University of Cape Town ~ Department of Computer Science

Computer Science 1016S ~ 2007

Practical Test 2 – Test One

Time: 45 minutes

Write a program to calculate the value of the mathematical constant Pi (3.141592…) using the formula attributed to François Viète:

$$\frac{\sqrt{2}}{2} \cdot \frac{\sqrt{2+\sqrt{2}}}{2} \cdot \frac{\sqrt{2+\sqrt{2+\sqrt{2}}}}{2} \cdot \ldots = \frac{2}{\pi}$$

Each term on the left-hand-side can be derived from the previous one and further refines the product. Finally, we can solve for Pi after a suitable number of iterations.

You MUST write a method called **calculatePi**, which takes as a parameter the precision required (either the number of iterations or the acceptable error). The value of Pi must then be printed to the screen using a call to this method. Your program must not take in any input.

You may consult your paper notes and textbook, but no electronic resources. You may NOT use a search engine or consult any Web resources (including Vula) or files on your flash disk, hard drive, etc.

Hint: Use the Math.sqrt method.

Submit the Java source files to Vula, using a Zip file if necessary. Name your file **PTest2One.java** or **PTest2One.zip.**

Marking Guide:

- *Correctness: Term calculation :30%, Iteration: 20%, Final Pi value: 10%*
- *Comments (Documentation): 40%*

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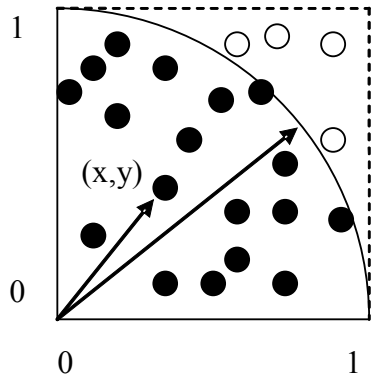
Practical Test 2 – Test Two

Time: 45 minutes

Write a program to calculate the value of the mathematical constant Pi (3.141592…) using what is known as a Monte Carlo method.



Support you have a quarter circle within a square, where all sides are of length 1. If you randomly choose (x, y) points within this square (where x and y are both less than 1), the points may fall within the circle (i.e., $\sqrt{x^2 + y^2} < 1$) or not. If you repeat this many times and count the proportion of points within the circle (18/22 in the picture), you get an approximation for Pi/4 because of the formula for area of a circle. It is then trivial to compute Pi.

You MUST write a method called **calculatePi**, which takes as a parameter the precision required (either the number of iterations or the acceptable error). The value of Pi must then be printed to the screen using a call to this method. Your program must not take in any input.

You may consult your paper notes and textbook, but no electronic resources. You may NOT use a search engine or consult any Web resources (including Vula) or files on your flash disk, hard drive, etc.

Hint: Use the Math.random and Math.sqrt methods.

Submit the Java source files to Vula, using a Zip file if necessary. Name your file **PTest2Two.java** or **PTest2Two.zip.**

Marking Guide:

- *Correctness: Random numbers :15%, Within circle counter: 15%, Iteration: 20%, Final Pi value: 10%*
- *Comments (Documentation): 40%*

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Practical Test 2 – Test Three

Time: 45 minutes

Write a program to calculate the value of the mathematical constant Pi (3.141592…) using the formula attributed to Wallis:

$$\prod_{n=1}^{\infty} \left(\frac{n+1}{n}\right)^{(-1)^{n-1}} = \frac{2}{1} \cdot \frac{2}{3} \cdot \frac{4}{3} \cdot \frac{4}{5} \cdot \frac{6}{5} \cdot \frac{6}{7} \cdot \frac{8}{7} \cdot \frac{8}{9} \cdots = \frac{\pi}{2}$$

Each term on the right-hand-side can be derived from the previous one or the formula, and further refines the product. Finally, we can trivially solve for Pi after a suitable number of iterations.

You MUST write a method called **calculatePi**, which takes as a parameter the precision required (either the number of iterations or the acceptable error). The value of Pi must then be printed to the screen using a call to this method. Your program must not take in any input.

You may consult your paper notes and textbook, but no electronic resources. You may NOT use a search engine or consult any Web resources (including Vula) or files on your flash disk, hard drive, etc.

Hint: Use the Math.pow (base, exp) method.

Submit the Java source files to Vula, using a Zip file if necessary. Name your file **PTest2Three.java** or **PTest2Three.zip.**

Marking Guide:

- *Correctness: Term calculation :30%, Iteration: 20%, Final Pi value: 10%*
- *Comments (Documentation): 40%*