

A microscopic image of kidney tissue stained with hematoxylin and eosin (H&E). The image shows several cross-sections of renal corpuscles, including glomeruli and Bowman's capsules. The glomeruli are clusters of capillaries, and the Bowman's capsules are the surrounding double-layered structures. The surrounding tissue consists of various types of cells and connective tissue. The overall appearance is that of a healthy kidney section.

Vessel segmentation from kidney
images using U-Nets

Outline



Motivation



Dataset description



Approaches

SwinUnetR

MedSAM

Transfer learning



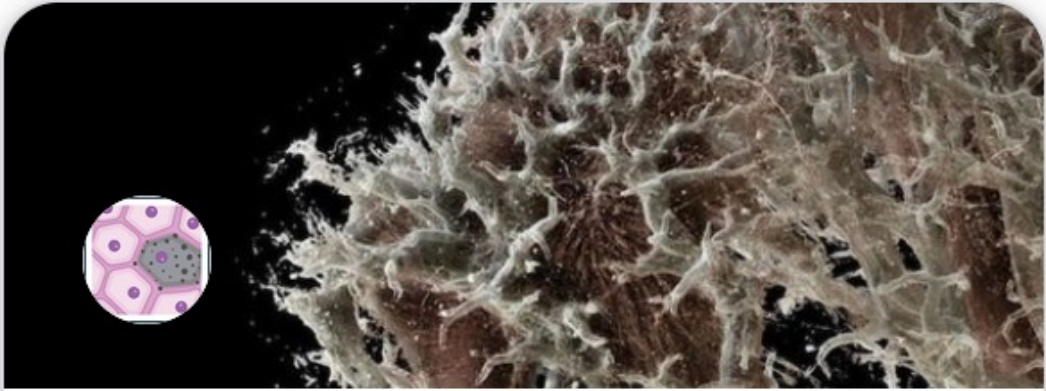
Winning solution



**Comments &
Questions**

Motivation and problem statement

- Kaggle competition: Hacking the human vasculature
 - Help researchers understand structure of vessels
 - Help in bulk and quick diagnosis of slices
 - Monitor vessel changes



SenNet + HOA - Hacking the Human Vasculature in 3D ⋮

Segment vasculature in 3D scans of human ...

