**FILE FORMATS FOR THE MNIST DATABASE**

The data is stored in a very simple file format designed for storing vectors and multidimensional matrices. General info on this format is given at the end of this page, but you don't need to read that to use the data files.

All the integers in the files are stored in the MSB first (high endian) format used by most non-Intel processors. Users of Intel processors and other low-endian machines must flip the bytes of the header.

There are 4 files:

train-images-idx3-ubyte: training set images   
train-labels-idx1-ubyte: training set labels   
t10k-images-idx3-ubyte:  test set images   
t10k-labels-idx1-ubyte:  test set labels

The training set contains 60000 examples, and the test set 10000 examples.

The first 5000 examples of the test set are taken from the original NIST training set. The last 5000 are taken from the original NIST test set. The first 5000 are cleaner and easier than the last 5000.

**TRAINING SET LABEL FILE (train-labels-idx1-ubyte):**

[offset] [type]          [value]          [description]   
0000     32 bit integer  0x00000801(2049) magic number (MSB first)   
0004     32 bit integer  60000            number of items   
0008     unsigned byte   ??               label   
0009     unsigned byte   ??               label   
........   
xxxx     unsigned byte   ??               label

The labels values are 0 to 9.

**TRAINING SET IMAGE FILE (train-images-idx3-ubyte):**

[offset] [type]          [value]          [description]   
0000     32 bit integer  0x00000803(2051) magic number   
0004     32 bit integer  60000            number of images   
0008     32 bit integer  28               number of rows   
0012     32 bit integer  28               number of columns   
0016     unsigned byte   ??               pixel   
0017     unsigned byte   ??               pixel   
........   
xxxx     unsigned byte   ??               pixel

Pixels are organized row-wise. Pixel values are 0 to 255. 0 means background (white), 255 means foreground (black).

**TEST SET LABEL FILE (t10k-labels-idx1-ubyte):**

[offset] [type]          [value]          [description]   
0000     32 bit integer  0x00000801(2049) magic number (MSB first)   
0004     32 bit integer  10000            number of items   
0008     unsigned byte   ??               label   
0009     unsigned byte   ??               label   
........   
xxxx     unsigned byte   ??               label

The labels values are 0 to 9.

**TEST SET IMAGE FILE (t10k-images-idx3-ubyte):**

[offset] [type]          [value]          [description]   
0000     32 bit integer  0x00000803(2051) magic number   
0004     32 bit integer  10000            number of images   
0008     32 bit integer  28               number of rows   
0012     32 bit integer  28               number of columns   
0016     unsigned byte   ??               pixel   
0017     unsigned byte   ??               pixel   
........   
xxxx     unsigned byte   ??               pixel

Pixels are organized row-wise. Pixel values are 0 to 255. 0 means background (white), 255 means foreground (black).