

AbdomenAtlas: AI & Radiologists Unite to Map the Abdomen

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DATA SCIENCE AND AI
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OPPORTUNITIES

Data Science and AI Trusted Dataset Awards

Part of the mission of the Data Science and AI Institute is to strengthen the reputation of Johns Hopkins as a premier source of trusted datasets that can be used for research, scholarship, and the development of trustworthy AI systems. As the NAIRR notes, there is a need for "Trusted data providers and hosts for a transparent and responsible AI data commons. Access to data should be tiered, controlled by the data providers, and provided through the same portal through which computational resources are provided."

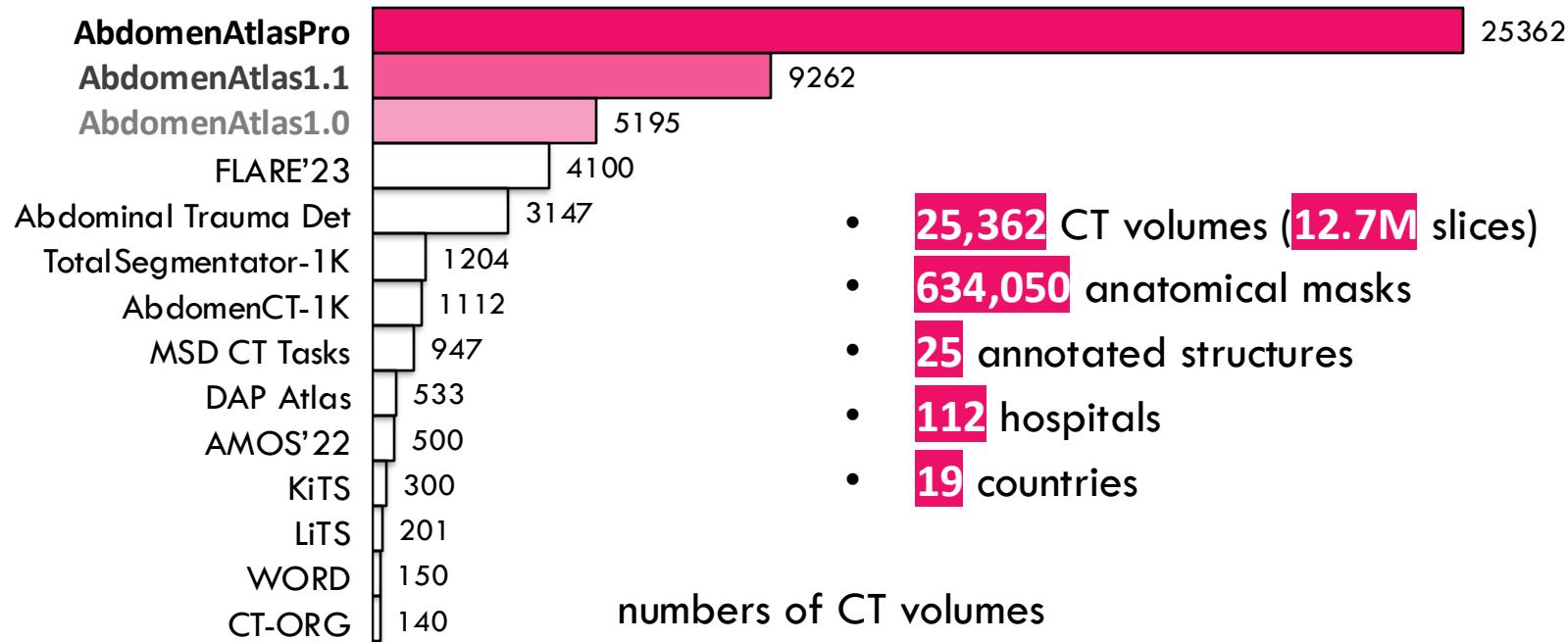
Poor data practices can lead to a variety of problems including 'bad' data, inherent biases, representational disparities, inability to generalize to real-world situations, and lack of robustness. In practical application, these problems can in turn lead to a host of consequences including miscarriage of justice, reputational damage, and liability.



AbdomenAtlasPro = 25K CT Volumes + 600K 3D Masks

AbdomenAtlas1.1 = 9K CT Volumes + 225K 3D Masks

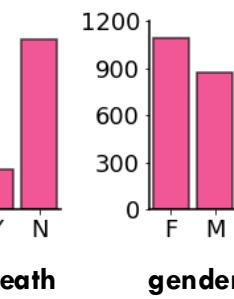
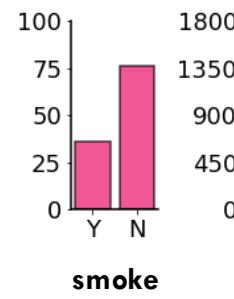
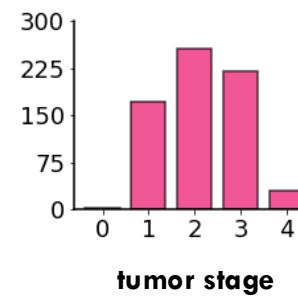
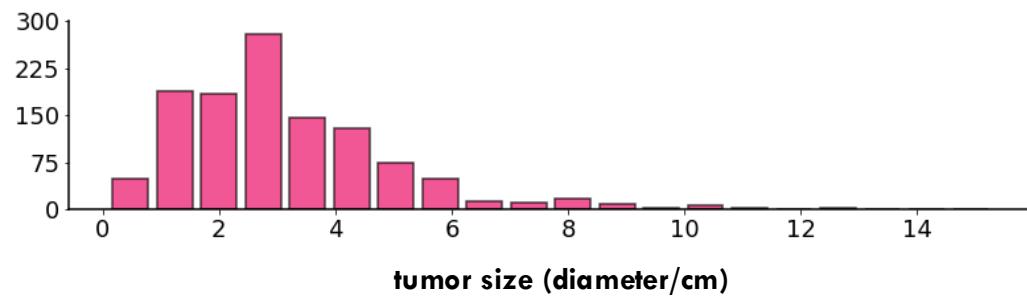
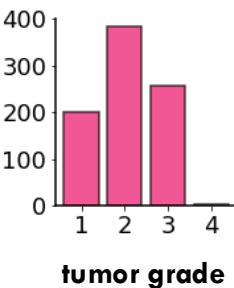
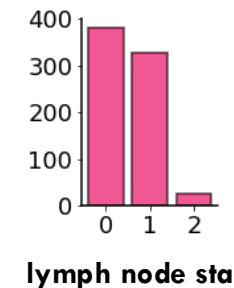
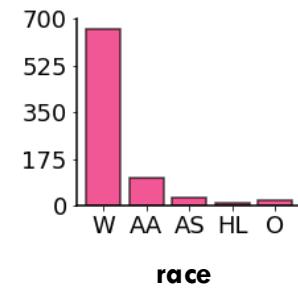
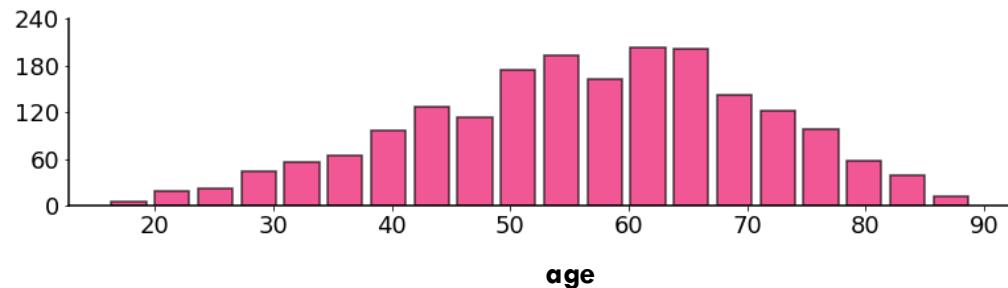
AbdomenAtlas1.0 = 5K CT Volumes + 45K 3D Masks

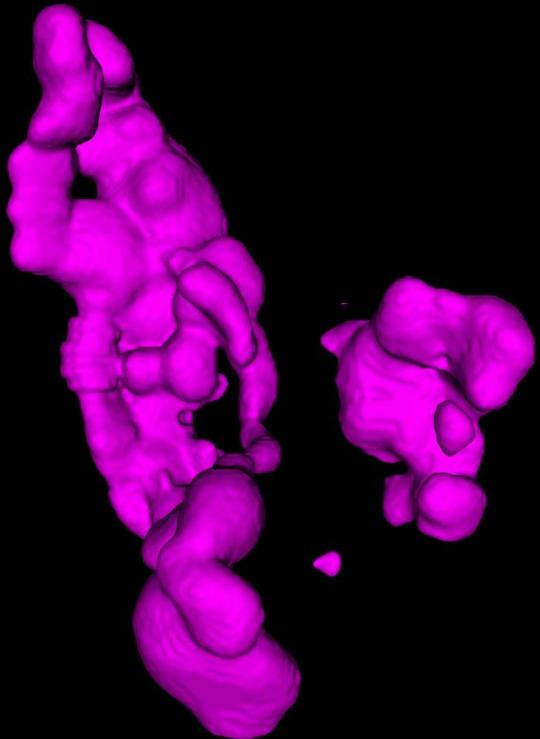


AbdomenAtlasPro = 25K CT Volumes + 600K 3D Masks

AbdomenAtlas1.1 = 9K CT Volumes + 225K 3D Masks

AbdomenAtlas1.0 = 5K CT Volumes + 45K 3D Masks





annotated colon in
TotalSegmentator

“The colon contour should include entire wall and lumen of cecum, appendix, ascending colon, transverse colon, descending colon and sigmoid colon **continuously**, as well as any colon lesions. **Adjacent structures** such as small intestine, surrounding fat, mesentery, and omentum should be excluded. The boundary between the ileum and colon is defined by the ileocecal valve. The boundary between the rectum and sigmoid colon is defined by the sigmoid take-off.”

