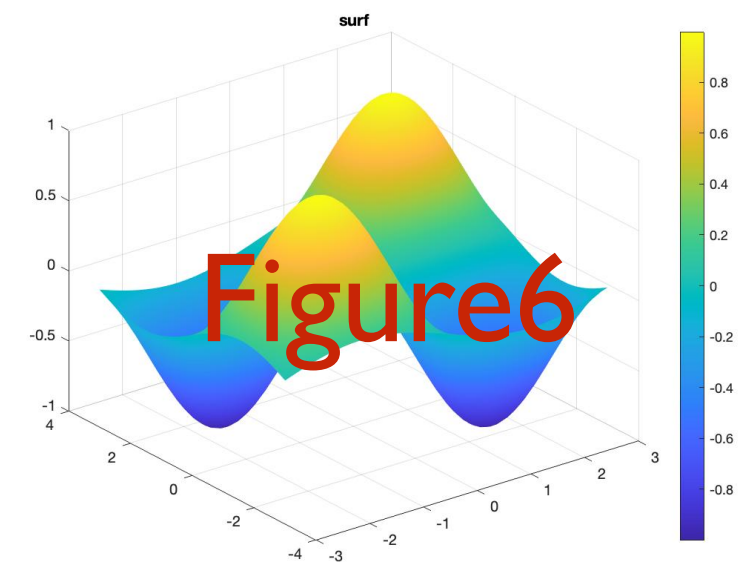
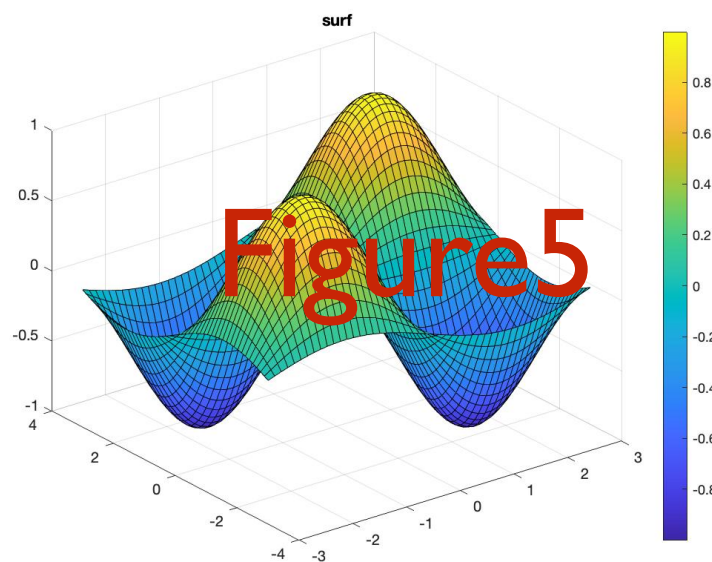
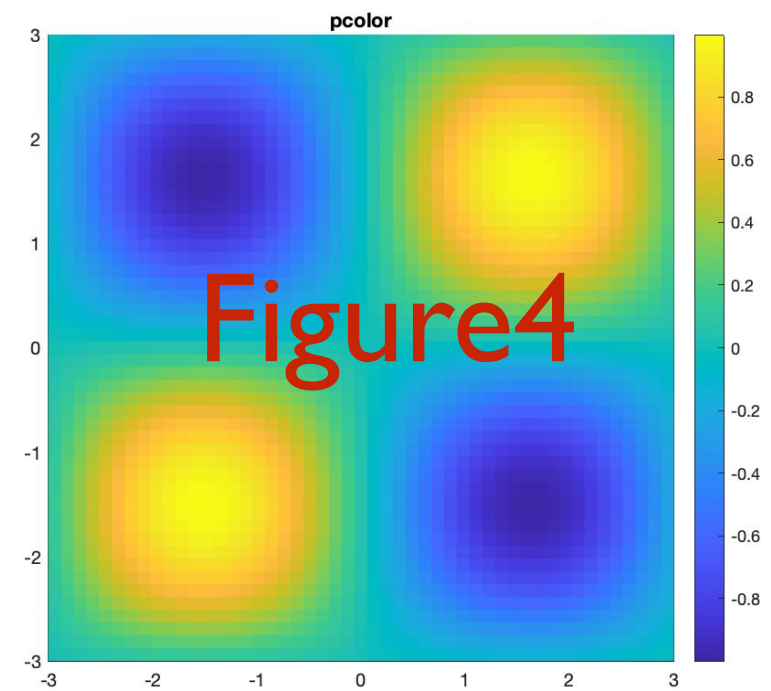
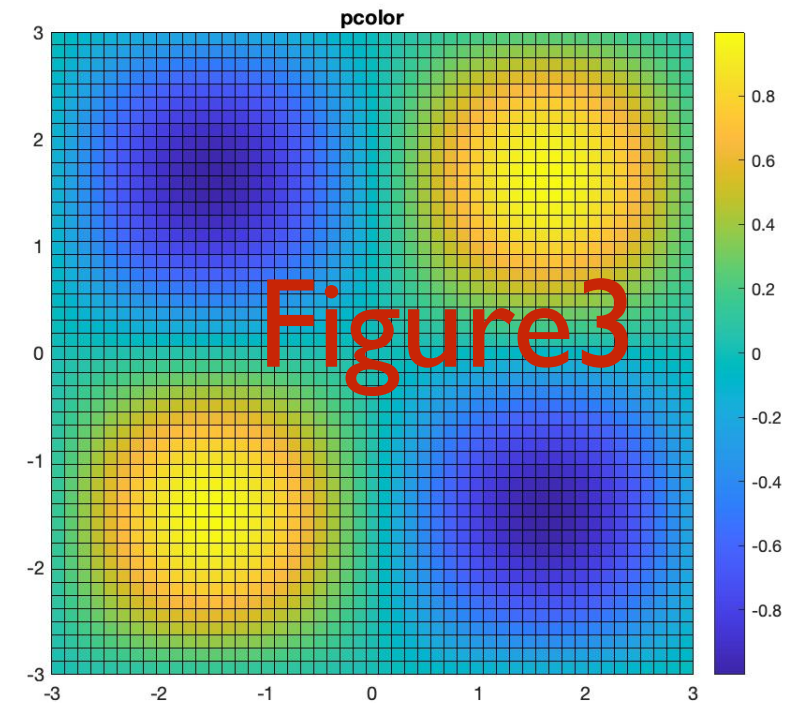
