

CLIP-Driven Universal Model for Organ Segmentation and Tumor Detection



Jie Liu¹, Yixiao Zhang², Jie-Neng Chen², Junfei Xiao²,
 Yongyi Lu, PhD², Bennett A. Landman, PhD³, Yixuan Yuan, PhD^{4,5},
 Alan Yuille, PhD², Yucheng Tang, PhD^{6,*}, Zongwei Zhou, PhD^{2,*}

¹City University of Hong Kong ²Johns Hopkins University ³Vanderbilt University

⁴Chinese University of Hong Kong ⁵CUHK Shenzhen Research Institute ⁶NVIDIA

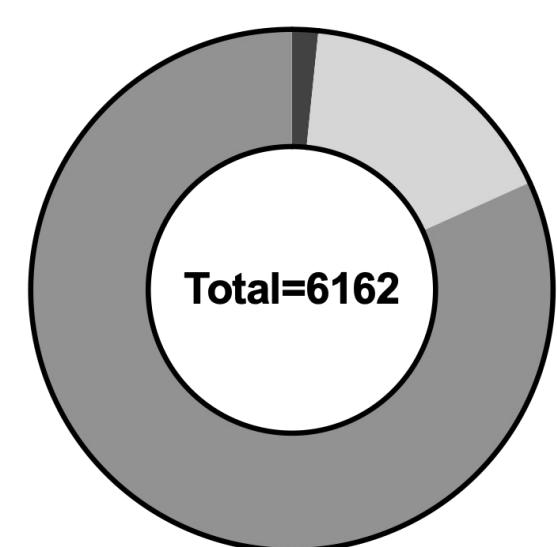
Project Page: <https://github.com/ljwztc/CLIP-Driven-Universal-Model> US Patent App.: D17670



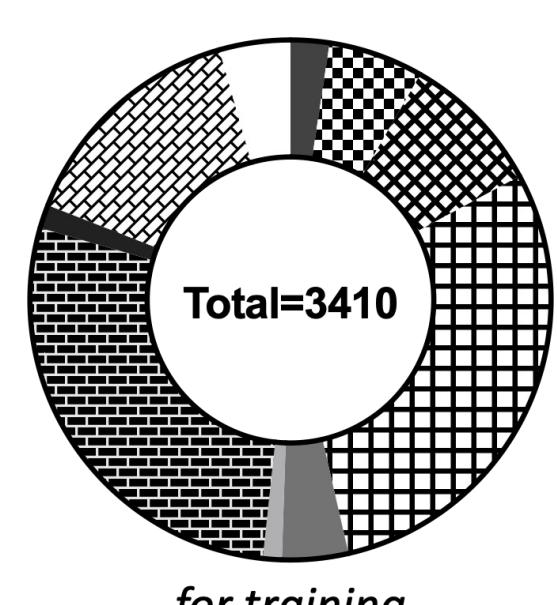
"This work is the first to introduce language models for improving 3D medical image analysis, and to train the AI algorithm with almost all public dataset for organ/tumor segmentation."

Background: An increasing number of public datasets have shown a marked clinical impact on assessing anatomical structures. However, each of the public datasets is small, partially labeled, and rarely investigates severe tumor subjects. The potential of AI models, trained on a combination of existing public datasets, for multi-organ segmentation and tumor detection is *unclear*.