— Annotation standard
for the colon



annotated colon in
AbdomenAtlas

dataset [year] [source]	# of CTs	# of classes	# of hospitals	annotation standard
organ datasets				
1. CHAOS [2018] [link]	40	1	1	gold
2. BTCV [2015] [link]	50	13	1	gold
3. Pancreas-CT [2015] [link]	82	1	1	gold
4. CT-ORG [2020] [link]	140	6	8	silver
5. WORD [2021] [link]	170	16	1	gold
6. AMOS22 [2022] [link]	500	15	2	silver
7. AbdomenCT-1K [2021] [link]	1,112	4	12	silver
8. TotalSegmentator [2023] [link]	1,228	117	1	silver
9. Trauma Detect. [2023] [link]	4,274	6	23	silver
tumor datasets				
10. TCGA-SARC [2016] [link]	5	1	1	-
11. TCGA-KICH [2016] [link]	15	1	1	-
12. TCGA-KIRP [2016] [link]	33	1	1	-
13. CTpred-Sunitinib-panNET [2022] [link]	38	1	1	-
14. Pancreatic-CT-CBCT-SEG [2021] [link]	40	7	1	gold
15. TCGA-STAD [2016] [link]	46	1	1	-
16. MSD Spleen [2019] [link]	61	1	1	gold
17. CPTAC-SAR [2019] [link]	88	1	1	-
18. MSD Lung [2019] [link]	96	1	1	gold
19. TCGA-LIHC [2016] [link]	97	1	1	-
20. HCC-TACE-Seg [2021] [link]	105	1	1	gold
21. TCGA-BLCA [2016] [link]	120	1	1	-
22. TCGA-OV [2016] [link]	143	1	1	-
23. CPTAC-PDA [2018] [link]	168	2	1	gold
24. CT Lymph Nodes [2015] [link]	176	2	1	gold
25. MSD Colon [2019] [link]	190	1	1	gold
26. MSD Liver [2019] [link]	201	2	7	gold
27. LiTS [2019] [link]	201	2	7	gold
28. PCL[2021] [link]	221	3	1	silver
29. StageII-Colorectal-CT [2022] [link]	230	1	1	-
30. CPTAC-UCEC [2019] [link]	250	1	1	-
31. CPTAC-CCRCC [2018] [link]	262	1	1	-
32. TCGA-KIRC [2016] [link]	267	1	1	-
33. TCIA-LDCT [2020] [link]	299	1	1	-
34. MSD Pancreas [2019] [link]	420	2	1	gold
35. MSD Hepatic Vessels [2019] [link]	443	2	1	gold
36. Med-Lymph-Node-SEG[2024] [link]	513	1	3	gold
37. KitTS23 [2020] [link]	599	3	2	gold
38. TCIAColon [2015] [link]	825	1	1	-
AbdomenAtlasPro	25,362	25	112	silver

**“How long does it take
to annotate**

25K CT volumes

600K 3D masks?”

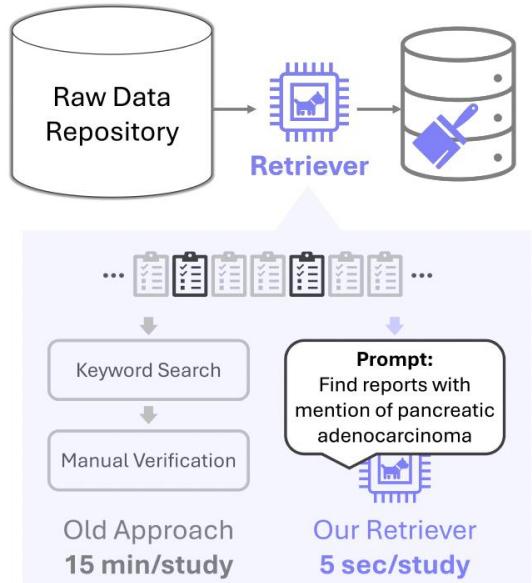


dataset [year] [source]	# of CTs	# of classes	# o
organ datasets			
1. CHAOS [2018]	1		
2. BTCV [2018]	13		
3. Pancreas [2018]	1		
4. CT-SEG [2019]	4		
5. WLI [2020]	6		
6. AbdomenAtlasPro [2024]	25,362	25	112
7. KITS23 [2020]	599	3	silver
8. TCGA-KIRC [2016]	190	1	
9. TCGA-LDCT [2020]	201	2	
10. LiTS [2019]	201	2	
11. PCL [2021]	221	3	
12. StageII-Colorectal-CT [2022]	230	1	
13. CPTAC-UCEC [2019]	250	1	
14. CPTAC-CCRCC [2018]	262	1	
15. TCGA-KIRCO [2016]	267	1	
16. TCIA-LDCT [2020]	299	1	
17. MSD Pancreas [2019]	420	2	
18. MSD Hepatic Vessels [2019]	443	2	
19. Med-Lymph-Node-SEG [2024]	513	1	
20. KITS23 [2020]	599	3	
21. TCGA-KIRC [2016]	825	1	

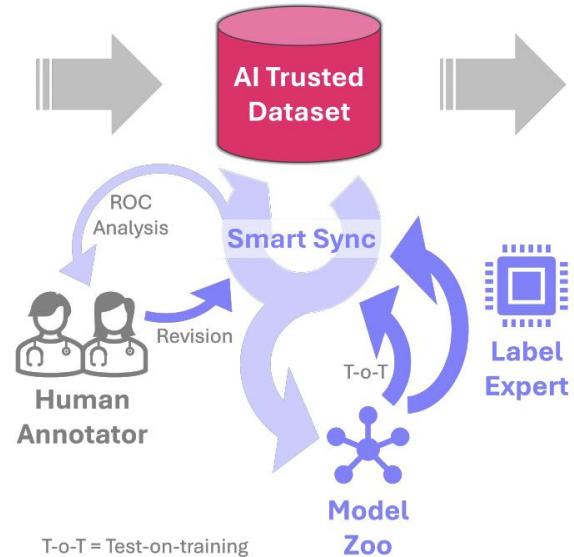


ScaleMAI – Accelerating the Development of Trusted Datasets and AI Models

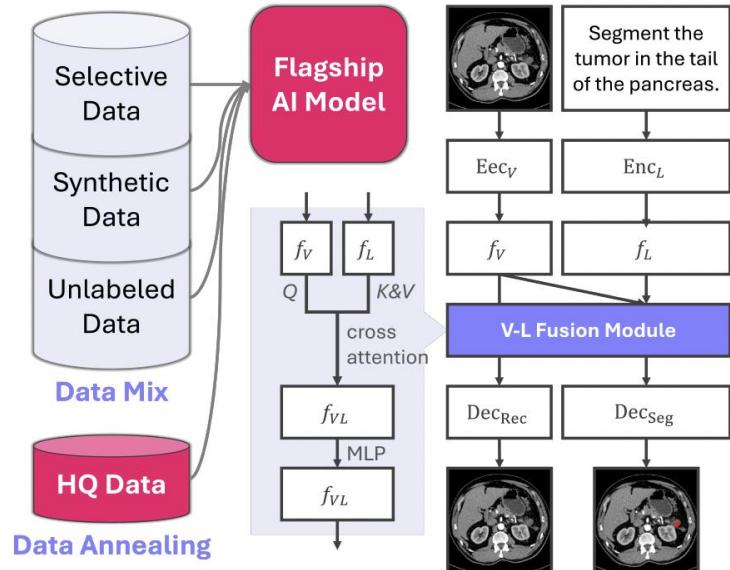
Curation: Clinical Needs → Suitable Data



