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Monte Carlo

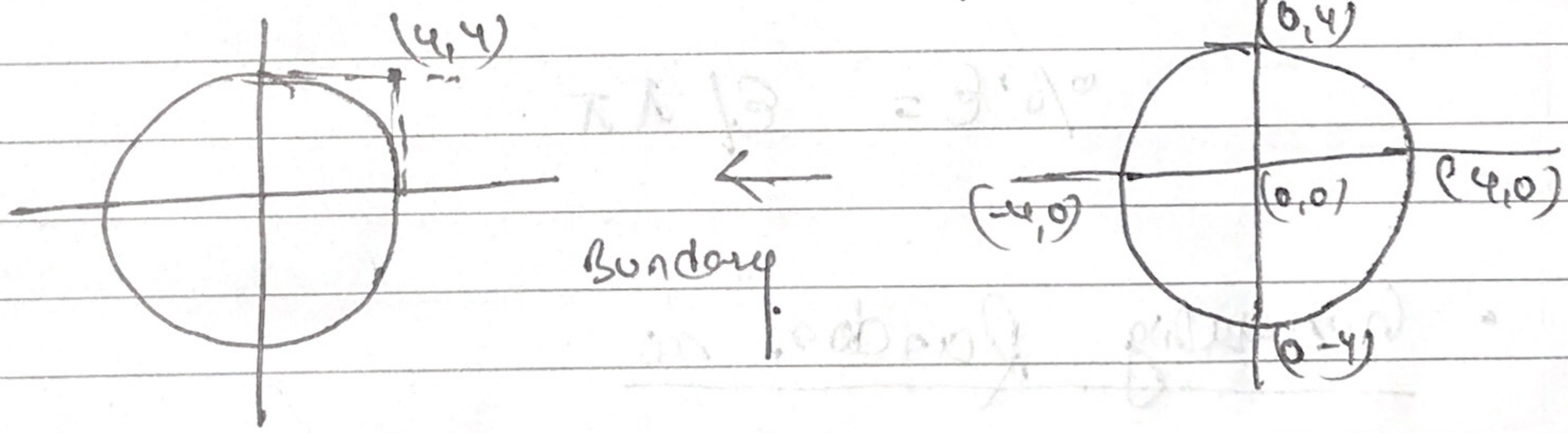
- Static modeling • Random sampling to obtain numerical result

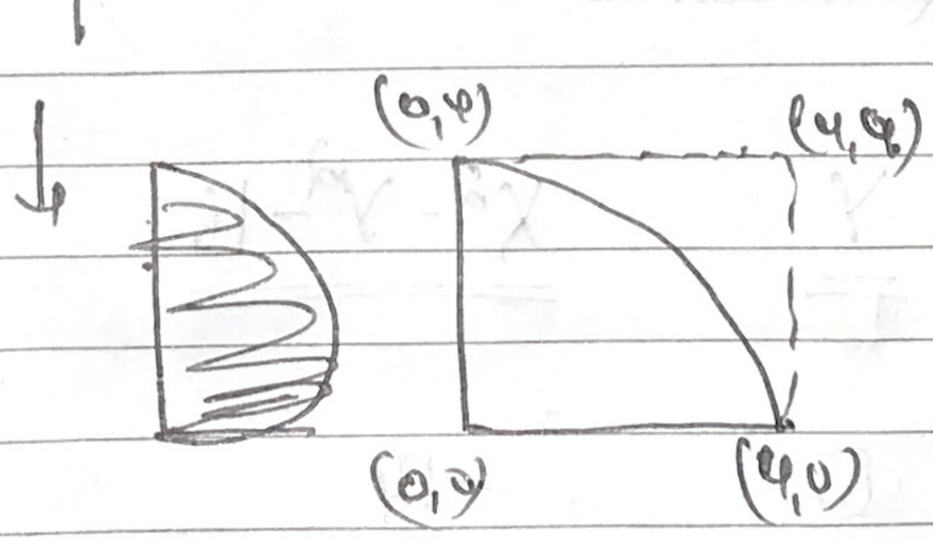
- Finance – • risk assessment • option pricing
- Engineering – • Reliability analysis • optimizing problems
- Environmental Science – • climate models
- Health care – medical decision making

- Find content & area – • π • $\int$

Method to find the value of PI (π)

- Find the area under curve
- Consider circle $x^2+y^2=16$ $\therefore r=16$





Rectangle $x \geq 0$ & $x \leq 4$, $y \geq 0$ & $y \leq 4$.

Circle $x^2+y^2-16 \leq 0$ Inside circle
Else outside circle

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Here
N → Total no of random ~~no~~ no.
n → Total no of R.N inside boundary

$$\therefore \frac{n}{N} = \frac{\text{Area of Rectangle}}{\text{Area of curve.}}$$

$\therefore$ Area of curve = ? $\therefore \pi = ?$

- Analytical value = 3.14 (we know.)
- Error $\varepsilon = |\pi_A - \pi_c|$

$$\% \varepsilon = \varepsilon / \pi \pi$$

- Generating Random no.

SN	X	Y	$X^2 - Y^2 - 16$	Remark
1	0	0	-14	IN.
2	2.180	1.328	-9.4	IN
3	2.07	0.68	-11.22	IN
4	1.148	0.58	-14	IN
5	2.24	3.84	3.5	OUT

$A = x^2 + y^2 - 16$; $x = r\cos\theta(4)$; $y = r\sin\theta(4)$

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6	0.75	0.86	-14.68	IN
7	2.24	1.46	-8.03	IN
8	2.52	0.612	-9.27	IN
9	1.55	1.44	-11.5	IN
10	3.12	3.12	8.04	OUT
11	0.69	3.09	-5.9	IN
12	2.57	3.84	5.44	OUT
13	0.48	2.8	-7.8	IN
14	2.572	0.69	-8.9	IN
15	2.54	2.41	-3.7	IN
16	3.88	0.496	-0.6	IN
17	1.34	0.46	-13.96	IN
18	3.41	1.82	-1.03	IN
19	0.46	2.33	-10.35	IN
20	3.43	1.34	-2.3	IN

from above

Total no of R.N (N) = 20

Tot no of RN inside curve (n_c) = 17

By using Monte Carlo method

$$\frac{N}{T} = \frac{\text{Area of Rect}}{\text{Area of curve}}$$

or Area of curve = $\frac{n_c}{N}$ Area of Rect

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Area of curve $= (a \times b) \times \frac{7}{11}$

$= (4 \times 4) \times \frac{17}{20}$

$= 13.6$ sq. units

~~or $\pi \times 2 = 13.6$~~

~~or $\pi = \frac{13.6}{2}$~~

we have Area of curve $= \pi R^2 / 4$

or $= \frac{\pi}{4} \times R^2 / 4$

or $\pi = \frac{13.6}{R^2} \times 4$

$\pi = \frac{13.6}{(4 \times 4)} \times 4$

$\pi_{c.} = 3.4$

$\therefore \pi_A = 3.14 \quad \pi_C = 3.4$

Error $= |(\pi_A - \pi_e)| = |3.14 - 3.4|$

$= |(-0.26)| = 0.26$

$\% E = \frac{0.26}{3.14} \times 100 = 8.28\%$