Developing AI approaches to unravel factors that drive disease relapse in low-risk, early-stage colorectal cancer

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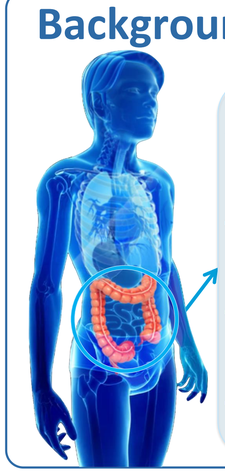
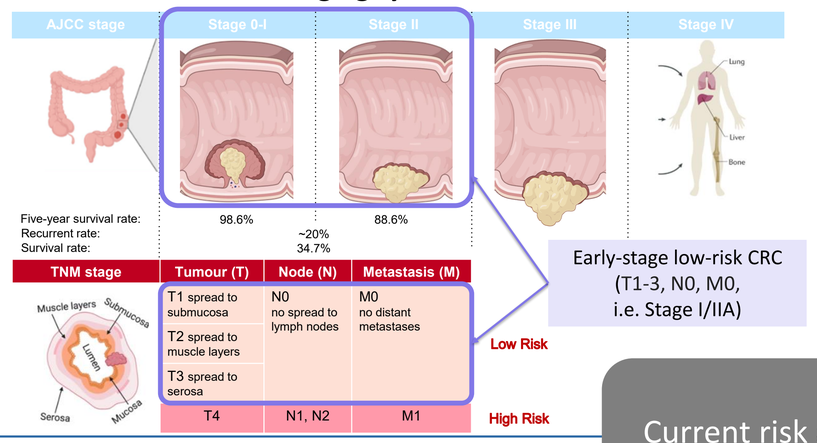
Background:



- 3rd — Common cancer worldwide
- 2nd — Deadliest cancer in Australia
- 1.5k — New cases in 2023
- 40% — Diagnosed in the early stages

Current clinical staging system for colorectal cancer



Early-stage low-risk CRC (T1-3, N0, M0, i.e. Stage I/IIA)

Current surveillance of early-stage low-risk CRC patients is inadequate

Post-surgery management

Risk Assessment						Treatment	
Physical examination	CEA testing	CT scan	ctDNA	Oncotype DX Colon Cancer Assay	Immunoscore	Chemotherapy	Radiotherapy
American Society of Clinical Oncology Resource-Stratified Guideline			Limited sensitivity	Need further investigation and validation	Moderate accuracy	For patients at high-risk	Specific to rectal cancer

Research gap:
Current risk assessments are insufficient to provide an adequate treatment plan. This is partly due to our limited knowledge of underlaying mechanisms and the associated biomarkers that contribute to disease recurrence.

Hypothesis and Objective:

Hypothesis: Tumour tissues with **biomarker signatures** that drive recurrence predispose some patients to **disease relapse**.

Objective: To develop a **multi-modal data-driven AI** approach for CRC **prognostic prediction** and identification of **biomarkers** associated with CRC relapse.

Aims:

Aim 1

Develop a custom model for automated detection of tumour type based on whole slide images (WSIs).

Aim 2

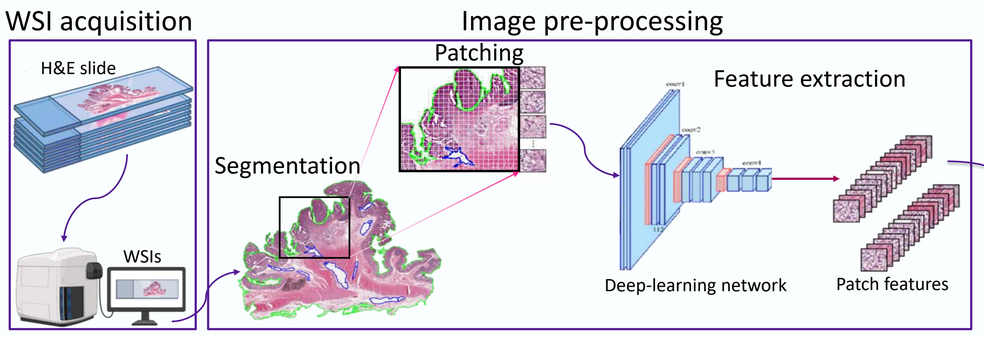
Develop custom models for predicting overall survival and the time to relapse of CRC patients.

