CAggNet: Crossing Aggregation Network for Medical Image Segmentation

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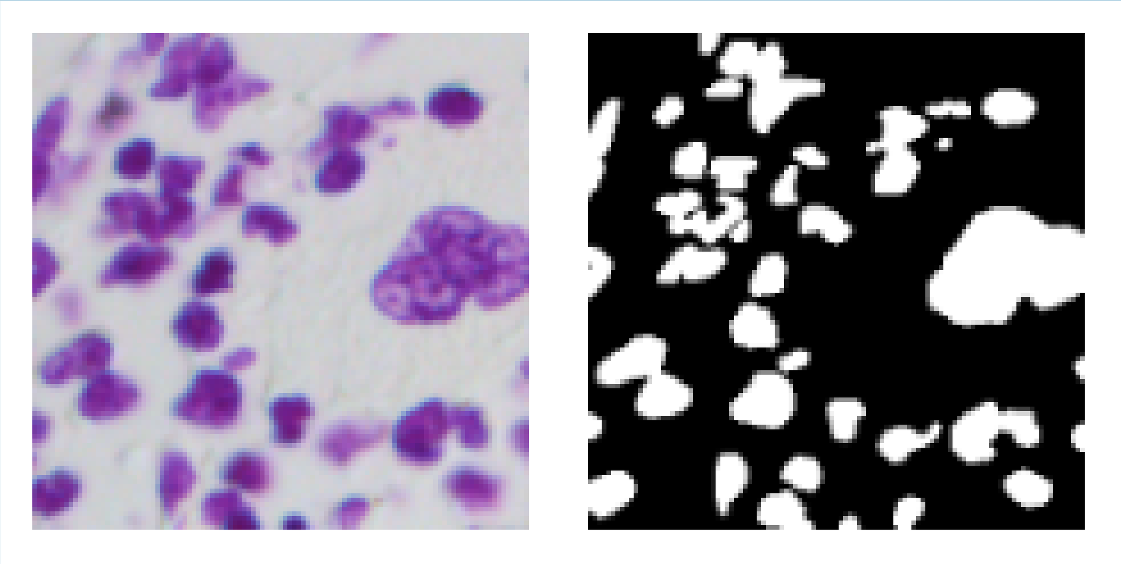
Problem

Among plenty of semantic segmentation jobs, medical image segmentation is one of the most challenging tasks due to its lack of data and labels. In clinical research and application, medical image segmentation is a significant procedure for clinical evaluation and diagnosis. It includes all kinds of segmentation tasks from the 2D cell level to the 3D organ and system level of human bodies. The shape and area of unusual objects in medical images such as CT images, nuclear magnetic images, and microscopy images can offer clinicians crucial insight into patients' severity and plan for treatment. It has become a consensus of clinical researchers using computers to assist in the diagnosis of medical images nowadays.



Performance

We compared CAggNet with its baselines: U-Net and UNet++. As seen, CAggNet consistently outperforms UNet++ and general U-Net in both the CELL and GLAND datasets. These results prove the effectiveness of our proposed architecture.

	IoU	F1-score
U-Net	0.8459	0.9166
UNet++	0.8489	0.9188
CAggNet	**0.8581**	**0.9236**

