

Cluster-to-Conquer: A Framework for End-to-End Multi-Instance Learning for Whole Slide Image Classification

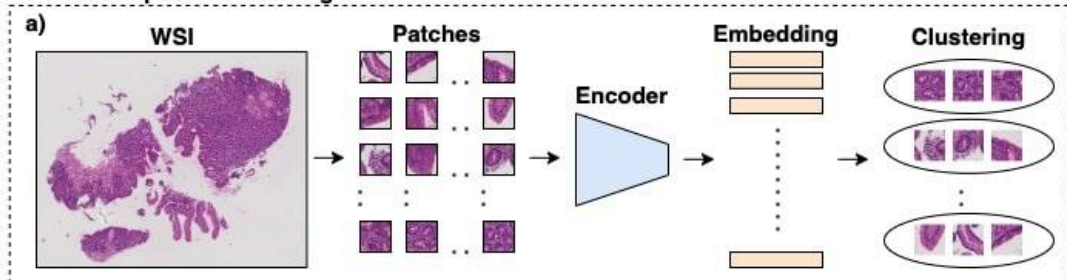
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*co-corresponding authors

Key Contributions

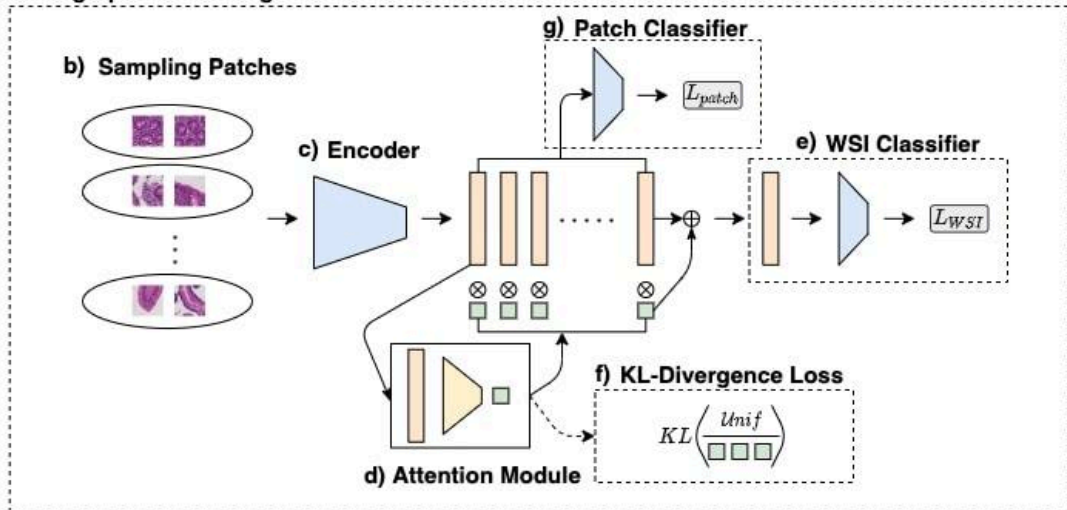
- Proposed an **end-to-end** WSI classification training framework (C2C) using clustering based sampling technique, adaptive attention pooling, and KL-divergence loss.
- End-to-End training on WSI has the potential to perform better than two-stage training.
- **ResNet18** trained using C2C performed **better** than **ResNet34/ResNet50** of two-stage training.
- Inclusion of **KL-Divergence loss** regularizes the attention distribution for same cluster patches.

Proposed Approach - C2C framework

At Start of Epoch - Clustering

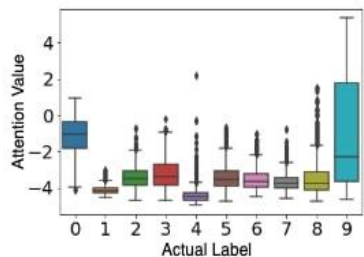
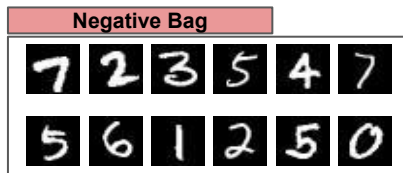


During Epoch - Training

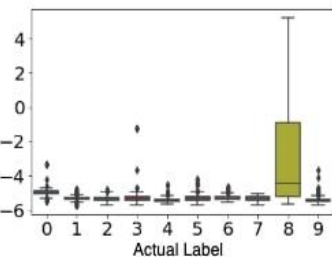


At the start of the epoch, **clustering** is performed for sampling discriminative patches from a WSI

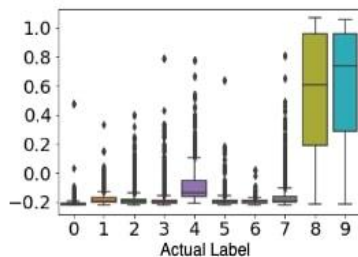
During epoch, sampled patches are used with an adaptive **attention** mechanism and a combination of **cross-entropy** and **KL-divergence loss** for training.



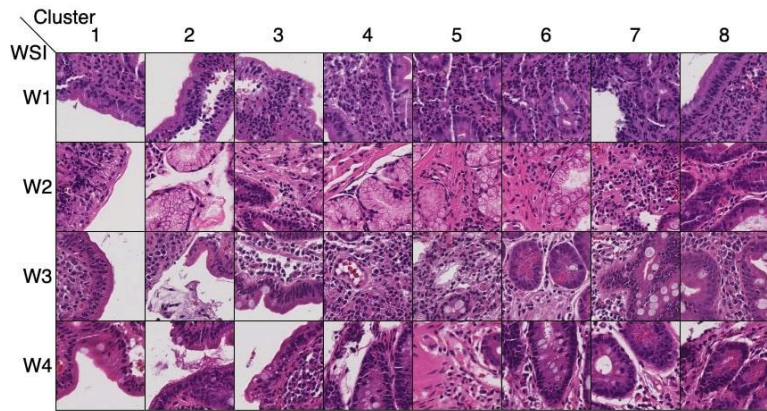
a) Bag Loss



b) Bag & Instance Loss

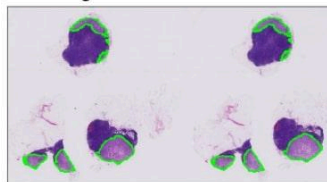


c) Bag, Instance, & KLD Loss

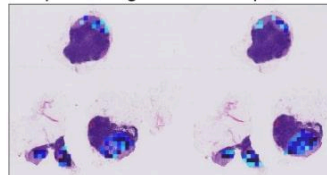


a) Celiac Disease

Pathologist Annotation



Deep Learning Attention Map



0.0 Attention Distribution 1.0

b) Breast Cancer Dataset

Code: <https://github.com/YashSharma/C2C>

Feel free to reach out!

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Inclusion of KL-divergence loss regularizes the high variance of attention distribution observed in similar positive instance class of 8 and 9.

a) Gastrointestinal Dataset - Patches sampled from clusters of different WSI in decreasing order of attention importance.
 b) CAMELYON Dataset - Top figure contains the actual tumor regions annotated by the pathologists, and the bottom figure contains the patches assigned high attention importance by our model.

Thank you!