# MCSC6280: Particle Based Modeling and Simulation
# Assignment 1

September 18, 2015

**Important Notes**
- do your own work
- please submit your material as a single archive file (e.g. *.zip)
- the title of the archive file you submit must contain your last name and the assignment number
- for each question I indicate what material must be submitted; although not explicitly stated, **you must also include a discussion of the results!** (ie, does the result make sense? why or why not?)

**1. Inverse transform sampling**
a) Write a program to generate random numbers from the following distribution using the inverse transform sampling method:

$$\rho(x) = \sin(x) \qquad [0, \pi] \tag{1}$$

b) Make a plot of the distribution of the random numbers produced from your program. You should generate enough random numbers to verify the distribution.
TO BE SUBMITTED:
- your program
- your data file containing the random numbers
- your plot of the distribution of random numbers that includes the original distribution for verification

**2. Central Limit Theorem**
a) select a non-Gaussian distribution with a zero mean and a standard deviation of one
(you can use any distribution you like - but not a Guassian!)
b) write a program to generate $N_{samples}$ from the distribution and calculate the average and repeat this $N$ times
(you can use any of the methods we discussed in class to generate the random numbers according to the distribution you chose)
c) plot the distribution of the averages; include the normal distribution for verification
TO BE SUBMITTED:
- details of your original distribution
- your program
- your data file containing the averages
- your plot of the distribution including the normal distribution for verification

**3. Ideal Gas**
a) Write a program to simulate an ideal gas in three dimensions.
b) calculate the pressure on the walls of the system for a minimum of three different sizes
(note that you will want L to be smaller than the 2D case we looked at it class to ensure you simulate a sufficient number of collisions)
c) plot $P$ vs. $V$; include the ideal gas law for verification

TO BE SUBMITTED:
- your program
- your data file containing the data you used to verify the ideal gas law
- your plot of the $P$ vs. $V$ including the ideal gas law for verification