Section 1: Week 1: Evaluate Cybersecurity

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# Section I: Significant Problem

## What Problem Exists

Cybersecurity requires capabilities to defend against sophisticated attackers, which employs continuously evolving techniques that are funded by nation-states. These advanced persistent threats (APT) weaponize zero-day exploits, devise precise spear-phishing campaigns, and leverage vulnerabilities in unpatched software, among other strategies. As administrators operate within this ‘assume breach’ hostile environment, they need solutions that detect the onset of an attack and automatically augment the network topology. For example, a system might detect an unexpected yet, trusted resource is downloading sensitive information for exfiltration. That system could mitigate this scenario by identifying traffic anomalies and provisioning firewall policies to stop the attack.

## How is this problem being addressed

One realization of this vision comes from machine learning, which provides mechanisms for rule association discovery, regression, classification, and clustering. These primitives enable systems engineers to create adaptive technologies that react to implicit patterns versus explicit rules. For example, clustering algorithms can use the device’s open network ports to predict which other machines are most similar. While it might not understand that one grouping is webservers and the other malware infected zombies, the tooling enables domain experts to make informed decisions. An ensemble of algorithms could further enhance these clusters through regression analysis to detect traffic surges during off-hours and similar use-cases. There is virtually an unlimited number of specific security-critical concerns that machine learning can address. This approach enables security teams to focus on human differentiating efforts, such as higher-level objectives and less mundane tasks.

## What challenges does this create

While machine learning appears to the naïve as science-fiction magic, it is statistics coupled with better marketing. These mindless algorithms possess a unique set of challenges where they do what we say, not necessarily what we mean. A prerequisite to accurate forecasting requires that both the model’s specific question structure and supporting facts are extensively curated. When the training data contains missing or erroneous examples, then garbage-in/garbage-out results will surely follow. It can be nearly impossible for a team to enumerate every training scenario that occurs in the real-world. Consider how many different ways the previous dynamic firewall example could halt production environments. The organization might intentionally need to change the definition of normal by deploying new features. Meanwhile, an attacker could abuse these protections to introduce a denial of service by manipulating third-party traffic.

## Whom does it impact and why

When the network topology relies on automation to perform a task, then transparency and control are removed. This trade-off creates a double-edged sword where the administrators have fewer lower-level details but operate at higher-level business objectives. While the ability to participate in every decision is comforting, it does not scale efficiently across to large enterprise environments. However, at the same time, having black-box decision engines manipulating the state of production environments introduces risk across business continuity. Since a sweet spot exists between extremes of fully autonomous and nothing, organizations need to determine how and where machine learning reduces explicitly overhead and increases business value.

# Section II: Cybersecurity Overview

## Goal of cybersecurity

A medical facility has a business requirement to collect private information from patients. While building a system that stores and retrieves this data is relatively trivial, several specific considerations influence the final implementation. Which users can issue queries against the datastore? What maintains the confidentiality of these records? How will auditing and compliance reporting work? Does this data have legal or regulatory implications? Answering these sorts of questions produces a model of acceptable risks and identification of business policies that require cybersecurity enforcement. These enforcements protect the business against both negligent and malicious attacks that could harm the integrity or reputation of the brand.

## What challenges exist

The interconnected nature of modern businesses, across a hybrid of technologies, creates protecting these incredibly complex systems challenging. Vulnerabilities and configuration errors exist in all levels of the network topology.

**Network Switches and Routing**. Firewall policies, intrusion detection, and prevention systems provide the first layer of defense. However, the dynamic nature of many environments can introduce drift overtime.

**Core infrastructure services**. Many distributed system technologies rely on core technologies such as Domain Name Services (DNS), Lightweight Directory Access Protocol (LDAP), and Dynamic Host Configuration Protocol (DHCP). If one of these systems becomes compromised or made unaccessible, then a cascade of outages can impact business continuity.

**Application Layer**. Applications rely on numerous protocols that model communication flows between systems, and ensuring each authorization and authentication is difficult to scale.

**Cloud Layer**. Resources in the cloud have unique footprints

## Who produces these issues

1. Nation-states and well funded organizations

## What is the role of network security

1. Define risk management protocols
2. Limit the scope of escalations
3. Ensuring SLA and QoS features

## What is the role of assessment

1. Validate that design == implementation
2. Confirm expected versus in acted risks

## How do team communication and culture factor in

1. Security is not about critism, its about reliability and continuity