OCR Handwriting Project Outline

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1 May 14, 2019

1.1 Summary of Design Decisions

The project will follow an abstraction based design: letters, words, lines, and entire documents. Every document can be broken down into these respective groups of abstraction.

(i) An entire document.

(ii) A collection of lines in a document.

(iii) A collection of words that are consecutively placed on each line.

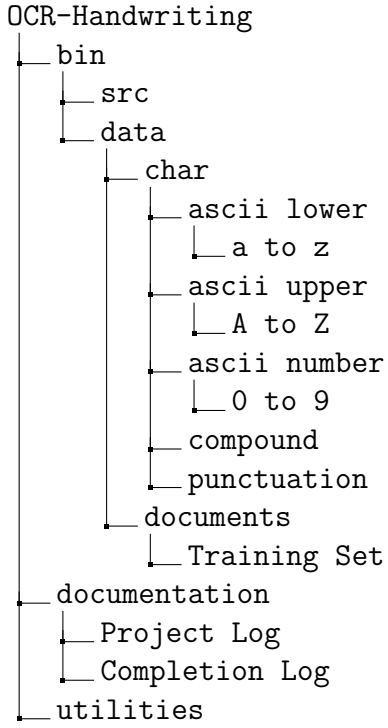
(iv) Single characters that make up the words.

It can be seen that each level abstraction relies on the previous, going all the way down to the individual letters that are on the document. Given the nature of that abstraction Dr. Johnson suggested we start from the ground up, meaning first we will be building the data set for letters, and training a model to recognize other letters of similar (1800's English) style. Our current priority is to build this large data set of characters for our neural network to pull from. After this set is built up we will work on figuring out the optimal design of our model and start to train it. After this section is completed we will have a network that can identify individual characters. From this base level we will then work on the next level of abstraction, that will be able to identify the words in a line. The project will follow a similar style of abstraction based progress until we can use every level to read an entire document.

1.2 Some specifics

We currently have 7 documents that have been allocated for our project. The first 4 will be used to create the data set of images. On top of simple screenshots, we will also employ GPUs to transform the images to get the most mileage out of each photo. The last 3 will be later allocated into development and strict testing sets. These will be allocated as the training set is developed.

1.3 Description of file system



(i) Bin contains all of the 'raw' data such as images, and documents where the images come from. Each sub directory is ordered.

(ii) The section 'compound' has been added due to the nature of John Quincy Adams handwriting. There are several small phrases like 'Mr' and 'Dr' that appear more as one character than 2. This is why it is denoted as 'compound', meaning more than one letter interpreted as a single unit.

(iii) Documentation contains this document, as well as any other documents that are needed to explain the project.

(iv) Utilities contains all scripts, programs, or software that we use as a supplement in order to complete the project.

1.4 Significant Developments

1.4.1 May 14, 2019

Total images taken: 296

Matt created a python script that renames the pictures in the subdirectories according to a naming scheme, this allows for saving files without having to worry about typing the name into the save box. Doing this means the whole process takes 10x less time. When taking photos one can either: focus on a letter saving several in a certain directory (fastest), or save all photos to a "dump" folder and place them afterwards in their correct directory.

1.4.2 May 15, 2019

Letters completed: 'a' , 'e' .

Total images taken: 2,075

Process for quickest imaging (Modified 5/21):

(i) Pick a letter that has a lower than needed sample size (¡ 500).

(ii) Using Lightshot, take a screenshot of a letter, and click the save button. Navigate to the respective directory and save.

(iii) For all subsequent letters, take the photo and use shortcut CTRL-S and it will auto-save to the same directory.

(iv) After you find as many as you can on the page, or several pages, move on to the next page.

(v) After around 125-150 letters from a given set of pages, go onto another set of pages.

(vi) Before pushing to git, run the renameUtilityScript.py file which will rename all of the files to the appropriate schema.

1.5 May 16, 2019

Letters completed: 'b'.
Total images taken: 864

(i) Made changes to the script so that it can be run on any machine without needing to edit the path in the file. If anybody wants to run it, python must be installed and they can either manually run it or write a bat file. There is a provided bat file skeleton, all that needs to be added is the path to the .py utility, and it can be run from anywhere.

1.6 May 21, 2019

Letters completed: 'c', 'd', 'i', 'f', 'g', 'h'
Total images taken: 3,054

(i) Purchased the font "Old Man Eloquent" that we will use to diversify our samples. The current plan is to photograph the font in various contexts and use CUDA to transform the images to extract a large amount of diverse images from one example.

(ii) Mike and Matt had a conversation outlining the plan for hardware to be able to transform images. Once the types of image transformations are chosen, Matt will create software that will be able to be used without programming experience.

(iii) Matt suggested using an image normalization algorithm to give each image the same scale. It would involve locating the global min and max for width and height, and setting each photo to those dimensions. This could be important for making sure the network does not pick up on unintended scale related differences between letters.

