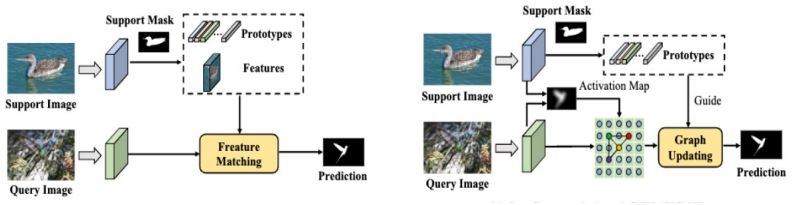
Few-shot Semantic Segmentation with Support-induced Graph Neural Network

Jie Liu*[1], Yanqi Bao*[2], Yang Gao[2], Jan-Jakob Sonke[3], Efstratios Gavves[1]
[1]University of Amsterdam, [2]Nanjing University, [3]The Netherlands Cancer Institute

Motivation



(a). Existing few-shot segmentation methods generate support prototypes /features from the support image, then implement feature matching to obtain mask prediction for the query image. However, merely leveraging support information usually fail to work when support and query image exhibits large apprearance/scale variance.

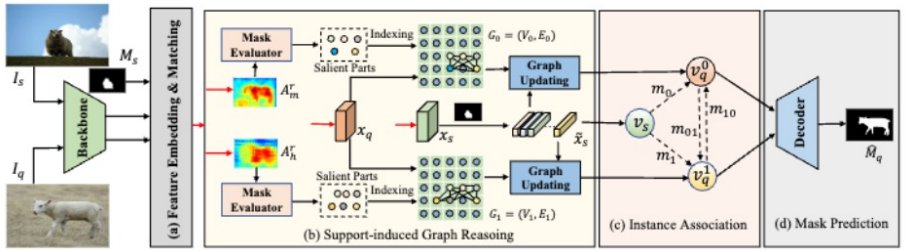
(b). Our main idea is to explicitly enrich the query context information with the guidance of support information. In practice, we adopt a support-induced graph convolutional network to achieve this goal.

Contribution

(a) We propose a support-induced graph convolution network (SiGCN), which utilizes the proposed IA and SiGR modules to capture complementary context from the query and the support set, for addressing the appearance variation problem in the FSS task.

(b) We propose a novel graph updating mechanism, in which support prototypes guide the node updating in the query graphs. This mechanism brings a significant performance gain to the proposed SiGCN.

Methodology



(a) A support-induced graph reasoning module to mine context information from query image.

(b) An instance assosication module to explore information from both support and query images..

Experiment Results

Results on PASCAL-5^i

Methods	Backbone	1-shot Fold-0	1-shot Fold-1	1-shot Fold-2	1-shot Fold-3	1-shot Mean	1-shot FB-IoU	5-shot Fold-0	5-shot Fold-1	5-shot Fold-2	5-shot Fold-3	5-shot Mean	5-shot FB-IoU
OSLSM (BMVC'17) [21]	VGG16	33.6	55.3	40.9	33.5	40.8	61.3	35.9	58.1	42.7	39.1	43.9	61.5
co-FCN (ICLRW'18) [18]	VGG16	36.7	50.6	44.9	32.4	41.1	60.1	37.5	50.0	44.1	33.9	41.4	60.2
PFENet (TPAMI'20) [24]	VGG16	56.9	68.2	54.4	52.4	58.0	72.0	59.0	69.1	54.8	52.9	59.0	72.3
HSNet (ICCV'21) [15]	VGG16	59.6	65.7	59.6	54.0	59.7	73.4	64.9	69.0	64.1	58.6	64.1	76.6
PFENet (TPAMI'20) [24]	ResNet50	61.7	69.5	55.4	56.3	60.8	73.3	63.1	70.7	55.8	57.9	61.9	73.9
RePRI (CVPR'21) [1]	ResNet50	59.8	68.3	62.1	48.5	59.7	-	64.6	71.4	71.1	59.3	66.6	-
SAGNN (CVPR'21) [27]	ResNet50	64.7	69.6	57.0	57.3	62.1	73.2	64.9	70.0	57.0	59.3	62.8	73.3
MMNet (ICCV'21) [26]	ResNet50	62.7	70.2	57.3	57.0	61.8	-	62.2	71.5	57.5	62.4	63.4	-
HSNet (ICCV'21) [15]	ResNet50	64.3	70.7	60.3	60.5	64.0	76.7	70.3	73.2	67.4	67.1	69.5	80.6
CyCTR (NIPS'21) [36]	ResNet50	67.8	72.8	58.0	58.0	64.2	-	71.1	73.2	60.5	57.5	65.6	-
Baseline	ResNet50	62.5	69.4	58.9	55.9	61.7	72.0	63.2	70.5	60.1	57.6	62.9	74.4
SiGCN	ResNet50	65.1	70.1	65.2	60.8	**65.3**	**77.5**	68.9	72.6	66.8	65.8	**68.5**	**78.3**

