Homework 2

Jared Goldman

September 2018

1 Problem 1

1.1 Part a

If the value of delta is zero and the error case was not checked, the function returns an overflow error. This is caused by the third 'for loop' in which one is divided by delta to find the upper bound of the range. When delta is equal to zero and one is divided by zero, then the range's upper bound approaches infinity.

1.2 Part b

The general trend is that the smaller the value of delta is, the closer to zero the returned value of the calcSum function is. Also, the more bits that are used when representing delta, the more accurate the calcSum function is for delta values of increasingly negative powers of ten. This is a result of rounding errors stemming from the inaccuracy of the binary representation of delta using a limited number of bits.

When delta cannot be represented with complete accuracy due to limited bits, the returned value of the calcSum function will not be equal to the expected value: one. This is a result of the division of one by an inaccurate delta value in the second 'for loop' in which the upper bound of the range of iteration is defined as one divided by delta.

1.3 Part c

For the calcSum float16, calcSum float32, and the calcSum float64 functions, the thresholds of accepted delta values (before the value is rounded to zero) are 10^-7, 10^-45, and 10^-323; however, there is an overflow error (described in part a) in the calcSum float64 function between the values 10^-308 and 10^-323.

2 Problem 2

The graphs of functions one, two, three, and four provided in the HW2p2 template are displayed within the domain [-1, 1]. The roots of these functions within the given domain are found using a bisection search. Functions one and two return meaningful roots as the domain only encloses one root for each of these functions; however, functions three and four do not have such straightforward results.

Function three is sinusoidal and, as a result, has many roots within the given domain, so the root found using the bisection search is meaningless as it is not an exclusive solution. Function four does not have a real root as it is a pathological function. The graph of function four is asymptotic at x = 0.5 and encounters a ZeroDivisionError when iterated over by the bisection search. This error occurs because the second x-midpoint term of the bisection method is 0.5, the exact point of inconsistency in the graph. In order to avoid this error a try/except clause is employed to ensure that the function returns a value when called instead of an error message. A possible solution to this error would be to change the domain to [-0.75, 0.75]. This would result in a bisection search that does not call function four at the asymptote; however, the function would still not return a root as it lacks a real root. The bisection method would simply exceed the maximum iterations defined by the variable 'nmax'.