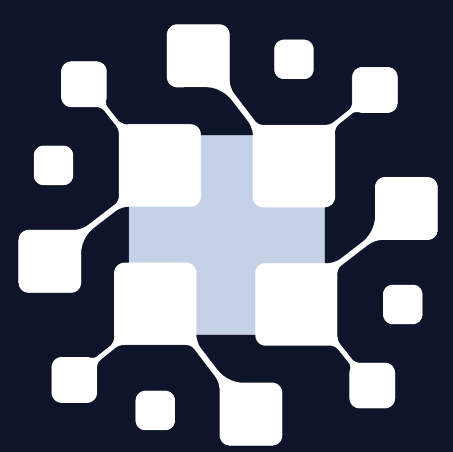




AI-Powered Virtual Tissues from Spatial Proteomics for Clinical Diagnostics and Biomedical Discovery

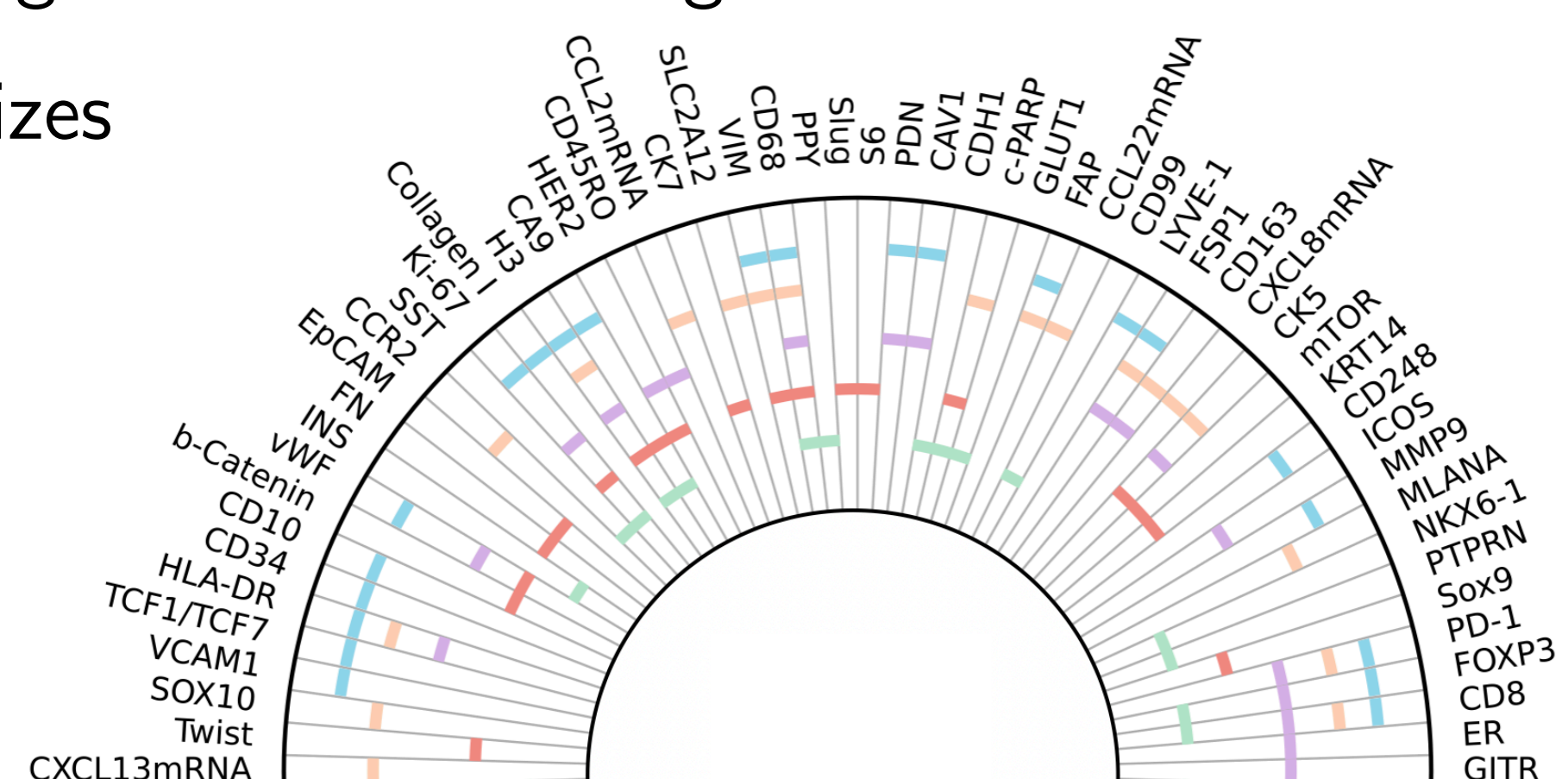
Johann Wenckstern*, Eeshaan Jain*, Kiril Vasilev, Matteo Pariset, Andreas Wicki, Gabriele Gut, Charlotte Bunne

