lecture_4

January 26, 2017

0.1 When using the command prompt, anything in your path or working directory can be run either as a script, function or class (to define objects)

Questions from last class: - I downloaded GitHub to my desktop but I cannot sign into my UConn account like I can online. - I checked my grades on HuskyCt recently and I received a 0 / 100 for Homework 1. - It is very hard to tell if what I'm doing on github is right or wrong. - How often will be using our laptops during the lecture? - How many frogs would it take to move a car that is stuck in the snow? And what would be the approximate cost to do so

m_{frog}=22.7 g (https://en.wikipedia.org/wiki/Common_frog)

v_{frog}=17 kph = 4.72 m/s (http://purelyfacts.com/question/14/is-a-toad-faster-than-a-frog?DDA=113&DDB=40)

m_{car}=1000 kg (reasonable guess)

conservation of momentum:

$mv_1 + mv_2 = mv_1' + mv_2' = m_{total}v_2'$

```
In [64]: number_of_frogs = 1;
         v2=0;
         while v2 < 1 % 1 m/s
             m_frogs=number_of_frogs*22.7e-3;
             number_of_frogs=number_of_frogs+1;
             p1=(m_frogs)*4.72; % momentum 1
             v2=p1/(m_frogs+1000); % p2=p1, so v2=p1/m_total
         end
         number_of_frogs
```

```
number_of_frogs =

       11844
```

```
In [2]: %myscript
```

```
In [3]: %plot --format svg
```

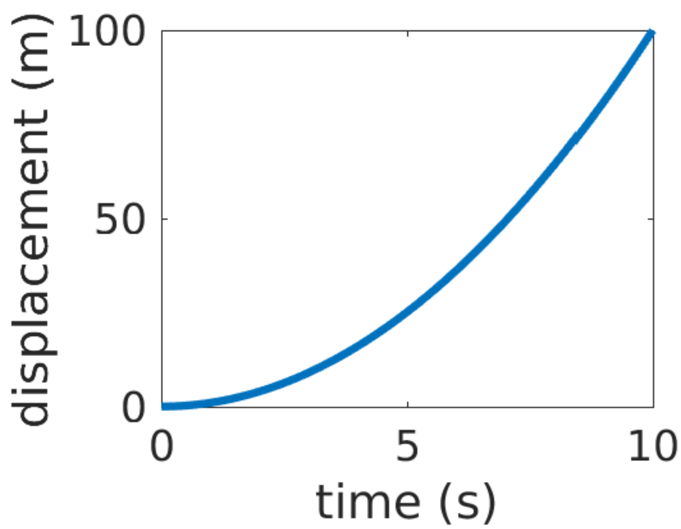
When using the GUI, your command history is saved, but it is better to save your work either as a script or a function or combination of both

Creating a default graph script: `setdefaults.m`

```
set(0, 'defaultAxesFontSize', 16)
set(0,'defaultTextFontSize',14)
set(0,'defaultLineLineWidth',3)
```

```
In [4]: set(0, 'defaultAxesFontSize', 16)
        set(0,'defaultTextFontSize',14)
        set(0,'defaultLineLineWidth',3)
```

```
In [63]: t_linear=linspace(0,10,100);
         plot(t_linear,t_linear.^2)
         xlabel('time (s)')
         ylabel('displacement (m)')
```



1 EOL

1.1 Graphics can be produced with a number of functions

2-D plots, 3-D plots, contour plots, 3D contour plots ...

```
In [6]: x=linspace(-1,1,21); y=linspace(-1,1,21);
        [X,Y]=meshgrid(x,y);
        Z=(X.*Y.^3-X.^3.*Y)
```

```
Z =

  Columns 1 through 7

         0    0.1710    0.2880    0.3570    0.3840    0.3750    0.3360
   -0.1710         0    0.1224    0.2016    0.2430    0.2520    0.2340
   -0.2880   -0.1224         0    0.0840    0.1344    0.1560    0.1536
```

