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단순식과 경사해석

1. f(x,y) = xy ¶

In [17]:

```
x = 2; y = 4

f = x * y # f becomes 8

dfdx = y # dfdx becomes 4
dfdy = x # dfdy becomes 2

print("f =",f)
print("dfdx =",dfdx)
print("dfdy =",dfdy)
```

```
f = 8
dfdx = 4
dfdy = 2
```

2. f(x,y) = x + y

In [18]:

```
f = x + y # f becomes 6

dfdx = 1 # dfdx becomes 1
dfdy = 1 # dfdy becomes 1

print("f =",f)
print("dfdx =",dfdx)
print("dfdy =",dfdy)
```

```
f = 6
dfdx = 1
dfdy = 1
```

3. f(x,y) = max(x,y)

In [19]:

```
f = max(x,y)

# x값이 y보다 크다면 결과는 y값에 영향을 받지 않는다.
if(x >= y):
    dfdx = 1
    dfdy = 0
# y값이 x보다 크다면 결과는 x값에 영향을 받지 않는다.
elif (x <= y):
    dfdy = 1
    dfdx = 0

print("f =",f)
print("dfdx =",dfdx)
print("dfdy =",dfdy)
```

```
f = 4
dfdx = 0
dfdy = 1
```

복합식의 연쇄법칙

4. f(x,y,z) = (x+y)z

In [20]:

```
# set some inputs
x = -2; y = 5; z = -4

# perform the forward pass
q = x + y # q becomes 3
f = q * z # f becomes -12

# perform the backward pass (backpropagation) in reverse order:
# first backprop through f = q * z
dfdz = q # df/dz = q, so gradient on z becomes 3
dfdq = z # df/dq = z, so gradient on q becomes -4
# now backprop through q = x + y
dfdx = 1.0 * dfdq # dq/dx = 1. And the multiplication here is the chain rule!
dfdy = 1.0 * dfdq # dq/dy = 1

print("q =",q)
print("f =",f)
print("dfdz=",dfdz)
print("dfdq=",dfdq)
print("dfdx =",dfdx)
print("dfdy =",dfdy)
```

```
q = 3
f = -12
dfdz= 3
dfdq= -4
dfdx = -4.0
dfdy = -4.0
```

5. 시그모이드 예제

$x = 1/(1+ e^(-(w\_0\ x\_0+w\_1\ w\_1+w\_2)))$

In [21]:

```
import math

w = [2,-3,-3] # assume some random weights and data
x = [-1, -2]

# forward pass
dot = w[0]*x[0] + w[1]*x[1] + w[2]
f = 1.0 / (1 + math.exp(-dot)) # sigmoid function

# backward pass through the neuron (backpropagation)
ddot = (1 - f) * f # gradient on dot variable, using the sigmoid gradient derivation
dx = [w[0] * ddot, w[1] * ddot] # backprop into x
dw = [x[0] * ddot, x[1] * ddot, 1.0 * ddot] # backprop into w
# we're done! we have the gradients on the inputs to the circuit

print("dot =",dot)
print("f =",f)
print("ddot =",ddot)
print("dx =",dx)
print("dw =",dw)
```

```
dot = 1
f = 0.7310585786300049
ddot = 0.19661193324148185
dx = [0.3932238664829637, -0.5898357997244456]
dw = [-0.19661193324148185, -0.3932238664829637, 0.19661193324148185]
```

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