

CAMEL: A Weakly Supervised Learning Framework for Histopathology Image Segmentation

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THOROUGH IMAGES



Introduction

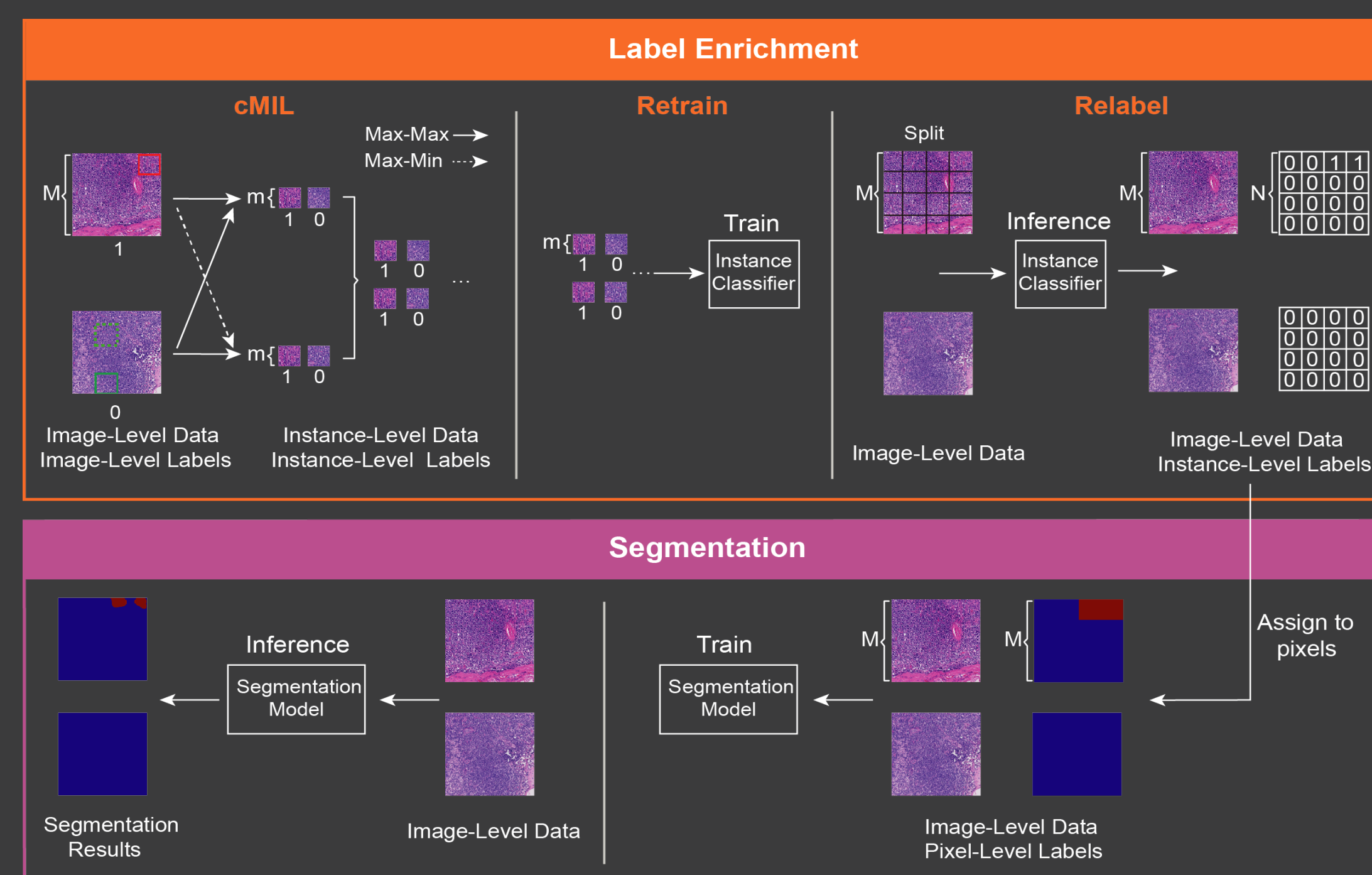
❖ We propose a weakly supervised learning framework, CAMEL, for histopathology image segmentation using only image-level labels. CAMEL automatically enriches supervision information of the image by generating the instance-level labels from the image-level ones and achieves comparable performance with the fully supervised baselines in both instance-level classification and pixel-level segmentation.