-0.3570	-0.2016	-0.0840	0	0.0546	0.0840	0.0924
-0.3840	-0.2430	-0.1344	-0.0546	0	0.0330	0.0480
-0.3750	-0.2520	-0.1560	-0.0840	-0.0330	0	0.0180
-0.3360	-0.2340	-0.1536	-0.0924	-0.0480	-0.0180	0
-0.2730	-0.1944	-0.1320	-0.0840	-0.0486	-0.0240	-0.0084
-0.1920	-0.1386	-0.0960	-0.0630	-0.0384	-0.0210	-0.0096
-0.0990	-0.0720	-0.0504	-0.0336	-0.0210	-0.0120	-0.0060
0	0	0	0	0	0	0
0.0990	0.0720	0.0504	0.0336	0.0210	0.0120	0.0060
0.1920	0.1386	0.0960	0.0630	0.0384	0.0210	0.0096
0.2730	0.1944	0.1320	0.0840	0.0486	0.0240	0.0084
0.3360	0.2340	0.1536	0.0924	0.0480	0.0180	0.0000
0.3750	0.2520	0.1560	0.0840	0.0330	0	-0.0180
0.3840	0.2430	0.1344	0.0546	-0.0000	-0.0330	-0.0480
0.3570	0.2016	0.0840	0	-0.0546	-0.0840	-0.0924
0.2880	0.1224	0	-0.0840	-0.1344	-0.1560	-0.1536
0.1710	0.0000	-0.1224	-0.2016	-0.2430	-0.2520	-0.2340
0	-0.1710	-0.2880	-0.3570	-0.3840	-0.3750	-0.3360

Columns 8 through 14

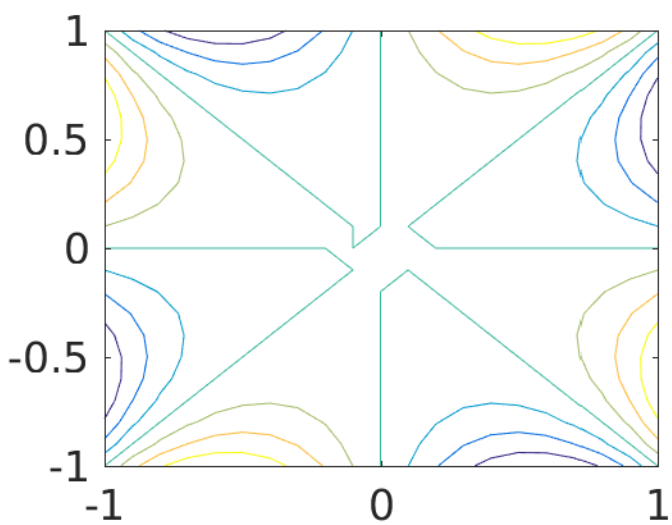
0.2730	0.1920	0.0990	0	-0.0990	-0.1920	-0.2730
0.1944	0.1386	0.0720	0	-0.0720	-0.1386	-0.1944
0.1320	0.0960	0.0504	0	-0.0504	-0.0960	-0.1320
0.0840	0.0630	0.0336	0	-0.0336	-0.0630	-0.0840
0.0486	0.0384	0.0210	0	-0.0210	-0.0384	-0.0486
0.0240	0.0210	0.0120	0	-0.0120	-0.0210	-0.0240
0.0084	0.0096	0.0060	0	-0.0060	-0.0096	-0.0084
0	0.0030	0.0024	0	-0.0024	-0.0030	0
-0.0030	0	0.0006	0	-0.0006	0	0.0030
-0.0024	-0.0006	0	0	0.0000	0.0006	0.0024
0	0	0	0	0	0	0
0.0024	0.0006	-0.0000	0	0	-0.0006	-0.0024
0.0030	0	-0.0006	0	0.0006	0	-0.0030
0	-0.0030	-0.0024	0	0.0024	0.0030	0
-0.0084	-0.0096	-0.0060	0	0.0060	0.0096	0.0084
-0.0240	-0.0210	-0.0120	0	0.0120	0.0210	0.0240
-0.0486	-0.0384	-0.0210	0	0.0210	0.0384	0.0486
-0.0840	-0.0630	-0.0336	0	0.0336	0.0630	0.0840
-0.1320	-0.0960	-0.0504	0	0.0504	0.0960	0.1320
-0.1944	-0.1386	-0.0720	0	0.0720	0.1386	0.1944
-0.2730	-0.1920	-0.0990	0	0.0990	0.1920	0.2730

