Homework Assignment 1
Due Wednesday, August 30 at 6 pm

In class we’ll be discussing the trapezoidal rule. It’s an algorithm for estimating the area between the graph of a function \( y = f(x) \), the \( x \)-axis, and two vertical lines: \( x = a \) and \( x = b \). Another, more accurate method for estimating the area is called Simpson’s rule. In both methods the interval \([a, b]\) is divided into \( n \) equal length segments. Then the area above each segment is estimated, and the total area is estimated by adding the areas above each segment. In pseudo-code, we get something like this:

```java
double a, b, h, left_endpt, right_endpt;
double total_area = 0.0, ith_area;
int i, n;

h = (b-a)/n; // Length of segments on x-axis
for (i = 1; i <= n; i++) {
    // Find area above ith segment
    left_endpt = a + (i-1)*h;
    right_endpt = a + i*h;
    ith_area = Find_area(left_endpt, right_endpt, h);
    // Add ith_area into total
    total_area = total_area + ith_area;
}
```

As we’ll see in class, the problem with this pseudo-code is that we repeat a number of computations unnecessarily. In the case of Simpson’s formula, the computation of the total area can be reduced to this relatively simple formula:

\[
total\_area \approx \frac{h}{3} [(f(a) + f(b)) + 4f(x_1) + 2f(x_2) + 4f(x_3) + 2f(x_4) + \cdots + 2f(x_{n-2}) + 4f(x_{n-1})].
\]

Here, \( n \) is even, and \( x_i = a + ih \), for \( i = 1, 2, \ldots, n - 1 \).

For homework assignment 1, you should use this formula to implement Simpson’s rule in either Java or Python. Input to the program will be (in order)

- \( a \) : the left endpoint of the interval (a double)
- \( b \) : the right endpoint of the interval (a double)
• $n$: the number of segments that we divide $[a, b]$ into (an even int).

The function $f(x)$ will be $f(x) = x^2 + 1$. The output should be the area estimated by Simpson’s rule.

Your code should use a function or method for $f(x)$ and a function or method for the calculation of Simpson’s estimate. You should read in the input values, call or invoke the Simpson function/method, and print the results in the main function/method.

When you’re done, you should create a subdirectory of your submit directory on any CS department computer:

```
$ mkdir /home/submit/cs220-01/<your-id>/h1
```

Don’t type the “$” sign: that’s the shell prompt. Also be sure to use a lower-case “h” in “h1” not a capital “H”. After you’ve created the h1 directory, you should copy your code to this directory. For example, if you used Java, you might type

```
$ cp Simpson.java /home/submit/cs220-01/<your-id>/h1
```

The copy should be completed by 6 pm on Wednesday.