Hw 1

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Problem 1

For problem 1 we are asked to use the Matlab commands rand, randn, plot, and polar to generate 1000 points and the plot them. In python we will be using the modules numpy and matplotlib.pyplot (here on refered to as plt). From these we will be using random.normal, plt.plot, plt.show, and plt.polar.

A

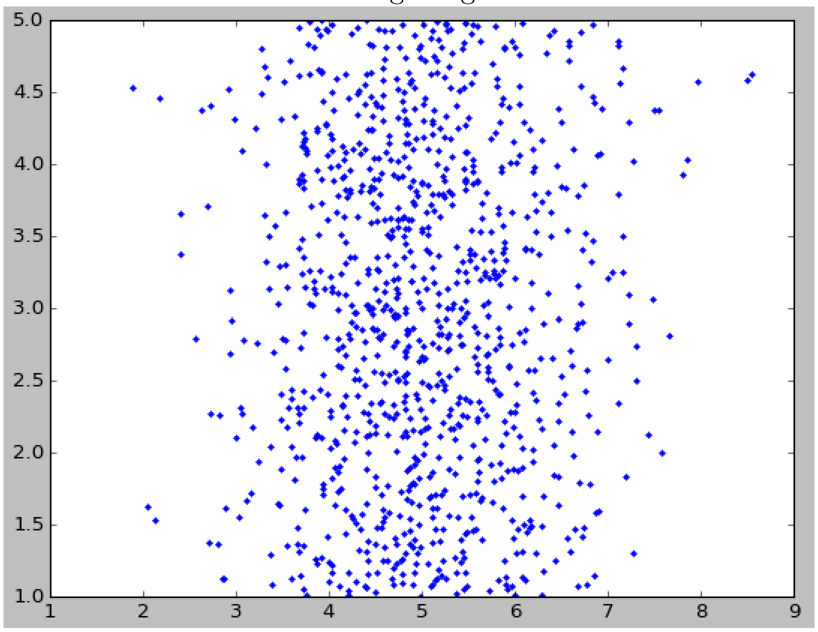
Write a script to plot 1000 points where the x coordinates are randomly chosen from a normal distribution about 5 with a standard deviation of 1. The y coordinate is randomly chosen to form a uniform distribution over the interval (1,5).

The following code is an example of a solution to the problem.

```
# Much of this code will be similar to MatLab since numpy is similar
# to MatLab
from numpy import random as ran # random module will be
                                # called with ran
import matplotlib.pyplot as plt # plot will be called
                                # with plti
mu = 5                          # mu value for normal
                                # distribution
sigma = 1                       # standard deviation
N=1000                          # number of coordinates we are creating
x = ran.normal(mu,sigma,N)      # random numbers created
                                # with normal distribution
y=1+4*ran.random(N)             # random numbers created
                                # between 1 and 5

# Plot is almost exactly the same as MatLab's version of plot
f = plt.plot(x,y,'.')           # plot the x and y coordinates
                                #  with . as a marker
plt.show(f)                     # show the plot that is
                                # generated from above
```

This results in the following image.

