a01_1

October 3, 2025

[1]:
```
# pip install python-mnist
```

[2]:
```
# pip install ipympl
```

[1]:
```
# ---
# jupyter:
#   jupytext:
#     text_representation:
#       extension: .py
#       format_name: percent
#       format_version: '1.3'
#       jupytext_version: 1.16.7
#   kernelspec:
#     display_name: Python (ML25_assignments)
#     language: python
#     name: ml25
# ---



# %% [markdown]
# # Task 1: Train a Naive Bayes Classifier
# The class `nb_train` is located in `a01_functions.py`. You can make
# experimental changes to that class in the other file (`a01_functions.py`). All
# saved changes will be automatically reflected here due to the IPython
# autoreload extension (see below).

# %%
```

[2]:
```
import math

import numpy as np
import numpy.random
%matplotlib widget
import matplotlib.pyplot as plt
# %load_ext autoreload
# %autoreload 2

from a01_helper import *
from a01_functions import nb_train
```

[3]:
```
# setup plotting
from IPython import get_ipython
import psutil
inTerminal = not "IPKernelApp" in get_ipython().config
inJupyterNb = any(filter(lambda x: x.endswith("jupyter-notebook"), psutil.
 ↪Process().parent().cmdline()))
get_ipython().run_line_magic("matplotlib", "" if inTerminal else "notebook" if␣
 ↪inJupyterNb else "widget")
def nextplot():
    if inTerminal:
        plt.clf()     # this clears the current plot
    else:
        plt.figure()  # this creates a new plot
```

[4]:
```
# %% [markdown]
# # Load the data
# ## Inspect the data
# %%
# Example: show first digit
nextplot()
```

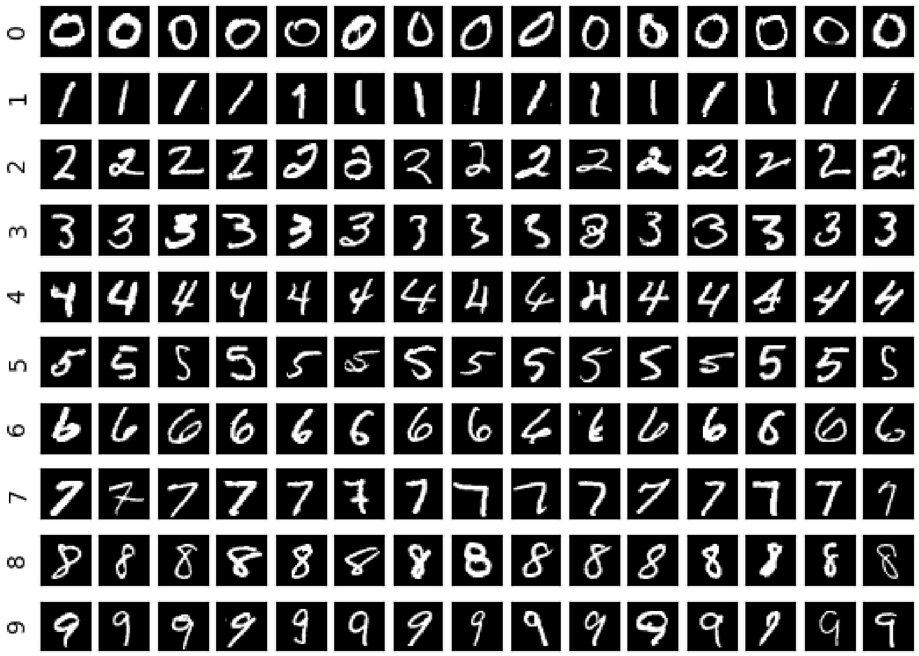
[5]:

```
showdigit(X[0,])
print(y[0])
```

```
5
```

