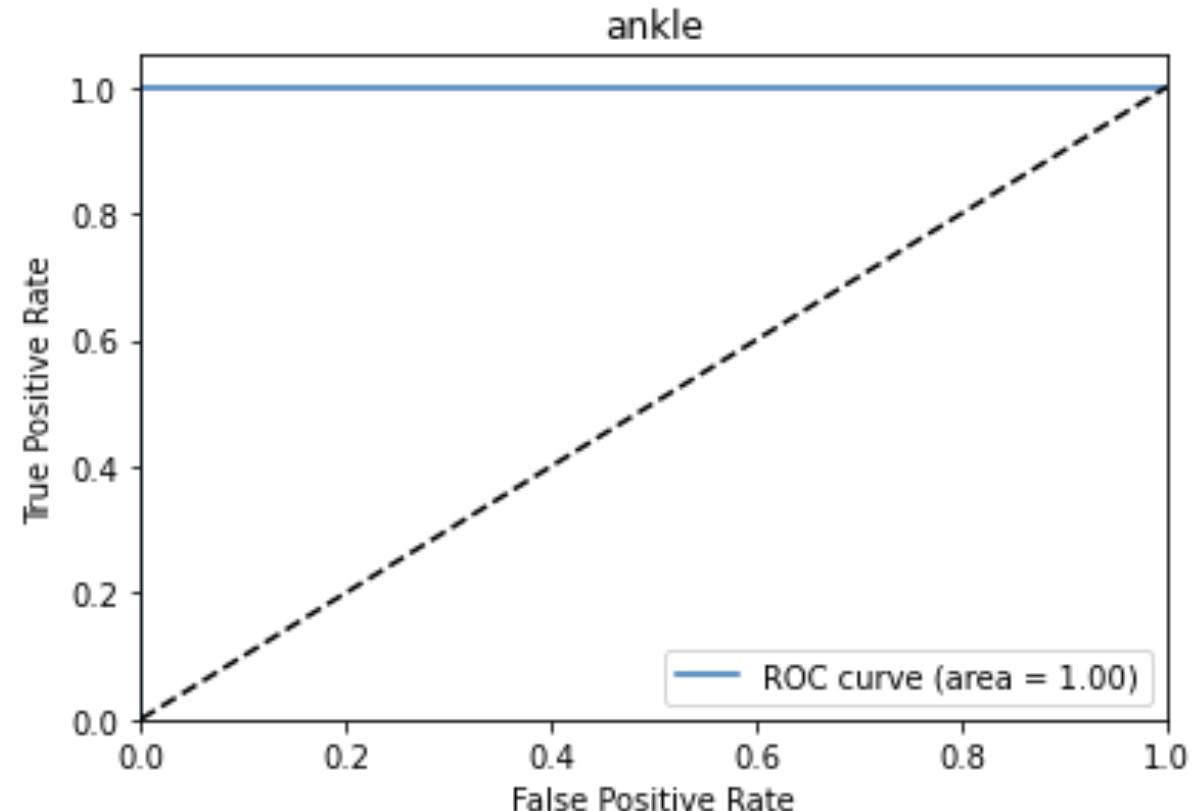
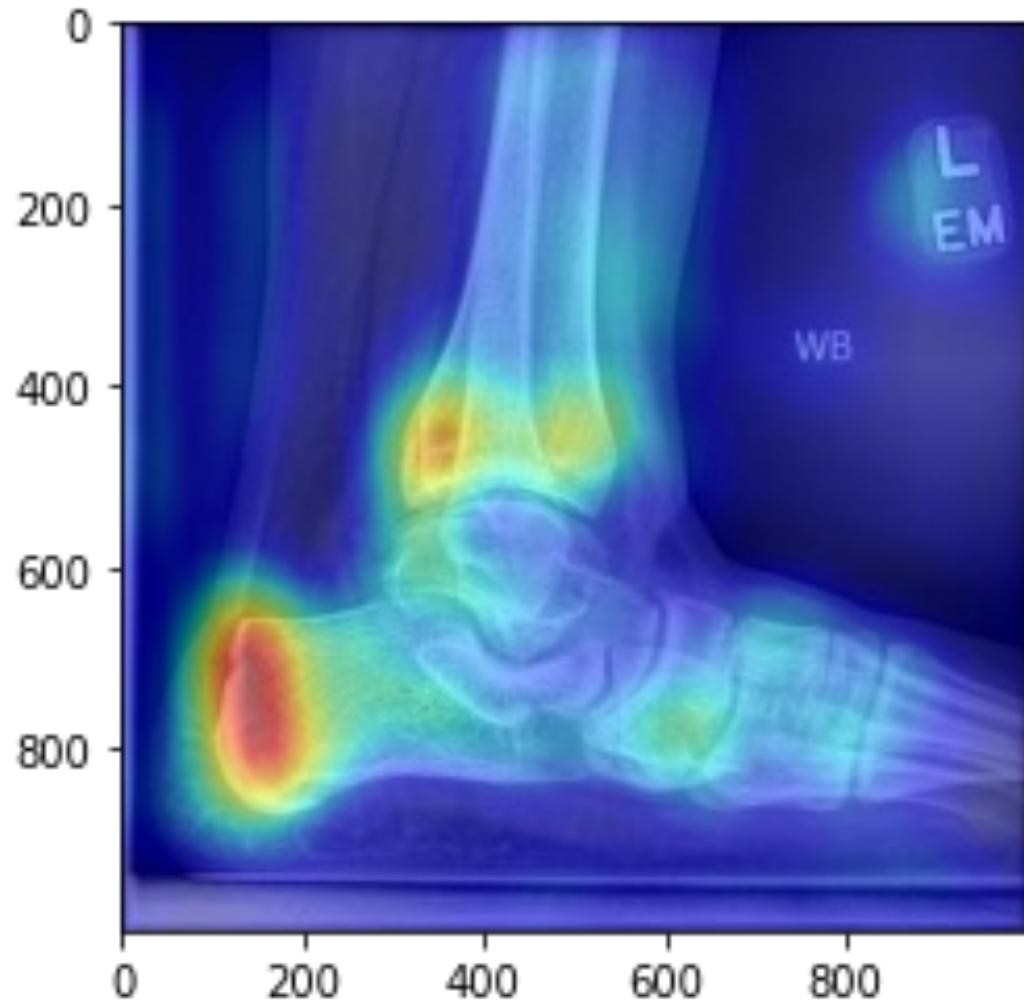


Braden – Weekly Update #2

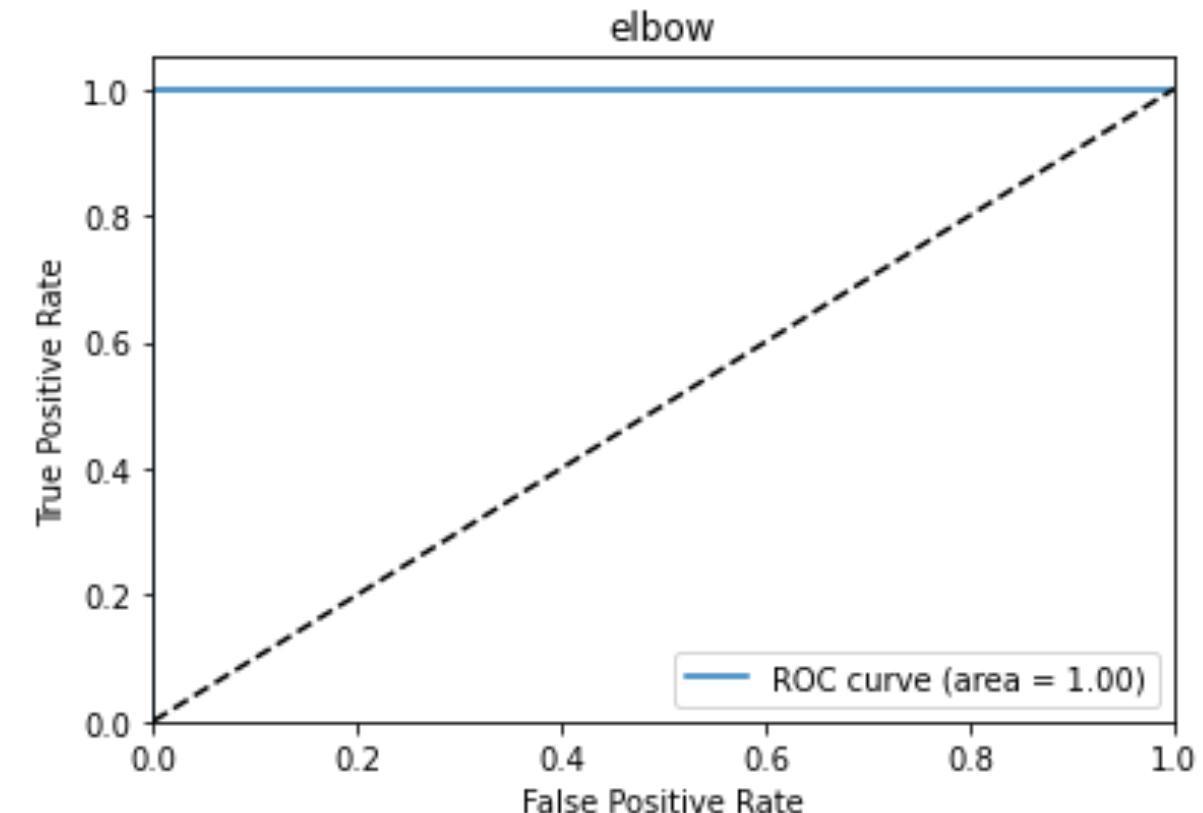
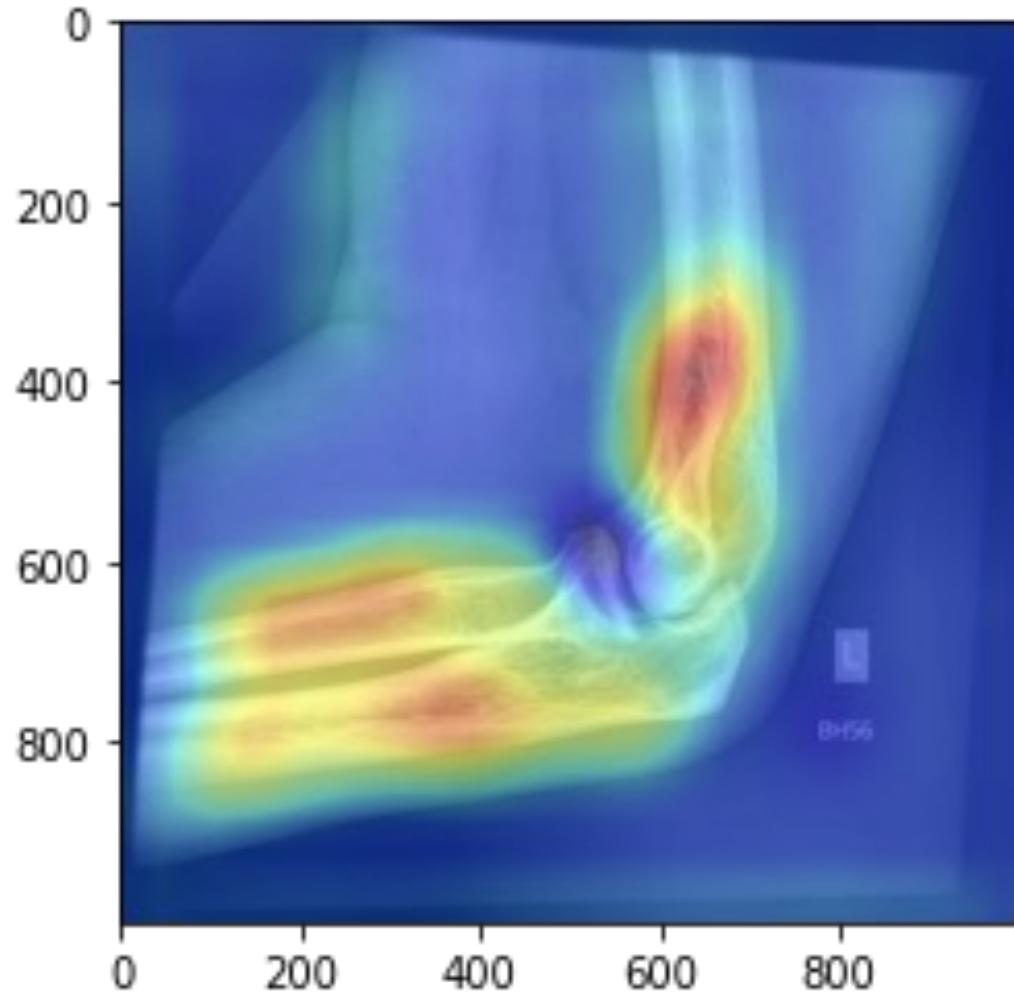
Ankle Class



Heatmap: 80.36% certain

Class accuracy: 100% (30/30)

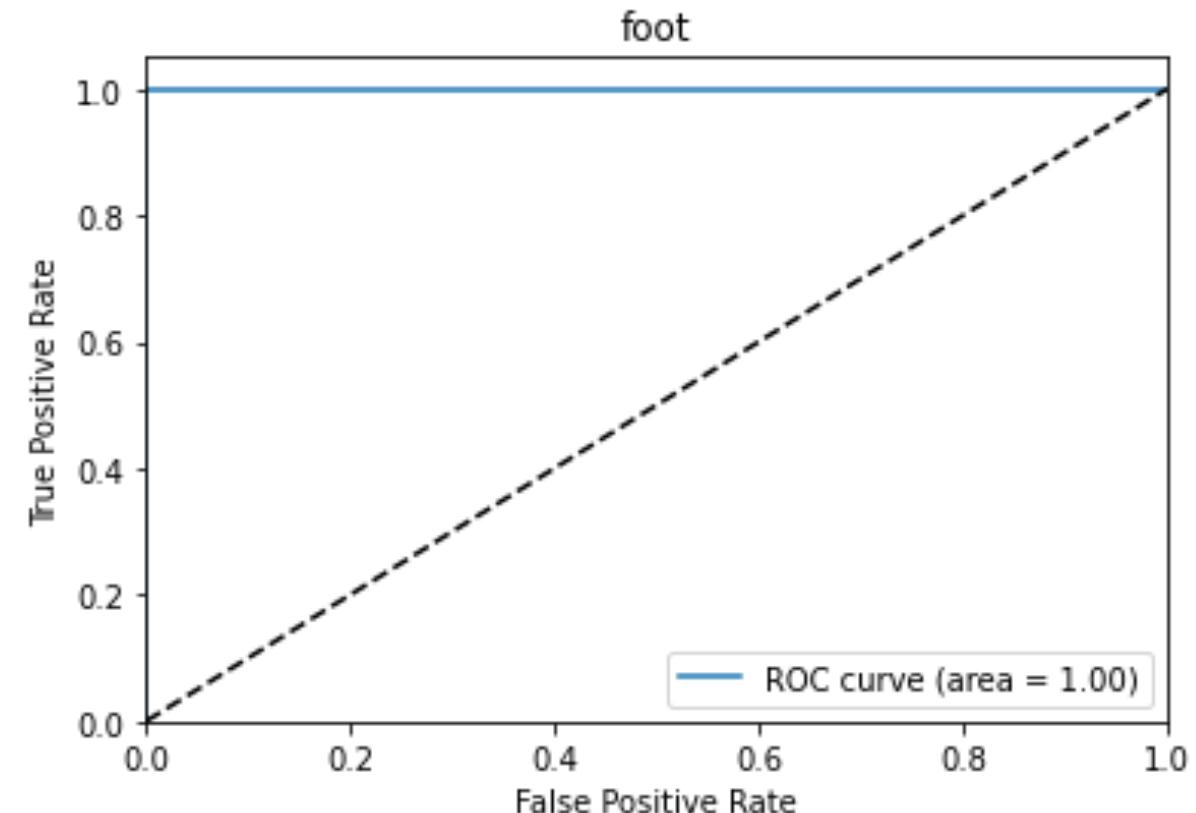
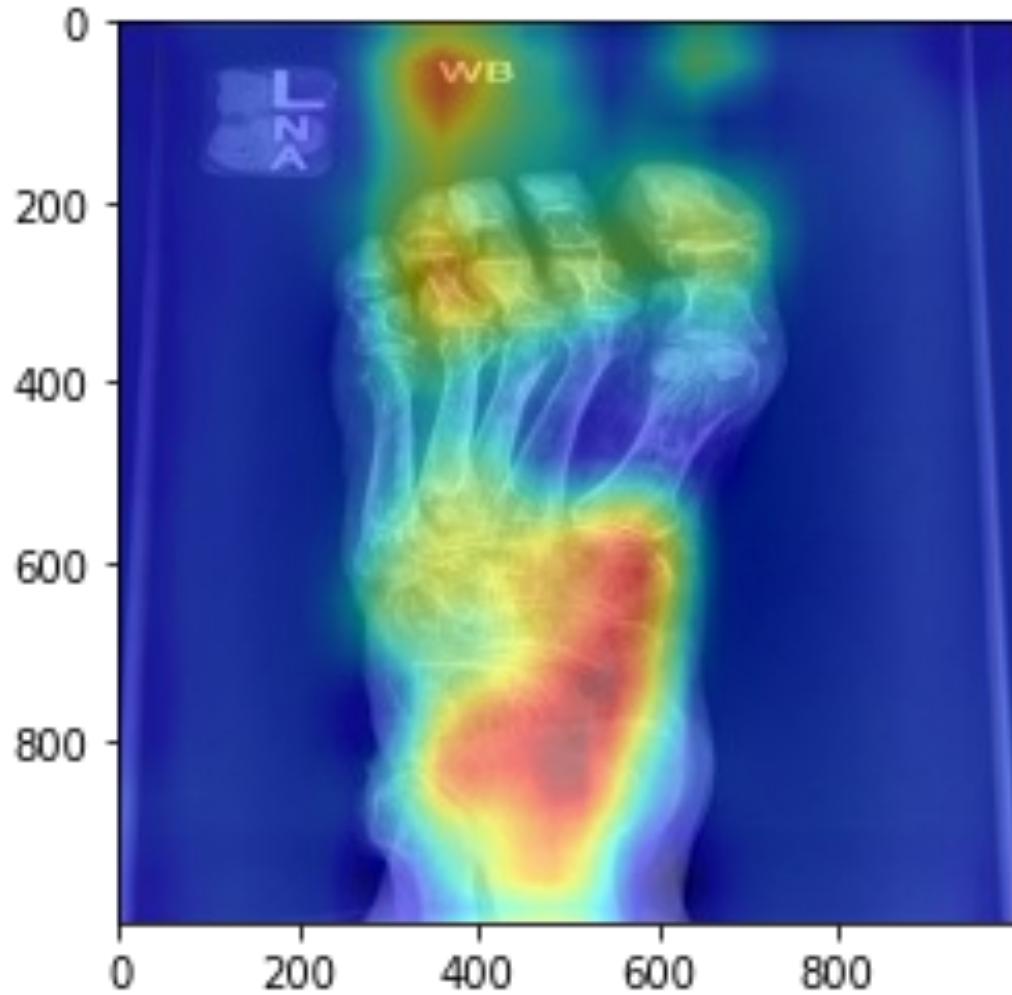
Elbow Class