Table 1: Performance on CELL dataset

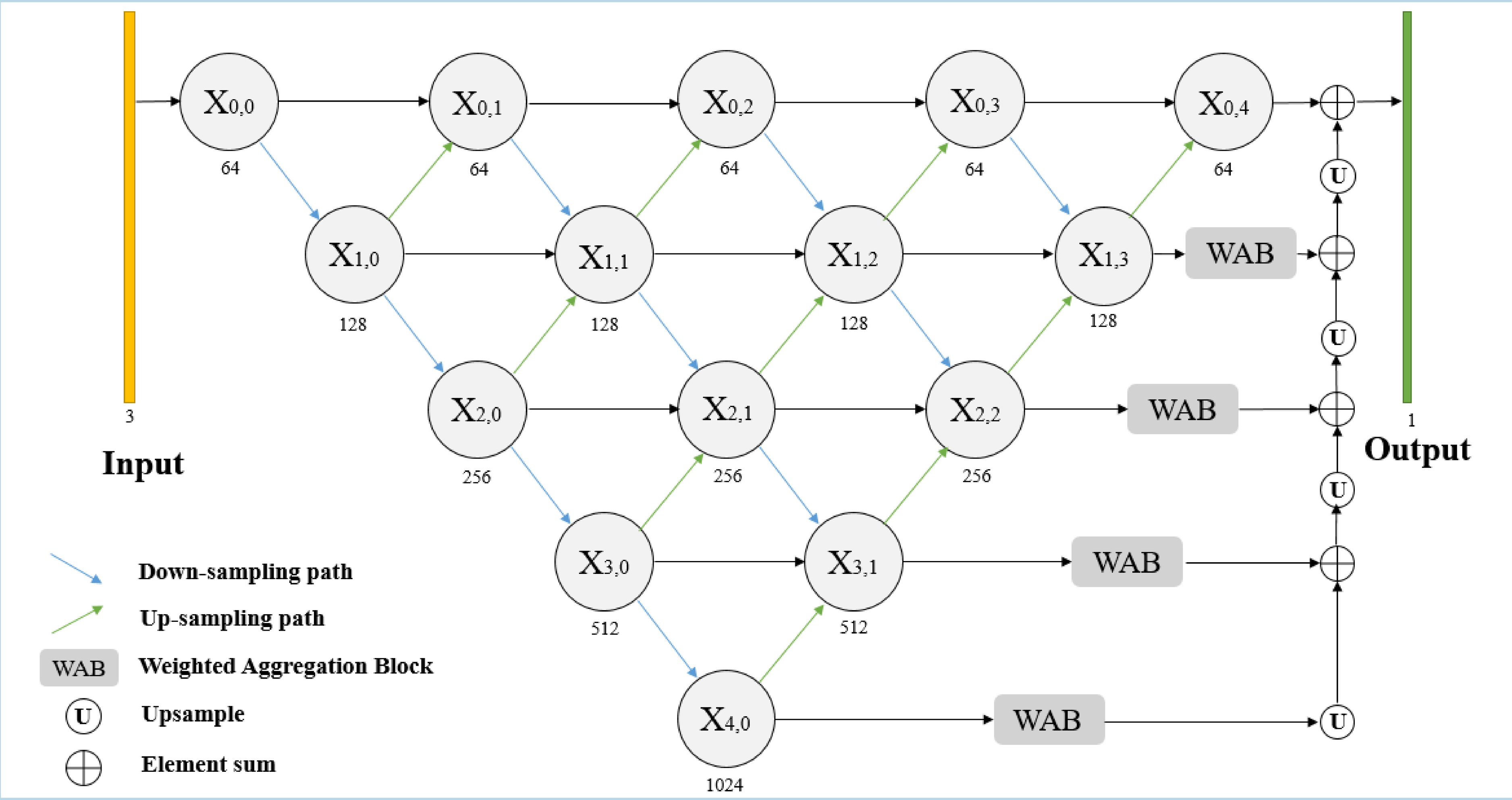
	IoU	F1-score
U-Net	0.7873	0.8810
UNet++	0.7919	0.8836
CAggNet	**0.8063**	**0.8927**

