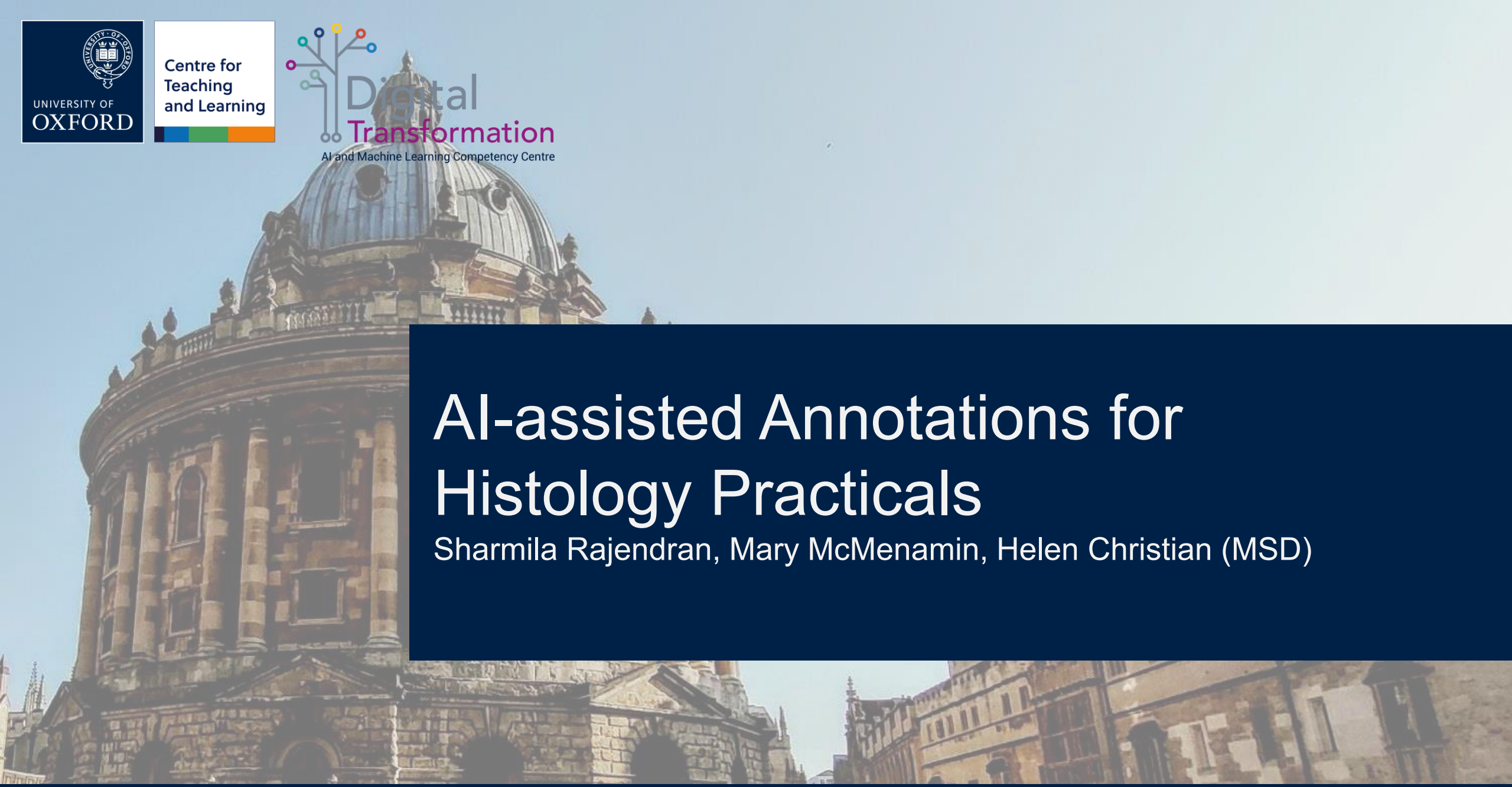


AI-assisted Annotations for Histology Practicals

Sharmila Rajendran, Mary McMenamin, Helen Christian (MSD)