Heatmap: 99.99% certain

Class accuracy: 100% (30/30)

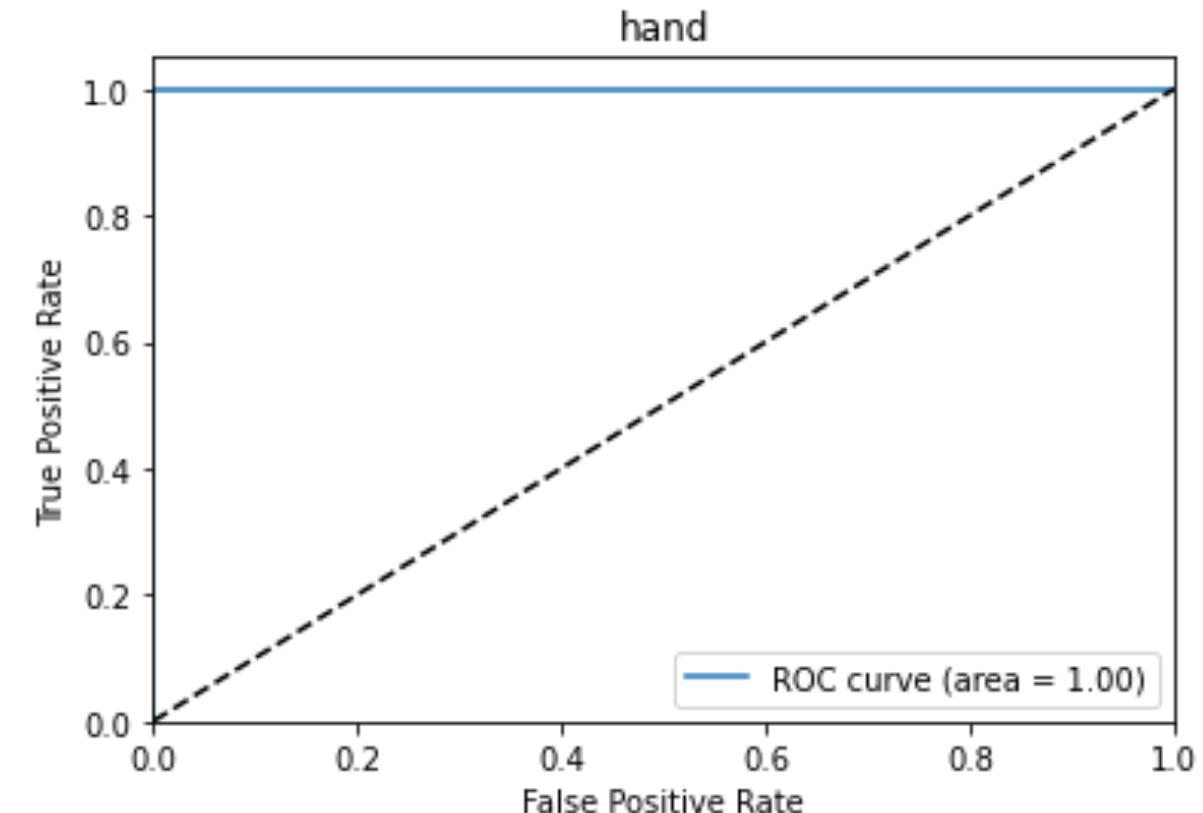
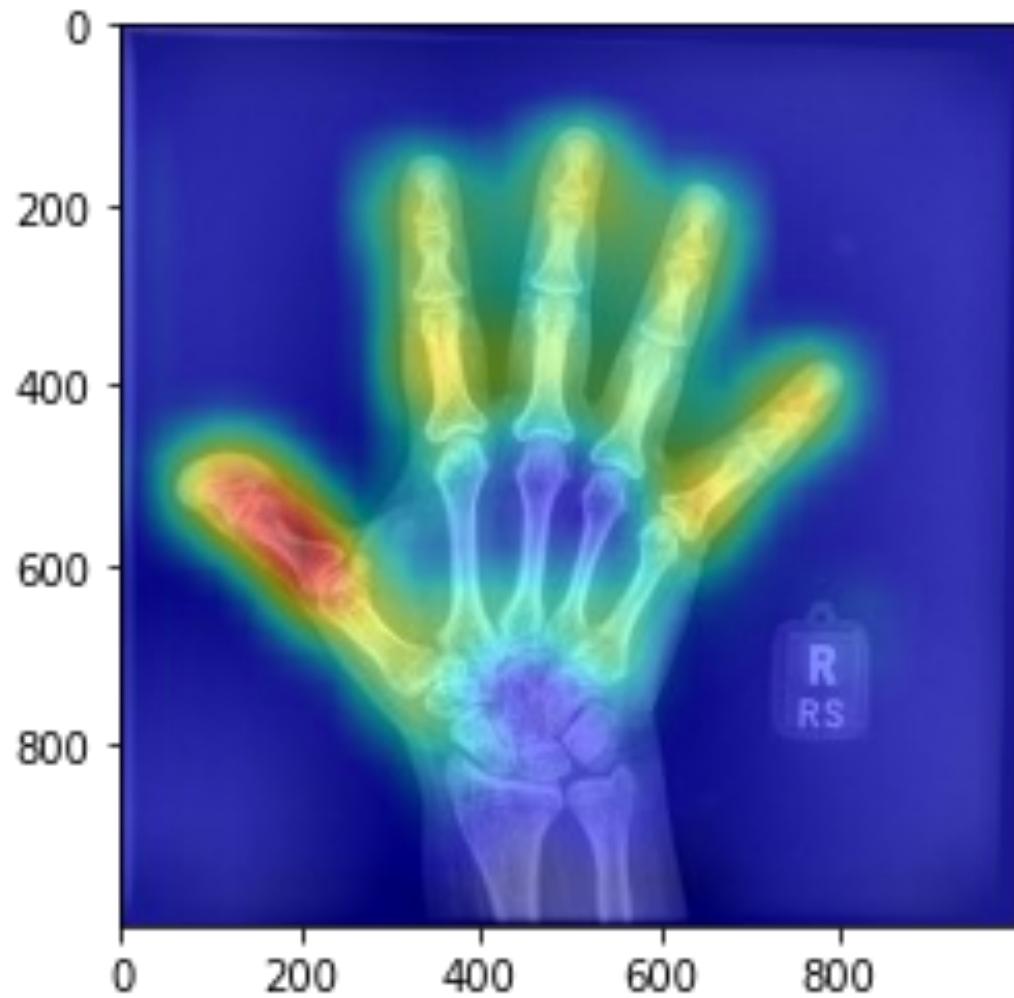
Foot Class



Heatmap: 99.92% certain

Class accuracy: 100% (30/30)

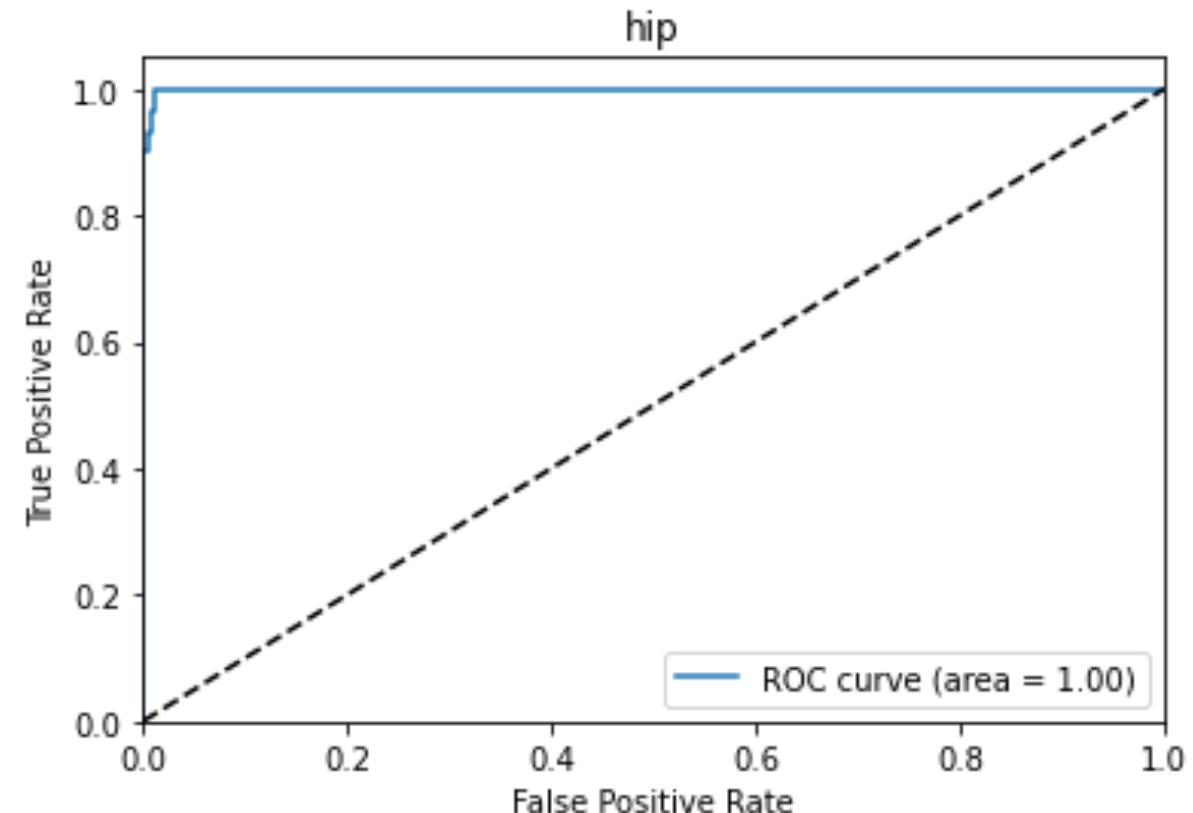
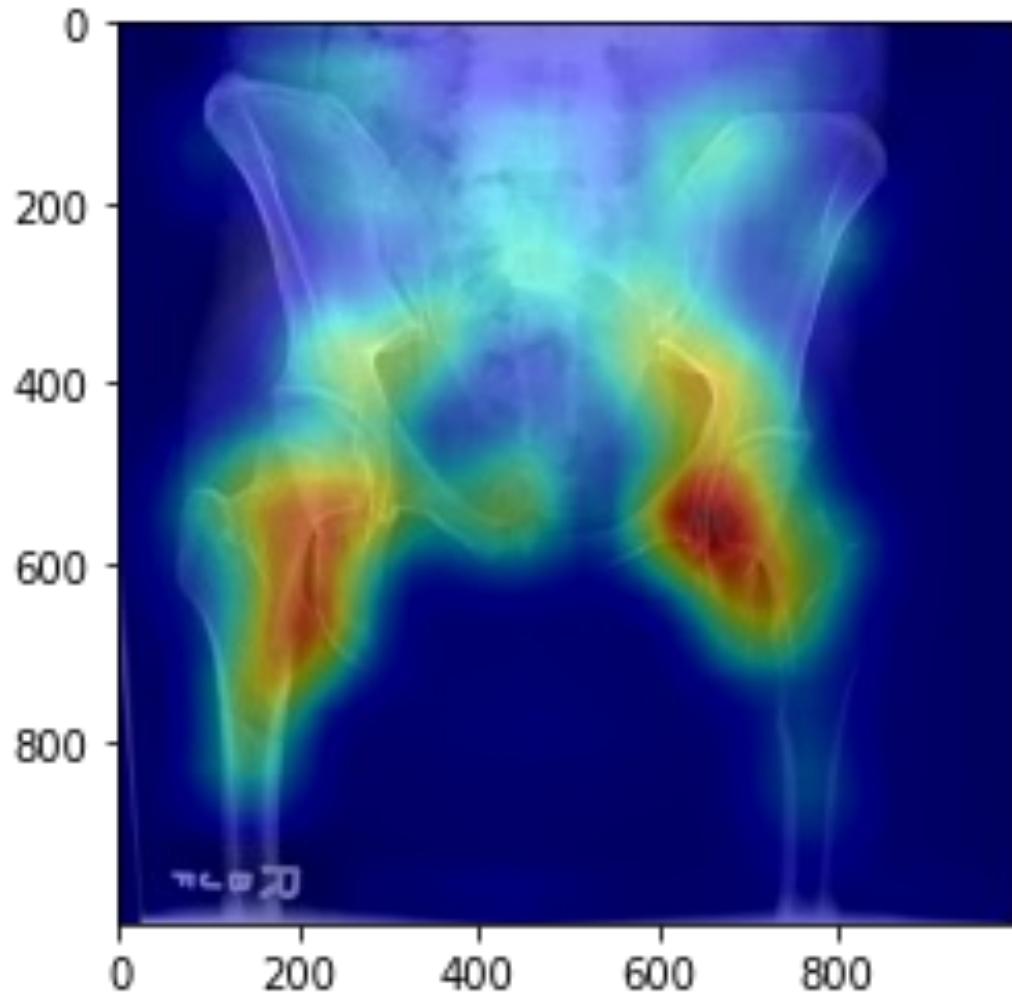
Hand Class



Heatmap: 99.99% certain

Class accuracy: 100% (30/30)