Aim 3

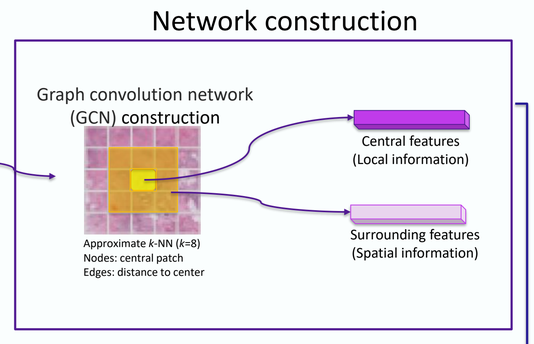
Integrate generated models to identify pathological biomarkers associated with disease recurrence.

Methods:

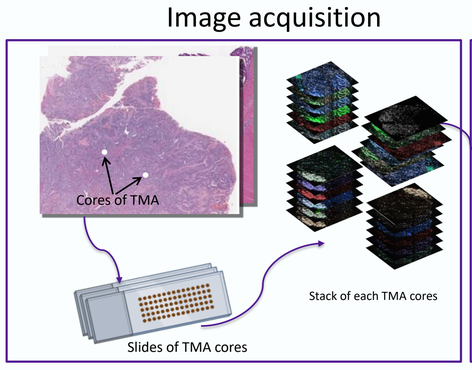
Pipeline for whole slide image pre-processing