Columns 15 through 21

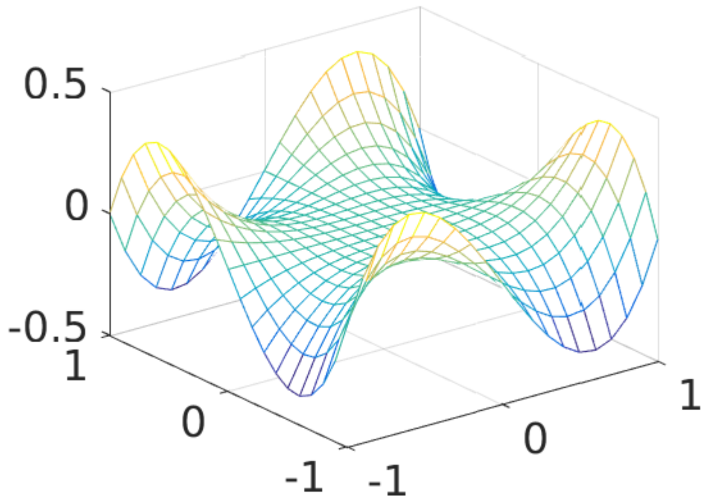
-0.3360	-0.3750	-0.3840	-0.3570	-0.2880	-0.1710	0
-0.2340	-0.2520	-0.2430	-0.2016	-0.1224	-0.0000	0.1710
-0.1536	-0.1560	-0.1344	-0.0840	0	0.1224	0.2880

```
  -0.0924   -0.0840   -0.0546         0    0.0840    0.2016    0.3570
  -0.0480   -0.0330    0.0000    0.0546    0.1344    0.2430    0.3840
  -0.0180         0    0.0330    0.0840    0.1560    0.2520    0.3750
  -0.0000    0.0180    0.0480    0.0924    0.1536    0.2340    0.3360
   0.0084    0.0240    0.0486    0.0840    0.1320    0.1944    0.2730
   0.0096    0.0210    0.0384    0.0630    0.0960    0.1386    0.1920
   0.0060    0.0120    0.0210    0.0336    0.0504    0.0720    0.0990
        0         0         0         0         0         0         0
  -0.0060   -0.0120   -0.0210   -0.0336   -0.0504   -0.0720   -0.0990
  -0.0096   -0.0210   -0.0384   -0.0630   -0.0960   -0.1386   -0.1920
  -0.0084   -0.0240   -0.0486   -0.0840   -0.1320   -0.1944   -0.2730
        0   -0.0180   -0.0480   -0.0924   -0.1536   -0.2340   -0.3360
   0.0180         0   -0.0330   -0.0840   -0.1560   -0.2520   -0.3750
   0.0480    0.0330         0   -0.0546   -0.1344   -0.2430   -0.3840
   0.0924    0.0840    0.0546         0   -0.0840   -0.2016   -0.3570
   0.1536    0.1560    0.1344    0.0840         0   -0.1224   -0.2880
   0.2340    0.2520    0.2430    0.2016    0.1224         0   -0.1710
   0.3360    0.3750    0.3840    0.3570    0.2880    0.1710         0
```

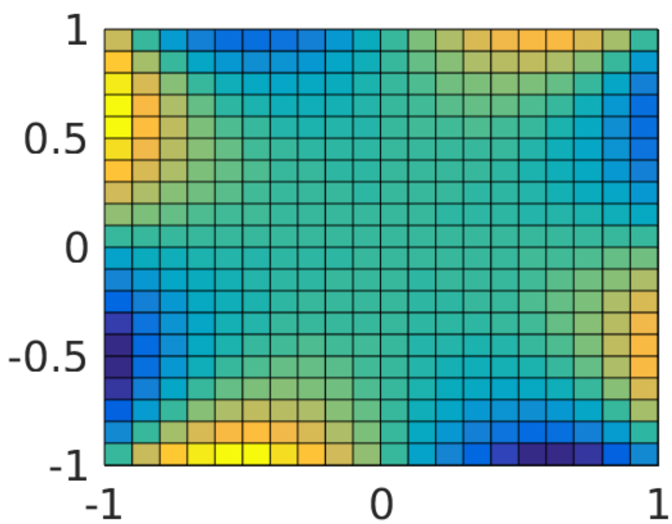
In [7]: `contour(X,Y,Z)`



In [8]: `mesh(X,Y,Z)`




```
In [9]: pcolor(X,Y,Z)
```



1.2 Functions

So far, everything has been executed as a script, or calling a built-in function. Now we begin building our own functions.

Functions are saved in memory (or better yet) in a folder in your path or current directory

Example of storing function in memory

$f(x, y) = (xy^3 - x^3y)$

```
In [10]: f= @(x,y) (x.*y.^3-x.^3.*y)
```

```
f =

    @(x,y)(x.*y.^3-x.^3.*y)
```

```
In [15]: f(0.1,-0.5)
```

```
ans =

   -0.0120
```

