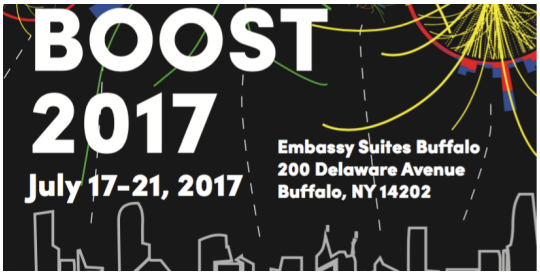

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How Much Information is in a Jet?

Machine learning techniques are increasingly being applied toward data analyses at the Large Hadron Collider, especially with applications for discrimination of jets with different originating particles. Previous studies of the power of machine learning to jet physics has typically employed image recognition, natural language processing, or other algorithms that have been extensively developed in computer science. While these studies have demonstrated impressive discrimination power, often exceeding that of widely-used observables, they have been formulated in a non-constructive manner and it is not clear what additional information the machines are learning. In this paper, we study machine learning for jet physics constructively, expressing all of the information in a jet onto sets of observables that completely and minimally span N-body phase space. For concreteness, we study the application of machine learning for discrimination of boosted, hadronic decays of Z bosons from jets initiated by QCD processes. Our results demonstrate that the information in a jet that is useful for discrimination power of QCD jets from Z bosons is saturated by only considering observables that are sensitive to 4-body (8 dimensional) phase space.

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