ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Monte Carlo Method to Estimate Pi

Parallel Programming in Scala

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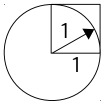
A Method to Estimate π (3.14...)

Consider a square and a circle of radius one inside a square:



Ratio between the surfaces of $1/4$ of a circle and $1/4$ of a square:

$$\lambda = \frac{(1^2)\pi/4}{2^2/4} = \frac{\pi}{4}$$

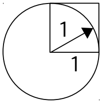
Estimating λ: randomly sample points inside the square

Count how many fall inside the circle

Multiply this ratio by 4 for an estimate of π

Sequential Code for Sampling Pi

```
import scala.util.Random
def mcCount(iter: Int): Int = {
  val randomX = new Random
  val randomY = new Random
  var hits = 0
  for (i <- 0 until iter) {
    val x = randomX.nextDouble  // in [0,1]
    val y = randomY.nextDouble  // in [0,1]
    if (x*x + y*y < 1) hits= hits + 1
  }
  hits
}
def monteCarloPiSeq(iter: Int): Double = 4.0 * mcCount(iter) / iter
```



Four-Way Parallel Code for Sampling Pi

```
def monteCarloPiPar(iter: Int): Double = {
  val ((pi1, pi2), (pi3, pi4)) = parallel(
    parallel(mcCount(iter/4), mcCount(iter/4)),
    parallel(mcCount(iter/4), mcCount(iter - 3*(iter/4))))
    4.0 * (pi1 + pi2 + pi3 + pi4) / iter
}
```