1. $\neg a \vee b \vee \neg c$

Only when $a=1,\ b=0,\ c=1$, Output = 0

else, Output = 1

Perceptron: $\hat{y} = f(w_1 a + w_2 b + w_3 c + b)$

$f(\ )$: activation function

w_1, w_2, w_3: weights

b: bias term

use step function for $f(x)$,

$$f(x) = \begin{cases} 1, & x \geq 0 \\ 0, & x < 0 \end{cases}$$

when $a=1,\ b=0,\ c=1$, Output = 0

$$\hat{y} = f(w_1 + w_3 + b) = 0$$

$$w_1 + w_3 + b < 0 \quad ①$$

$a=1,\ b=1,\ c=1$	$w_1 + w_2 + w_3 + b \geq 0$	②
$a=1,\ b=1,\ c=0$	$w_1 + w_2 + b \geq 0$	③
$a=1,\ b=0,\ c=0$	$w_1 + b \geq 0$	④
$a=0,\ b=1,\ c=1$	$w_2 + w_3 + b \geq 0$	⑤
$a=0,\ b=1,\ c=0$	$w_2 + b \geq 0$	⑥
$a=0,\ b=0,\ c=1$	$w_3 + b \geq 0$	⑦
$a=0,\ b=0,\ c=0$	$b \geq 0$	⑧

