In-Class Lab: Estimating PI

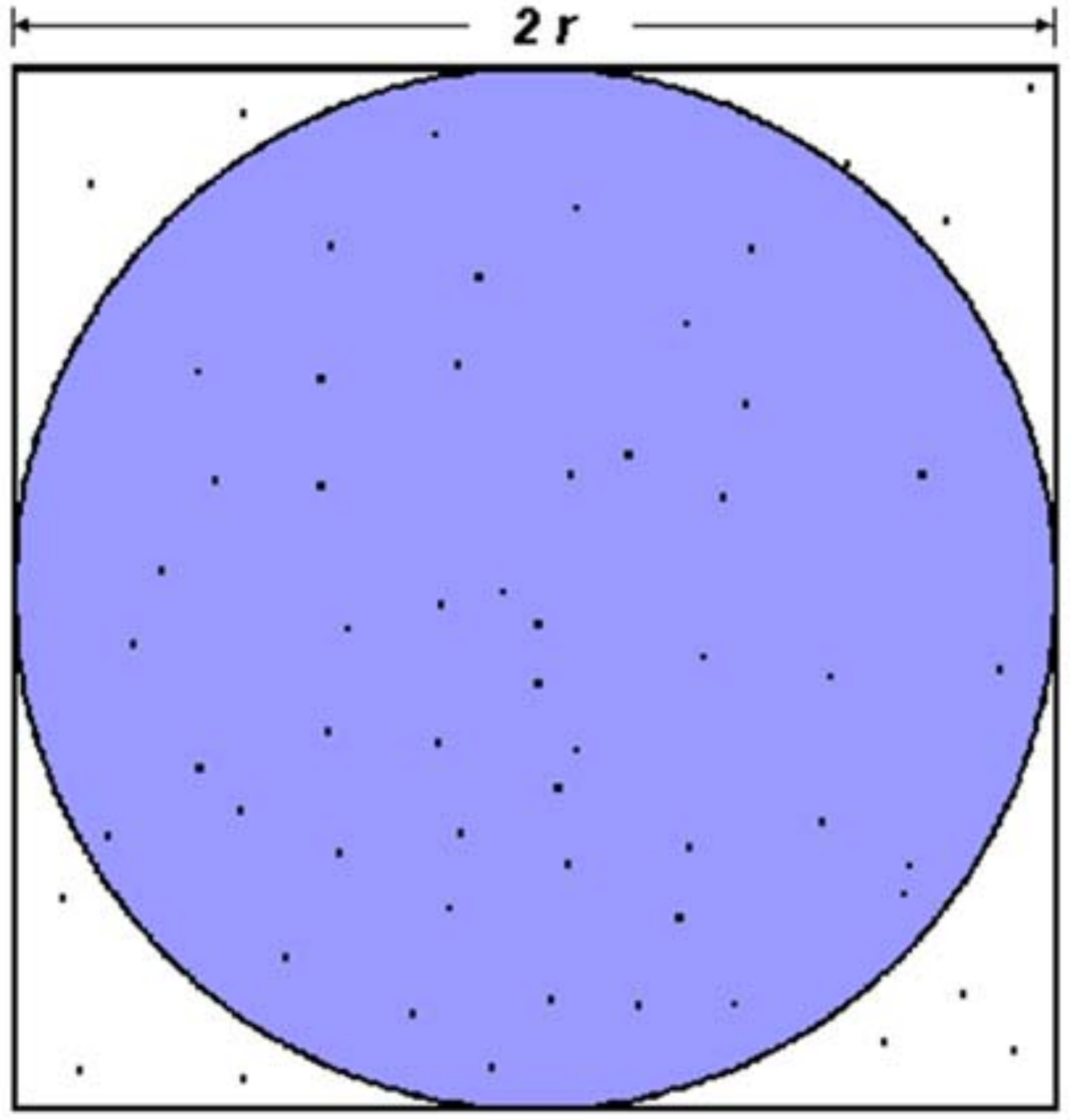
Problem: Estimating the value of π

The value of π can be estimated by the following serial algorithm.

Algorithm: *EstimatePI*(*n*)
Input: *n*, number of points
Output: *PI*, an estimate value of π

1. Inscribe a circle in a square
2. Randomly generate *n* points in the square
3. Determine *m* , the number of points in the square that are also in the circle
4. *PI* = 4 * *m* / *n*

Note that the more points that are generated, the better the approximation.

