Math 306 - Numerical Methods

Introduction to MATLAB

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College of Aeronautical Engineering
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Cartesian Plots

- We have already seen the plot function

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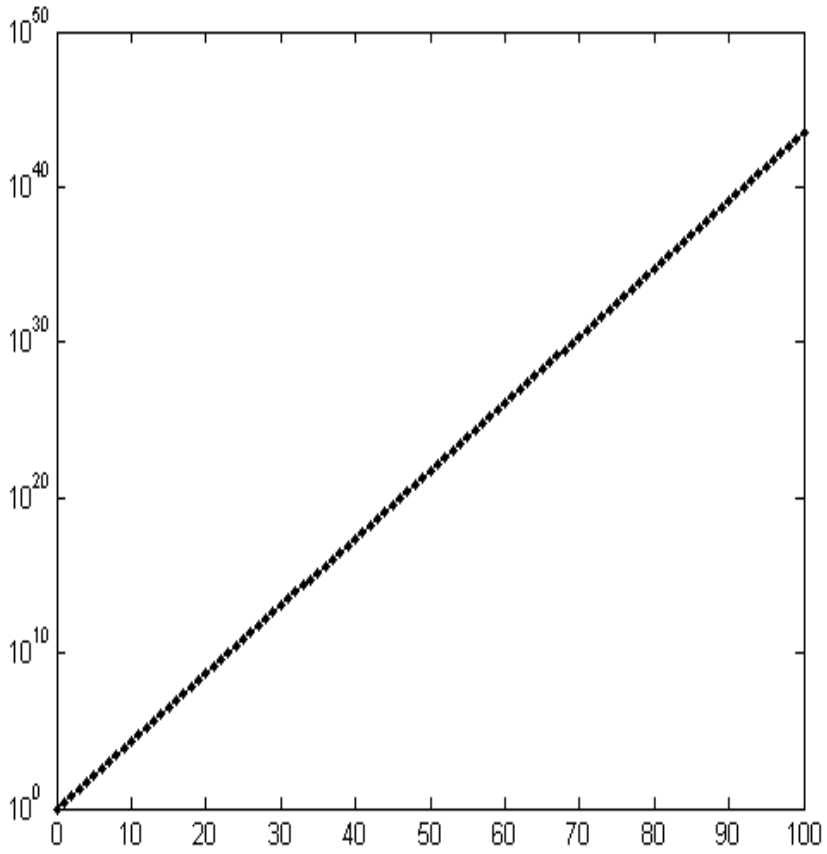

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- Explore and familiarize yourself thoroughly with all these tools, ... , it is important !

Line and Marker Options

- Everything on a line can be customized
  »plot(x,y,'–rs','LineWidth',2, 'MarkerEdgeColor','k', 'MarkerFaceColor','g', 'MarkerSize',10)

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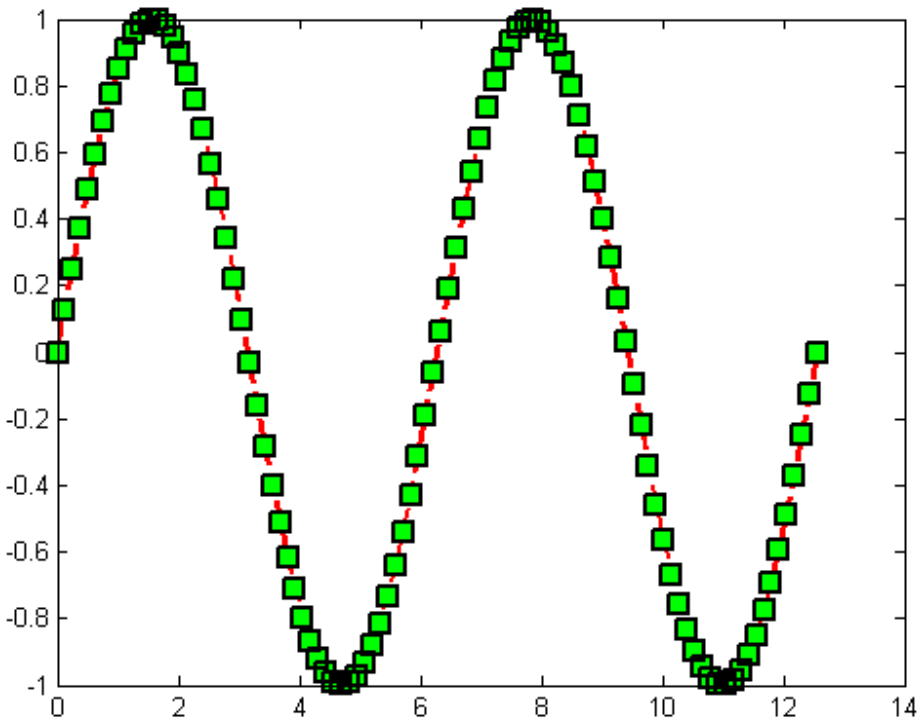

