Lab 7: Convolutional Neural Networks

Jupyter Labs

1. Load course virtual environment

   ```
   source /usr/swat/bin/CS63
   ```

2. Exit virtual environment using `deactivate`

3. Clone and enter your github directory

   ```
   cd cs63
   git clone git@github.swarthmore.edu:CS63-Fall26/lab07-...
   cd lab07-...
   ```

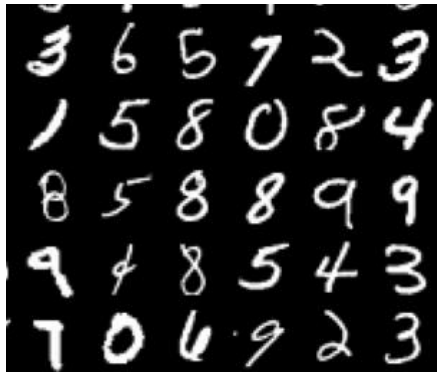
4. Run `jupyter-lab`

Lab 7 as warmup for final projects

- Pick a machine that has a good GPU (see lab writeup)
- Primary output is a lengthy writeup (code only small part of grade)
- Writing a paper using LaTeX
  - Go to /home/meeden/public/latex-example
  - See paper.tex for examples of how to make a table, insert a figure, include an algorithm, and add a bibliography

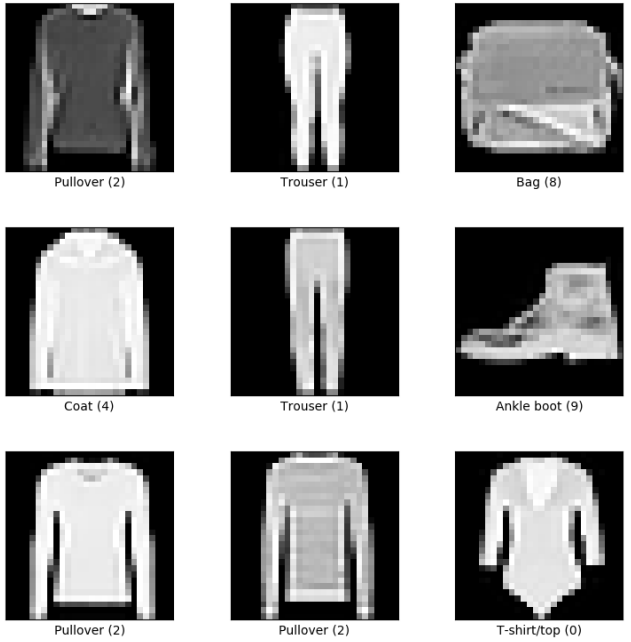
Lab Overview

There are two Jupyter notebooks associated with this lab



1. digits.ipynb – build a neural net and convnet for the digits MNIST dataset

2. fashion.ipynb - uses the (more challenging) fashion MNIST dataset



Digits Notes

- Must of the code has been provided – walk through to **understand** how to use Keras/AITK to build, train, and inspect a model

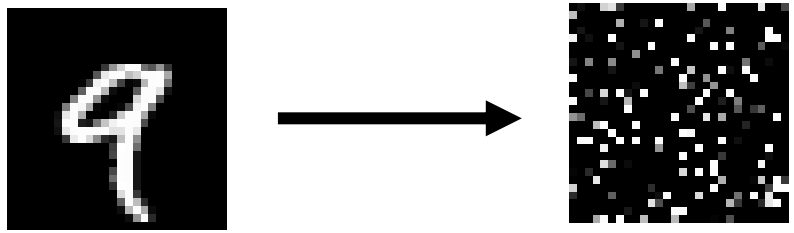
- Write observations in the notebook

- When you want to re-run a network you have to remake the architecture (this is where new random initial weights are set)
  - Try and modify, re-compile, and re-train the network

Digits Notes

1 2 3 4

- Part 1 & 2: Neural network vs Convolutional Net
  - What is the biggest difference between a standard neural network and a convolutional network?
  - Which do you expect to do better on this data set?
  - Interpret results to identify common errors
- Part 3: Permuting the data
  - Jumble up the pixel ordering for each example – random but consistent (i.e., pixel 1 is randomly assigned to the same spot in every image)
  - If we permute the training data, what do we expect to happen to each network?