Dataset

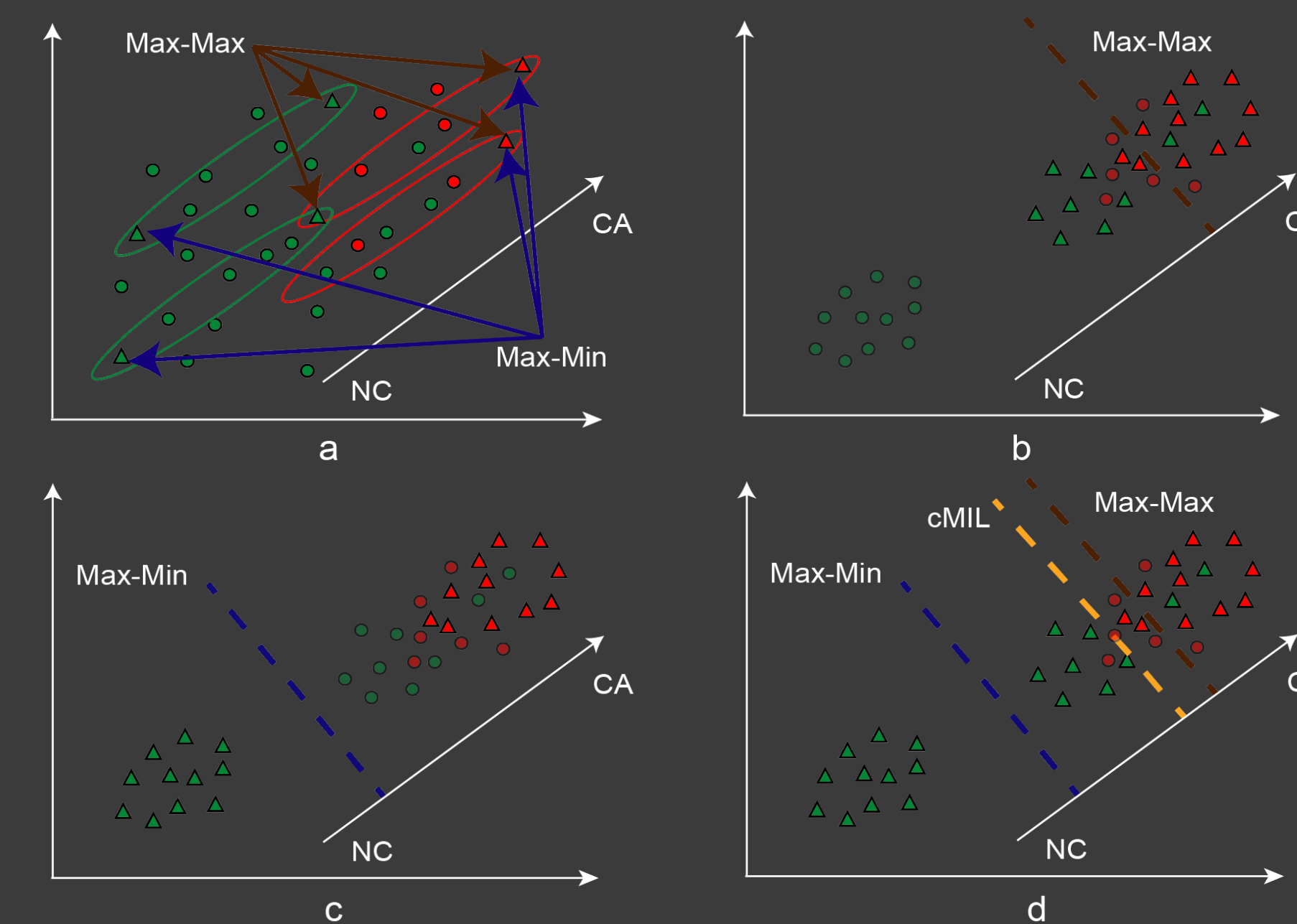
- ❖ We conducted our experiments on CAMELYON16 and a colorectal adenoma dataset.
- ❖ To facilitate the research in histopathology field, our colorectal adenoma dataset will be made publicly available at <https://github.com/ThoroughImages/CAMEL>.