EPFL

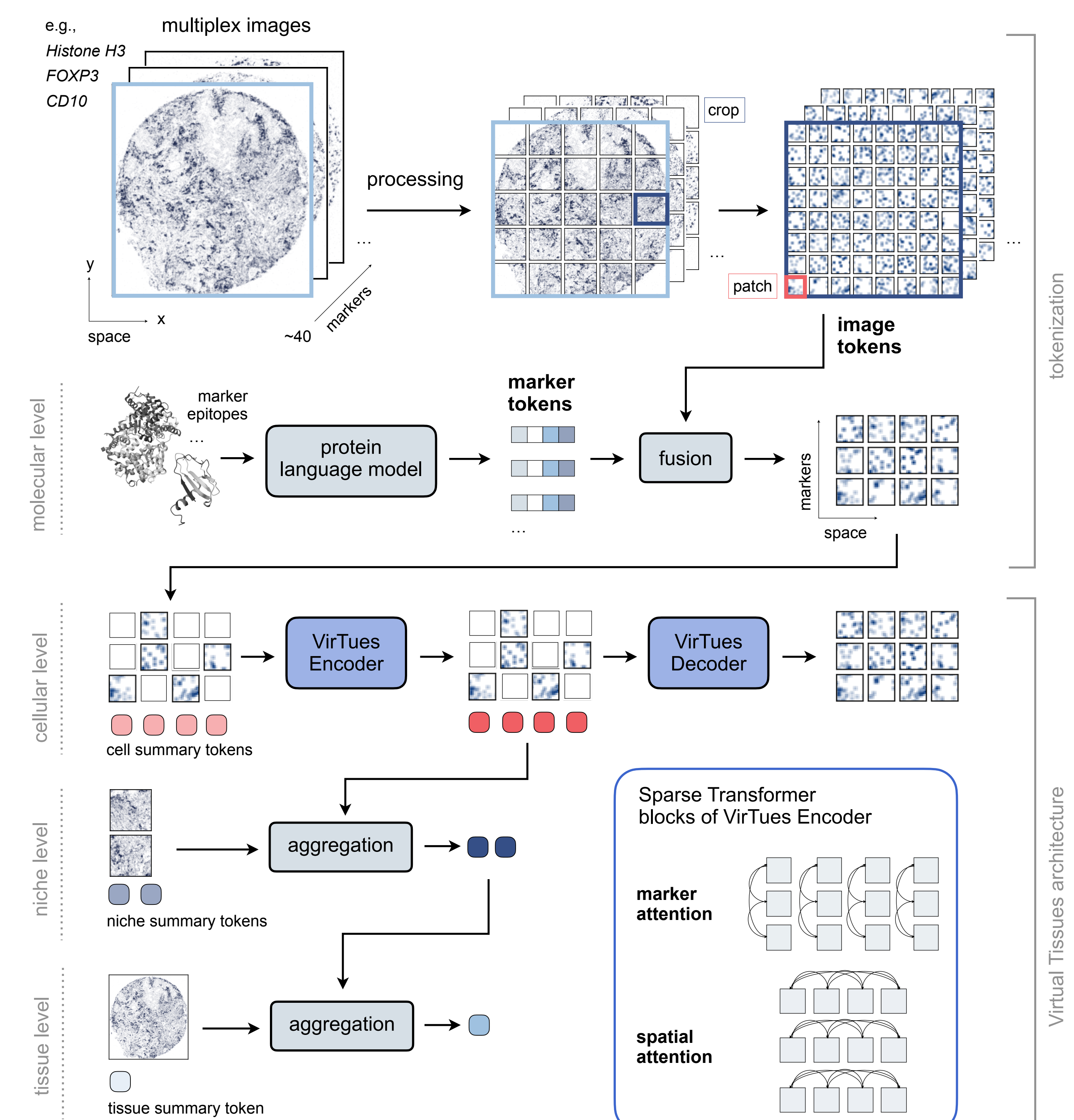
Tissues, particularly in cancer, **display pronounced heterogeneity** across patients, disease stages and even within individual tumors — evident in diverse cell phenotypes, states and spatial organization. **Accounting for this heterogeneity is critical**: tumor development and response to therapy depend not just on cancer cells, but on their complex interactions with their surrounding tumor microenvironment (TME). The **emergence of multiplexed imaging technologies** — such as imaging mass cytometry (IMC), co-detection by indexing (CODEX), and multiplex immunohistochemistry (IHC) — **has enhanced our ability to study the TME** by enabling *in situ* detection of multiple markers on a single slide.