Here we will save a function called `my_function` as `my_function.m`

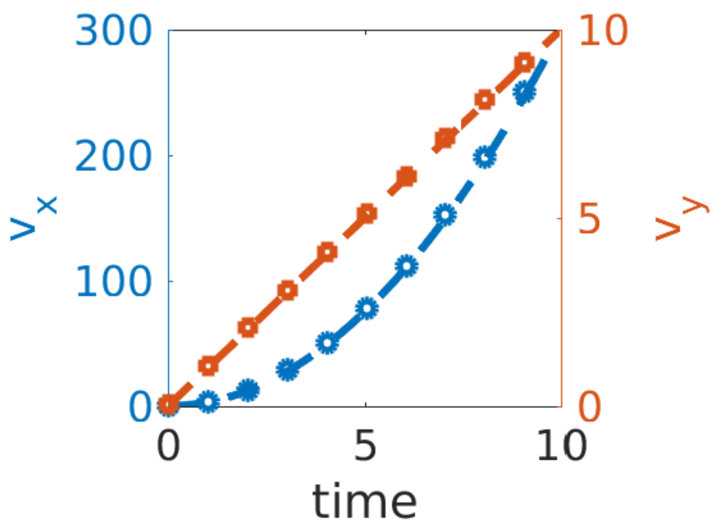
```
function [vx,vy] = my_function(x,y,t)
    % Help documentation of "my_function"
    % This function computes the velocity in the x- and y-directions given
    % three vectors of position in x- and y-directions as a function of time
    % x = x-position
    % y = y-position
    % t = time
    % output
    % vx = velocity in x-direction
    % vy = velocity in y-direction

    vx=zeros(length(t),1);
    vy=zeros(length(t),1);

    vx(1:end-1) = diff(x)./diff(t); % calculate vx as delta x/delta t
    vy(1:end-1) = diff(y)./diff(t); % calculate vy as delta y/delta t

    vx(end) = vx(end-1);
    vy(end) = vy(end-1);

end
```

```
In [18]: help my_function
```

```
Help documentation of "my_function"
  This function computes the velocity in the x- and y-directions given
  three vectors of position in x- and y-directions as a function of time
  x = x-position
  y = y-position
  t = time
  output
  vx = velocity in x-direction
  vy = velocity in y-direction
```

```
In [51]: t=linspace(0,10,100)';
         x=t.^3; % vx = 3*t^2
         y=t.^2/2;  % vy = t
         [vx,vy]=my_function(x,y,t);
```

```
In [54]: yyaxis left
         plot(t(1:10:end),vx(1:10:end),'o',t,3*t.^2)
         ylabel('v_{x}')
         yyaxis right
         plot(t(1:10:end),vy(1:10:end),'s',t, t)
         ylabel('v_{y}')
         xlabel('time')
```



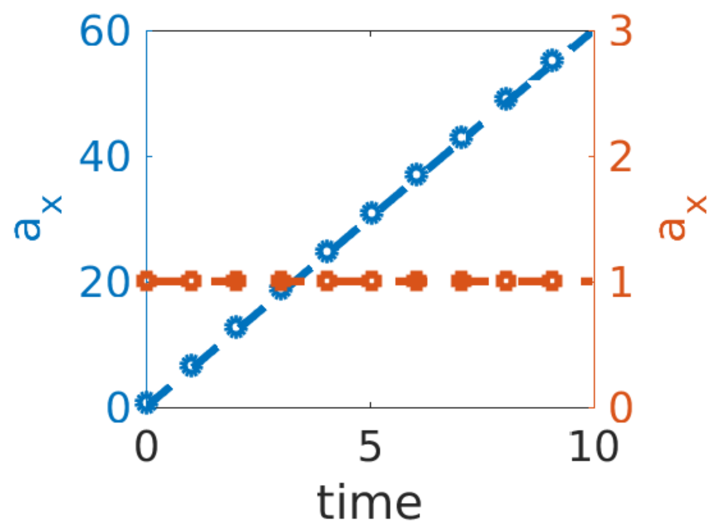
Now, create a new function that calls 'my_function' called, `my_caller.m`

```
In [40]: help my_caller
```

```
Help documentation of "my_caller"
  This function computes the acceleration in the x- and y-directions given
  three vectors of position in x- and y-directions as a function of time
  x = x-position
  y = y-position
  t = time
  output
  ax = velocity in x-direction
  ay = velocity in y-direction
```

```
In [59]: [ax,ay]=my_caller(x,y,t);
```

In [61]:
```
yyaxis left
plot(t(1:10:end),ax(1:10:end),'o',t,6*t)
ylabel('a_{x}')
yyaxis right
plot(t(1:10:end),ay(1:10:end),'s',t, 1*t./t)
ylabel('a_{x}')
xlabel('time')
axis([0,10,0,3])
```



In [62]:
```
diff_match_dims(x,t)
```

```
Undefined function 'diff_match_dims' for input arguments of type 'double'.
```

In [ ]: