PH2150 Scientific Computing Skills

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1 Exercise Wk3Ex1:

This week we are introducing arrays as a Python construct. Using the *%timeit* statement compare how long Python takes to add 1 to a million points in a list, with adding 1 to a million points in an array [hint: *timeit?* returns help file , list = range(1000000), array = arange(1000000)]

The *NumPy* package contains *ufuncs* (Universal functions that act on arrays) compare the time taken to evaluate sin(i) on each element of the million point array with that using the *Numpy uFunc* sin(array) [import numpy as np, np.sin(array)]

Comment on the differences in speed between operations on lists and arrays, and the differences in speed when using *NumPy ufuncs*?

2 Exercise Wk3Ex2:

Write code to create and print the following arrays:

a) A two dimensional floating point array with 4 rows and 4 columns all filled with 0.0, call this array Wk3a.

b) A two dimensional floating point array with 4 rows and 4 columns filled with the range of numbers 1-16, call this array Wk3b.

c) A two dimensional floating point array with 4 rows and 4 columns filled with random numbers, call this array Wk3c.

d) Use linspace() to create a two dimensional array with 4 rows and 4 columns. The first row containing numbers between 1 and 17, the second row containing 1 and 2, the third row containing numbers between 100 and 200, the fourth row should be equal to the 3rd row rounded to to decimal places. Call this array WK3d.

The next exercises are to demonstrate how basic arithmetic works on arrays:

e) Add Wk3a to Wk3b to Wk3c, call the answer Wk3e, return the element that is 4 across on the third row.

f) Multiply Wk3b by itself, return Wk3f take the dot product of Wk3b with itself and calculate the difference from Wk3f, comment on what these two operations are doing.

g) Calculate sin(x)**2 for each element of Wk3c, return as Wk3g.

h) Transpose the elements of Wk3c.

i) Return the diagonal() of Wk3c.

j) Create a (8,4)array by stacking Wk3a and Wk3b.

k) Create a (4,8) array by stacking Wk3a and Wk3c.

3 Exercise Wk3Ex3:

a) The file stars.dat on moodle contains a catalog of temperatures and magnitudes for 7860 nearby stars, create an array using this data. The plot a HertzsprungRussell diagram using this catalog.

b) The file stm.dat contains a grid of values from a scanning tunneling microscope measurement of the [111] surface of silicon. The STM is a device that measures the shape of a surface at the atomic level by tracking a sharp tip over the surface and measuring quantum tunneling current as a function of position. The end result is a grid of values that represent the height of the surface. Use imshow() to create a density plot to represent the surface of the silicon, explore the options to create a clear image of the surface.

4 Exercise Wk3Ex4:

This exercise is for bonus points, and goes beyond the scope of this weeks work.

From the met office website:

http://www.metoffice.gov.uk/climate/uk/stationdata/heathrowdata.txt

Extract the climate data from 1950 to 2010 and store in an array. Write a program that will allow the user to input a date range, the return the mean rainfall within that date range. The program should then produce a plot to show the monthly minimum and maximum temperature over the range of dates.