Challenges

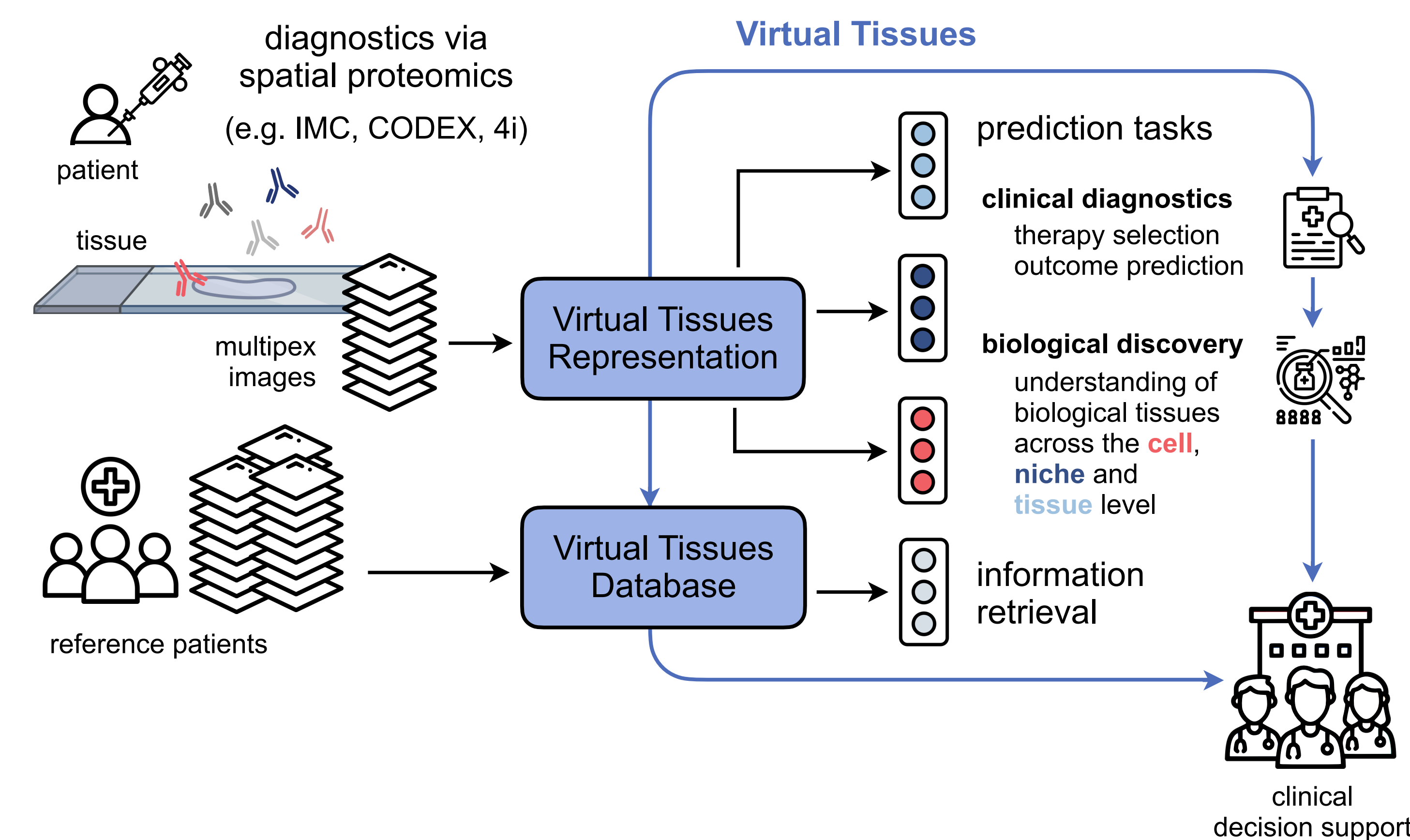
- ... dozens of markers measured per sample and spatial resolution results in high-dimensional images
- ... small clinical cohort sizes
- ... number and combination of measured markers vary across studies