AI- ASSISTED ANNOATIONS FOR HISTOLOGY PRACTICALS

Sharmila Saran Rajendran, Helen Christian, Mary McMenamin, Damion Young, Rumyana Smilevska, Jon Mason

Context & Importance

- Studying cells and tissues – core part of Year 1 pre-clinical medicine & biomedical science
- Understanding microscopic tissue structures is key to learning cellular structure/function

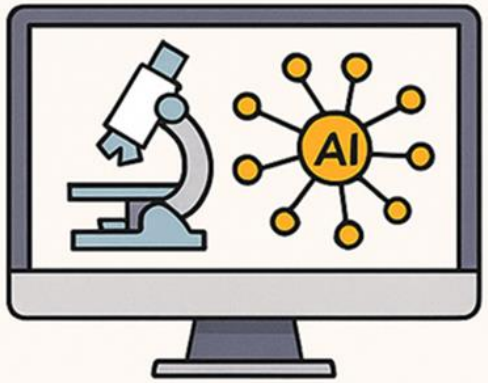
Current Tools: CSlide

- A digital platform developed by Medical Sciences Division's Learning Technologies team
- Provides remote access to scanned histological slides
- Enables students to pan, zoom, & manually annotate regions of interest
- Supports distance learning, revision & independent study

Challenges identified

- Difficult to locate labelled areas on large, high-resolution slides
- Manual annotation is time-consuming and heavily reliant on expert input
- Limits scalability and flexibility in creating annotated resources

Objectives



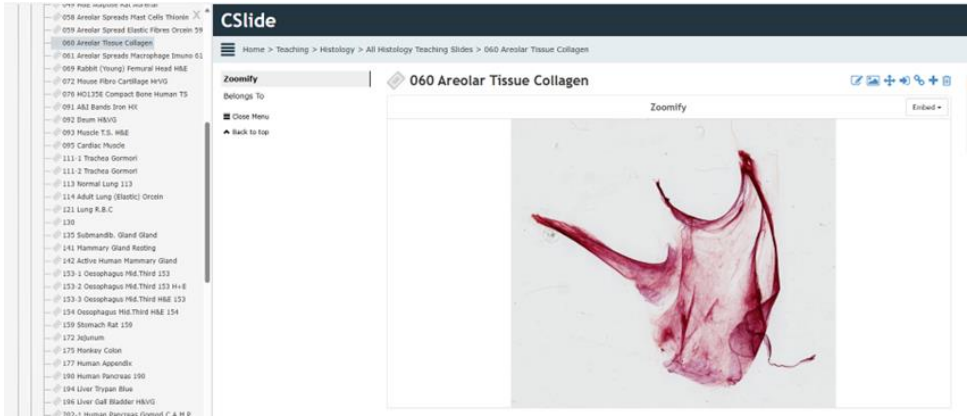
- Enhance histology teaching & learning for Year 1 medical and biomedical science students
- Leverage artificial intelligence to support the exploration & annotation of digital histological slides

Automate key processes:

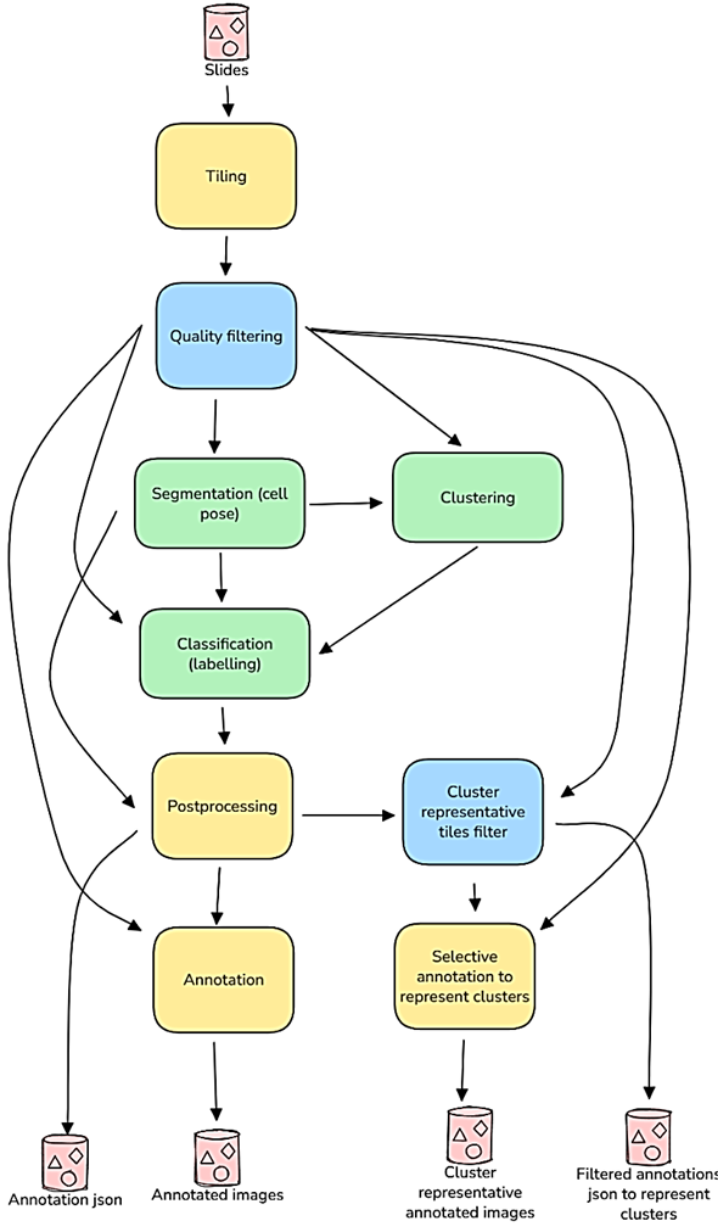
- Cell identification
- Segmentation
- Clustering
- Labelling
- Develop sustainable, scalable tool adaptable to different tissue types & educational contexts.

Data sources & Methodologies

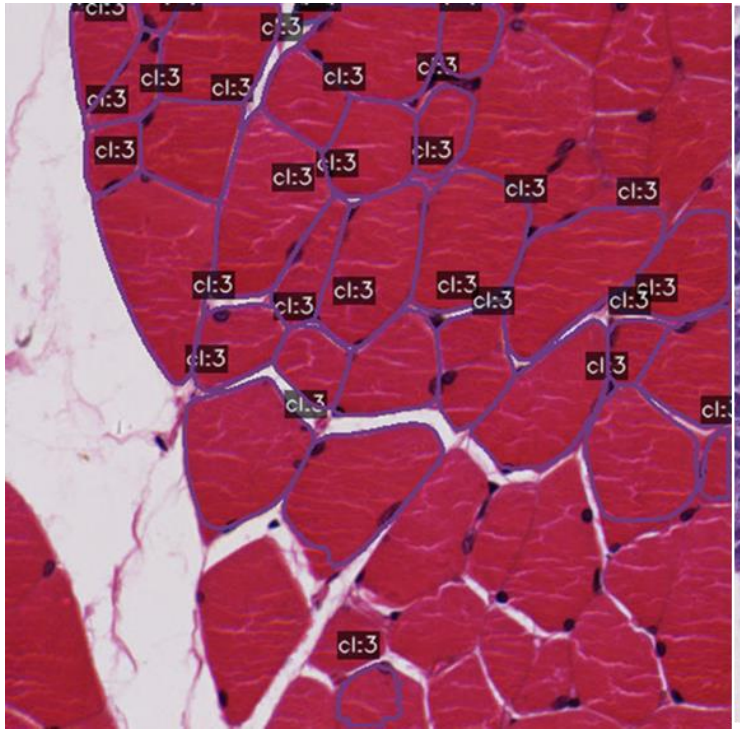
Data set source - Existing digital histology slide collection accessible through CSlide platform, is key focus for annotation work.



Manually annotated digital slides – A limited set of these already available served as a benchmark for qualitatively evaluating performance of AI model.

