MedOpenSeg: Open-World Medical Segmentation with Memory Augmented Transformers

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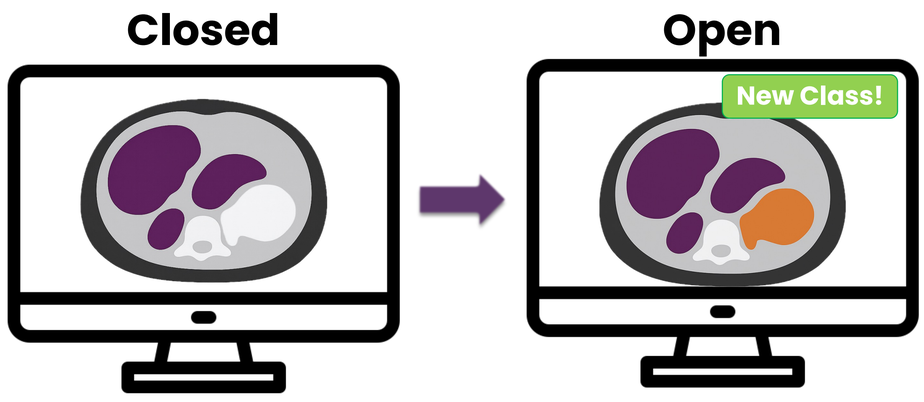
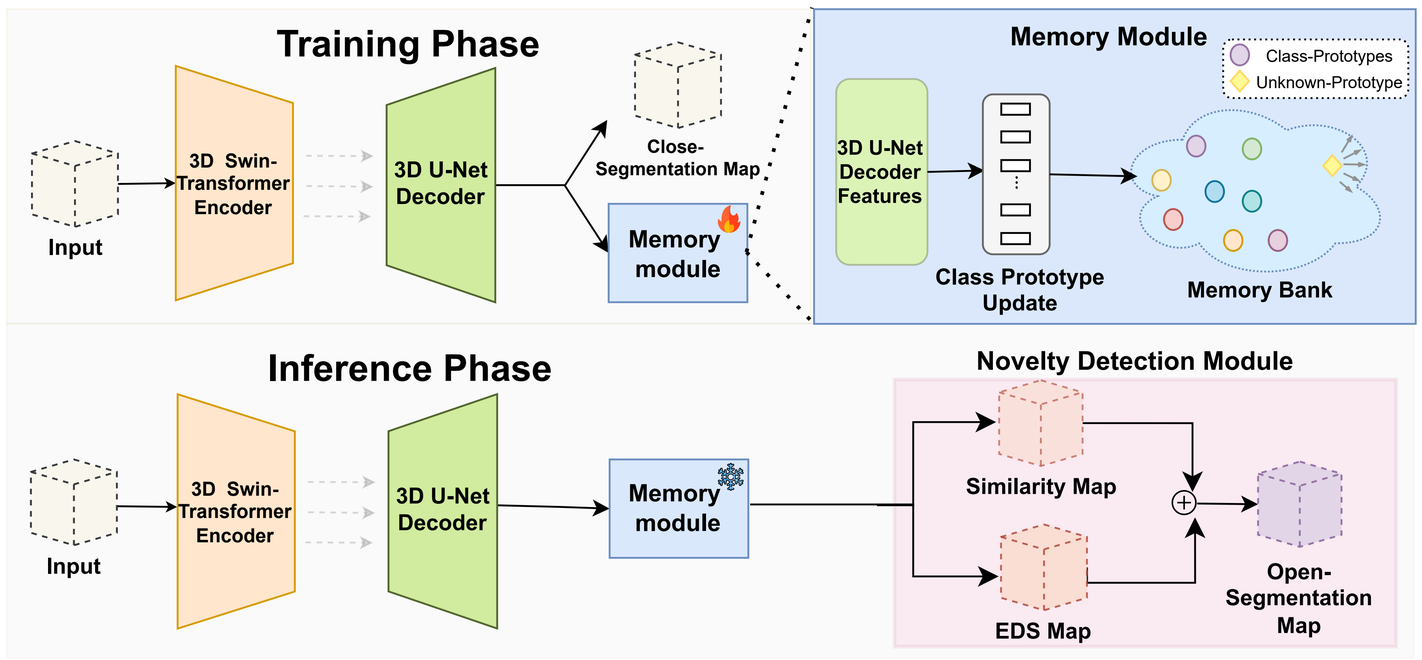
1. Motivation

