RadOmni: Advancing Foundation Model for Non-contrast CT with Omni Radiology Knowledge

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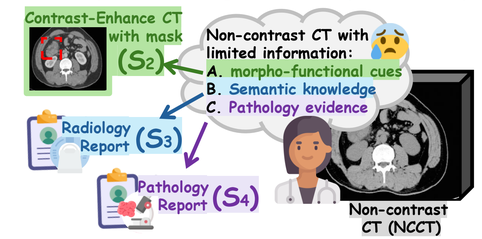
奇跡 Medical Imaging, Robotic, Analytic Computing & LEarning

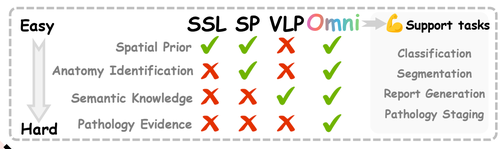
NEURAL INFORMATION PROCESSING SYSTEMS

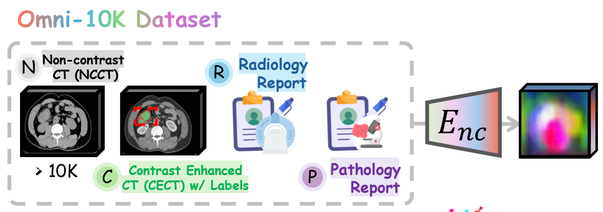


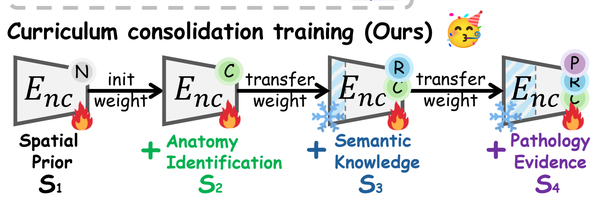
Motivation

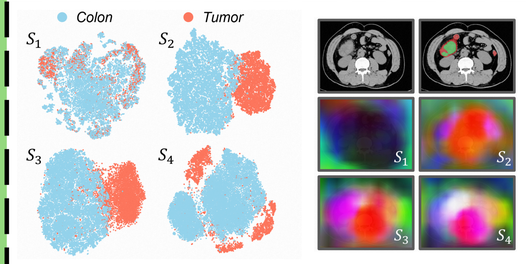
Can pre-training with complementary knowledge push NCCT beyond its diagnostic limits?

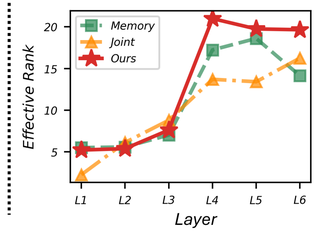


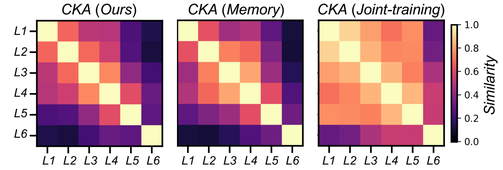


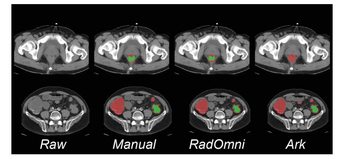






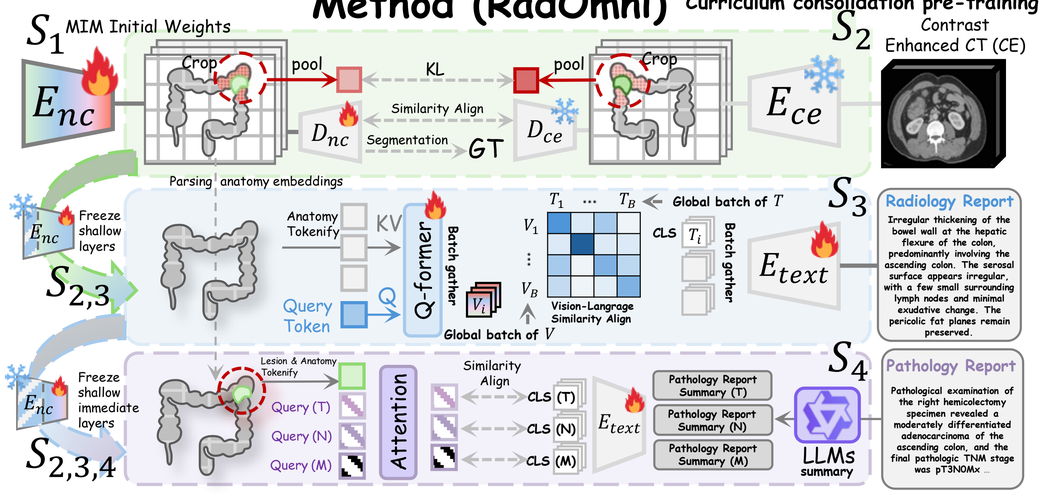




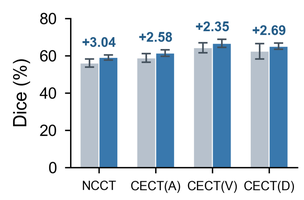


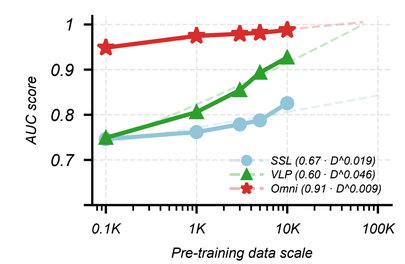
Method (RadOmni)

