# Physics Colloquium

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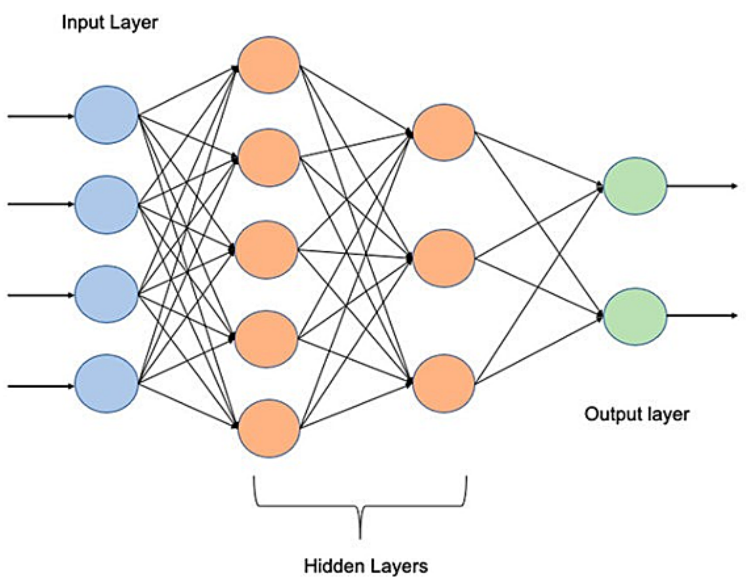
## Classifying Di-Higgs Production Modes with Deep Learning Algorithms


### ABSTRACT

The Standard Model (SM) of particle physics is a well-tested theory, successfully describing all known particles and their interactions due to three of the four fundamental forces. Arguably the greatest success is the prediction of the Higgs boson, which was experimentally discovered by the ATLAS and CMS experiments at CERN in 2012.

Di-Higgs production is a rare process predicted by the SM where two Higgs bosons are simultaneously created in a proton-proton collision event. The classification of gluon-gluon fusion (ggF) and vector boson fusion (VBF) di-Higgs production modes enables precise measurements of the Higgs self-coupling as well as its coupling strength to the weak vector bosons. Successful separation ability of these processes is essential for refining the shape of the Higgs potential, bettering our understanding of electroweak symmetry break, and probing for physics beyond the SM.

This study investigates the performance of Deep Neural Networks (DNN) and Deep Learning (DL) algorithms to classify these production modes in two di-Higgs decay channels. A comparison is made with the widely used Boosted Decision Tree (BDT) method and the more advanced Graph Neural Network (GNN) algorithm. A thorough training procedure was conducted to optimize the DNN and DL models and their performance was evaluated using receiver operating characteristic curves as the main metric. Results indicate that the DNN and DL methods offer improved separation of ggF and VBF events compared to the BDT; however, the GNN model demonstrated the highest classification accuracy.


3:00-4:00 p.m., Friday, April 25th, 2025

In-person in McLane Hall 162