Physics 281 - Computational Physics

Wednesday/Friday Section

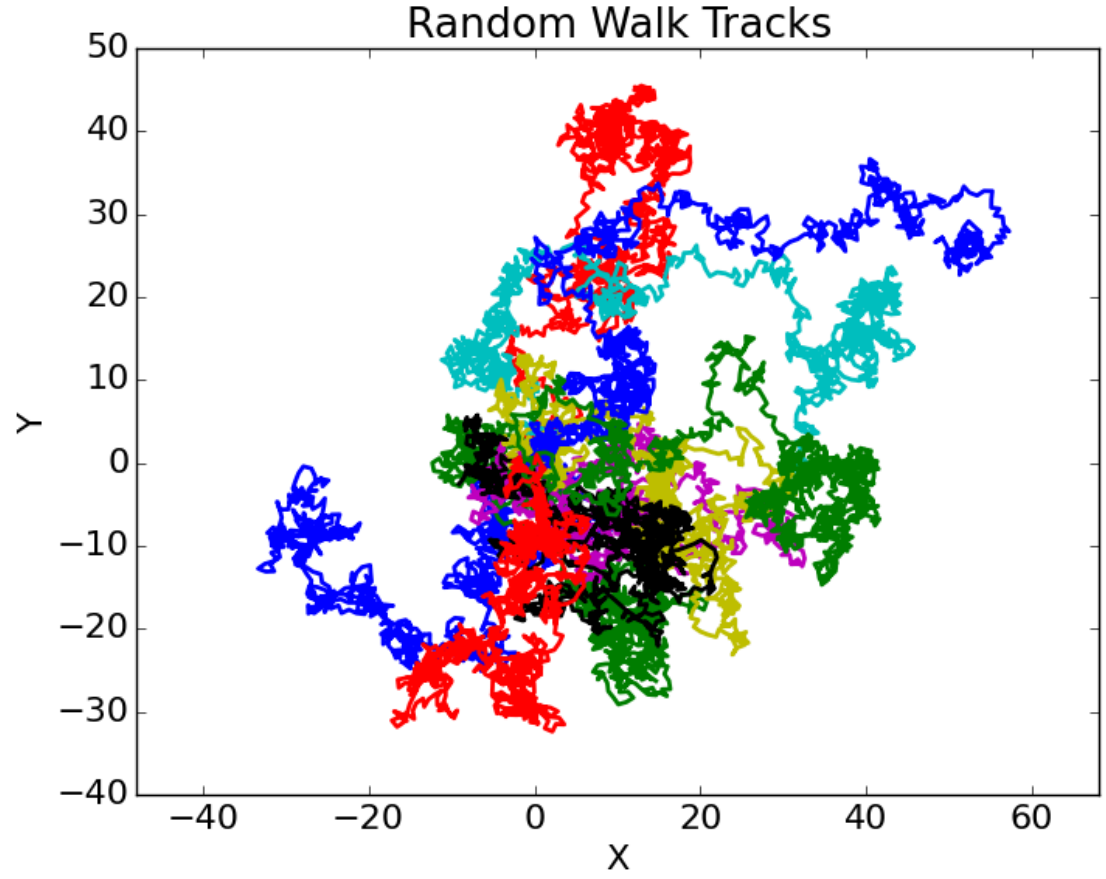
Fall 2015

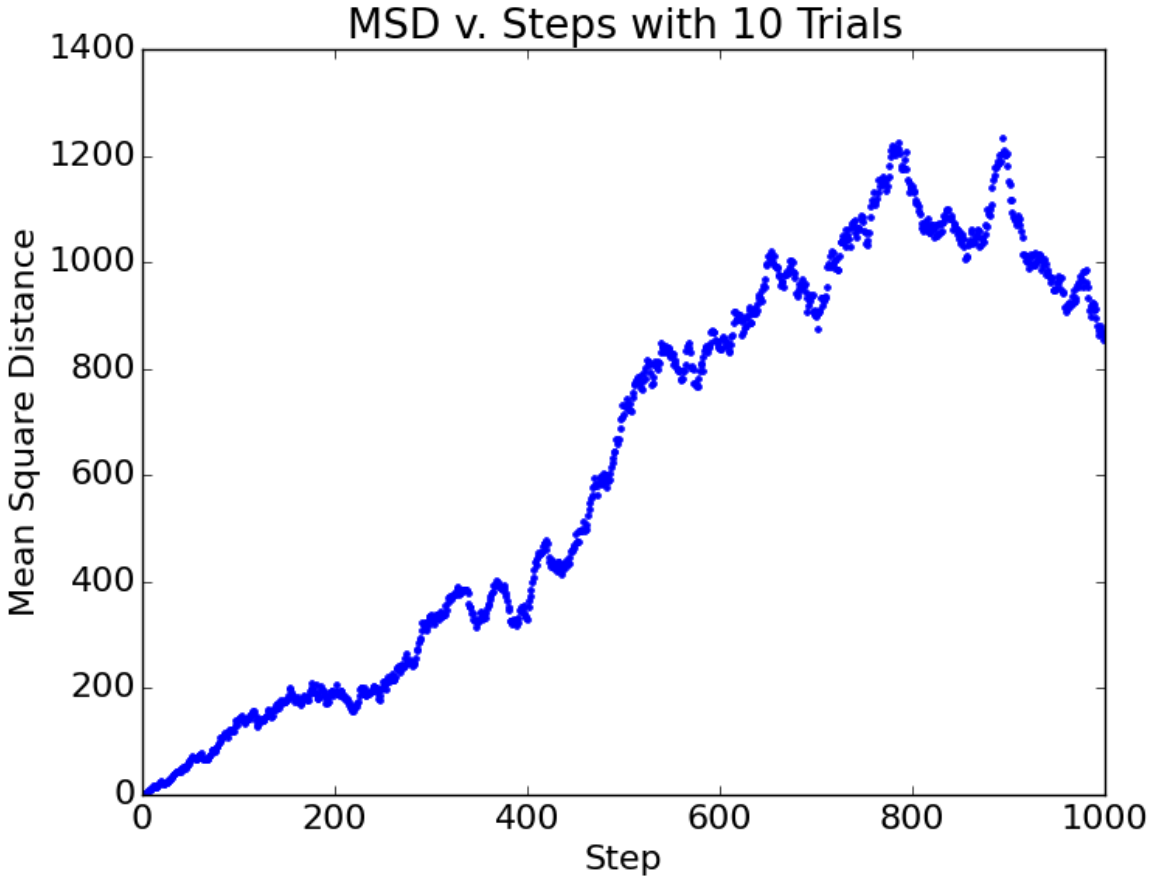
Exercise 7 - Random Walk

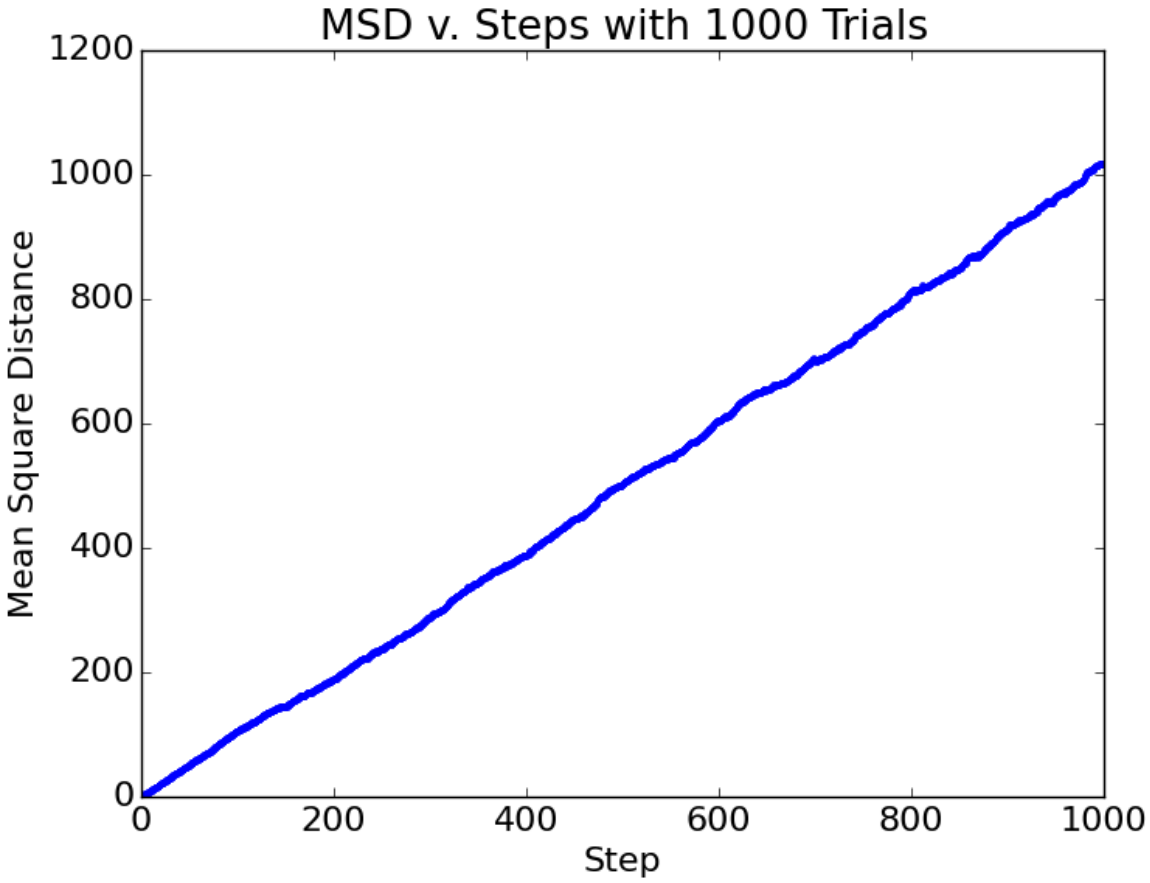
Here is the script

```
# exercise 7.py

import numpy as np
import matplotlib.pyplot as pl
import math
from numpy.random import RandomState

# initialize parameters
r = RandomState()
ntrials = 1000
nsteps = 1000
step_size = 1.
# set up to show the individual random walk tracks
show_tracks = False

x = np.zeros(nsteps)
y = np.zeros(nsteps)
s = np.arange(nsteps)

distance_squared = np.zeros(nsteps)

