

Conventional detection and classification problems in communications networks commonly rely on either rule-based expert systems or machine learning models that are trained with collections of manually engineered features derived from network traffic. This paper presents a new direction, demonstrating that it is possible to solve these problems using a general representation of network traffic -- a bitfield-based encoding of the packet's headers -- as input. In this paper, we develop this representation and demonstrate its utility for several common classification problems: router fingerprinting, IoT device fingerprinting, and operating system fingerprinting. We show that the representation that we develop, Packets as Pictures produces both deep learning and ensemble models that are not only more accurate than existing tools that are based on manually engineered features, but also more generally applicable to a wider variety of settings.