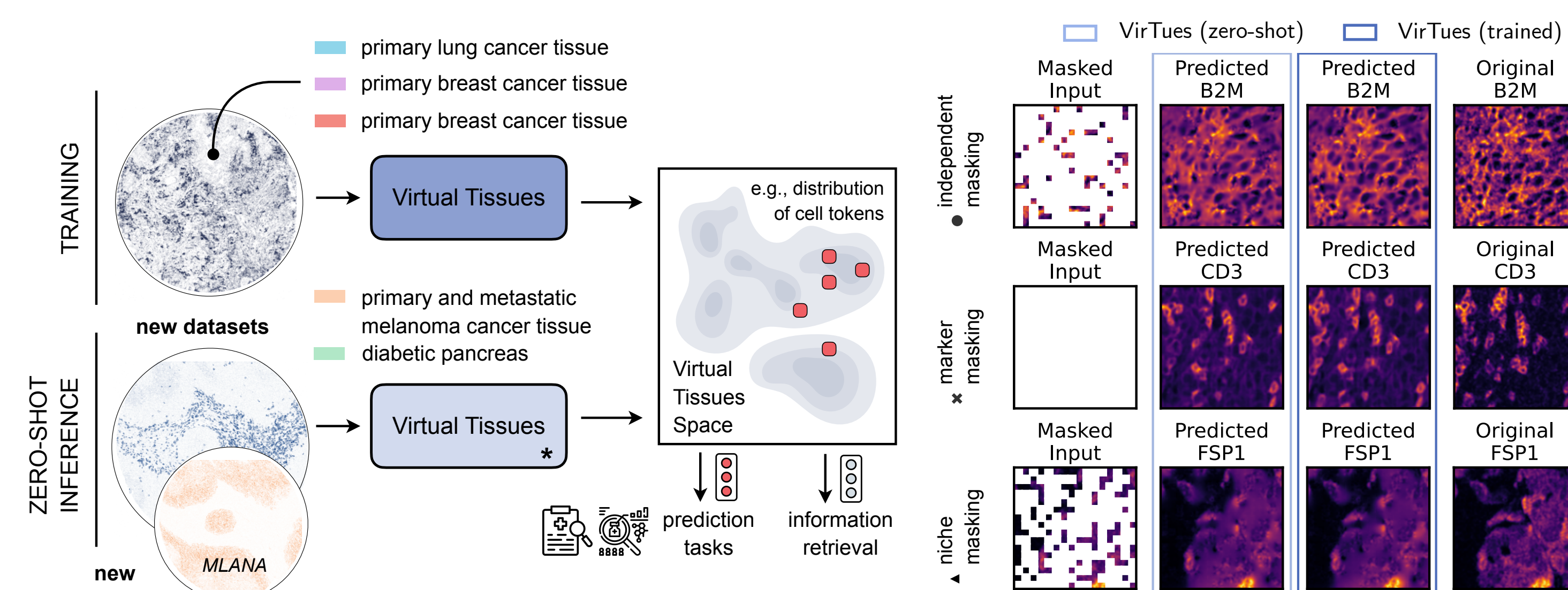
A Multi-Scale Multi-Modal Vision Transformer Architecture for Multiplexed Images



