PHYS 512 - Assignment 2

Question 2

Suppose that I start off with the following set of x values:

$$x = [1 , 2, 3, 4, 5]$$

If the error is too large after the first iteration, the interval of x values will be split into the following intervals:

$$x\_1 = [1, 1.5, 2, 2.5, 3] \qquad x\_2 = [3, 3.5, 4, 4.5, 5]$$

One can easily see that the first, third and fifth values of x1 correspond to the first three values of x, and the first, third and fifth values of x_2 correspond to last three values of x. Since we already computed f(x) for each value in x, we can reuse these five values during the next recursion and so on. Thus, we can easily do the math of how many function-calls were avoided in a given computation.

Suppose that we call the integrate_adaptive function and it completes 15 recursions before returning an answer. The initial call computes five values of f(x), and then each recursion computes 10 values of f(x) (5 on the left and 5 on the right). So, we end up calling 5 + 14*10 = 145 functions. However, if we reuse our values of f(x) from the previous iterations, then we compute five values of f(x) on the initial call, and we compute 4 values for each iteration (2 on the left and 2 on the right). This gives us 5 + 14*4 = 61 function calls.

Thus, for a 15-step recursion, we would save ourselves from 145 – 61 = 84 function calls. This seems to be a large difference.