U-Net

December 14, 2023

The need for automation





Segmentation techniques



Figure: Segmentation example from Tensorflow

- 1. U-Net
- 2. YOLO
- 3. Deeplab

U-net

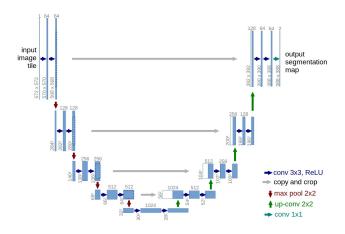


Figure: U-Net schematic

U-net implementation

Github

Complexity

FCNN Model size is constant: 118 MG

Time complexity:

- 1. Inference time (CPU)
- 2. Train time (CPU)
- 3. Inference time (GPU)
- 4. Train time (GPU)

Memory complexity:

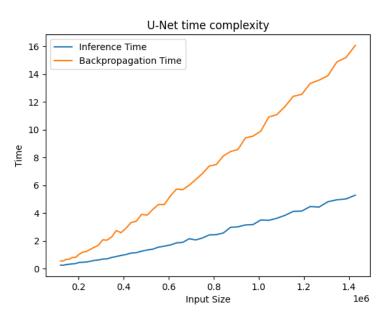
- 1. Inference memory (GPU)
- 2. Train memory (GPU)

CPU time complexity

Image Size	Inference Time	Train Time
256×256	0.369 s	1.320 s
512×512	2.429 s	9.094 s
576×576	3.408 s	12.201 s
1024×1024	13.780 s	50.855 s
1280×1280	23.943 s	93.930 s

Table: CPU Complexity Table

CPU time complexity continue

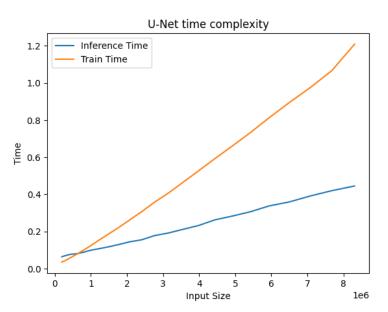


GPU complexity

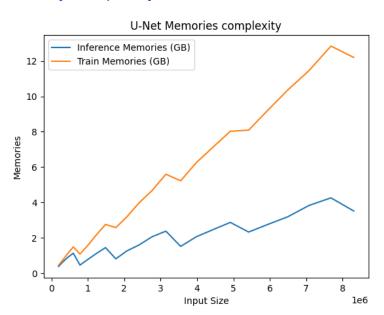
Image size	Infer time	Train time	Infer memory	Train memory
256×256	0.055 s	0.033 s	0.371 GB	0.439 GB
512×512	0.064 s	0.095 s	0.453 GB	1.077 GB
576x576	0.087 s	0.121 s	0.763 GB	1.551 GB
1024×1024	0.184 s	0.404 s	1.551 GB	5.594 GB
1472×1472	0.353 s	0.893 s	3.193 GB	10.379 GB
1664×1664	0.449 s	1.208 s	3.512 GB	12.206 GB

Table: GPU Complexity Table

GPU time complexity



GPU memory complexity



Optimization

- ► Adjusting Network architucture: deepth, ...
- ► Tuning hyperarameters: batch size, learing rate,
- ▶ Use existing model: use pretrained encoder

Medical Application

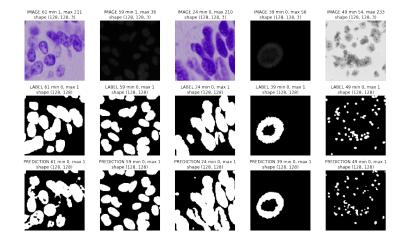


Figure: Kaggle: Automating nucleus detection

Medical Application continue

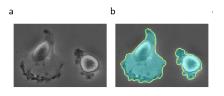


Figure: Glioblastoma-astrocytoma U373

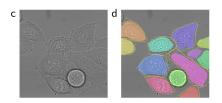
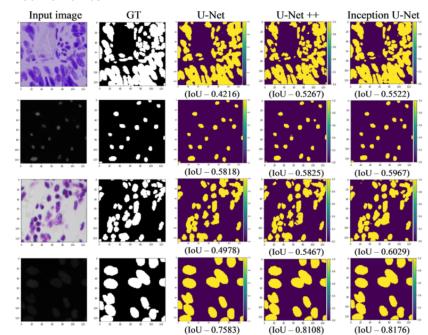


Figure: HeLa cells

U-Net variants



Other models

- ▶ DeepLab
- ► SegNet
- ► YoLo
- **...**