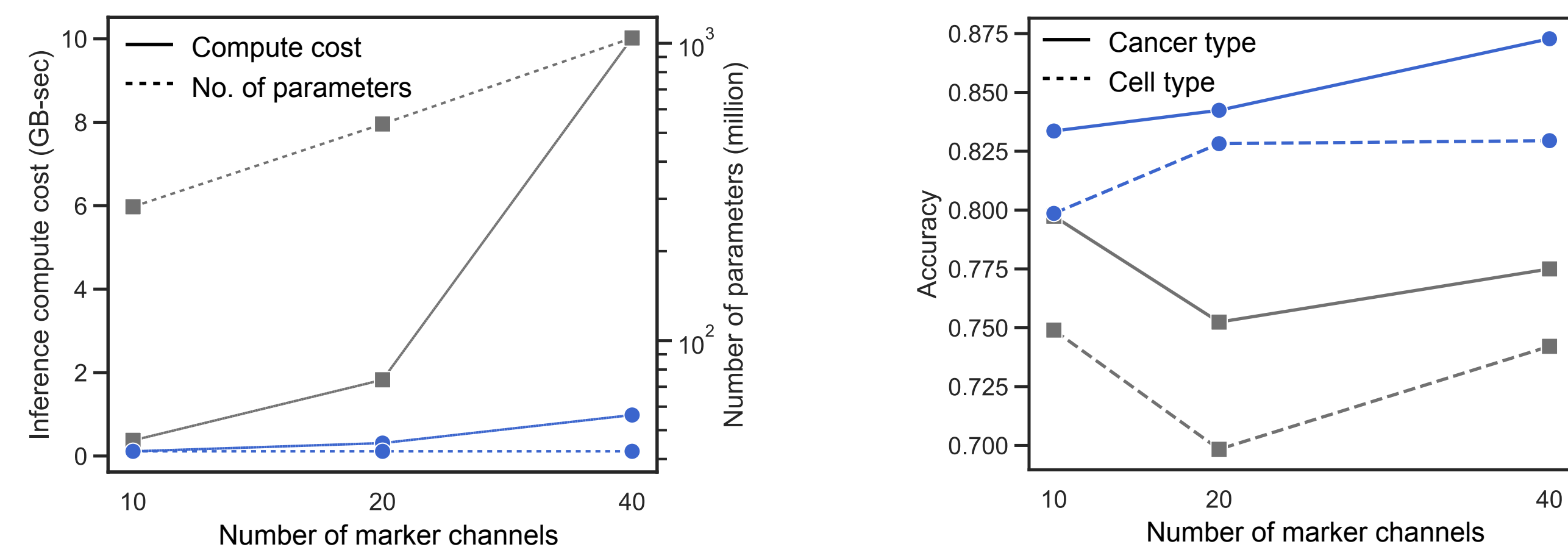
Virtual Tissues (VirTues) Platform



Tokenization allows zero-shot inference on new datasets and markers



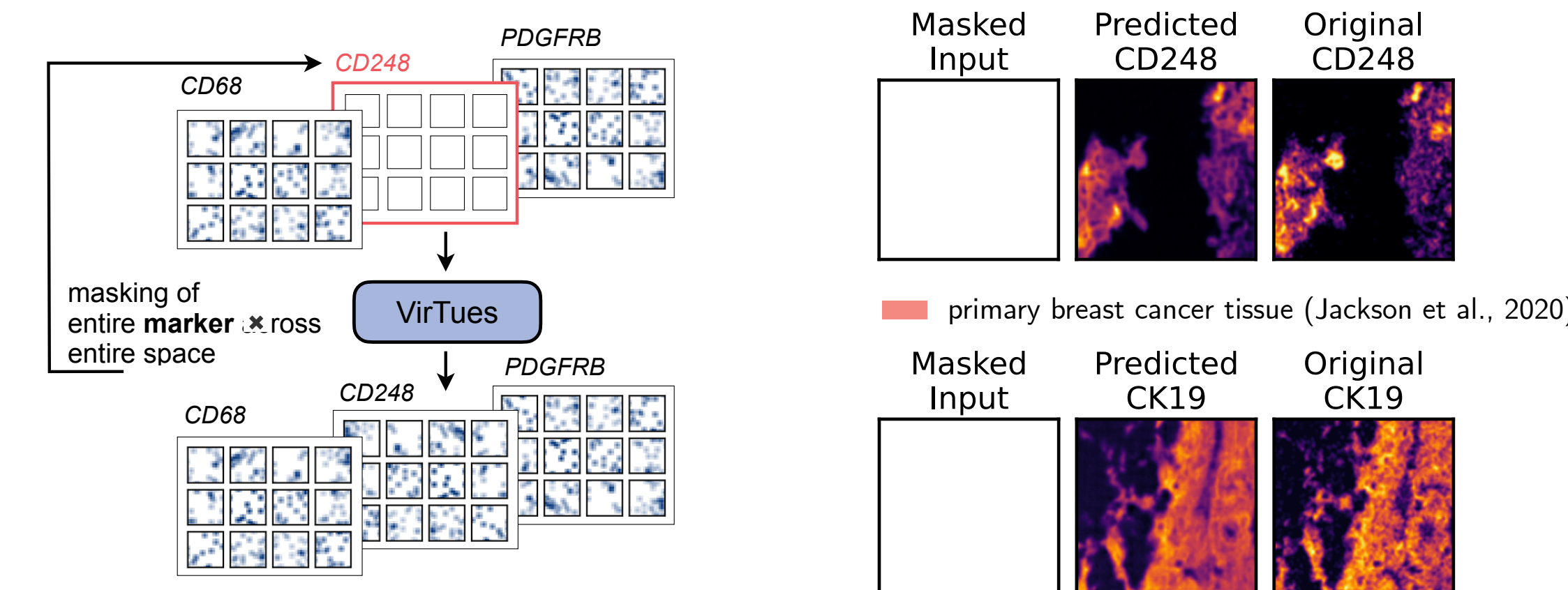
