2010 IEEE Symposium on Security and Privacy

Outside the Closed World: On Using Machine Learning For Network Intrusion Detection

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***Abstract*—In network intrusion detection research, one popular strategy for finding attacks is monitoring a network's activity for *anomalies*: deviations from profiles of normality previously learned from benign traffic, typically identified using tools borrowed from the machine learning community. However, despite extensive academic research one finds a striking gap in terms of actual deployments of such systems: compared with other intrusion detection approaches, machine learning is rarely employed in operational "real world" settings. We examine the differences between the network intrusion detection problem and other areas where machine learning regularly finds much more success. Our main claim is that**

deployments in the commercial world. Examples from other domains include product recommendations systems such as used by Amazon [3] and Netflix [4]; optical character recognition systems (e.g., [5], [6]); natural language translation [7]; and also spam detection, as an example closer to home [8].

In this paper we set out to examine the differences between the intrusion detection domain and other areas where machine learning is used with more success. Our main claim is that the task of finding attacks is fundamentally