

# Programming Assignment #1

This is a short assignment to practice creating simple functions using iteration. You'll also gain more experience using floating-point numbers. The program will approximate the value of pi ( $\pi$ ) using two different methods. The first method calculates the area of a quarter-circle using rectangles. As the number of rectangles increases, the width of each rectangle decreases and gives a more accurate value for pi. Diagrams are posted on the website.

The second method that approximates pi uses a formula derived by Gottfried Leibniz, also known as "the father of calculus." This method uses an infinite series of additions and subtractions to approximate pi:

$$\pi/4 = 1 - 1/3 + 1/5 - 1/7 + 1/9 - 1/11 + . . .$$

Notice that this approximates  $\pi/4$ . After the summation of the terms, you need to multiply the value by 4 to arrive at the final approximation. Analogous to the previous method, the more terms in the series, the closer the approximation of pi.

The result of these functions will be used to create a table of approximations for pi, comparing the two algorithms, the circle-arc method, and Leibniz's algorithm. The table will look something like this:

Approximations for pi		
Iterations	Circle Method	Leibniz Method
1	3.46410162	4.00000000
10	3.15241143	3.04183962
100	3.14193686	3.13159290
1000	3.14160354	3.14059265
10000	3.14159300	3.14149265
100000	3.14159266	3.14158265
1000000	3.14159265	3.14159165

## Details

You are given a file called **driver.c**, which includes the main function. There are two functions prototyped in that file. One for the circle method and one for Leibniz's method. You must implement both of these functions *exactly as prototyped* in another file named **pi.c**. A sample command line to build this assignment looks like this:

```
gcc -Werror -O -Wall -Wextra -ansi -pedantic driver.c pi.c -o pi
```

If your code is valid, this will compile and link both files and produce an executable file named **pi.exe**. If you are using Linux or Mac OS X, you will also need to add **-lm** (that's a lowercase 'L' and a lowercase 'M'). This is so the linker will use the math library.

```
gcc -Werror -O -Wall -Wextra -ansi -pedantic driver.c pi.c -o pi -lm
```

This assignment will require you to perform some simple mathematical calculations such as calculating square roots. There is a function in the C library called **sqrt** which returns the square root of a number as a double. To use any of the math functions, you will need to include **math.h** in your **pi.c** file. All of the code that you write must be in **pi.c**, since you will not be turning in **driver.c**. **REPEAT: You will not turn in driver.c**, so any changes you make to **driver.c** will not be seen by me. Also: **NEVER PUT A main( ) FUNCTION IN YOUR FILE. EVER.** (Unless instructed to do so...)

Be sure to follow the guidelines for documenting your code. This includes the file header comment, function header comments, and in-line commenting.

Both functions will be doing some sort of looping. For the first function (**circle\_pi**), you *must* use a **for** loop. For the second function (**leibniz\_pi**), you *must* use a **while** loop. The time to complete this assignment should be less than 2 hours. However, don't feel bad if you spend more time on it, especially if you are taking the time to code it in the best way possible. Remember, your code says a lot about the type of software developer you are going to be. Professional developers can look at a people's coding and make judgments about them (for better or worse.) Also, some of you will be tempted to use the **pow** function from **math.h**. **DO NOT USE IT.** You don't need it. You only really need **sqrt**. Using **pow** will cause you to receive a 0 on the assignment, no questions asked.

**What to submit**

You must submit the C file (**pi.c**) to the submission server by the due date/time. Refer to the web page for this assignment for any additional details on how to submit this assignment. **Do not submit any other files than the ones listed.**

Documents	Description
pi.c	The C file. This file contains all of the source code for the program, properly formatted and commented.

If you've forgotten how to submit files, the details about how to submit are posted on the course website and in the syllabus. Failure to follow the instructions will result in a poor score on the assignment (and possibly a zero).

**Make sure your name and other info is on all documents (paper and electronic).**

**Special note:**

The due date/time posted is the positively latest you are allowed to submit your code. Since the assignments can easily be completed well before the deadline, you should strive to turn it in as early as possible. If you wait until the deadline, and you encounter unforeseen circumstances (like being sick, or your car breaking down, your Internet goes down, or something else), you may not have any way to submit the assignment on time. You are given plenty of time to complete this assignment. However, it is **your choice** when you want to do it. Waiting until later to start is always a bad idea. Moral: **Don't wait until the last minute to do your homework.**