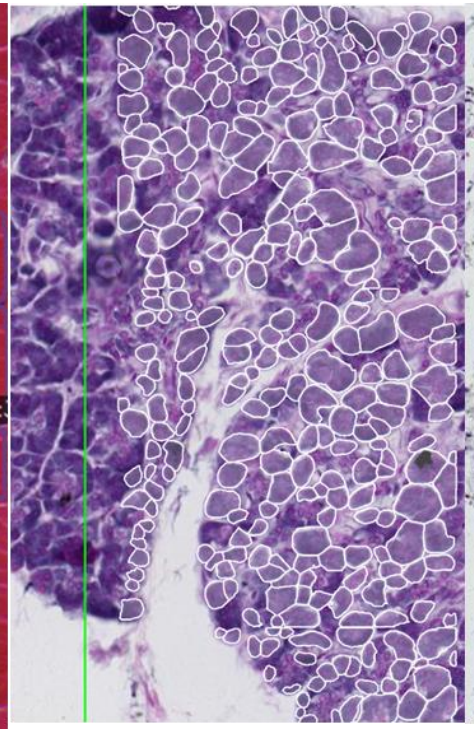


Examples of models use for segmentation



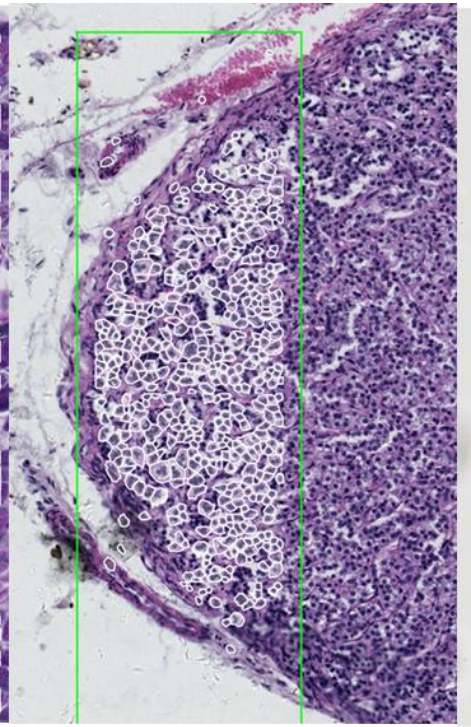
Skeletal muscle - excellent

AI segmentation model successfully delineated individual muscle fibres and each segmented fibre is assigned a cluster ID [cl:3], indicating that the model has grouped these muscle fibres into a single morphological or cluster.



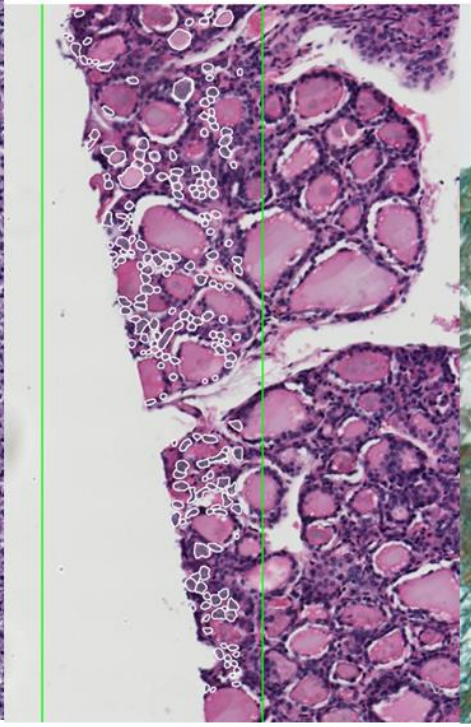
Pancreas - good

Shows fine, smooth segmentation outlines around nearly all visible cluster of cells.
Acinar cells, which are densely packed, sometimes irregular in shape, are clearly distinguished, demonstrating strong model generalization.