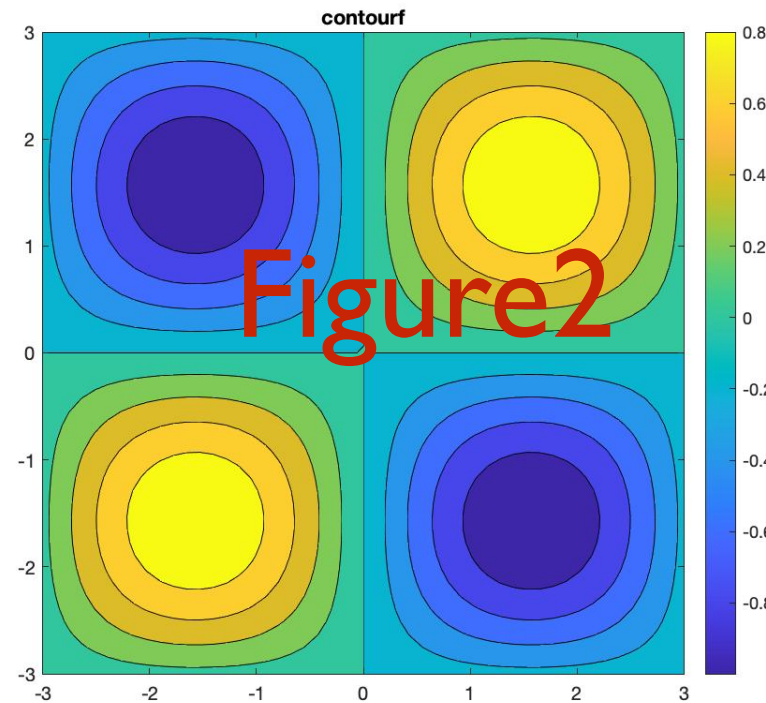
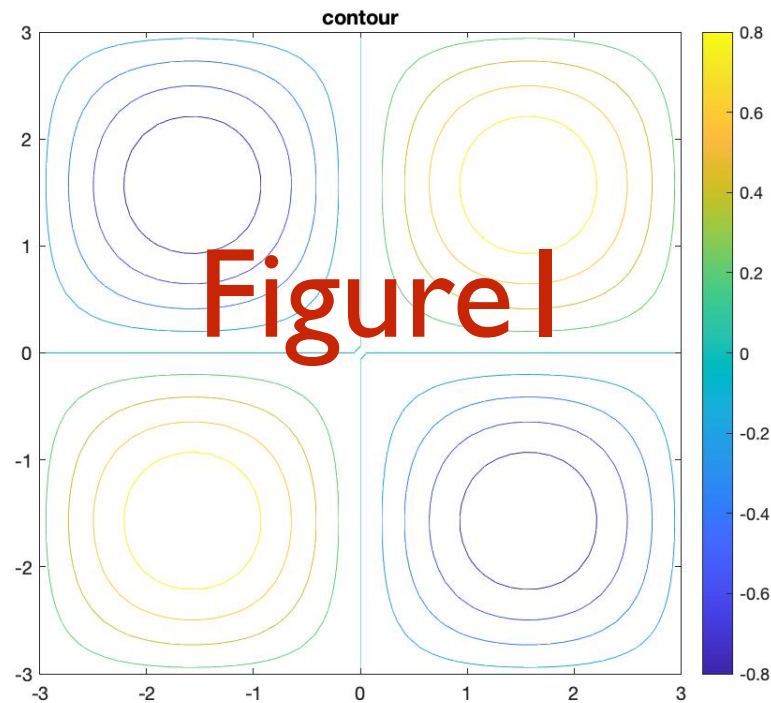


shading interp

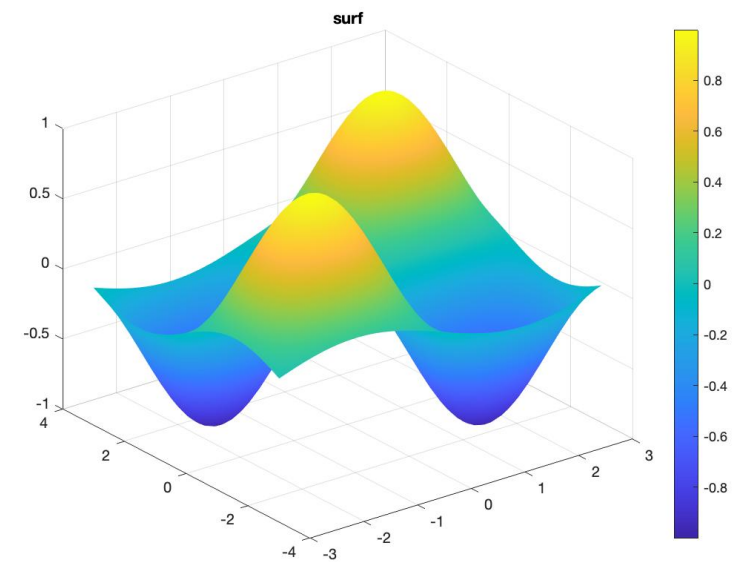
