Computational Methods in Physics (PHY 365)

FA23

Dr. Muhammad Kamran

Department of Physics

COMSATS University Islamabad

Lab 25

Value of π

- There are many methods to calculate the value of π using MCM.

Value of π

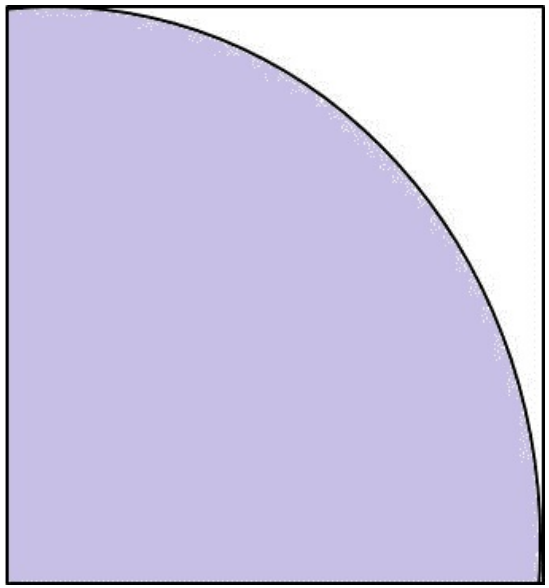
- There are many methods to calculate the value of π using MCM.
- In the method we use here
  - A square is drawn, whose side length is 'r'.

Value of π

- There are many methods to calculate the value of π using MCM.
- In the method we use here
  - A square is drawn, whose side length is 'r'.
  - A (quarter) circle of radius 'r' in inscribed in the square.

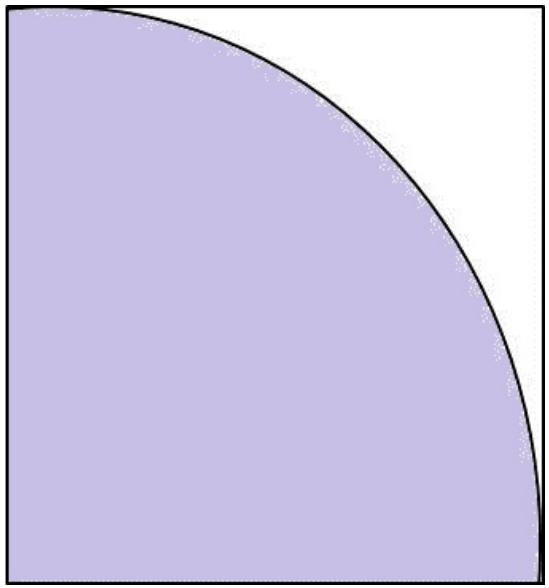
Value of π

- There are many methods to calculate the value of π using MCM.
- In the method we use here
  - A square is drawn, whose side length is 'r'.
  - A (quarter) circle of radius 'r' in inscribed in the square.



Value of π

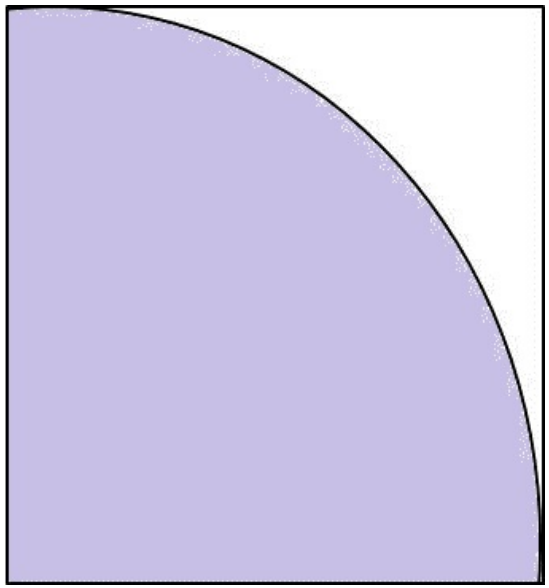
- There are many methods to calculate the value of π using MCM.
- In the method we use here
  - A square is drawn, whose side length is 'r'.
  - A (quarter) circle of radius 'r' in inscribed in the square.