1.7 May 22, 2019

Letters completed: 'j', 'l', 'm', 'n'
Total images taken: 1,928

(i) Matt created a completion log complete with all characters so that we can more easily keep track of completed characters.

1.8 May 23, 2019

Letters completed: 'k', 'o', 'p'
Total images taken:1,004

(i) No important developments today. Good progress on imaging.

1.9 May 28, 2019

Letters completed: 'q', 'r', 's', 't', 'u'
Total images taken: 2,244

(i) Today we completed 5 characters towards the end of the alphabet. I have high confidence that by tomorrow we will complete all lowercase imaging. This means we are slightly under halfway to completing the data set

(ii) Another important development is that we passed 10,000 images in just 7 working days, a great achievement. We are currently working with: **11,465 images.**

1.10 May 29, 2019

Letters completed: 'v', 'w', 'x', 'y', 'z'
Total images taken: 1,924

(i) Today I completed 5 characters. Additionally, with the completion of 'z' the entire lowercase alphabet has been concluded. I would venture to say we are likely half way currently. Although there are more than just the upper-case section left, those are far less common and hence will include fewer screenshots.

1.11 May 30, 2019

Total images taken: 1,001

(i) Today I worked from home, the log is being updated retroactively.

(ii) The most important development from the day was a change in the way we collect screenshots for the upper case characters. Rather than picking a character and moving through each page for that character, for upper case (or generally less frequent sets of multiple characters) find all examples on the page and screenshot them. After this, move onto the next page.

(iii) Because the amount of upper case characters is far lower than lower case letters, we are just taking as many samples as we can get. Therefore there will be no more "letters completed." Upper case letters will be completed when all examples of them are recorded

(iv) Finished up to page 17 of DJQA 1829-02.

1.12 June 4th, 2019

Total images taken: 1,495

(i) Today was a standard day, continued to image the upper case letters.

(ii) There was quite a lot of progress in terms of images taken as well as total traversal of the data set. We are almost half way through the data for upper case letters. This puts us in a great position, well over half way done with overall imaging.

(iii) Finished up to page 16 of DJQA 1829-03.

1.13 June 5th, 2019

Total images taken: 1,247

(i) Not many important developments today, the only noticable change would be that as I have progressed, the density of upper case characters has seemed to dwindle, as can bee seen from the total for today.

(ii) Finished up to DJQA 1829-04 section 17. Meaning we got just over 30 pages of material today, exactly the same as the previous 2 days of upper case imaging.

1.14 June 6th, 2019

Total images taken: 936

(i) Completed up to DJQA 1829-05 section 19. On the road to complete upper case before lunch of the next work day.

1.15 June 11th, 2019

Letters Completed: All capital letters besides 'O', 'L', 'X', 'Z'.
Total images taken: 1,077

(i) Capital letters are virtually completed, all that is left is specfic imaging to expand the sets of several select capital letters.

(ii) Imaging has moved onto compound letters, completed through DJQA 1829-03 Section 20.

1.16 June 12th, 2019

Letters Completed: 'Mrs', 'Mr', 'Dr', 'ss'
Total images taken: 750

(i) Completed all compound letters.

(ii) After completing compound letters, we moved onto completion of imaging the numbers.

(iii) Imaging of numbers reached DJQA 1829-03 section 24.

(iv) Also did a lot of reading that is necessary for the continuation of the project.

1.17 June 13th, 2019

Total images taken: 750

(i) Continued imaging of numbers for numbers, currently on DJQA 1829-04 section 19.

1.18 June 18th, 2019

Letters Completed: ':', comma, period, question mark, exclamation mark.
Total images taken:

(i) Significant imaging of the punctuation set.

(ii) The last 2-3 hours were spent on the first iteration of proof of concept.

(iii) This proof of concept will focus on making a convnet that properly identifies 4 of our letters with using minimal data altercations. After this we will move to iteration 2 where we simply alter the data.

(iv) After 2 we will most likely open up to more letters and continually scale and test the software.

(v) Phase 1 of the testing was completed. With a data set totaling 2,000 images in 4 categories (namely 'a', 'b', 'c', 'd') Matt constructed a convolutional neural network that has a peak of 94.69% validation accuracy. Note, the network did not use image preproccesing to change the size of the dataset, which will be used in test 2.

(vi) The network form that was used in this exercise was as follows:

(vii) Model: Sequential

(viii) Layer 1: Convolutional 2D

(ix) Layer 2: Max Pooling 2D

(x) Layer 3: Convolutional 2D

(xi) Layer 4: Max Pooling 2D

(xii) Layer 5: Convolutional 2D

(xiii) Layer 6: Max Pooling 2D

(xiv) Layer 7: Convolutional 2D

(xv) Layer 8: Max Pooling 2D

(xvi) Layer 9: Flatten

(xvii) Layer 10: Dense (512)

(xviii) Layer 11: Dense(4 - categories)

(xix) Below is an image that depicts the 'learning' of the model from test 1.

(xx)