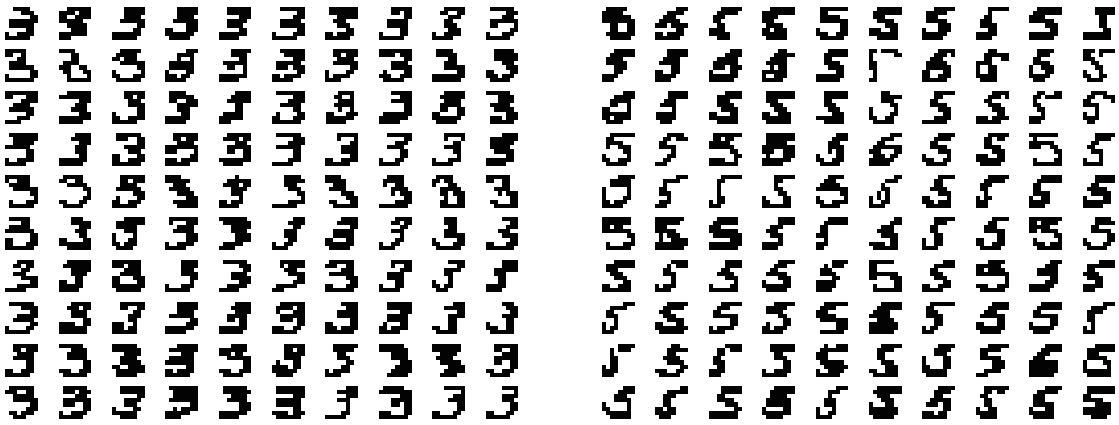
5.5 Handwritten digit classification

In this problem, you will use logistic regression to classify images of handwritten digits. From the course web site, download the files `train3.txt`, `test3.txt`, `train5.txt`, and `test5.txt`. These files contain data for binary images of handwritten digits. Each image is an 8x8 bitmap represented in the files by one line of text. Some of the examples are shown in the following figure.



(a) Training

Perform a logistic regression (using gradient ascent or Newton's method) on the images in files `train3.txt` and `train5.txt`. Indicate clearly the algorithm used, and provide evidence that it has converged (or nearly converged) by plotting or printing out the log-likelihood on several iterations of the algorithm, as well as the percent error rate on the images in these files. Also, print out the 64 elements of your solution for the weight vector as an 8x8 matrix.

(b) Testing

Use the model learned in part (a) to label the images in the files `test3.txt` and `test5.txt`. Report your percent error rate on these images.

(c) Source code

Turn in a print-out of your source code. Once again, you may program in the language of your choice. You should write your own routines for computing the model's log-likelihood, gradient, and/or Hessian, as well as for updating its weight vector.