Computational Intelligence Laboratory Exercise 1

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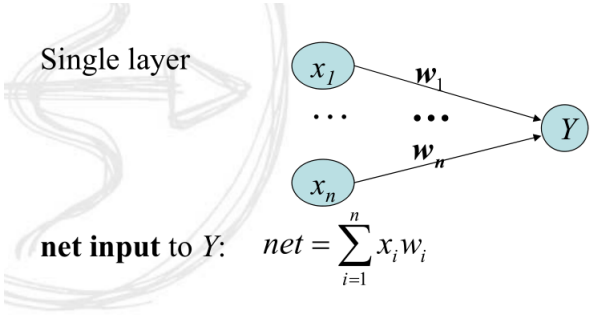
1 Task One: Artificial Neural Networks

1.1 Single-Layer Neural Networks

In Single-Layer Neural Networks, there are just input-layer and output-layer without hidden layer. And Single-layer neural networks aims to solve Linearly Separable Problem.



threshold θ related to Y

output $y = f(net) = \begin{cases} 1 & \text{if } net \geq \theta \\ -1 & \text{if } net < \theta \end{cases}$

Fig. 1. single-layer

1.2 Multi-Layer Neural Networks

A Multi-Layer Neural Networks consist of neurons which are organized in layers and the hidden layers are non-linear units.The layers are fully connected by weighted connections. MLP are trained in a supervised fashion which are Forward phase and Backwards phase. Backwards phase is a gradient descent method similar to single layer ANNs.

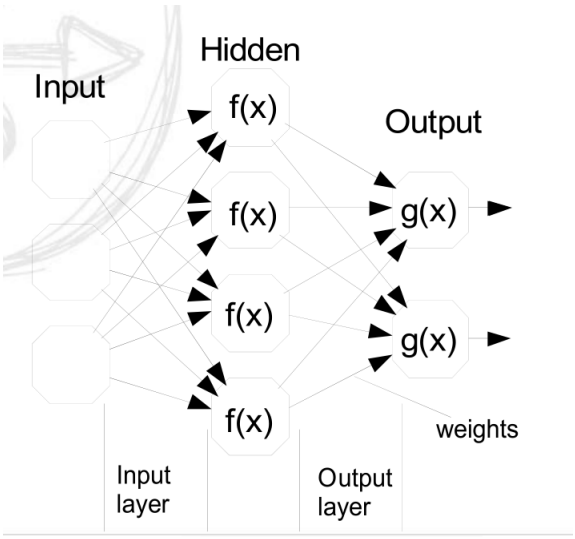


Fig. 2. Multi-layer

1.3 Shallow Neural Networks

Shallow Neural Networks is a term used to describe Nerual Networks that usually have only one hidden layer.

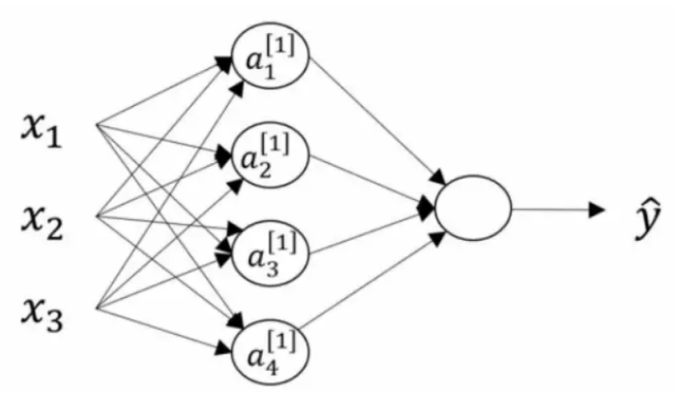


Fig. 3. Shallow

1.4 Deep Neural Networks

Deep Neural Networks is a term used to describe Nerual Networks that usually have several hidden layer.

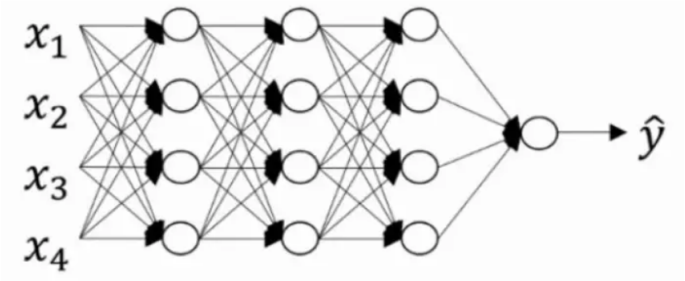


Fig. 4. Deep

2 Task Two: Build ANNs with C++

```
#include <stdio.h>
#include <stdlib.h>
#include <cmath>

int w11=3, w12=2, w21=1, w22=4;
int v11=3, v12=5, v21=2, v22=1;
int x1=1,x2=2;

int main()
{
    int w11=3, w12=2, w21=1, w22=4;
    int v11=3, v12=5, v21=2, v22=1;
    int x1=1,x2=2;
    int u,v;
    u = w11 * x1 + w21 * x2 + 1;
    v = w12 * x1 + w22 * x2 + 1;
    float h1,h2,o1,o2;
    h1 = 1/(1+exp(-u));
    h2 = 1/(1+exp(-v));
    printf("h1=%f, h2=%f\n", h1, h2);
    float Net_o1, Net_o2; o1, o2;
    Net_o1 = v11 * u + v21 * v + 1;
    Net_o2 = v12 * u + v22 * v + 1;
    o1 = 1/(1+exp(-Net_o1));
    o2 = 1/(1+exp(-Net_o2));
    printf("o1=%f, o2=%f\n", o1, o2);
}
```

```
[Running] cd "c:\Users\72715\Desktop\UOW\第二学
h1=0.997527, h2=0.999983
o1=0.997509, o2=0.999078
```

Fig. 5. Hidden and output