Fashion Notes

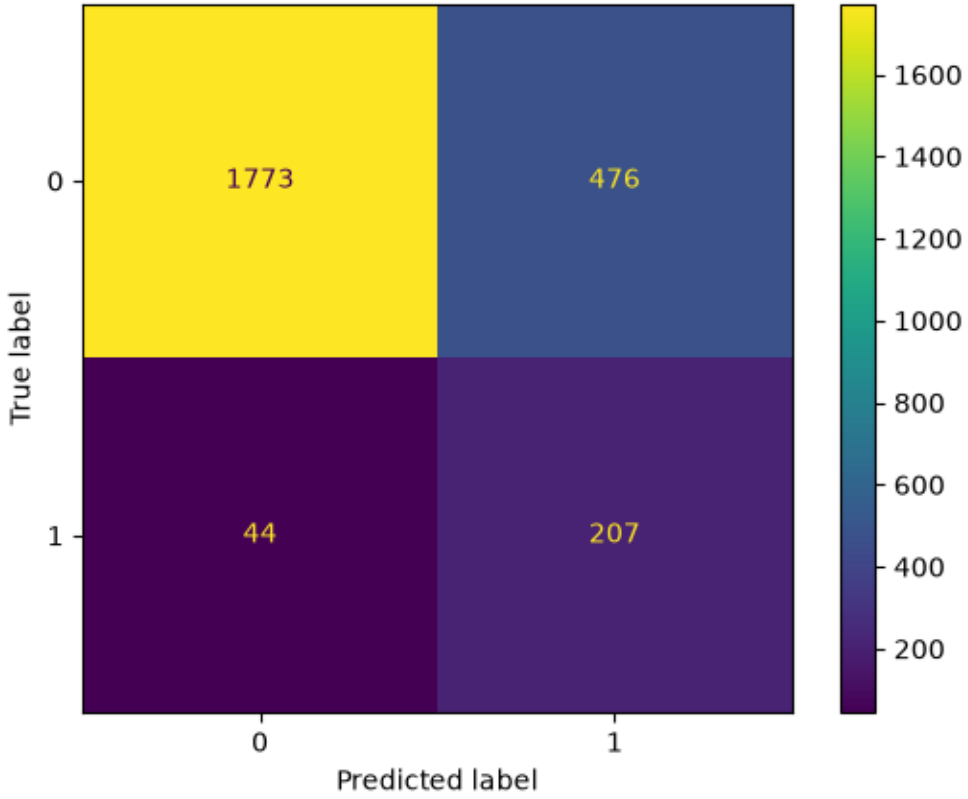
- Fashion data set is much more complex (will struggle to run on a standard laptop)
- You will write code and document observations
- Write all of your observations in the LaTex file.

Confusion Matrix

- How well does a model perform on prediction?
- So far we have only used accuracy. What are limitations of accuracy?

Confusion Matrix

- A confusion matrix is a table used to evaluate model performance
- It compares the model's prediction to the actual value



Example

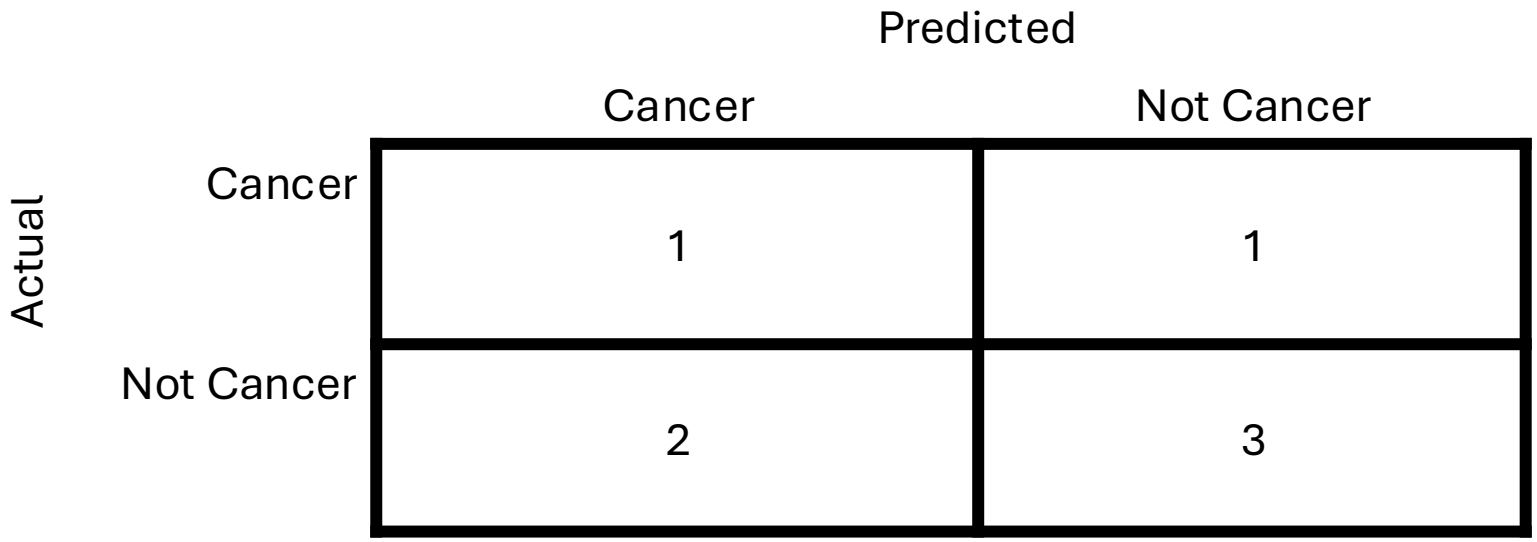
Actual	Prediction
Cancer	Cancer
Not Cancer	Cancer
Cancer	Not Cancer
Not Cancer	Cancer
Not Cancer	Not Cancer
Not Cancer	Not Cancer
Not Cancer	Not Cancer

How many Cancer patients are predicted to have had Cancer? Not Cancer?

How many Not Cancer patients are predicted to have had Cancer? Not Cancer?

Example

Actual	Prediction
Cancer	Cancer
Not Cancer	Cancer
Cancer	Not Cancer
Not Cancer	Cancer
Not Cancer	Not Cancer
Not Cancer	Not Cancer
Not Cancer	Not Cancer



What information can you extract from this table?

Confusion Matrix for Multi-Class Prediction

