**PatStrat: AI-Driven Patient Stratification Framework for Predicting and Monitoring Treatment Response – A Use Case with Multi-Modal Multiple Myeloma Dataset**

Cancers such as multiple myeloma are complex and heterogeneous diseases, and patients respond differently to various drug treatments. The challenge lies in identifying effective treatment strategies tailored to individual patients. Traditional approaches often lack precision and fail to account for the diverse molecular and clinical characteristics of patients.

To address this challenge, we have developed PatStrat, an innovative multimodal network embedding framework that leverages state-of-the-art graph representation learning methods. This framework seamlessly integrates biological a priori knowledge to capture intricate relationships among patients. By combining data from diverse sources—pharmacometrics, genomics, transcriptomics, proteomics, cytokines, and clinical records—PatStrat reveals biologically significant latent patterns that facilitate patient stratification and predict drug responses.

Testing PatStrat with hematological data from myeloma patients have shown promising outcomes: (1) Improved patient stratification: Our AI-based approach outperforms traditional methods in predicting drug responses; (2) Identification of novel biomarkers: PatStrat could discover previously unrecognized biomarkers associated with treatment outcomes. (3) Integration of signaling pathways: development of disease-specific pharmacodynamic biomarkers.

In conclusion, our research contributes to personalized medicine technologies by providing clinicians with precise guidance on selecting optimal treatments for improving patient outcomes. As we continue to refine our models and validate them in clinical settings, we envision a future where patients receive tailored therapies based on their unique characteristics.