

Week 1

Progress

Over the break, we made little of the progress that we originally hoped to achieve. Chase got in contact with a Rheumatoid Arthritis expert from OHSU whose response to our application proposal was tepid at best. He responded to the idea of the application, saying “I am not trying to discourage you, but truthfully, I am not sure how much use this app will be for me or my patients.” After a urgent series of emails with Brett, Chase determined that the value of the application we are trying to create does exist, but that it is not well recognized by physicians because it is simply the first step on the path to developing a technology that we hope will be able to predict flares.

Another development was our discovery of the MASK_RCNN segmentation network, which we will be using to segment hands out from images that patients take with their phones. The goal of segmentation is to reduce the amount of noise in each image, which we believe will allow us to achieve higher accuracy with fewer training images. MASK_RCNN uses TensorFlow, Python3, and the Keras API, which is exactly what we plan to use for our project. It is designed to be easily extensible, according to its creators, which is important since we need to train it with our own dataset of hand images.

As of 1/10/19, Ethan has gotten the base MASK_RCNN working, and Chase has not.

Problems

As mentioned above, Chase has not been able to get the basic version of MASK_RCNN working. He has run into issues with the make file included in coco/PythonAPI.

Another issue that has arisen over Winter Break involves our plan to use the template application named “FDA MyStudies” as a base for our data collection application we will market through Facebook. Brett and Arif hired a developer team to investigate using the template app for other parts of their business. But according to those developers, the app is not well documented, not easily extensible, and very hard to get working.

Plans

We plan to avoid the issues with FDA MyStudies by avoiding it altogether. At the moment, we plan to go back to a progressive web app and use that to harvest the images and accompanying surveys we need.

Week 2

Progress

This week, we made some progress on the segmentation network. The open source library we found, Mask_RCNN, has a convenient docker container that we can use with it to install all unmet dependencies. Docker is extremely convenient, and we thought it would be useful to learn how to use it both because it has value within the scope of our project, and because it will be a useful tool once in industry. Unfortunately it is rather difficult to install docker. Docker is only available for Windows 10 Pro, Enterprise, or Educational editions. It is also available for Ubuntu server. Since ubuntu servers don't have a GUI, and since whatever computer we run our server on would benefit tremendously from being remotely accessible, the only current option is to run Docker on Windows 10.

This necessitates an annoying and time consuming switch from Ubuntu development to Windows development, which we are currently in the process of performing. Since Chase's laptop is the only one among the group with a graphics card, it needs to be set up to train the segmentation network, therefore Chase must install docker, tensorflow gpu version, and anaconda.

Chase found out on Friday that he could download Windows 10 Educational edition from the school, which he did. After doing so, he downloaded Docker.

Chase also made a connection with a PHD student named Aayam Shrestha, who has volunteered to consult on our project. He is currently doing research on the topic of making deep learning neural nets more comprehensible. Hopefully Aayam can provide some useful advice and correct some of our (as of yet unknown) misconceptions.

Jared has also made some progress on building a progressive web app.

Problems

As mentioned above, installing docker has been very challenging. This challenge would have been substantially alleviated were we to gain access to the hardware we were promised in Fall term.

Unfortunately, as relayed to Chase by an email from Kevin, the instructors are still working on getting hardware, and are also looking at getting students set up on AWS (which would also work for our project, but which would be substantially more expensive)

Plans

The next step is to get MASK_RCNN training on Chase's laptop graphics card. This will require him to install anaconda and tensorflow-gpu on his laptop.

After that, Ethan and Chase need to figure out how to manually segment images for use in training the segmentation network.

Chase is also planning to arrange a meeting with Aayam to review our project outline and make sure it is at least feasible. Hopefully the meeting will also yield useful suggestions about how we could improve our approach.

Week 3

Progress

Chase talked with Aayam Shrestha about how to specifically implement the neural network. In the meeting Aayam described a process of identifying knuckles by essentially creating two filters: a joint identifier and a swelling identifier.

Jared did some work on getting the progressive web app working.

Problems

Getting a joint identifier working is going to require a massive number of labeled examples. Probably in the neighborhood of 100,000 bounding boxes. There may also be issues with training the identifier to identify unswollen knuckles using the dataset of 10,000 hands and getting the identifier to identify swollen joints and knuckles once we collect our data.