Methods

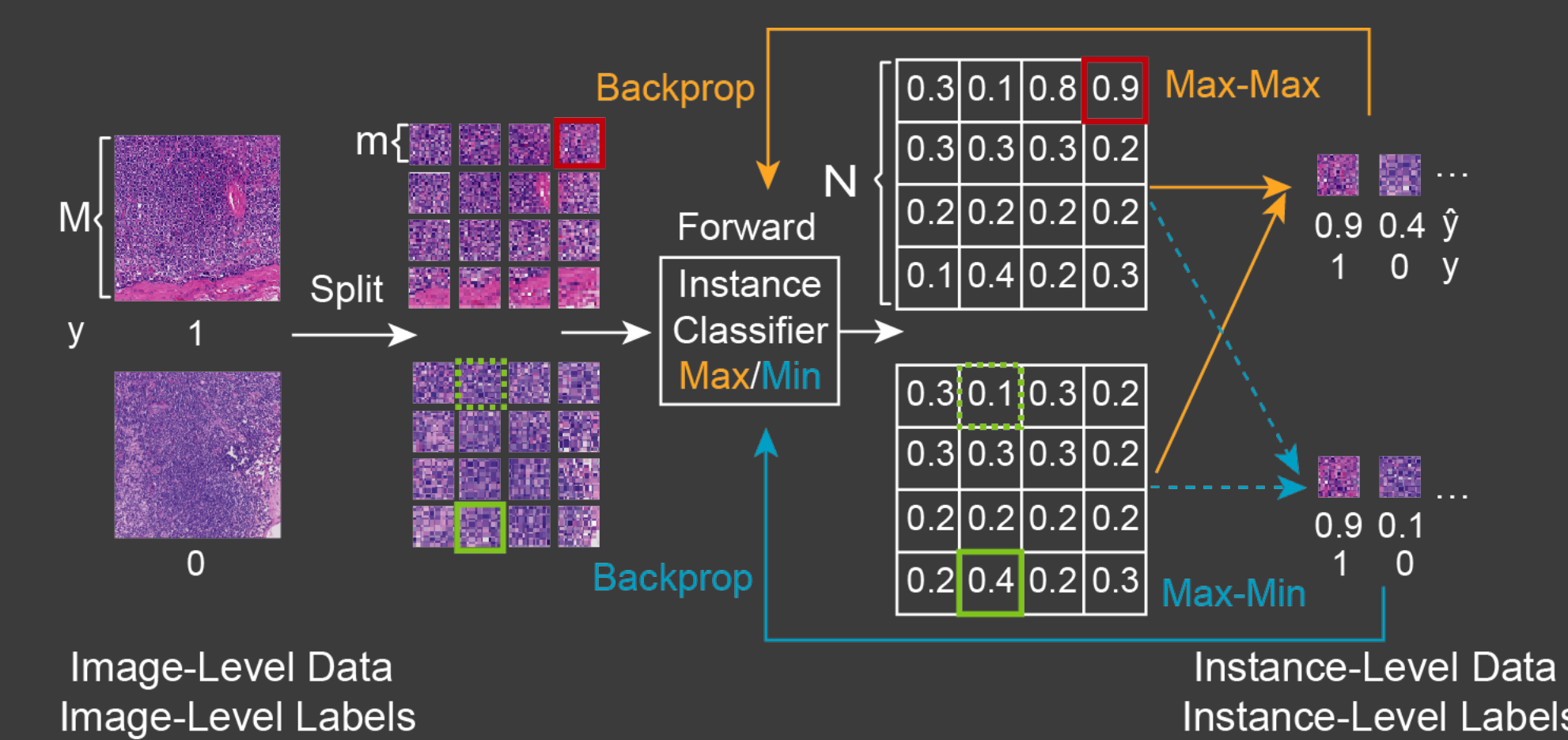
❖ System architecture of CAMEL



❖ Instance selection criteria



❖ Training procedure of cMIL