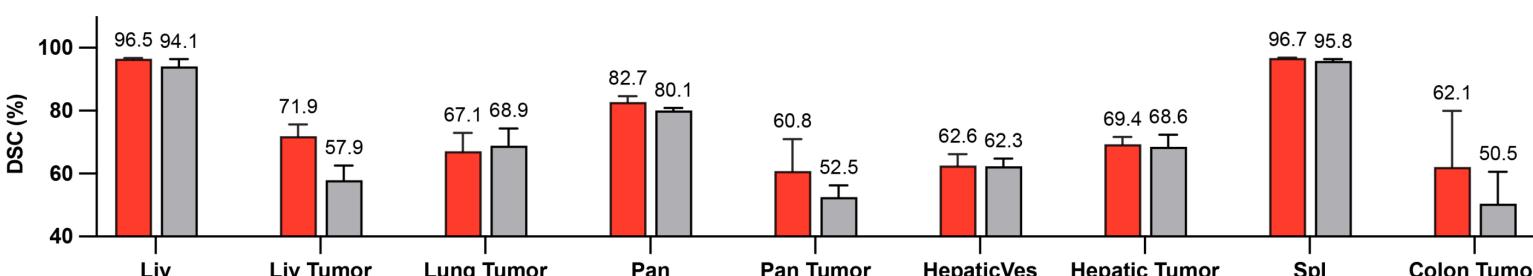
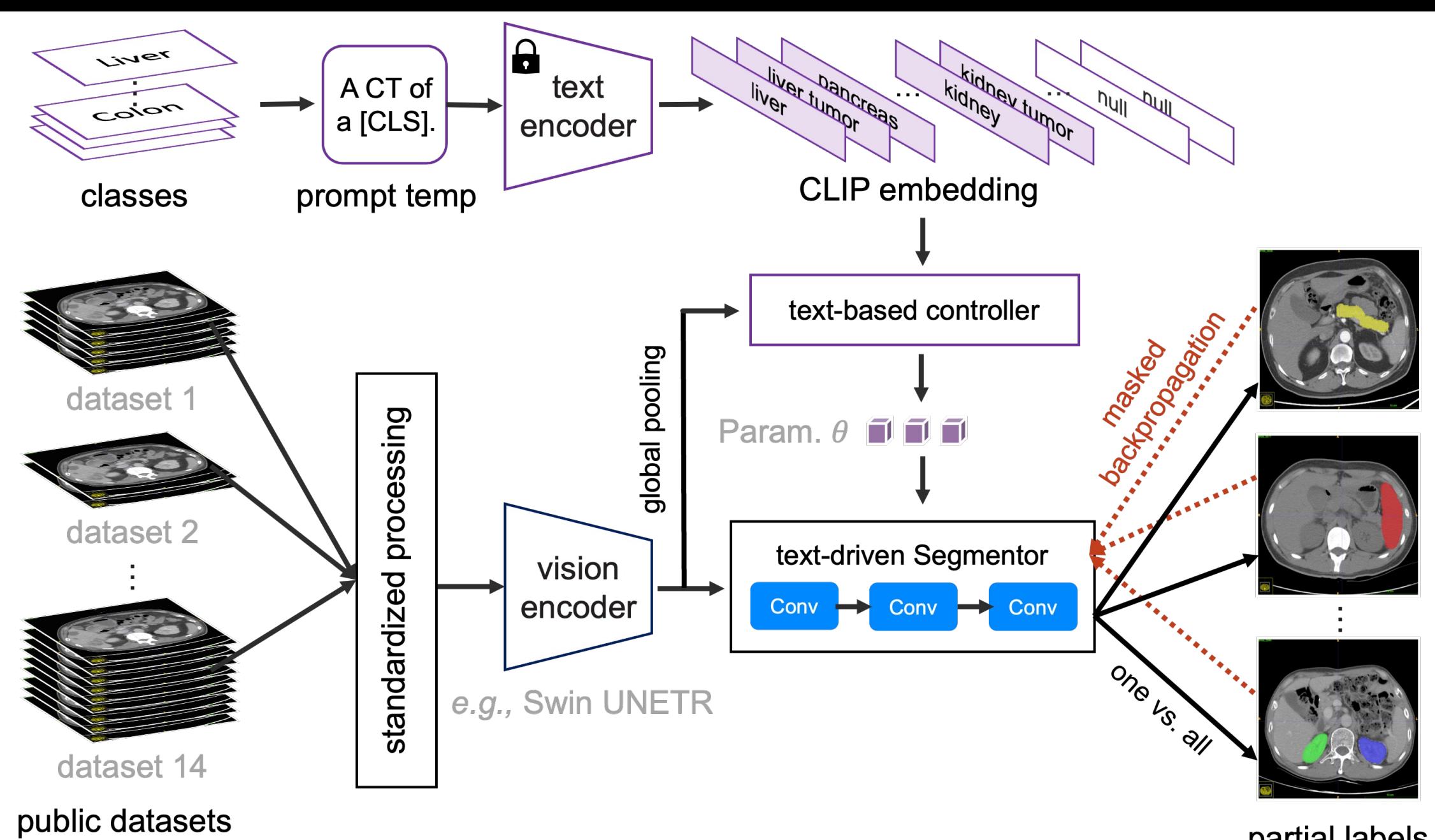
Contribution: We have developed a Universal Model from an assembly of 14 public datasets of 3,410 CT scans; the model can segment 25 organs and detect 6 types of tumors from CT scans, **ranking first** in the public medical segmentation benchmarks (e.g., MSD and BTCV). In addition, we have demonstrated the clinical impact of Universal Model in terms of generalizability, transferability, and extensibility. Finally, we created a dataset of 3,410 CT scans with 6 major abdominal organs fully annotated (i.e., Spleen, Liver, Kidneys, Stomach, Gallbladder, and Pancreas).