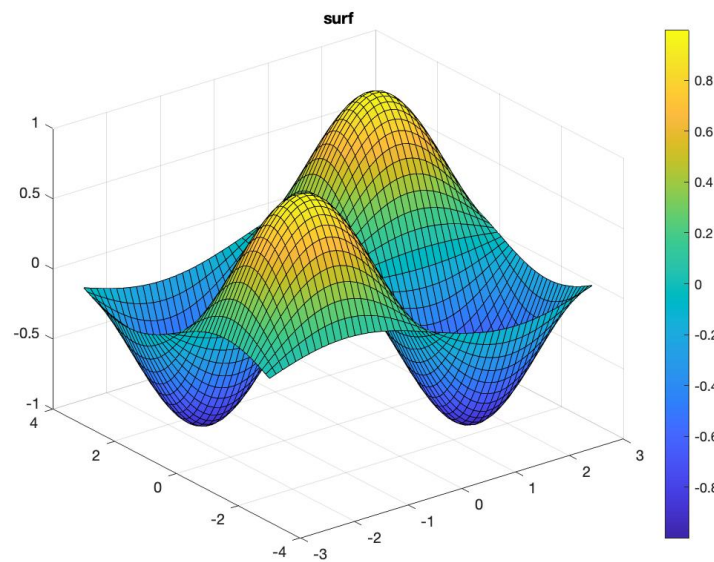
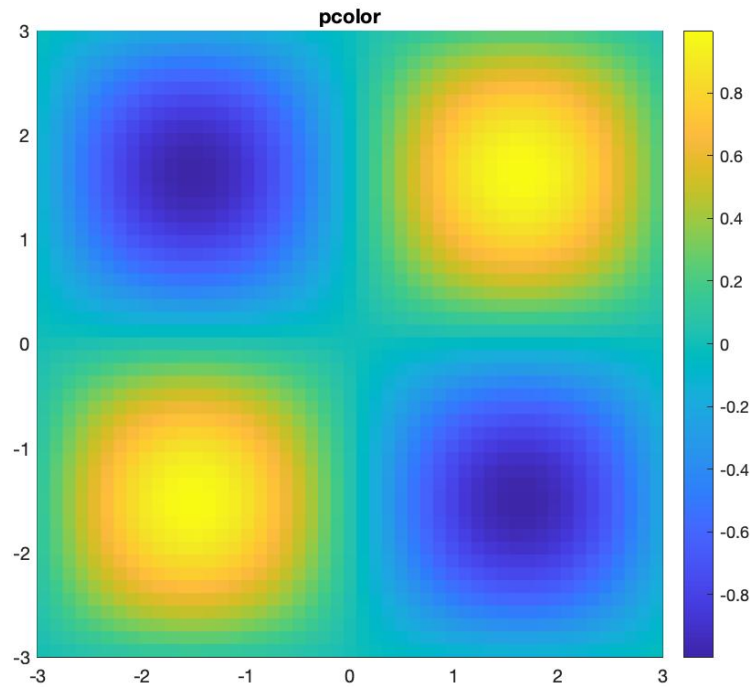
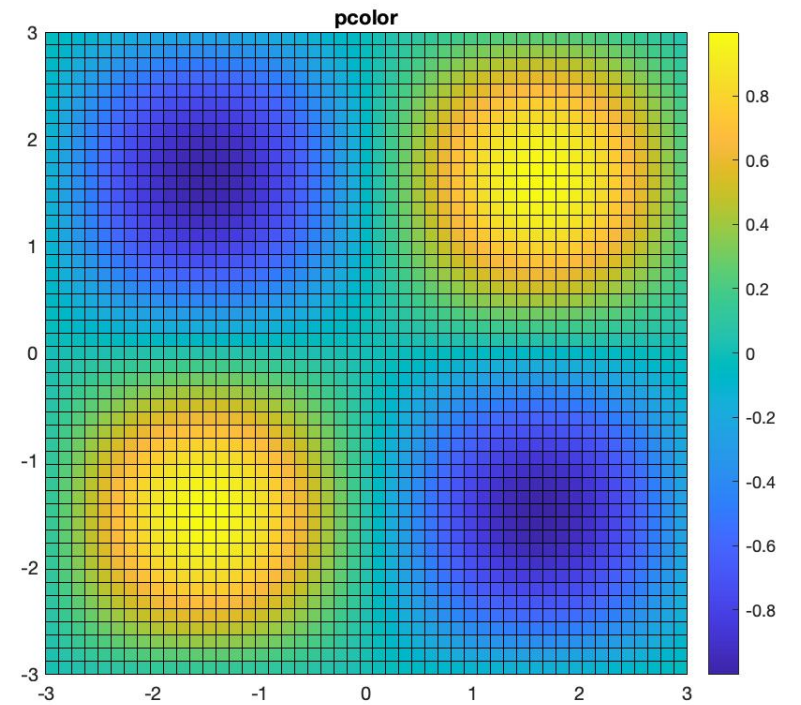
