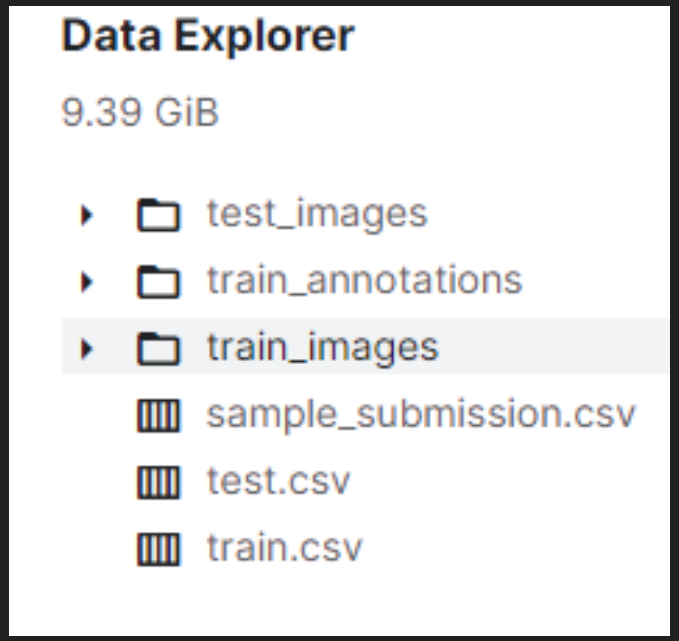
Group B Progress Report 4

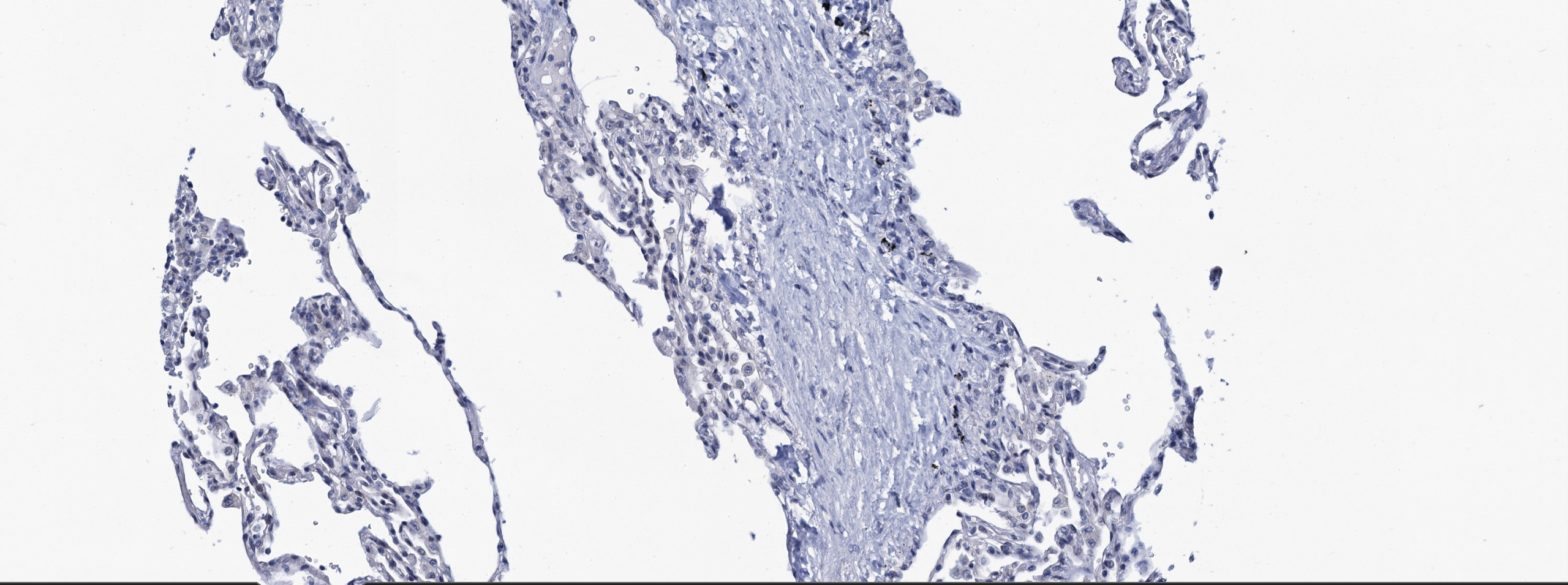
Content

- HuBMAP walkthrough
- Tile Strategy
- Baseline model analysis

HuBMAP + HPA - Hacking the Human Body

- The goal of this competition is to identify the locations of each functional tissue unit (FTU) in biopsy slides from several different organs.
- All HPA images are 3000 x 3000 pixels with a tissue area within the image around 2500 x 2500 pixels.
- The HuBMAP images range in size from 4500x4500 down to 160x160 pixels.