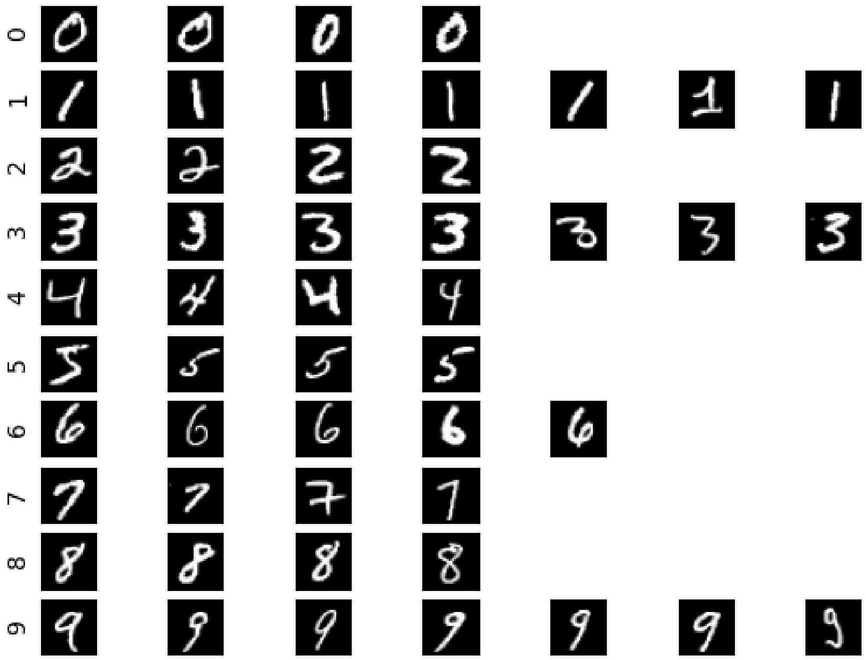
[6]:

```
# %%
# Example: show 15 random digits per class from training data
nextplot()
showdigits(X, y)
```



[7]:

```
# %%
# Example: show a specific set of digits
nextplot()
showdigits(X[0:50,], y[0:50])
```



[8]:

```
# %%
# A simple example dataset that you can use for testing
Xex = np.array([1, 0, 0, 1, 1, 1, 2, 0]).reshape(4, 2)
yex = np.array([0, 1, 2, 0])
```

[9]:

```
# %% [markdown]
# # 1 Training

# %%
# Test your code (there should be a warning when you run this)
model = nb_train(Xex, yex, alpha=1)
model
# This should produce:
# {'logcls': array([[[       -inf, -0.69314718, -0.69314718],
#          [ 0.        ,        -inf,        -inf]],
#
#         [[ 0.        ,        -inf,        -inf],
#          [       -inf,  0.        ,        -inf]],
#
#         [[       -inf,  0.        ,        -inf],
#          [       -inf,  0.        ,        -inf]]]),
#  'logpriors': array([-0.69314718, -1.38629436, -1.38629436])}
```

```
/home/jovyan/shared/MachineLearning/MachineLearningAssignment/a01-
nb/a01_functions.py:77: RuntimeWarning: divide by zero encountered in log
  return dict(logpriors=np.log(priors), logcls=np.log(cls))
```

[9]:

```
{'logpriors': array([-0.69314718, -1.38629436, -1.38629436]),
 'logcls': array([[[       -inf, -0.69314718, -0.69314718],
         [ 0.        ,        -inf,        -inf]],

        [[ 0.        ,        -inf,        -inf],
         [       -inf,  0.        ,        -inf]],

        [[       -inf,  0.        ,        -inf],
         [       -inf,  0.        ,        -inf]]])}
```

[10]:

```
# %%
# Test your code (this time no warning)
model = nb_train(Xex, yex, alpha=2)  # here we use add-one smoothing
model
# This should produce:
# {'logcls': array([[[-1.60943791, -0.91629073, -0.91629073],
#          [-0.51082562, -1.60943791, -1.60943791]],
#
#         [[-0.69314718, -1.38629436, -1.38629436],
#          [-1.38629436, -0.69314718, -1.38629436]],
#
#         [[-1.38629436, -0.69314718, -1.38629436],
#          [-1.38629436, -0.69314718, -1.38629436]]]),
#  'logpriors': array([-0.84729786, -1.25276297, -1.25276297])}
```

[10]:

```
{'logpriors': array([-0.84729786, -1.25276297, -1.25276297]),
 'logcls': array([[[-1.60943791, -0.91629073, -0.91629073],
         [-0.51082562, -1.60943791, -1.60943791]],

        [[-0.69314718, -1.38629436, -1.38629436],
         [-1.38629436, -0.69314718, -1.38629436]],

        [[-1.38629436, -0.69314718, -1.38629436],
         [-1.38629436, -0.69314718, -1.38629436]]])}
```