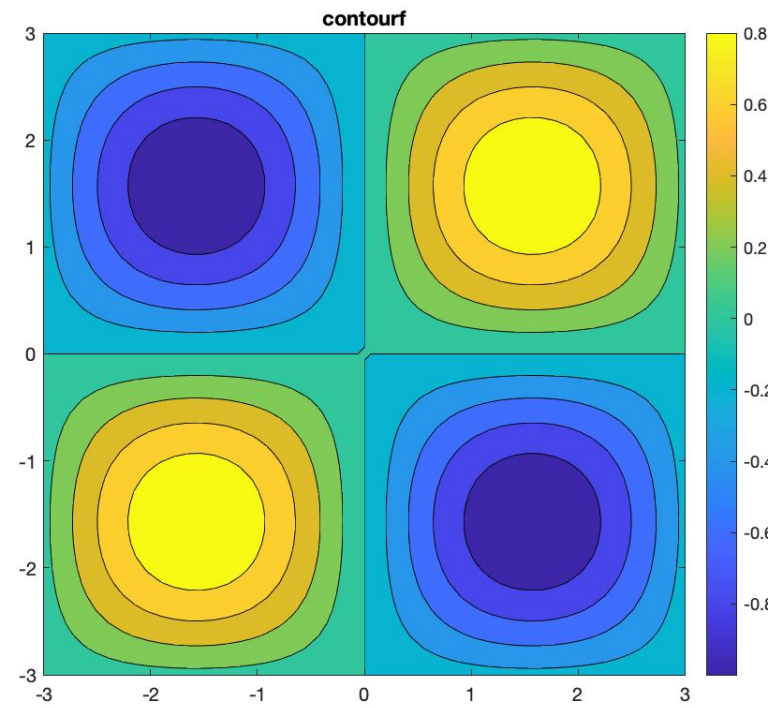
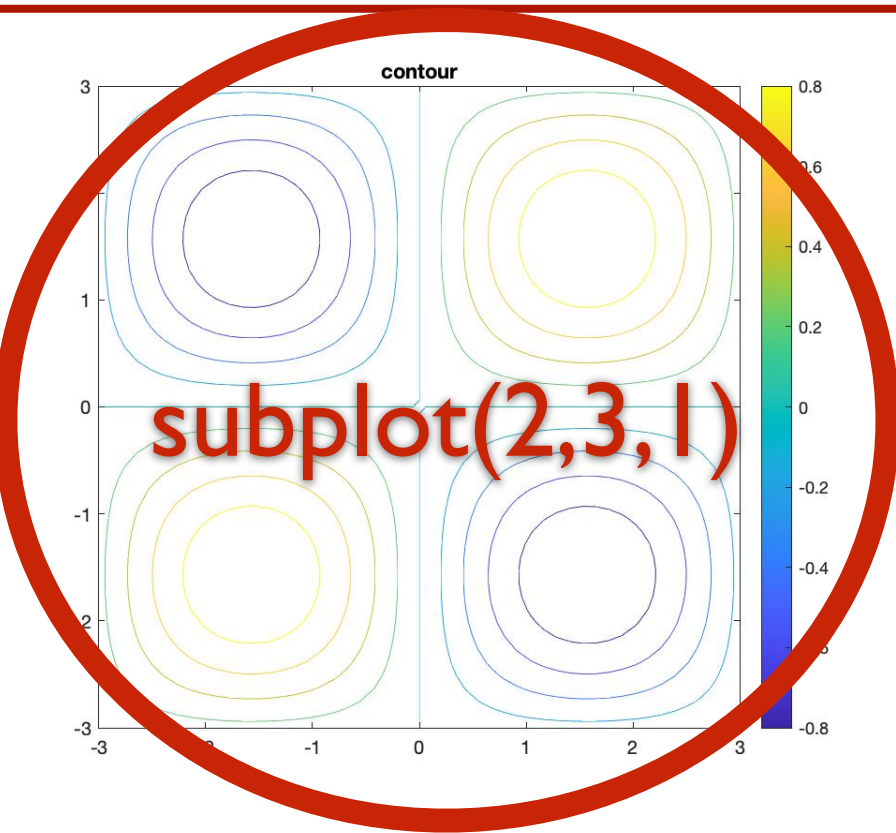
Our 6 fancy figures



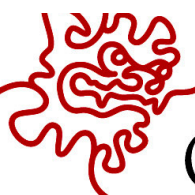
