Project Proposal
ATLAS Trigger - Discovering new physics

a. Both students' IDs, names, and mail addresses:

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b. **What paper/papers did you choose:**
We chose to participate in the ATLAS group effort led in TAU by Liron Barak and Erez Etzion. The group is working on improving the trigger system, allowing events vs. background separation. Our project will focus on the work done by Hadar Cohen in his PhD paper –
t Trigger Using Deep Learning

c. What is the problem that you will be investigating? Why is it interesting?
Proposing a new method of predicting the tau-tau decay event vs. jet event using deep learning techniques on a raw calorimeter data. Predicting correctly the event would allow us to implement on-line algorithms in the trigger level and save only events that pass a trigger and delete all others. Next stage of ATLAS project will have higher collision rates, so efficient trigger mechanism is one of the main focuses in the current research.

d. **What data will you use?**
Simulation data of the tau and the jet (background) when passing the planned ATLAS detector. The data includes raw sensors' cell energy readings from multiple layered detectors. This data involves both spatial and multi-layered domains, creating a structure similar to multi-spectral images.

e. **What method/model will you use? Are there any existing implementations? If so, in which libraries are they written?**
We will continue an investigation of the multi-layered calorimeters representation as a multi-spectral image and propose an improved CNN architecture. The existing DL methods tested on the Run3 data are CNN and a Deep-Set implementation. Both were written using PyTorch.

f. How will you evaluate the results?
The proposed algorithm will be compared to the existing techniques, given that the results were calibrated to the same False Positive rate. The testing will be done on the simulated data from the ATLAS collision simulators.

g. What will be the innovation in your project?
Our project will propose an improved architecture for the CNN and will be focused on the next ATLAS experiment run, which will have much higher collision rates and different detectors resolution.
Taking into consideration the FPGA limitations we will optimize the architecture to allow faster prediction times and simpler deployment process. Given that most current libraries used to translate Python code to VHDL mostly work with TensorFlow implementations we will utilize the TF library instead of the existing PyTorch implementations.