

# Exploration: fast.ai

Eckel, TJHSST AI2, Spring 2022

## Background & Explanation

The use of deep learning is still a new and burgeoning field of computer science, and the makers of the fast.ai Python library have recently written a textbook, available online with runnable Python code cells and accompanied by optional video lectures, that will get you very nearly to the current state of the art in the field. We'll finish out the year with you getting a chance to play around!

The material in this textbook is **dense** and **thorough**, and will often cover material we've discussed in class already. All of these are good things if you give yourself patience to read through them – seeing similar material from another perspective helps form new connections. As a result, part 1 of this assignment is **mostly just reading** with a quick response at the end of each chapter. I strongly recommend that you don't try to sit down and do this whole assignment in one sitting; a plan like "read 20-30 mins a day each day until it's done" is a better idea!

For part 2, I'll give you several options for something to do with what you've learned!

## Part 1: Setup & Required Reading

Go to the link on the course website. Follow the instructions **COMPLETELY AND CAREFULLY** to make sure you can get each chapter of the online textbook copied to your google drive **and running on a GPU runtime**. (Many students make the mistake of just clicking to open a chapter and not reading further; **YOU DO NEED TO READ ALL THE INSTRUCTIONS!**)

It is worth noting that these chapters were exported to a real actual textbook; as such, they do occasionally have formatting oddities and missing links. You can purchase the real textbook if that bothers you, but in practice, I didn't have any problems following along. (The link to the real textbook is also on the course website.)

To get credit for part 1 of this assignment, you need to do the following:

- Copy and read the introduction to Jupyter Notebooks
- Copy and read Chapter 1, running every code block as you go. At the end of the chapter, pick the 4 most interesting questions in the questionnaire and answer them OR write a 2-paragraph response describing a couple of high points of the chapter and your reactions to them.
- Repeat the same instructions for Chapter 2 – read, run every code block, respond at the end. There are exceptions - **you don't have to do anything that doesn't work in colab, or anything that requires you to sign up for an Azure account** (see part 2).
- Repeat the same instructions for Chapter 4 – read, run every code block, respond at the end.

Put your three responses into a single DOC, DOCX, or PDF file and submit to the link on the course website.

## Specification for Part 1

Submit your **document** to the link on the course website.

This assignment is **complete** if:

- The "Name" field on the Dropbox submission form contains your **class period**, then your **last name**, then your **first name**, in that order.
- Your document matches the specification above.

## Part 2: Use What You've Learned

Below is a list of several options for something you can do with what you've learned. Some of them are quite short; some are quite long. What you'd like to do is up to you; no judgment from me!

I want to be clear, though, that I'm leaving a lot of instructions unwritten in this assignment because I want you to build skills at finding your way around websites like this yourself. We're approaching the current state of the art, and that means you're approaching a professional level of skill, and *that* means you'll need to be able to get set up on websites like this without much help from a teacher! Of course if you have problems you can ask me questions, but I haven't tried too hard to find all of the answers and I may tell you that you're on your own; this is *part of the assignment*, and you should be prepared to spend time being resilient, googling things, searching the fast.ai documentation, etc. This is not intended to be 100% smooth!

That all said, I'm **delighted for you to work with a partner or even a small group**; the flexibility is high on this assignment. Tell me what you're looking for and I'm in.

Some possibilities, in no particular order:

- Last year, Chapter 2 mentioned the ability to sign up for a free Azure account and do some image searching. If that's still true this year, this is one option; this counts as using what you've learned, but it comes with some caveats. Your free account needs validation by phone number and credit card. Obviously, I don't require that you do this! But if that doesn't bother you, it's fun to see how good an image classifier you can make. (I made a quite successful classifier of alien races in the Mass Effect games, for instance!) If this is no longer true, someone should tell me so I can update the assignment!
- The assignment at the end of Chapter 4 to redo the chapter with MNIST is an **outstanding** exercise that can be done at a couple different levels of detail. MNIST is included in fast.ai and can be accessed by using a similar line of code to what you see near the top of Chapter 4: `path = untar_data(URLs.MNIST)`
  - Simplest level of detail: don't worry about any of the nitty gritty, and just apply the resnet18 network. Including the line of code I gave you, you can write this entire training process in 4 lines! To get credit, you'll need to do a little more though. I'll want you to produce **a confusion matrix, a list of the most confused labels, and a plot of top losses**. Include them in your document. If any of these isn't demonstrated in Chapter 2, it is in either Chapter 5 or 6, and can be searched.
  - Alternately, you can really go through the whole of chapter 4, step by step, making each component as you go. If you want to understand how deep learning functions, this is an incredibly fulfilling exercise! It's definitely higher on the time commitment, though.
- Find your own data set on Kaggle and do something with it.
  - Kaggle.com has a ton of freely available data sets. The easiest option here is to find an image classification data set, figure out how to put it on Google Drive and point your Jupyter Notebook at it, and make an image classifier this way. You don't have to sign up for an Azure account, but you do have to do a little more work on Google Drive.
  - Alternately, find something more complex – something categorical. Something like (or perhaps just literally exactly this) the data set I gave about weather in Australia. Predict!
- Follow one of the other examples to use machine learning on data you have access to or can generate that isn't images. I'm open to pretty much anything here!
- Take a piece of one of the chapters you found difficult to understand. Find a better way of explaining it, and make a video to help a student next year understand that topic more thoroughly.
- Something else?

## Specification for Part 2

Whatever you choose, write / screenshot some kind of document about what it was and how it went. Submit your **document** to the link on the course website. If this doesn't feel like the right way to turn in your assignment, let me know and we'll work something out.

This assignment is **complete** if:

- The "Name" field on the Dropbox submission form contains your **class period**, then your **last name**, then your **first name**, in that order.
- Your document matches the specification above.

## Option for BLACK credit: Full MNIST Walkthrough

One thing I'd really love for someone to do is combine a couple bullet points from above and make a video walkthrough of recreating Chapter 4's piecemeal construction of an MNIST-SAMPLE construction with the full MNIST data set. You'd need to do this yourself, then start over with a new Chapter 4, and have a video where you narrate each piece of code you change and why, explaining concepts as you go. It can be a long video! (In fact, it ought to be!) You'll need, for example, to replace the entire structure in the chapter of using a single 1/0 output to using the 1x10 matrix like we did for the neural networks. This is a lot of work, but it'd be awesome.

## Option for BLACK credit: Spend a Lot of Time on This

If you spend more than 10 hours on whatever your Part 2 option is (not including the reading/responding in Part 1), whatever it is, just tell me and I'll give BLACK credit for that as well.