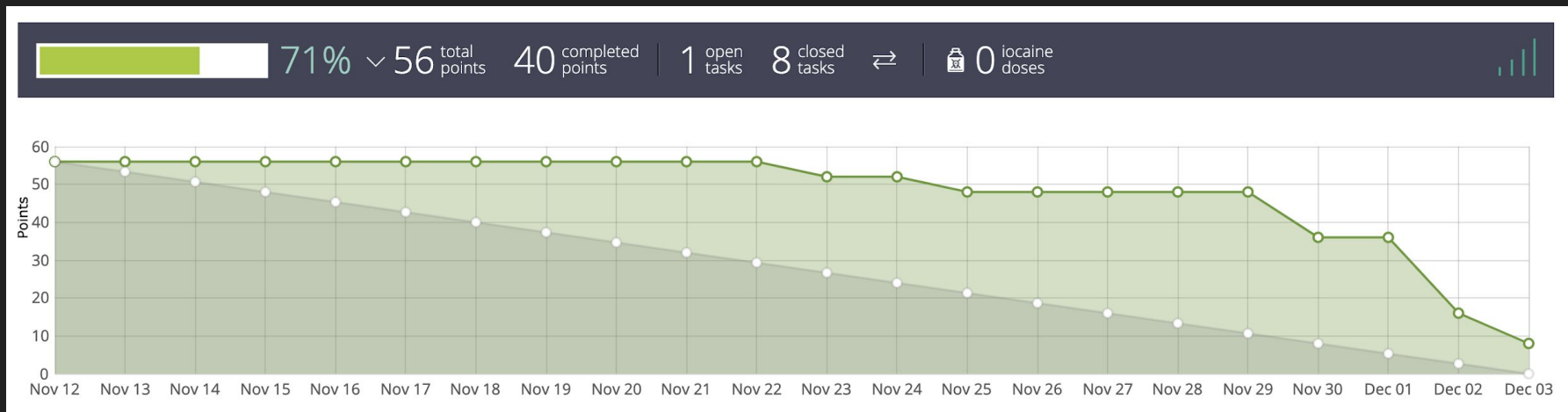# Containerizing Neural Network Apps for Medical Compute

Sprint 5

Mentors: Rudolph Pienaar, Sandip Samal

Group Members: Ken Krebs, Brian Mahabir, Tingyi Zhang, Cagri Yoruk, Xiaoyu An
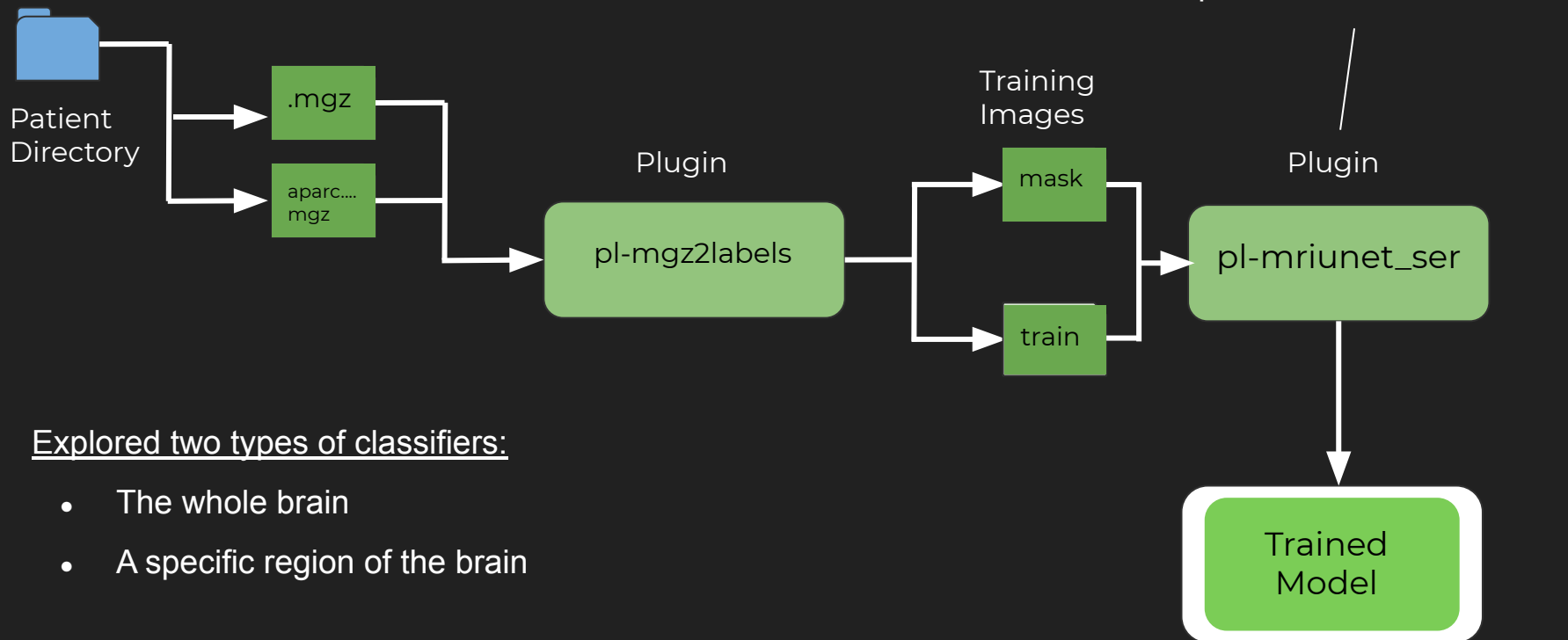
Burn down chart

