CS 241 Honor Project

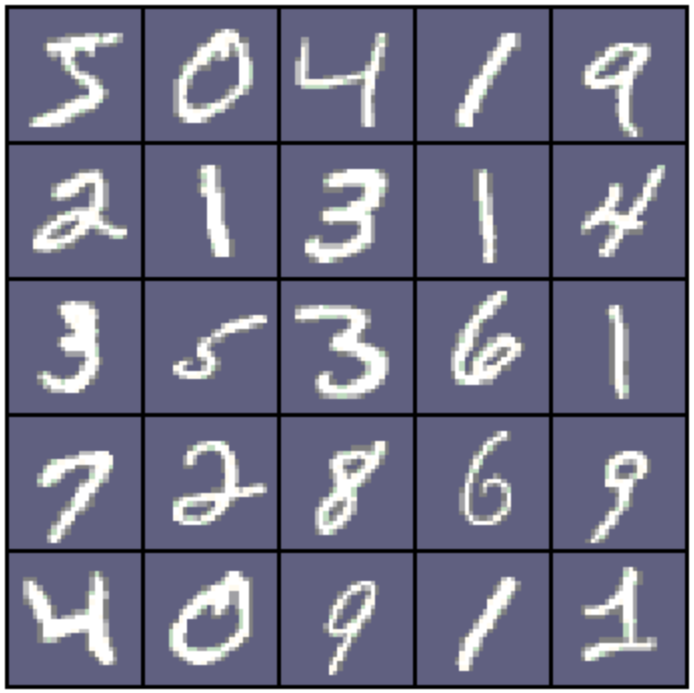
Jiarui Xu

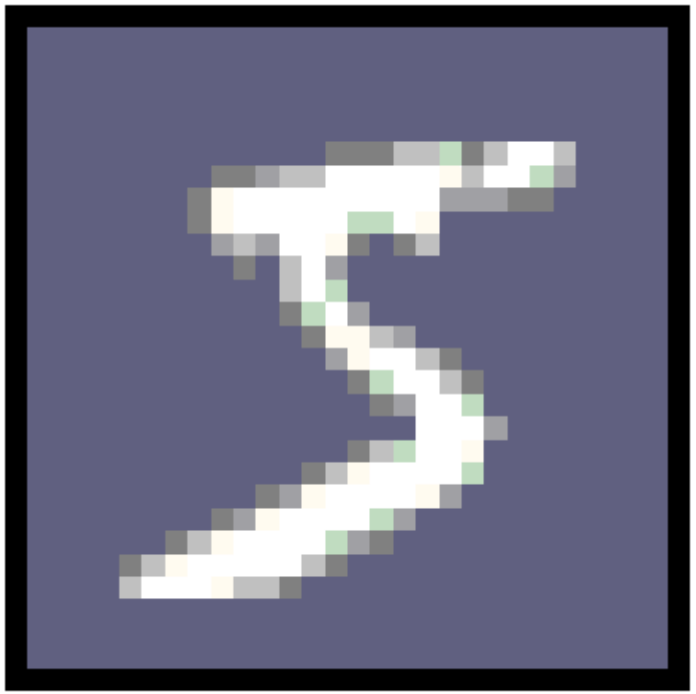
Li-Wei Huang

Project Topic:
Handwriting Digit Recognition

Multi-Threaded **Artificial Neural Network** with Back-Propagation Algorithm

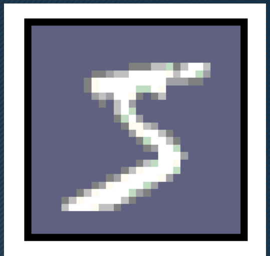
Handwriting digit:





Source: MNIST database, 60000 images

Handwriting digit:



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```
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```
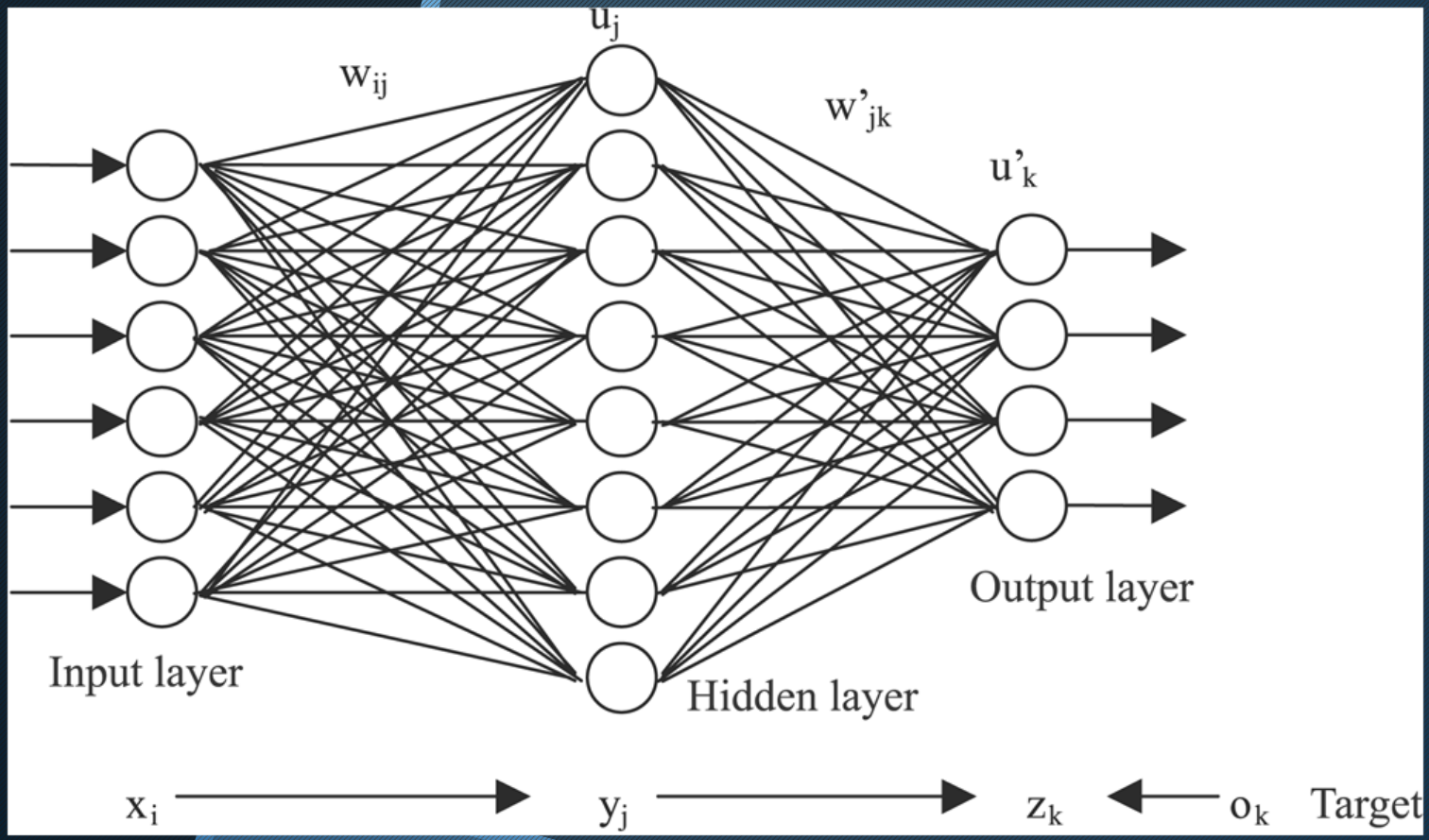

