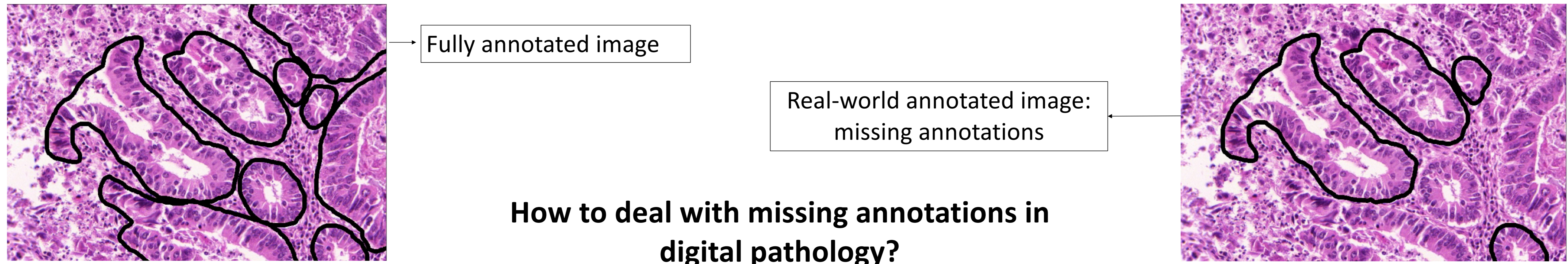# Computational Evaluation of the Combination of Semi-Supervised and Active Learning for Histopathology Image Segmentation with Missing Annotations
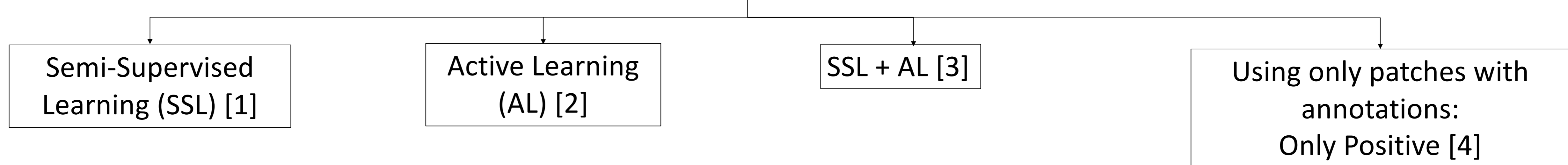
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laura.galvez.jimenez@ulb.be, maxime.amodei@uliege.be
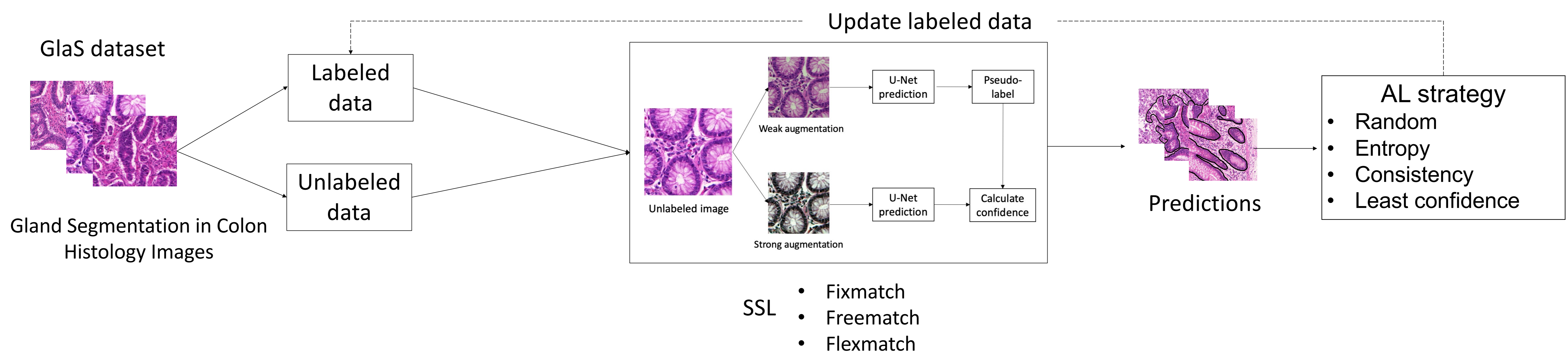
Context / Motivation

Fully annotated image

Real-world annotated image: missing annotations

How to deal with missing annotations in digital pathology?