- See doc line for a full list of properties that can be specified

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- To put parameter values into labels, need to use num2str and concatenate:
  »str= ['Strength of ' num2str(d) 'cm diameter rod'];
  »title(str)

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- More on advanced figure customization later in the semester

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- »axis ij
  ..puts the origin in the top left corner (for viewing matrices)

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- »close all
  ..closes all figures (useful in scripts/functions)

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- Save the figure as a pdf
- View with pdf viewer.

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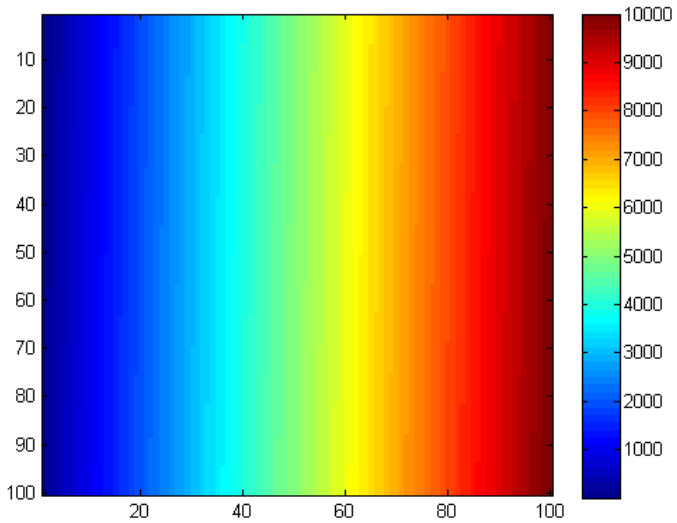

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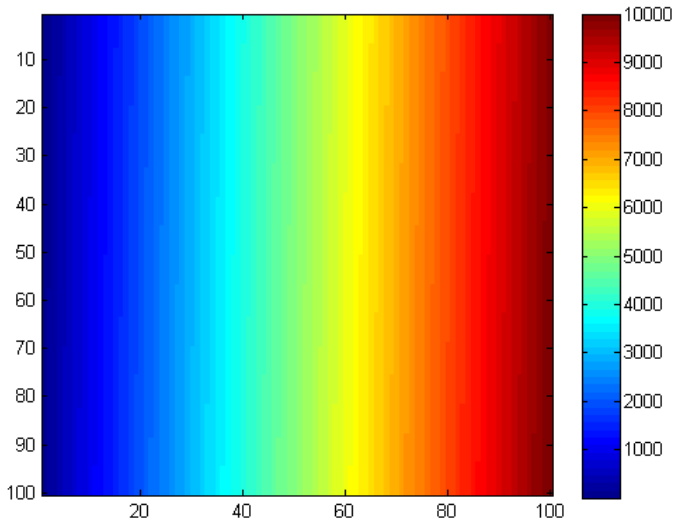

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- We can also set limits for the color axis (analogous to xlim, ylim)
  »caxis([3000 7000])

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  - »map=zeros(256,3);
    »map(:,2)=(0:255)/255;
    »colormap(map);

Images: Exercise

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- »dMat=dftmtx(128);
  »phase=angle(dMat);
  »imagesc(phase);
  »colormap(hot(256));