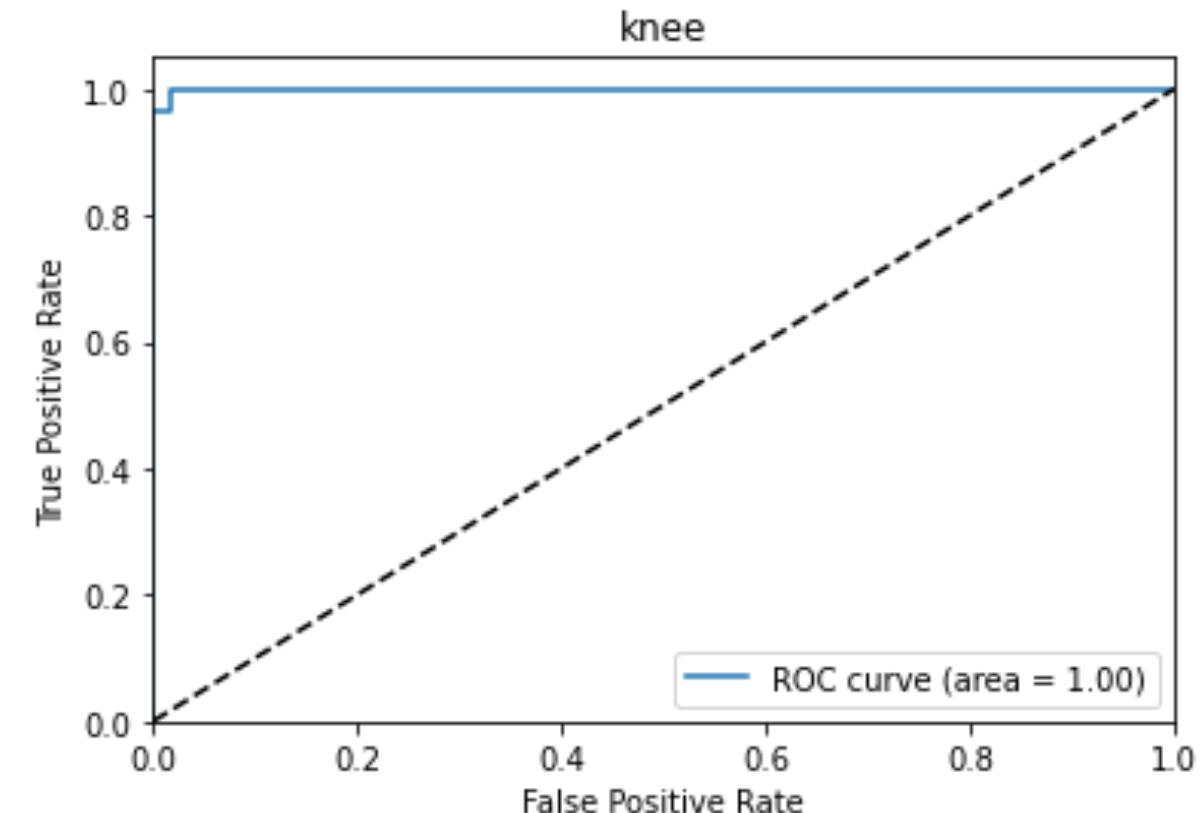
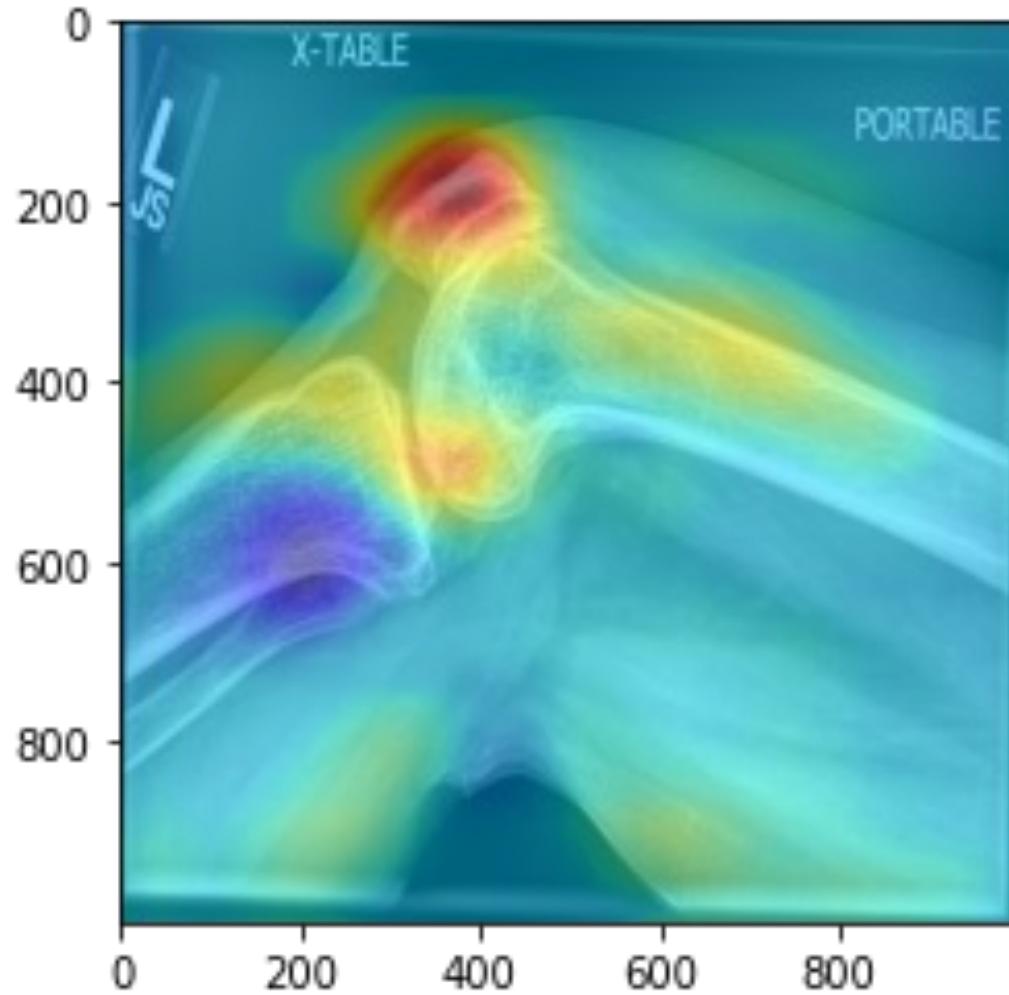
Hip Class



Heatmap: 99.98% certain

Class accuracy: 97% (29/30)

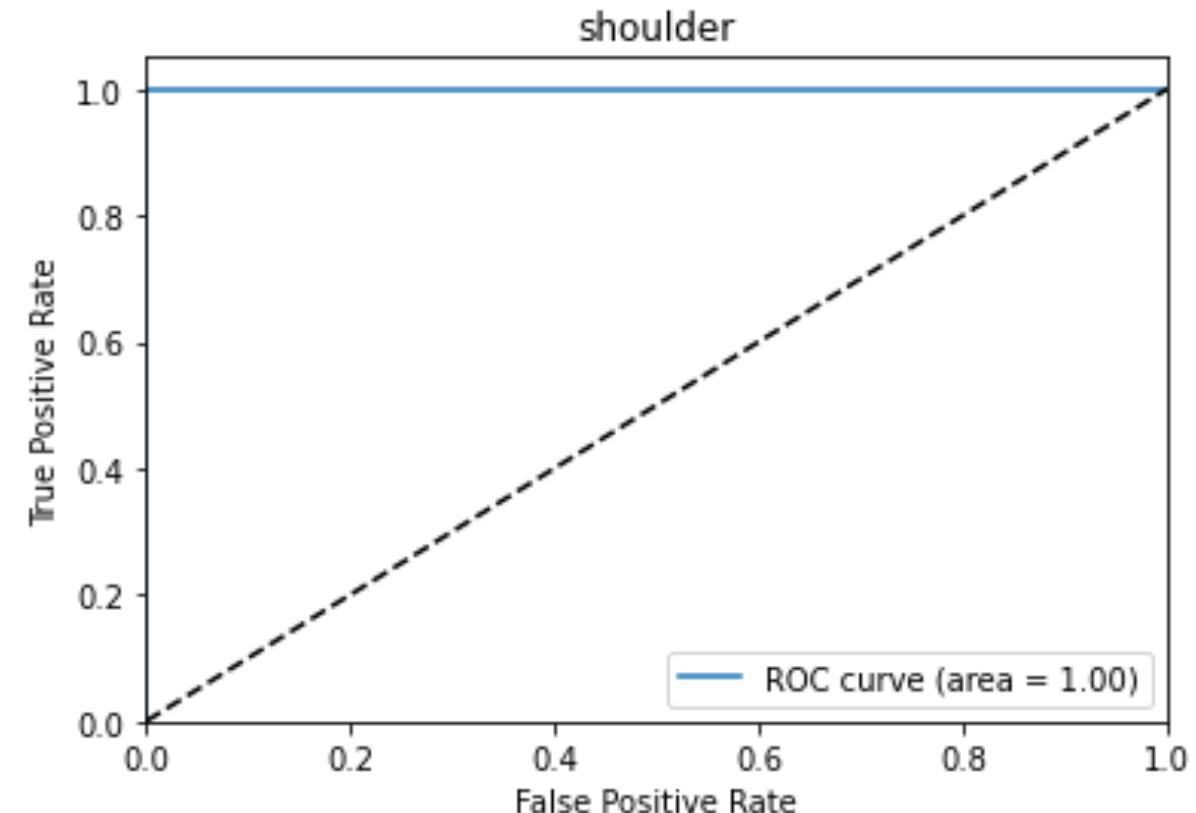
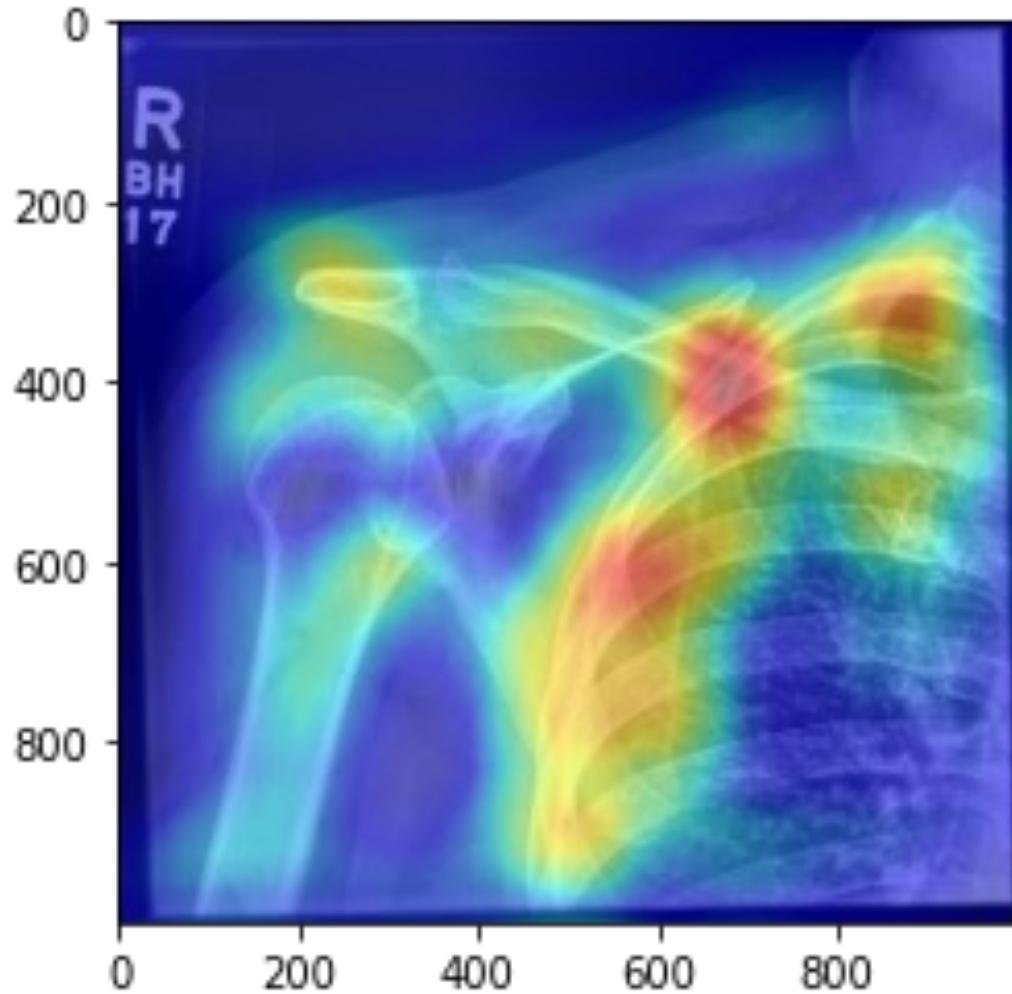
Knee Class



Heatmap: 80.51% certain

Class accuracy: 97% (29/30)

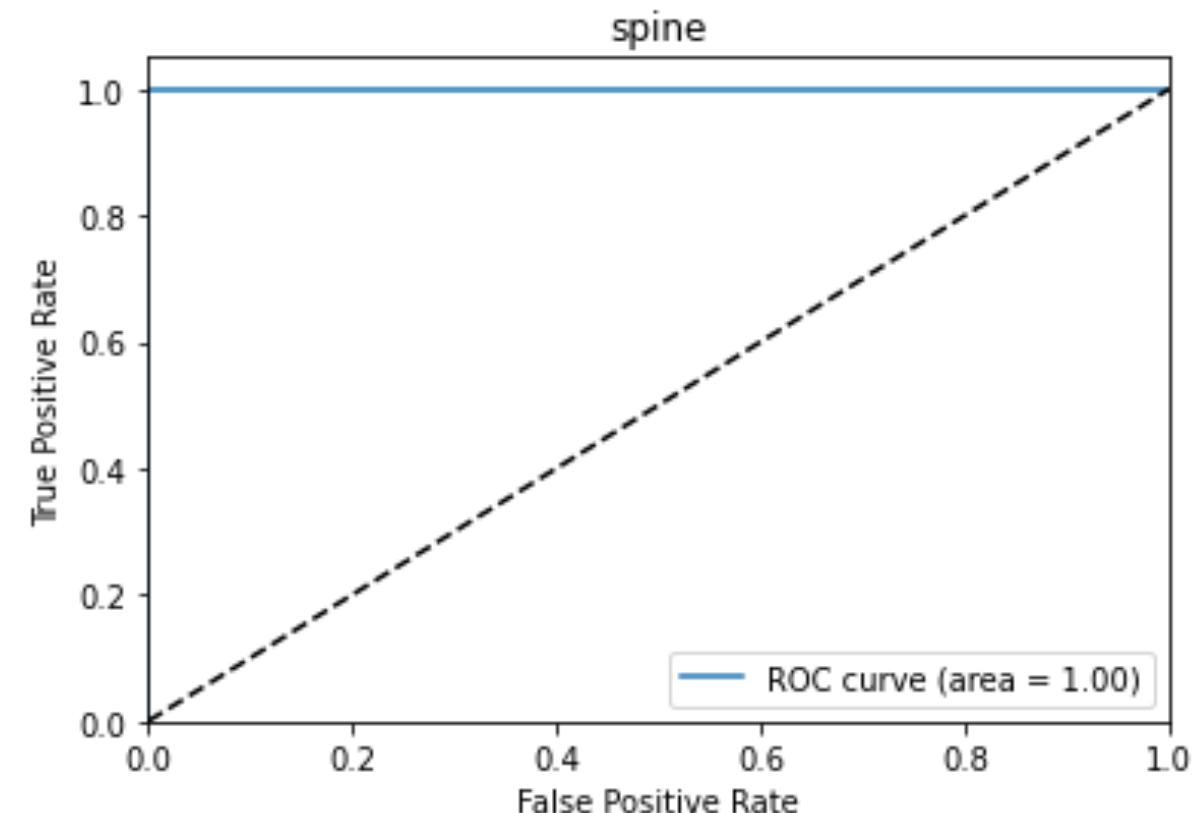
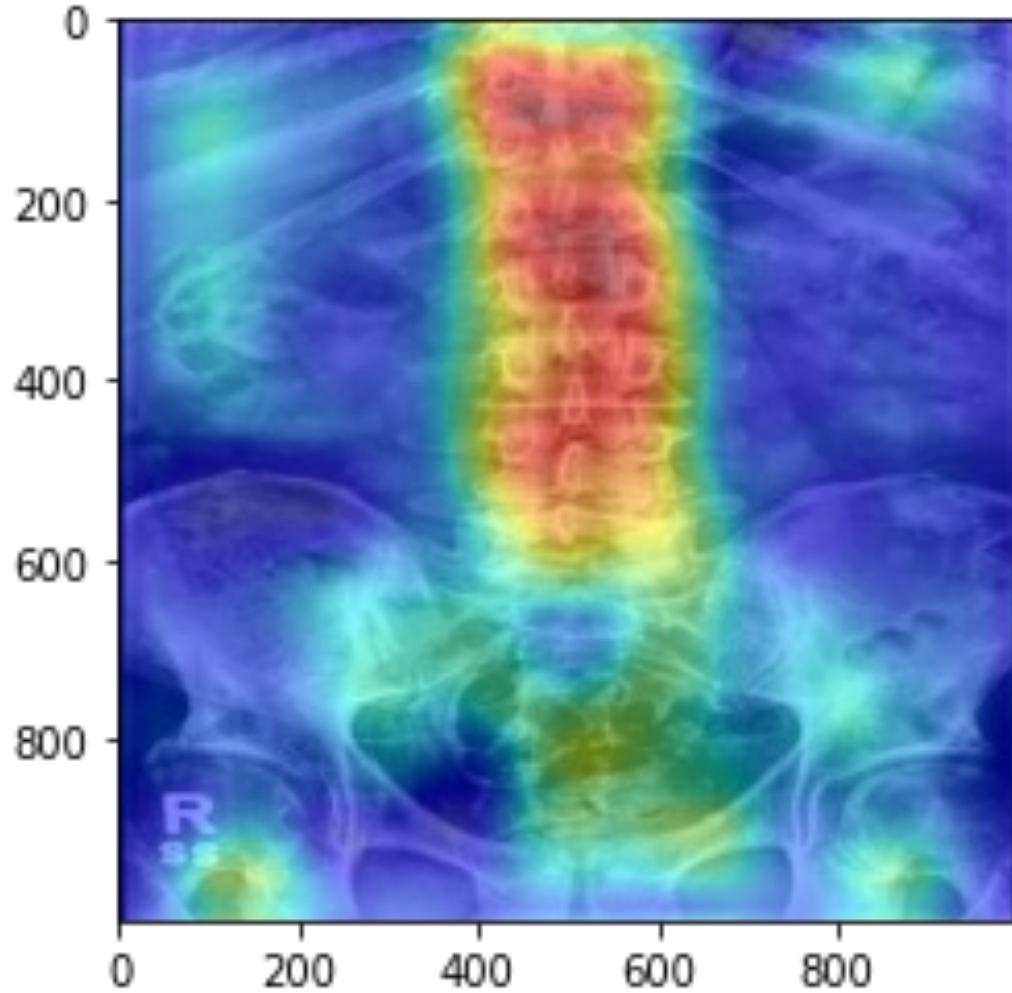
Shoulder Class



Heatmap: 99.99% certain

Class accuracy: 100% (30/30)