The Basics of ANN

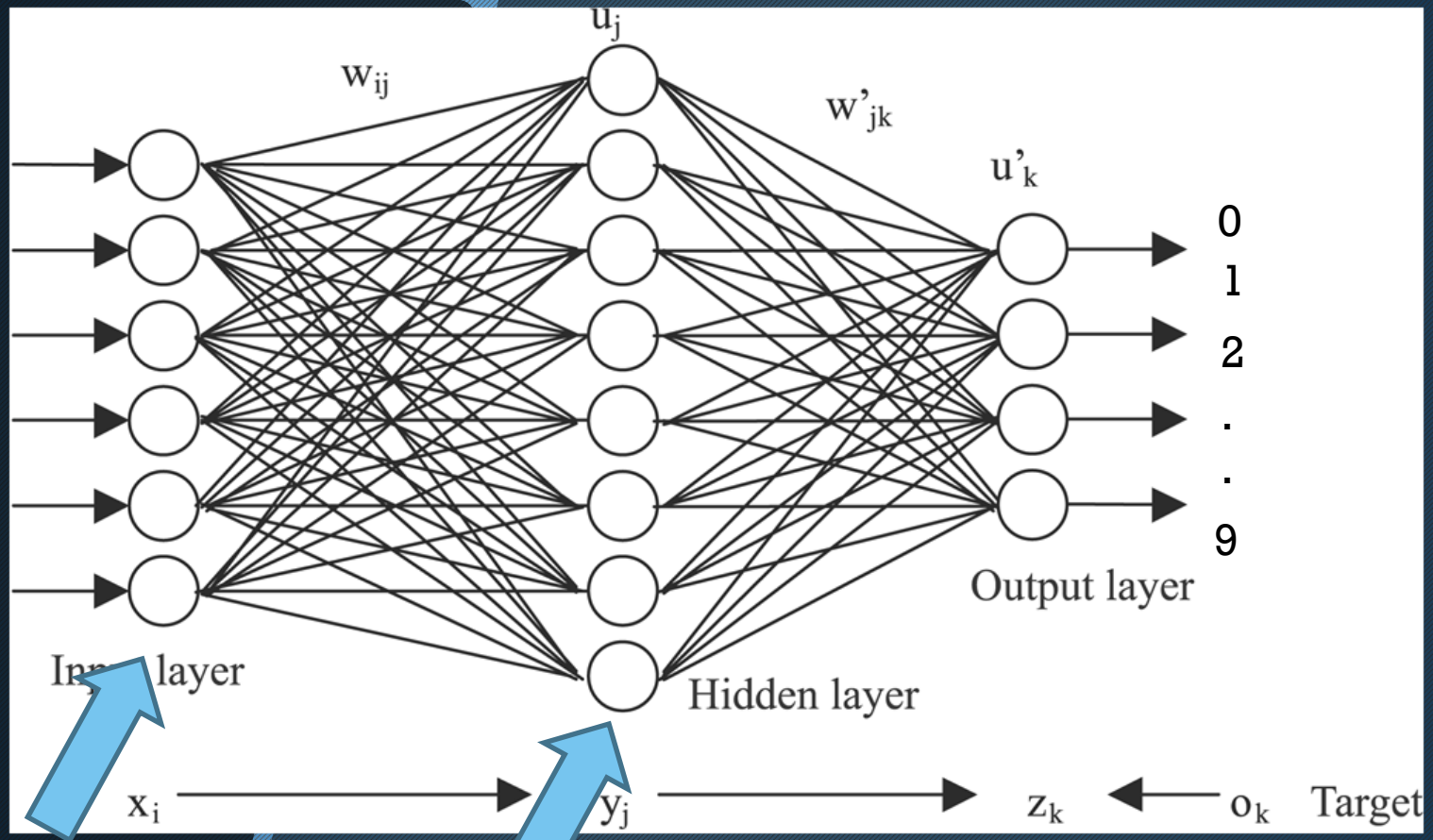
- Inspired by biological neural networks
- Nodes -> Neurons