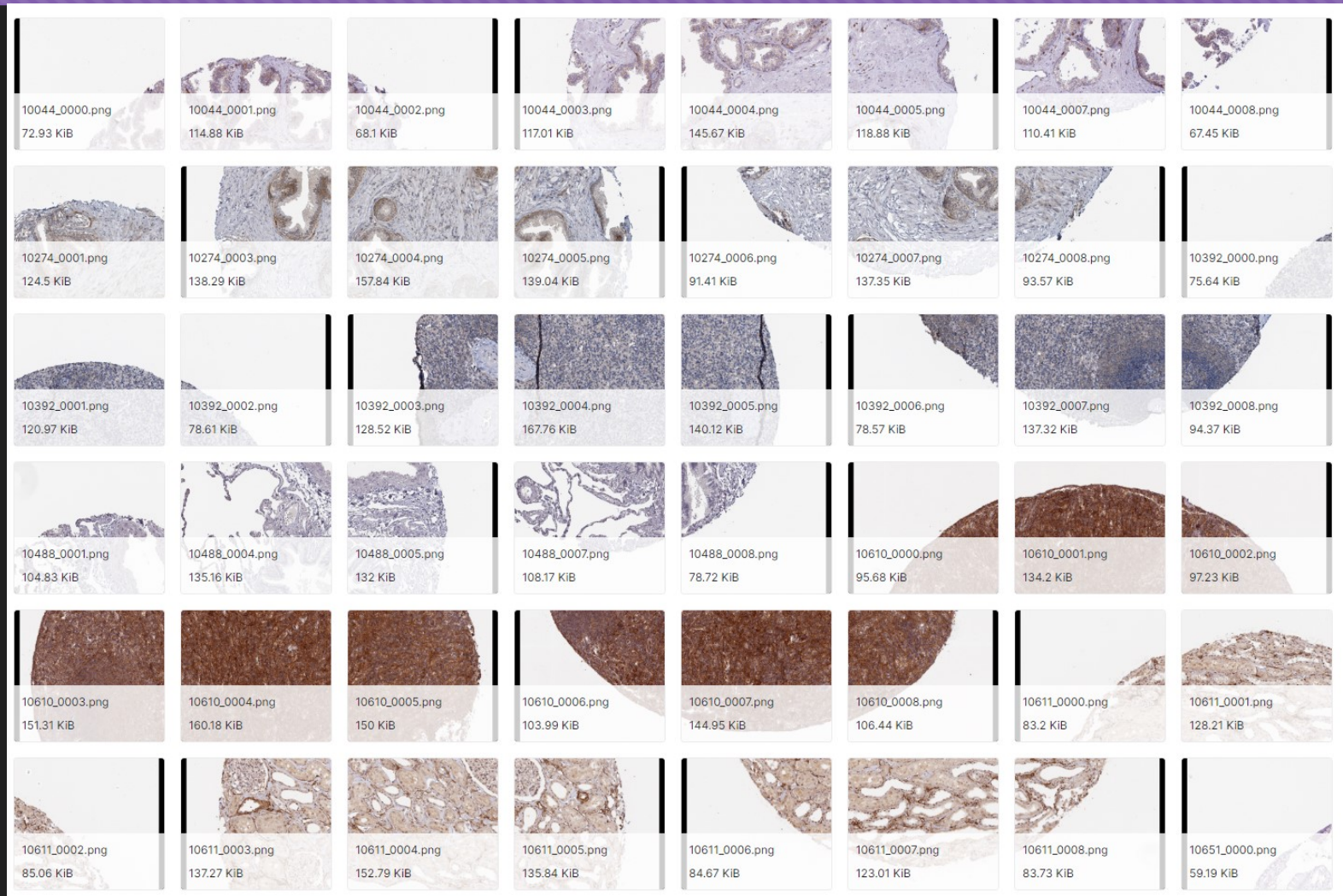
Samples

Size Problem

- Training with 3000*3000 sample size is not an easy task, which requires extravagant FLOP computations as well as memory consumption
- Therefore, the samples size need to be reduced for training.
- A feasible way is by tiling

Tiling Strategy

- In dataset HuBMAP_2022 256x256, the original images are separated into tiny blocks for the sake of efficiency.
- https://www.kaggle.com/code/thedevastator/converting-to-256x256



Tiling Strategy

- Compared with Resizing. The Tiling Strategy:
  - Preserves more detailed spatial information
  - Safes more memory for interpolation
- However…

https://ieeexplore.ieee.org/document/9025422

Tiling issues

- Some data leakage may happen because of overlapping regions are not correctly handled
- It will make some features become fragmented by block boundaries.

