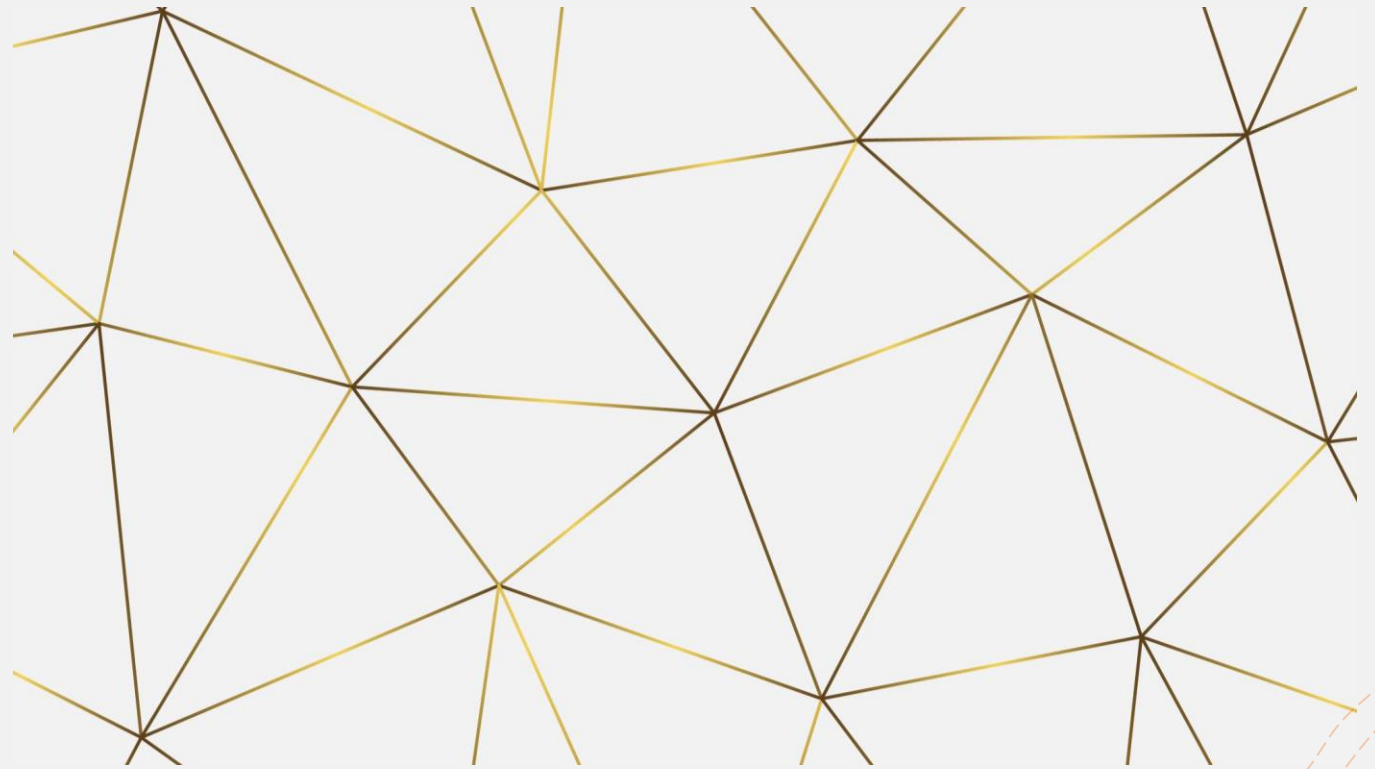


CSI 424

Simulation & Modeling Laboratory

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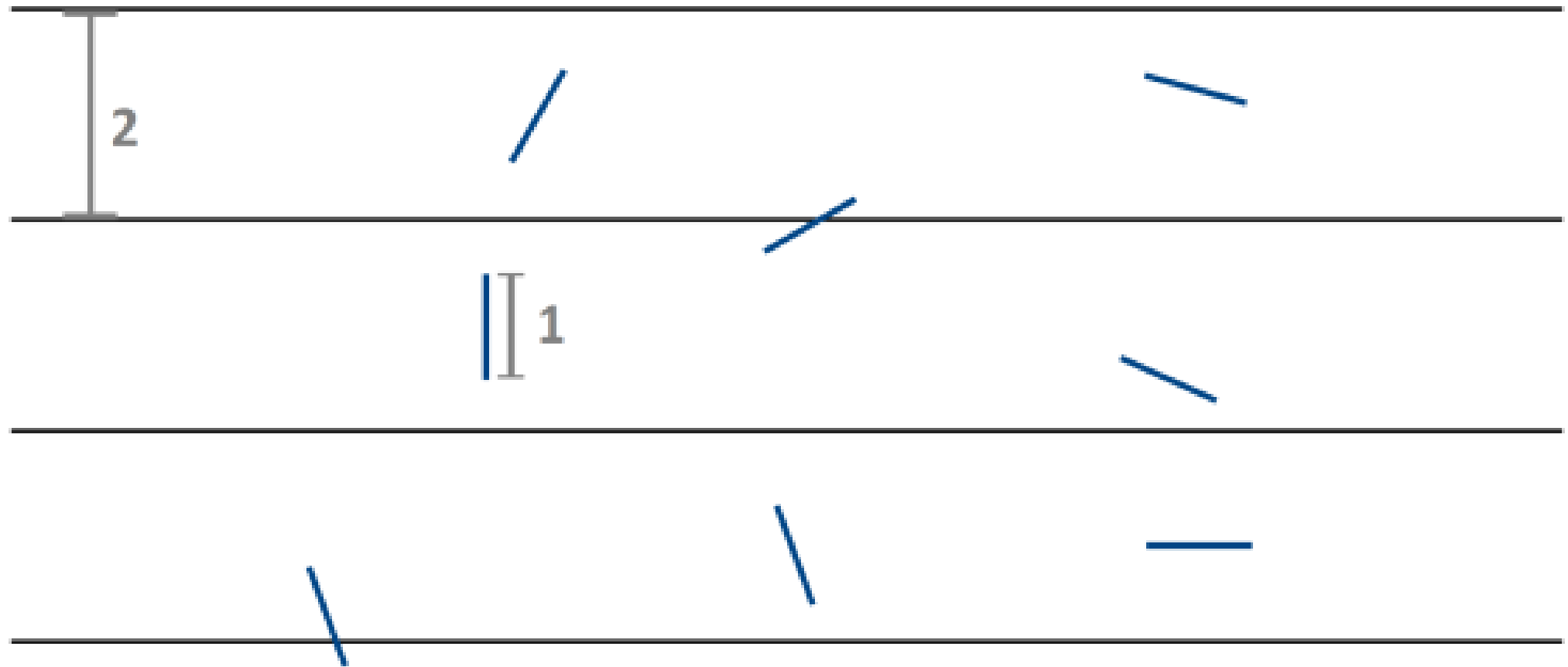
Monte Carlo Simulation

- + A Monte Carlo simulation is a statistical simulation technique that provides **approximate solutions** to problems expressed mathematically.
- + It utilizes a sequence of **random numbers** to perform the simulation

Buffon's Needle Problem

- + A board with parallel horizontal lines
- + Distance between the lines is $2L$
- + Drop randomly N needles each of length L
- + For simplicity, we take $L=1$