We also have still heard no word about when we will be getting hardware.

Plans

Chase needs to look into what kind of tools the group can use to create the knuckle identifier, and how to train a object localizer. He also needs to get a better idea of which knuckles can be grouped together for training purposes and how many examples we will need in order to achieve a satisfactory accuracy level.

Jared will continue working on the web app.

Week 4

Progress

This week we had a meeting with our Client in which we discussed the progress of the project and the direction we'll be heading.

Jared has also made some strong progress on the data collection app. He has made a simple UI, figured out how to access the camera, and is in the process of posting those images to a server, which can then store the images in a database.

Brett mentioned that there is a way to encrypt all personally identifiable information using Auth0 tokens. This will protect patient data in case we get hacked or do something stupid (the latter probably being the more likely scenario).

Brett also offered to let us use their Amazon Web Services account to train and run servers on if the school doesn't come through with their promise of hardware access.

Problems

Our lack of hardware access is killing us. Every week we get another vague statement about future plans from Professor McGrath, and every week he misses the deadlines he set to get us hardware or cloud access. Neither a half dozen emails nor in-person meetings with him have yielded any results in this area. Ethan simply cannot train neural networks on his computer, so he has opted to simply buy time on amazon web services with his own money while we wait for an AWS account from the school.

We also have a ton of work to do and not very much time. Our first term of this project was basically wasted creating a whole bunch of highly redundant documents.

Chase has also been swamped with work for other classes and for work, moving, preparing for his wife to enter nursing school, and commuting 2.5 hours per day to school. He has had difficulty making time to work on the capstone project.

Plans

The meeting with Aayam last week made clear just how much work we have to do to get even a joint identifier working. We're going to need tens of thousands of labelled examples, all of which we must create.

Chase is going to try to make some labelled examples of joints to feed to Mask_RCNN this week. He is also going to try to get his environment properly configured on his laptop so he can actually train using Mask_RCNN.

Week 5

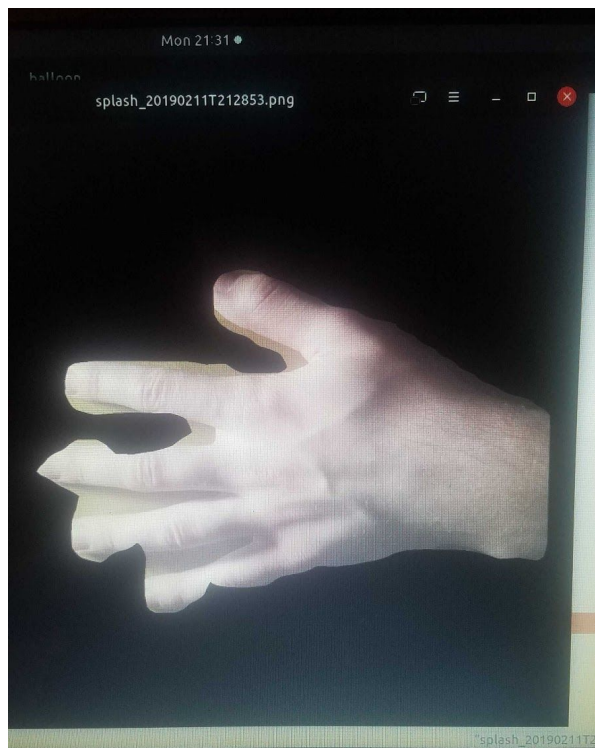
Progress

Three big things happened this week. The first was we finally got an email from Professor McGrath telling us that we had access to Amazon Web Services and giving us info to log in. The second (which resulted directly from the first), is that Ethan Patterson was able to get Mask_RCNN up and running on the server instance and train it to segment images of balloons. With a P2xlarge instance, it was able to train the segmentation network with 9 epochs in about 30 minutes, which is several orders of magnitude faster than his laptop was able to achieve.

The third thing was Jared got an awesome interface for the mobile app that will allow patients that download the app to easily enter their inflammation on every joint in their hand. The interface consists of a basic outline of a hand with a little toggle on every joint. The patient can toggle the switch on if they have tenderness or swelling in that joint. We think this sort of interface will result in more accurate and faster data entry than text-based instructions or any other alternative.