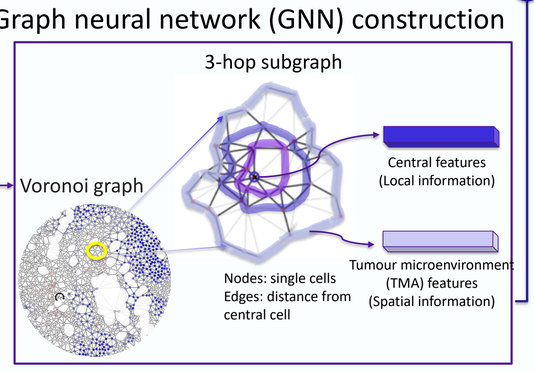
Model developing for WSIs



Pipeline of multiplex immunofluorescence images

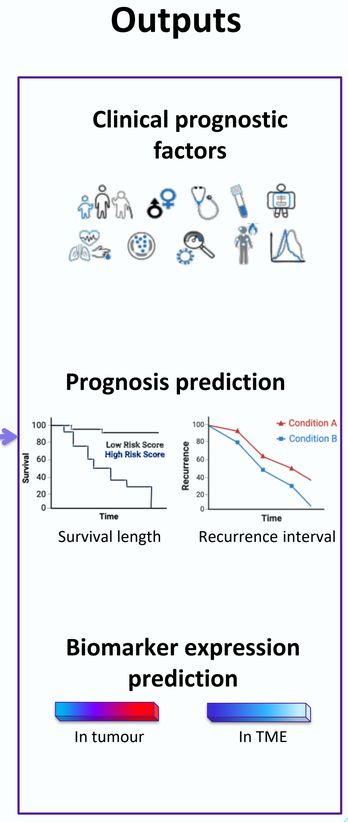


Model developing for mIFs



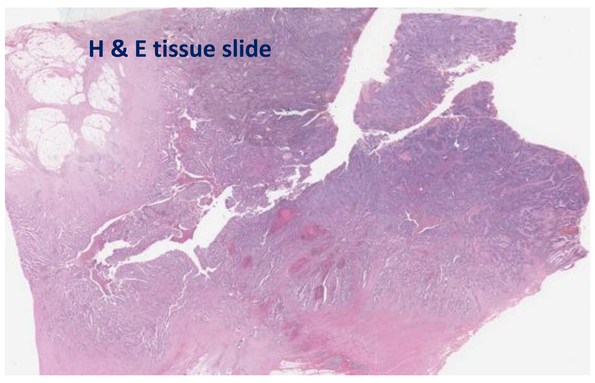
Deep-learning Model training

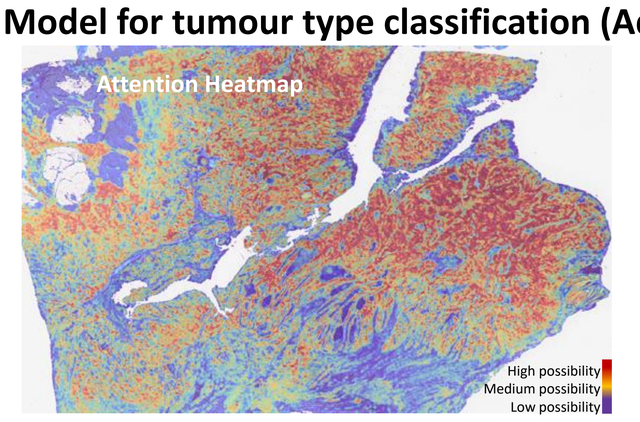
Outputs

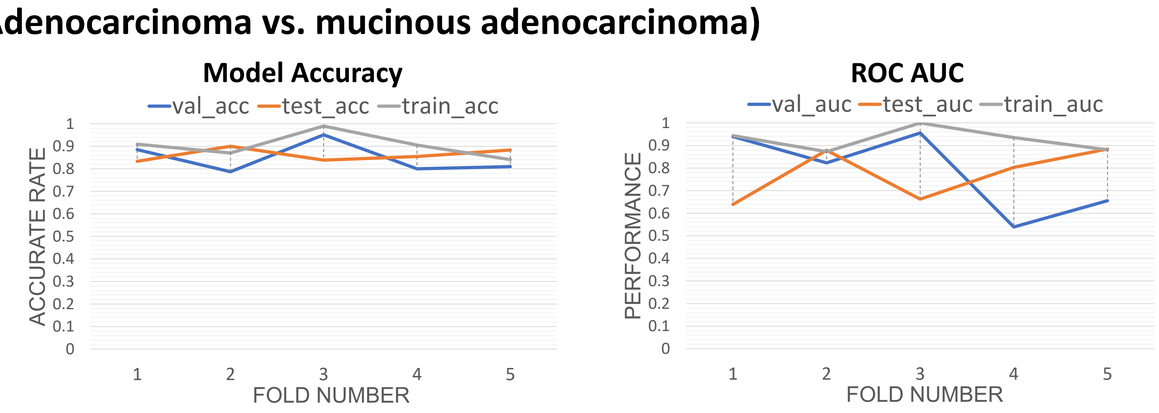


Results:

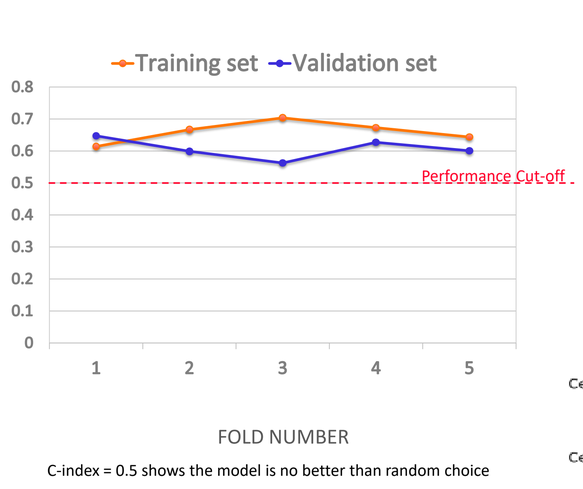
☑ Performance of Model for tumour type classification (Adenocarcinoma vs. mucinous adenocarcinoma)