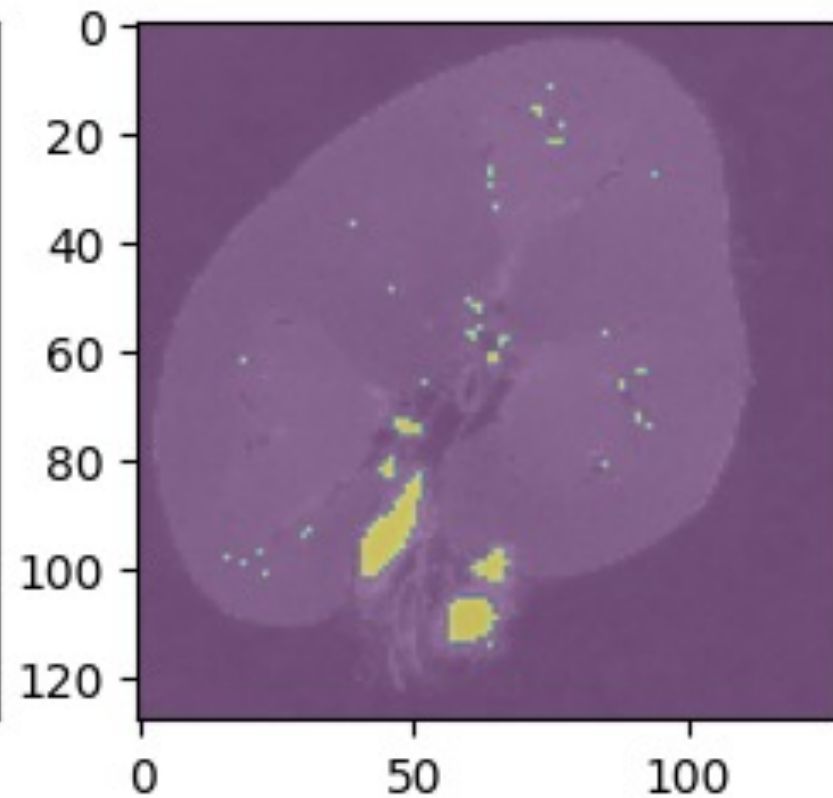
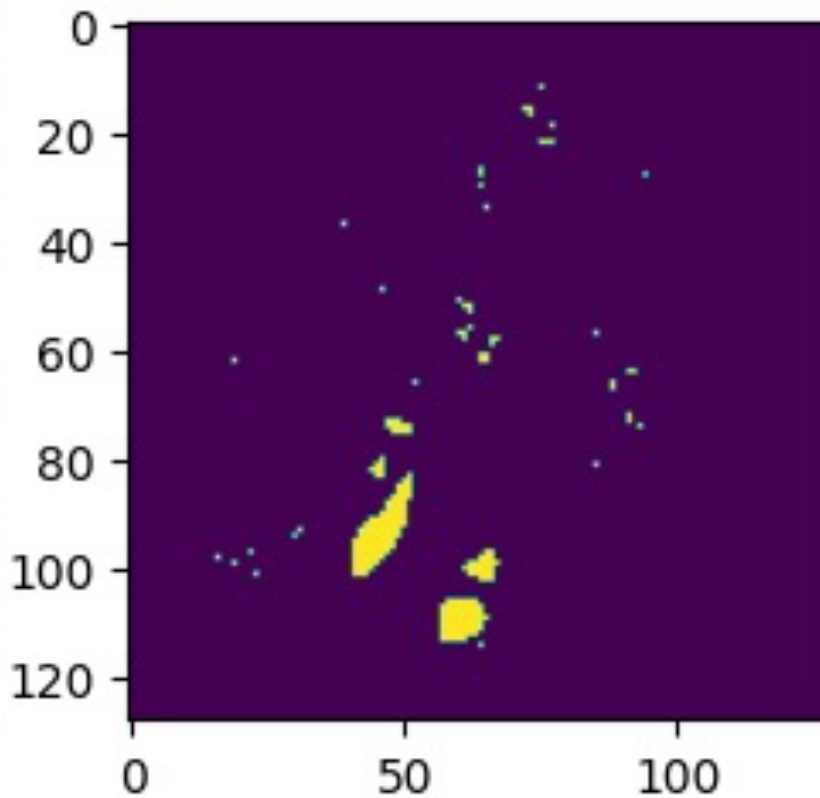
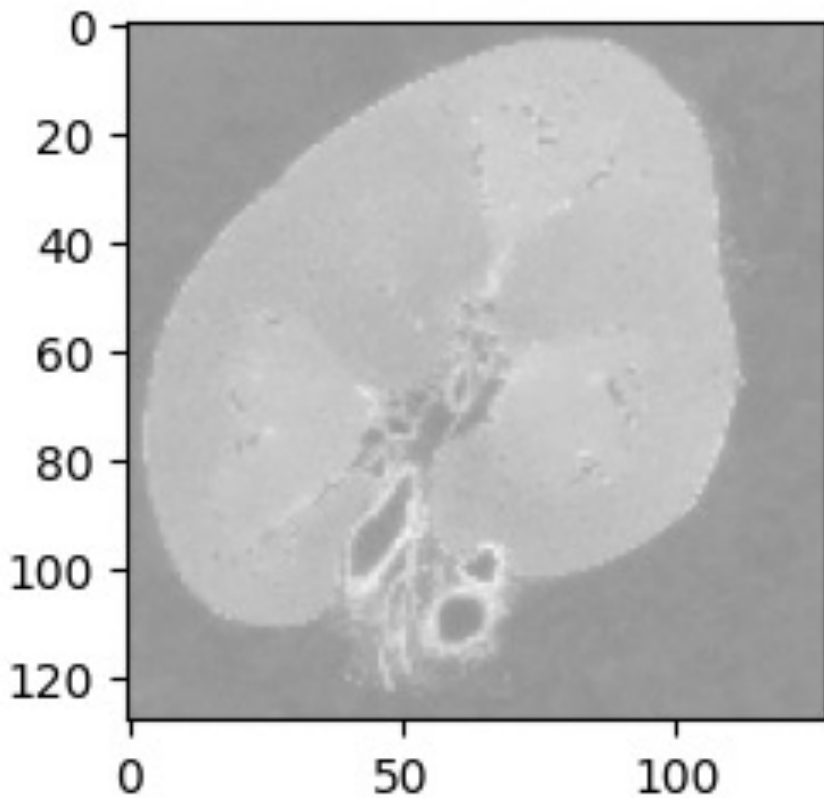
Research · Code Competition

