ARIA
APPLIED RESEARCH IN ACTION

Analysis of Single Cells in Pediatric Brain Tumours with Transfer Learning and a Pre-trained Transformer Model

Transfer learning and a context-aware, attention-based, deep learning transformer model is applied to analyze individual cells from pediatric brain tumours, simulating gene overexpression and deletion to investigate contributors to metastasis

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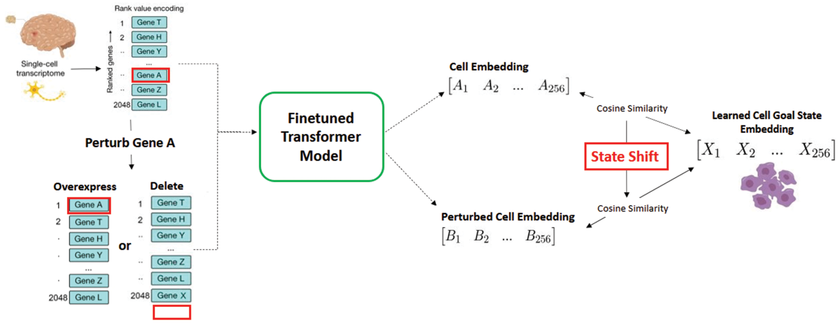

PROJECT SUMMARY

Recent developments in biomedical data analyses have seen the rise of both transformer models and transfer learning. Transformers excel at capturing complex data patterns and have had extensive success in analyzing diverse datasets such as medical images, health records, and protein structures, while transfer learning addresses data-scarce situations by making use of knowledge gained from one task to improve performance on another. Pediatric brain tumour analysis is one such case where both data availability as well as data complexity poses a challenge and serves as the focus of this study. Here, transfer learning is utilized alongside a transformer-based model to analyze single cells from tumours to identify genes that may contribute to cell characteristics such as metastasis. A context-aware, attention-based deep learning transformer model pretrained on a corpus of 30 million single-cell transcriptomes was finetuned on single-cell RNA-sequencing data from Group 3 and 4 medulloblastoma pediatric cases. The unique ranked-genes representation of individual cells, closely paralleling word representation within sentences by large language models (LLMs), enables simulation of the deletion or overexpression of genes. Perturbing the medulloblastoma cells highlighted genes currently understood to be drivers of metastasis as well as genes that are less studied prompting further investigation. This study demonstrates the ability to leverage new computational techniques in conjunction with additional datasets to improve the diagnosis and analysis of rare and challenging brain tumour cases.

REFERENCES

[1] Theodoris, C.V., Xiao, L., Chopra, A. et al. Transfer learning enables predictions in network biology. Nature 618, 616–624 (2023). https://doi.org/10.1038/s41586-023-06139-9

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