Results on COCO-20^i

Methods	Backbone	1-shot Fold-0	1-shot Fold-1	1-shot Fold-2	1-shot Fold-3	1-shot Mean	1-shot FB-IoU	5-shot Fold-0	5-shot Fold-1	5-shot Fold-2	5-shot Fold-3	5-shot Mean	5-shot FB-IoU
FWB(ICCV'19) [17]	VGG16	18.4	16.7	19.6	25.4	20.0	-	20.9	19.2	21.9	28.4	22.6	-
PFENet(TPAMI'20) [24]	VGG16	33.4	36.0	34.1	32.8	34.1	60.0	35.9	40.7	38.1	36.1	37.7	61.6
SAGNN(CVPR'21) [27]	VGG16	35.0	40.5	37.6	36.0	37.3	61.2	37.2	45.2	40.4	40.0	40.7	63.1
RePRI(CVPR'21) [1]	ResNet50	31.2	38.1	33.3	33.0	34.0	-	38.5	46.2	40.0	43.6	42.1	-
SAGNN(CVPR'21) [27]	ResNet101	36.1	41.0	38.2	33.5	37.2	60.9	40.9	48.3	42.6	38.9	42.7	63.4
MMNet(ICCV'21) [26]	ResNet50	34.9	41.0	37.2	37.0	37.5	-	37.0	40.3	39.3	36.0	38.2	-
HSNet(ICCV'21) [15]	ResNet50	36.3	43.1	38.7	38.7	39.2	68.2	43.3	51.3	48.2	45.0	46.9	70.7
CyCTR(NIPS'21) [36]	ResNet50	38.9	43.0	39.6	39.8	40.3	-	41.1	48.9	45.2	47.0	45.6	-
Baseline	ResNet50	33.6	39.2	36.5	34.2	35.9	60.7	35.3	43.1	38.4	38.7	38.9	62.0
SiGCN	ResNet50	38.7	46.3	43.1	37.5	**41.4**	**62.7**	44.9	54.5	46.5	45.9	**48.0**	**66.2**

Ablations

Components Analysis

SiGR	IA	1-shot mIoU 5^0	5^1	5^2	5^3	mean	FB-IoU
		62.5	69.4	58.9	55.9	61.7	72.0
	✓	62.0	70.0	58.5	59.4	62.7	73.5
✓		64.6	69.8	64.1	60.8	64.8	77.4
✓	✓	65.1	70.1	65.2	60.8	**65.3**	**77.5**

GCN variants

GCN Variants	1-shot mIoU 5^0	5^1	5^2	5^3	mean	FB-IoU
baseline	62.0	70.0	58.5	59.4	62.7	73.5
GCN [7]	63.0	69.4	59.7	57.1	62.3	73.3
SiGCN-1	63.4	69.6	62.2	60.0	63.8	75.4
SiGCN-2	65.1	70.1	65.2	60.8	**65.3**	**77.5**

Prototype number k

k prototypes	1-shot mIoU 5^0	5^1	5^2	5^3	mean	FB-IoU
1	64.8	69.7	63.5	59.0	64.3	75.9
3	64.1	70.2	64.3	59.5	64.5	76.2
5	65.1	70.1	65.2	60.8	**65.3**	**77.5**
7	63.7	69.8	63.8	60.2	64.4	75.5

Visualization

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