Combine ①~⑧,

suppose $b=1 \rightarrow ⑧$

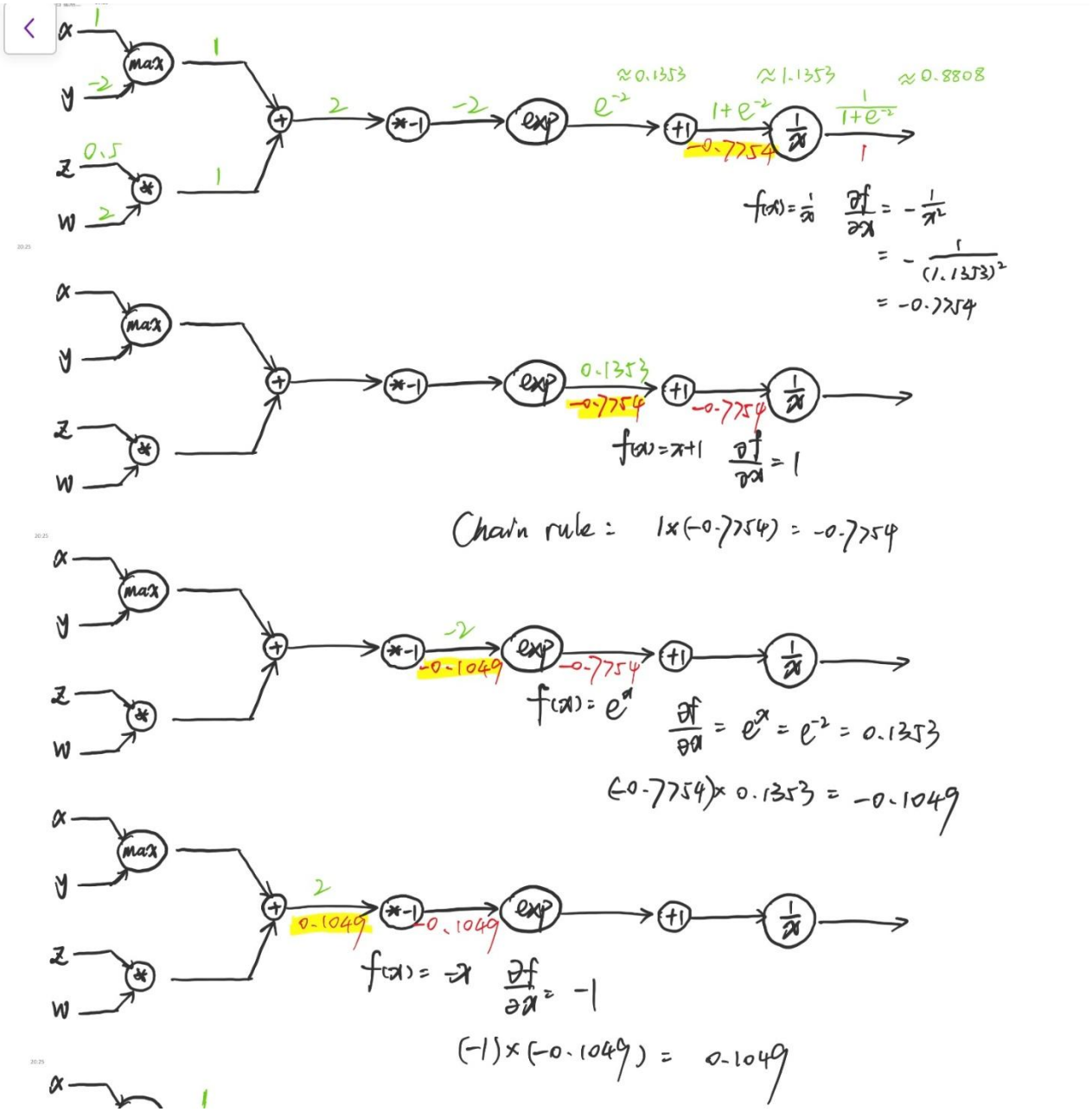
$w_1 = -1,\ w_3 = -1 \rightarrow ①$

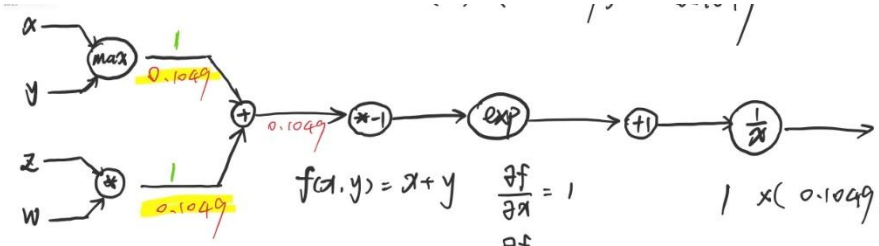
$w_2 = 1 \rightarrow ②$

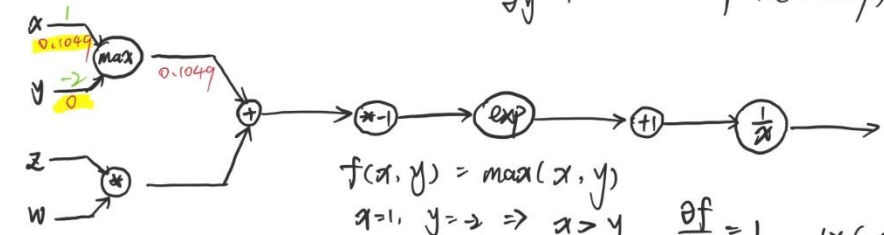
all requirements fullfilled.

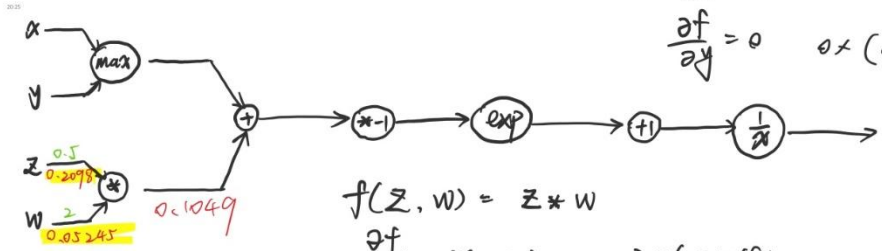
To sum up, $\hat{y} = f(-a + b - c + 1)$

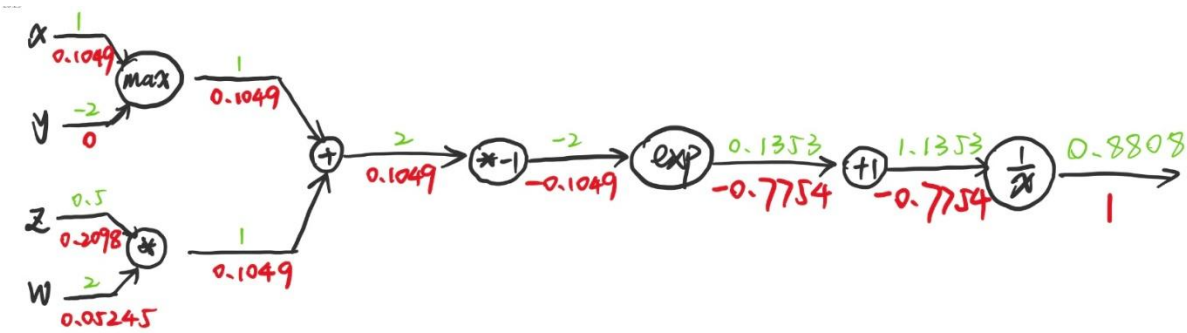
$$f(x) = \begin{cases} 1, & x \geq 0 \\ 0, & x < 0 \end{cases}$$


x
y
z
w
max
*
+
*-1
exp
+1
1/x
1
-2
0.5
2
≈0.1353
≈1.1353
≈0.8808
e^-2
1+e^-2
1/(1+e^-2)
-0.7754
f(x)=1/x ∂f/∂x = -1/x^2
= -1/(1.1353)^2
= -0.7754
0.1353
f(x)=x+1 ∂f/∂x = 1
Chain rule: 1×(-0.7754) = -0.7754
-0.1049
f(x)=e^x
∂f/∂x = e^x = e^-2 = 0.1353
(-0.7754)×0.1353 = -0.1049
f(x)=-x ∂f/∂x = -1
(-1)×(-0.1049) = 0.1049


x
y
z
w
max
*
+
*-1
exp
+1
1/x
1
0.1049
0.1049
0.1049
f(x, y) = x + y
∂f/∂x = 1
∂f/∂y = 1
1 x (0.1049) = 0.1049
1 x (0.1049) = 0.1049


x
y
z
w
1
0.1049
-2
0
max
*
+
*-1
exp
+1
1/x
0.1049
f(x, y) = max(x, y)
x=1, y=-2 ⇒ x > y
∂f/∂x = 1
1 x (0.1049) = 0.1049
∂f/∂y = 0
0 x (0.1049) = 0


x
y
z
w
max
*
+
*-1
exp
+1
1/x
0.5
0.2098
2
0.05245
0.1049
f(z, w) = z * w
∂f/∂z = w = 2
2 x (0.1049) = 0.2098
∂f/∂w = z = 0.5
0.5 x (0.1049) = 0.05245


x
y
z
w
1
0.1049
-2
0
0.5
0.2098
2
0.05245
max
*
+
*-1
exp
+1
1/x
1
0.1049
1
0.1049
2
0.1049
-2
-0.1049
0.1353
-0.7754
1.1353
-0.7754
0.8808
1