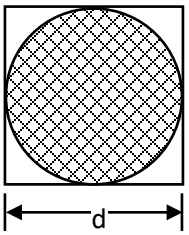
Lab 04 **CSC 220-03** **Spring 2018**

Objectives

1. Practice writing and using while loops to implement iteration.
2. Practice writing and using if statements for conditional execution.

Description

The mathematical constant π is defined as the ratio of a circle's circumference to its diameter. Another way to define π is using the definition of the area of a circle and the area of the square within which the circle is inscribed. Given the radius r = d/2 and the following definitions:



Area of a square with side of length d: $A_s = d^2 = 4r^2$

Area of a circle with diameter d: $A_c = \pi\left(\frac{d}{2}\right)^2 = \pi r^2$

then π may be defined using the ratio A_c/A_s as $\pi = 4\left(\frac{A_c}{A_s}\right) = 4\left(\frac{\pi r^2}{4r^2}\right)$

Using this definition, if we can estimate A_c/A_s then an estimate of π is obtained by multiplying that value by four.

An estimate of A_c/A_s may be computed using the following Monte Carlo technique:

1. Choose a value for *r*. Any positive value is acceptable.
2. Compute two uniformly distributed random numbers in [-r, r). Assign these values to the variables x and y.
3. Determine if the point (x, y) is within a circle with radius *r* by testing if $\sqrt{x^2 + y^2} \leq r$.
4. Repeat these three steps several thousand times. Choose 10,000 iterations to start and increase as necessary to improve your estimate.
5. Count the number of times that the random point is within the circle, which is indicated when the above inequality evaluates to true.
6. After all iterations are complete, estimate π by dividing the number of times the random point is within the circle by the total number of iterations, and multiplying the ratio by four.

Instructions

1. Create a new file called `Lab04.java`.
2. Write a program that estimates π using the procedure described above.
3. Use a while loop for iteration and an if-statement to test if random points are within the circle.
4. Define a variable to be used for the number of iterations to perform. Change the value of this variable and observe how the estimate improves as the value increases.
5. Print the estimate for π at the end of your program.
6. Compile and test your program.
7. Add header comments to your program file, including: (1) your name, (2) date, (3) file name, (4) A brief description of what the program does. Also add comments throughout your program describing what it does.
8. Include in your header comments the terminal command you used to compile your program (`javac …`), and the terminal command you used to run your program (`java …`).
9. Submit your `Lab04.java` file using Canvas.
    - Log in to Canvas and click on the link for this course
    - Click on "Assignments" in the left hand menu
    - Select "Labs" and then click on today's lab
    - Click the "Submit Assignment" button and the "Choose File" button
    - Find your `.java` file and submit