Buffon's Needle Problem



Buffon's Needle Problem

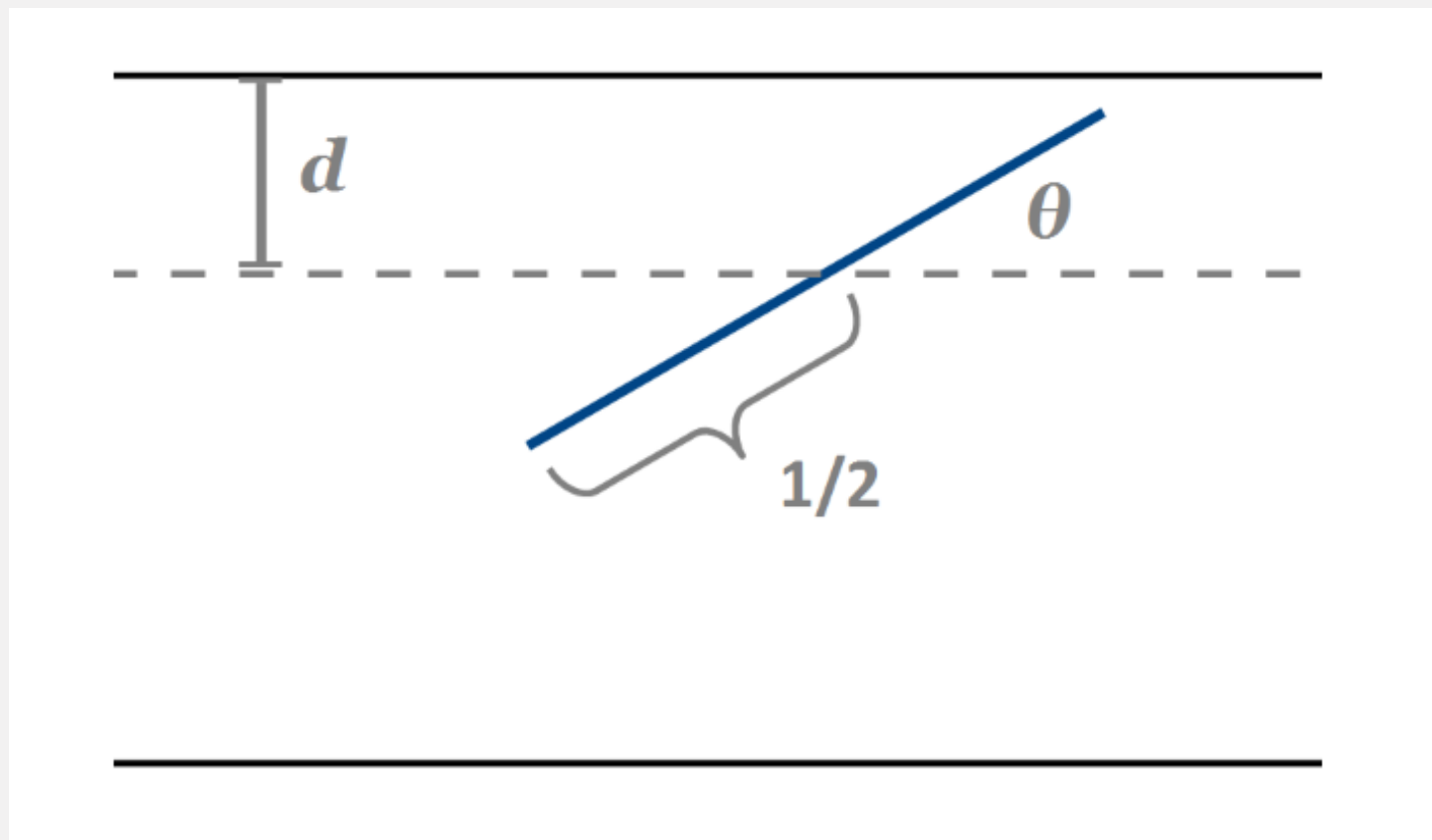
Claim: We can approximate the value of π from here as-