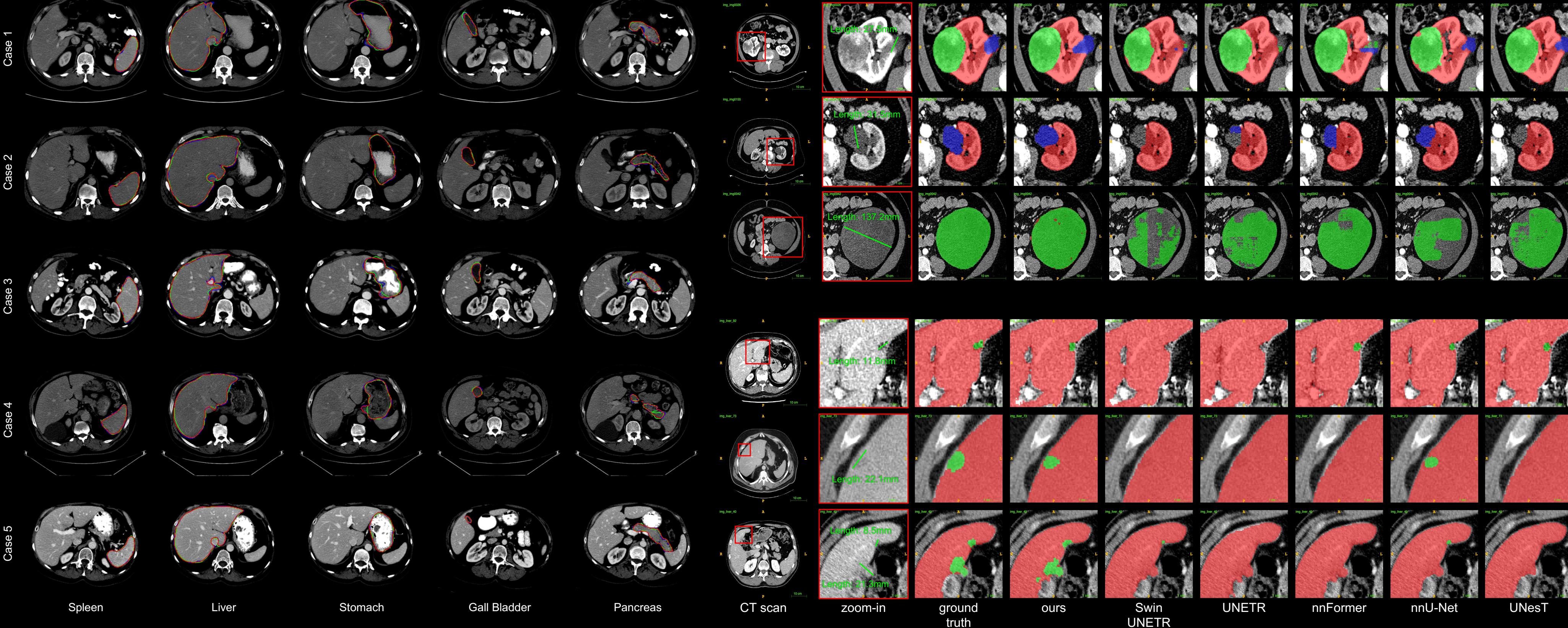
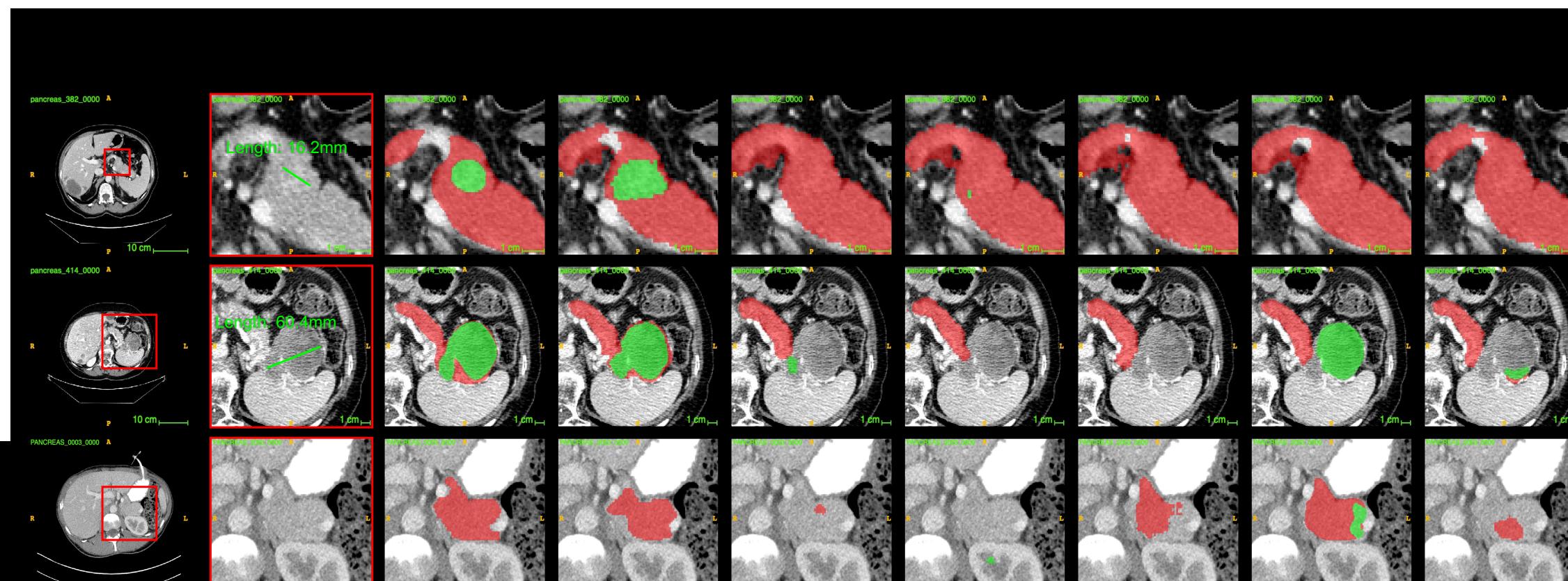
■ 100 3D-IRCADb (13:0)
 ■ 1024 TotalSegmentator (104:0)
 ■ 5038 JHH (21:0)



■ 82 Pancreas-CT (1:0)
 ■ 201 LiTS (1:1)
 ■ 300 KiTS (1:1)
 ■ 1000 AbdomenCT-1K (4:0)
 ■ 140 CT-ORG (4:0)
 ■ 40 CHAOS (4:0)
 ■ 947 MSD (7:4)
 ■ 50 BTCV (13:0)
 ■ 500 AMOS (15:0)
 ■ 150 WORD (16:0)



Benchmark on MSD validation dataset. We compare Universal Model with Swin UNETR (previously ranked first on the MSD leaderboard) on 5-fold cross-validation of the MSD dataset.



Acknowledgements. This work was supported by the Lustgarten Foundation for Pancreatic Cancer Research.