- Most medical segmentation models assume closed label space.
- Real clinical data includes unseen anatomies, devices, or pathologies.
- Retraining for every new class is unfeasible in deployment.
- Models must recognize when **they don't know** → open-world segmentation.



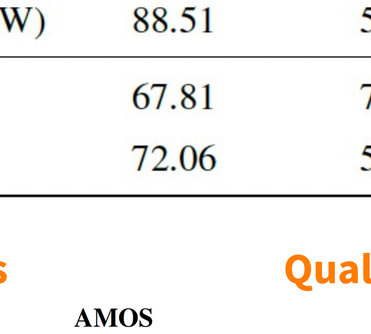
We propose **MedOpenSeg**, a Memory-Augmented Transformer that performs segmentation and novelty detection in a unified framework.

2. Our Solution



- **Prototype**: Class centroid in the learned embedding space.
- **Unseen detection:** By measuring **divergence** from prototypes.

Prototype-Guided Representation (PGR) Loss



Two terms:

- **Class Assignment (CA) Loss** pulls each embedding toward the correct class prototype.
- **Prototype Consistency (PC) Loss** enforces compact clusters reducing intra-class variance.

3. Protocol

Datasets

BTCV
Train on 13 organs.
Unseen: Pancreas, adrenals.

MSD-Pancreas
Train on Pancreas
Un seen: Pancreatic Tumor.

AMOS
Train on 10 anatomical structures.
Unseen: Duodenum, prostate, bladder, adrenals.

Baselines

- SwinUNETR
- CLIP-Universal
- MedSAM
- SAMMed-2D

Check our code!

4. Results

Table 1: Performance Comparison. MedOpenSeg outperforms other methods in known segmentation accuracy (Dice) and unseen class detection (AUROC). Best results in bold and percentage improvements compared to the best baseline.

Method	AMOS		BTCV		MSD-Pancreas	
	Known ↑	Unseen ↑	Known ↑	Unseen ↑	Known ↑	Unseen ↑
MedOpenSeg (Ours)	**90.11** ▲ 2%	**79.20** ▲ 13%	**88.18** ▲ 2%	**68.13** ▲ 3%	**88.96** ▲ 8%	**75.80** ▲ 8%
SwinUNETR (CW)	87.00	62.70	86.68	63.50	81.67	58.36
SwinUNETR (OW)	81.45	39.82	80.39	34.53	77.40	12.36
CLIP-Universal (OW)	88.51	52.70	83.17	42.70	82.43	49.60
MedSAM	67.81	70.24	64.40	66.34	58.86	70.45
SAM-Med2D	72.06	52.83	70.00	46.59	56.50	64.60

Ablation Results

Method	AMOS	
	Known ↑	Unseen ↑
MedOpenSeg (Ours)	**90.11**	**79.20**
w/o PGR	85.6	76.45
w/o Unknown Prototype	88.01	45.23
Cosine Similarity Only	-	68.30
EDS Only	-	77.82

Qualitative Results

5. Limitations and Future Work

- Performance partly relies on a dedicated unknown prototype
- Pursue fully unsupervised novelty detection
- Extend to diverse modalities and rare pathologies.

6. References

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2. Inigo Alonso, Alberto Sabater, David Ferstl, Luis Montesano, and Ana C Murillo. *Semi-supervised semantic segmentation with pixel-level contrastive learning from a class-wise memory bank*. In Proceedings of the IEEE/CVF international conference on computer vision, pages 8219–8228, 2021.
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