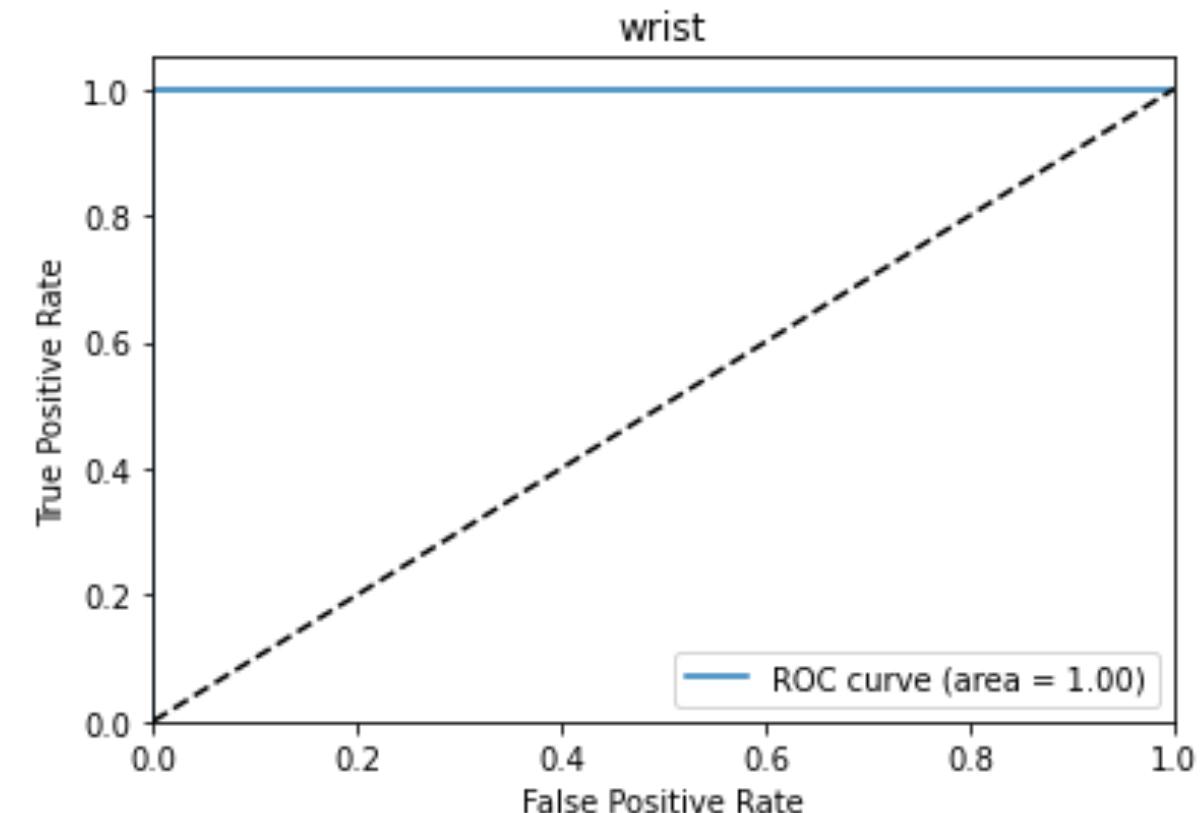
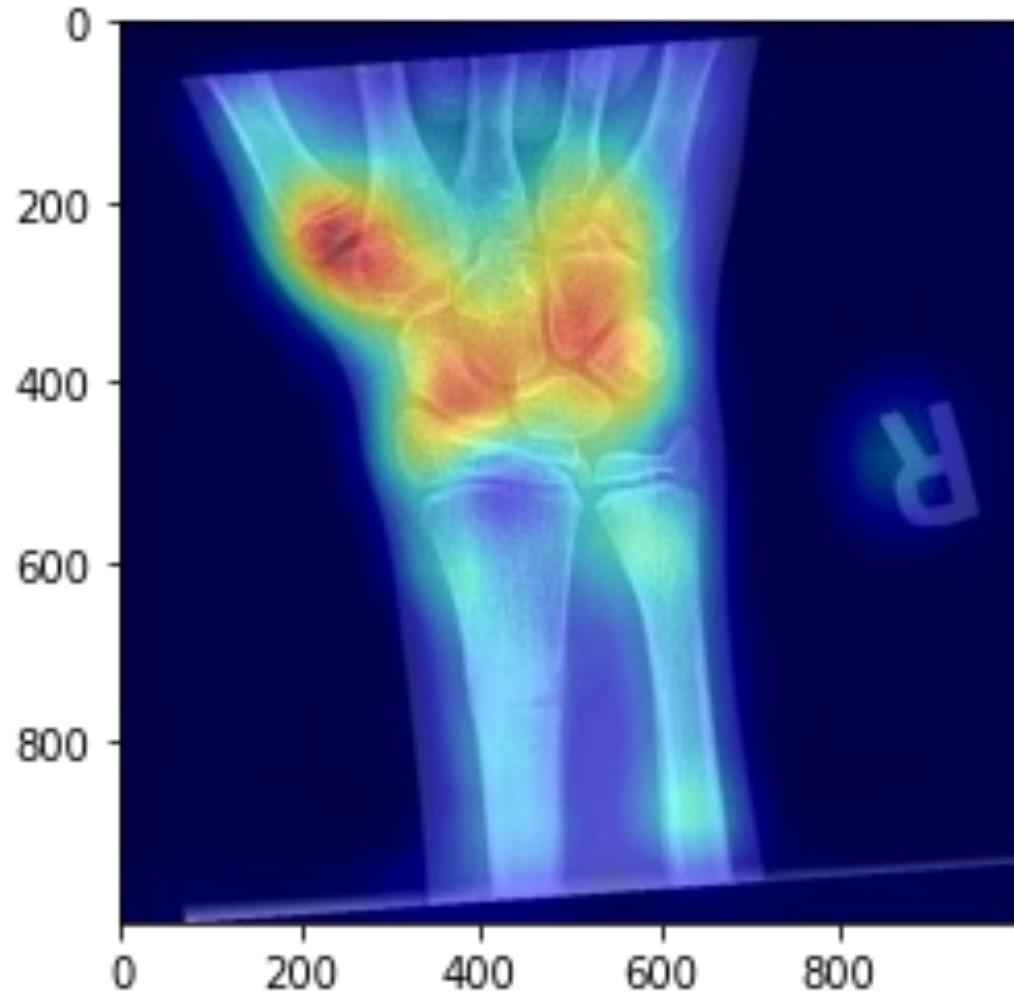
Spine Class



Heatmap: 100% certain

Class accuracy: 100% (30/30)

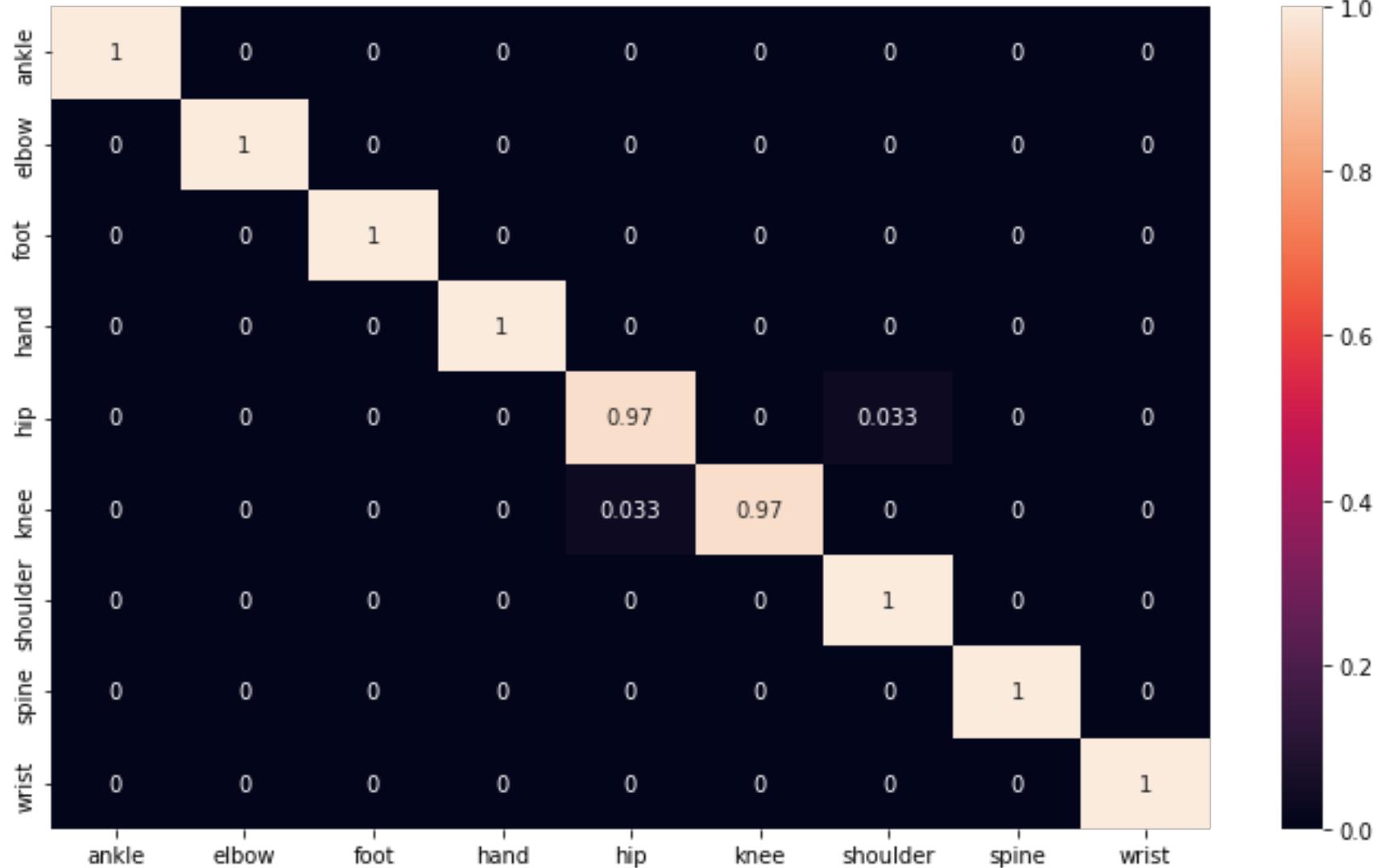
Wrist Class



Heatmap: 100% certain

Class accuracy: 100% (30/30)

Confusion Matrix



Next Steps

- Finish setting up network drives on Dev-Box2
- Work on ranking data

Braden – Weekly Update #3

Linked NAS to DevBox #1 & 2

- Added to /etc/fstab file with given info on DevBox #2
 - Edited same file on DevBox #1 to fix its mounting issue
 - Fixed network issue on DevBox #2 where it wouldn't connect to the internet after restart (had to manually reset its network settings each time)

```
# /etc/fstab: static file system information.
#
# Use 'blkid' to print the universally unique identifier for a
# device; this may be used with UUID= as a more robust way to name devices
# that works even if disks are added and removed. See fstab(5).
#
# <file system> <mount point> <type> <options> <dump> <pass>
#/dev/wd0 /dev/sda2 ext4 errors=remount-ro 0 1
UUID=e8c4cbaf-cc9c-41e6-82b6-6318a412e84f / ext4 defaults 0 2
#/dev/mdb1 /media/usb1 vfat umask=0077 0 1
# /home was on /dev/mdb17 during installation
UUID=c9f82c24-c0c3-453c-a375-f46b56d98a1 /home ext4 defaults 0 2
#/usr/local was on /dev/sde1 during installation
UUID=b578d99a-fd79-4b53-9919-cba3603fffb /usr/local ext4 defaults 0 2
/swappfile none swap sw 0 0
##/172.19.1.18/sdr1 /media/samba_share cifs username=sdo,password=... iocharset=utf8,sec=ntlmssp,file_mode=0666,dir_mode=0777 0 0
##/172.19.1.18/nfs /media/nfs cifs username=sdo,password=... iocharset=utf8,sec=ntlmssp,file_mode=0666,dir_mode=0777 0 0
##/172.19.2.227/sd0 /media/wd_share cifs username=sdo,password=... iocharset=utf8,sec=ntlmssp,file_mode=0666,dir_mode=0777 0 0
##/172.19.2.185/sd0 /media/synho2 cifs username=synho,password=... iocharset=utf8,sec=ntlmssp,file_mode=0666,dir_mode=0777 0 0
##/rfawincs.partners.org/MEEI-AITED /media/nfs_ted cifs username=s1198,password=... uid=sjeon3,gid=sjeon3,file_mode=0644,dir_mode=0755 0 0
##/rfawincs.partners.org/MGH-ORAI /media/nfs_fracture cifs username=s1198,password=... uid=sjeon3,gid=sjeon3,file_mode=0644,dir_mode=0755 0 0

#/etc/fstab" [readonly] 23L, 1778C
```

Sorted testing dataset by confidence

- Showed with normal images & heatmaps
- Modified testing dataset to 30 images for each class