Total Project Deliverables: Where we are

- 2 working pipelines for two different types of classifiers.
- 2 phases of each pipeline
- Training :
  - Train models using two different types of classifiers (one classifier to identify multiple parts of the brain, the other to utilize multiple classifiers to identify specific parts of the brain)
- Infererence :
  - Use models to infer data about brain structure volume and output text report.
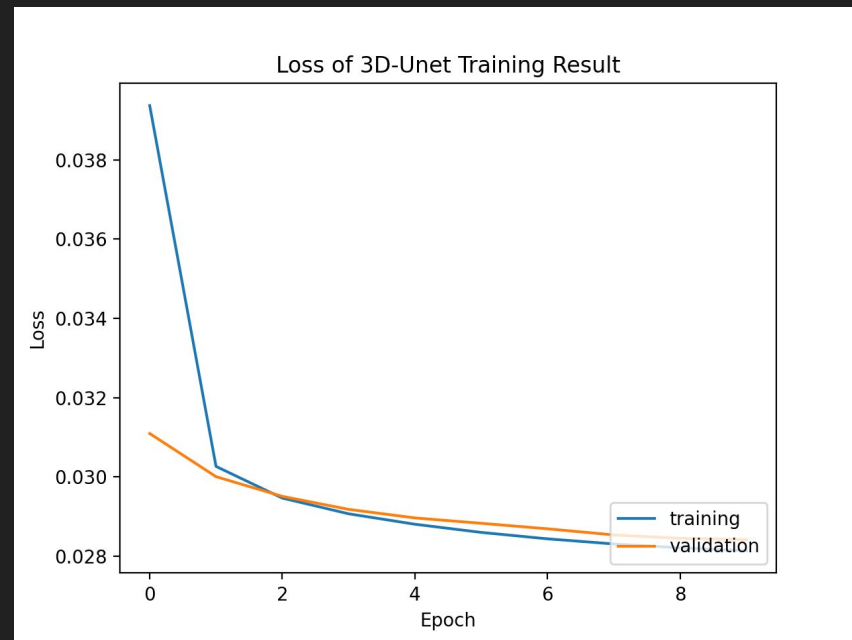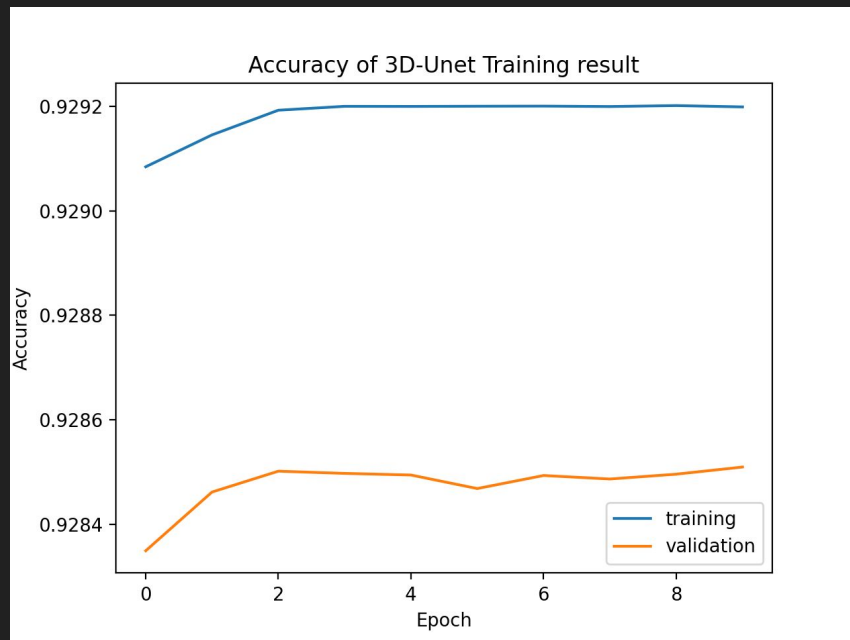
- MOC Deployment