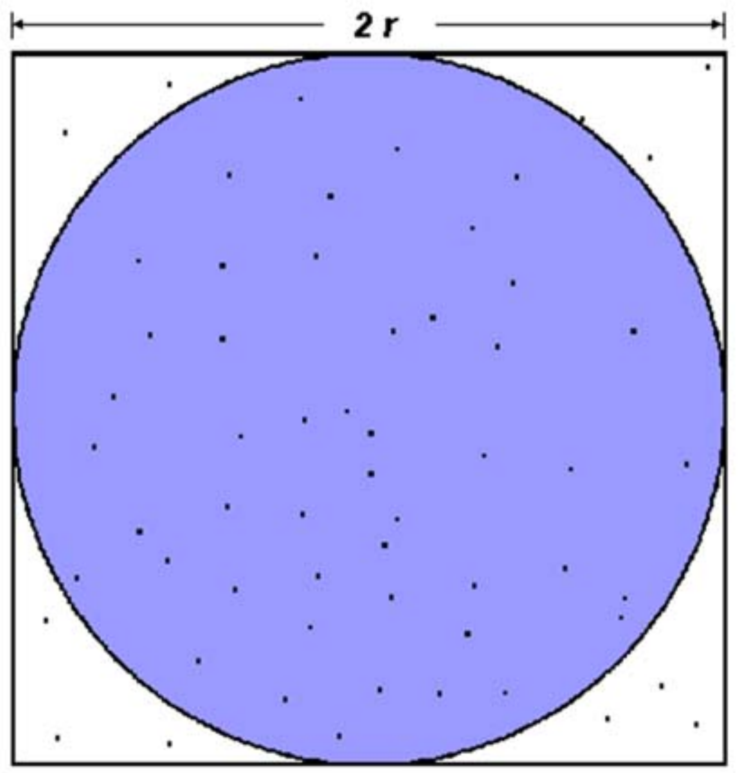


$$A_S = (2r)^2 = 4r^2$$
$$A_C = \pi r^2$$
$$\pi = 4 \times \frac{A_C}{A_S}$$

Question

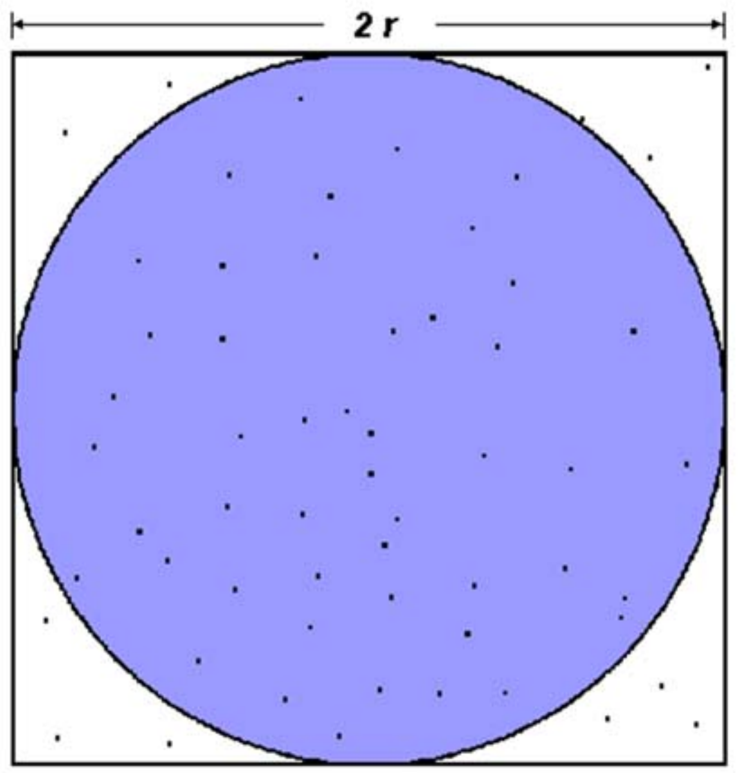
- Apply Foster's methodology to parallelize the EstimatePI algorithm. Develop parallel algorithms for shared-memory and distributed-memory systems

Performance



- Assumptions: $T_{Serial} = (A + B)n$
    - A:time to generate a random point
    - B: time to test if the point is inside the circle

Performance



- Define a parametrized formula for $T_{parallel}$
  Your formula should use n, p, the same *A* and *B* defined for the serial program and additional constants for other computations or overhead

- Derive formulas for speedup and efficiency, as functions of *n* and *p*.

- Based on your analysis, does it appear that your algorithms are scalable?

Question2

- Suppose that 20% of a program is not parallelizable, for a particular problem size. What is the maximum speedup that can be expected if that program were parallelized for that particular problem size?