ANN

300 Neurons

Outputs

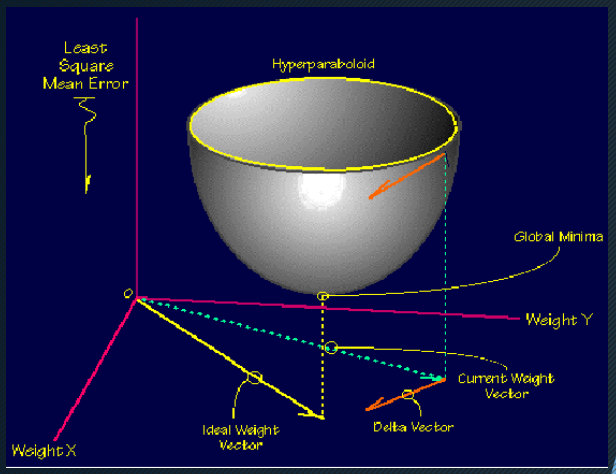


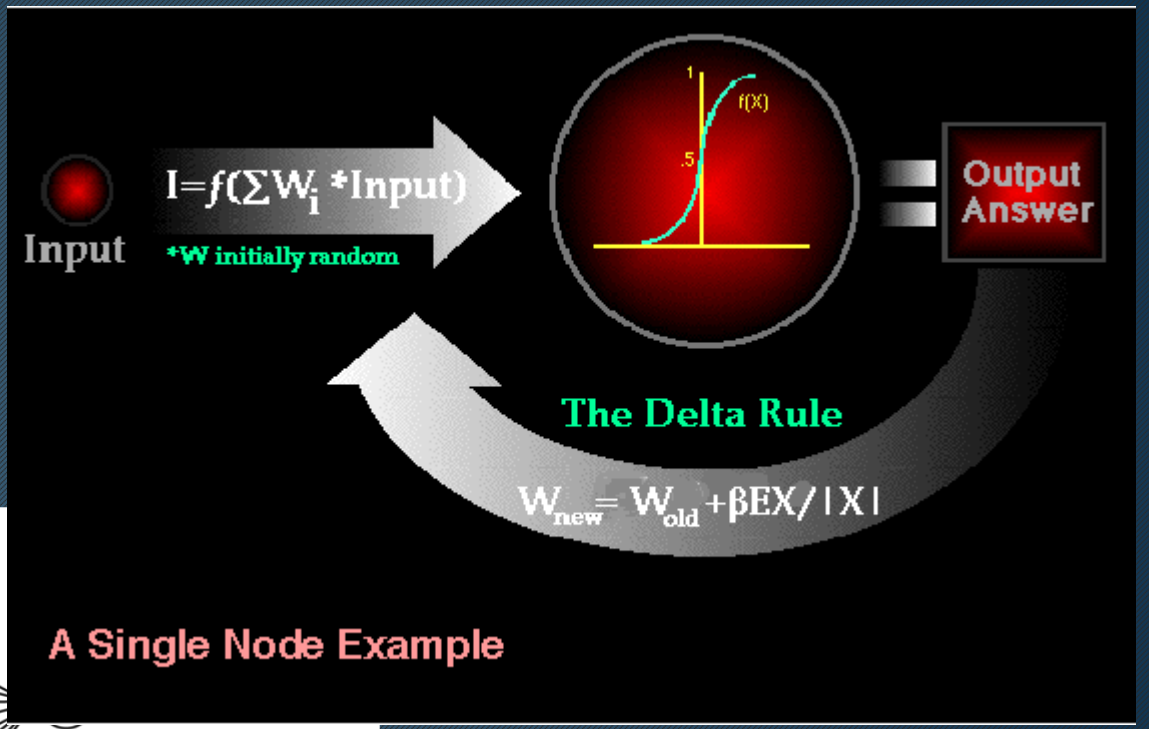
Inputs

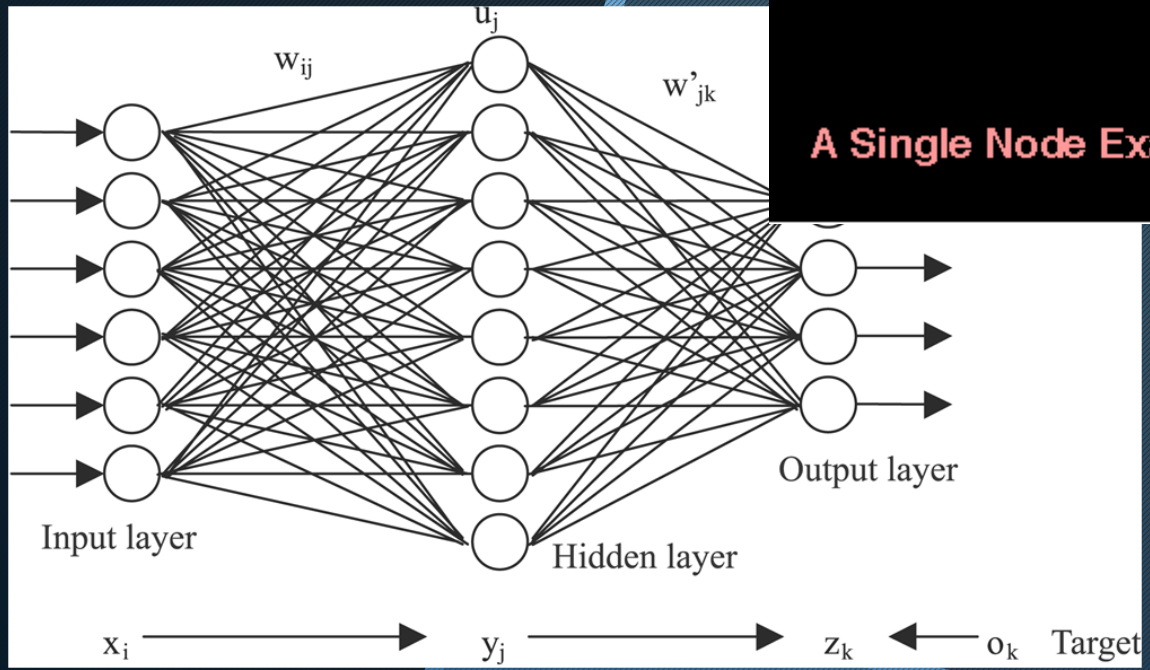
Bias （1）

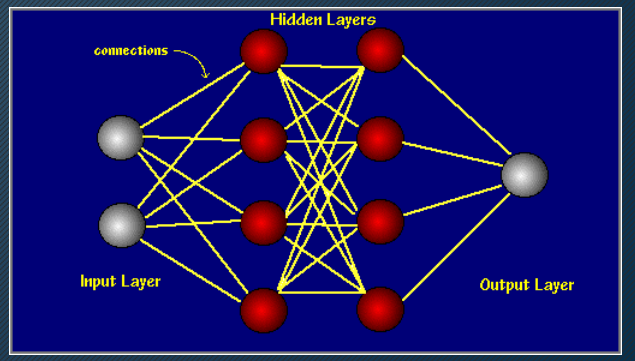
