PH2150 Scientific Computing Skills

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1 Problem Sheet 2, Ex 1: Lists

Create a list containing the first ten elements of the periodic table, create a second list containing the next ten elements of the periodic table. Concatenate (add) the lists together. Use the append function to add the next ten elements to your list. Use the len() function to confirm the new list has 30 elements. Print the 23rd element in your list. We will use this list in later exercises.

2 Problem Sheet 2, Ex 2: Lists and control structures

Write a program to create and print a new list containing the elements from your list (from Ex1) that begin with the letter "s" Write a program to create and print a new list containing the elements in your list (from Ex1) that consist of only 4 characters.

3 Problem Sheet 3, Ex 3: More Functions

Write a *function* to compute the area of an arbitrary triangle. An arbitrary triangle can be described by the coordinates of its three vertices: $(x_1, y_1), (x_2, y_2), (x_3, y_3)$. The area of the triangle is given by the formula:

$$A = \frac{1}{2}[x_2y_3 \ - \ x_3y_2 \ - \ x_1y_3 \ + \ x_3y_1 \ + \ x_1y_2 \ - \ x_2y_1]$$

Write a **function area(vertices)** that returns the area of a triangle whose vertices are specified by the argument vertices, which is a nested list of the vertex coordinates. For example, vertices can be [[0,0], [1,0], [0,2]] if the three corners of the triangle have coordinates (0, 0), (1, 0) and (0, 2). Test the area function on a triangle with known area. Name of program file: *area_triangle.py*.

4 Problem Sheet 2, Ex 4: Functions operating on Lists

Some object is moving along a path in the plane. At n points of time we have recorded the corresponding (x, y) positions of the object:$(x_0, y_0), (x_1, y_2), .., (x_{n-1}, y_{n-1})$. The total length L of the path from (x_0, y_0) to (x_{n-1}, y_{n-1}) is the sum of all the individual line segments $((x_{i-1}, y_{i-1})to(x_i, y_i)$, $i = 1, ..., n-1$:

$$L = \sum_{i=1}^{n-1} \sqrt{(x_i - x_{i-1})^2 + (y_i - y_{i-1})^2}$$

Make a function *pathlength(x, y)* for computing L according to the formula. The arguments x and y hold all the $x_0, ..., x_{n-1}$ and $y_0, ..., y_{n-1}$ coordinates, respectively. Make a list of the coordinates of a triangular path with the four points (1, 1), (2, 1), (1, 2), and (1, 1). Test your function on this List. Name the program file: pathlength.py.

5 Problem Sheet 2, Ex 5: Approximate pi

The value of *pi* equals the circumference of a circle with radius 1/2. Suppose we approximate the circumference by a polygon through $N+1$ points on the circle. The length of this polygon can be found using the *pathlength* function from Exercise 4. Make a list of $N + 1$ points (x_i, y_i) along a circle with radius 1/2 according to the formulas:

$$x_i = \frac{1}{2}\cos(2\pi i/N), \quad y_i = \frac{1}{2}\sin(2\pi i/N), \quad i = 0, ..., N.$$

Call the pathlength function and write out the error in the approximation of π for $N = 2^k, k = 2, 3, ..., 10$. Name the program file: pi_approx.py.