



FTDS // Calculus // Integral

Hacktiv8 DS
Curriculum
Team

Phase 0
Learning
Materials

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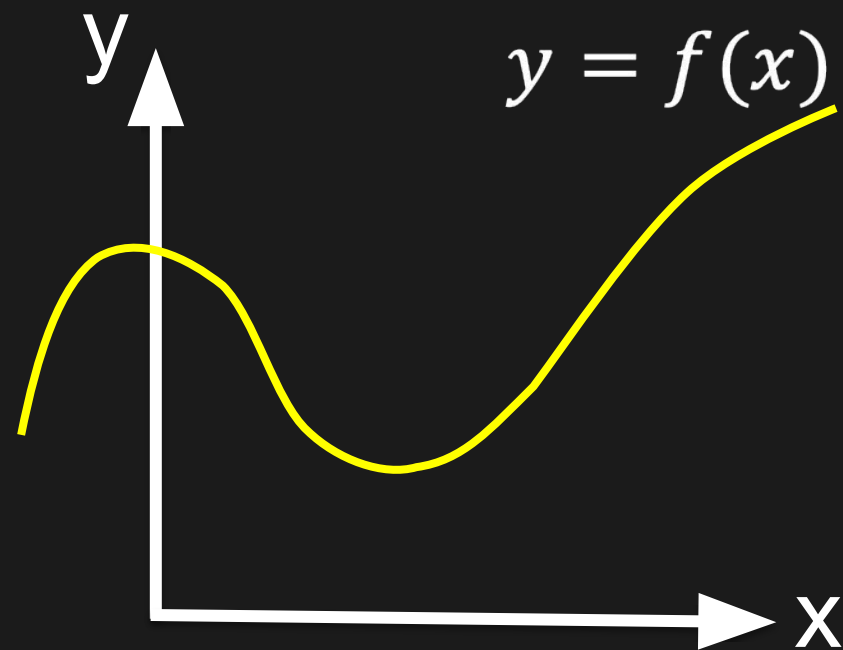
- **Basic understanding of integral**
- **Able to calculate the integral of a function**
- **Able to implement integral calculation on Python**