pred: ankle, prob: 0.8036



pred: ankle, prob: 0.9896



pred: ankle, prob: 0.999



pred: ankle, prob: 0.9996



pred: ankle, prob: 0.9998



pred: ankle, prob: 1.0



pred: ankle, prob: 0.9069



pred: ankle, prob: 0.9924



pred: ankle, prob: 0.9993



pred: ankle, prob: 0.9996



pred: ankle, prob: 0.9999



pred: ankle, prob: 1.0



pred: ankle, prob: 0.9284



pred: ankle, prob: 0.9929



pred: ankle, prob: 0.9993



pred: ankle, prob: 0.9998



pred: ankle, prob: 0.9999



pred: ankle, prob: 1.0



pred: ankle, prob: 0.9546



pred: ankle, prob: 0.9985



pred: ankle, prob: 0.9994



pred: ankle, prob: 0.9998



pred: ankle, prob: 0.9999



pred: ankle, prob: 1.0



pred: ankle, prob: 0.9807



pred: ankle, prob: 0.9988



pred: ankle, prob: 0.9996



pred: ankle, prob: 0.9998



pred: ankle, prob: 1.0



pred: ankle, prob: 1.0



pred: foot, prob: 0.9206



pred: foot, prob: 0.9962



pred: foot, prob: 0.9992



pred: foot, prob: 0.9998



pred: foot, prob: 1.0



pred: foot, prob: 1.0



pred: foot, prob: 0.9288



pred: foot, prob: 0.9984



pred: foot, prob: 0.9994



pred: foot, prob: 0.9999



pred: foot, prob: 1.0



pred: foot, prob: 1.0



pred: foot, prob: 0.9901



pred: foot, prob: 0.9989



pred: foot, prob: 0.9997



pred: foot, prob: 0.9999



pred: foot, prob: 1.0



pred: foot, prob: 1.0



pred: foot, prob: 0.9921



pred: foot, prob: 0.999



pred: foot, prob: 0.9997



pred: foot, prob: 1.0



pred: foot, prob: 1.0



pred: foot, prob: 1.0



pred: foot, prob: 0.9951



pred: foot, prob: 0.9991



pred: foot, prob: 0.9998



pred: foot, prob: 1.0



pred: foot, prob: 1.0



pred: foot, prob: 1.0



pred: hand, prob: 0.747



pred: hand, prob: 0.862



pred: hand, prob: 0.9908



pred: hand, prob: 0.9948



pred: hand, prob: 0.9973



pred: hand, prob: 0.9981



pred: hand, prob: 0.999



pred: hand, prob: 0.9996



pred: hand, prob: 0.9997



pred: hand, prob: 0.9998



pred: hand, prob: 0.9999



pred: hand, prob: 0.9999



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: hand, prob: 1.0



pred: knee, prob: 0.6622



pred: knee, prob: 0.987



pred: knee, prob: 0.9994



pred: knee, prob: 0.9999



pred: knee, prob: 1.0



pred: knee, prob: 1.0



pred: knee, prob: 0.8051



pred: knee, prob: 0.9898



pred: knee, prob: 0.9996



pred: knee, prob: 0.9999



pred: knee, prob: 1.0



pred: knee, prob: 1.0



pred: knee, prob: 0.8527



pred: knee, prob: 0.9904



pred: knee, prob: 0.9996



pred: knee, prob: 0.9999



pred: knee, prob: 1.0



pred: knee, prob: 1.0



pred: hip, prob: 0.8736



pred: knee, prob: 0.9978



pred: knee, prob: 0.9997



pred: knee, prob: 0.9999



pred: knee, prob: 1.0



pred: knee, prob: 1.0



pred: knee, prob: 0.8992



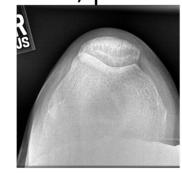
pred: knee, prob: 0.9993



pred: knee, prob: 0.9998



pred: knee, prob: 0.9999



pred: knee, prob: 1.0



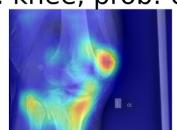
pred: knee, prob: 1.0



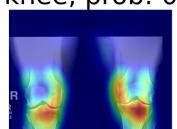
pred: knee, prob: 0.6622



pred: knee, prob: 0.987



pred: knee, prob: 0.9994



pred: knee, prob: 0.9999



pred: knee, prob: 1.0



pred: knee, prob: 1.0



pred: knee, prob: 0.8051



pred: knee, prob: 0.9898



pred: knee, prob: 0.9996



pred: knee, prob: 0.9999



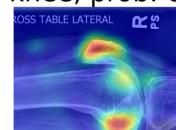
pred: knee, prob: 1.0



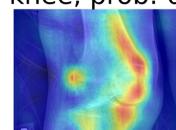
pred: knee, prob: 1.0



pred: knee, prob: 0.8527



pred: knee, prob: 0.9904



pred: knee, prob: 0.9996



pred: knee, prob: 0.9999



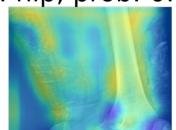
pred: knee, prob: 1.0



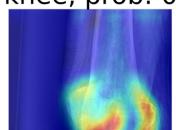
pred: knee, prob: 1.0



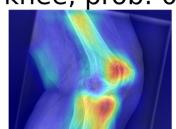
pred: hip, prob: 0.8736



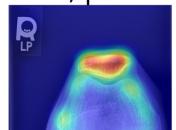
pred: knee, prob: 0.9978



pred: knee, prob: 0.9997



pred: knee, prob: 0.9999



pred: knee, prob: 1.0



pred: knee, prob: 1.0



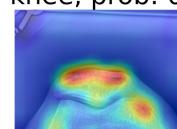
pred: knee, prob: 0.8992



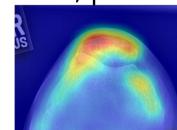
pred: knee, prob: 0.9993



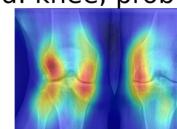
pred: knee, prob: 0.9998



pred: knee, prob: 0.9999



pred: knee, prob: 1.0



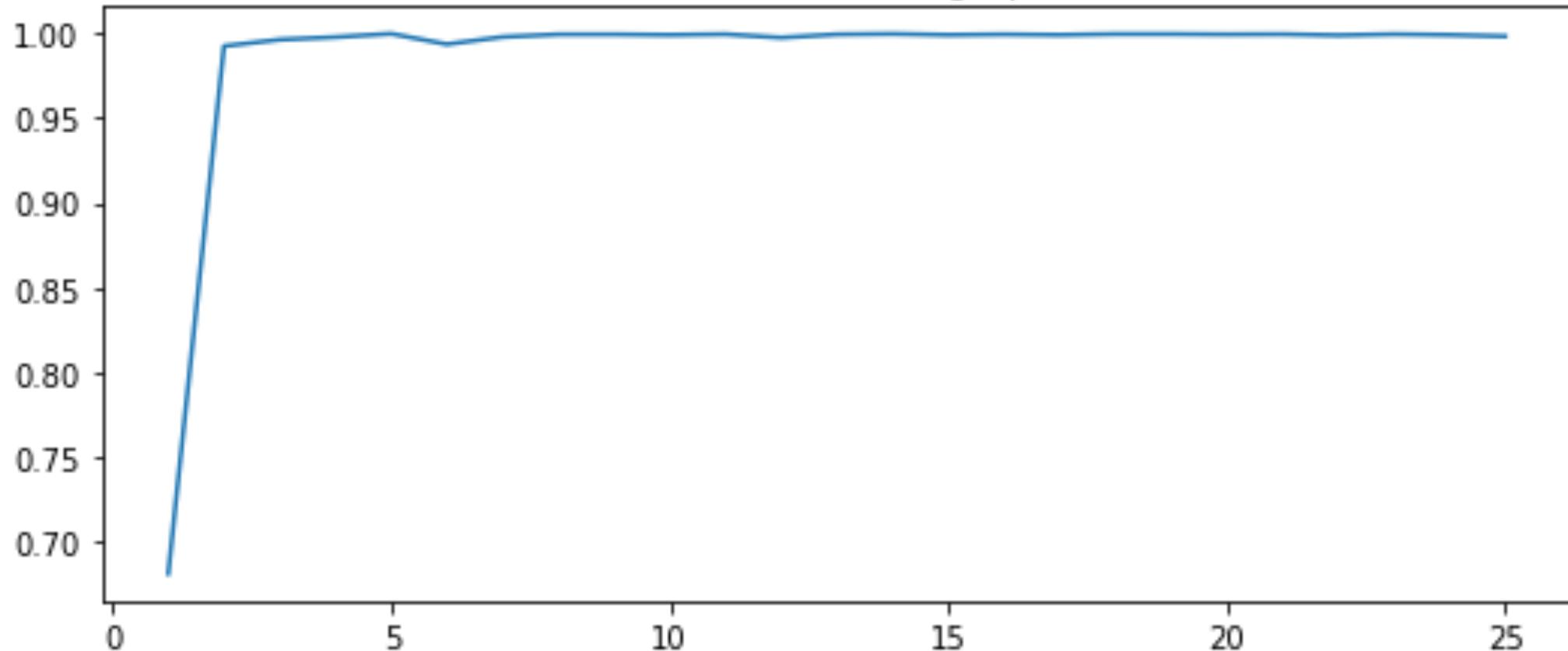
pred: knee, prob: 1.0



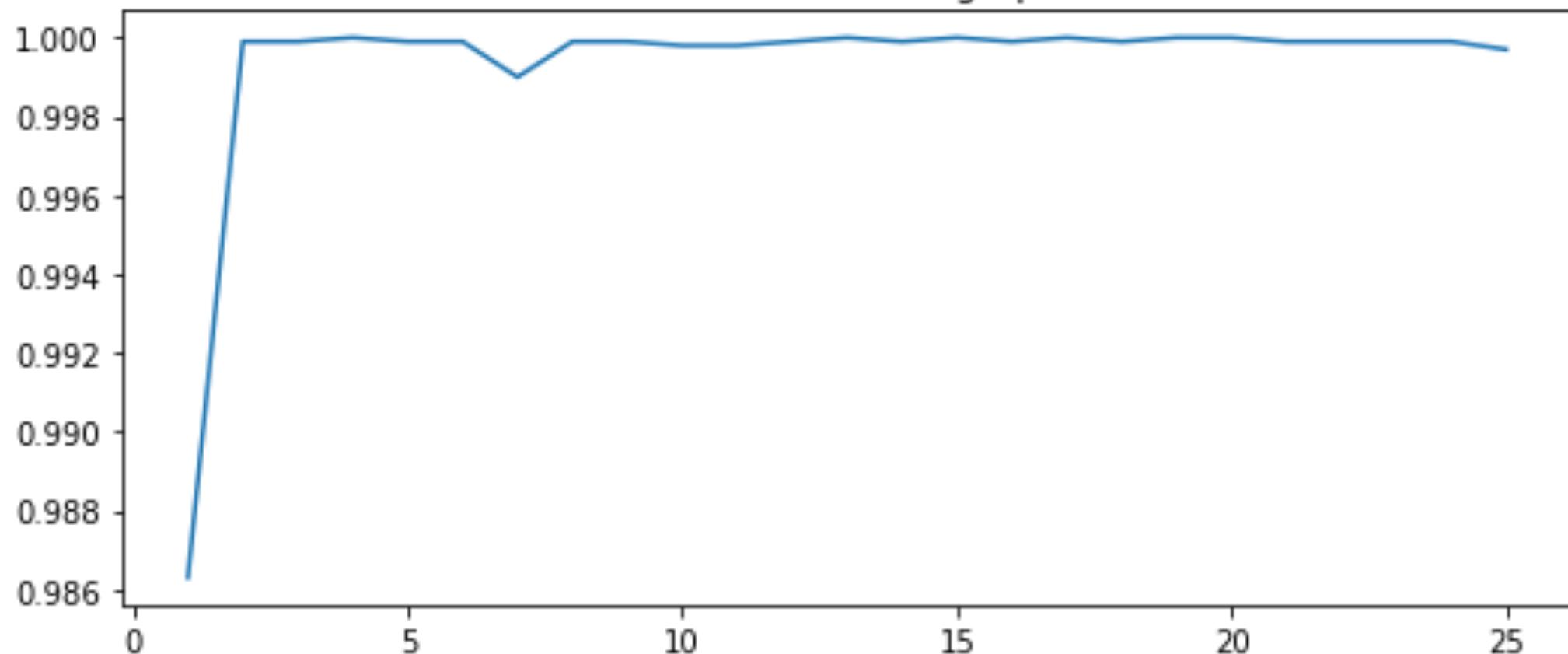
Heatmaps by Training Iteration

- Saved model after each training iteration
- Showed heatmap for each model with a specific testing dataset image
- Showed graph of confidence across training iterations