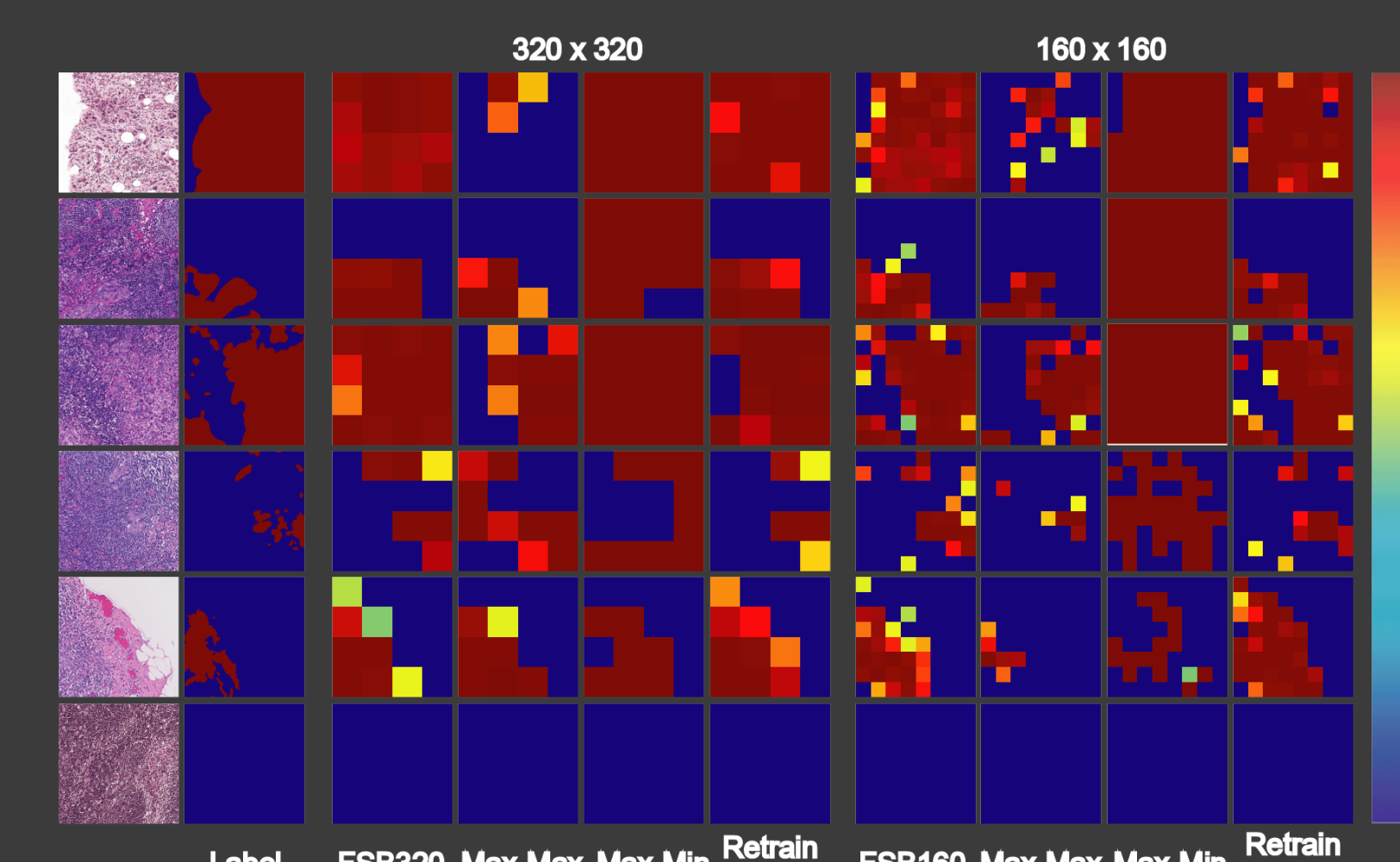


Results

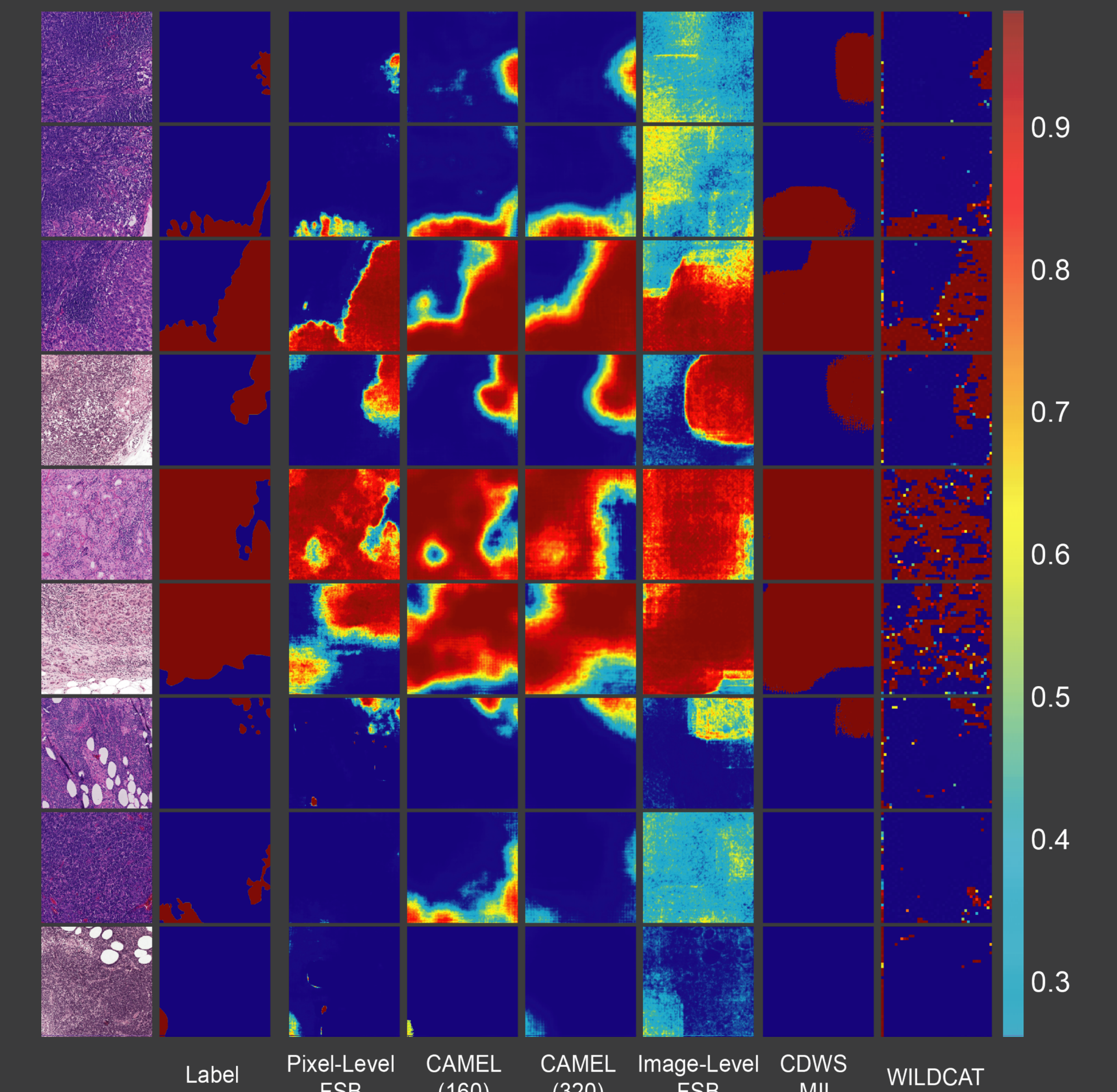
❖ Instance-level classification performance of label enrichment on CAMELYON16.

320×320 (%)	Sensitivity	Specificity	Accuracy
FSB320	90.0	97.4	94.5
Max-Max	56.9	98.1	81.9
Max-Min	82.0	82.6	82.3
Retrain (cMIL)	88.7	94.6	92.3
Retrain (constrained)	84.5	98.4	92.9