Sparse attention disentangling marker and spatial effects enables efficient processing of highly multiplexed images...



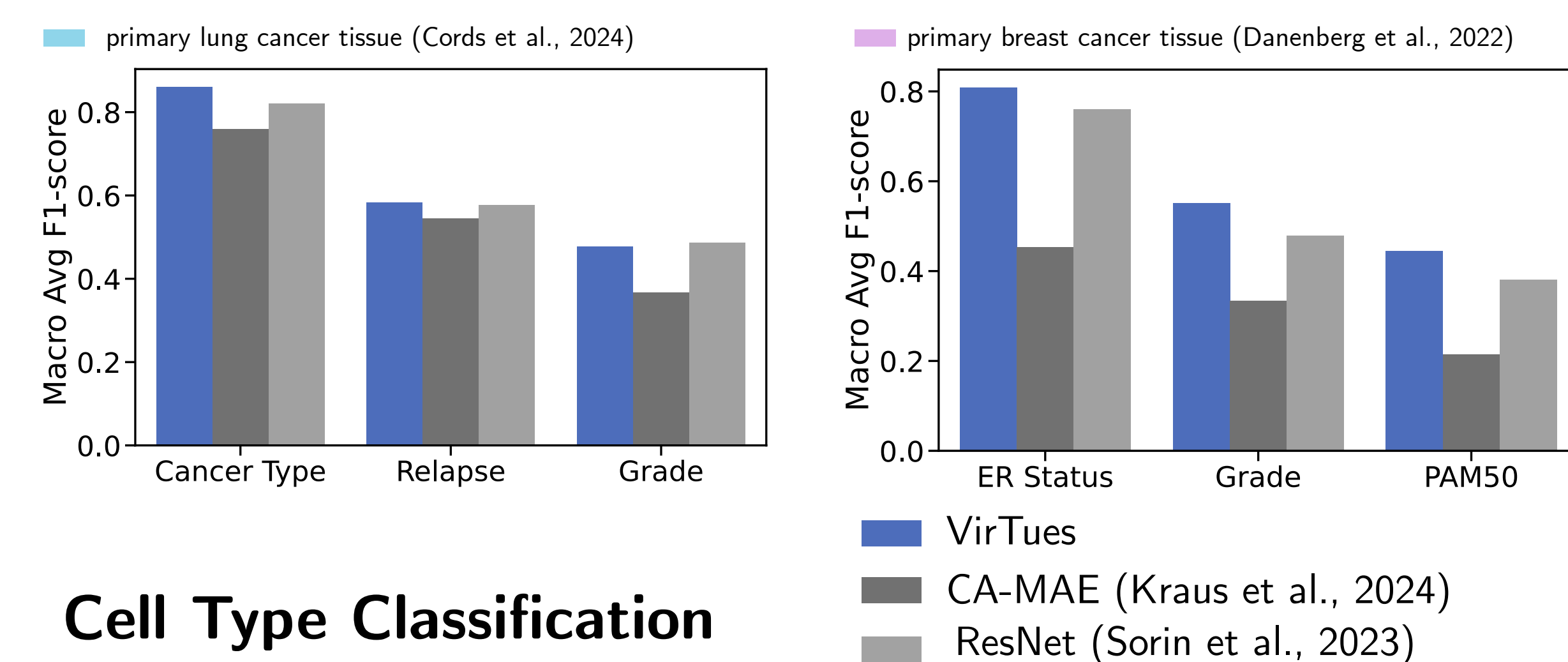
... leading to improved downstream performance.