Table 2: Performance on GLAND dataset

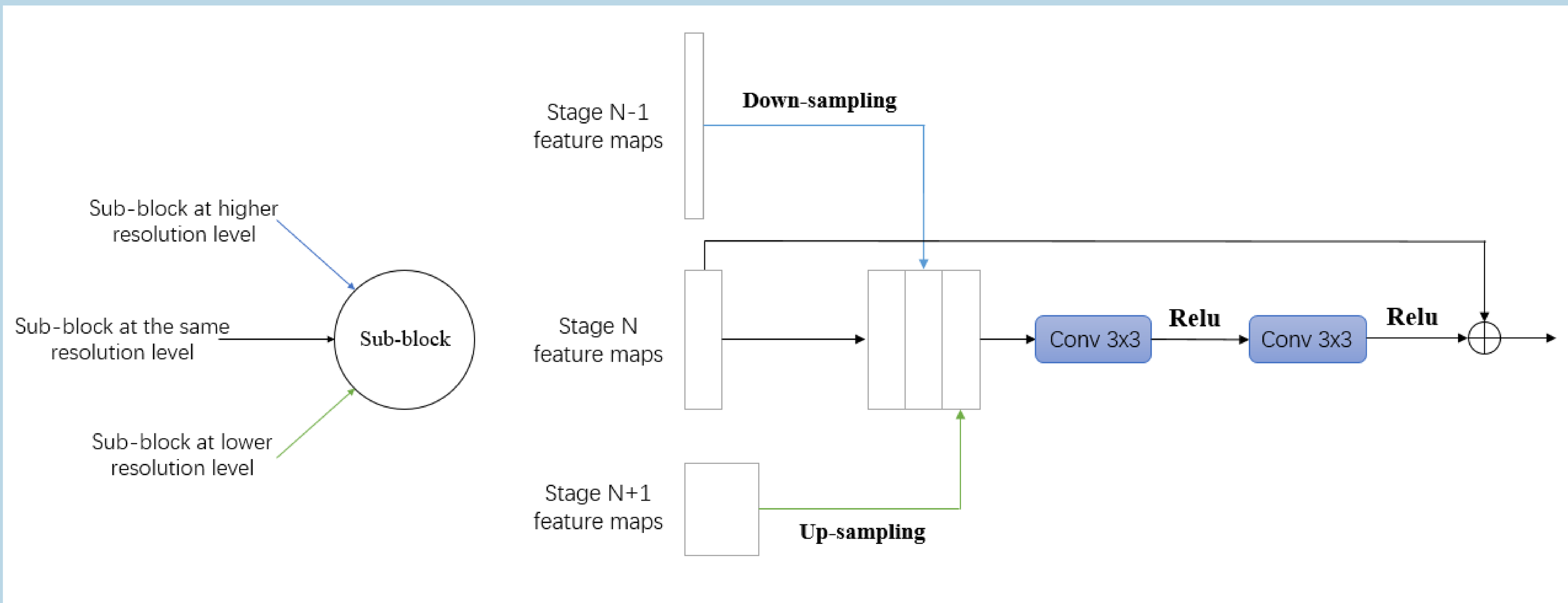
Associations

Network Architecture

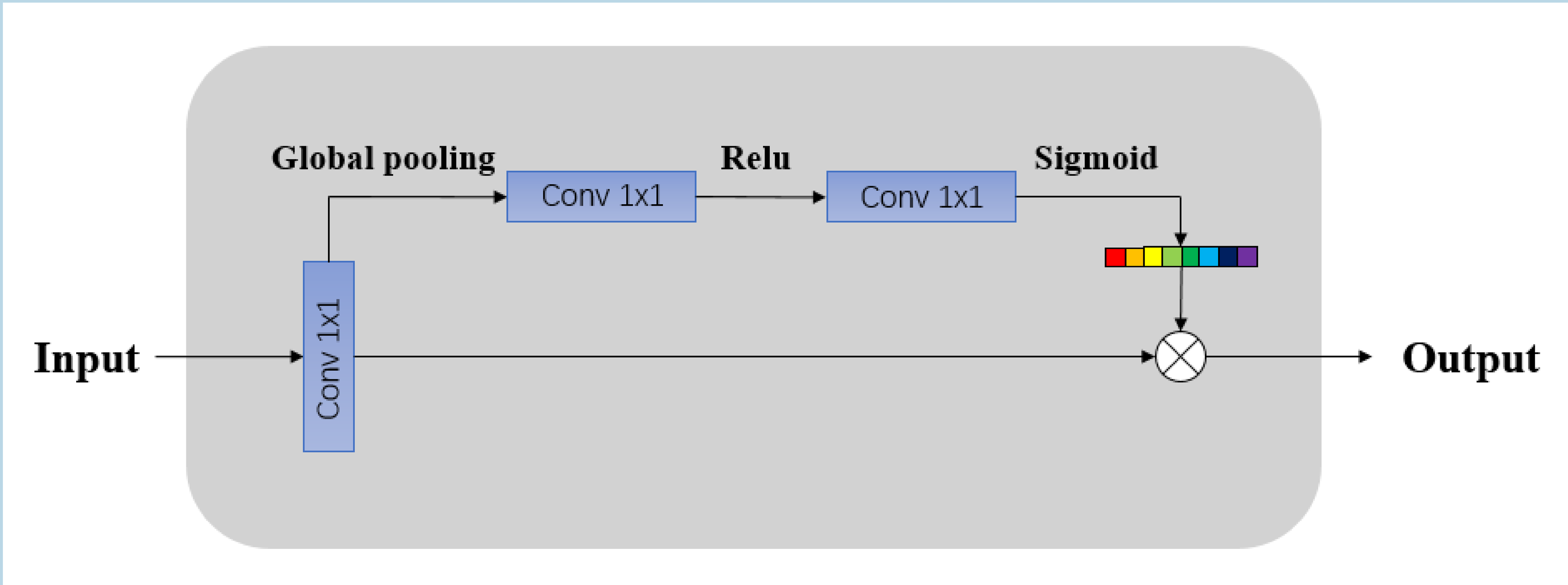
CAggNet is primarily based on an encoder-decoder architecture, with multiple convolutional layers in each resolution level's skip connection pathways. The network can be divided into two sub-structure: crossing aggregation module (denoted by $X_{i,j}$ in figure) and weighted aggregation module (denoted by WAB in figure). In crossing aggregation module, the parameters are transferred among convolutional layers through up-sampling, down-sampling and concatenate operation. Then, the weighted aggregation module merges the outputs of the cross-aggregation module from different resolution level in order to better recover the final probability predicted map.



CAggNet Architecture



Crossing Aggregation Module



Weighted Aggregation Module

Qualitative Result

The figure below compares the segmentation result of CAggNet with other conventional models. Overall, the segments detected by CAggNet are more clearly divided. For more detailed and quantitative results, please refer to our paper.