This Sprint Goals

- Finish workflows with text report plugin for our inference pipeline

- Fix authentication and most importantly persistent volume error with pfioh and pman on MOC

- Testing our workflow on the UI

Our Training Pipeline: Done!

An automation tool for training multiple labels

Patient Directory

.mgz

aparc.... mgz

Plugin

pl-mgz2labels

Training Images

mask

train

Plugin

pl-mriunet_ser

Trained Model

Explored two types of classifiers:

- The whole brain

- A specific region of the brain

Training Result
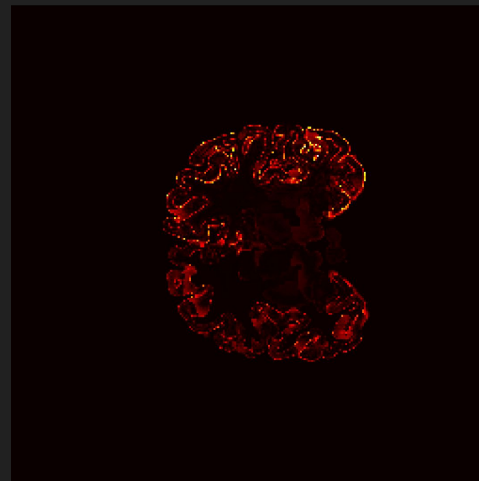

500 subjects, 10 epoch

Heatmap Result

Prediction

Ground Truth

Heatmap

Low

High

Our Inference Pipeline

This sprint

Patient Directory → .dcm → .png → pl-mricnn (Plugin) → Prediction images → .npy → pl-img2report → Report