Integration: AI, VLM, Human → Better Data

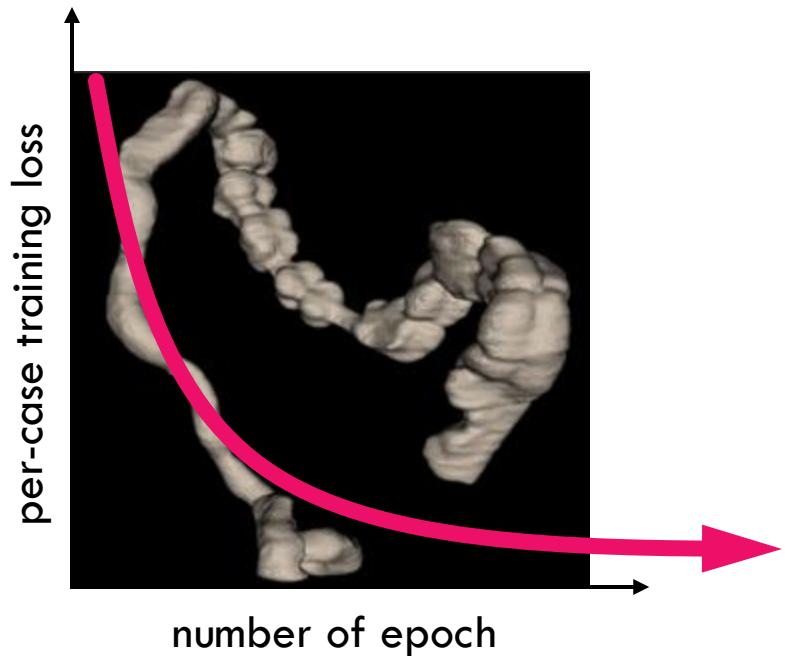


Integration: Data Mix, Annealing → Better AI

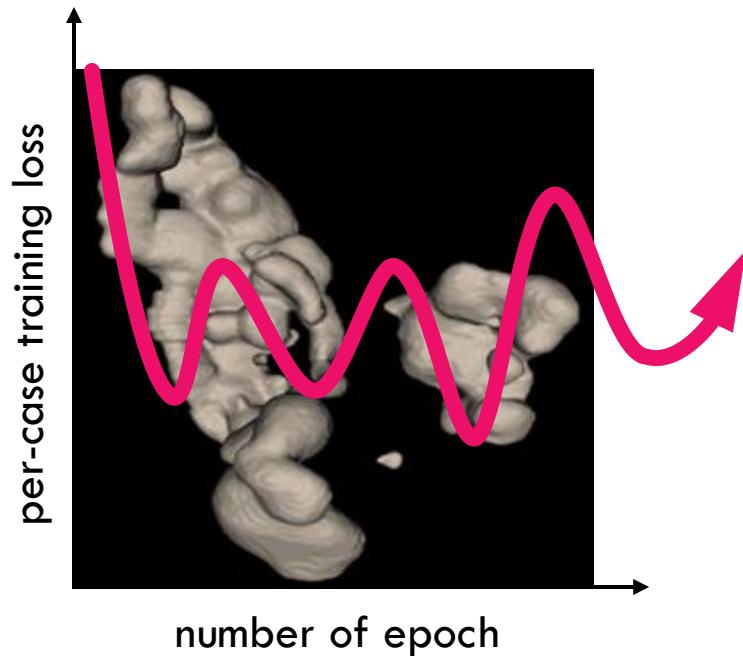


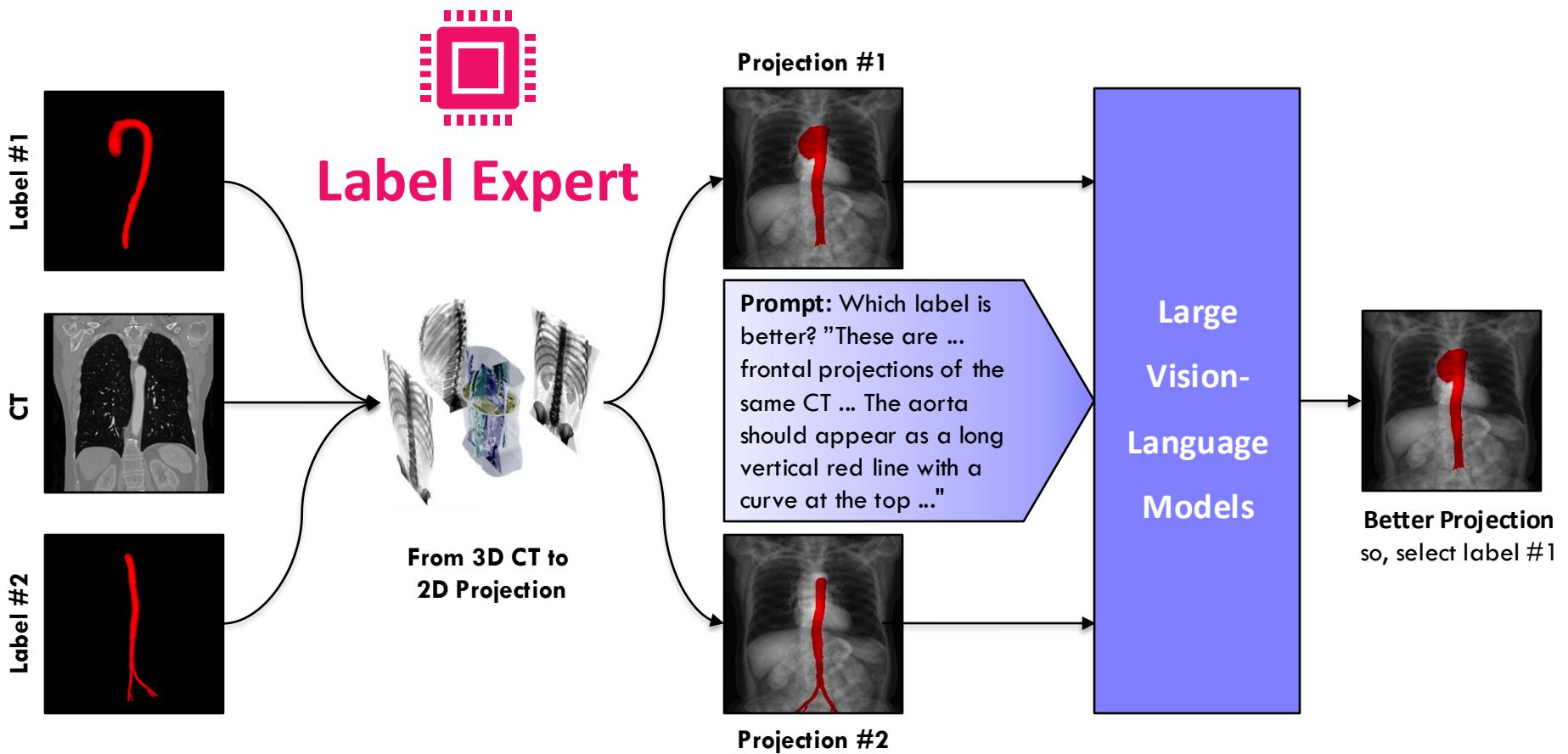
T-o-T Test-on-Training

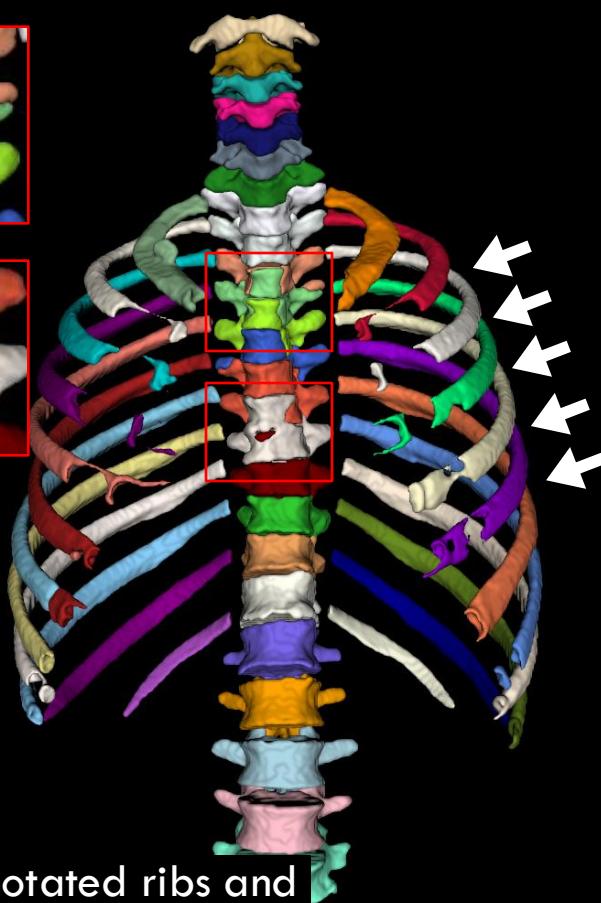
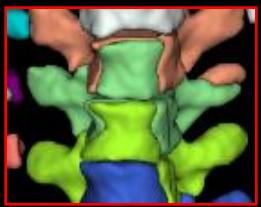
left: well-annotated training data