Bias （1）

ANN training - Matlab

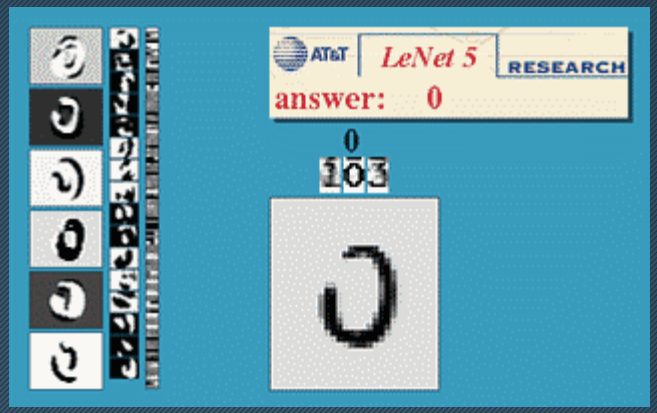


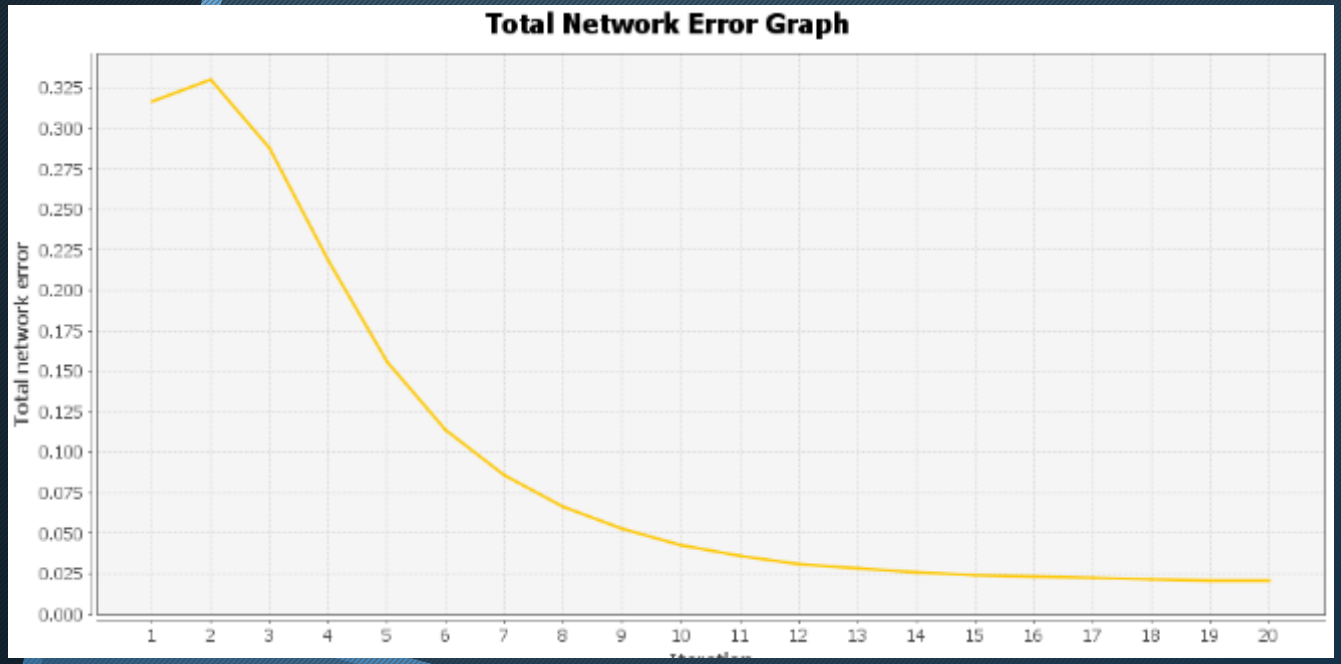






ANN demo


AT&T
LeNet 5
RESEARCH
answer: 0
0
103


Total Network Error Graph
Total network error
