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# Monte Carlo Methods

Programers swiss army knife

10<sup>th</sup> McGill Physics Hackathon

# 1 What are they?

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“Using repeated random sampling  
4 to compute results”

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# What are they?

“Using repeated random sampling to compute results”



# What are they?

“Using repeated random sampling to compute results”



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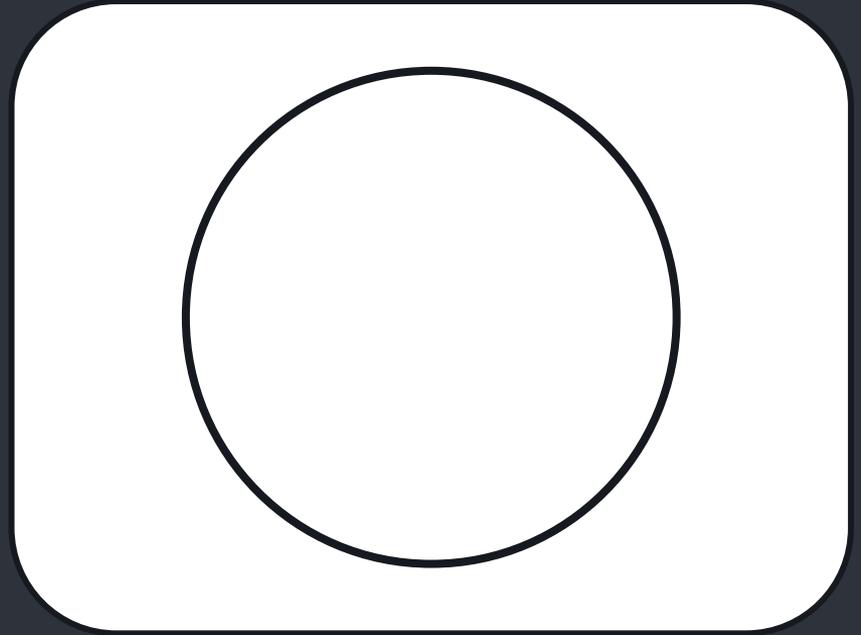
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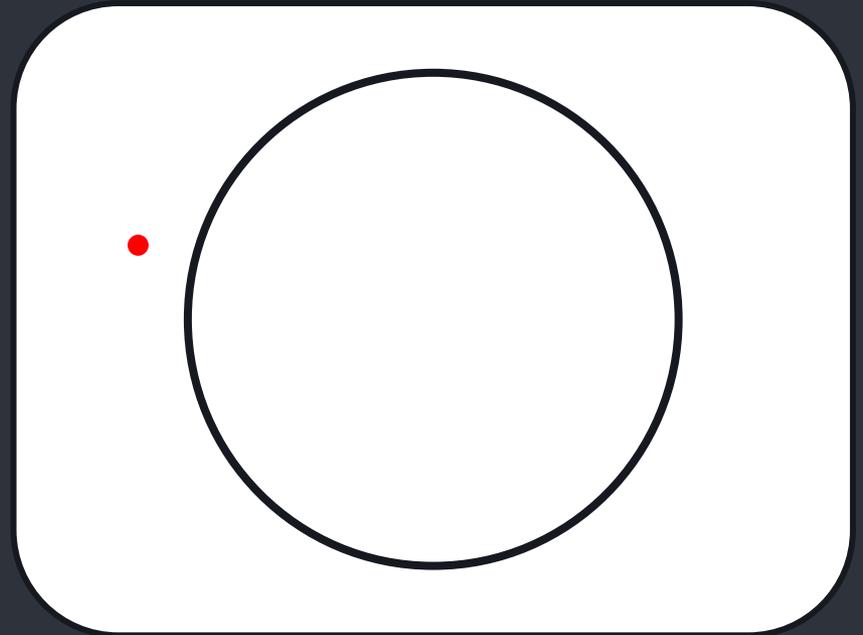
How is this  
useful?

How can we use this to find  $\pi$ ?