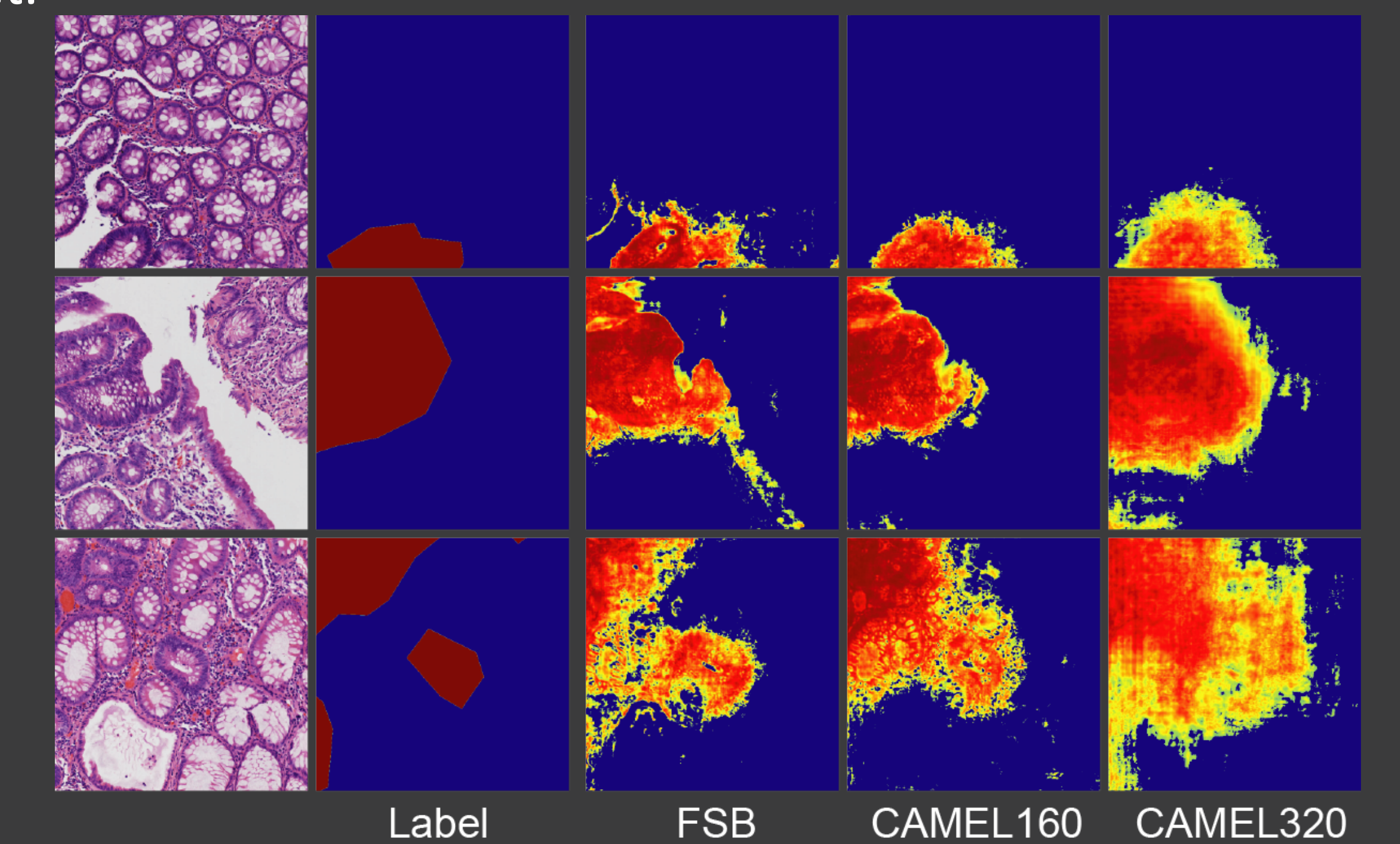
160×160 (%)	Sensitivity	Specificity	Accuracy
FSB160	89.0	95.0	92.8
Max-Max	44.9	99.3	79.3
Max-Min	87.7	86.5	86.9
Retrain (cMIL)	85.5	90.1	88.4
Retrain (constrained)	75.2	98.5	89.9
Cascade	87.7	92.0	90.4
Cascade (constrained)	83.6	96.4	91.7



❖ Pixel-level segmentation results (DeepLabv2) of CAMEL and other methods on CAMELYON16 test set.



❖ Pixel-level segmentation results (DeepLabv2) of CAMEL on colorectal adenoma dataset.



Discussions

- ❖ Computer-assisted diagnosis for histopathology image can improve the accuracy and relieve the burden for pathologists at the same time. In this research, we present a weakly supervised learning framework, CAMEL, for histopathology image segmentation using only image-level labels. CAMEL automatically enriches supervision information from image-level to instance-level with high quality and achieves comparable segmentation results with its fully supervised counterparts. More importantly, the automatic labeling methodology may generalize to other weakly supervised learning studies for histopathology image analysis.
- ❖ In CAMEL, the obtained instance-level labels are directly assigned to the corresponding pixels and used as masks in the segmentation task, which may result in the over-labeling issue. We will tackle this challenge using mask boundary refinement in future work.