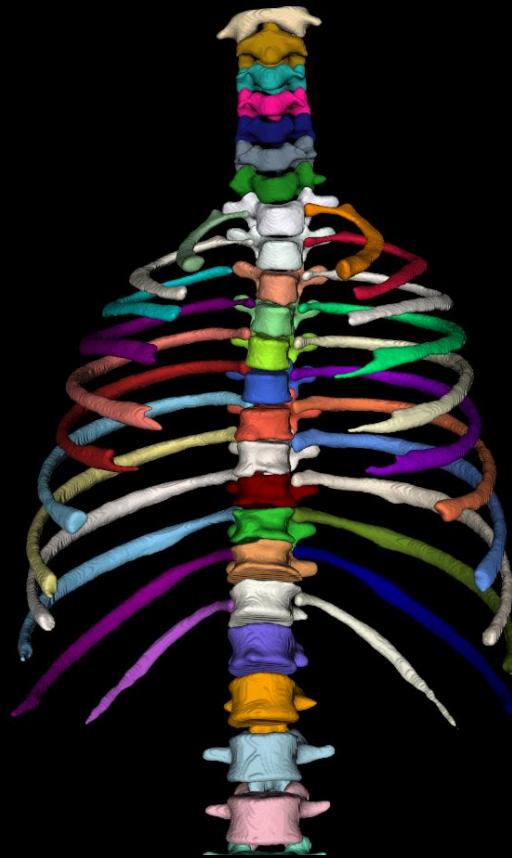
right: poorly-annotated training data







annotated ribs and
vertebrae in
TotalSegmentator



revised ribs and vertebrae
in
AbdomenAtlas

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AI and Radiologists Unite to Map the Abdomen

Hopkins researchers have leveraged the synergy between medical professionals and artificial intelligence algorithms to create the largest annotated multi-organ dataset to date.

AbdomenAtlasPro = 25K CT Volumes + 600K 3D Masks

AbdomenAtlas1.1 = 9K CT Volumes + 225K 3D Masks

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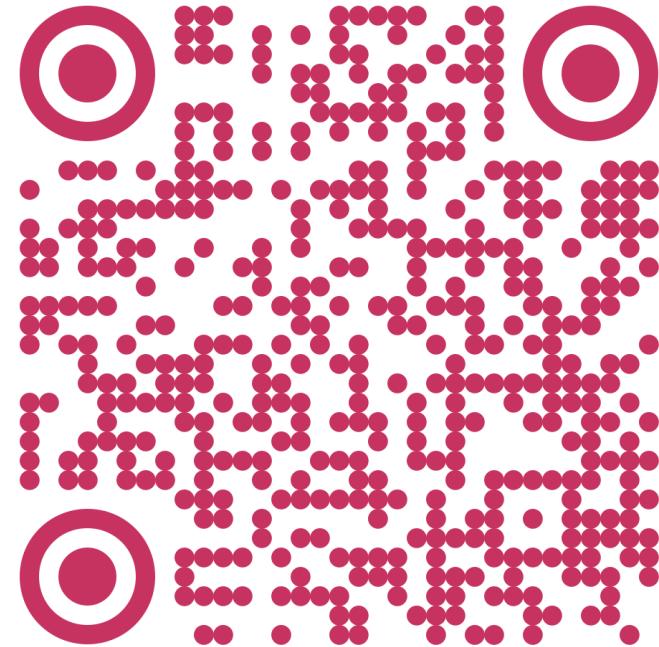
← **BodyMaps**
36 posts

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AbdomenAtlasPro = 25K CT Volumes + 600K 3D Masks

AbdomenAtlas1.1 = 9K CT Volumes + 225K 3D Masks

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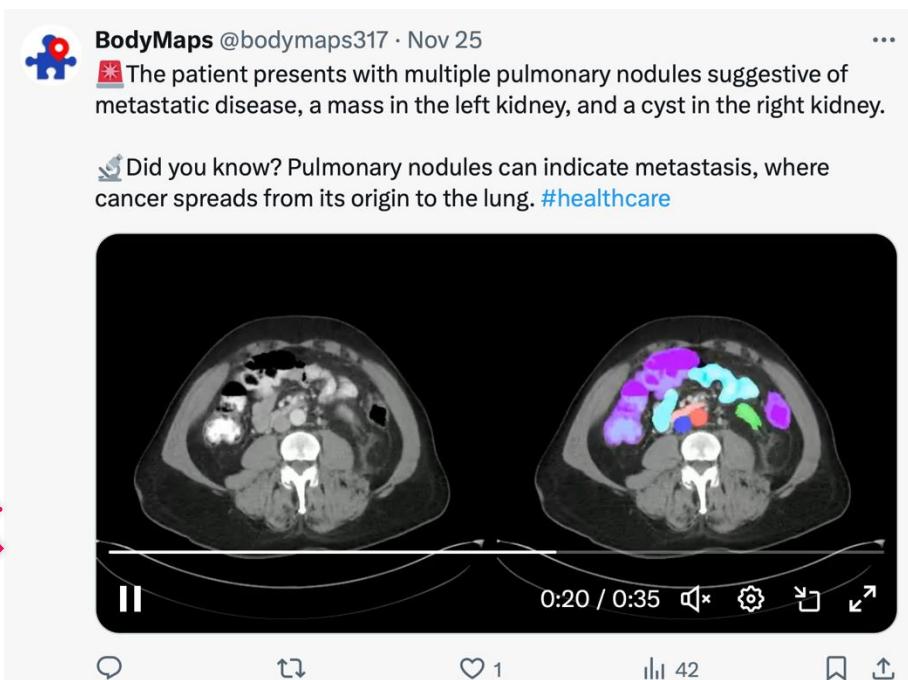
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BodyMaps @bodymaps317 · Nov 25

The patient presents with multiple pulmonary nodules suggestive of metastatic disease, a mass in the left kidney, and a cyst in the right kidney.

Did you know? Pulmonary nodules can indicate metastasis, where cancer spreads from its origin to the lung. #healthcare

II 0:20 / 0:35

1 42

Abdomer

Abdomer

Abdomer



BodyMaps @bodymaps317 · Nov 6

The patient has undergone bilateral femoral replacement, which is causing localized metal artifacts that affect the imaging clarity of the bladder and parts of the pelvic bowel loops. Additionally, the patient is post-cholecystectomy (gallbladder removal). #MedicalImaging

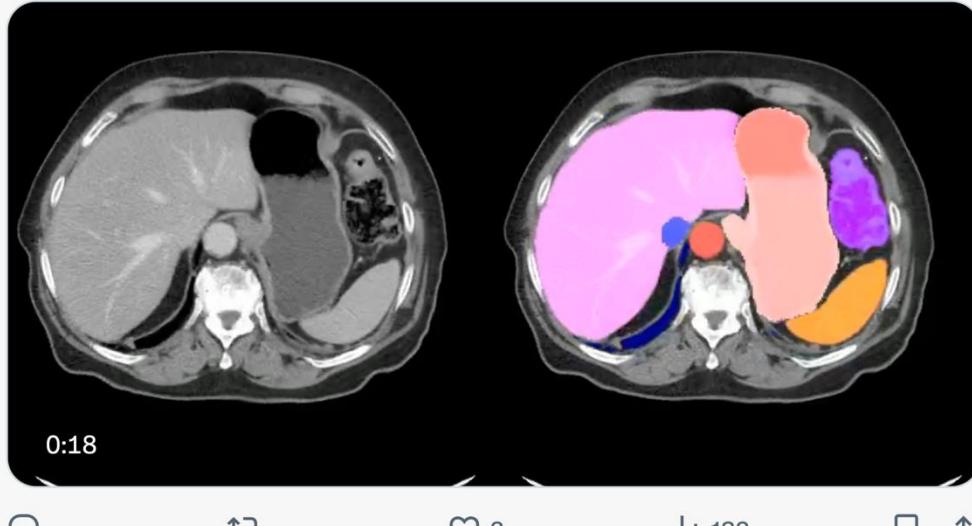
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Masks
Masks



BodyMaps

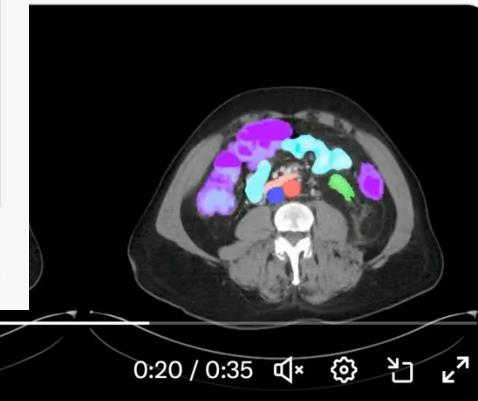
36 posts



v 25

Multiple pulmonary nodules suggestive of e left kidney, and a cyst in the right kidney.