Integral is an
alternative
way to
calculate area

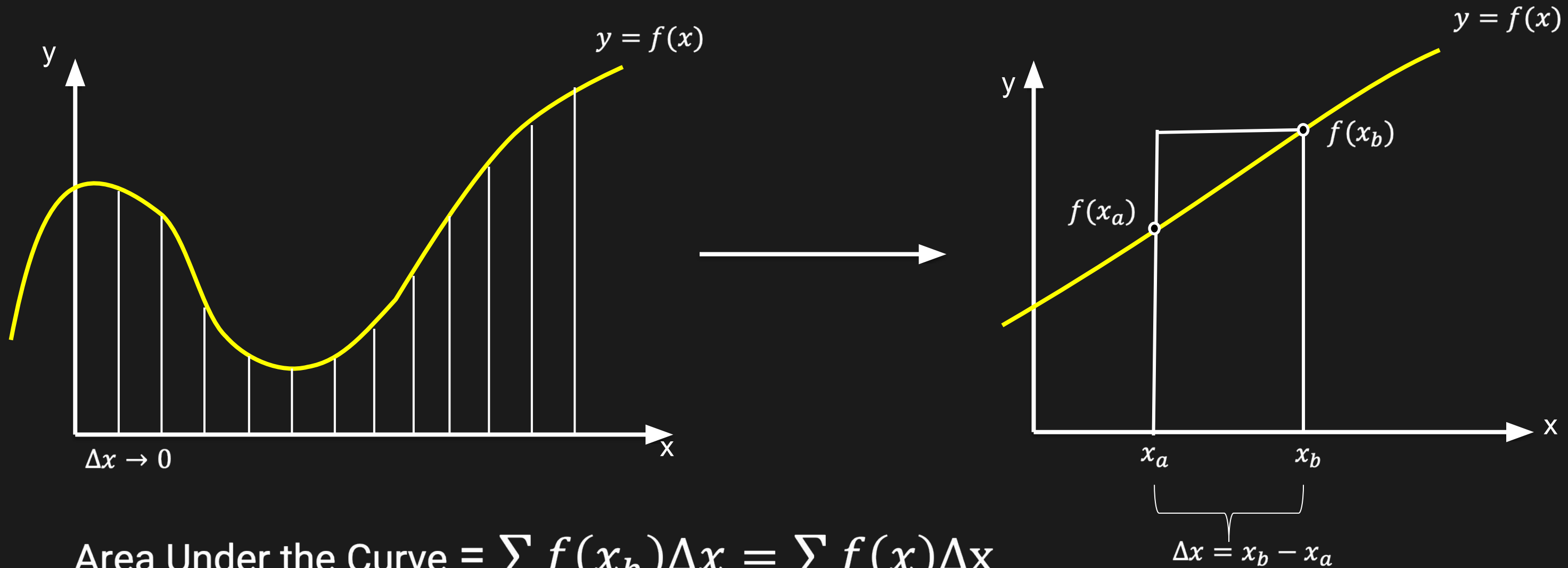


How much the area of this rectangle?

It is very easy to calculate the area of the rectangle. Just multiply the length and width.



But, how to calculate
area under this curve?



$$\text{Area Under the Curve} = \sum f(x_b)\Delta x = \sum f(x)\Delta x$$

To get more accurate
result, so $\Delta x \rightarrow 0$

$$\text{Area} = \int f(x)dx$$

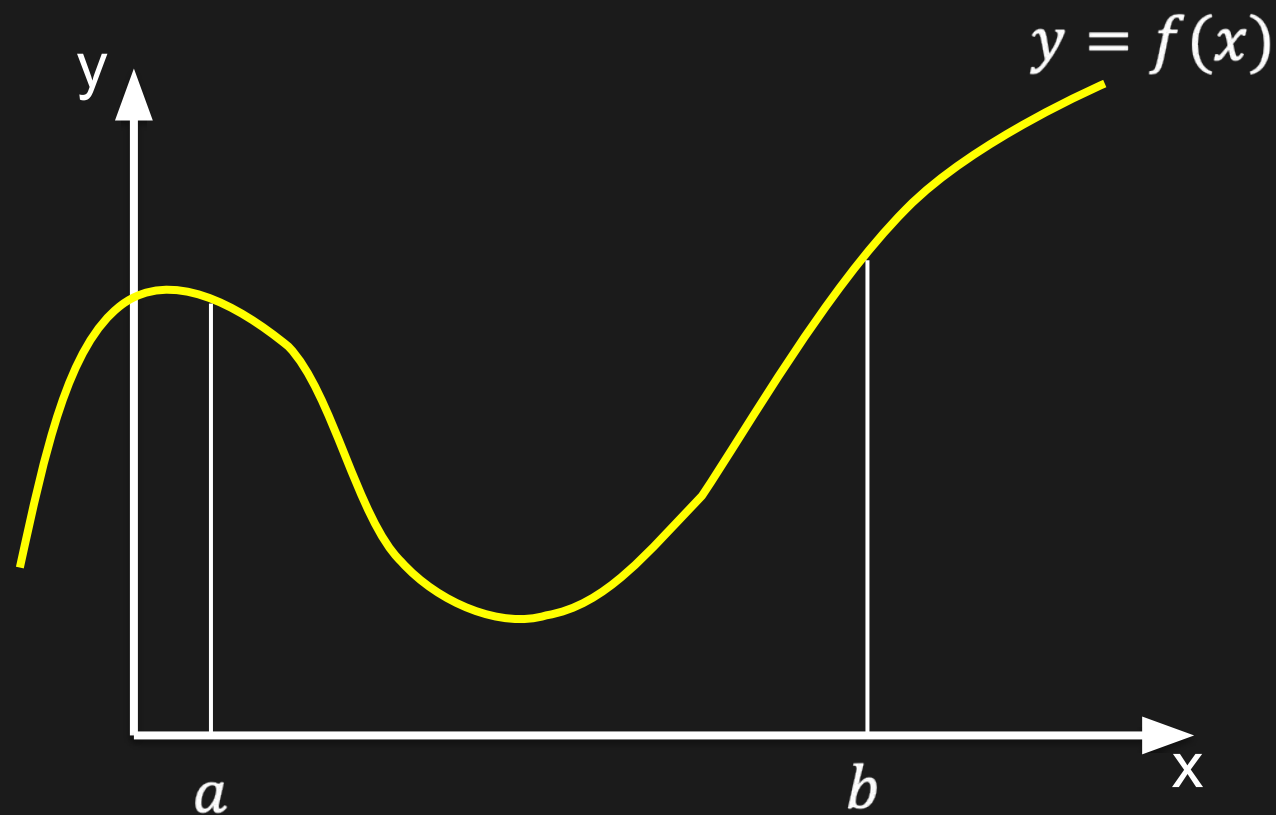
The formula of indefinite integral of a function $f(x)$:

$$\int f(x) dx = \frac{1}{n+1} x^{n+1} + C$$

Examples:

- $f(x) = x$
- $f(x) = 2x^2 + 1$
- $f(x) = 3x^2 + 2x - 4$

How do we measure the area under the curve using Integral?



$$\int_a^b f(x) dx = \frac{1}{n+1} x^{n+1} \Big|_a^b$$
$$= \frac{1}{n+1} b^{n+1} - \frac{1}{n+1} a^{n+1}$$

Integral on Code // Symbolic

$$f(x) = 2x^2 + 4x - 1$$

This method the input or the output as symbols even also the function. The 'C' factor is not included in the sympy integrate output.

```
import sympy as sy
```

```
x = sy.Symbol('x',real=True)  
f = 2*x**2+4*x-1
```

```
sy.integrate(f)
```

Output:

$$\frac{2}{3}x^3 + 2x - x$$

Integral on Code // Numerical - Function

$$f(x) = 2x^3 - 3x^2 + 3x - 4$$
$$\int_2^5 f(x) dx$$

There are two ways to perform integration using Scipy. The first one is that you have to define the function before doing the integration. Since it's a numerical method, you have to define the integration limit.

```
from scipy import integrate
```

```
def f(x):  
    return 2*x**2+4*x-1
```

```
A = integrate.quad(f,2,5)  
print(A)
```

Output:
(207.0, 2.298161660974074e-12)