3D Line Plots

- We can plot in 3 dimensions just as easily as in 2

```
»time=0:0.001:4*pi;
»x=sin(time);
»y=cos(time);
»z=time;
»plot3(x,y,z,'k','LineWidth',2);
»zlabel('Time');
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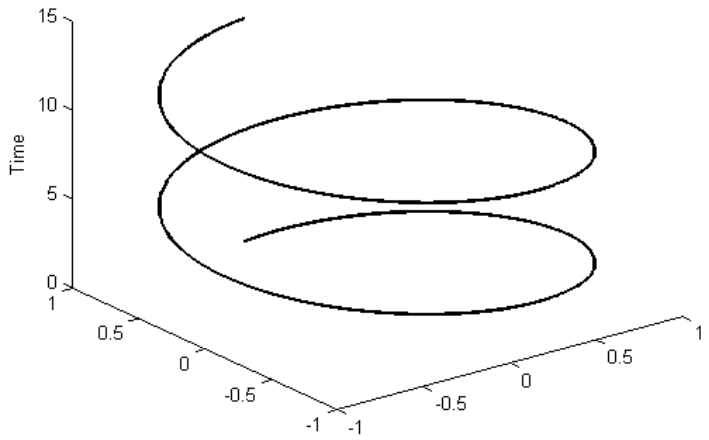

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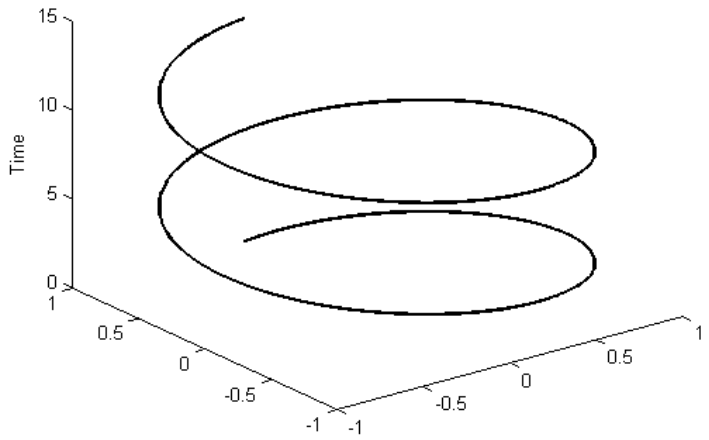

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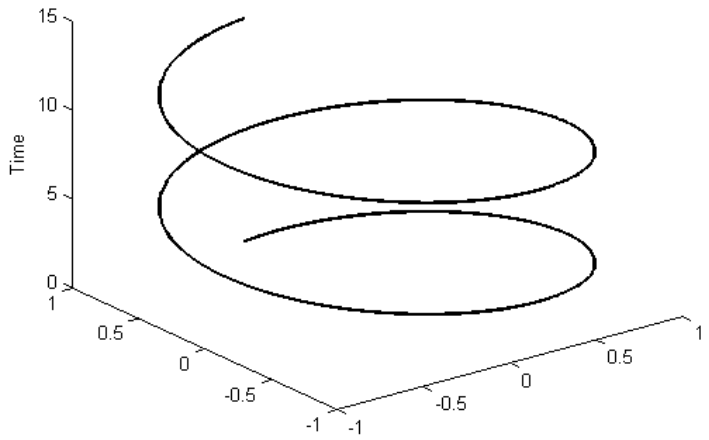

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- Can set limits on all 3 axes: »xlim, ylim, zlim

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  - built-in function: meshgrid

surf

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- Plot the surface
  »surf(X,Y,Z)
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- You can change colormaps
  »colormap(gray)

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- »hold on
  »mesh(X,Y,Z)

Exercise: 3-D Plots

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- »x=-2*pi:0.1:2*pi;
  »y=-2*pi:0.1:2*pi;
  »[X,Y]=meshgrid(x,y);
  »Z =exp(-.1*(X.^2+Y.^2)).*sin(X.*Y);
  »surf(X,Y,Z);
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Scripts: the Editor

Editor - C:\Documents and Settings\Administrator\My Documents\MATLAB\coinToss.m*

File Edit Text Go Cell Tools Debug Desktop Window Help

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- A student has taken three exams. The performance on the exams is random (uniform between 0 and 100)
- The first exam is worth 20%, the second is worth 30%, and the final is worth 50% of the grade
- Calculate the student's overall score
- Save script as practice Script.m and run a few times

```
»scores=rand(1,3)*100;
»weights=[0.2 0.3 0.5];
»overall=scores*weights'
```

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Editor - C:\Documents and Settings\Administrator\My Documents\MATLAB\stats.m

File Edit Text Go Cell Tools Debug Desktop Window Help

```
%stats: computes the average, standard deviation, and range
% of a given vector of data
%
%[avg,sd,range]=stats(x)
%avg - the average (arithmetic mean) of x
%sd - the standard deviation of x
%range - a 2x1 vector containing the min and max values in x
%x - a vector of values
function [avg,sd,range]=stats(x)
avg=mean(x);
sd=std(x);
range=[min(x);max(x)];
```

stats

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% we just want the inner product
average=scores*weights';
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- Take advantage of overloaded methods to make your code cleaner!

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ELSEIF

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elseifcond 2
    commands 2
else
    commands 3
end
```

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WHILE syntax

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while condition
    commands
end
```

Exercise: Control-Flow

- Write a function to calculate the factorial of an integer N using a loop (you can use a for or while loop). If the input is less than 0, return NaN. Test it using some values.

```
function a = factorial(N)
if N<0,
   a=nan,
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   a = 1;
   for k=1:N
      a = a*k;
   end
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- But note that factorial() is already implemented! You should see if there are built-in functions before implementing something yourself

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b=[0 a(1:end-1)]+a;
```

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  - Sometime a loop is better, it is clearer and simple