## 1: The First Problem

### (a) Data1:

For the intertwined two spiral, using the standard bp algorithm can solve the problem very well. In addition, the data set is not large and the data structure is not complicated. Therefore, the main adjustment directions are $learn_rate$ and epoch times. On the contrary, excessive adjustment of the hidden layer structure will be counterproductive.
Here is my progress report of data1:

```
Enter data filename: 1-SpiralData1.txt
TrainNet2: IP:2 H1:5 OP:1
Params: lrn_rat:0.4 Order:0
Testing mlp:
    MinErr      AveErr      MaxErr      %Correct
    0.331593    0.492433    0.659922   46.354164
End of program.
```

```
TrainNet3: IP:2 H1:12 H2:6 OP:1
Params: lrn_rat:0.01 Order:1
Testing mlp:
    MinErr      AveErr      MaxErr      %Correct
    0.474483    0.499983    0.525415   50.000000
End of program.
```

```
TrainNet3: IP:2 H1:12 H2:6 OP:1
Params: lrn_rat:0.01 Order:2
Testing mlp:
    MinErr      AveErr      MaxErr      %Correct
    0.000000    0.485068    1.000000   48.437500
End of program.
```

```
TrainNet4: IP:2 H1:12 H2:8 H3:12 OP:1
Params: lrn_rat:0.01 Order:3
Testing mlp:
    MinErr      AveErr      MaxErr      %Correct
    0.000000    0.488661    1.000000   48.958336
End of program.
```

It is obvious that using a single layer neural network and setting $learn_{rate}$ to 0.4 can achieve the best experimental results.

### (b) Data2:

For the abalone age problem, it has more features.So It may be a better way to combine the wrong samples with order3 and multi-layer neural network. Different models may have different performance, but multi-layer neural network should achieve good results.

Here is my progress report of data2:

```
TrainNet4: IP:8 H1:15 H2:9 H3:6 OP:1
Params: lrn_rat:0.01 Order:0
Testing mlp:
    MinErr      AveErr      MaxErr      %Correct
    0.016670    0.109487    0.561774   48.400002
End of program.
```

```
TrainNet3: IP:8 H1:12 H2:8 OP:1
Params: lrn_rat:0.4 Order:0
Testing mlp:
    MinErr      AveErr      MaxErr      %Correct
    0.000136    0.265219    0.680302   27.400000
End of program.
```

```
TrainNet4: IP:44 H1:12 H2:14 H3:8 OP:1
Params: lrn_rat:0.6 Order:3
Testing mlp:
    MinErr      AveErr      MaxErr      %Correct
    0.000096    0.265774    0.683462   28.200001
End of program.
```

It can be seen that Order3 with a three-layer structure and Order0 with a two-layer structure have achieved good results. The advantages and disadvantages of the two need to be further explored.

**(c) Data3:**

For the SPECT Heart Diagnosis problem, considering that it has very input values, too many neural networks may affect the calculation, so try to adjust the rate and single layer structure. Here is my progress report of data3:

```
TrainNet3: IP:44 H1:33 H2:14 OP:1
Params: lrn_rat:0.6 Order:0
Testing mlp:
    MinErr      AveErr      MaxErr      %Correct
    0.245555    0.550889    0.754445   60.000004
End of program.
```

```
Enter data filename: data3.txt
TrainNet2: IP:44 H1:33 OP:1
Params: lrn_rat:0.01 Order:1
Testing mlp:
    MinErr      AveErr      MaxErr      %Correct
    0.336831    0.467771    0.650450   36.000000
End of program.
```

It can be seen that a single-layer neural network achieves better results than a multi-layer.

## 2: The Second Problem

### (a) Data1:

To be able to learn classification correctly the experiment shows that the mlp that is most suitable for problem 1 is a structure of 5 neurons in a single layer, and the learning rate is 0.4 and a suitable number of iterations is 10000 at the same time, each setting can see in Figure 1:

### (b) Data2:

To be able to learn classification correctly, by comparison, the mlp that is most suitable for problem 2 is a two-layer neural network with nodes 12 and 8, and a suitable number of iterations is 8000, each set can see in Figure 2 adn Figure 3:

### (c) Data3:

To be able to learn classification correctly, the experiment shows that the MLP that is most suitable for Problem 3 is a single-layer hidden layer but contains a large number of nodes. The appropriate number of iterations is 6000, and each setting can see in Figure 4:

```
NumIPs: 2
NumOPs: 1
NumTrnPats: 192
NumTstPats: 192
NumIts: 10000
NumHN: 1
NumHN1: 5
LrnRate: 0.4
Mtm1: 1.2
Mtm2: 0.4
ObjErr: 0.005
Ordering: 0
```

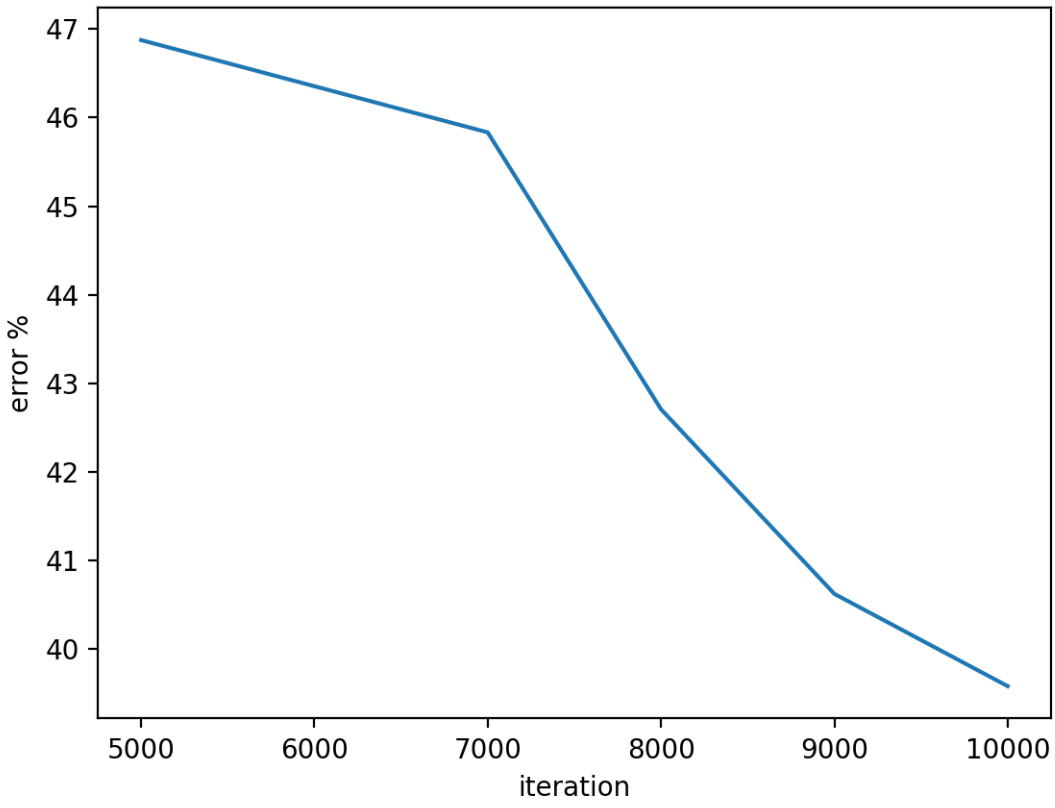


Figure 1: d1 parameters and error vs iteration

```
NumIPs: 8
NumOPs: 1
NumTrnPats: 3677
NumTstPats: 500
NumIts: 10000
NumHN: 3
NumHN1: 12
NumHN2: 8
NumHN3: 12
LrnRate: 0.4
Mtm1: 1.2
Mtm2: 0.4
ObjErr: 0.005
Ordering: 0
```