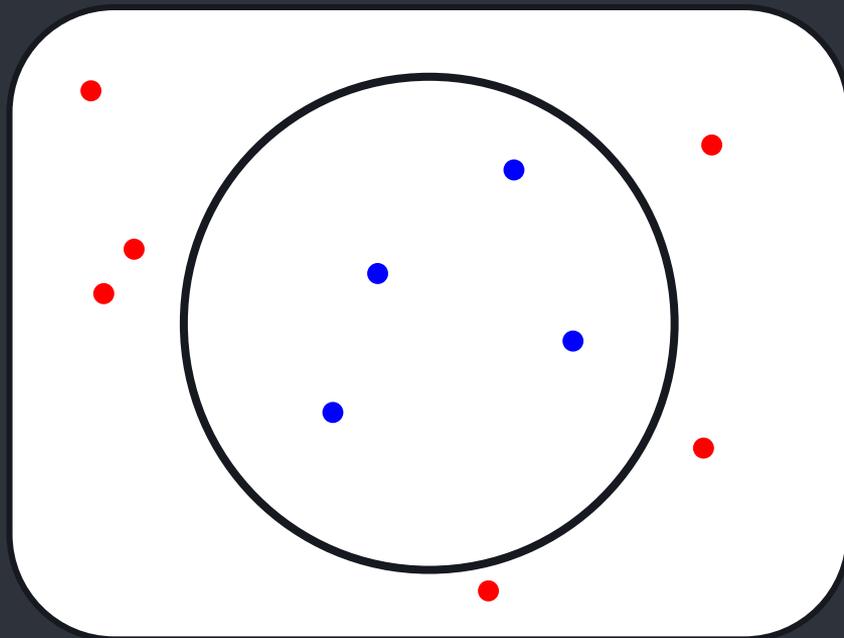
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How can we use this to find  $\pi$ ?



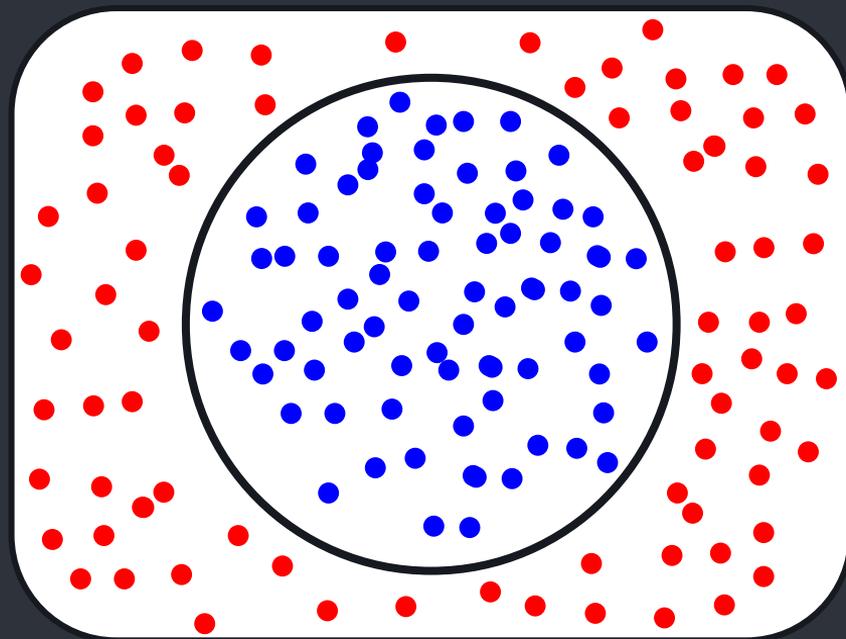
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How can we use this to find  $\pi$ ?



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How can we use this to find  $\pi$ ?