Brain Segmentation Report

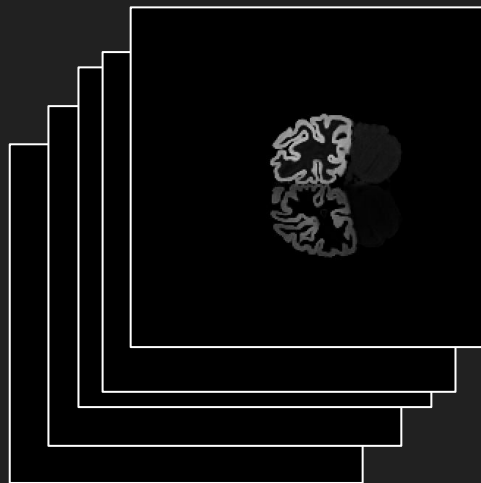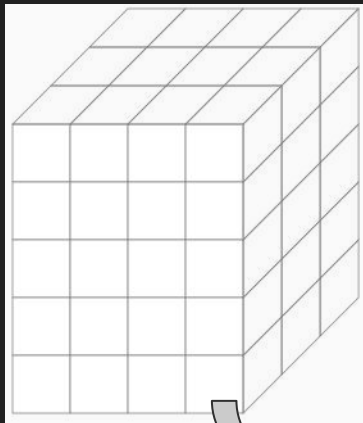| Index	Label Name	Volume (in cc)
1	Unknown	15251.0
2	Left-Cerebral-White-Matter	286.7
3	Left-Lateral-Ventricle	6.1
4	Left-Inf-Lat-Vent	0.3
5	Left-Cerebellum-White-Matter	16.7
6	Left-Cerebellum-Cortex	71.2
7	Left-Thalamus-Proper*	9.4
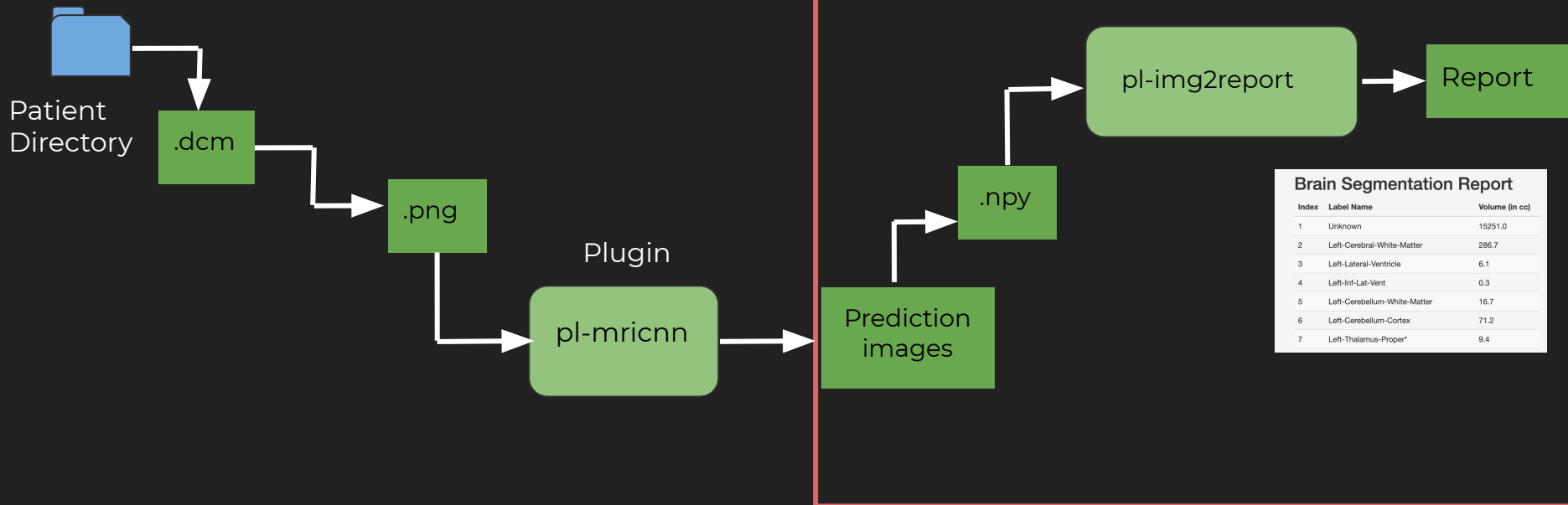
Our plugin: convert images to text report

Segmented images
256 images with size of (256, 256)

Numpy array
(256, 256, 256)

Volume text report

Brain Segmentation Report

Index	Label Name	Volume (in cc)
1	Unknown	15251.0
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Each pixel value is corresponding to the index of a label

Credits: https://github.com/FNNDSC/pl-mgz2LUT_report

MOC issues for Sprint 5

Upon testing using some lightweight plugins pman gave a persistent volume error

Due to the docker image pull limit established on Nov 20 we only had a few shots to debug our problem

Apparently MOC doesn't support 5Gi persistent storage. They only have 2Gi, 10Gi, 20Gi storage options.