dules can indicate metastasis, where the lung. #healthcare



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Abdomer

Abdomer

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BodyMaps @bodymaps317 · Nov 6

The patient has undergone bilateral femoral replacement, which is causing localized metal artifacts that affect the imaging clarity of the bladder and parts of the pelvic bowel loops. Additionally, the patient is post-cholecystectomy (gallbladder removal). #MedicalImaging



BodyMaps

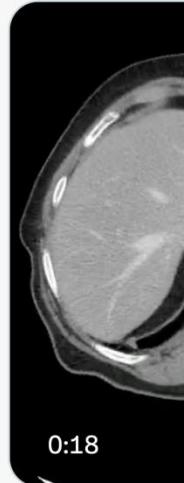
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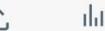
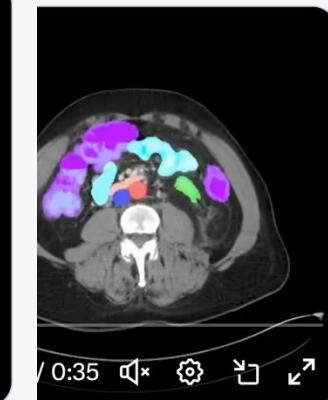
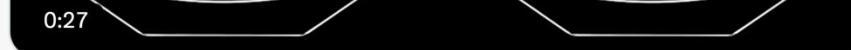
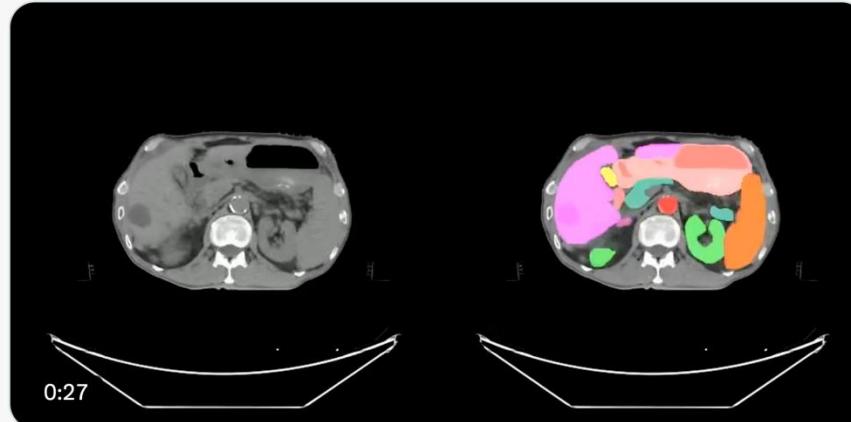
Joined May 2024



BodyMaps @bodymaps317 · Oct 29

The patient has undergone surgery resulting in the absence of the colon and part of the small intestine. Imaging reveals a protruding nodule on the right kidney and multiple cysts with calcification in the liver.

Liver calcification and cysts are often benign. #Healthcare



D Masks
Masks
Acks



y nodules suggestive of
d a cyst in the right kidney.

ate metastasis, where
lthcare



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Abdomer

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BodyMaps @bodymaps317 · Nov

The patient has undergone bilateral nephrectomy causing localized metal artifacts in the bladder and parts of the pelvic bones post-cholecystectomy (gallbladder removed).



BodyMaps @bodymaps317 · Oct 21

The patient is post-sigmoidectomy and ileostomy in the right lower abdomen.

...



BodyMaps

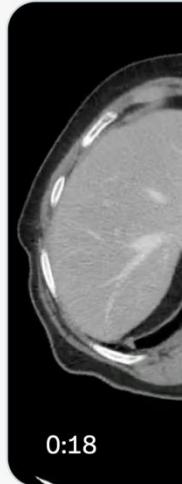
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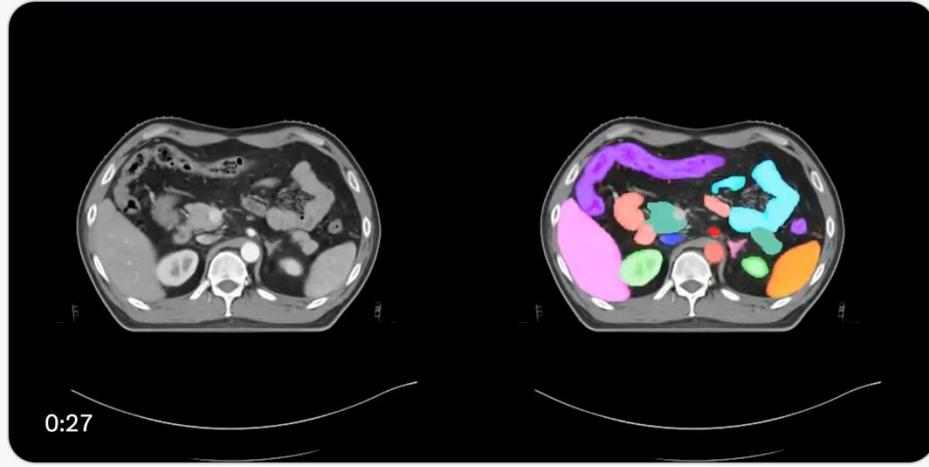
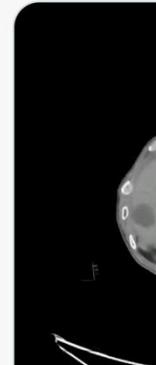
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BodyMaps 🇺🇸

The patient had a bilateral nephrectomy and part of the right kidney was removed.

Liver calcifications



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BodyMaps @bodymaps317 · Sep 24

This patient has multiple cystic lesions in the right kidney and a mass in the left kidney.

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of the sigmoid
leostomy is

← BodyMaps

36 posts

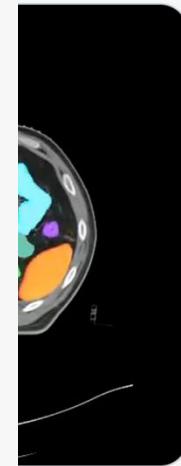
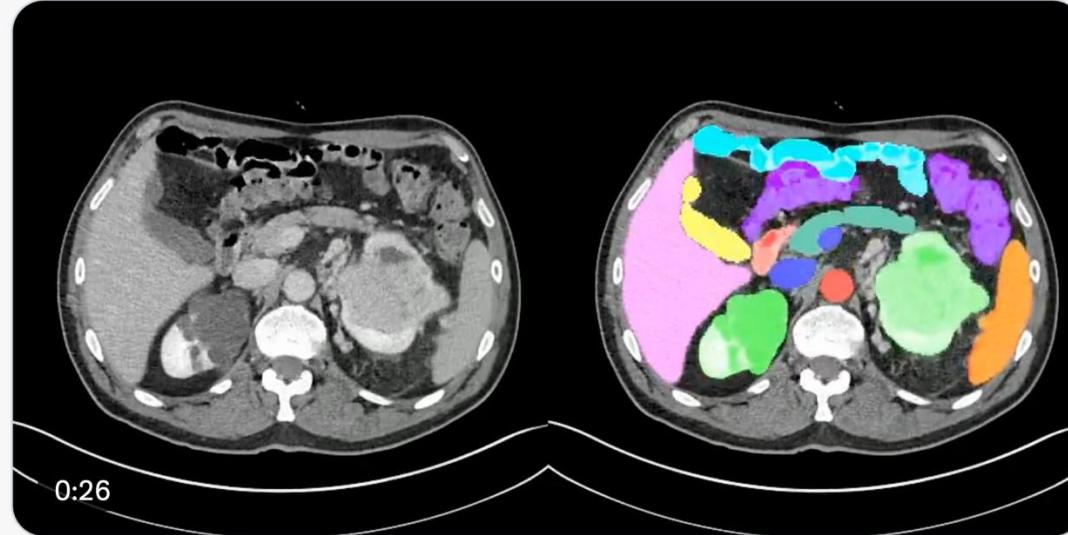


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Cystic lesions in the kidney are often fluid-filled and can be benign, but a mass in the kidney may require further evaluation to rule out malignancy. #KidneyHealth #MedicalImaging



<https://www.zongweiz.com/dataset> CC-BY-NC-SA-4.0

Abdomer

Abdomer

Abdomer



BodyMaps @bodymaps317 · Sep 17

Patient is experiencing colonic obstruction, leading to compression and displacement of multiple intra-abdominal organs.

