MWilliamson96 / FlatironCapstone

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data	changes to final notebook and moving sample images	3 hours ago
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src	expanded on model_dev_10 to get better performance on the recreate...	yesterday
.gitignore	changes to final notebook and moving sample images	3 hours ago
README.md	Update README.md	7 minutes ago
environment.yml	final notebook all code added	7 days ago

About

Classifying images from reddit.com/r/Art by their medium

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Jupyter Notebook	99.8%
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README.md

Reddit Art Classifier

This project is designed to create a CNN classifier using images pulled from r/Art on Reddit.

Image classification is a widely used process and a significant ammount of research and applied technologies have indicated that convolutional neural networks are one of the most optimal algorithms for image recognition. Convolutional neural networks have proven to be highly capable and extremely accurate at recognizing objects within images as well as identifying diseases and tumors in tissue and brain scans. This project will be something simmilar to the latter of the two in that the objects in the image are irrelevant, instead I'm trying to get my model to pick up on the small details in the image that would indicate the difference between a real brushstroke and a digital brushstroke.

This project was built primarily as a way for me to practice building large datasets by writting code to automate the process of pulling data from a website, attaching labels to the data, and then sorting and storing the data. The process I used to develope my dataset is probably the most generalizable work contained in this project, though I can see some potential applications for the model itself given time to train it on a large enough dataset. I think a potentially more useful approach, specifically in terms of applications aimed at improving the user experience on reddit, would be to build a classifier that pulls images from a multitude of different subreddits that could then be used to classify new images by which subreddit they should be posted to (for example an art piece would be classified as r/Art while a meme might get classified as r/memes). This type of classification would require a slightly different model architecture but the overall process developed in this project would lend itself nicely to this extrapolation.

