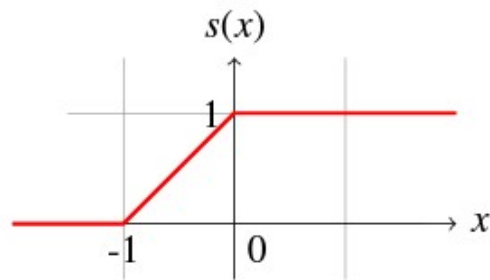
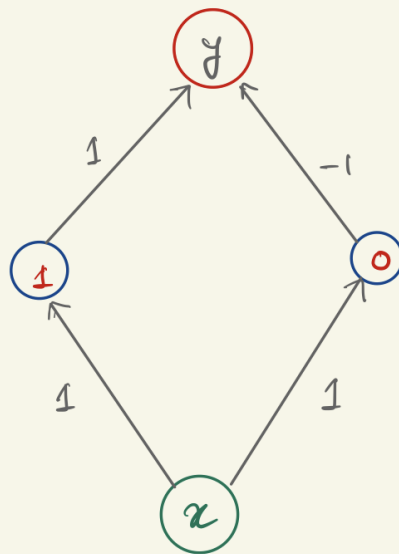


Let  $\sigma(x) = x_+$  denote the ReLU activation function. Write the function  $s$  given below using a one hidden layer ReLU neural network containing 2 neurons.



$$y = s(x)$$



1st hidden layer.

```
In [1]: import numpy as np
import matplotlib.pyplot as plt

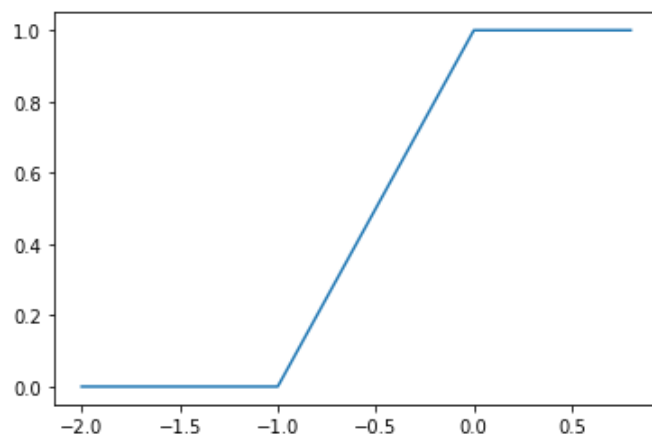
def relu(x):
    return(max(0.0, x))

def s(x):
    return(relu(x + 1) - relu(x))

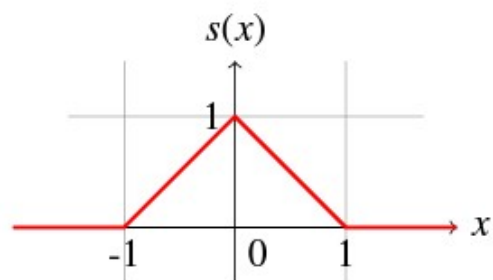
x = np.arange(-2,1,0.2)
y = np.zeros(x.shape).reshape(-1)

for i in range(len(x)):
    y[i] = s(x[i])

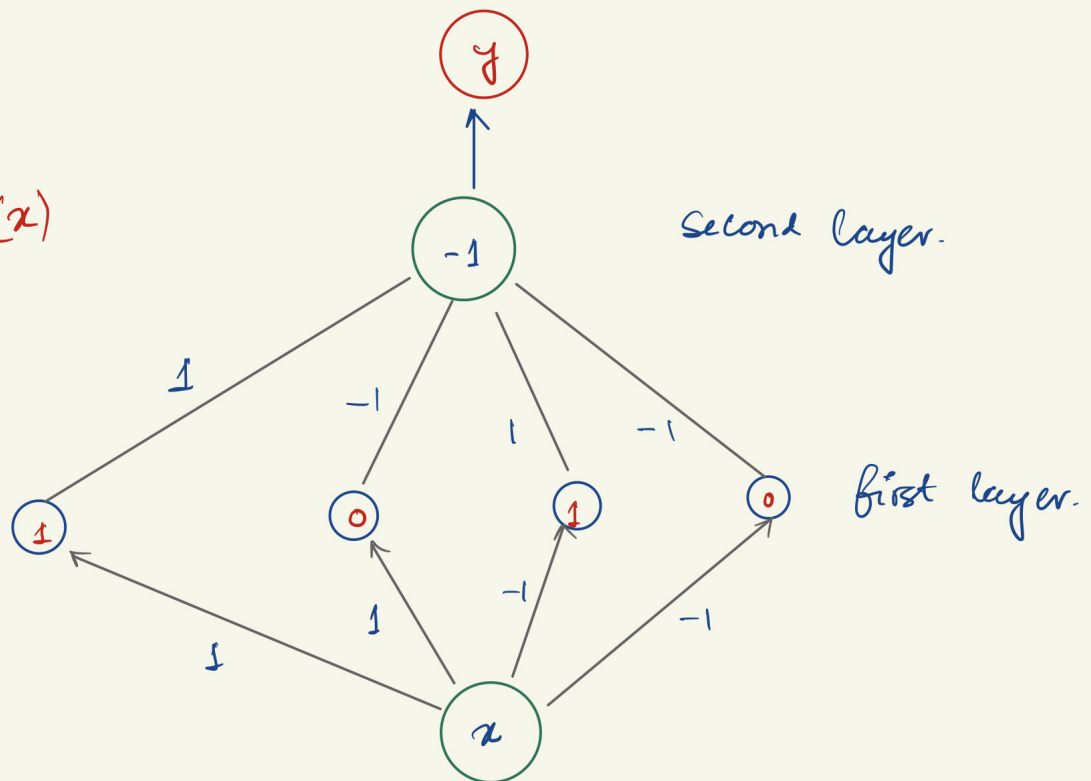
plt.plot(x,y)
plt.show()
```



Express the spike  $f$  function below in terms of  $s$ , and give a two-hidden layer ReLU neural network containing 5 neurons that computes  $f$ .



$$y = f(x)$$



```
In [2]: def both(x):
        s1 = s(x)
        s2 = s(-x)
        return(relu(s1 + s2 - 1))

x = np.arange(-2,2,0.2)
y = np.zeros(x.shape).reshape(-1)

for i in range(len(x)):
    y[i] = both(x[i])

plt.plot(x,y)
plt.show()
```