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

ANN weights

- Input to Hidden Layer
- Hidden Layer to Output

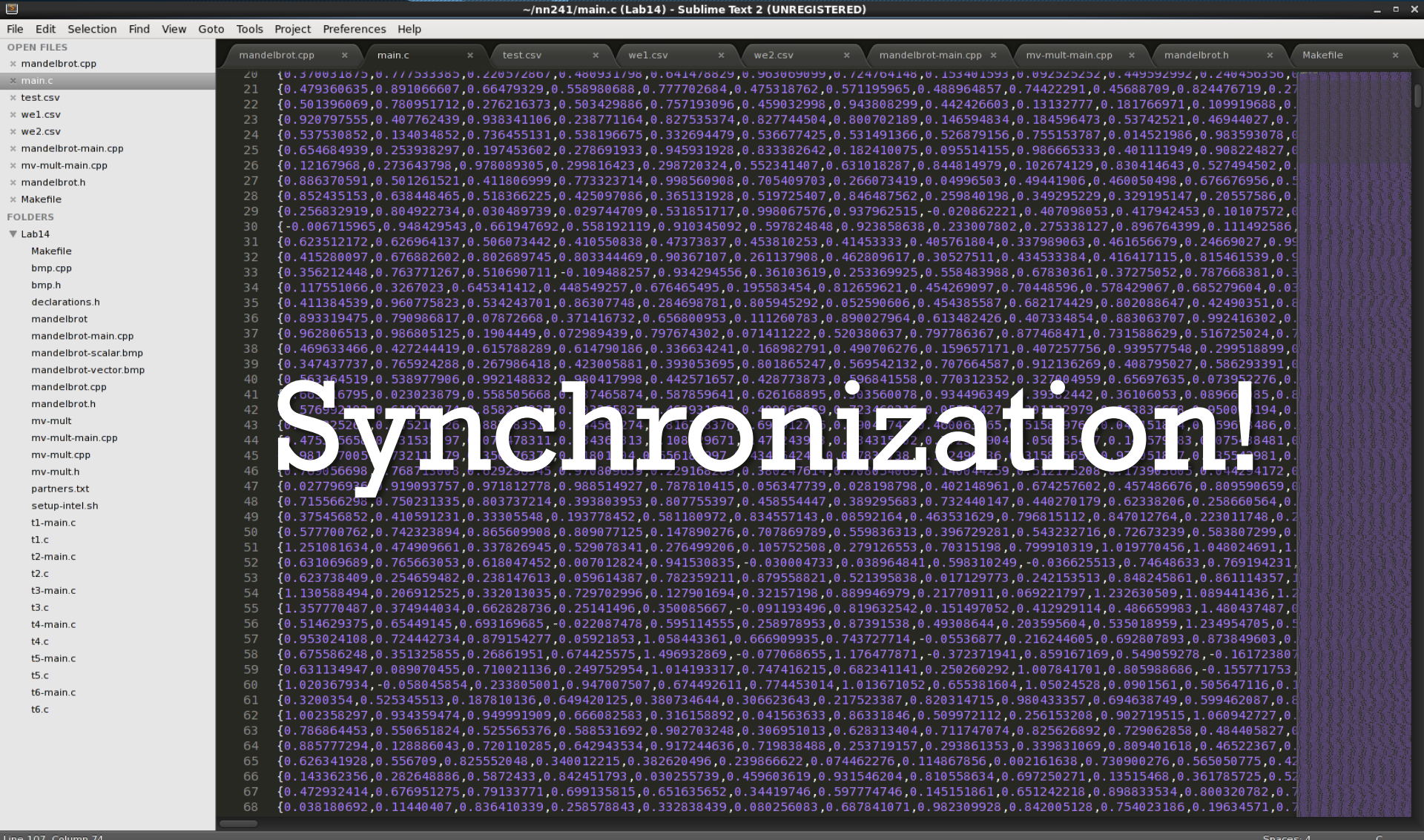
- --------Massive data
- --------Heavy Calculation