828 Teams

\$80,000 20 days to go

Task and evaluation metric

- Given an RGB images of a kidney slice, predict a binary mask that's overlaid on the image.
 - Single class segmentation: blood vessels
 - Blood vessels are thin, so masks are sparse
- Evaluated using DICE score



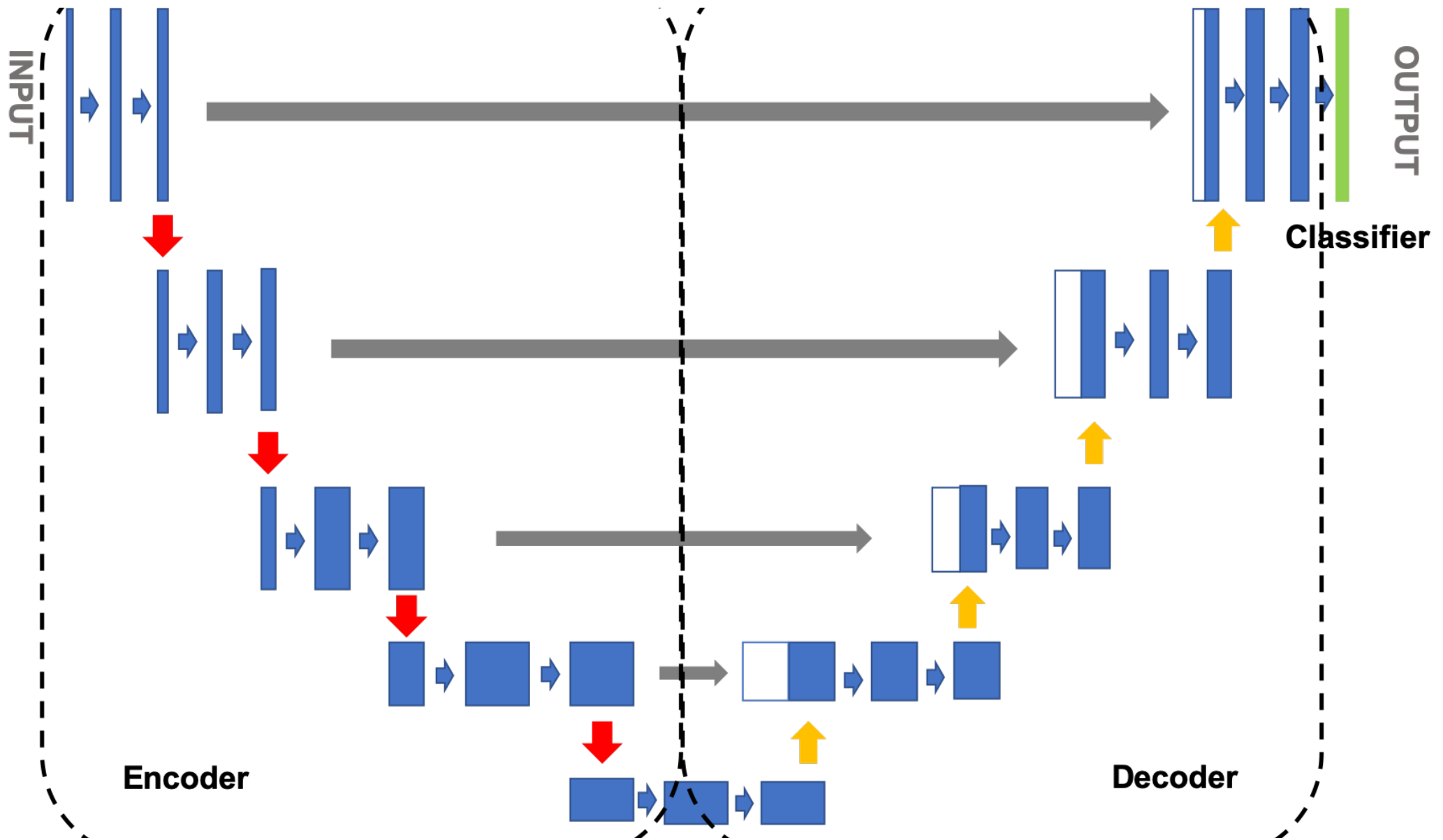