MOC Demonstration

Demo

ul-Post-ventral</td><td>3.6</td></tr><tr><td>145</td><td> ctx_rh_G_cuneus</td><td>3.7</t
d></tr><tr><td>146</td><td> ctx_rh_G_front_inf-Opercular</td><td>3.8</td></tr><tr><td>14
7</td><td> ctx_rh_G_front_inf-Orbital</td><td>3.8</td></tr><tr><td>148</td><td> ctx_rh_G
_front_inf-Triangul</td><td>4.0</td></tr><tr><td>149</td><td> ctx_rh_G_front_middle</td>
<td>4.2</td></tr><tr><td>150</td><td> ctx_rh_G_front_sup</td><td>4.3</td></tr><tr><td>15
1</td><td> ctx_rh_G_Ins_lg_and_S_cent_ins</td><td>4.3</td></tr><tr><td>152</td><td> ctx_
rh_G_insular_short</td><td>4.5</td></tr><tr><td>153</td><td> ctx_rh_G_occipital_middle</
td><td>4.5</td></tr><tr><td>154</td><td> ctx_rh_G_occipital_sup</td><td>4.6</td></tr><tr
><td>155</td><td> ctx_rh_G_oc-temp_lat-fusifor</td><td>4.7</td></tr><tr><td>156</td><td>
 ctx_rh_G_oc-temp_med-Lingual</td><td>4.8</td></tr><tr><td>157</td><td> ctx_rh_G_oc-temp
_med-Parahip</td><td>5.0</td></tr><tr><td>158</td><td> ctx_rh_G_orbital</td><td>4.9</td>
</tr><tr><td>159</td><td> ctx_rh_G_pariet_inf-Angular</td><td>4.8</td></tr><tr><td>160</
td><td> ctx_rh_G_pariet_inf-Supramar</td><td>4.8</td></tr><tr><td>161</td><td> ctx_rh_G_
parietal_sup</td><td>4.8</td></tr><tr><td>162</td><td> ctx_rh_G_postcentral</td><td>4.8<
/td></tr><tr><td>163</td><td> ctx_rh_G_precentral</td><td>4.8</td></tr><tr><td>164</td><
td> ctx_rh_G_precuneus</td><td>4.6</td></tr><tr><td>165</td><td> ctx_rh_G_rectus</td><td
>4.5</td></tr><tr><td>166</td><td> ctx_rh_G_subcallosal</td><td>4.4</td></tr><tr><td>167
</td><td> ctx_rh_G_temp_sup-G_T_transv</td><td>4.2</td></tr><tr><td>168</td><td> ctx_rh_
G_temp_sup-Lateral</td><td>4.1</td></tr><tr><td>169</td><td> ctx_rh_G_temp_sup-Plan_pola
r</td><td>4.1</td></tr><tr><td>170</td><td> ctx_rh_G_temp_sup-Plan_tempo</td><td>4.0</td
></tr><tr><td>171</td><td> ctx_rh_G_temporal_inf</td><td>3.8</td></tr><tr><td>172</td><t
d> ctx_rh_G_temporal_middle</td><td>3.6</td></tr><tr><td>173</td><td> ctx_rh_Lat_Fis-ant
-Horizont</td><td>3.4</td></tr><tr><td>174</td><td> ctx_rh_Lat_Fis-ant-Vertical</td><td>
3.3</td></tr><tr><td>175</td><td> ctx_rh_Lat_Fis-post</td><td>3.2</td></tr><tr><td>176</
td><td> ctx_rh_Pole_occipital</td><td>3.0</td></tr><tr><td>177</td><td> ctx_rh_Pole_temp