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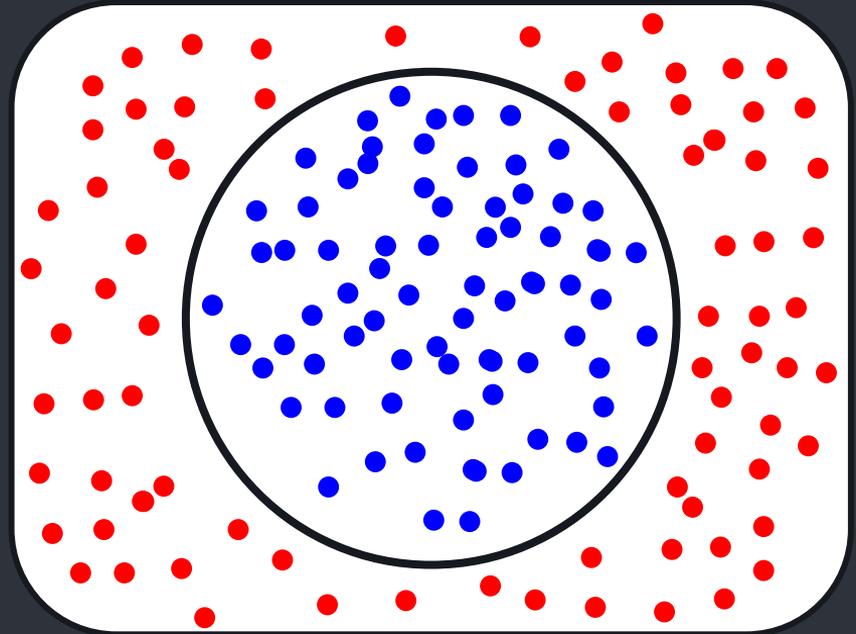
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1 How can we use this to find  $\pi$ ?

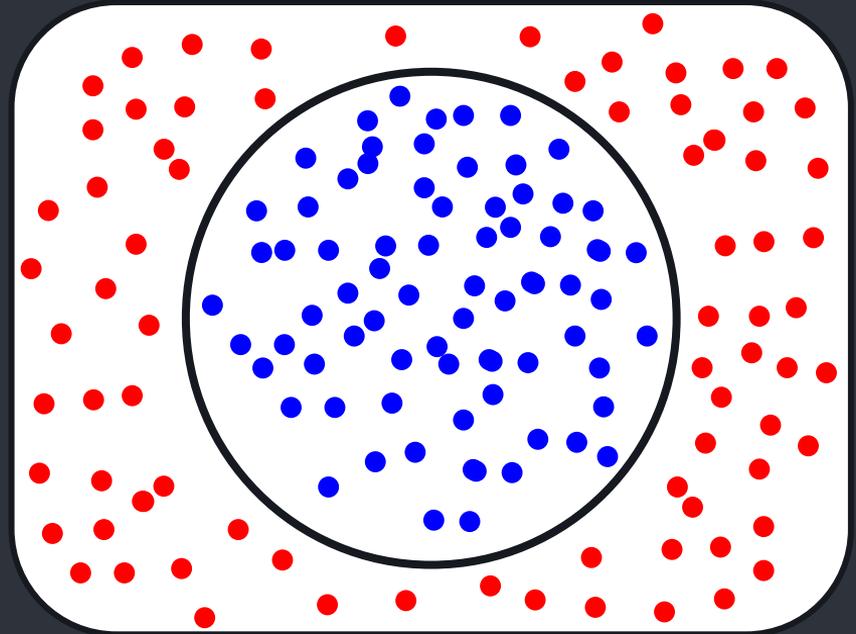
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4  $\frac{A}{A} = \frac{\text{\# of dots in circle}}{\text{\# of dots outside circle}}$



1 How can we use this to find  $\pi$ ?

2  
3  
4  $\frac{A}{A} = \frac{\text{\# of dots in circle}}{\text{\# of dots outside circle}}$

5  
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8  $\frac{\pi r^2}{4r^2} = \frac{355}{452}$

