INTERACTIVE H&E CLASSIFIER

Existing AI solution: The Interactive H&E Classifier (Final Year Group Project)
The Interactive H&E Classifier is a Python Shiny application developed to assist pathologists in identifying breast cancer cells from H&E-stained tissue images.
Trained on ~140,000 CLAHE-preprocessed breast cell images using data augmentation and mixed sampling to produce objective, real-time predictions across two CNN pipelines:

- **Double Layer CNN** first performs binary classification [*91% accuracy]* (tumour vs. immune), then if tumour, subtype classification among 4 tumour categories [*66% accuracy]*. → *Overall validation accuracy: 71%*
- **Multiclass CNN** directly classifies 5 cell subtypes/type (4 tumour subtypes + 1 immune type [most predictions >80%]) → *Overall validation accuracy: 77%*

Delivered through a shiny app interface, on top of receiving predictions, pathologists can contribute feedback. The app supports session logging, allowing users to save and resume analyses later, creating a feedback loop for continuous use and potential model refinement.

Limitation: In high-risk contexts where false negatives can result in delayed treatment, which can be life-threatening, human-in-the-loop is essential. To truly assist rather than replace pathologists, it must go beyond increasing accuracy and user interaction. It must allow pathologists to understand why a prediction was made. Transparency is critical for ensuring safe collaboration between AI and humans.

Proposed idea: Grad-CAM (add-on to an existing AI solution)
Integrating Grad-CAM to pop up with predictions extends the app from a black-box predictor to a collaborative assistant. Grad-CAM allows pathologists to 'see how the models think' (which regions of the image have the greatest influence on the model's prediction), enabling them to assess whether the model's focus aligns with biologically meaningful features. eg:

- If Grad-CAM highlights fall on non-biological regions, predictions can be rejected.
- If heatmaps align with diagnostically relevant cell structures, predictions gain credibility.

This allows pathologists to apply their expertise in tandem with AI insights and to know exactly when to trust or question the model.

Commercial Value: Accessibility and Safety

- Scales easily across digital pathology platforms and low-resource settings as a lightweight, browser tool
- Safe AI-assisted diagnostics with grad-CAM transparency enabling human-in-the-loop workflows

Technologies & Methods
ORIGINAL.py: Trains Binary and Multiclass CNNs using TensorFlow/Keras; CLAHE & data augmentation & mixed sampling image preprocessing.
Gradcam.py: **+ implement Grad-CAM using Keras Functional API (multiclass rebuilt from Sequential wrapper); OpenCV used for heatmap overlays**
Python Shiny app: image upload, feedback logging & resume, **+ dynamic Grad-CAM selection**
LLM Support: Grad-CAM integration required additional model rebuilding and compatibility checks across different architectures, which I streamlined with assistance from ChatGPT