PHYS 210, Assignment 3

Create a new directory somewhere in your home directory with the name `yourusername_assignment_3` to store the files you will create for this assignment. To hand the assignment in, copy the directory with your results to `/home2/phys210/yourusername/`. Make sure it's there and has the right permissions (read and execute for everyone, write for you).

1 Array creation

1. Create a 1d array with 5 elements of your choice.
2. Create a 1d array with 3 single precision floating point numbers (4 bytes per number). Show that this array has indeed the correct data type.
3. Create an array with elements 0 to 500.
4. Print elements 3, 25, and 100 to 110 of the array you created in the previous questions. Note that the first elements has index 0!
5. Create a 1d array of size 10 filled with random numbers between 0 and 1.

Put the commented code in a file called `array_creation.py`. It should be a valid, executable python file.

2 Array routines

1. Create an array with elements 0 to 9.
2. Create an array with elements x^2 for $x = 0, 1, ..., 9$.
3. Take the square root of the array from the last question.
4. Last week you calculated the volume of one sphere. Calculate the volumes of spheres with radii $r = 1, 2, 3, ..., 10$.
5. Create a 1d array of size 12 with random numbers in the range 0 to 2π.
6. Calculate the sine of the numbers you created in the previous question.

Put the commented code in a file called `array_routines.py`. It should be a valid, executable python file.

2.1 Statistics

Create a 1d array of size 100 with numbers drawn uniformly from the interval $[0, 1)$, using `numpy.random.random`. This will be your "data" for this exercise and you will calculate some statistics of your newly created data.

The mean of a sample $x_1, x_2, ..., x_N$ can be estimated as

$$\hat{\bar{x}} = \frac{1}{N}\sum_{i=1}^{N} x_i \ . \tag{1}$$

The (unbiased) estimator for the sample variance and standard deviation given by

$$\begin{aligned} \widehat{\mathrm{Var}[x]} &= \frac{1}{N-1}\sum_{i=1}^{N}(x_i - \bar{x})^2 \ , \\ \widehat{\mathrm{Std}[x]} &= \sqrt{\widehat{\mathrm{Var}[x]}} = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \bar{x})^2} \ . \end{aligned} \tag{2}$$

1. Calculate the mean of your data using equation (1), without using `numpy.mean`. You may, and should, use `numpy.sum`, however. Is the results what you would expect?

2. Calculate the variance and standard deviation using equation (2), without using statistical functions from `numpy`, `scipy`, or the like. You may use `numpy.sum` and `numpy.sqrt`. Are the results what you would expect, given what you know about the function you used to create the random numbers (`numpy.random.random`)?

3. Repeat the previous calculations but this time use `numpy.mean`, `numpy.var`, and `numpy.std`. Do the results match with those you got earlier?

Put the commented code in a file called `array_stats.py`. It should be a valid, executable python file.