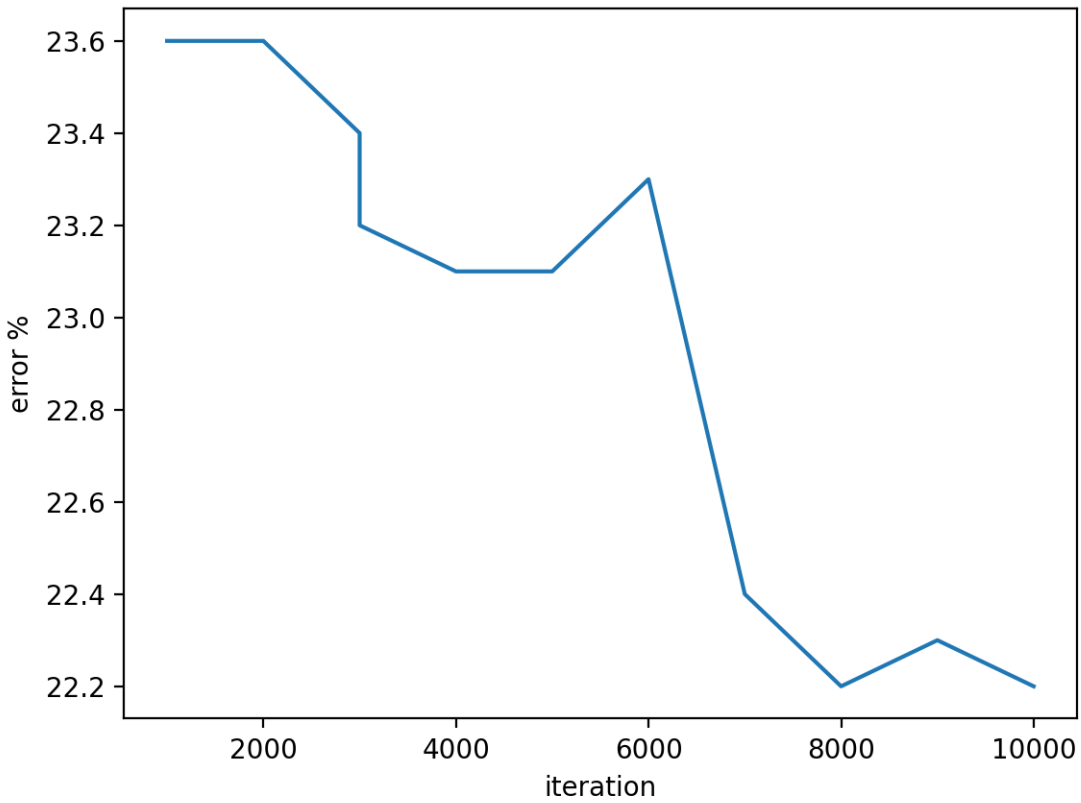


Figure 2: d2.1 parameters and error vs iteration

```
NumIPs: 8
NumOPs: 1
NumTrnPats: 3677
NumTstPats: 500
NumIts: 10000
NumHN: 2
NumHN1: 12
NumHN2: 8
LrnRate: 0.4
Mtm1: 1.2
Mtm2: 0.4
ObjErr: 0.005
Ordering: 0
```

