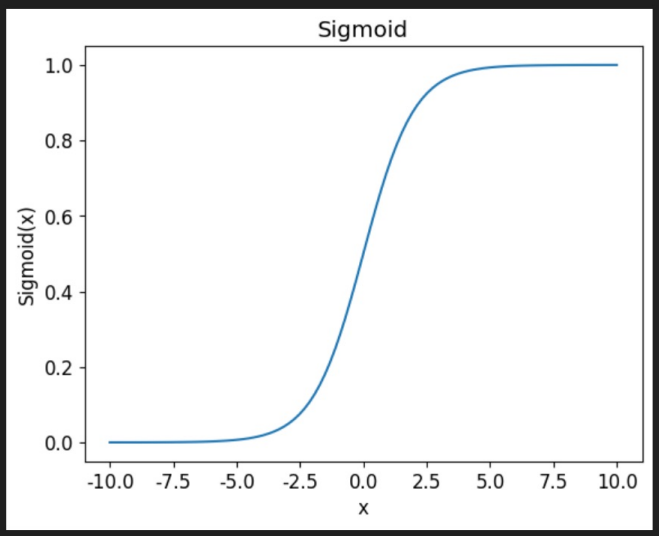
#1. sigmoid 함수를 계산 그래프로 그려보기

$x \xrightarrow{y=-x} -x \xrightarrow{y=e^x} \exp(-x) \xrightarrow{y=1+x} 1+\exp(-x) \xrightarrow{y=\frac{1}{x}} \frac{1}{1+\exp(-x)}$

```python
#1. sigmoid 함수를 계산 그래프로 그려보기
import numpy as np
import matplotlib.pyplot as plt

def sigmoid(x):
    return 1 / (1+np.exp(-x))
# 예시 그림과 같이 x값의 범위 설정
x=np.linspace(-10,10,100)
y=sigmoid(x)
plt.plot(x,y)
plt.title("Sigmoid")
plt.xlabel("x")
plt.ylabel("Sigmoid(x)")
plt.show()
```

✓ 0.0s



#2. $y = \frac{1}{1+e^{-x}}$

연쇄법칙 활용해 $\frac{dy}{dx}$ 구하고, y에 대한 함수로 return!

[1] 연쇄법칙 사용

① $u = -x$ $\quad \frac{du}{dx} = -1$

② $v = e^u = e^{-x}$ $\quad \frac{dv}{du} = e^u$

③ $w = 1+v = 1+e^{-x}$ $\quad \frac{dw}{dv} = 1$

④ $y = \frac{1}{w} = \frac{1}{1+e^{-x}}$ $\quad \frac{dy}{dw} = -\frac{1}{w^2}$

$$\frac{dy}{dx} = \frac{dy}{dw}\cdot\frac{dw}{dv}\cdot\frac{dv}{du}\cdot\frac{du}{dx} = -1\cdot e^u\cdot 1\cdot\left(-\frac{1}{w^2}\right) = \frac{e^u}{w^2} = \frac{e^{-x}}{(1+e^{-x})^2} = \frac{1}{1+e^{-x}}\cdot\frac{e^{-x}}{1+e^{-x}}$$

by chain rule

$$= y\cdot(1-y)$$

[2] 미분 공식 사용

$$y = \frac{1}{1+e^{-x}}$$

$$y' = \frac{+e^{-x}}{(1+e^{-x})^2}$$

$$= \frac{1}{1+e^{-x}}\cdot\frac{e^{-x}}{1+e^{-x}}$$

$$= y\cdot(1-y)$$

$y = \frac{1}{f(x)} \rightarrow y' = -\frac{f'(x)}{(f(x))^2}$ ($g(x) = f(x)$)

pf) $y' = \lim_{h\to 0}\frac{g(x+h)-g(x)}{h}$

$$= \lim_{h\to 0}\frac{\frac{1}{f(x+h)}-\frac{1}{f(x)}}{h}$$

$$= \lim_{h\to 0}\frac{\frac{f(x)-f(x+h)}{f(x+h)f(x)}}{h}$$

$$= \lim_{h\to 0} -\frac{f(x+h)-f(x)}{h}\times\frac{1}{f(x+h)f(x)}$$

$$= -f'(x)\times\frac{1}{(f(x))^2}$$

$$= \frac{-f'(x)}{(f(x))^2}$$