Integral on Code // Numerical – Data Points

$$f(x) = 2x^3 - 3x^2 + 3x - 4$$
$$\int_2^5 f(x) dx$$

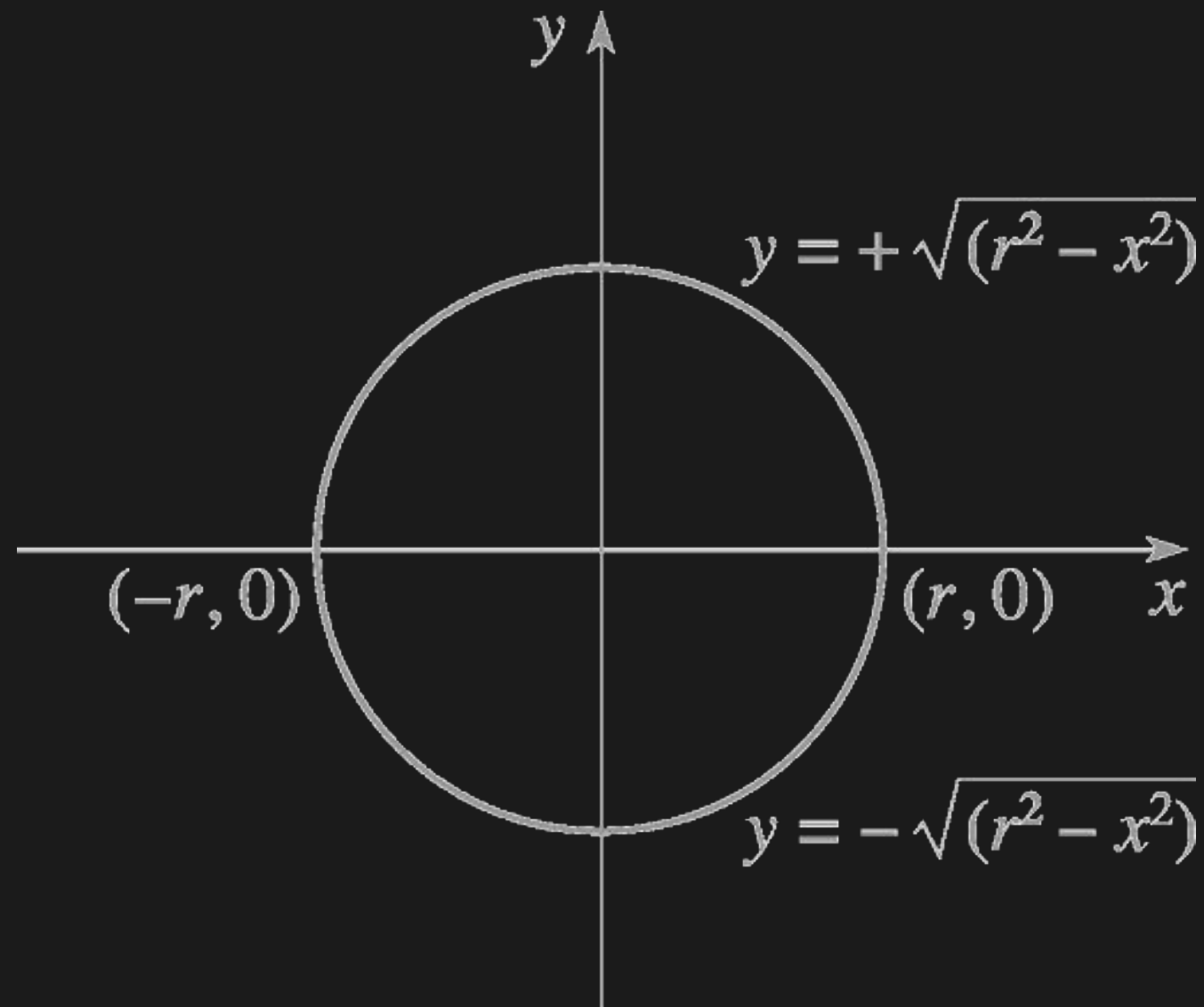
The second one is that you have give an input as data points. Since it's a numerical method, you have to define the integration limit.

```
from scipy import integrate  
Import numpy as np
```

```
def f(x):  
    return 2*x**2+4*x-1
```

```
x = np.linspace(2,5)  
y = f(x)  
A = integrate.trapezoid(y,x)  
print(A)
```

Output:
(207.03373594335693)