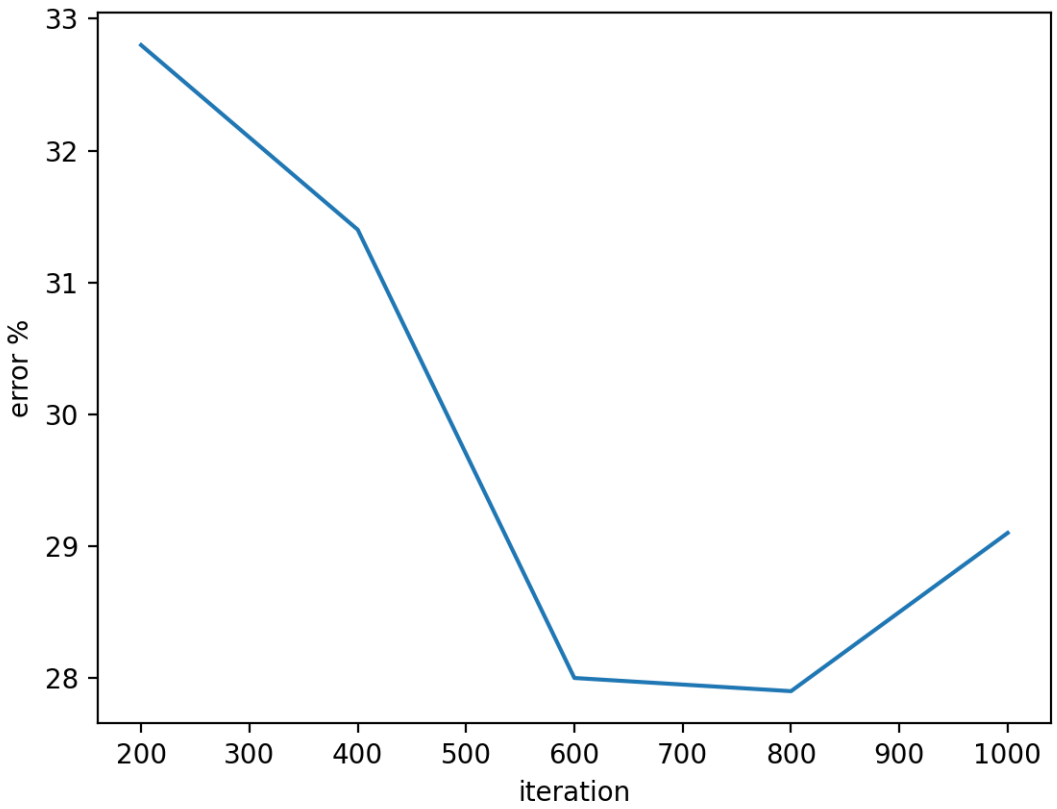


Figure 3: d2.2 parameters and error vs iteration

```
NumIPs: 44
NumOPs: 1
NumTrnPats: 299
NumTstPats: 50
NumIts: 6000
NumHN: 1
NumHN: 33
LrnRate: 0.01
Mtm1: 1.5
Mtm2: 0.4
ObjErr: 0.005
Ordering: 1
```

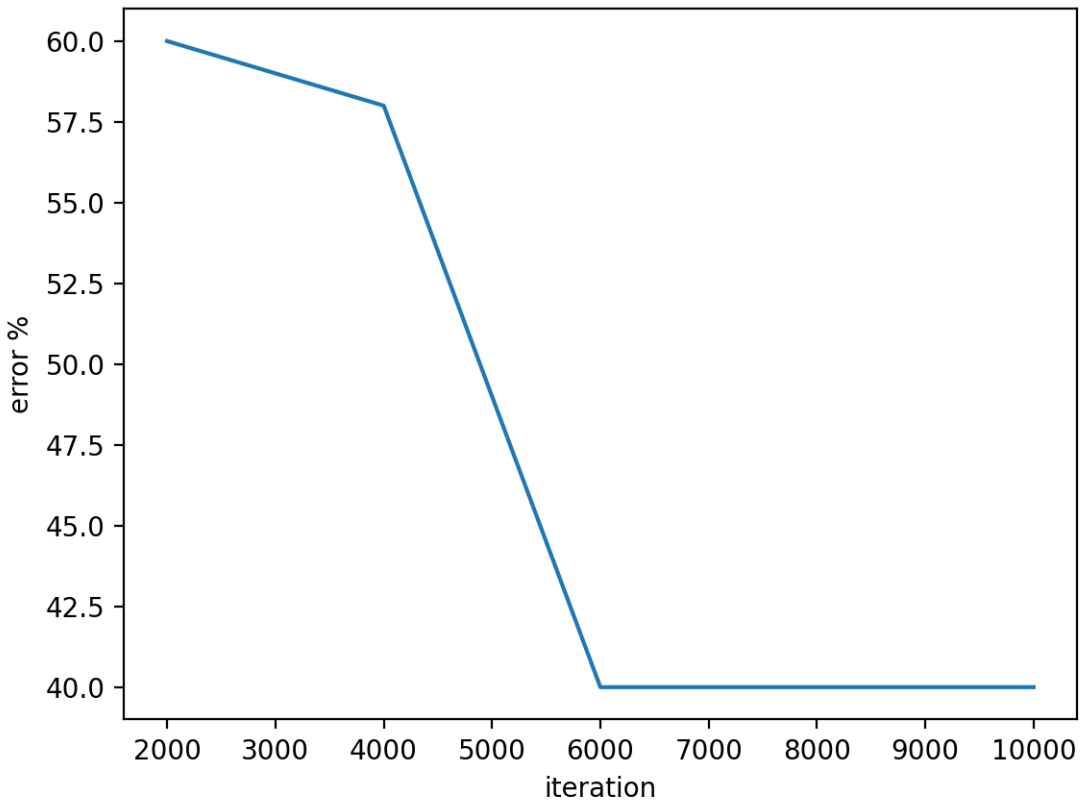


Figure 4: d3 parameters and error vs iteration