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ower

of the sigmoid
leostomy is

Colonic obstruction occurs when the colon is blocked, preventing the normal passage of contents. This can lead to series complications.

nign, but

#MedicallImaging



BodyMaps

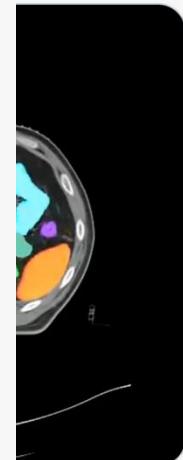
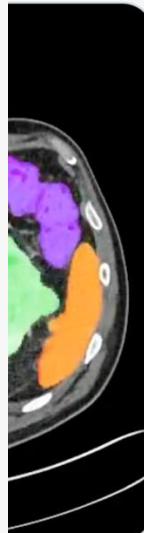
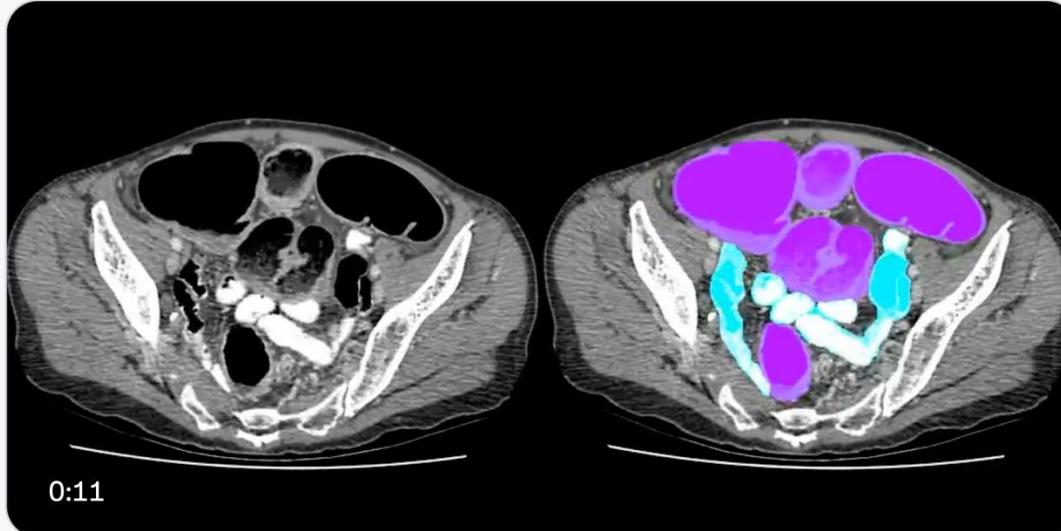
36 posts



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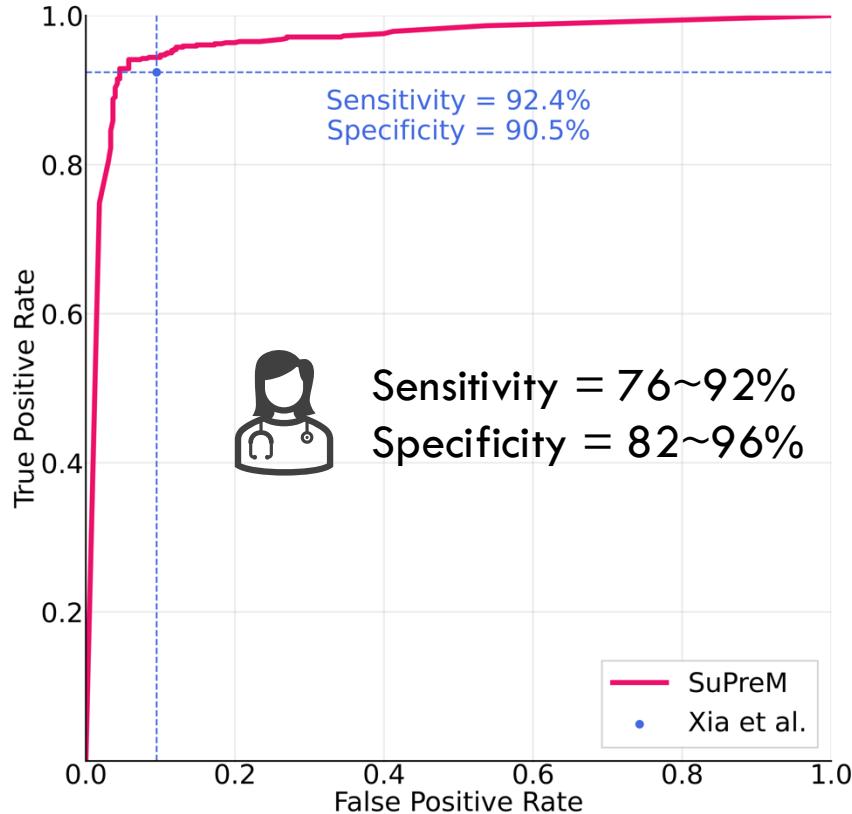
@bodymaps317 Follows you

Joined May 2024



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AbdomenAtlasPro → Improved Tumor Detection

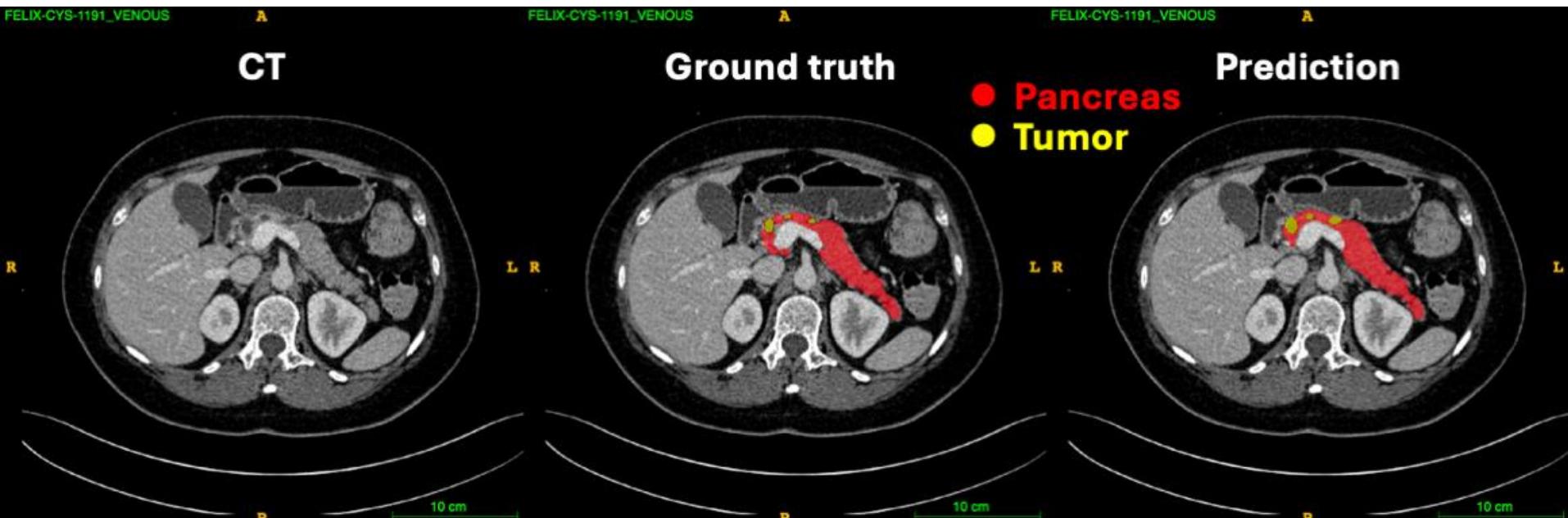


The FELIX Project: Deep Networks To Detect Pancreatic Neoplasms

Yingda Xia^{1,†}, Qihang Yu^{1,†}, Linda Chu^{2,†}, Satomi Kawamoto^{2,†}, Seyoun Park², Fengze Liu¹, Jieneng Chen¹, Zhuotun Zhu¹, Bowen Li¹, Zongwei Zhou¹, Yongyi Lu¹, Yan Wang¹, Wei Shen¹, Lingxi Xie¹, Yuyin Zhou¹, Christopher Wolfgang³, Ammar Javed³, Daniel Fadaei Fouladi², Shahab Shayesteh², Jefferson Graves², Alejandra Blanco², Eva S. Zinreich², Benedict Kinny-Köster³, Kenneth Kinzler^{4,6,7,8}, Ralph H. Hruban⁵, Bert Vogelstein^{4,6,7,8,9}, Alan L. Yuille^{1,*}, Elliot K. Fishman^{2,*}

¹Department of Computer Science, Johns Hopkins University; ²Department of Radiology and Radiological Science, Johns Hopkins Medicine; ³Department of Surgery, New York University; ⁴Department of Oncology, Johns Hopkins Medicine; ⁵Department of Pathology, Johns Hopkins Medicine; ⁶Ludwig Center, Johns Hopkins University School of Medicine; ⁷Sidney Kimmel Comprehensive Cancer Center, Johns Hopkins University School of Medicine; ⁸Sol Goldman Pancreatic Cancer Research Center, Johns Hopkins University School of Medicine; ⁹Howard Hughes Medical Institute, Johns Hopkins Medical Institutions