elbow confidence graph



ankle confidence graph



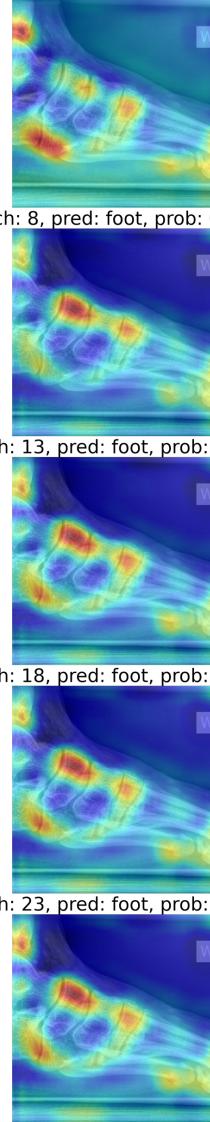
epoch: 1, pred: foot, prob: 0.5005



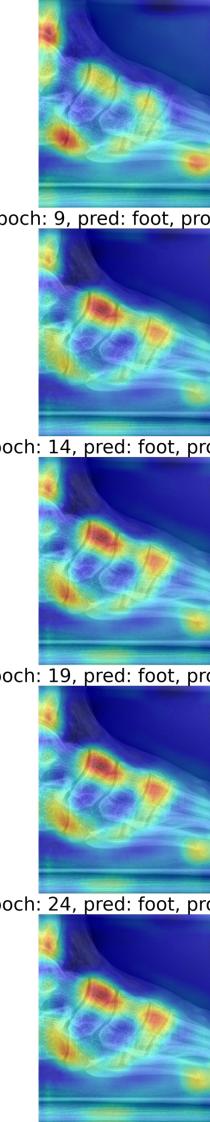
epoch: 2, pred: foot, prob: 0.9431



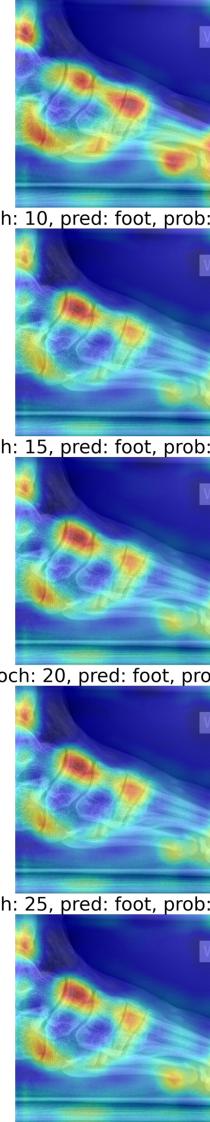
epoch: 3, pred: foot, prob: 0.7825



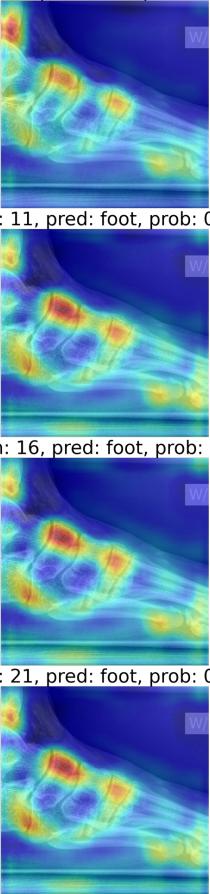
epoch: 4, pred: foot, prob: 0.9924



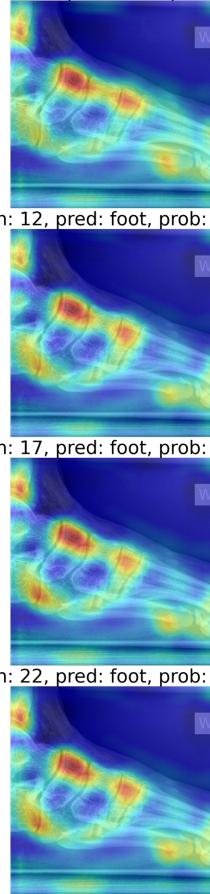
epoch: 5, pred: foot, prob: 0.9999



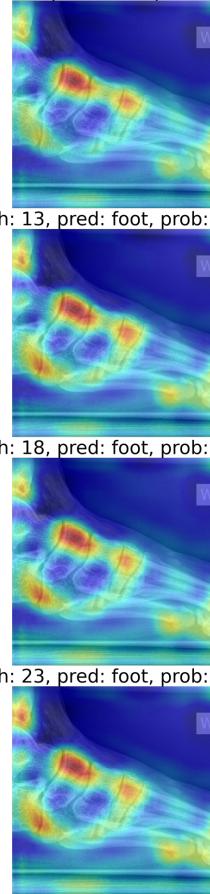
epoch: 6, pred: foot, prob: 0.9995



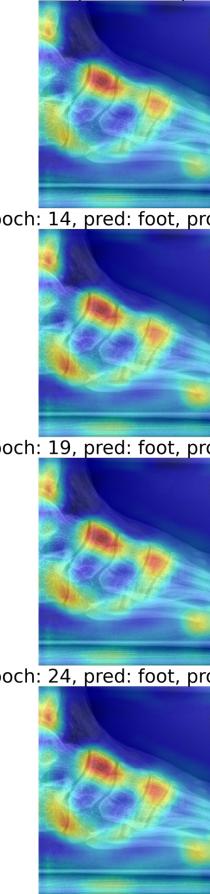
epoch: 7, pred: foot, prob: 1.0



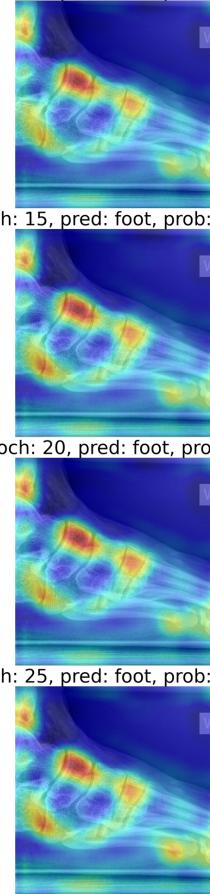
epoch: 8, pred: foot, prob: 0.9999



epoch: 9, pred: foot, prob: 0.9999



epoch: 10, pred: foot, prob: 0.9999



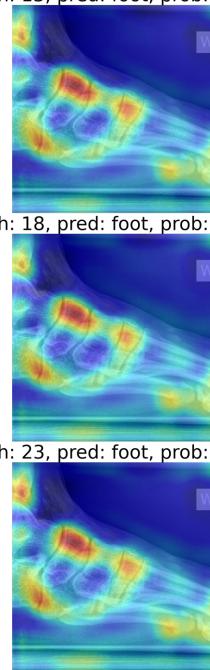
epoch: 11, pred: foot, prob: 0.9998



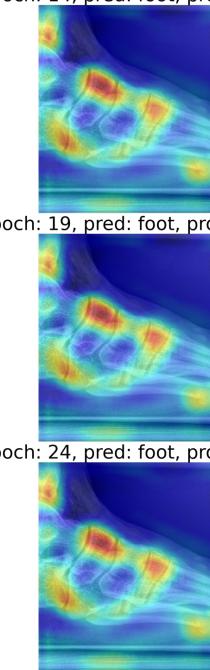
epoch: 12, pred: foot, prob: 0.9996



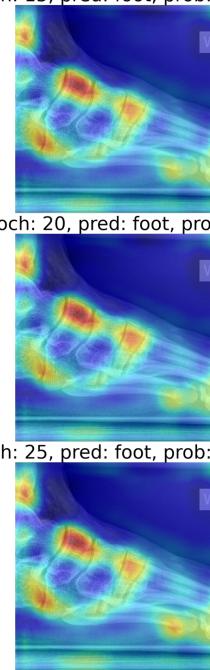
epoch: 13, pred: foot, prob: 0.9996



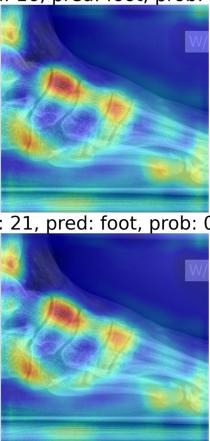
epoch: 14, pred: foot, prob: 0.9999



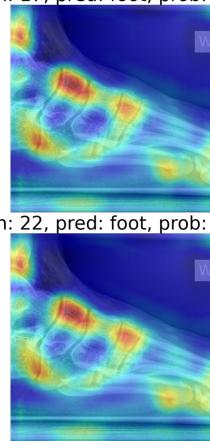
epoch: 15, pred: foot, prob: 0.9998



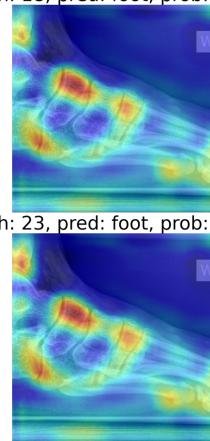
epoch: 16, pred: foot, prob: 0.999



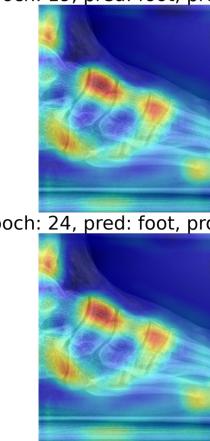
epoch: 17, pred: foot, prob: 0.9999



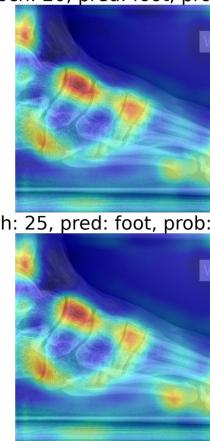
epoch: 18, pred: foot, prob: 0.9988



epoch: 19, pred: foot, prob: 0.9999



epoch: 20, pred: foot, prob: 1.0



epoch: 21, pred: foot, prob: 0.9999



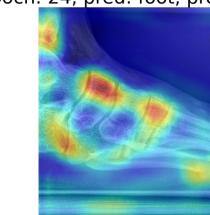
epoch: 22, pred: foot, prob: 0.9999



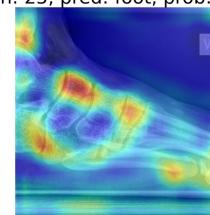
epoch: 23, pred: foot, prob: 0.9999



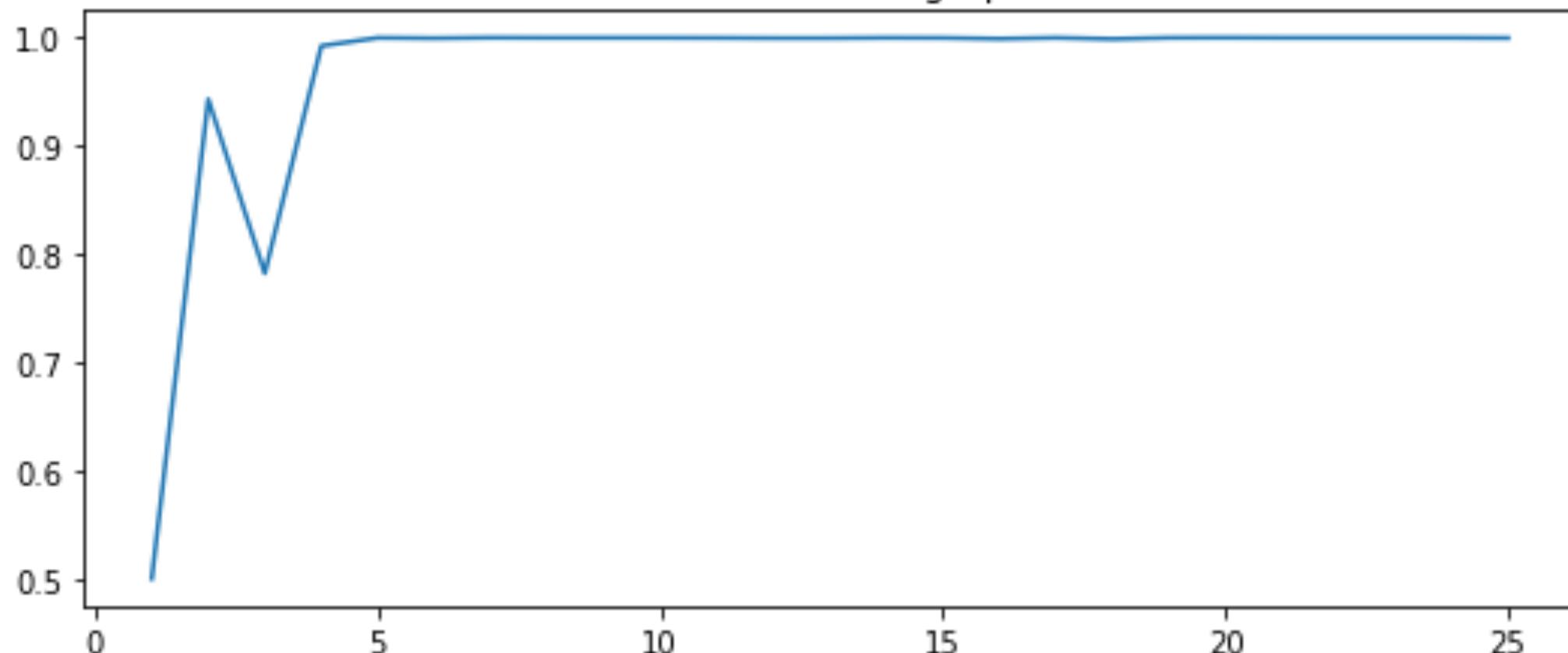
epoch: 24, pred: foot, prob: 0.9999



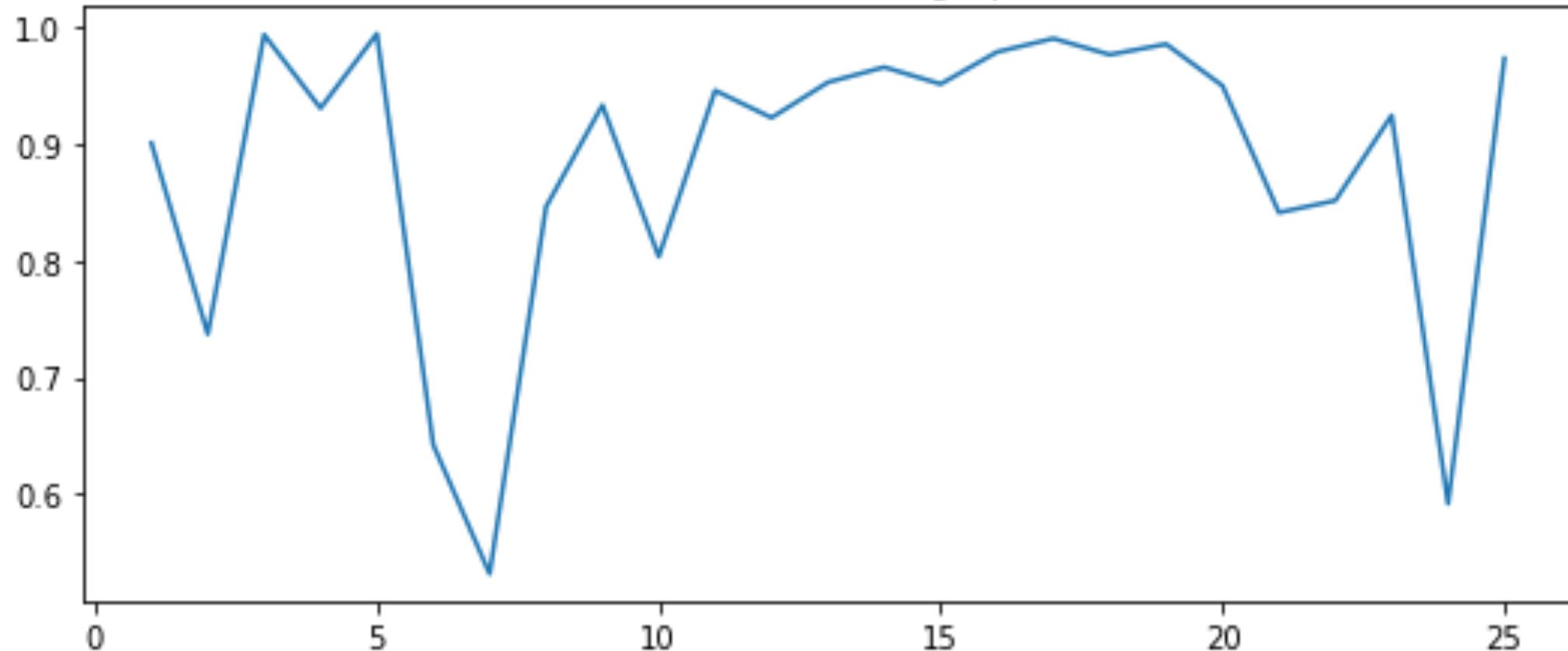
epoch: 25, pred: foot, prob: 0.9997



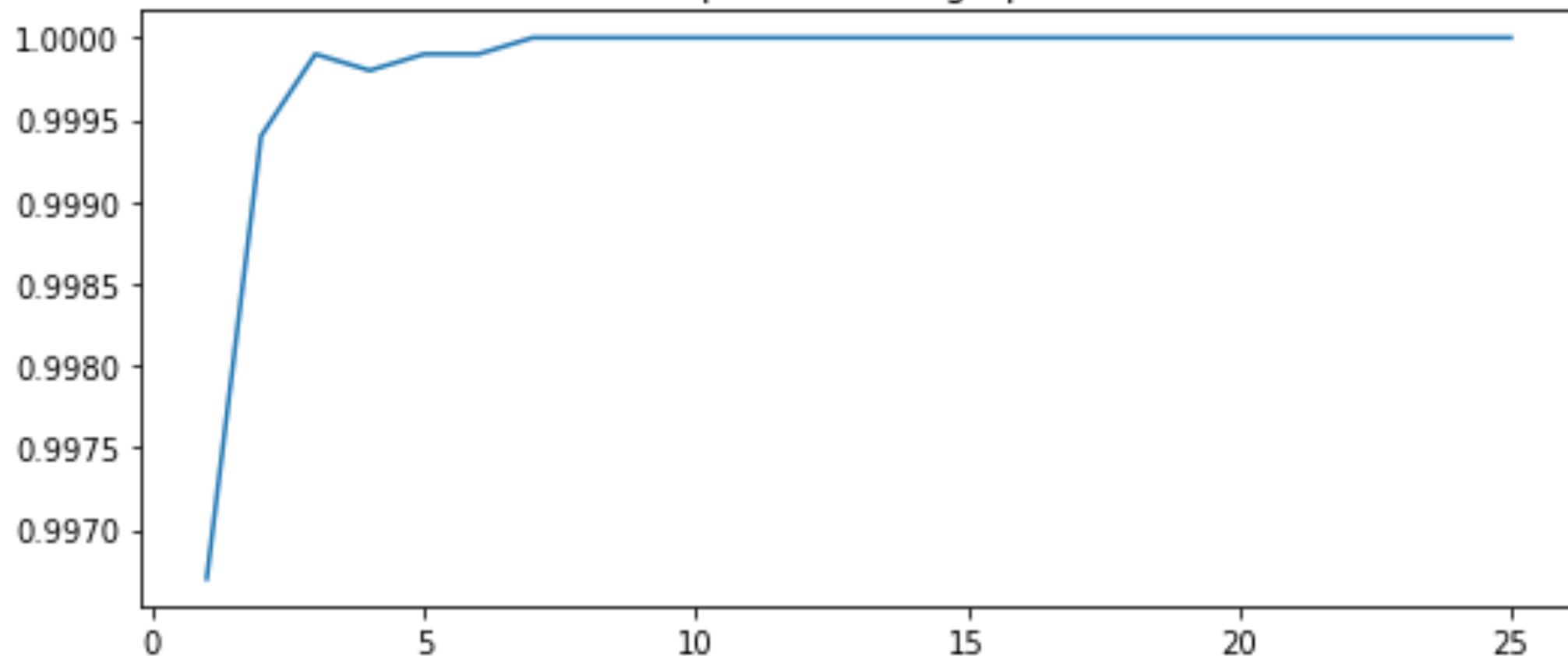
foot confidence graph



hand confidence graph



hip confidence graph



Next Steps

- Continue working on image contribution ranking in training
 - Finished training 45 models (5 training images from each class, one is excluded each time)

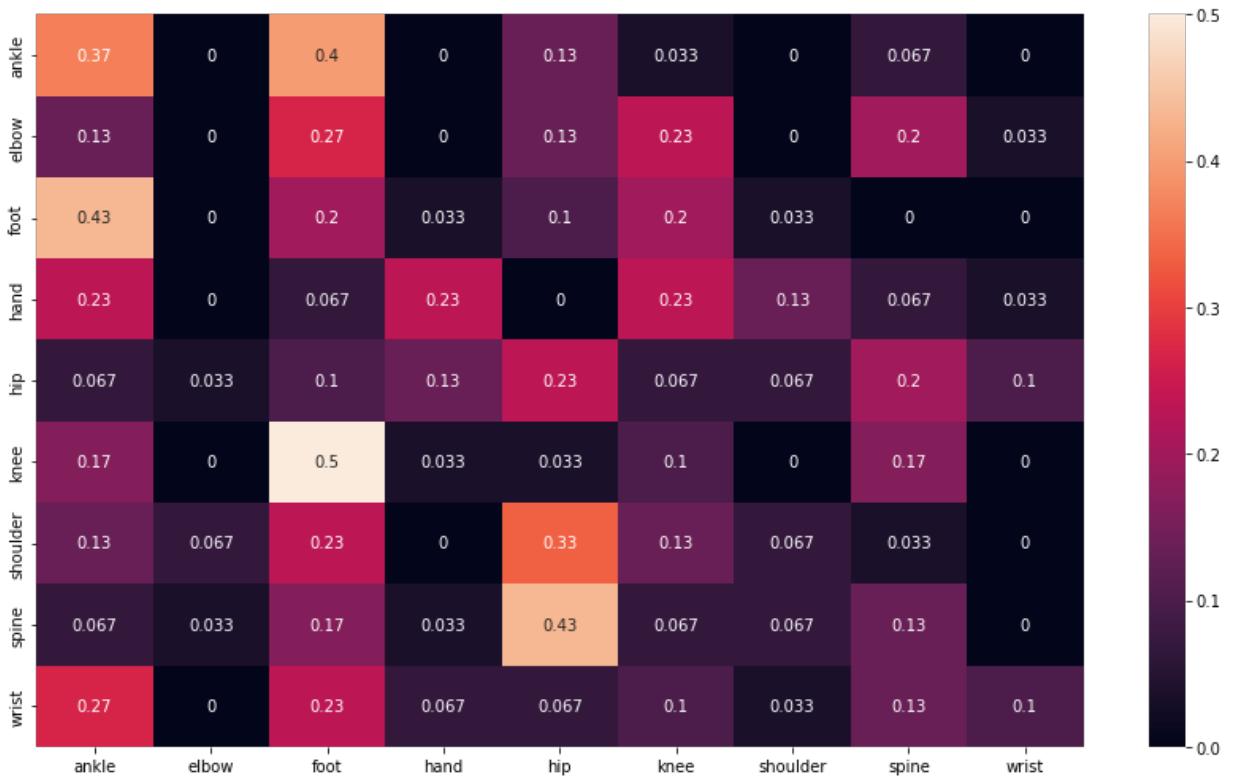
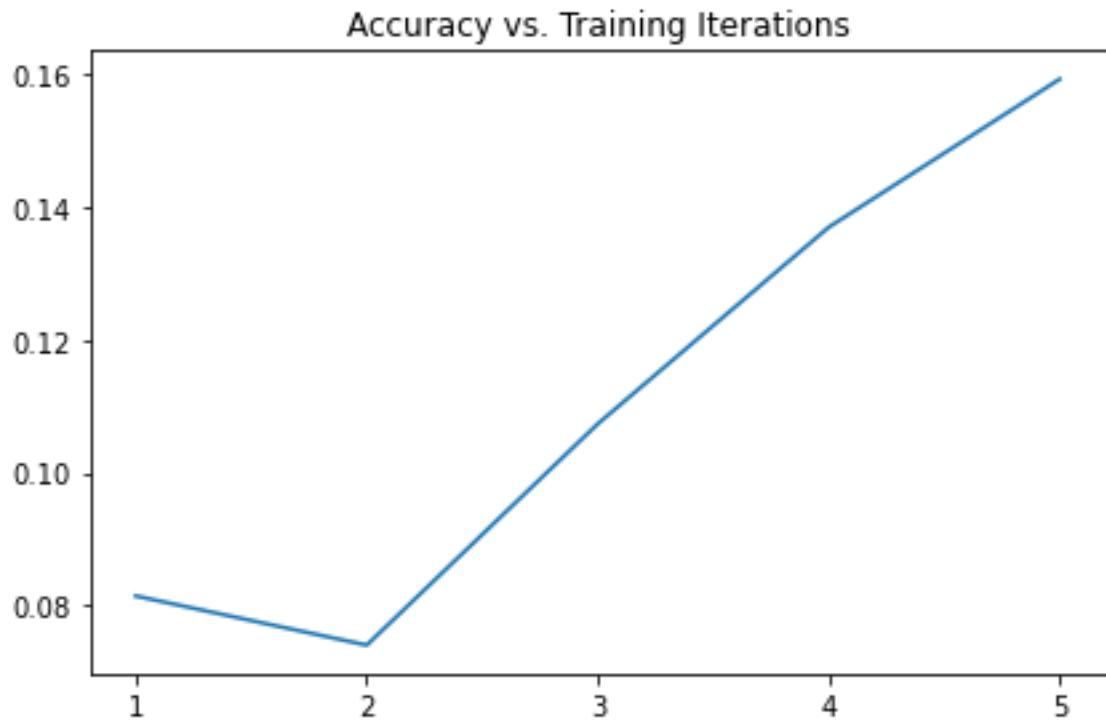
Braden – Weekly Update #4

Image Exclusion in Training

- 5 Images from each class
 - 45 training images and 45 different models
- 1 excluded from training for each model
- Each model trained for 5 iterations
 - ~49 seconds to train entirely
- Remember that a lower accuracy for an excluded image is better