Evaluation

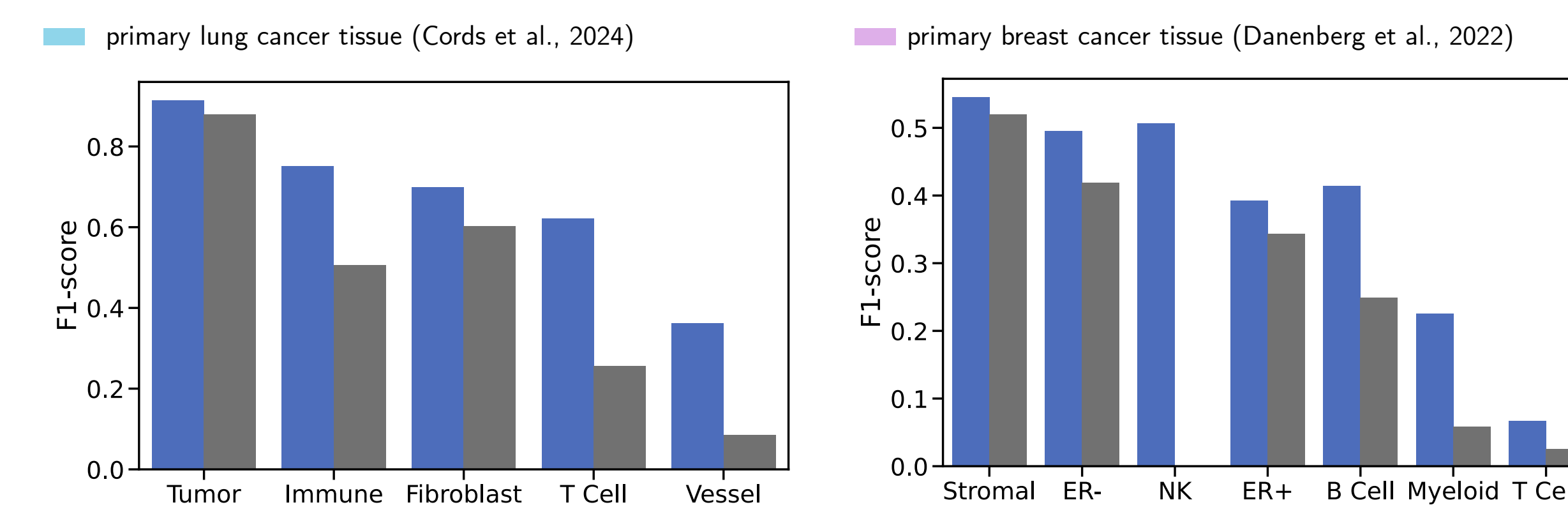
Channel Inpainting



Prediction of Clinical Patient Features



Cell Type Classification



Information Retrieval