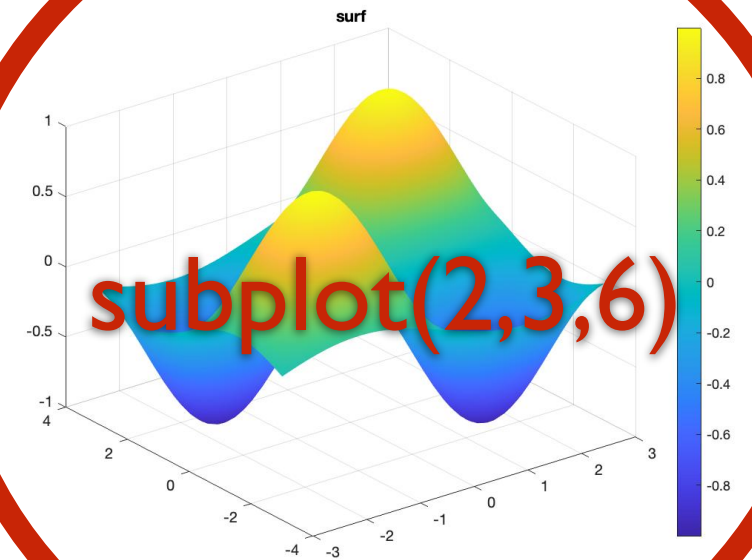
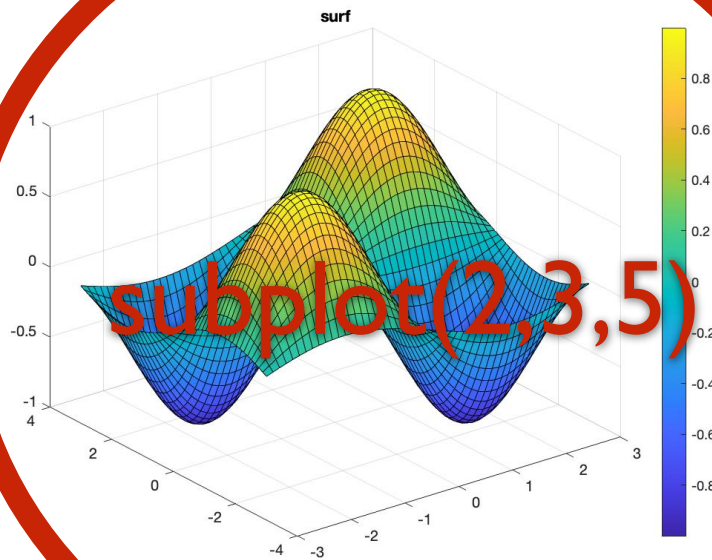
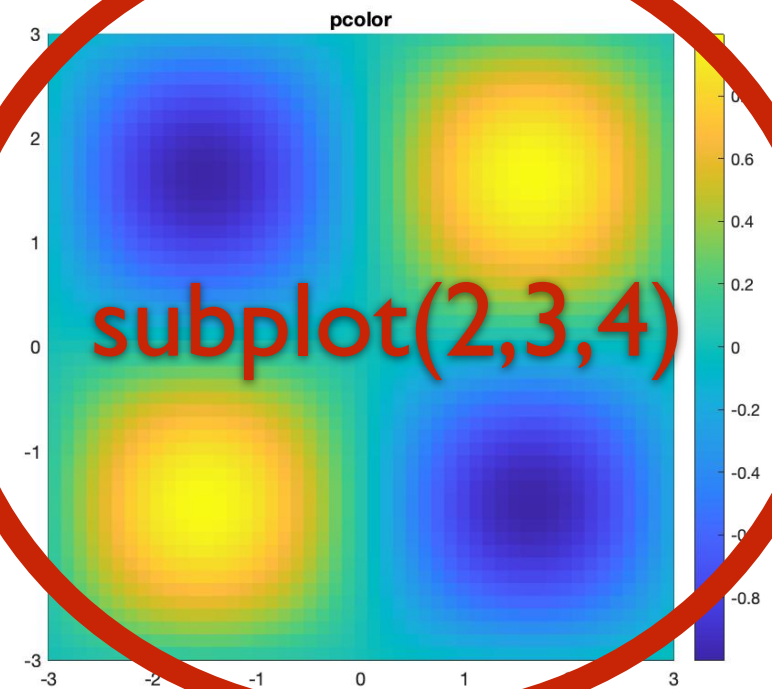
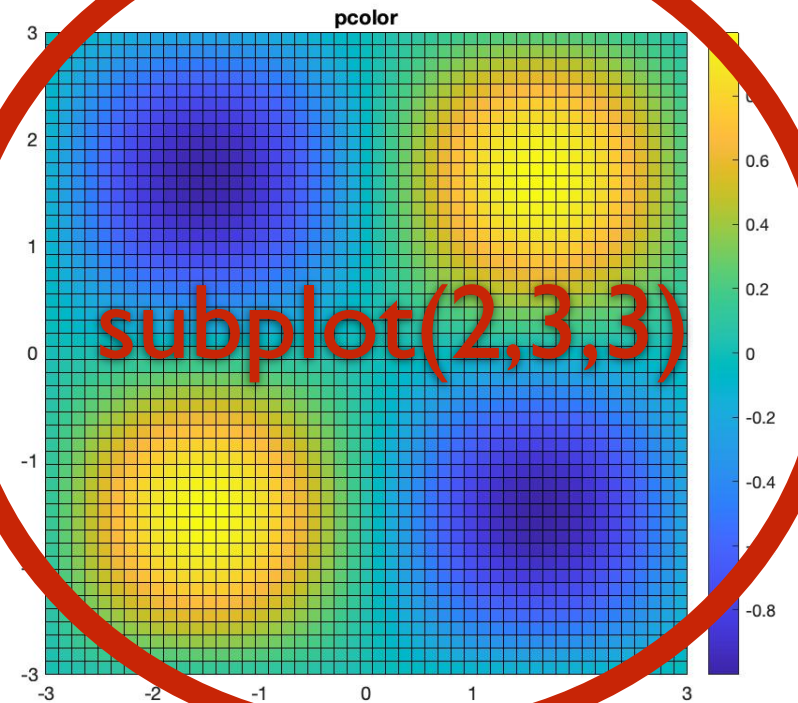