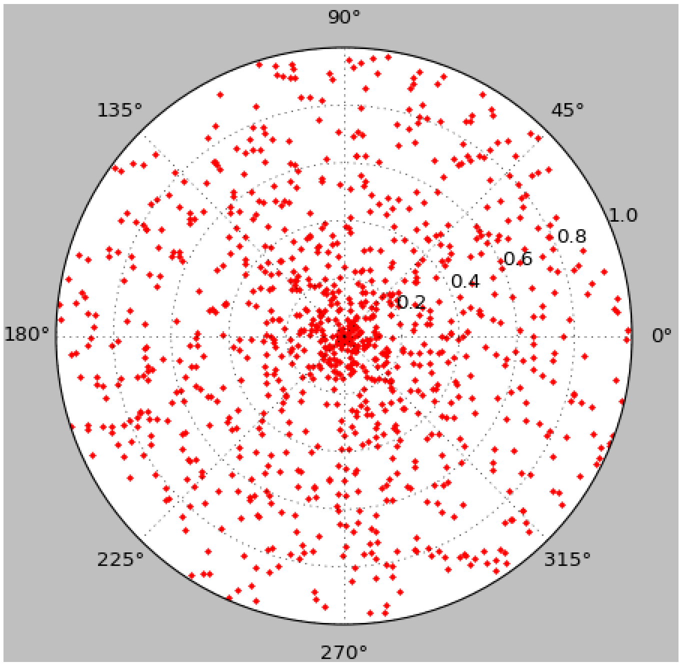


B

This time we will use radial coordinated with a normal distribution about 0 with width 1 and the angular coordinate theta is randomly chosen from a uniform distribution over the interval $(0, 2\pi)$
The code should look something like this.

```
## Part 2
# We are asked to plot random points in polar coordinates
from math import pi          # We need pi for our next plot
theta = 2 * pi * ran.random(N)   # randomly generated theta value,
                                 # between 0 and 2pi
r = ran.random(N)            # random number generated between 0 and 1
p = plt.polar(theta,r,'r.')# polar plot in red
plt.show(p)                  # shows the plot
```

This results in a figure like the following.



Problem 2

See solutions by Dr Gretarsson.

Problem 3

We are given the equations

$$x = (a + b)\cos\phi - h\cos\left(\frac{a+b}{b}\phi\right)$$

$$y = (a + b)\sin\phi - h\sin\left(\frac{a+b}{b}\phi\right)$$

We are asked to set $a = 2$, $b = h = 1$ and run ϕ from 0 to 2π. We use the following code to solve the problem.

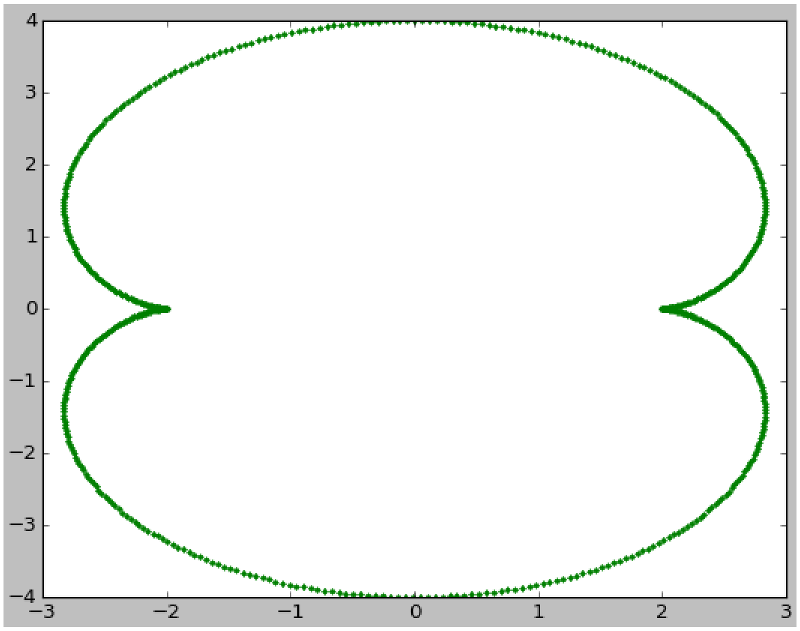
```
## Problem 3 ##
# Now we are asked to plot a parametric curve.  The equation is given
# for x and y as below.  Variables are chosen for consistency and easy
# understanding
from numpy import arange    # arange creates a list from the first to the
                            # second with specified step sizes
from math import cos        # import cosine function
from math import sin        # import sine function
# Given variables
a = 2
b = 1
h = 1
step = .01
# We must create empty arrays that will be updated by loop
x3 = [ ]
y3 = [ ]
# We need to create an array in step sizes.  Step can be changed
# for accuracy
phi = arange(0, 2*pi,step)

# We must use loops to append the arrays.  We will use a for loop
# and keep it in the range of phi, so that when step size changes
# the code does not break.
i = 0    # initialize i to be zero, regardless of previously stored value
for i in range(0, len(phi)):
   x3.append((a + b) * cos(phi[i]) - h * cos(((a + b)/b) * phi[i]))

i = 0    # reinitialization of i
for i in range(0, len(phi)):
   y3.append((a + b) * sin(phi[i]) - h * sin(((a + b)/b) * phi[i]))

q = plt.plot(x3,y3,'g.')    # plot the function
plt.show(q)                 # show the function
```

We should get a picture like the following.



We are asked to plot more curves, changing a,b, and h. This is left for the student. The pictures will be the same as those in the MatLab solutions.