oral</td><td>3.0</td></tr><tr><td>178</td><td> ctx_rh_S_calcarine</td><td>2.9</td></tr><
tr><td>179</td><td> ctx_rh_S_central</td><td>2.7</td></tr><tr><td>180</td><td> ctx_rh_S_
cingul-Marginalis</td><td>2.7</td></tr><tr><td>181</td><td> ctx_rh_S_circular_insula_ant
</td><td>2.6</td></tr><tr><td>182</td><td> ctx_rh_S_circular_insula_inf</td><td>2.5</td>
</tr><tr><td>183</td><td> ctx_rh_S_circular_insula_sup</td><td>2.4</td></tr><tr><td>184<
/td><td> ctx_rh_S_collat_transv_ant</td><td>2.4</td></tr><tr><td>185</td><td> ctx_rh_S_c
ollat_transv_post</td><td>2.2</td></tr><tr><td>186</td><td> ctx_rh_S_front_inf</td><td>2
.2</td></tr><tr><td>187</td><td> ctx_rh_S_front_middle</td><td>2.1</td></tr><tr><td>188<
/td><td> ctx_rh_S_front_sup</td><td>2.0</td></tr><tr><td>189</td><td> ctx_rh_S_interm_pr
im-Jensen</td><td>1.9</td></tr><tr><td>190</td><td> ctx_rh_S_intrapariet_and_P_trans</td
><td>1.8</td></tr><tr><td>191</td><td> ctx_rh_S_oc_middle_and_Lunatus</td><td>1.7</td></
tr><tr><td>192</td><td> ctx_rh_S_oc_sup_and_transversal</td><td>1.6</td></tr><tr><td>193
</td><td> ctx_rh_S_occipital_ant</td><td>1.5</td></tr><tr><td>194</td><td> ctx_rh_S_oc-t
emp_lat</td><td>1.5</td></tr><tr><td>195</td><td> ctx_rh_S_oc-temp_med_and_Lingual</td><
td>1.3</td></tr><tr><td>196</td><td> ctx_rh_S_orbital_lateral</td><td>1.3</td></tr><tr><
td>197</td><td> ctx_rh_S_orbital_med-olfact</td><td>1.2</td></tr><tr><td>198</td><td> ct
x_rh_S_orbital-H_Shaped</td><td>1.1</td></tr><tr><td>199</td><td> ctx_rh_S_parieto_occip
ital</td><td>0.9</td></tr><tr><td>200</td><td> ctx_rh_S_pericallosal</td><td>0.9</td></t
r><tr><td>201</td><td> ctx_rh_S_postcentral</td><td>0.8</td></tr><tr><td>202</td><td> ct
x_rh_S_precentral-inf-part</td><td>0.7</td></tr><tr><td>203</td><td> ctx_rh_S_precentral
-sup-part</td><td>0.6</td></tr><tr><td>204</td><td> ctx_rh_S_suborbital</td><td>0.5</td>
</tr><tr><td>205</td><td> ctx_rh_S_subparietal</td><td>0.5</td></tr><tr><td>206</td><td>
 ctx_rh_S_temporal_inf</td><td>0.4</td></tr><tr><td>207</td><td> ctx_rh_S_temporal_sup</
td><td>0.3</td></tr><tr><td>208</td><td> ctx_rh_S_temporal_transverse</td><td>0.2</td></
tr></table></body></html>
Reports saved
(base) Tingyis-MacBook-Pro:pl-img2report tingyizhang$
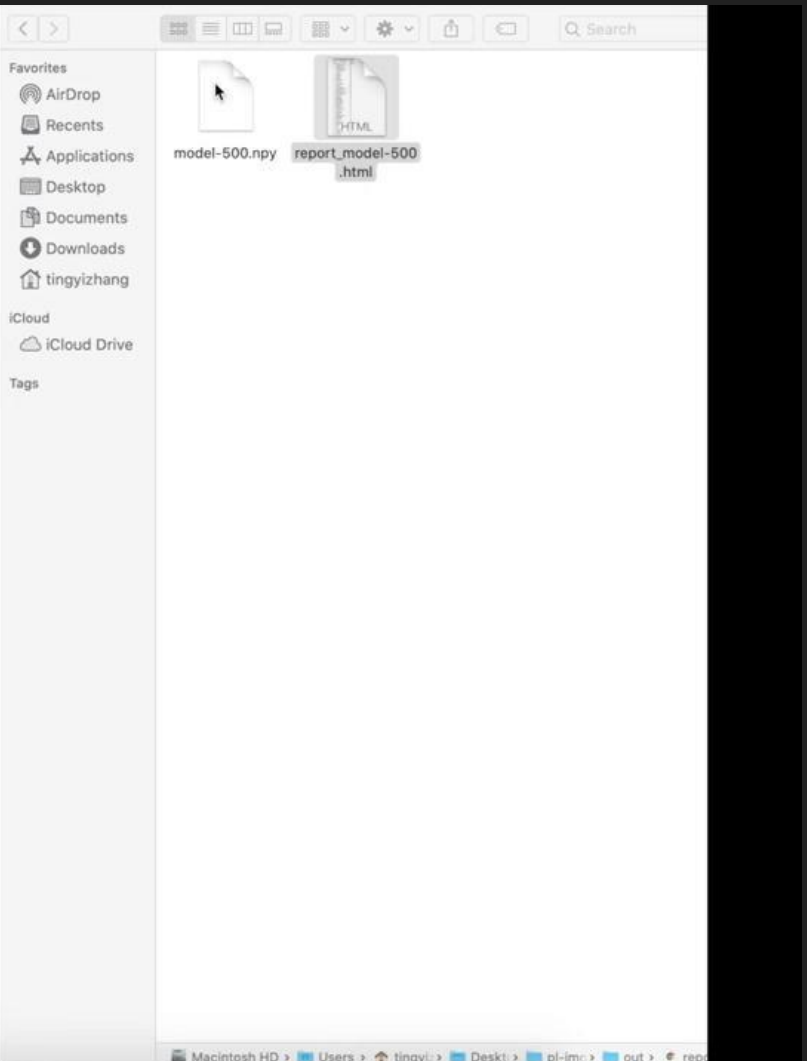
Testing the Workflow on ChRIS UI