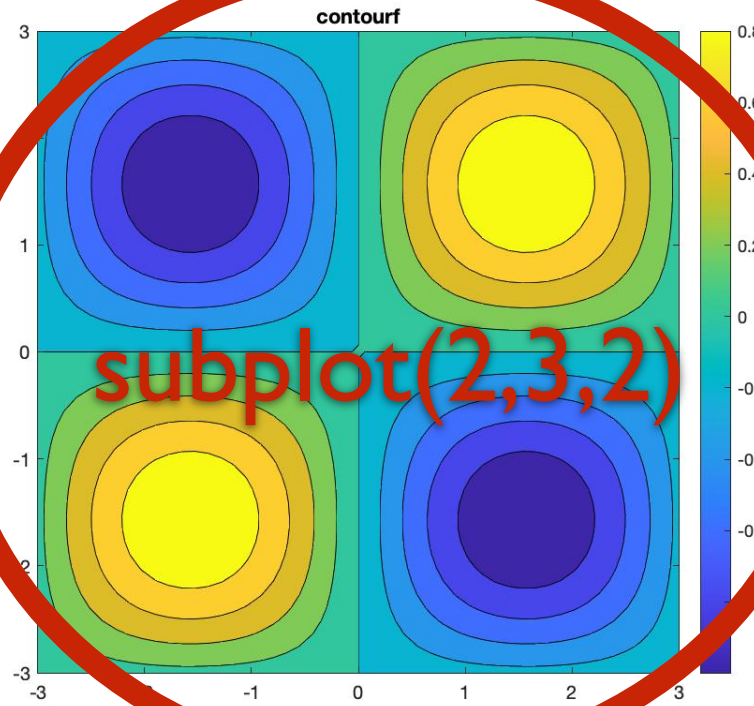
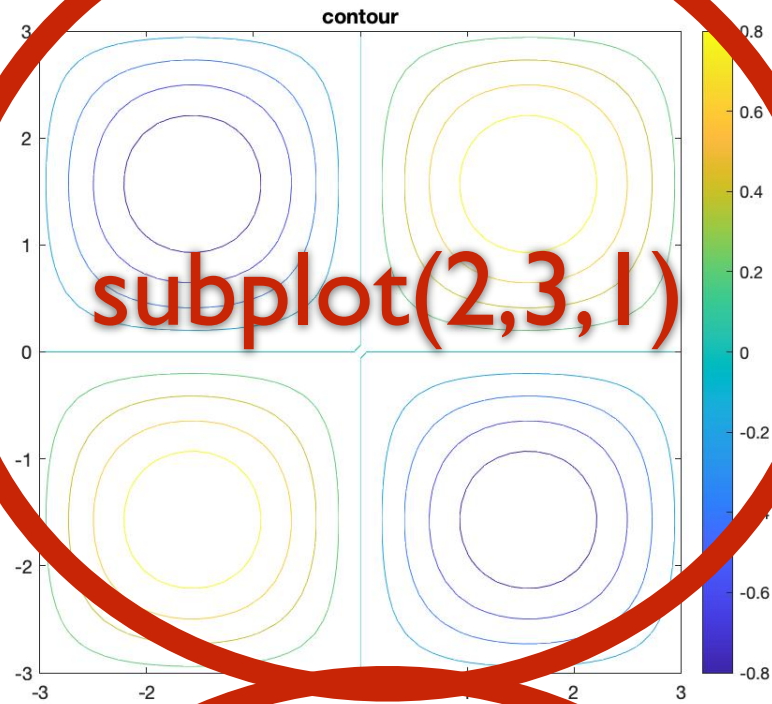
Our 6 fancy figures



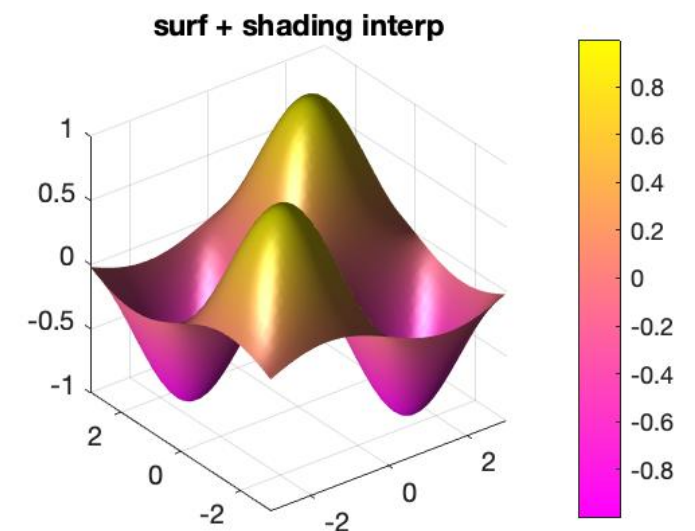
