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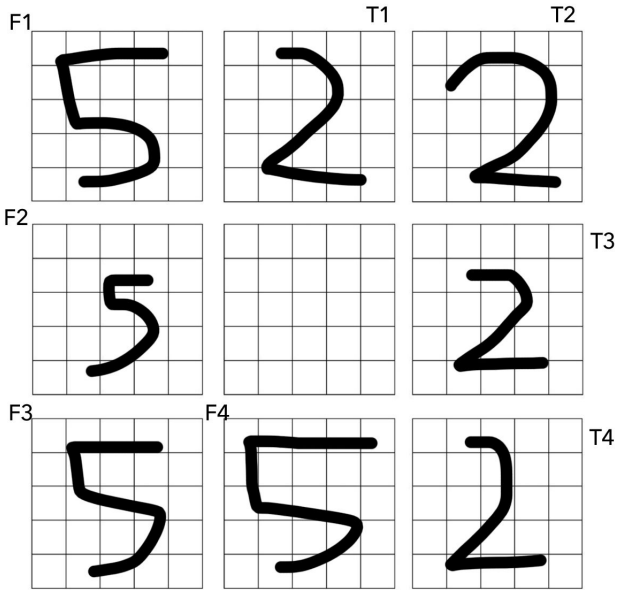
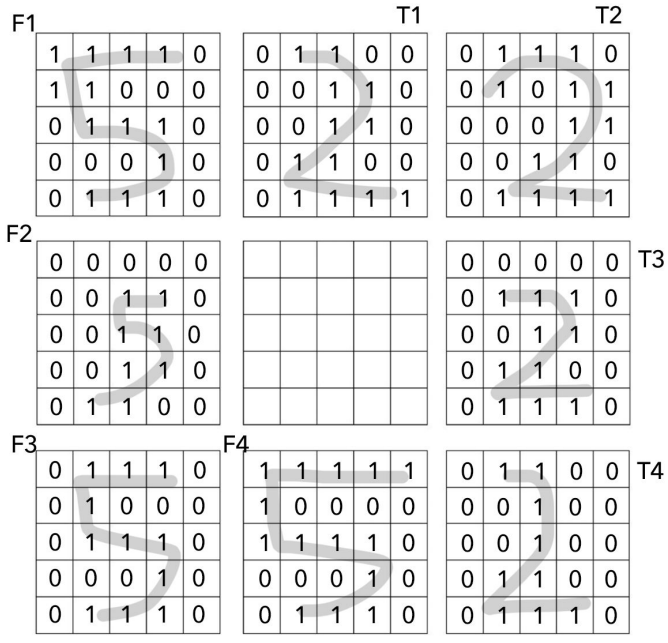
CSCI3202
Assignment 4 Report
22 November 2019

Part 1, Data Preparation

Step 1.



Step 2.



Step 3.

F1: [1, 1, 1, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1, 0]
F2: [0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0]
F3: [0, 1, 1, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1, 0]
F4: [1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1, 0]

T1: [0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1]
T2: [0, 1, 1, 1, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1]
T3: [0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 1, 1, 1, 0]
T4: [0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 1, 0]

Part 2, Hopfield Network

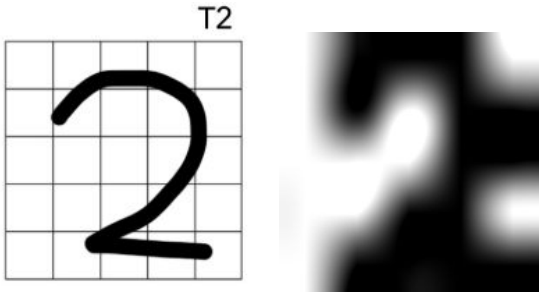
** my test data is ordered with four 5s, then four 2s*

Output:

```
mrmerola: a4-code/$ python3 A4.py
CLASS: five
CLASS: five
CLASS: five
CLASS: five
CLASS: two
CLASS: five
CLASS: two
CLASS: two
```

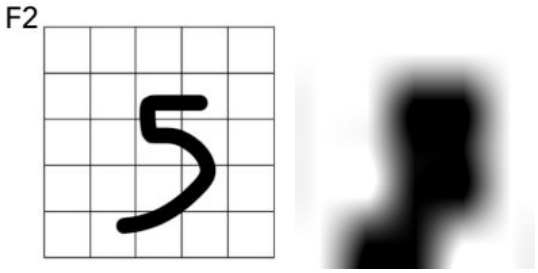
Accuracy = ⅞ = 87.5%

My Hopfield Model classifies the test data mostly accurately, but mis-classifies the T2 datapoint as a five. When looking at the data compared to the visualizer:



it's clear that the hangover color into multiple cells from the drawn 2 greatly affect the way the visualizer interprets the drawing. This misinterpretation definitely contributes to my model classifying the data incorrectly, and could be resolved by increasing the number of nodes in the grid to increase the resolution of the visualized image and get more precise data representations of the drawing.

** *on multiple runs, my model will occasionally mis-classify F2*



Part 3, Train an MLP

```
/Users/mrmerola/miniconda3/lib/python3.7/site-packages/sklearn/neural_network/
py:566: ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) rea
ion hasn't converged yet.
  % self.max_iter, ConvergenceWarning)
prediction:  ['five' 'two' 'five' 'five' 'two' 'five' 'two' 'two']
score:  0.75
```

Accuracy = 75%

The MLP Classifier mis-classifies the same two data points as my own Hopfield model (F2, T2), and it warns that the model had to run to its maximum iteration limit without convergence. This indicates that the data of those two points are messy enough to not guarantee a correct classification, but are similar enough to the stored memories to be classified as its opposite.

Part 4, Distortion

The accuracy of each plot decreases as the distortion rate increases, meaning that it's harder for each model to classify the inputs as they get distorted. Although that behavior makes sense, the MLP model curiously increases its accuracy between rate 0.3 and 0.4. This could be due to anomalies in the data like with F2 and T2.