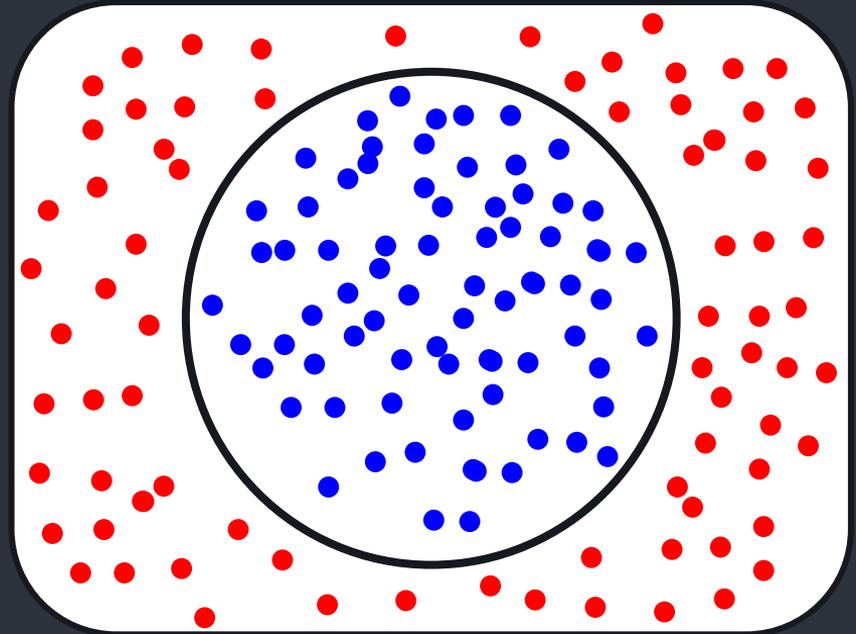


1 How can we use this to find  $\pi$ ?

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4  $\frac{A}{A} = \frac{\text{\# of dots in circle}}{\text{\# of dots outside circle}}$

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8  $\frac{\pi r^2}{4r^2} = \frac{355}{452}$

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12  $\frac{\pi}{4} = \frac{355}{452}$



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Okay that was  
cool, but not  
useful?

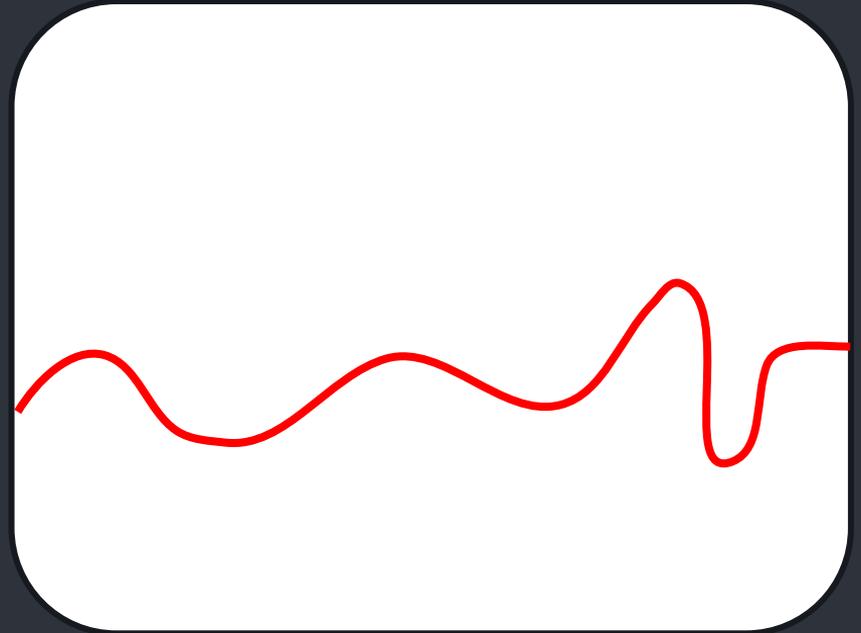
How can we use this to integrate?

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How can we use this to integrate?