AbdomenAtlasPro → Improved Small Tumor Detection



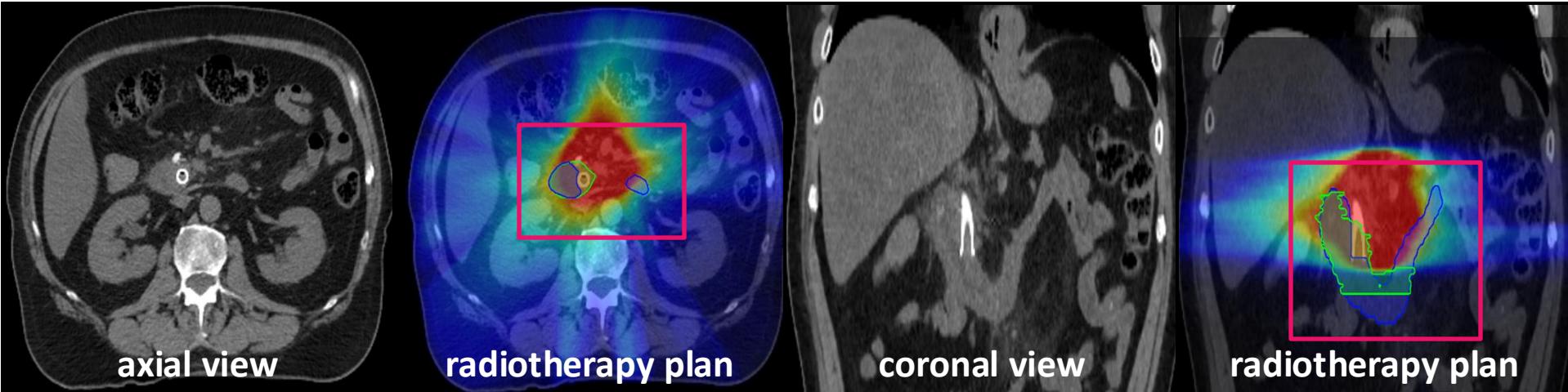
Sensitivity = 89%
Specificity = 93%



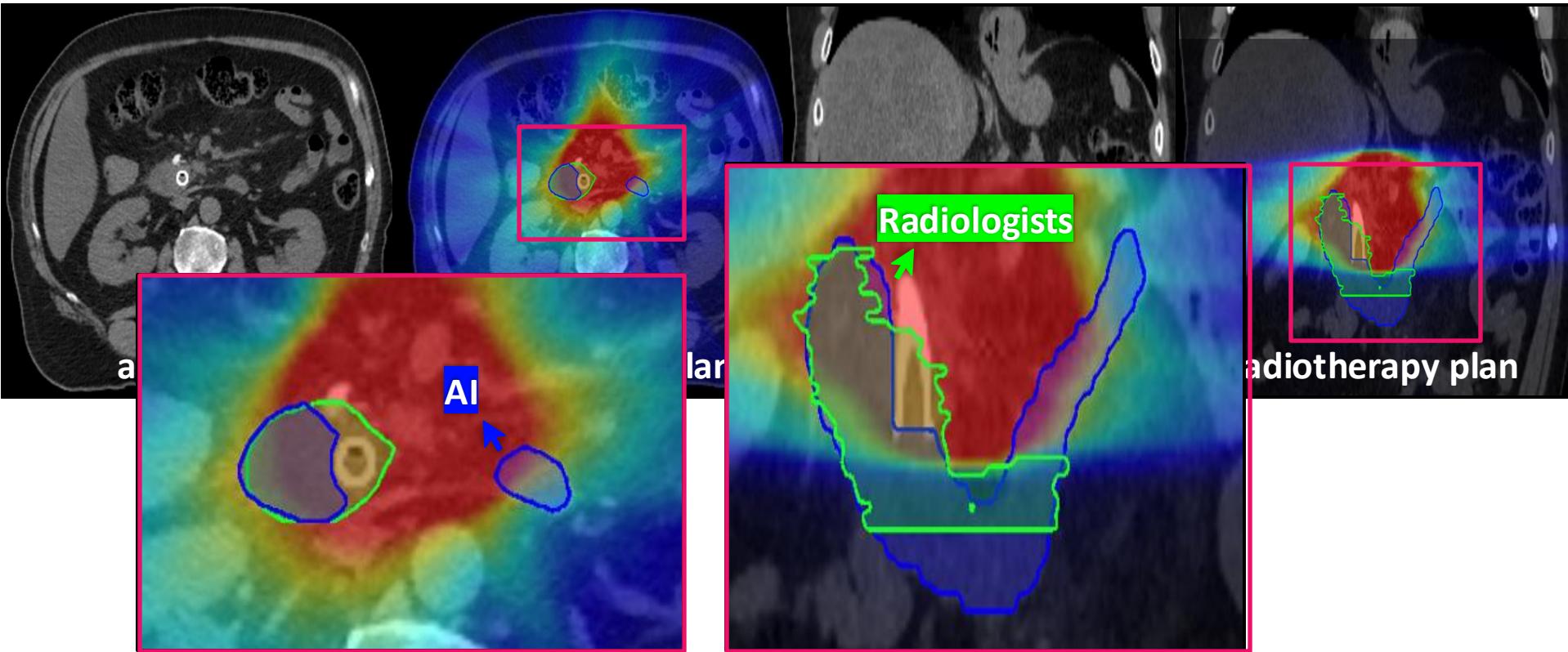
Sensitivity = 33~44%
Specificity = 82~96%



AbdomenAtlasPro → Generalized to Planning CT Scans



AbdomenAtlasPro → Generalized to Planning CT Scans





Touchstone

@MICCAI @ISBI Challenges



Backbone	Author	Institute	Publication	Backbone	Author	Institute	Publication
U-Net	O. Ronneberger	Uni Freiburg	MICCAI	nnU-Net	Fabian Isensee	DKFZ	Nat. Methods
nnFormer	Hong-Yu Zhou	HKU	TIP	SAT	Ziheng Zhao	SJTU	arXiv
CoTr	Yutong Xie	NPU	MICCAI	Swin UNETR	Ali Hatamizadeh	NVIDIA	MICCAIW
UniverSeg	Victor Ion Butoi	MIT	ICCV	UniSeg	Yiwen Ye	NPU	MICCAI
UNet++	Zongwei Zhou	ASU	TMI	MagicNet	Duowen Chen	ECNU	CVPR
TransUNet	Jieneng Chen	JHU	ICMLW	MedSegDiff	Junde Wu	NUS	AAAI
Swin-Unet	Hu Cao	Huawei	ECCVW	3D UNeXt	Jeya Maria Jose	JHU	MICCAI
DiNTS	Yufan He	JHU	CVPR			

So far, **53 groups** have confirmed the contribution—we will invite more inventors of **famous backbones** for medical segmentation.

Wenxuan Li

wli131@jh.edu

Code, Dataset, & Model:

<https://www.zongweiz.com/dataset>



Touchstone Benchmark: Are We on the Right Way for Evaluating AI Algorithms for Medical Segmentation?

Pedro R. A. S. Bassi^{1,2,3*} Wenzuan Li^{1*} Yucheng Tang⁴ Fabian Isensee^{5,6}
Zifu Wang⁷ Jieneng Chen¹ Yu-Cheng Chou¹ Saikat Roy^{5,8} Yannick Kirchhoff^{5,8,9}
Maximilian Rokuss^{5,8} Ziyuan Huang¹⁰ Jin Ye¹¹ Junjun He¹¹ Tassilo Wald^{5,6}
Constantin Ulrich⁵ Michael Baumgartner^{5,6} Klaus H. Maier-Hein^{5,12} Paul Jaeger^{6,13}
Yiwen Ye¹⁴ Yutong Xie¹⁵ Jianpeng Zhang¹⁶ Ziyang Chen¹⁴ Yong Xia¹⁴
Zhaohu Xing¹⁷ Lei Zhu^{17,18} Yousef Sadegheih¹⁹ Afshin Bozorgpour¹⁹
Pratibha Kumari¹⁹ Reza Azad²⁰ Dorit Merhof^{19,21} Pengcheng Shi²²
Ting Ma²² Yuxin Du²³ Fan Bai^{23,24} Tiejun Huang^{23,25} Bo Zhao^{10,23}
Haonan Wang¹⁸ Xiaomeng Li¹⁸ Hanxue Gu²⁶ Haoyu Dong²⁶
Jichen Yang²⁶ Maciej A. Mazurowski²⁶ Saumya Gupta²⁷ Linshan Wu¹⁸
Jiaxin Zhuang¹⁸ Hao Chen²⁸ Holger Roth⁴ Daguang Xu⁴
Matthew B. Blaschko⁷ Sergio Decherchi²⁹ Andrea Cavalli^{2,29,30}
Alan L. Yuille^{1†} Zongwei Zhou^{1†}

¹Department of Computer Science, Johns Hopkins University

²Department of Pharmacy and Biotechnology, University of Bologna

³Center for Biomolecular Nanotechnologies, Istituto Italiano di Tecnologia

⁴NVIDIA

⁵Division of Medical Image Computing, German Cancer Research Center (DKFZ)

⁶Helmholtz Imaging, German Cancer Research Center (DKFZ)

Full affiliations are given in Appendix F.