# make a plot of random walk tracks if requested
pl.ion()
if show_tracks:
    pl.figure(1)
    pl.xlabel('X')
    pl.ylabel('Y')
    pl.title('Random Walk Tracks')
    pl.axis('equal')

for trial in range(ntrials):
    # initialize for this random walker
    x[0] = 0.
    y[0] = 0.
    for step in range(1,nsteps):
        # take next step
        t = 2.*math.pi*r.rand()
        x[step] = x[step-1] + step_size*math.cos(t)
        y[step] = y[step-1] + step_size*math.sin(t)
        # accumulate distance squared for this step for all random walkers
        distance_squared[step] = distance_squared[step] + x[step]**2 + y[step]**2
    if show_tracks:
        pl.plot(x,y)

distance_squared = distance_squared/ntrials
pl.figure(2)
pl.plot(s,distance_squared,'.',label='%d'%ntrials)
pl.xlabel('Step')
pl.ylabel('Mean Square Distance')
pl.title('MSD v. Steps with %d Trials'%ntrials)
```

Here is graph. Note improvement as number of trials increases.


Random Walk Tracks
50
40
30
20
10
0
−10
−20
−30
−40
Y
−40
−20
0
20
40
60
X


MSD v. Steps with 10 Trials
1400
1200
1000
800
600
400
200
0
Mean Square Distance
0
200
400
600
800
1000
Step


MSD v. Steps with 1000 Trials
Mean Square Distance
Step
0
200
400
600
800
1000
1200