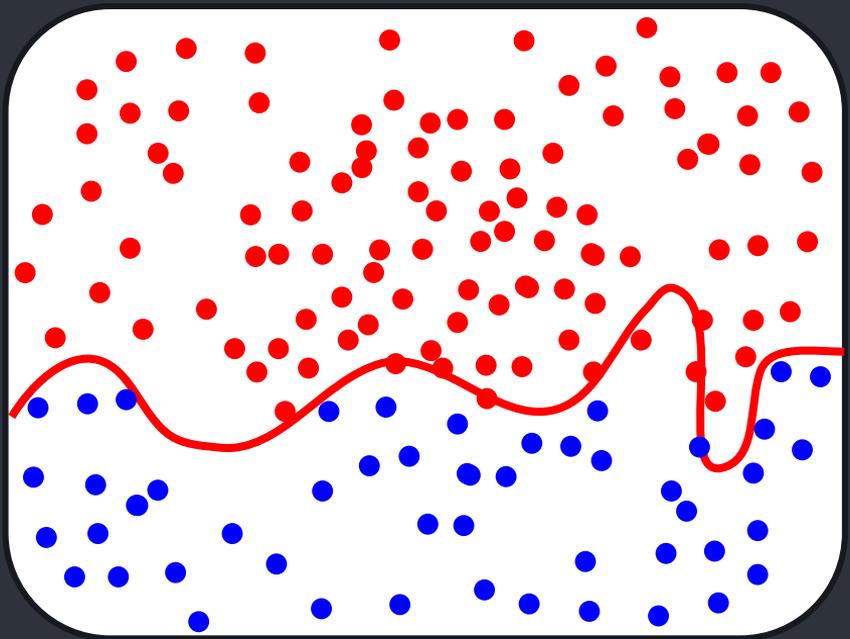
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# How can we use this to integrate?

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$$\frac{A}{A} = \frac{\text{\# of dots under}}{\text{\# of dots over}}$$

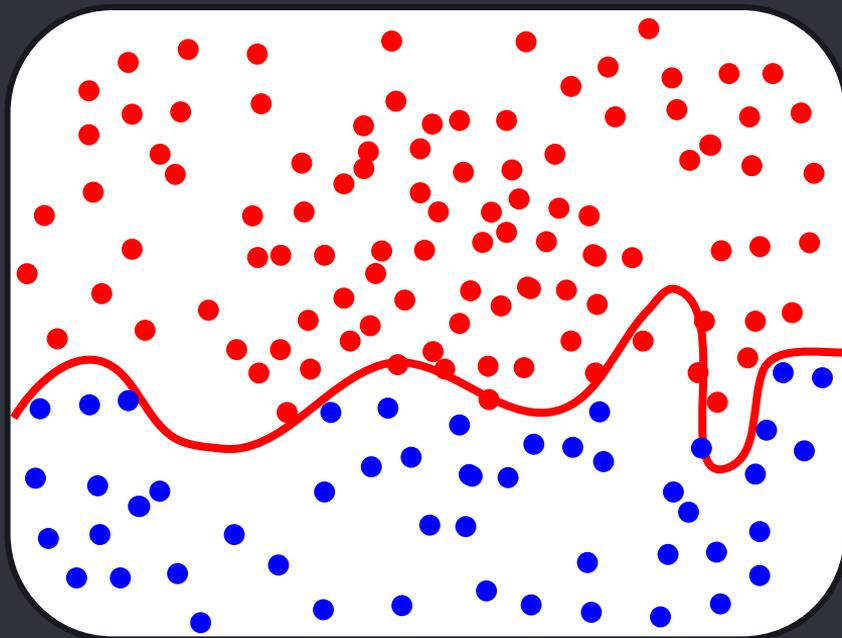


1 How can we use this to integrate?  
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4  $\frac{A}{A} = \frac{\# \text{ of dots under}}{\# \text{ of dots total}}$   
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8  $\frac{\text{Area}}{1} = \frac{352}{500}$   
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12  $\text{Area} = \frac{352}{500}$   
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Alright, any  
other uses?

# Monte Carlo is used in

Geant 4

Used for simulating  
particles

ANSYS

Engineering  
simulations

OpenFOAM

Turbulence  
simulations

OpenMC

Neutron/photon  
simulator

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# A parting exercise

# Exercises

## Pi

Just Calculate Pi

## Integrate

Find some bound function and integrate it

## Populate a circle

Uniformly populate a circle using cylindrical coordinates.