- The ratio of circle's area to the square's area is equal to

Value of π

- There are many methods to calculate the value of π using MCM.
- In the method we use here
  - A square is drawn, whose side length is 'r'.
  - A (quarter) circle of radius 'r' in inscribed in the square.



- The ratio of circle's area to the square's area is equal to $\pi/4$.

Value of π

- Problem: Calculate the value of π using MCM.

Value of π

- Problem: Calculate the value of π using MCM.

- Generating random numbers

```
Total_no_pnts = input('Please give the number of random points: ');
disp(' ')
x = rand (Total_no_pnts,1);
y = rand (Total_no_pnts,1);
```

Value of π

- Problem: Calculate the value of π using MCM.

- Generating random numbers

```
Total_no_pnts = input('Please give the number of random points: ');
disp(' ')
x = rand (Total_no_pnts,1);
y = rand (Total_no_pnts,1);
```

- Radius of the circle

```
r = sqrt(x .^2 + y .^2);
```

Value of π

- Separating the points inside the circle of unit radius from the outside ones

```
points_inside_circle = find (r <= 1);

points_outside_circle = find (r > 1);

inside_points_x = x (points_inside_circle);

inside_points_y = y (points_inside_circle);

outside_points_x = x (points_outside_circle);

outside_points_y = y(points_outside_circle);
```

Value of π

- Separating the points inside the circle of unit radius from the outside ones

```
points_inside_circle = find (r <= 1);
points_outside_circle = find (r > 1);
inside_points_x = x (points_inside_circle);
inside_points_y = y (points_inside_circle);
outside_points_x = x (points_outside_circle);
outside_points_y = y(points_outside_circle);
```

- No. of points inside the circle

```
no_inside = length(points_inside_circle);
```

Value of π

- The value of pi

```
value_of_pi = 4 * no_inside / Total_no_pnts;
disp([ 'The calculated value of pi = ', num2str
(value_of_pi) ])
```

Value of π

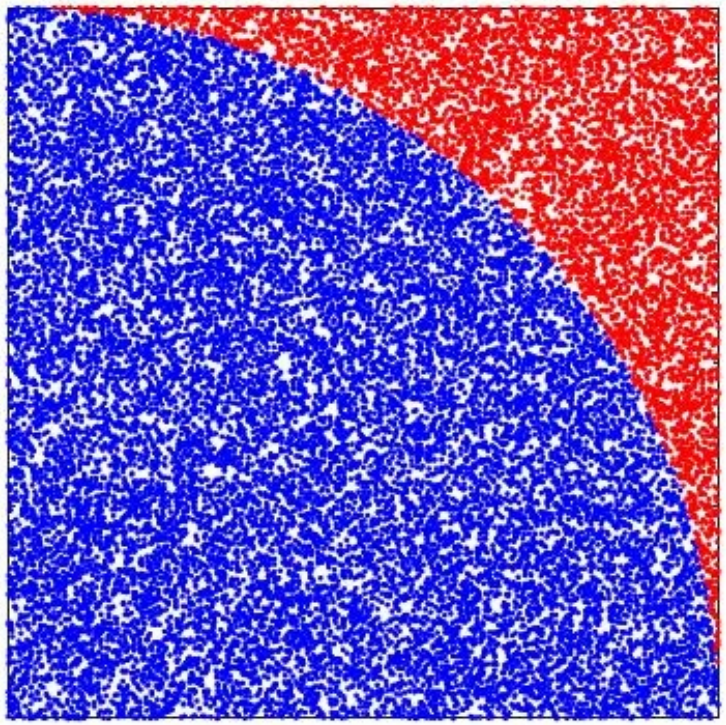
- The value of pi

```
value_of_pi = 4 * no_inside / Total_no_pnts;
disp([ 'The calculated value of pi = ', num2str
(value_of_pi) ])
```