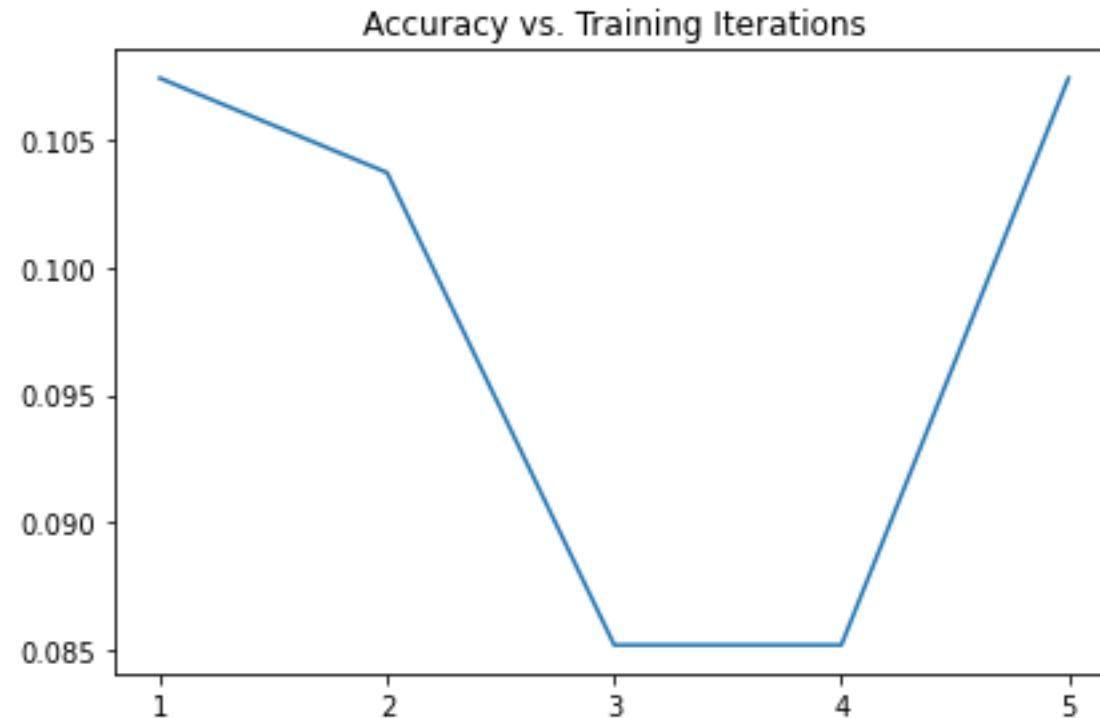
Control

- Control model trained with all 45 images (instead of 44)
- Best accuracy was 15.93%
 - Slightly better than guessing which would be an accuracy of 11.1%



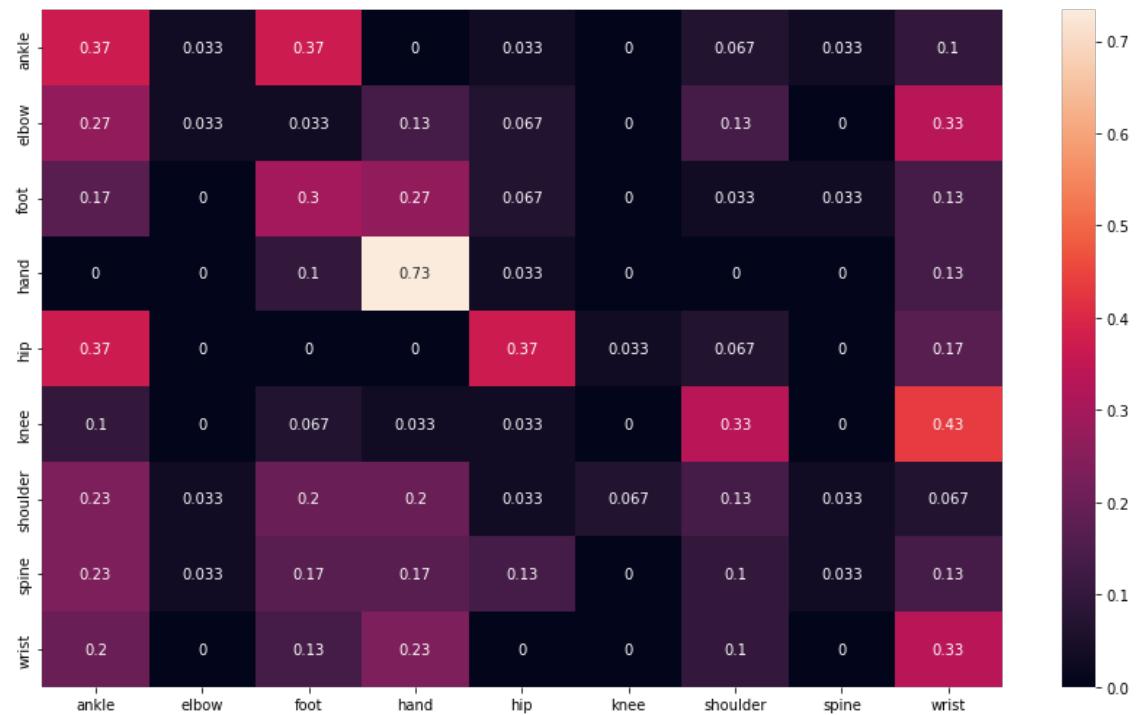
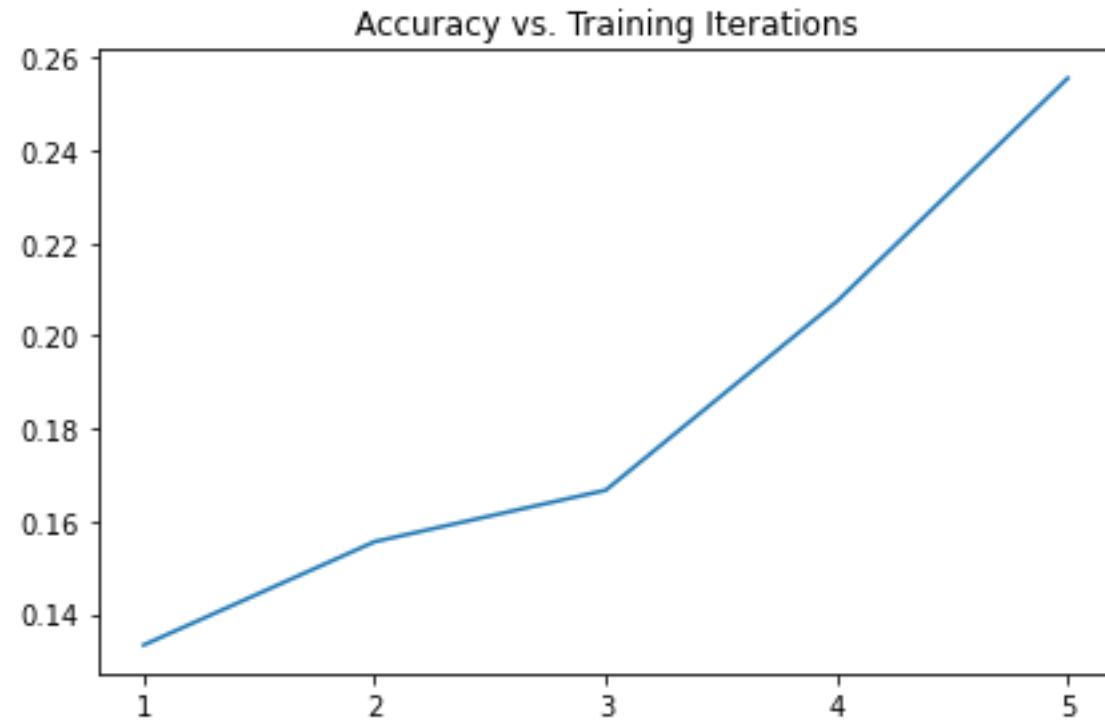
Wrist2.png (Most Valuable Image)

- Best accuracy was 10.74%
- Model is the least accurate
- 1st and 5th iteration accuracies are the same



Wrist4.png (Least Valuable Image)

- Best accuracy was 25.56%
- Model is the most accurate



Next Steps

- Continue work on grouping excluded images for bigger datasets
 - Possibly use this code for SIIM data
 - Use more training iterations
- Assist with MarkIt issue

Linking NAS Steps

- See “storage resource.pdf” in our Microsoft Teams files for list of IPs and more info
- After logging into pc, in terminal write: “sudo mkdir /media/**” replacing *** with name of NAS ideally, if unavailable keep any name you choose consistent
- “sudo chown -R root /media/**”
- “sudo vim /etc/fstab”
- In VIM editor, in the next empty line below the other drives add:
 - “//ip/nas_name media/** cifs username=username,password=password 0 0”
 - Replace ip, nas_name, **, uname, and pword accordingly
 - Indents in between these words
- Press escape then type :wq and press enter to save and exit
- (next slide)

- “sudo mount /media/****”
- Type “df –h” to check if the mounted drive is shown properly

Braden - Weekly Update #5

Image Group Exclusion

- Use more images and make data more reliable with more training iterations and grouping
- Dataset consists of 10 images from each class
 - 90 total images
- 9 images (1 from each class) excluded from training each time
 - 10 different models (and one control)
- Each model trained for 25 iterations
 - ~4 mins and 49 seconds to train each group

ankle0.png



elbow0.png



ankle1.png



elbow1.png



ankle2.png



elbow2.png



ankle3.png



elbow3.png



ankle4.png



elbow4.png



ankle5.png



elbow5.png



ankle6.png



elbow6.png



ankle7.png



elbow7.png



ankle8.png



elbow8.png



ankle9.png



elbow9.png



foot0.png



foot1.png



foot2.png



foot3.png



foot4.png



foot5.png



foot6.png



foot7.png



foot8.png



foot9.png



hand0.png



hand1.png



hand2.png



hand3.png



hand4.png



hand5.png



hand6.png



hand7.png



hand8.png



hand9.png



Group #0, Acc: 0.2741

hip0.png



Group #1, Acc: 0.3111

hip1.png



Group #2, Acc: 0.2370

hip2.png



Group #3, Acc: 0.2074

hip3.png



Group #4, Acc: 0.2963

hip4.png



Group #5, Acc: 0.2926

hip5.png



Group #6, Acc: 0.2407

hip6.png



Group #7, Acc: 0.2852

hip7.png



Group #8, Acc: 0.2037

hip8.png



Group #9, Acc: 0.3185

hip9.png



knee0.png



knee1.png



knee2.png



knee3.png



knee4.png



knee5.png



knee6.png



knee7.png



knee8.png



knee9.png



shoulder0.png



shoulder1.png



shoulder2.png



shoulder3.png



shoulder4.png



shoulder5.png



shoulder6.png



shoulder7.png



shoulder8.png



shoulder9.png



spine0.png



spine1.png



spine2.png



spine3.png



spine4.png



spine5.png



spine6.png



spine7.png



spine8.png



spine9.png



wrist0.png



wrist1.png



wrist2.png



wrist3.png



wrist4.png



wrist5.png



wrist6.png



wrist7.png

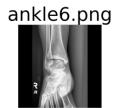


wrist8.png



wrist9.png





Group #8, Acc: 0.2037



Group #3, Acc: 0.2074



Group #2, Acc: 0.2370



Group #6, Acc: 0.2407



Group #0, Acc: 0.2741



Group #7, Acc: 0.2852



Group #5, Acc: 0.2926



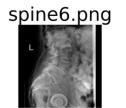
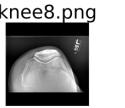
Group #4, Acc: 0.2963



Group #1, Acc: 0.3111

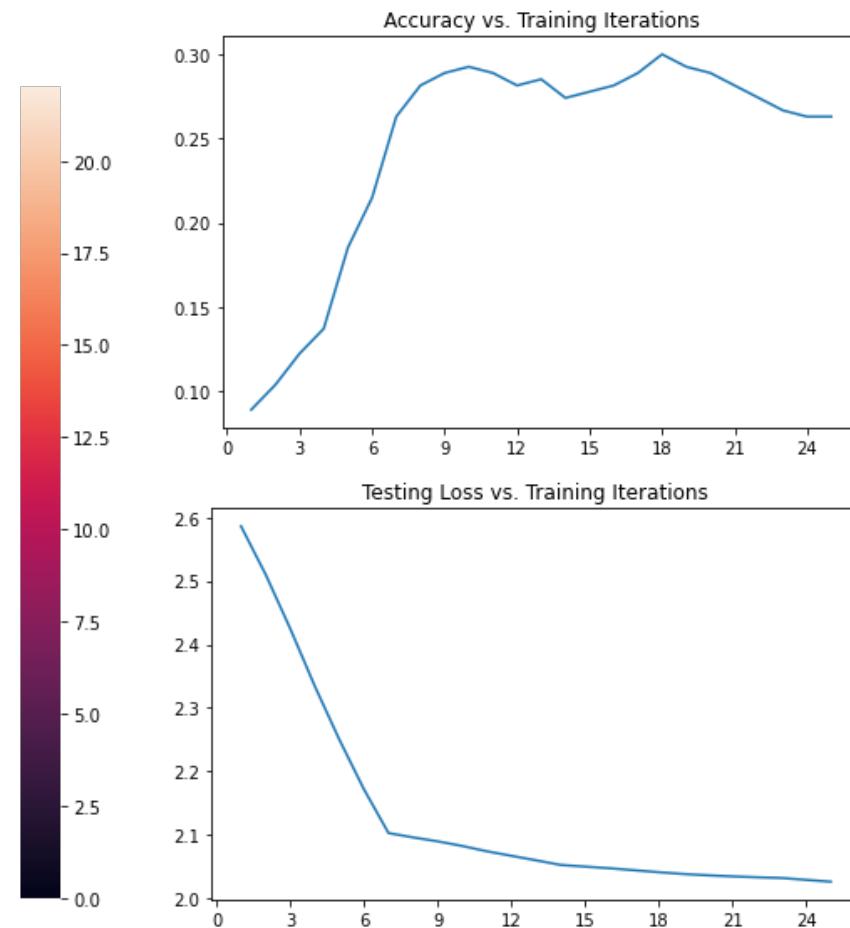
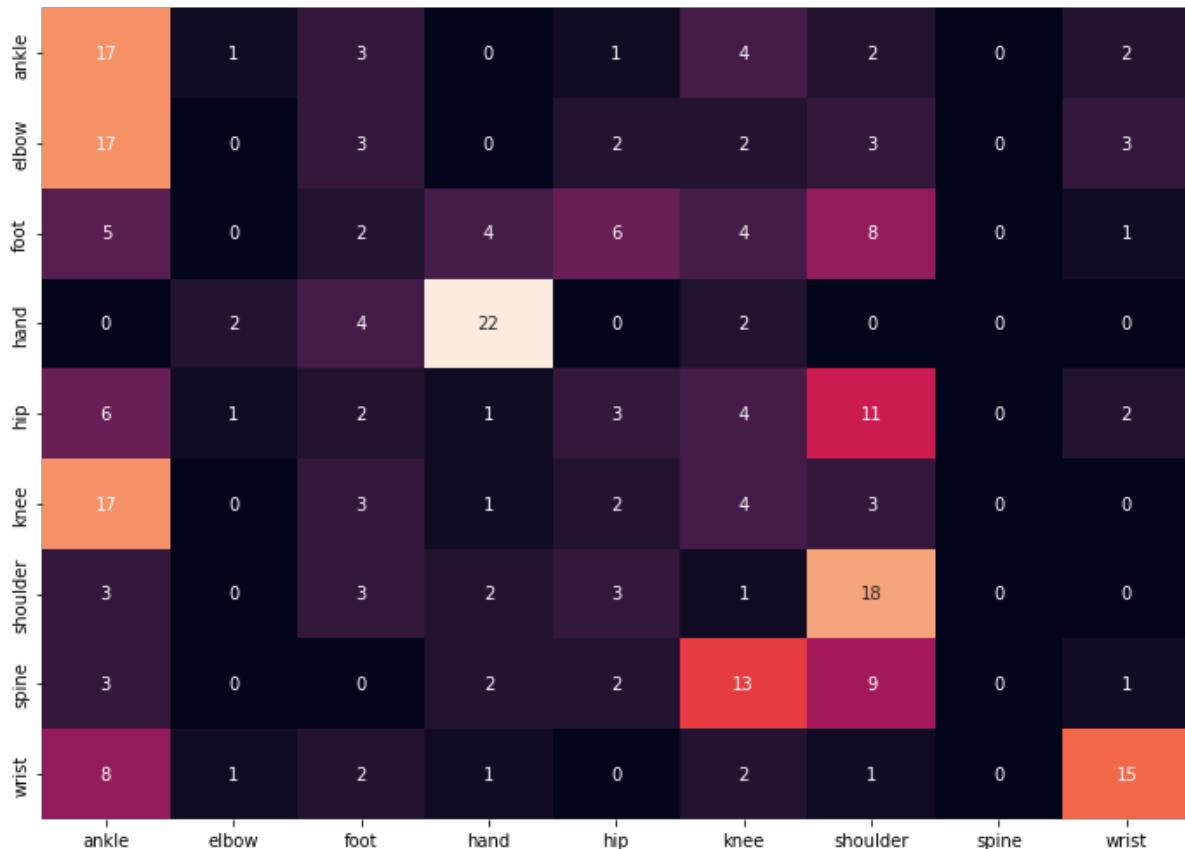


