

Q 0) The program Lagrange.py writes its output to a file, and in class we have used gnuplot to display the results. Modify the program so that you can use matplotlib to directly plot the graph from within the program itself.

Q 1) Use the Lagrange.py function to build a table of a function, whose values at  $x = 1, 2.5, 3, 7, 8, 9.2$  are given by  $y = 0.17091, 0.47257, 0.96095, 0.39701, 0.01070$  and  $0.90534$  respectively. The table should have values of the function for  $x$  between  $x = 1$  and  $x = 9.2$  at spacings of  $0.01$ . The values should be printed to a file and quoted to 5 decimal places. Graphically compare your results with the function

$$f(x) = \frac{\cos^2(x)}{1 + \sin^2(x)}$$

that I have used to create the given data points.

Q 2) The program newtonDD.py uses the divided difference method to print out the interpolated value of  $f(x)$  for a given, user supplied value of  $x$ . By following this code write a function newtonDD() that will take in data points and a value of  $x$  as arguments and return the interpolated value (along the lines of the Lagrange() function in Lagrange.py). Use this function and the sys module to write a function that does the same thing as Lagrange.py does - but using divided difference.

Q 3) Write a program that will take in a set of uniformly spaced data points written in a input file and print out the interpolated value for a user supplied value of  $x$  using the Newton-Gregory forward interpolation. Use this on the data points given by

$x$	1	2	3	4	5	6	7
$f(x)$	0.01745241	0.0348995	0.05233596	0.06975647	0.08715574	0.10452846	0.12186934

Q 4) Repeat, but this time using backward interpolation.

Q 5) Write a program that asks the user for a positive integer  $n \geq 2$  and prints out the values of the Runge function

$$\frac{1}{1 + 25x^2}$$

at  $n$  equally spaced values between  $-1$  and  $1$  (both included) to a file. Use this and the function Lagrange.py to investigate the Runge phenomenon.