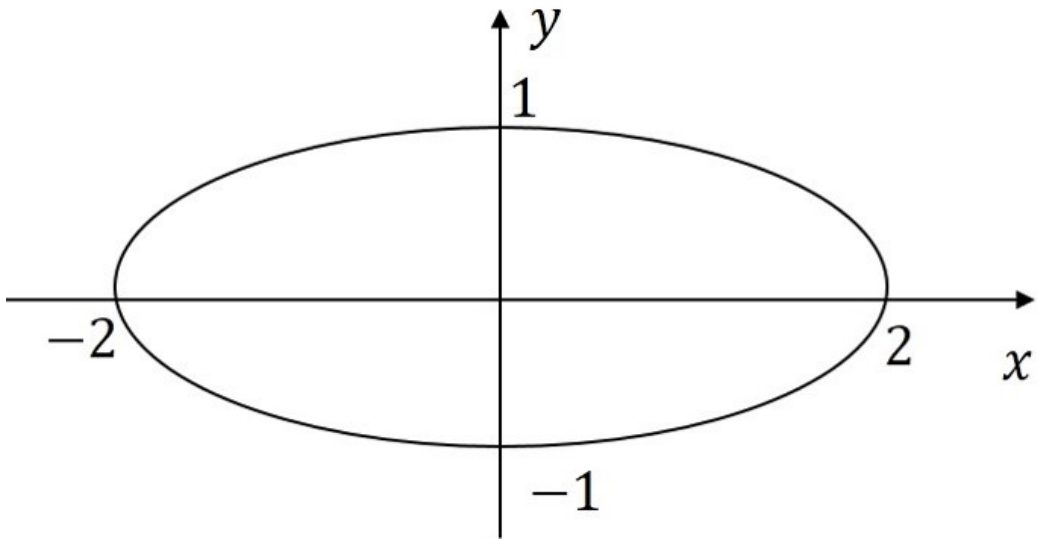
- Plotting

```
plot(inside_points_x, inside_points_y, 'b.')
hold on
plot(outside_points_x, outside_points_y, 'r.')
hold off
axis square
```

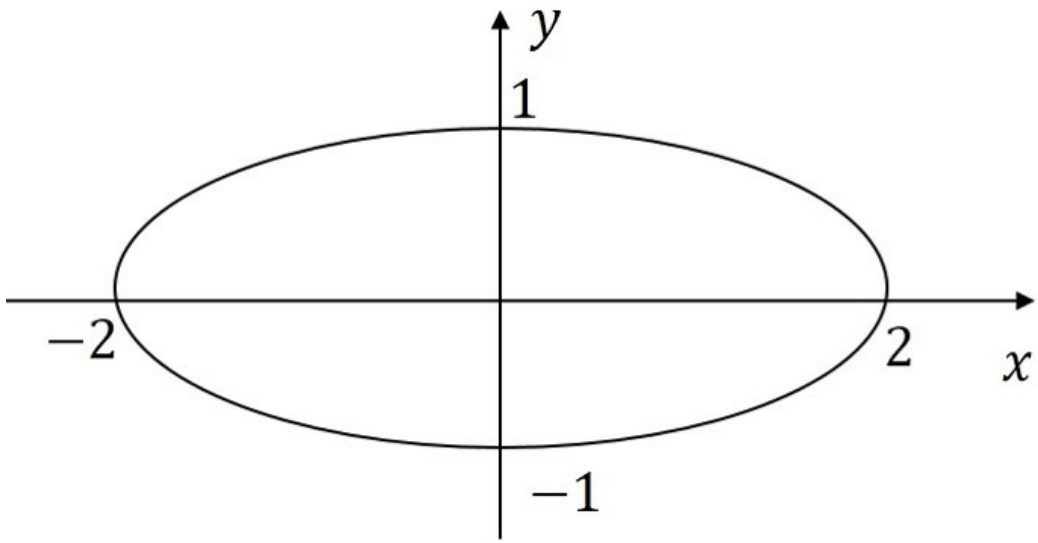
Value of π



- Problem: Generate random points uniformly distributed inside the ellipse $x^2 + 4y^2 = 4$.



- Problem: Generate random points uniformly distributed inside the ellipse $x^2 + 4y^2 = 4$.



- Hints
  - Generate random numbers in the ranges $-2 \le x \le 2, \quad -1 \le y \le 1$.
  - Use the rejection technique.

References

- https://en.wikipedia.org/wiki/Monte_Carlo_method
- https://www.youtube.com/watch?v=ADA82D0j9HY