Curriculum consolidation pre-training



Method (Backbone)	Cls. (AUC %)	Seg. (DSC %) Organ	Seg. (DSC %) Tumor	Pathology (AUC %) T	Pathology (AUC %) N	Pathology (AUC %) M	Pathology (AUC %) Avg	Report Generation (%) BLEU-4	Report Generation (%) ROUGE-L	Report Generation (%) CIDEr	Report Generation (%) SPICE	Report Generation (%) GREEN	MSD Colon
Train from scratch													
Swin [40]	90.55	92.90	45.75	62.23	58.05	39.25	53.18	0.01	21.62	2.21	18.58	32.34	35.13*
nnUNet [39]	85.44	94.41	53.82	55.94	51.40	30.89	29.41	0.61	23.62	2.19	21.64	20.59	41.69*
Self-supervised pretraining													
VoCov2 [29] (Swin)†	97.51	93.18	48.43	60.63	57.23	38.70	52.19	0.01	20.28	1.85	7.59	19.20	42.57*
SparK [25, 26, 11] (nnUNet)	95.80	94.51	53.95	57.30	52.53	41.99	50.61	0.01	26.83	1.83	28.97	14.48	44.47
Supervised pretraining													
SuPreM [18] (Swin)†	98.43	92.78	46.23	61.77	59.25	48.70	56.57	0.66	25.66	2.49	23.29	18.12	38.78*
SuPreM [18] (nnUNet)	97.39	94.85	58.30	63.91	57.26	53.42	58.20	0.01	27.29	1.97	24.43	24.34	48.42*
UniModel [17] (UNet)†	94.07	91.53	39.16	55.93	39.73	59.20	51.62	1.02	25.91	2.73	25.15	35.27	45.43
Vision-Language pretraining													
CLIP [41, 33] (nnUNet)	88.08	94.32	51.82	62.40	54.23	39.11	51.91	3.38	29.03	8.76	28.84	28.34	37.93
fVLM [6] (nnUNet)	97.28	94.18	54.47	63.74	52.05	11.44	42.41	1.97	28.41	4.78	27.41	22.31	41.76
Merlin [7] (ResNet)†	94.76	94.40	57.89	52.36	24.73	58.48	45.19	0.01	28.33	1.71	28.03	17.37	43.21
Multi-modal supervised pretraining													
VoComni [29] (nnUNet)†	98.50	93.87	48.97	59.84	53.15	41.37	51.45	0.01	28.47	1.90	27.59	15.06	43.85
Triad [34] (nnUNet)	98.06	94.54	54.44	64.63	58.17	35.62	52.81	3.30	28.54	11.15	29.58	32.70	45.61
Argus [35] (nnUNet)	98.14	94.85	56.24	66.24	56.52	48.15	56.97	5.36	32.65	16.47	31.52	34.57	49.43
Ark [36] (nnUNet)	98.23	94.98	61.62	66.46	60.43	**74.59**	67.16	0.13	19.17	0.43	21.81	22.05	50.22
Omni-supervised pretraining													
RadOmni (nnUNet)	**98.54**	**95.01**	**63.67**	**67.44**	**63.35**	73.56	**68.12**	**5.97**	**34.34**	**18.10**	**32.18**	**37.02**	**51.02**





Method	Cls. (AUC %)	Pathology (AUC %) T	Pathology (AUC %) N	Pathology (AUC %) M	Pathology (AUC %) Avg
Train from scratch					
Swin [40]	78.97	69.39	54.03	50.39	57.94
nnUNet [39]	61.09	64.27	48.74	47.90	53.64
Self-supervised learning					
VoCov2 [29] (Swin)†	92.03	70.51	53.79	49.96	58.09
SparK [25, 26, 11] (nnUNet)	69.33	64.64	54.20	44.68	54.51
Supervised pretraining					
SuPreM [18] (Swin)†	90.51	66.75	58.33	48.62	57.90
SuPreM [18] (nnUNet)	81.80	67.22	64.04	47.89	59.72
UniModel [17] (UNet)†	68.37	66.32	54.51	51.49	57.44
Vision-language pretraining					
CLIP [41, 33] (nnUNet)	62.08	67.73	56.89	45.22	56.61
fVLM [6] (nnUNet)	88.12	64.67	50.47	44.76	53.30
Merlin [7] (ResNet)†	74.06	69.60	48.96	51.67	56.74
Multi-modal supervised pretraining					
VoComni [29] (nnUNet)†	93.97	67.37	51.94	44.25	54.52
Triad [34] (nnUNet)	92.01	72.97	58.94	43.87	58.59
Argus [35] (nnUNet)	96.81	71.00	60.32	**55.21**	62.18
Ark [36] (nnUNet)	97.58	70.51	63.45	52.01	61.99
Omni-supervised pretraining					
RadOmni (nnUNet)	**98.53**	**74.64**	**64.61**	53.54	**64.27**

Method	MSD (%) Liver	Vessel	Pancreas	Lung	Avg
Swin	67.85	64.80	47.88	70.28	62.70
nnUNet	67.43	68.92	46.08	64.73	61.79
SuPreM (Swin)	68.20	64.71	50.02	72.55	63.87
VoCo (Swin)	71.22	67.25	51.34	**75.74**	66.39
VoCo (nnUNet)	70.09	68.99	50.43	68.99	64.63
RadOmni (nnUNet)	**71.36**	**70.92**	**64.48**	74.38	**70.29**

Omni-CT10K

Omni-pretraining Hospital A → Fintune → **Fine-tuning Hospital B** → Generalize → **Zero-shot Hospital C**

Omni-CT10K
6K Normal & 4K CRC
10K paired reports
~6K paired CECT
~4K paired pathology report

ExtBench A (4K)
2K Normal & 2K CRC
4K paired reports
~1.3K paired pathology reports

ExtBench B (0.5K)
0.2K Normal & 0.3K CRC
0.5 K paired reports
~0.3K paired pathology reports