ANN weights

- Training Set: 600,000 Images
- Learning Rate: 0.1
- Beta: 0.01 (scaling factor in Sigm Func)
- MAX_Iterations: 100

- Calculations: over 1*10^14
- (including forward & backward propagation)
- Running Time: over 3 hours !

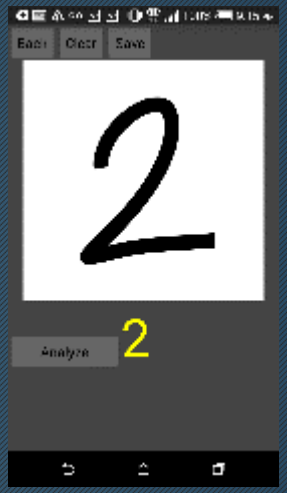
ANN weights!

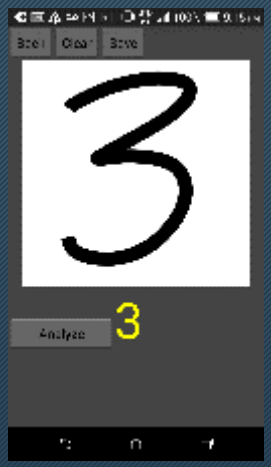


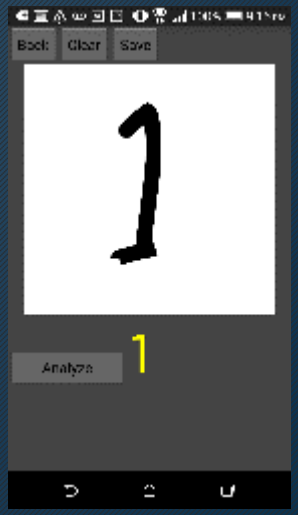
Synchronization!