The Repository

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FlatironCapstone
|
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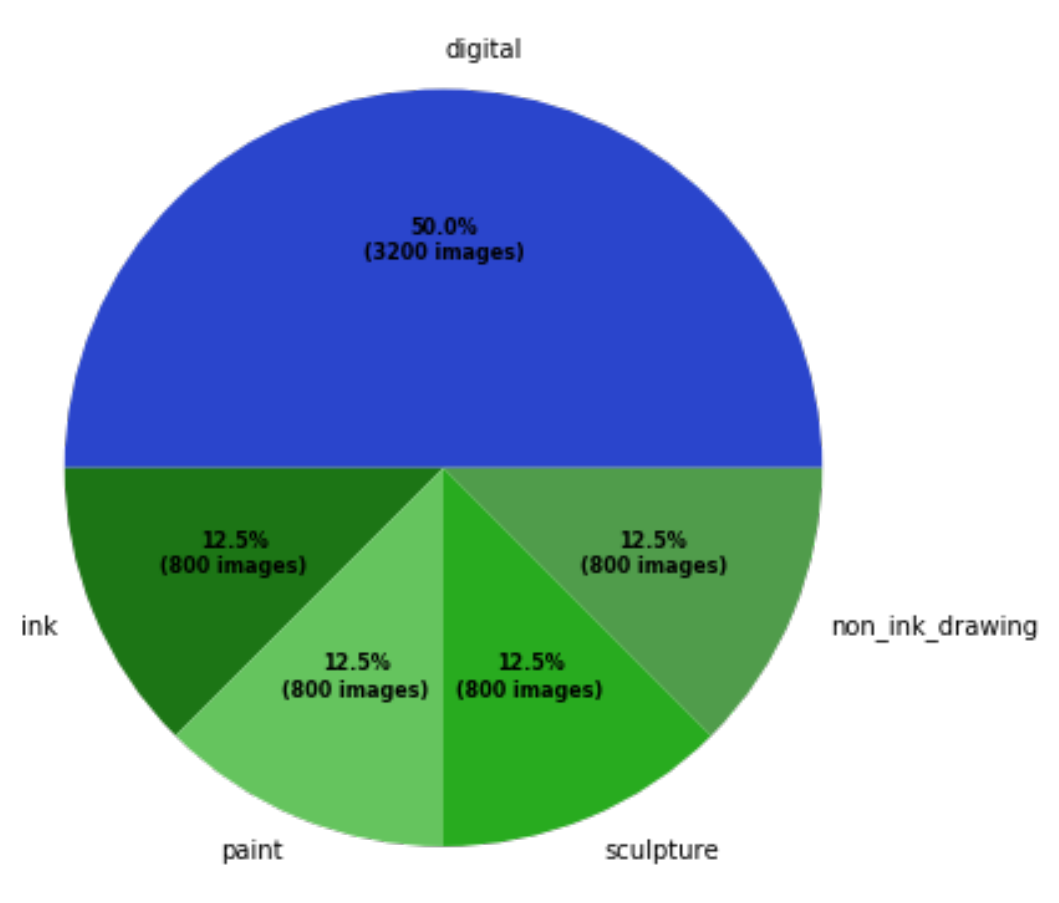
```

The Data

To gather the data used in this project, I used the Python Reddit API Wrapper (PRAW) coupled with the PushShift API (PSAW). I used the APIs to pull batches of 1000 r/Art submissions at a time. I then parsed those submissions to find ones that had titles formatted according to the subreddits title standards. Additionally, I checked the properly formatted posts for upvote ratio and self-text. This additional check was performed to identify and remove poor quality, offensive, or deleted images. I found that posts with deleted images contained a self-text string equal to either *[deleted]* or *[removed]*. Similarly, I found that many of the poor quality or offensive images I had collected had extremely low upvote ratios typically below .4 while the average upvote ratio for the entire dataset was .92. As a result I decided not to include the image from any post that had an upvote ratio of less than .4 as these images were typically either such a low quality submission that they were not really representative of the images I was trying to classify or they were simply too offensive to be included in a project that I intended to use as a showcase of my skills in a proffesional setting.

For this project I used a dataset of 6400 images, 3200 that were made using digital means, and 3200 made using other means. Only about one third of posts made to r/Art are created using digital means, so my code ensures that an equal number of posts is collected from each category to produce a balanced dataset. Taking a look at the distribution of medium types, you can see that the number of digital and non-digital images is equal, although there are still a total of 5 different medium classes (digital and non-digital which contains 4 classes: ink, non-ink-drawing, paint, sculpture).



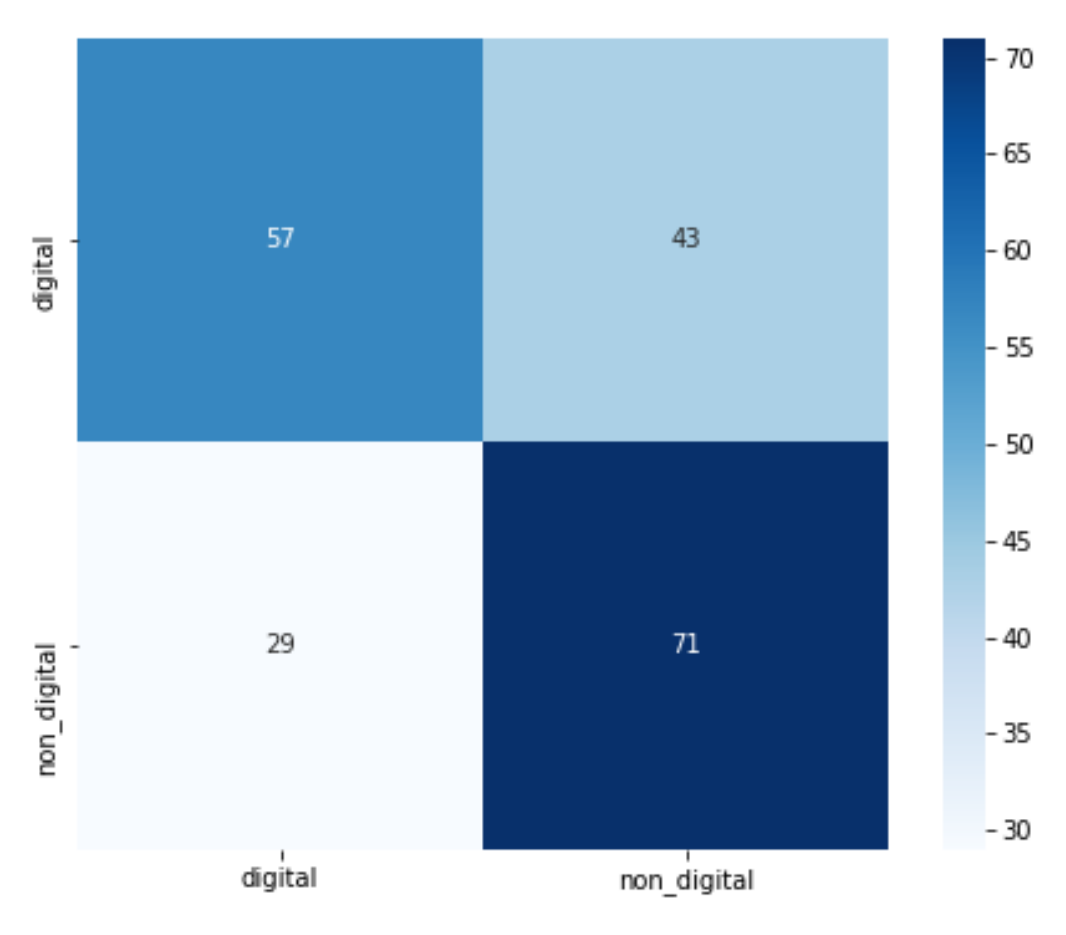
If you would like to reproduce the exact dataset that I used, there is a json file in the data folder of this repository that contains the meta-data for all of the images I used. There is code that has been commented out in the final_report that can be uncommented and run that will read the json into the notebook. After running the specified lines of code, running the following code cells will download the images to your local drive.

Modeling

I chose to model my dataset using a Convolusional Neural Network since CNNs typically produce good results when using a dataset comprised of images. When considering the architecture of my network, I thought it would be important to get the model to pick up on the small details in the images such as brush or pen strokes as this would be most indicative of medium. With that in mind I made two significant decisions regarding model architecture. The first and most effective decission was to ensure that the data generators used to feed images into the model were scaling down the image in a way that minimized loss of pixel level information like small scale lines and gradients. I did this by keeping the images relatively large (300x300 pixels) relative to many typical CNN models as well as by using bicubic interpolation which creates much smoother gradients and is better at retaining crisp lines compared to other interpolation methods. The second key decision I made in an attempt to target low level features was to choose tanh as the activation function for my first convolutional layer while using relu for the rest of my layers. The first layer of a convolutional layer is where the low level features are the most prominent so by using tanh as my activation in the first layer I can get my model to express even greater emphasis on differences in the low level features since tanh can produce negative activations while relu can only produce activation values of zero or greater.