Model Structure

- The model used in this kernel is based on Unet architecture proposed in 2015 for medical images: while there is some variation in the subparts which use some ImageNet pretrained computer vision models could drastically improve the quality of a segmentation model because of optimized architecture of the encoder, high encoder capacity.
- The skip connections between encoder and decoder allow us to utilize features from the intermediate conv layers of the encoder effectively, without a need for the information to go the full way through entire encoder and decoder. The latter is especially important to link the predicted mask to the specific pixels of the detected object.

U-Net FPN

- There are several important things that must be added to a Unet network:
  - First, it is Feature Pyramid Network (FPN): additional skip connection between different upscaling blocks of the decoder and the output layer. So, the final prediction is produced based on the concatenation of U-net output with resized outputs of the intermediate layers. These skip-connections provide a shortcut for gradient flow improving model performance and convergence speed.
  - Since intermediate layers have many channels, their upscaling and use as an input for the final layer would introduce a significant overhead in terms of the computational time and memory. Therefore, 3x3+3x3 convolutions are applied (factorization) before the resize to reduce the number of channels.

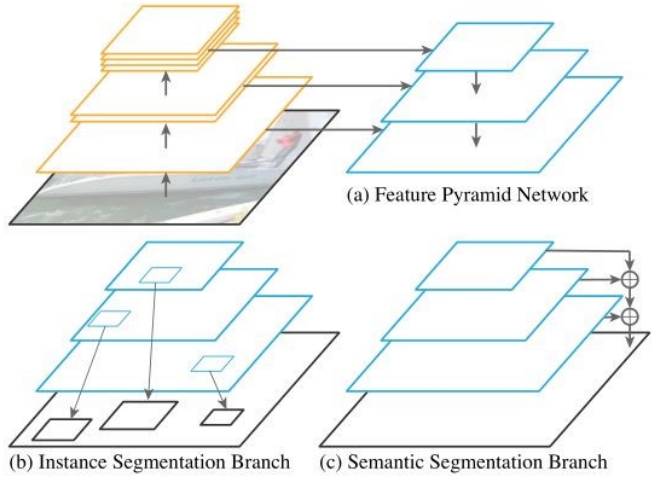
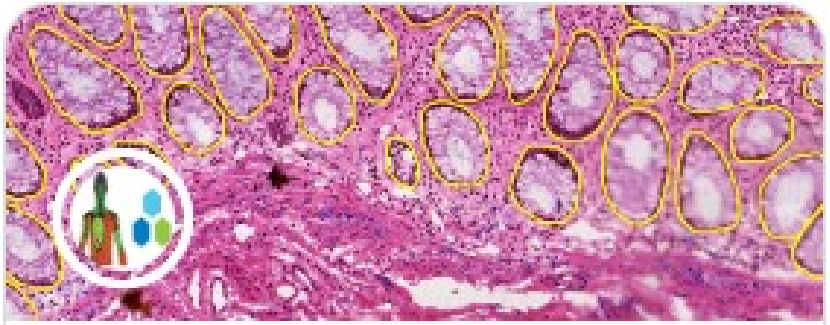


Figure 1: **Panoptic FPN**: (a) We start with an FPN backbone [36], widely used in object detection, for extracting rich multi-scale features. (b) As in Mask R-CNN [24], we use a region-based branch on top of FPN for instance segmentation. (c) In parallel, we add a lightweight dense-prediction branch on top of the same FPN features for semantic segmentation. This simple extension of Mask R-CNN with FPN is a fast and accurate baseline for both tasks.

https://arxiv.org/pdf/1901.02446.pdf

Future plans

- We are trying to improve current baselines and still ready to adapt new models and implementations as long as it performs well.



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Segment multi-organ functional tissue units

Research

Code Competition · 236 Teams

$60,000 2mo to go

Discussion