Related works / Gap

Medical image segmentation with missing annotations

- Semi-Supervised Learning (SSL) [1]
- Active Learning (AL) [2]
- SSL + AL [3]
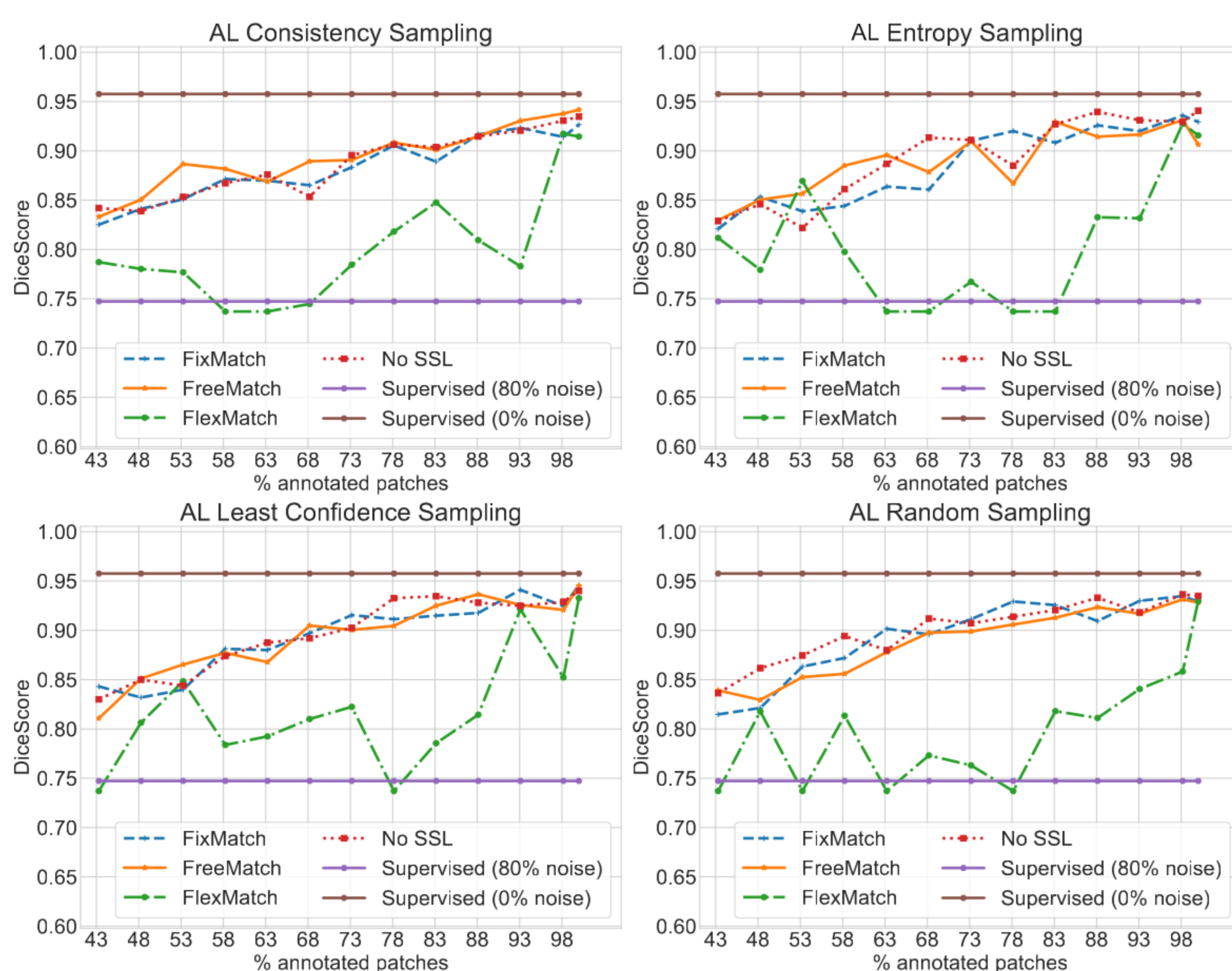- Using only patches with annotations: Only Positive [4]

- We test if combining different SSL and AL methodologies improves performance over using SSL, AL or other strategies separately for segmentation in histopathology images when training with missing annotations.

Our approach

GlaS dataset

Gland Segmentation in Colon Histology Images

Labeled data

Unlabeled data

Update labeled data

Unlabeled image — Weak augmentation — U-Net prediction — Pseudo-label

Strong augmentation — U-Net prediction — Calculate confidence

Predictions

AL strategy
- Random
- Entropy
- Consistency
- Least confidence

SSL
- Fixmatch
- Freematch
- Flexmatch

Results

Conclusions

- Only Positive strategy performs as good as consistency-based SSL methods.

- Fixmatch and Freematch obtain similar results while Flexmatch does not perform well on this task.

- AL combined with Only Positive strategy improves model's performance.

- AL random strategy obtains similar results as more elaborate selection methodologies.

- Future work: Test if other SSL/AL strategies and combinations are more suitable for histopathology image segmentation.

References

[1] Lai, Z. et al. (2021). A semi-supervised learning for segmentation of gigapixel histopathology images from brain tissues. (EMBC) (pp. 1920-1923). IEEE.
[2] Yang, L. et al. (2017). Suggestive annotation: A deep active learning framework for biomedical image segmentation. In MICCAI 2017: 20th International Conference, Proceedings, Part III 20 (pp. 399-407).
[3] Lai, Z. et al. (2021). Joint semi-supervised and active learning for segmentation of gigapixel pathology images with cost-effective labeling. In Proceedings of the IEEE/CVF International Conference on Computer Vision (pp. 591-600).
[4] Foucart, A. et al. (2019). SNOW: Semi-supervised, NOisy and/or Weak data for deep learning in digital pathology. In (ISBI 2019) (pp. 1869-1872). IEEE.