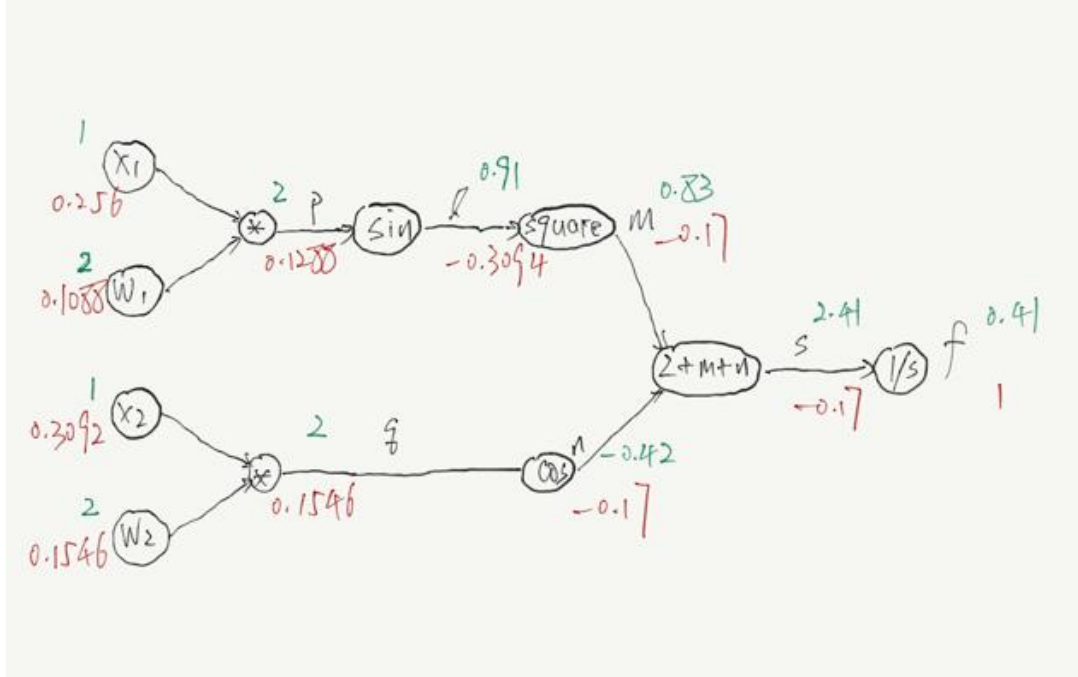


# Homework 2

Haocong Wang

## Q1

The computational graph is shown as below:



The derivation by hand is shown below:

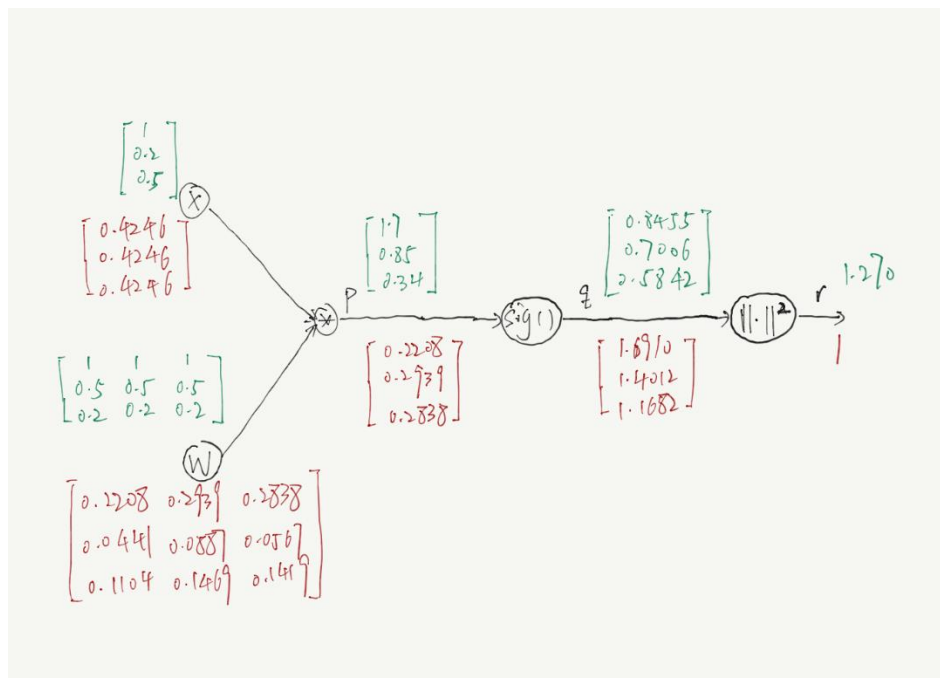
$$\begin{aligned} \frac{df}{dx_1} &= -\frac{2\omega_1 \sin(\omega_1 x_1) \cos(\omega_1 x_1)}{(2 + \sin^2(\omega_1 x_1) + \cos(\omega_2 x_2))^2} \\ \frac{df}{d\omega_1} &= -\frac{2x_1 \sin(\omega_1 x_1) \cos(\omega_1 x_1)}{(2 + \sin^2(\omega_1 x_1) + \cos(\omega_2 x_2))^2} \\ \frac{df}{dx_2} &= \frac{\omega_2 \sin(\omega_2 x_2)}{(2 + \sin^2(\omega_1 x_1) + \cos(\omega_2 x_2))^2} \\ \frac{df}{d\omega_2} &= \frac{x_2 \sin(\omega_2 x_2)}{(2 + \sin^2(\omega_1 x_1) + \cos(\omega_2 x_2))^2} \end{aligned}$$

The input is chosen as  $x = [1, 1]$  and  $\omega = [2, 2]$ . The result is shown as follow. The computation results of derivation by hand and program are exactly same.

```
derivation of x1 by hand: 0.26045651924973107
derivation of x1 by program: 0.26045651924973107
derivation of x2 by hand: 0.3129382424372049
derivation of x2 by program: 0.3129382424372049
derivation of w1 by hand: 0.13022825962486553
derivation of w1 by program: 0.13022825962486553
derivation of w2 by hand: 0.15646912121860246
derivation of w2 by program: 0.15646912121860246
```

## Q2

The computational graph is shown as below:



The result by program is shown below. It is the same as above.

```
dr_x: [[0.42458608]
       [0.42458608]
       [0.42458608]]
dr_w: [[0.22086339 0.29391989 0.28381373]
       [0.04417268 0.05878398 0.05676275]
       [0.1104317  0.14695995 0.14190686]]
```