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Abstract Title:- A Comparative Study of deep learning and Machine learning models for Predicting Cancer-Associated T Cell Receptors

Presenting author name :- Rushika Patel

Presenting author institute:- Varahi IO; SNGene Lab Pvt. Ltd.

Co-author name:- Kunal Patel

Co-author institute:-Varahi IO

Aims:-The purpose of this work was to assess the performance of two artificial intelligence tools, DeepCAT and ImmuneML, in predicting cancer-associated T cell receptors (TCRs) using TCR sequences. DeepCAT is a deep learning approach created expressly for this purpose, whereas ImmuneML is an open-source software ecosystem for studying adaptive immune receptor repertoires.

Methods:- DeepCAT and ImmuneML were thoroughly tested on a varied variety of TCR datasets, available from immuneACCESS and rearrangement-CDR3 was obtained from immunoSEQ ANALYZER. DeepCAT uses a multiple keras layers and CNN model with PCA encoding, whereas immuneML takes a modular architecture with several machine learning algorithms written in python include decision trees, support vector machines, random forests, k-nearest neighbors. ImmuneML allowing customizable workflows for machine learning model training, exploration of data. DeepCAT was used to predict cancer-specific TCRs scores, while ImmuneML was used for comparable predictions with accuracy.

Results:- DeepCAT revealed significant prediction accuracy for cancer-associated TCRs, with an AUC of 0.92 for early-stage breast tumors. ImmuneML, on the other hand, supports many ML approaches and encodings, allowing for study repeatability and transparency. Further post-analysis of immuneML is under progress.

Conclusions:- DeepCAT and ImmuneML were shown to be excellent tools for TCR analysis, each with their own set of advantages. DeepCAT excelled in prediction accuracy, notably for cancer diagnosis. ImmuneML offers a modular and scalable environment for comprehensive AIRR research, allowing for flexibility in a variety of investigations such as replication of existing studies, expansion with novel ML algorithms, and benchmarking with synthetic datasets. The study contrasts DeepCAT's specific effectiveness in cancer diagnosis with immuneML's broader flexibility and adaptability for immune receptor research.

Keywords:- T cell receptor, Adaptive immune receptor repertoires, DeepCAT, immuneML