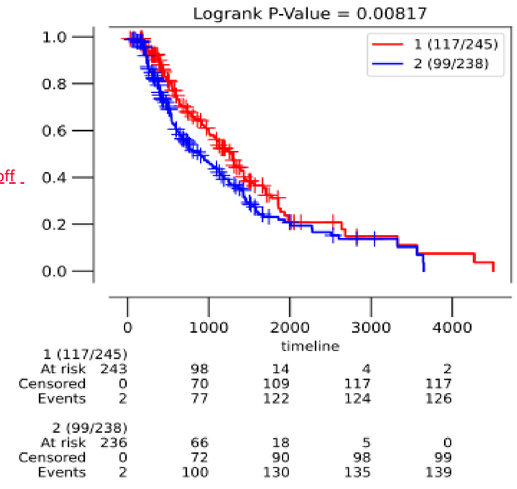




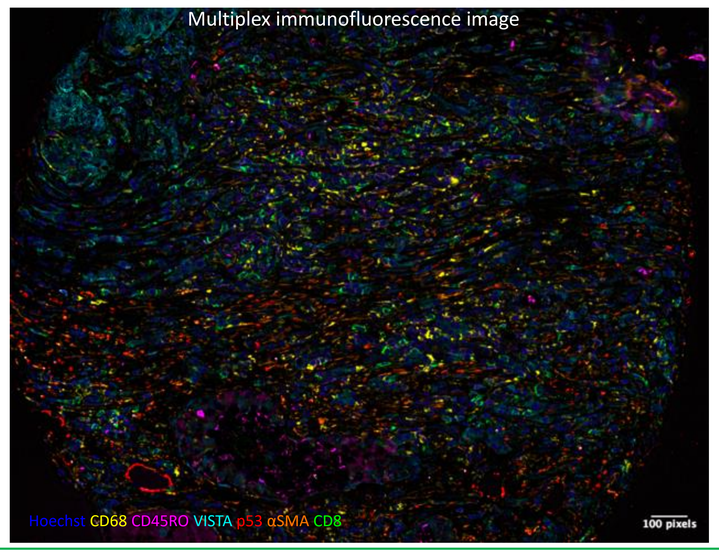


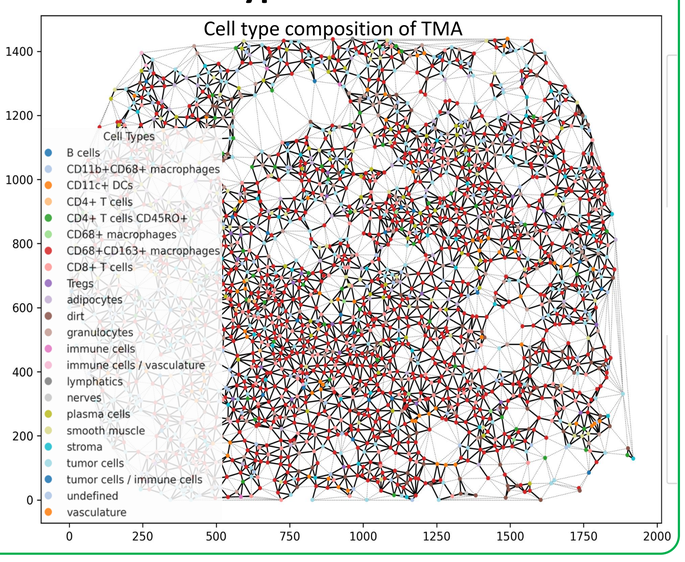
☑ Performance of Survival Model for overall survival





☑ Progress of developing prognostic Model – cell type identification





Conclusion and Future Directions:

- We developed a deep-learning network to classify CRC tumour type, as well as a deep-learning network to predict the overall survival of CRC patients using whole slide hematoxylin and eosin (H&E) images. The Graph neural network model for prognostic prediction using multiplex immunofluorescence images has made progress in identifying cell types.
- Future integration of these models will allow for the analysis of the saliencies of prediction outcomes, as well as the detection of biomarkers associated with the underlying

Contact

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