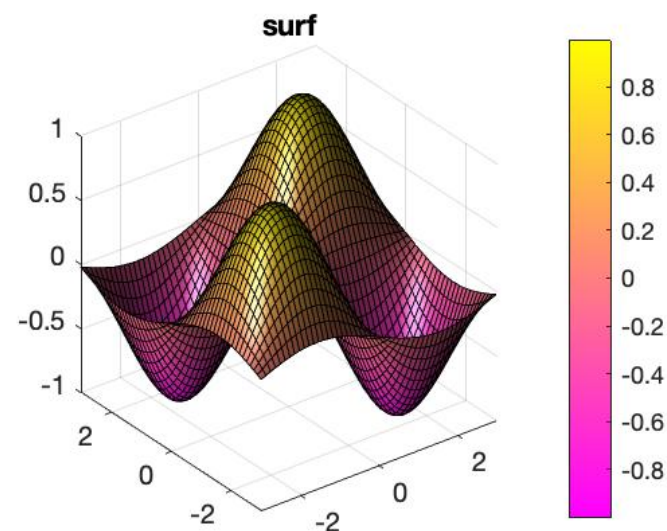
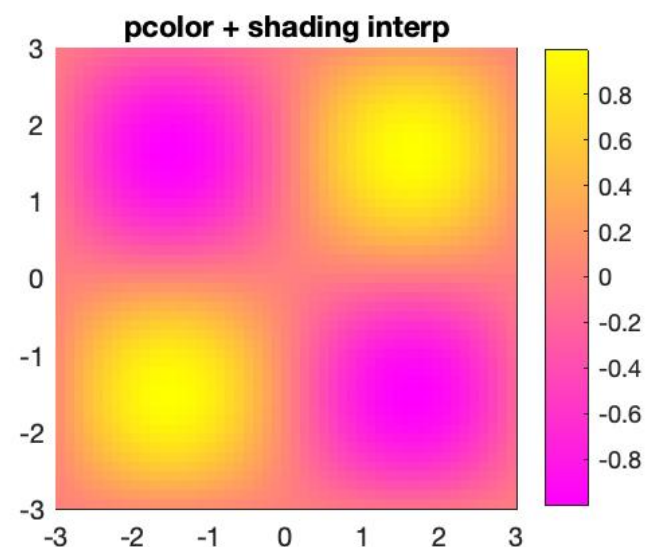
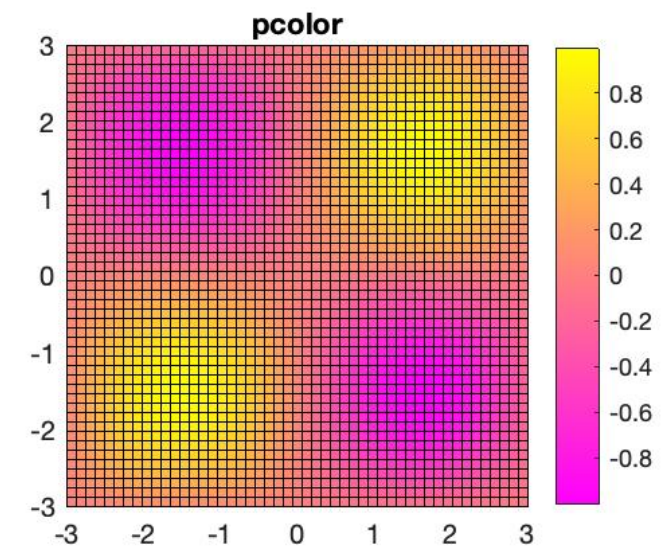