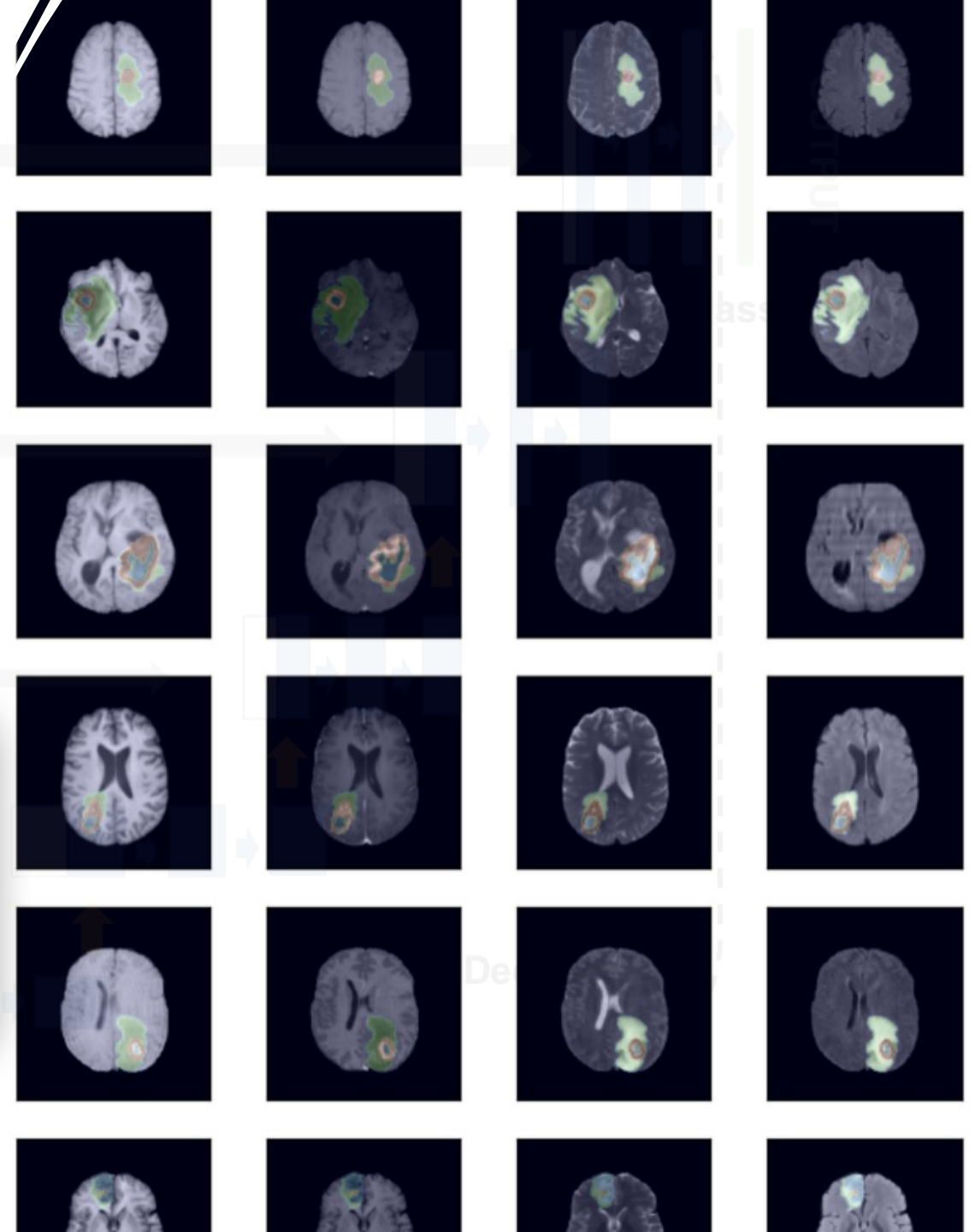
Image extracted from: <https://www.dounaite.com/article/627925a8ac359fc9132727f7.html>

SwinUnetR

- UNet + Transformers
- Segmentation of brain tumors.
- Multi-class segmentation
 - Tumor core (blue)
 - Enhancing tumor (red)
 - Whole tumor (green)
- <https://arxiv.org/pdf/2201.01266.pdf>