Chase and Ethan have also begun work on manually segmenting images of hands for training purposes. The balloon segmentation network required a surprisingly small number of labeled images to function correctly: only 60. This was partially due to transfer learning from the COCO image segmentation network, which I believe is an image segmentation network trained on many categories of objects. This significantly reduces the need for labelled examples, so we will definitely use it in our project. <http://cocodataset.org/#home>

The first result



Pretty amazing that it is working so well.

Problems

We still have a ton of work to do. We haven't yet figured out how to do the joint labelling or which GitHub repository we're going to raid to make our program work. That is Chase's job, since Ethan has done so much work on the segmentation network.

But most of the major problems we faced (lack of hardware, no working prototypes) have been addressed in significant ways over the past week.

Plans

Chase is going to start to look into feature extraction and localization. Perhaps he will ask Aayam, who helped identify the need for such a process earlier in the project's history. He will also help Ethan create more segmented images of hands if that turns out to be necessary.

Now that we have AWS access, Jared is going to try to set up a server that can receive images from the app and store them in a database.

Week 6

Progress

This week Ethan and Chase made some small amount of progress on the segmentation network. Ethan made it so the portion of the image that has been cropped out by the segmentation network is black.

Jared also made some minor progress on the data collection app.

Problems

The segmentation network only works well at certain angles (particularly when the wrist of the hand is at the top of the image and the fingers are pointing down). In other words, our segmentation network is not rotation invariant.

Another problem is we are running out of time to do the biggest part of the network (the joint detector). The amount of labelled training data we are going to need to create to train the network is mind-boggling: a hundred thousand bounding boxes. We suspect that Mask_RCNN may actually be able to do this step too, but we have yet to look into the details.

Plans

We plan to fix the rotation variance issue of the segmentation network by writing a simple script to rotate the segmented hand images, crop the areas that end up outside the frame, and infill the areas that are within the frame with white to match the color of the background. Perhaps this will be unnecessary if we can use some keras functions to set the rotation range of the images. This seems likely since rotational invariance is a commonly desired trait in neural networks. Chase will look more into this.

Chase will also get more up to speed on the segmentation network since he has fallen a little behind in his understanding of Amazon Web Services.

Chase will start looking into how to get Mask_RCNN working as a knuckle detector this weekend too, along with working on the rough draft of the progress report.

Week 7

Progress

This week we made some minor progress on the segmentation network and began work on the joint detector. During a meeting with our clients, Brett and Arif of Karate Health, they agreed to pay for data labelling through amazon turk so long as it costs less than \$500. This is a huge boon for us, as it removes about 60 hours of work for our group.

Jared has also started working on getting the data collection app to communicate with the server. Ethan has been working on getting labelled images to and from the server, as well as coming up with a plan for how to run inference on a webcam stream using Amazon Web Services.

Problems

We have not figured out how to run CNN inference on a video stream. This is a challenging task. We also have not yet started any serious work on the joint detector, which is one of the biggest challenges of this project.

Designing the network architecture to run this is particularly challenging, as we have only a vague idea of how CNN network architecture should be arranged. The placement of convolutional layers relative to fully connected layers, the placement of max pooling operations, the step of each max pooling operation, and other such considerations are among the choices we must make. Our plan is to imitate some of the architectures from the ImageNet challenge winners in 2012, 2013, and 2014. The later winners are probably too big for us to train in a reasonable time.

Plans

We plan to come up with a cost estimate and instructions to get the data labelled through Amazon Mechanical Turk using the VGG image annotator. So long as these instructions are reasonably simple, we should be able to get all of our joint images labelled this way.

Jared is going to get the phone app to send pictures to a server.

Chase is going to get his homework for other classes done so he can finally contribute something meaningful to this project. When he is done with that he will start designing the joint detector network.

Week 8

Progress

This week we made minor progress on data labelling and our expo presentation. Ethan finally managed to get the server/client system setup so that we can feed frames from a webcam to an Amazon Web Services server for the purposes of running neural network inference. This allows us to go from a rate of 1 frame per minute to several frames per second, which will make a huge difference for our expo-day presentation.