Group #9, Acc: 0.3185



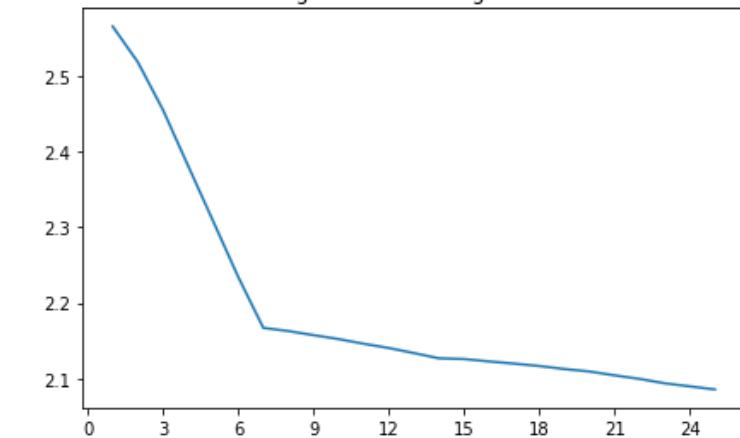
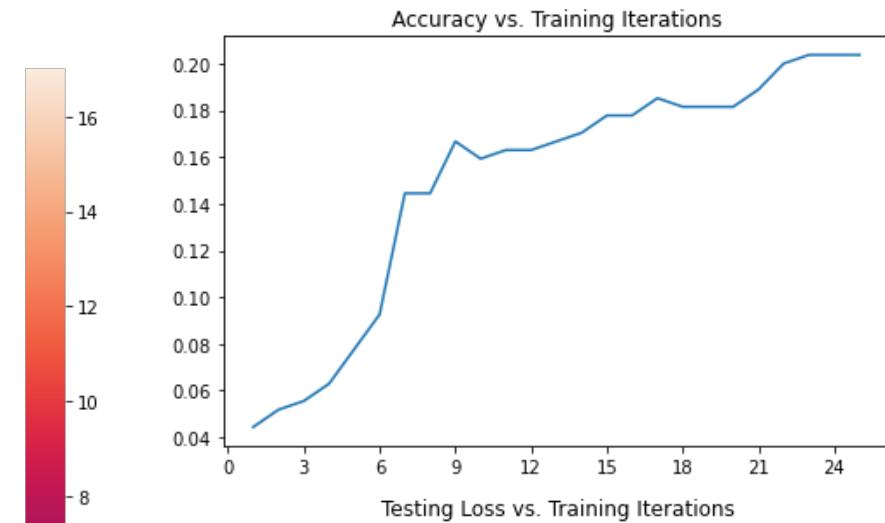
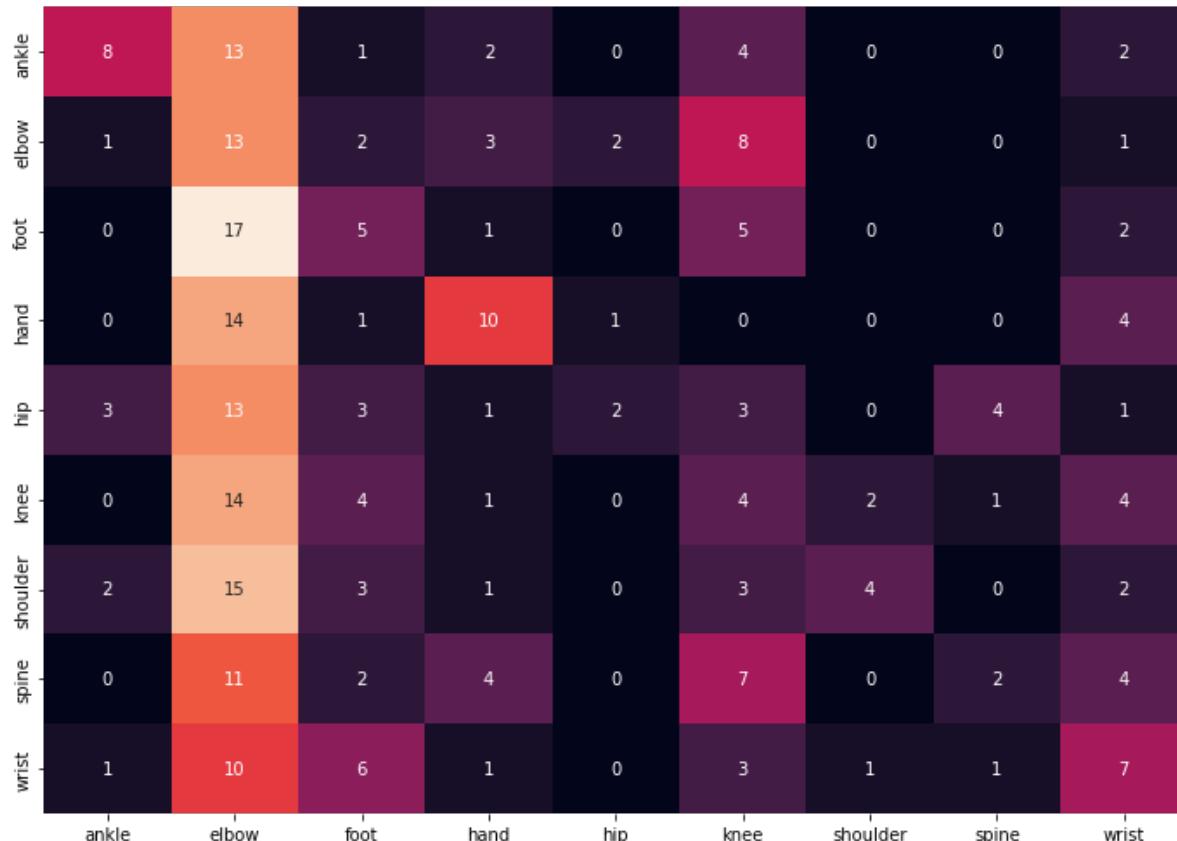
Control

- Best Accuracy was 30.0%
- Used full dataset of 90 images



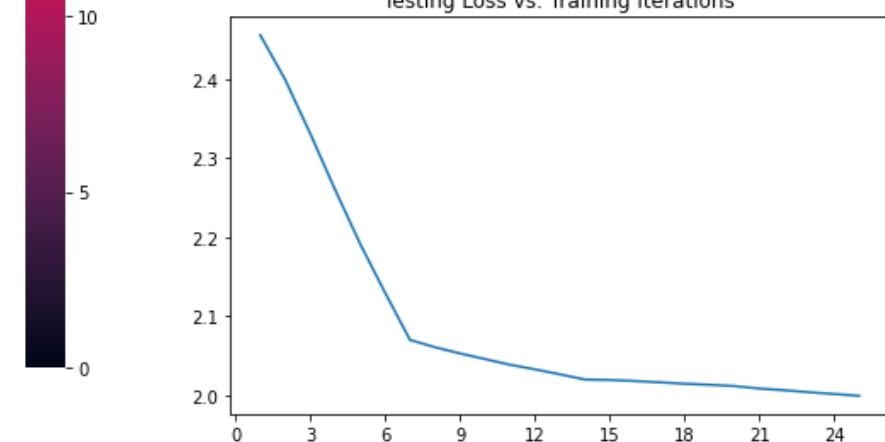
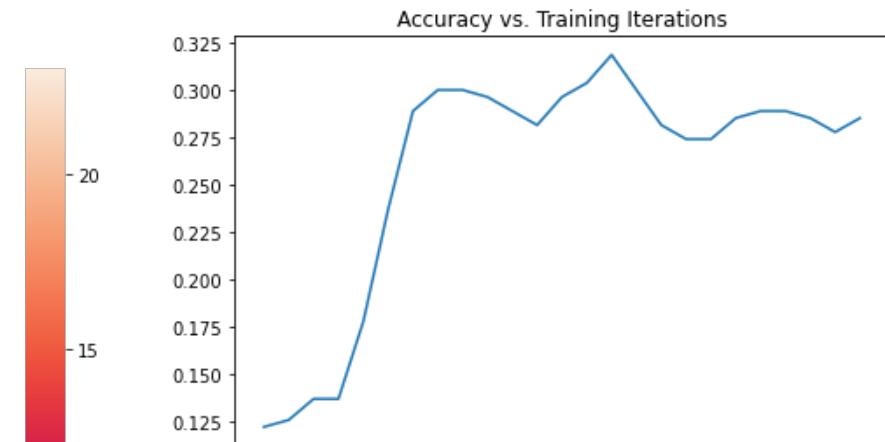
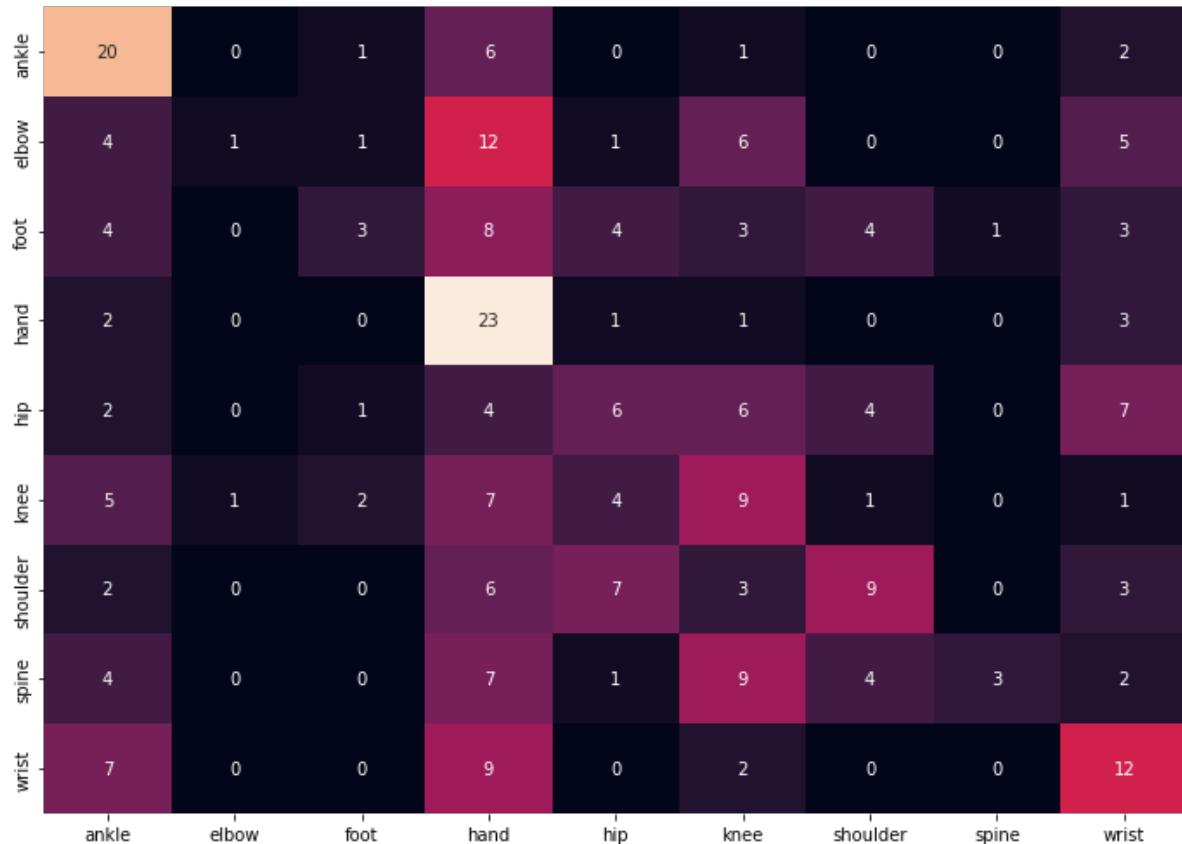
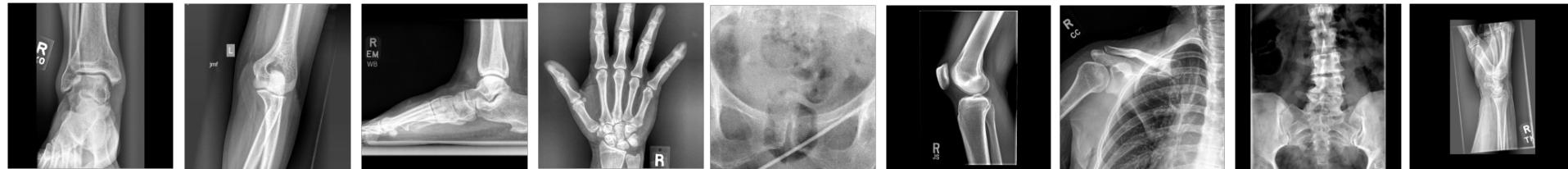
Ankle – 57%
Elbow – 0%
Foot – 7%
Hand – 73%
Hip – 10%
Knee – 13%
Shoulder – 60%
Spine – 0%
Wrist – 50%

Group #8 (Lowest performing – 20.4% acc.)



Ankle – 27%
Elbow – 43%
Foot – 17%
Hand – 33%
Hip – 7%
Knee – 13%
Shoulder – 13%
Spine – 7%
Wrist – 23%

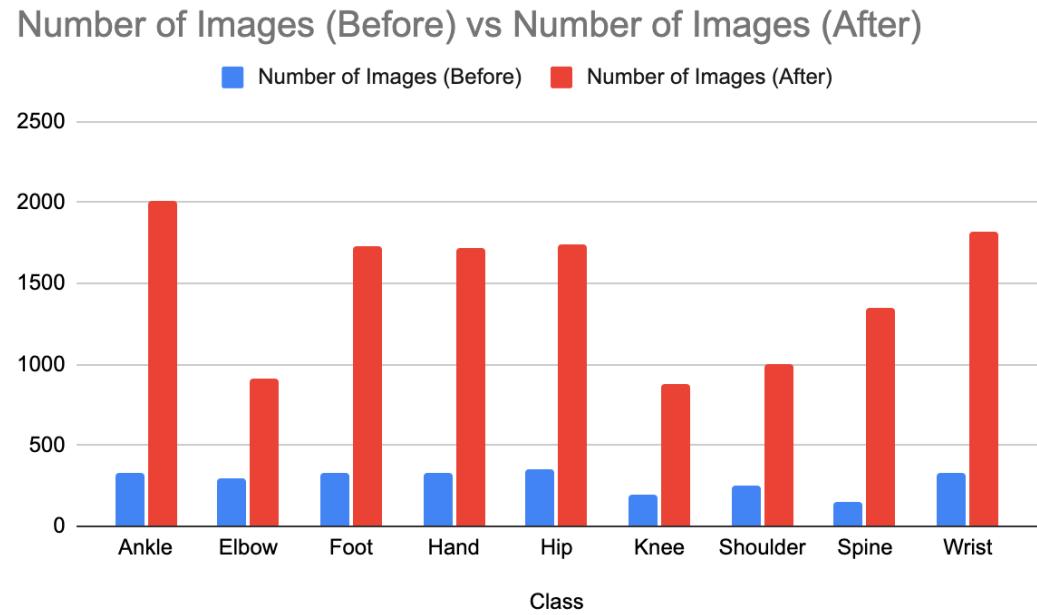
Group #9 (Highest performing – 31.9% acc.)



Ankle – 67%
Elbow – 3%
Foot – 10%
Hand – 77%
Hip – 20%
Knee – 30%
Shoulder – 30%
Spine – 10%
Wrist – 40%

Expanding Body Part Project Dataset

- Wanted to compile all available body part images on NAS to explore using a bigger testing dataset in data rankings and for UMAP visualizations
- This new dataset includes original data as well (but no duplicates)
- Total images went from 2570 to 13174



UMAP Visualizations w/ Data Rankings

- Started project to show each datapoint's data ranking in UMAP visualization
- Using fully trained model's prediction probabilities of training data as rankings for now
 - Data was normalized since most were around 99.9%
- Next step is to use group exclusion data ranking on a much larger training dataset where accuracies are much greater and closer together
 - Use new body part images to make a bigger testing dataset
 - Normalize data

Braden - Weekly Update #6

Exclusion Data Rankings

- Used many methods to keep the model's learning ability consistent for each image excluded, but at the cost of increased training time
 - <https://pytorch.org/docs/stable/notes/randomness.html>
 - Model's accuracy doesn't change at all (when dataset isn't changed) when it is trained again, so I am confident it can be used on a bigger dataset with reliable results
- Doing single image exclusion on full dataset currently
 - 3000 total images, 270 testing images and 2700 training images (images were distributed equally among the nine classes)
 - One epoch for each model (since there's 2700 images to exclude, more would take too long) with 1m 37s per training
 - My next step would be to increase the number of epochs to 5 or 10 for more reliability, try to optimize training code to be more time-efficient
 - Started Monday afternoon, expected to finish Thursday afternoon

Last Day

- Code is available on my GitHub for ResNet training, visualizations (heatmaps, ROC curves, confusion matrices), exclusion data ranking, and also the ResNet models (for 100x100 images and 1000x1000 images)
 - Username: b-johnsen
 - https://github.com/MGH-LMIC/BodyPartClassification_Braden
- Some datasets also available on DropBox
 - All available body part images (13,174):
<https://www.dropbox.com/sh/4l05oych30uspo8/AAACz5HTehyTV59QrpYOlehTa?dl=0>
 - Evenly distributed training dataset (2,700):
<https://www.dropbox.com/sh/u70miodyh1h46vl/AACMDwyrjtxz8aGwH09aK7pna?dl=0>