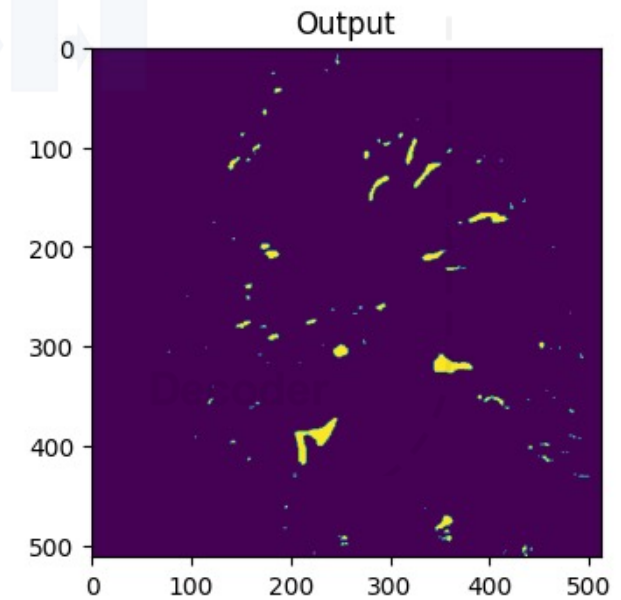
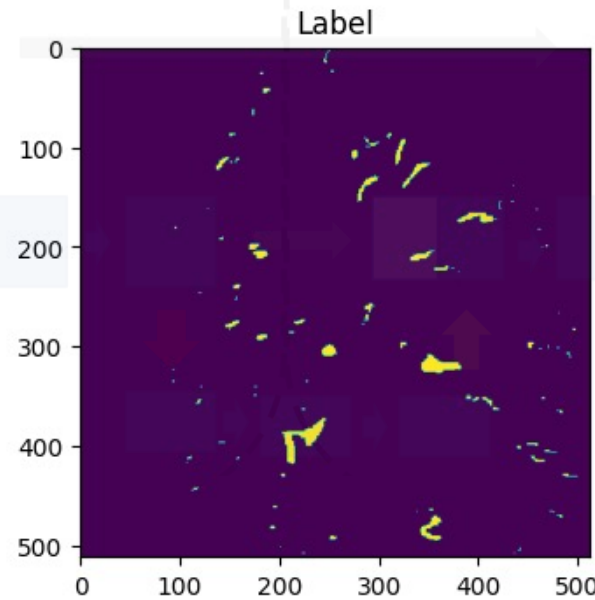
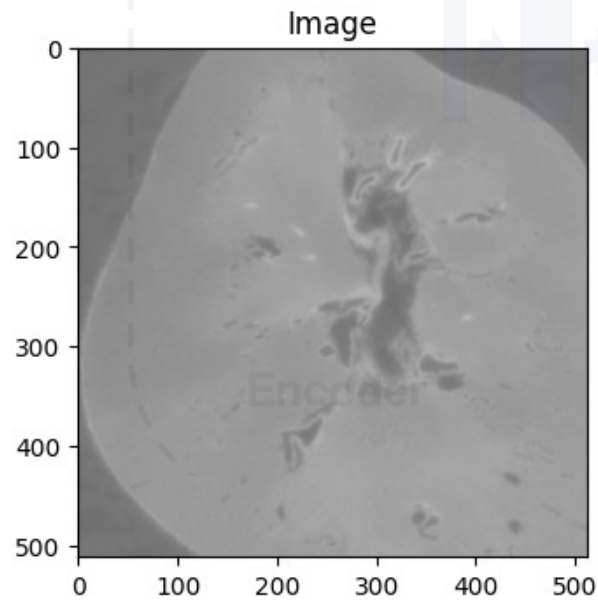
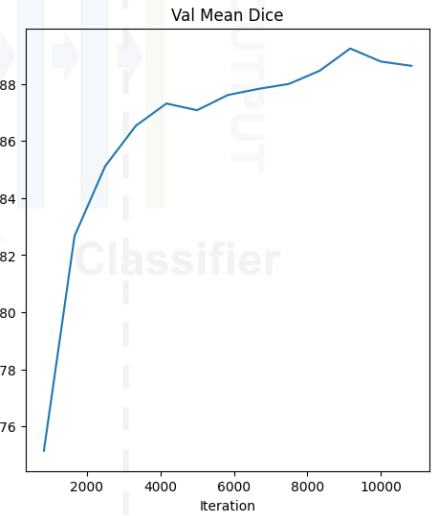
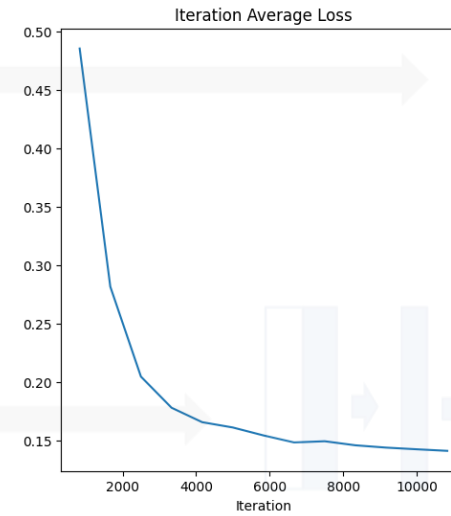
Table 2. Five-fold cross-validation benchmarks in terms of mean Dice score values. ET, WT and TC denote Enhancing Tumor, Whole Tumor and Tumor Core respectively.