Chase also made some progress submitting a Amazon Mechanical Turk job for the purposes of data labelling. Getting 3000-5000 images labelled this way will significantly reduce the time we have to spend on boring menial labor. We calculated roughly 60 hours of time spent labelling data if we did it ourselves. Doing it through Amazon Mechanical Turk will reduce that time to just a few hours to set up the proposal. And best of all, Karate Health has agreed to fund the data labelling.

Jared added a user agreement and title page to the survey in the data collection app. This is very important for making sure we are on firm legal ground with regards to how we use patient data. Basically the user agreement is there to help people understand what we're doing with their data and to protect us from lawsuits.

Jared also added a page with info about us and the project and is working on a list view to display results submitted to the app by users.

Problems

Chase is having problems making time for capstone work. We also still have a large volume of work to do to get our project working by the code freeze deadline, particularly work relating to the joint detector.

We are also running out of time to collect actual patient data that will make this project different from the tens of thousands of other neural network projects that undergrads have done.

Plans

Chase is going to email Brett to figure out how to get on Karate Health's Amazon account so that we can bill them directly for the data labelling. He is also going to try to run some training with just a few examples for the joint detector.

Jared is going to finish the list view for the app.

Ethan is probably going to join Chase on the joint detector.

Week 9

Progress

This week Chase investigated getting an Amazon Mechanical Turk job set up. He found that it is possible to display a rendered HTML page to the workers, and that the images needed for labelling can be remotely hosted. So long as the URLs for those images are in the source code, the client will be able to see and thus label them.

Ethan got the client and server code for the webcam image segmentation working.

Jared did some work on displaying previously taken images within the data collection app.

Problems

The tricky part of making the Amazon Mechanical Turk job work will be hosting the roughly 3000-5000 pictures of hands on a server where each image gets its own URL. Two simple options for hosting platforms are Imgur and Google Photos. Chase has looked into the API for google photos to see how to copy the URLs for a large number of pictures into a text file, but has not yet done so.

Another thing Chase has to figure out is how to modify the HTML document for the VGG Image Annotator to display some simple instructions to the workers.

Lastly, automatically loading pre-defined image annotations does not seem to be that simple. The proper way to do it is to load a project from the VIA page, but that will require the workers to download and open a file, and Chase is not sure whether that will be too complicated.

Plans

Chase will write a script to copy the image URLs into a text document so that the remotely hosted images will automatically populate into the client used by the Amazon Mechanical Turk workers. He will also put a tag on the project when he submits it for actual workers to do so that Karate Health can cover the bills for this data labelling. He will also figure out the other problems that might arise.

Ethan will begin work on the joint detector.

Jared will continue working on the data collection app.

Week 10

Progress

Well Christopher, as usual, it has been a week in which Chase planned to do more than he actually did.

This week Jared, Ethan and Chase made some reasonable progress on the data collection app and on connecting the image segmentation to the data collection app via AWS. Chase mostly went in circles trying to figure out how to work with the Google Photos API, but he got a better idea of the problems that will need to be solved

Problems

We plan to outsource our data labelling to Amazon Mechanical Turk workers. However, this requires us to make an HTML-based interface for workers to label our images. We plan on using a slightly modified version of the VGG image annotator with remote image hosting, a custom set of instructions for workers and pre-defined attributes with which the workers can label the images.

We need image URLs to be able to populate the HTML tool with for the purposes of labeling. Our plan is to use Google Photos with Chase's personal email account and write a simple python script to format the URLs from an album of photos containing all the pictures of hands we need to label.

Unfortunately it is quite difficult to work with the Google Photos API. The tutorials assume a level of web development knowledge that Chase is lacking. The extensions that must be used and installed work well with Eclipse, the most popular Java IDE, but Chase has been unable to install Eclipse. There are some critical files missing, and after reading several stack overflow posts containing purported fixes, he is still unable to install the IDE.

Another issue is working with the API itself and getting OAuth2.0 tokens to work properly. Hopefully this won't be too difficult.

As usual, we are running short on time and brain power.

Plans

Chase will try to get the data labelling HTML code to work. Jared may help him get the custom instructions and attributes to be part of the page.