$$\frac{\textit{Number of needles}}{\textit{Number of hits}} \approx \pi$$

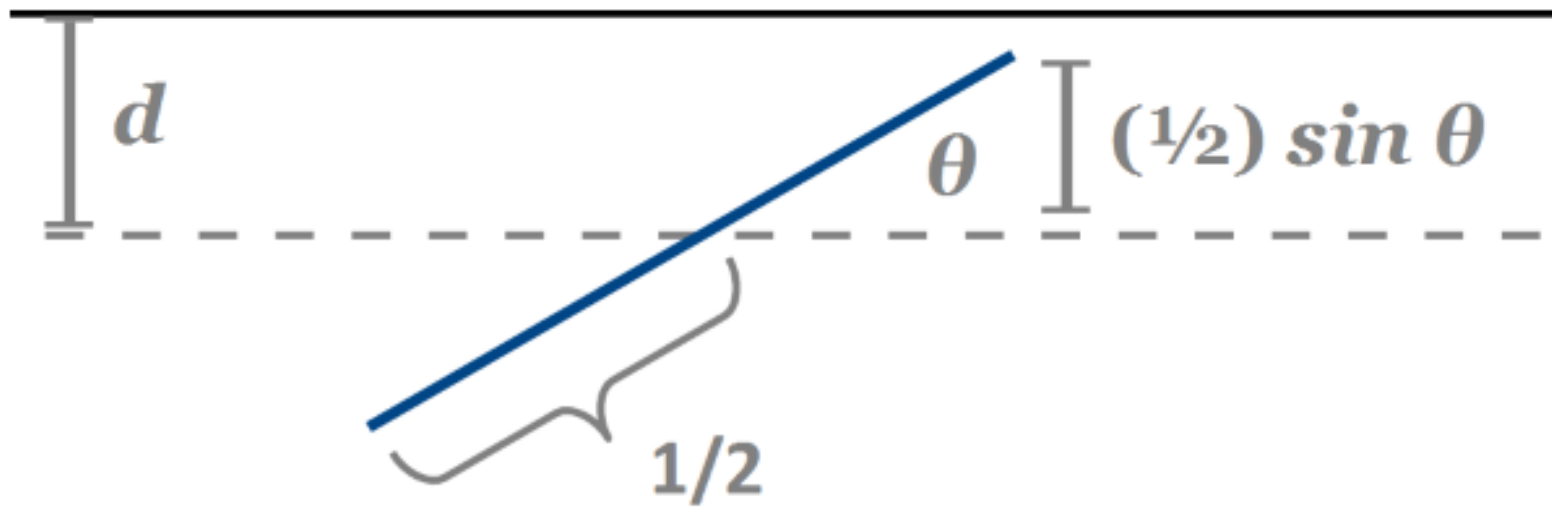
We need to prove,

$$P(\text{Intersecting a line}) = 1/\pi$$

Proof



Proof

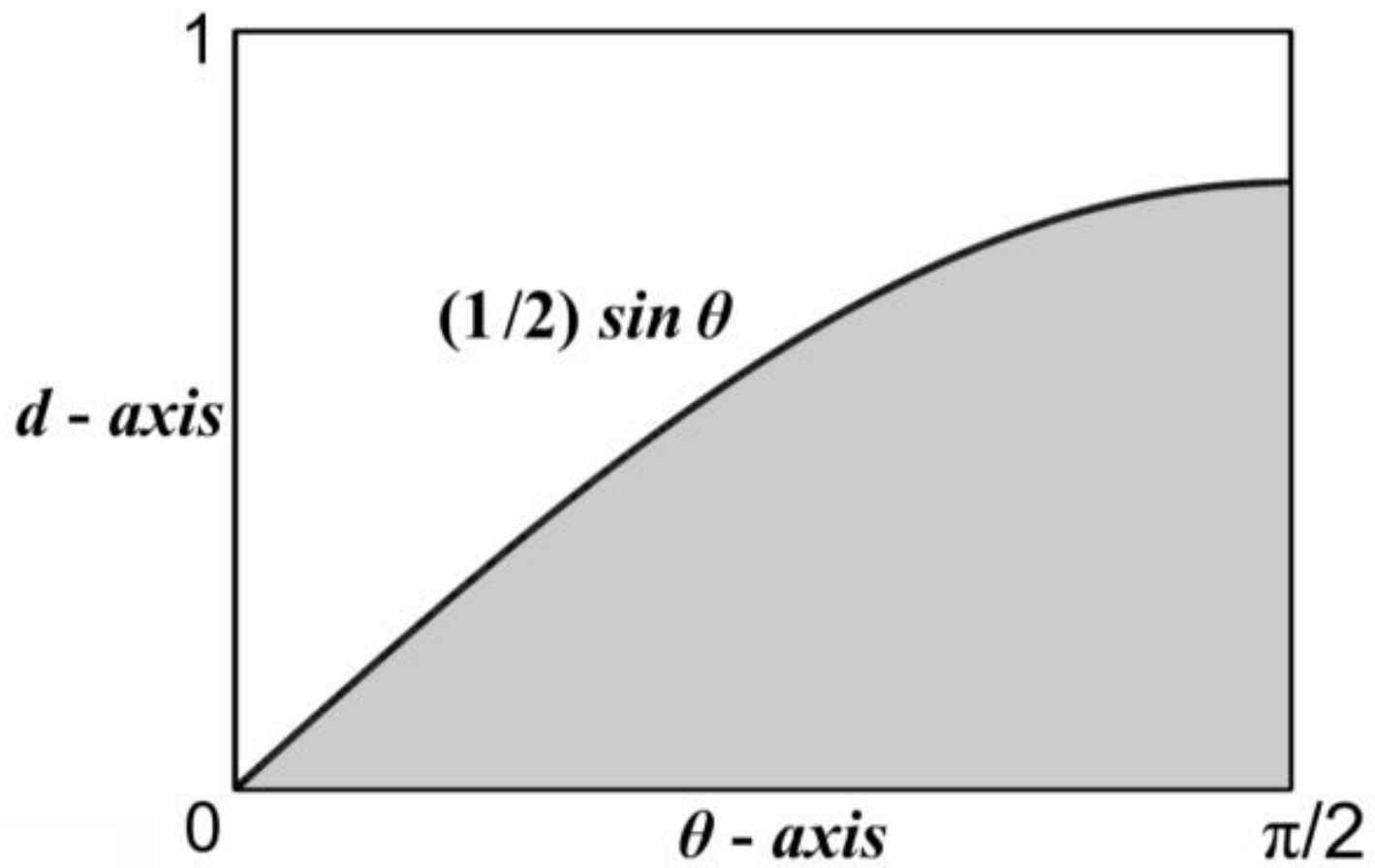


Proof

Condition of intersection

$$d \leq \frac{1}{2} \sin(\theta)$$

Proof



Proof

+Area under the curve

$$\int_0^{\pi/2} (1/2) \sin(\theta) d\theta = \frac{1}{2}$$

+P(Intersection)

$$\frac{1/2}{\pi/2} = \frac{1}{\pi}$$

Programming Task

- + Take input N (number of needles)
- + For each needle, generate random pair (d, θ)
- + Check intersection and count hits
- + Report value of π
- + Plot d vs θ (Scatterplot of samples generated)

Try this...