Dice Score	Swin UNETR				nnU-Net				SegResNet				TransBTS			
	ET	WT	TC	Avg.	ET	WT	TC	Avg.	ET	WT	TC	Avg.	ET	WT	TC	Avg.
Fold 1	0.876	0.929	0.914	0.906	0.866	0.921	0.902	0.896	0.867	0.924	0.907	0.899	0.856	0.910	0.897	0.883
Fold 2	0.908	0.938	0.919	0.921	0.899	0.933	0.919	0.917	0.900	0.933	0.915	0.916	0.885	0.919	0.903	0.902
Fold 3	0.891	0.931	0.919	0.913	0.886	0.929	0.914	0.910	0.884	0.927	0.917	0.909	0.866	0.903	0.898	0.889
Fold 4	0.890	0.937	0.920	0.915	0.886	0.927	0.914	0.909	0.888	0.921	0.916	0.908	0.868	0.910	0.901	0.893
Fold 5	0.891	0.934	0.917	0.914	0.880	0.929	0.917	0.909	0.878	0.930	0.912	0.906	0.867	0.915	0.893	0.892
Avg.	0.891	0.933	0.917	0.913	0.883	0.927	0.913	0.908	0.883	0.927	0.913	0.907	0.868	0.911	0.898	0.891



Proposed solution I

- SwinUnetR
 - Trained it from scratch
 - We achieved 0.89 dice score in validation



Problems with this model

Poor performance on test set (~ 0.21)

Potential issues:

- Overfitting
- Multi-class segmentation is not the same as single-class segmentation