Digit Master

--examples

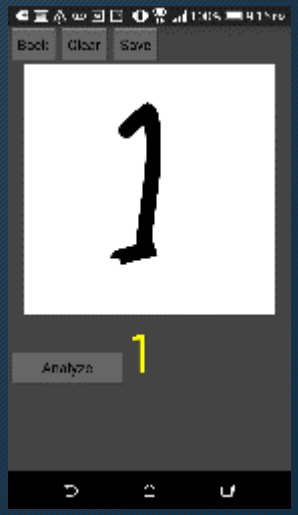






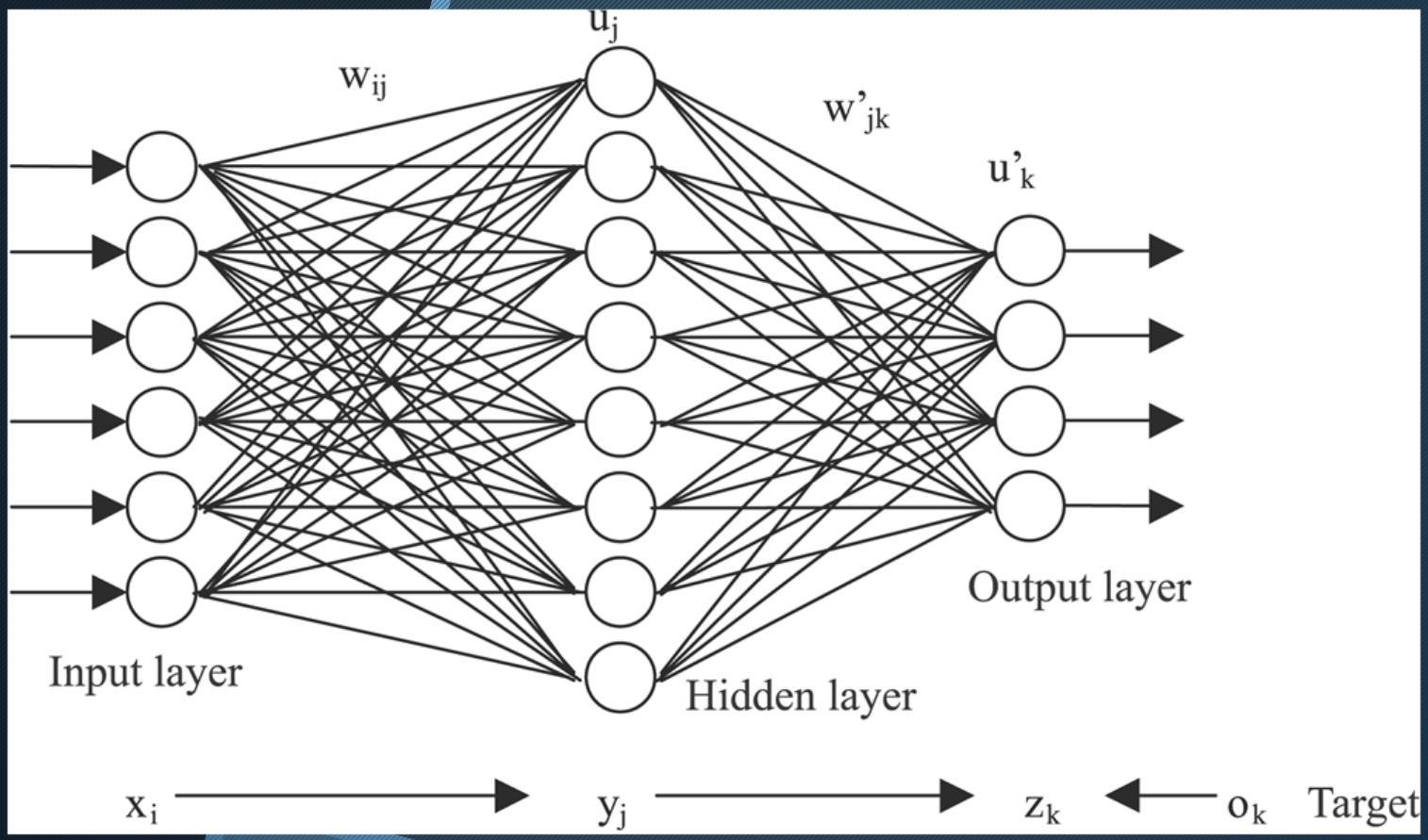
Digit Master

xamples



Digit Master
Multi-Threaded

300 10



Digit Master
What's more ?

```
If ( Image Recognition is Right)
        Skip this;
else{
        Make as wrong;
        Select the right answer
        Save the image with target;
        Send to Server;
        Server get Image;
}
```

After N time:

Server combine all the images and re-run the training process;

Self Learning ! Keep Learning !