Laboratory Programming Exercise 04
Computer Engineering 160
Fall 2018
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The Maclaurin series expansion for *cos(x)* is the infinite alternating series

$$\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} \cdots = \sum_{k=0}^{\infty} \frac{(-1)^k x^{2k}}{(2k)!}$$

Write a program using one or more iteration structures to approximate the cosine function, given a radian value *x*, input using `scanf()`. During each iteration of the summation, output the value of the iteration index *k*, the k[th] approximation of *cos(x)*, and the k[th] approximation error

$$\text{error}_k = \left| \cos_k(x) - \cos_{stdlib}(x) \right|$$

where $cos_k(x)$ refers to the k[th] iteration approximation and $cos_{stdlib}(x)$ is the value returned by the C standard library cosine function. Example output:

```
$ ./Lab04.exe
? 3.14
k:  0, cos(x):  1.000000, err: 1.999999e+00
k:  1, cos(x): -3.929800, err: 2.929802e+00
k:  2, cos(x):  0.120688, err: 1.120687e+00
k:  3, cos(x): -1.210518, err: 2.105196e-01
k:  4, cos(x): -0.976140, err: 2.385835e-02
k:  5, cos(x): -1.001817, err: 1.818018e-03
k:  6, cos(x): -0.999899, err: 9.988098e-05
k:  7, cos(x): -1.000003, err: 4.009919e-06
k:  8, cos(x): -0.999998, err: 2.816154e-07
k:  9, cos(x): -0.999999, err: 1.624061e-07
k: 10, cos(x): -0.999999, err: 1.624061e-07

$ ./Lab04.exe
? 3.14159265359
k:  0, cos(x):  1.000000, err: 2.000000e+00
k:  1, cos(x): -3.934803, err: 2.934803e+00
k:  2, cos(x):  0.123910, err: 1.123910e+00
k:  3, cos(x): -1.211353, err: 2.113529e-01
k:  4, cos(x): -0.976022, err: 2.397776e-02
k:  5, cos(x): -1.001829, err: 1.829147e-03
k:  6, cos(x): -0.999900, err: 1.004338e-04
k:  7, cos(x): -1.000004, err: 4.172325e-06
k:  8, cos(x): -1.000000, err: 1.192093e-07
k:  9, cos(x): -1.000000, err: 3.774758e-15
k: 10, cos(x): -1.000000, err: 3.774758e-15
```

Modify your program so you store the error computed during the previous iteration and stop iterating when the previous error equals the current iteration error. In your comment block header explain how many iterations were invoked for $x = \pi$, $\pi/2$, $\pi/3$, and $\pi/4$, for a reasonable approximate value of π. Use multiple selection and iteration structures where needed.

Generate a screen capture of your Eclipse IDE workspace, showing the relevant section of code you modified, and the output of two invocations of your program in the terminal. Under Microsoft Windows, press the Windows Key and the PrtScr key, simultaneously, and move the generated image file in Pictures\Screenshots to your Eclipse IDE project folder. On macOS, Shift-Command (⌘)-3 will take a screenshot of the screen and save the screenshot as a .png file on your desktop. See article https://support.apple.com/en-us/HT201361 for instructions on how to take a screenshot on a Mac.

Please name your Eclipse IDE project

`Lastname_REDID_Lab_04`

Your project folder will be found in your `eclipse-workspace` directory. For example, in the Windows environment, the path will resemble

C:\Users\Christopher Paolini\eclipse-workspace\Paolini_807456566_Lab_04

Note that your executable will be found in the `Debug` directory within your project directory and will be named *`Lastname_REDID_Lab_04.exe`*.

Create a ZIP file of your project folder (i.e. your *`Lastname_REDID_Lab_04`* folder) and submit the ZIP file through Blackboard.