970

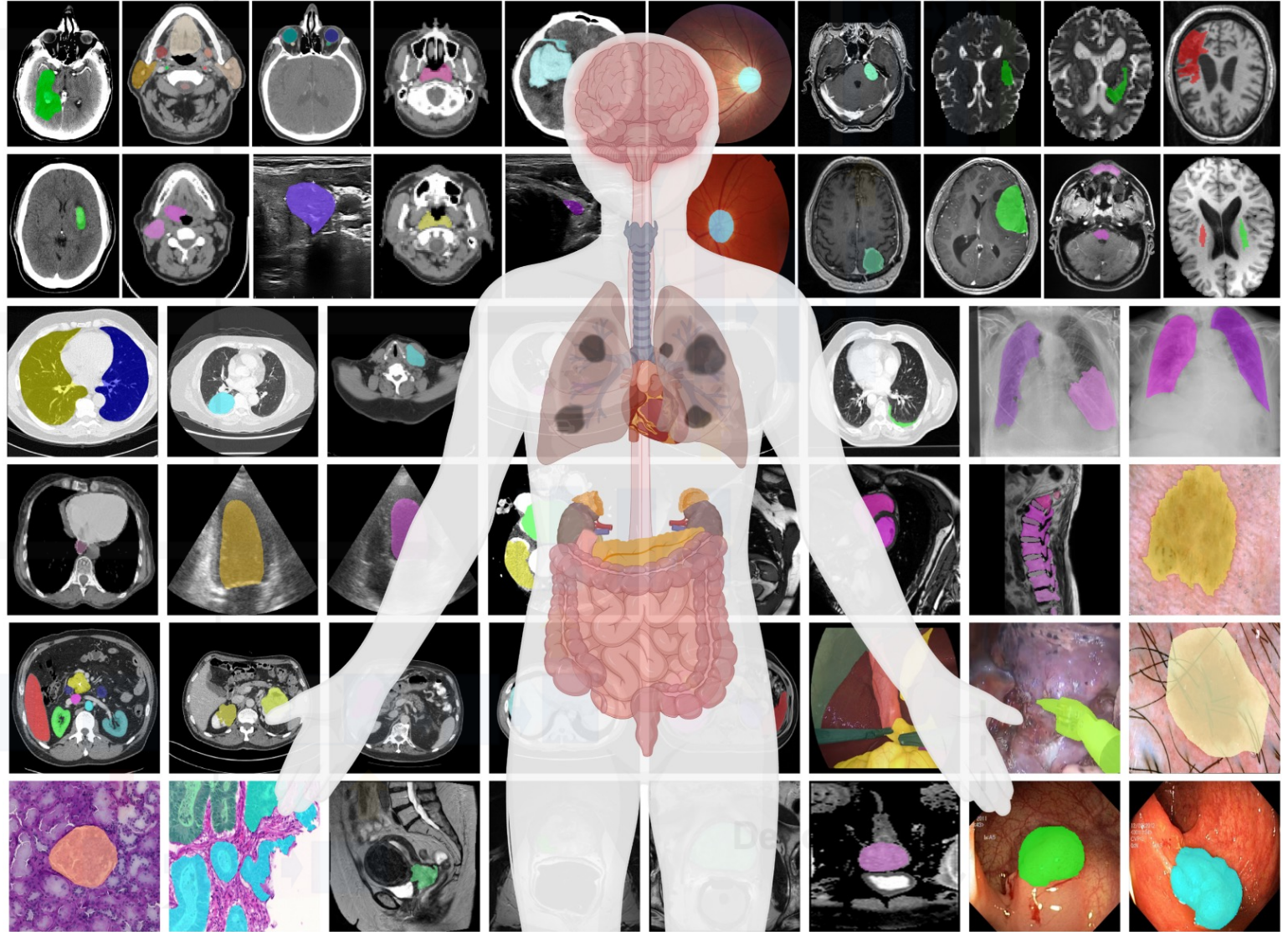
▲ 3

George Tang27



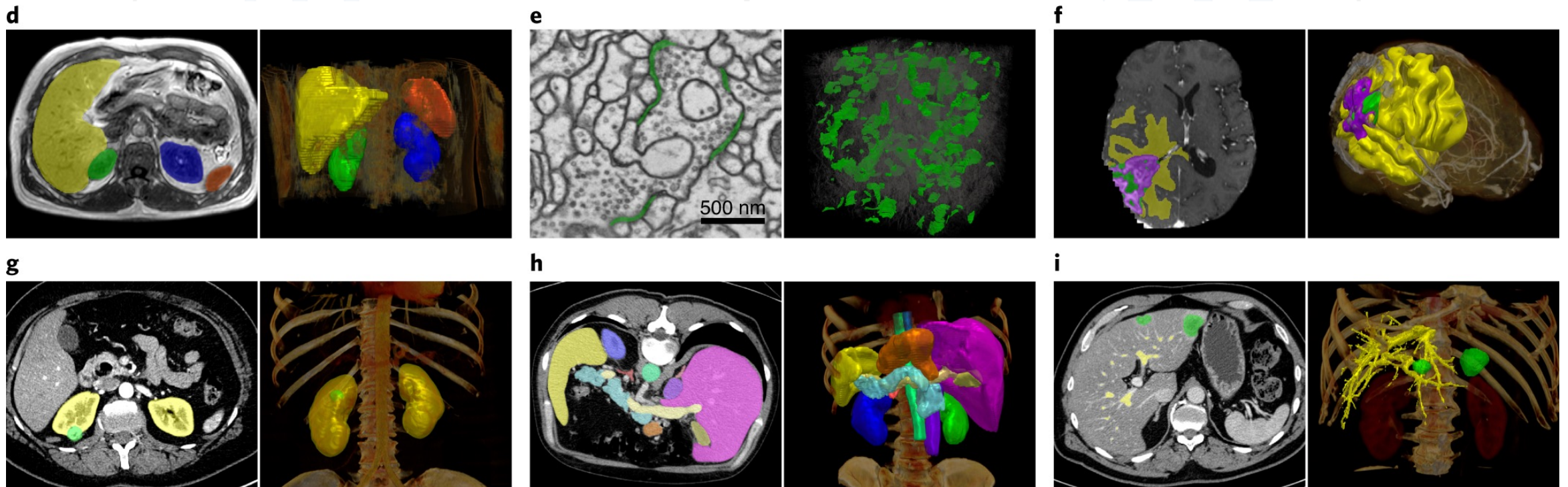
Proposed solution II

- MedSAM: foundational model
 - Multi class segmentation
 - Organ segmentation
- <https://arxiv.org/pdf/2304.12306.pdf>
- Poor results
 - Stuck in low validation dice score of 0.11



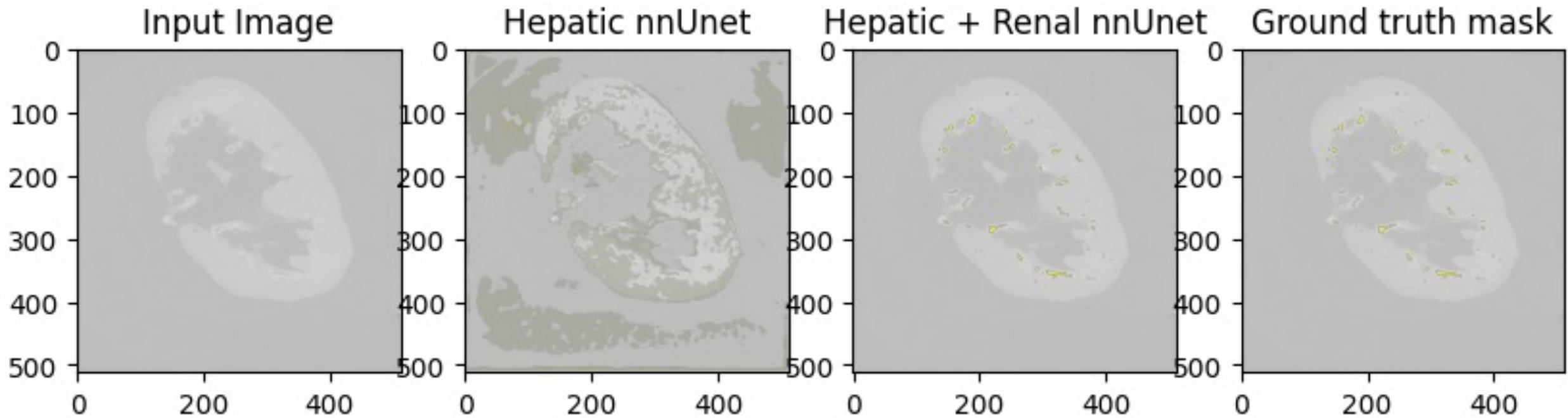
Proposed solution III

- Transfer learning from nnUnet trained on liver vessel segmentation
 - Binary class segmentation
 - <https://www.nature.com/articles/s41592-020-01008-z>



Proposed solution III

- nnUnet
 - Fine-tuned for 10 epochs
 - We achieved 0.87 dice score in validation



Problems with this model

Poor performance on test set (~ 0.013)



hack-vasculature-transfer-learning-inference - Version 3

Succeeded · awxlong · 1mo ago · Notebook hack-vasculature-transfer-learning-inference | Version 3

0.01332

Potential issues:

- Poor generalization

Encoder

Decoder

OUTPUT

Classifier



Competitions Grandmaster
29 of 199,858

forcewithme

ForcewithMe



Student at kaggle



Guangzhou, Guangdong Province, China



Joined 3 years ago · last seen in the past day

A brief
description of
third place

1. Refining labels from sparse to dense
2. Emulating the magnification factor of the test set
3. Maintaining an appropriate resolution

...

<https://www.kaggle.com/competitions/blood-vessel-segmentation/discussion/475074>

A small modification to threshold



hack-vasculature-transfer-learning-inference - Vers...

Succeeded (after deadline) · awxlong · 2d ago · Notebook hack-vasculat...

0.676025

0.670039





Questions &
Feedback?