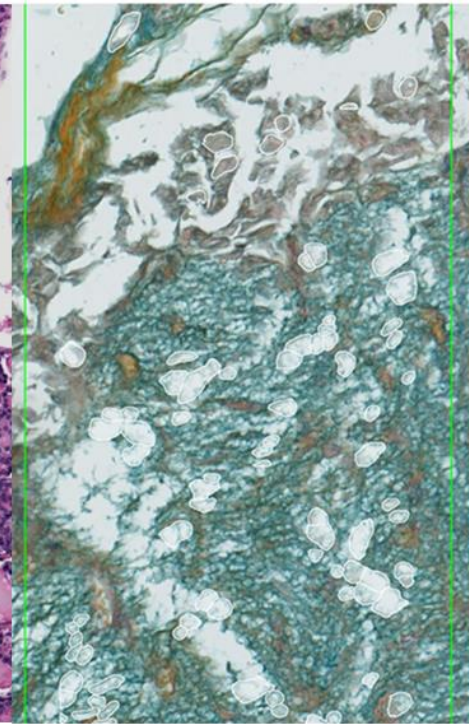
Adrenal gland - good

Segmentation model effectively identified cell boundaries in regions where cells are larger, more isolated, & well-spaced—typical of glomerulosa & fasciculata. These segmented cells are uniform in size & distribution, consistent with adrenal cortical cells, which tend to have clear borders & rounded nuclei



Thyroid gland - fair

A thyroid gland image showed partial success, primarily detecting individual cuboidal follicular epithelial nuclei around colloid-fllled follicles.
In regions with flattened or low cuboidal cells some were missed where contrast is minimal.



Pituitary gland - poor

Polygon outlines generated around areas that appear empty or sparsely structured; no obvious cellular structures detected by the model in a region known to be rich in nerve fibers and supporting (glial) cells –posterior pituitary gland

How Trained AI Model Will be Used in CSlide V2

For Staff – Simplified Slide Labelling

- ✔ **Label all items** in cluster collectively
- ✔ **Edit, delete**, or refine polygons as needed
- ✔ **Add new labels** or regions manually

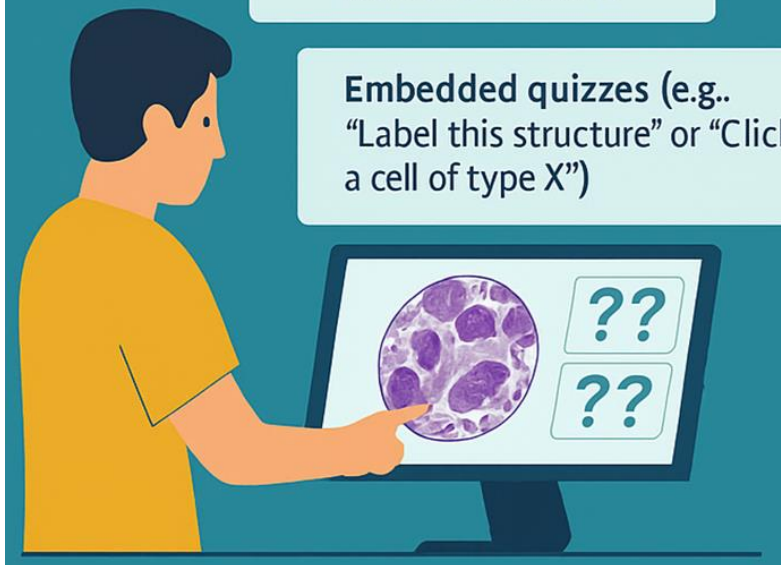
Reduces annotation time while maintaining expert control and ensuring high-quality teaching resources.

Further development will focus on improving the current AI pipcline by:

- Enhancing detection and grouling of similar cells/structures
- Testing model selection for various tissue types
- Exploring integration of the AI pipeline into CSlidide V2 to support large-scale slide processing
- Managing compute and cost challenges

For Students: Interactive Learning Tools

- ✔ **Slides** with AI-assisted labelled structures
- **Embedded quizzes** (e.g.. "Label this structure" or "Click on a cell of type X")



Future enhancements may include:

- Arrows and interactive lists to guide user through slide content
- Self-assessment toois such as "Click on a cell of type X" or "Identify this highlighted cell," using AI-generated polygons and expert labelling to support active leaming