- Goals:
  - Make sure all inputs and outputs of each plugin in the workflow work seamlessly together
 - Fix issues if any with inputs and outputs of the plugin

- Progress
  - Test Training Pipeline #1 (One classifier for every part of the brain) ✔️
  - Test Training Pipeline #2 (Many classifiers for different parts of the brain)
  - Test Inference Pipeline #1
  - Test Inference Pipeline #2

Testing on the UI

- Process
  - Instantiate an image of the ChRIS backend
  - Deploy an image of the ChRIS UI
- Hurdles:
  - File upload of patient data methods:
    - Direct upload option to Feed Synthesis
    - Pushing files to swift storage, creating a feed from the UI
    - Pushing files to swift container directly, running instance of pl-dircopy from the backend
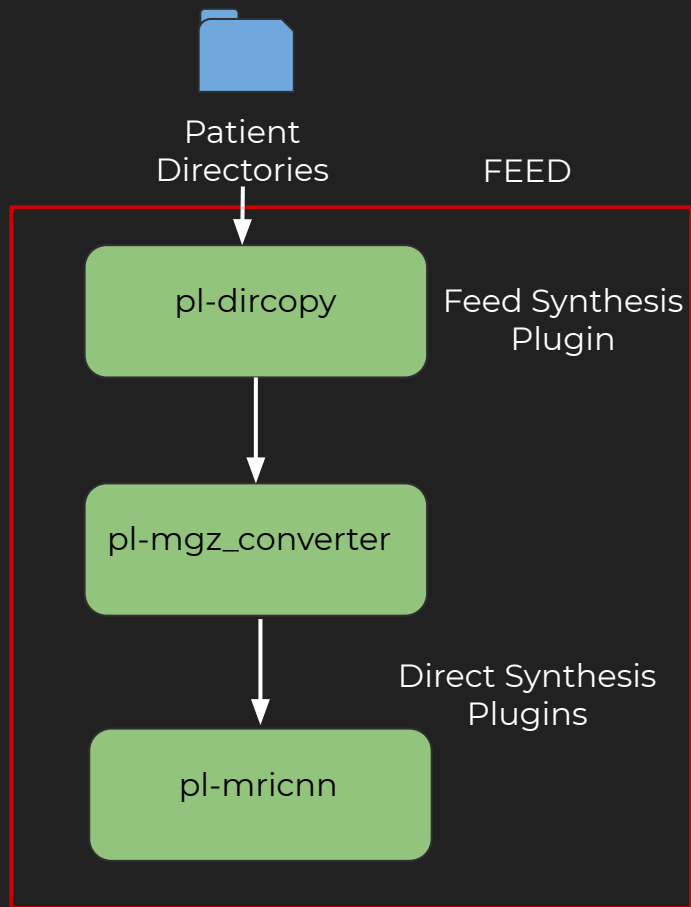
Current Project Status

COMPLETE
- 2 working pipelines for two different types of classifiers (MVP)
  - Designed plugins for separating brain region labels, training multiple regions, text reports of volumes of regions, tools to differentiate
- Deployment of Pfioh and Pman and tested with a lightweight plugin

Extra TO-DO
- Test the entirety of the workflow on the UI
- Test inference workflow on MOC

Questions?