Model Evaluation

Below is the confusion matrix for my model's predictions on the validation data



Overall my model was able to achieve 64% accuracy which is significantly better than randomly guessing, but still not quite as good as I had hoped to achieve. The main issue is a severe underperformance when predicting on images that have been produced digitally. I think this is partly due to many digitally produced images being created with the intention of mimiking traditional art media. This can be seen in the sample images that were misclassified by my model below. Additionally it appears that my model had some difficulty distinguishing between digital art and sculptures. I believe this is in part due to the fact that many digital images also strive for photorealism and the model then begins to think that real images of sculptures are actually digital images. The model was generally pretty good at identifying images that were not produced using digital means, but of the non-digital images it did misclassify, a significant percentage were sculptures.

This image is a sculpture, however the style and material used appears to resemble other medium types which may be confusing the model

This image was produced digitally, though it is extraordinarily similar to a graphite drawing

Stereozont 2020

This image was also produced digitally, though again the photorealism is truly stunning and difficult for the model to discern

Conclusion and Potential Improvements

I could potentially improve on this model a few different ways. The first could be as simple as increasing the size of the dataset. Due to time constraints and the ammount of time it took to download all of the images necessary to create the dataset as well as the time it takes to train on larger datasets, I capped my training data at 6000 images. My code searches for posts in chronological order and the 6400 it collected (the additional 400 being the testing and validation sets) only dated back about a month at the oldest. Considering the subreddit was established in 2008, there are plenty more images available for me to concatonate to my dataset. Another potential solution would be to create an ensemble of CNN models that pick up on different features within the images. This could potentially increase accuracy on images that my current model is less certain about. Regarding my process for collecting data, using both PRAW and PSAW APIs was not entirely necessary for my purposes. PRAW is only necessary if you need live updates from reddit or if your application needs to make posts or comments or needs to use moderator commands. My use case didn't need any of these things, so just using PSAW would have likely been sufficient while also reducing the complexity of my code in some places. Moving forward I would like to use this code as a starting point for creating a generalized dataset constructor that allows a user to build any kind of dataset using Reddit data given unique search and validation parameters. Considering most of the time spent in data science projects is gathering and cleaning data, anything I could produce that might expedite this process could prove to be extremely useful to both myself and others.