



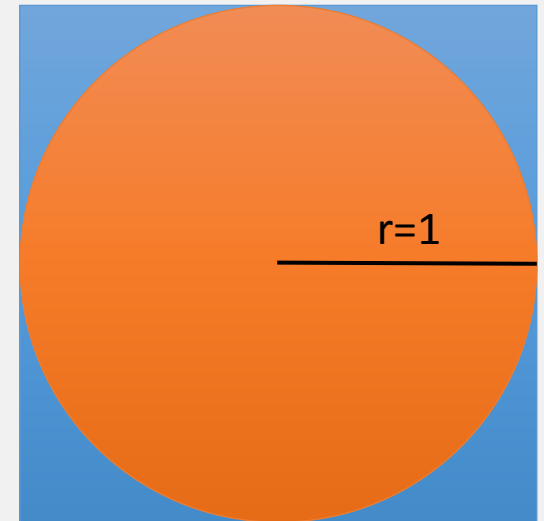
CLOUD COMPUTING APPLICATIONS

MapReduce Example:
Pi Estimation & Image Smoothing

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Pi Estimation

- Using Monte Carlo simulation, estimate the value of π
- Throw darts
- Compute the ratio of the darts landed within the square vs. the darts landed within the circle
- Evaluating whether a particular dart landed within the circle is easy



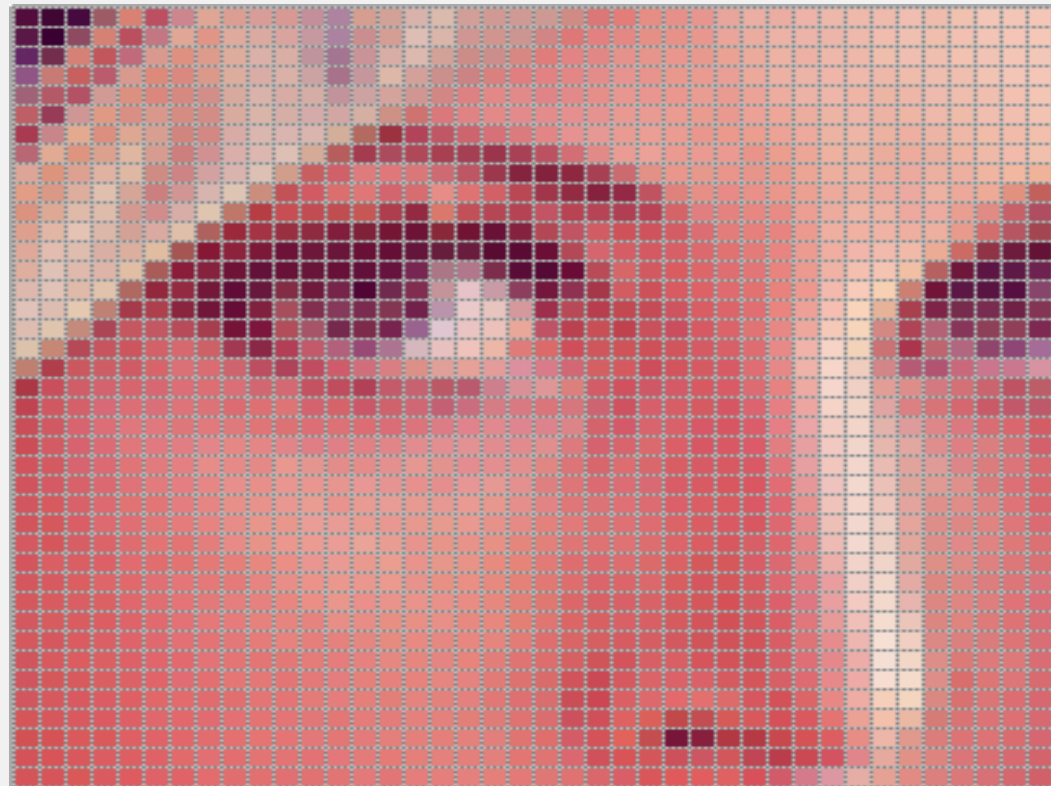
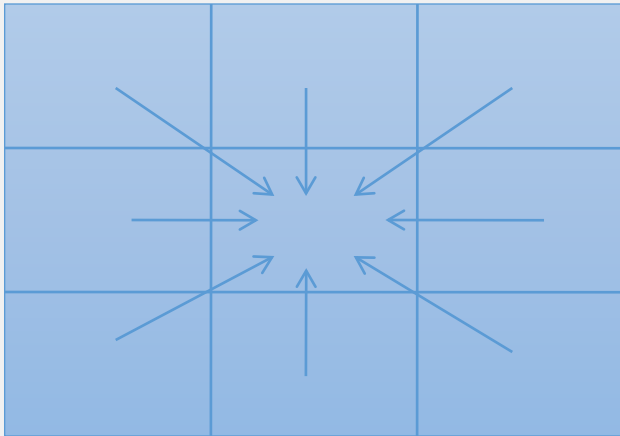
Circle Area = π
Square Area = 4
 $\pi = 4 \cdot C/S$

Pi Estimation

- **Mapper:** Generate points in a unit square and then count points inside/outside of the inscribed circle of the square
- **Reducer:** Accumulate points inside/outside results from the mappers
- After the MapReduce job, estimate Pi
 - The fraction **NumInside/NumTotal** is an approximation of the value
 - $(\text{Area of the circle}) / (\text{Area of the square})$
 - Then, Pi estimated value to be **(NumInside/NumTotal)**

Exercise 2: Image Smoothing

- To smooth an image, use a sliding mask and replace the value of each pixel



Exercise 2: Image Smoothing

- Map: input key = x, y input value = R, G, B
 - Emit 9 points
 - (x-1, y-1, R, G, B)
 - (x, y-1, R, G, B)
 - (x+1, y-1, R, G, B)
 - Etc.
- Reduce: input key = x, y input value: list of R, G, B
 - Compute average R, G, B
 - Emit key = x, y value = average R, G, B