$$R = 30, L = \pi R^2 = 2826$$

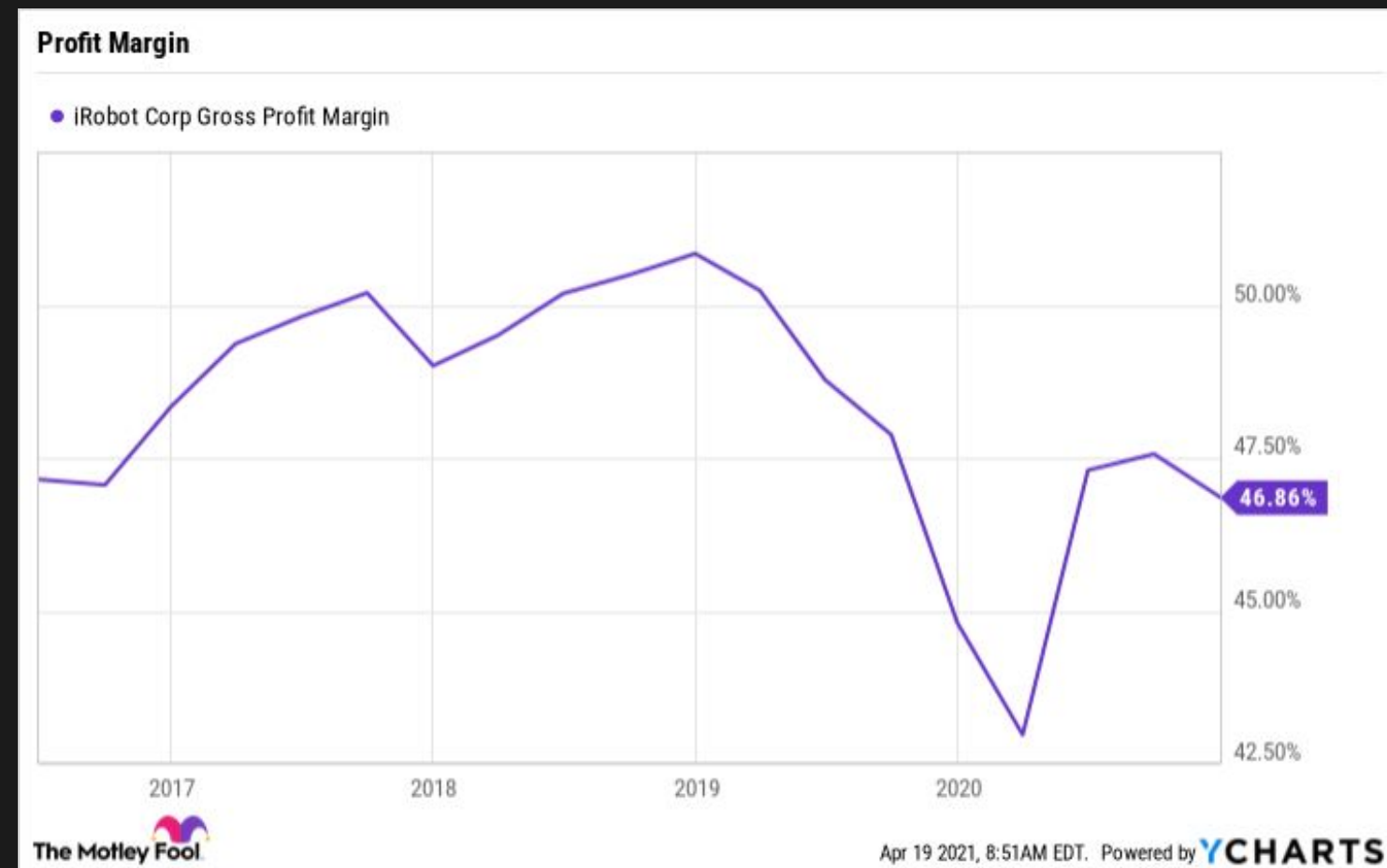
```
from scipy.integrate import trapezoid
import numpy as np
```

```
R=30
x=np.linspace(-R,R)
```

```
upper = np.sqrt(R**2 - x**2)
lower = -upper
```

```
area = trapezoid(upper,x) - trapezoid(lower,x)
print(area)
```

Output:
2818.716702242422



Let we have csv data contains two columns which are year and profit.

We can measure the total of y value for a certain range of x using integral. Suppose we want to measure total profit from 2017 to 2020.

```
from scipy import integrate
import pandas as pd
```

```
data=pd.read_csv('profit_data.csv')
dat=data[(data['year']>=2017) & (data['year']<=2020)]
```

```
x = dat['year']
y = dat['profit']
profit_total = integrate.trapezoid(y,x)
```