Code, Models & Data: <https://github.com/MrGiovanni/Touchstone>



NEURAL INFORMATION
PROCESSING SYSTEMS

rank	model	organization	average DSC	paper	github
1	MedNeXt	DKFZ	89.2	arXiv 2303.09975	Stars 327
2	STU-Net-B	Shanghai AI Lab	89.0	arXiv 2304.06716	Stars 269
3	MedFormer	Rutgers	89.0	arXiv 2203.00131	Stars 262
4	nnU-Net ResEncL	DKFZ	88.8	arXiv 1809.10486	Stars 5.7k
5	UniSeg	NPU	88.8	arXiv 2304.03493	Stars 163
6	Diff-UNet	HKUST	88.5	arXiv 2303.10326	Stars 149
7	LHU-Net	UR	88.0	arXiv 2404.05102	Stars 23
8	NexToU	HIT	87.8	arXiv 2305.15911	Stars 55
9	SegVol	BAAI	87.1	arXiv 2311.13385	Stars 212
10	U-Net & CLIP	CityU	87.1	arXiv 2301.00785	Stars 565
11	SwinUNETR & CLIP	CityU	86.7	arXiv 2301.00785	Stars 565
12	SwinUNETR	NVIDIA	80.1	arXiv 2211.11537	Stars 1.8k
13	UNesT	NVIDIA	79.1	arXiv 2303.10745	Stars 1.8k
14	SAM-Adapter	Duke	73.4	arXiv 2404.09957	Stars 120
15	UNETR	NVIDIA	64.4	arXiv 2111.04004	Stars 1.8k





University of California
San Francisco



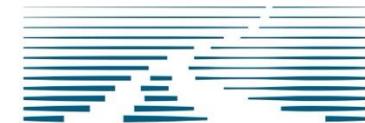
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UNIVERSITY
HOSPITAL



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA



JOHNS HOPKINS UNIVERSITY



上海人工智能实验室
Shanghai Artificial Intelligence Laboratory



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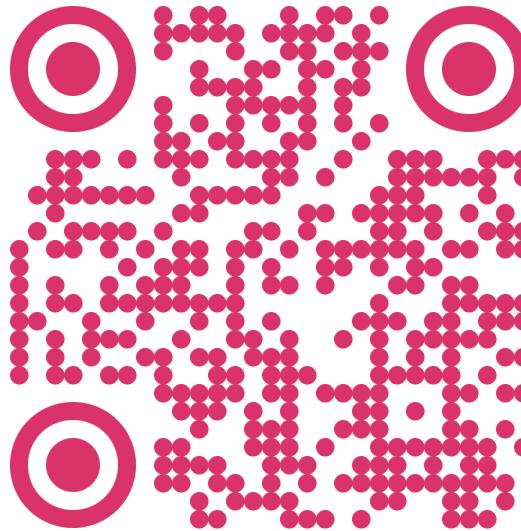


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Code, Dataset, & Model:

<https://www.zongweiz.com/dataset>



Touchstone Benchmark

PARTICIPATE - TOUCHSTONE 1.0

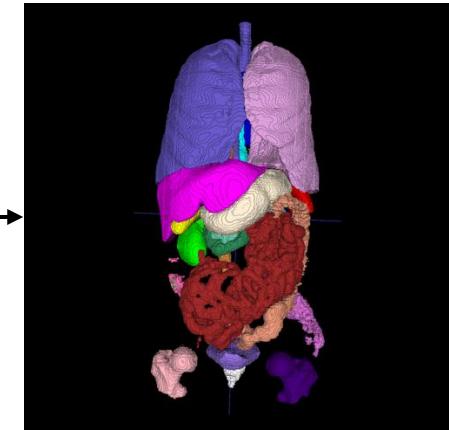
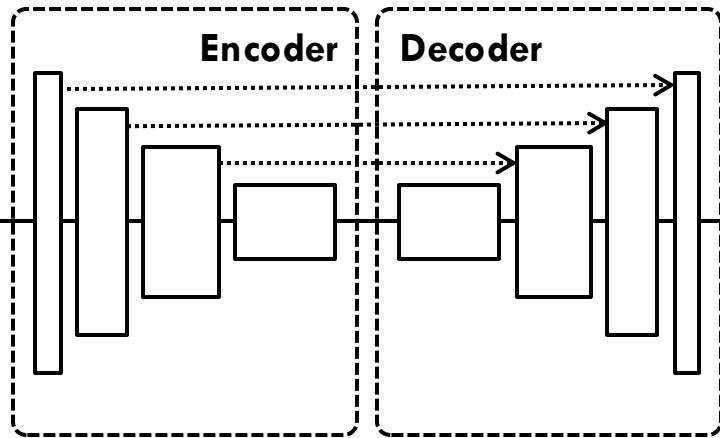
PARTICIPATE - TOUCHSTONE 2.0

Stars 71 Follow @BodyMaps

We present Touchstone, a large-scale medical segmentation benchmark based on annotated **5,195** CT volumes from **76** hospitals for training, and **6,933** CT volumes from **8** additional hospitals for testing. We invite AI inventors to train their models on AbdomenAtlas, and we independently evaluate their algorithms. We have already collaborated with **14** influential research teams, and we remain accepting new submissions.



“How Well Do Models Pre-Trained on 25K CT Volumes and 600K 3D Masks Transfer to Medical Imaging Tasks?”



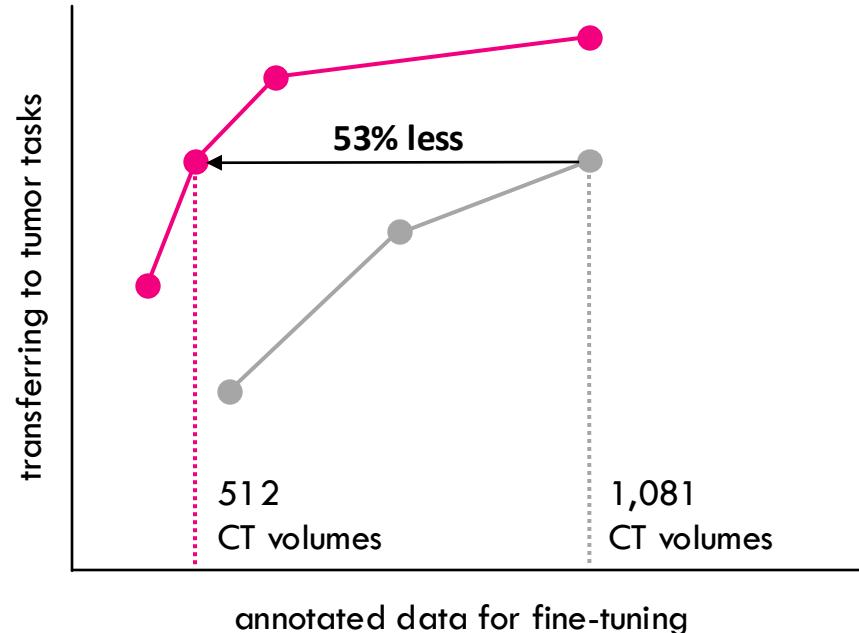
Foundation Models

AI pre-trained on broad data and
can be applied across tasks

▼ U-Net

name	params	pre-trained data	resources	download
Models Genesis	19.08M	623 CT	Stars 741	weights
UniMiSS	tiny	5022 CT&MRI	Stars 58	weights
	small	5022 CT&MRI		weights
Med3D	85.75M	1638 CT	Stars 2k	weights
DoDNet	17.29M	920 CT	Stars 180	weights
Universal Model	19.08M	2100 CT	Stars 585	weights
SuPreM	19.08M	2100 CT	ours ✨	weights

Supervised > Self-supervised
annotation & learning efficiency



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Guiqin Zhang · Damin Li · Yixiao Zhang · Jieneng Chen · Linda Chu ·
Satomi · Kawamoto · Seyoun Park · Christopher Wolfgang · Ammar Javed
· Daniel Fadaei · Shahab Shayesteh · Jefferson Graves · Alejandra Blanco ·
Eva S. Zinreich · Benedict Kinny-Köster · Kenneth Kinzler · Ralph H.
Hrurban · Bert Vogelstein · Elliot K. Fishman · Jaimie Patterson · Junfei
Xiao · Yongyi Lu · Xinyi Li · Huimiao Chen · Yaoyao Liu · Qi Chen · Jianning
Li · Yu-Cheng Chou · Angtian Wang · Yixiong Chen · Yuxiang Lai · Jincheng
Wang · Huimin Xue · Yining Cao · Haoqi Han · Xiaorui Lin · Yutong Tang ·
Meihua Li · Yujiu Ma · Jinghui Xu · Jiawei Liu · Zheyuan Zhang

