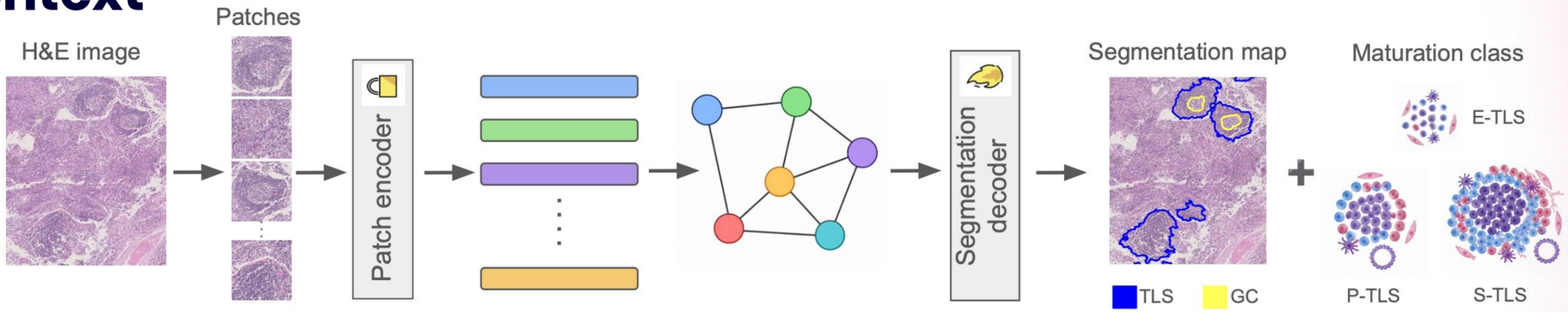
Beyond the Patch : Context Aggregation Strategies for Foundation Model-Driven Tertiary Lymphoid Structure Segmentation

Project 11

01

Context



- **TLSs & germinal centers (GCs):** key biomarkers for cancer prognosis & immunotherapy response.
- **Goal:** automated TLS/GC segmentation & classification on routine H&E whole-slide images (WSIs).
- **Current baseline:** data-intensive (~1,000 annotated TCGA slides), poor cross-cohort generalization.
- **Foundation models (FM):** may cut annotation needs, but underexplored for dense segmentation.
- **Key question:** implicit (cross-attention) vs. explicit (graph-based) context aggregation.

TRAIL
TRUSTED AI LABS

02

Founding Team

- Isinsu Katircioglu (isinsu.katircioglu@chuv.ch) – Team Leader
  - Institution: CHUV
  - Expertise: Computer vision (object segmentation & tracking), self-supervised learning, vision–language foundation models, multimodal data integration.

- Caner Ercan (caner.ercan@chuv.ch) – Team Leader
  - Institution: CHUV
  - Expertise: Computational & translational molecular pathology; spatial modeling of the tumor microenvironment to identify outcome-relevant features in pathology images.

- Additional members to be recruited at TReC'26

TRAIL
TRUSTED AI LABS

03

Work Plan

- **WP1** — Build & benchmark FM-based context aggregation (Week 1)
  - Task 1: Build the **cross-attention strategy** on FM encoders. Compare a single-branch model against a multi-resolution dual-branch model, and test frozen encoders versus LoRA fine-tuning.
  - Task 2: Build **graph-based strategy** using patch graphs with FM node embeddings and different attention-based neighborhood aggregation.

TRAIL
TRUSTED AI LABS

03

Work Plan

- **WP1** — Build & benchmark FM-based context aggregation (Week 1)
  - Task 1: Build the **cross-attention strategy** on FM encoders. Compare a single-branch model against a multi-resolution dual-branch model, and test frozen encoders versus LoRA fine-tuning.
  - Task 2: Build **graph-based strategy** using patch graphs with FM node embeddings and different attention-based neighborhood aggregation.

- **WP2** — Label efficiency (Week 2):
  - Task 1: Pick the best-performing WP1 variant and retrain it alongside the specialist baseline on progressively smaller labelled-slide fractions to quantify annotation efficiency.

TRAIL
TRUSTED AI LABS

03

Work Plan

- **WP1** — Build & benchmark FM-based context aggregation (Week 1)
  - Task 1: Build the **cross-attention strategy** on FM encoders. Compare a single-branch model against a multi-resolution dual-branch model, and test frozen encoders versus LoRA fine-tuning.
  - Task 2: Build **graph-based strategy** using patch graphs with FM node embeddings and different attention-based neighborhood aggregation.

- **WP2** — Label efficiency (Week 2):
  - Task 1: Pick the best-performing WP1 variant and retrain it alongside the specialist baseline on progressively smaller labelled-slide fractions to quantify annotation efficiency.

- **WP3** — Cross-cohort evaluation to quantify domain generalization (Week 2):
  - Task 1: Evaluate all models zero-shot on the in-house cohort.

TRAIL
TRUSTED AI LABS

04

Expertise Sought

- **Required:**
  - Solid Python and PyTorch experience.
  - Deep-learning fundamentals: CNNs, encoder–decoder architectures, embeddings/ViT tokens, and a conceptual grasp of semantic segmentation.
  - Comfort reading ML papers and picking up new libraries quickly.

TRAIL
TRUSTED AI LABS

04

Expertise Sought

- **Required:**
  - Solid Python and PyTorch experience.
  - Deep-learning fundamentals: CNNs, encoder–decoder architectures, embeddings/ViT tokens, and a conceptual grasp of semantic segmentation.
  - Comfort reading ML papers and picking up new libraries quickly.

- **What you'll get to explore:**
  - Transformer-based visual segmentation and graph neural networks.
  - Digital pathology basics: whole-slide image handling with OpenSlide/Lazyslide/AnnData.
  - Model benchmarking and evaluation.

TRAIL
TRUSTED AI LABS

Unil.

civis

TRAIL

TRUSTED AI LABS

THANK YOU FOR YOUR ATTENTION !

WWW.TRAIL.AC

CONTACT@TRAIL.AC

ULB Université Libre de Bruxelles · UMONS University of Mons · UCLouvain · Liège université · Université de Namur · LIEU Liaison Entreprises-Universités · Multitel Innovation Centre · cetic · Cenaero · sirris · S3 · AI4Belgium · digital wallonia .be

Cofinancé par l'Union européenne