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USING A MACHINE LEARNING BASED ALGORITHM TO IMPROVE THE SENSITIVITY OF THE HAWC GAMMA-RAY OBSERVATORY

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The High Altitude Water Cherenkov (HAWC) observatory is a detector sensitive to gamma-rays (photons) with energies between 100 GeV and 100 TeV. Both gamma and cosmic-rays stream through the universe from their origins outside our solar system, and eventually enter the Earth's atmosphere where they interact with the constituent air molecules. The result is a precipitation of charged particles known as an Extensive Air Shower (EAS). Sitting at an altitude of 4.1 km, HAWC detects thousands of EAS footprints per second. HAWC then uses characteristics of each footprint to reconstruct the properties of the original ray; these include species (gamma or cosmic), energy, angle of incidence, etc. The primary purpose of HAWC is to detect gamma-rays. Therefore, EAS generated by hadronic cosmic-rays are significant sources of background. Currently, HAWC analysis packages use subtle differences between computer simulated gamma and cosmic-ray shower footprints to identify gamma-rays in the real data. The particles constituent to a gamma-ray shower are a subset of those present in a cosmic-ray shower; in most cases it is challenging to determine the original species responsible for each shower. An efficient algorithm with the ability to separate gamma-ray generated showers from cosmic-ray generated showers could drastically improve the sensitivity of HAWC. My research has explored the potential of using Python in conjunction with SciKit Learn's AdaBoostClassifier and DecisionTreeClassifier to develop a more efficient tool for selecting gamma-rays.