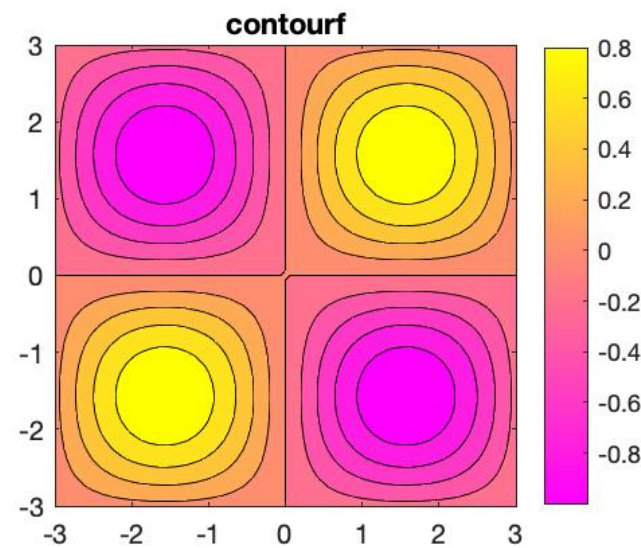
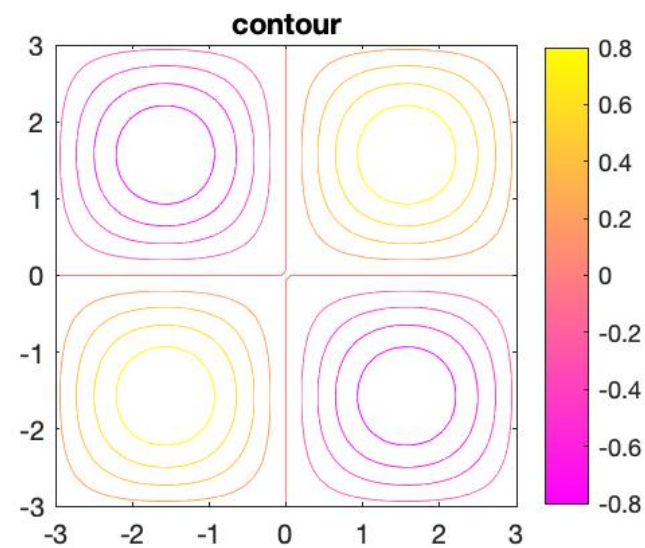
Making Subplots



Making Subplots



Subplots in Matlab



Colormap
spring