Productizing ML For Behavior Modeling and Security

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September 27, 2017 | Washington, DC
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Agenda

- SAIC Overview
- The Challenges and Opportunities
- SAIC Approach
- Solution Examples
SAIC Overview

- Leading technology integrator specializing in technical, engineering, intelligence, and enterprise IT services to the U.S. government
- 47-year history of mission service delivery and customer relationships
- Significant scale of about $4.3 billion with diversified contract base
- Highly skilled workforce of about 15,000 employees, with presence in all 50 states, and focuses on
  - low-cost and low-risk enterprise project management,
  - visualization and data analysis, modeling and simulation, data publication and distribution, and big data analysis,
  - technology integration, IT security, application services and tools
  - user services, networking and communications, facility operations
Effectively understanding and exploiting the rich content of machine-generated data is both an increasing challenge and huge opportunity for our customer organizations.

- Lack of Operational Situational Awareness/Understanding trending/Ability to act
- Lack of visibility for Security threats and fraud detection across enterprise

- Network, System, Applications, User and Entity Activity Monitoring
- Using machine data to improve customer mission execution
- Streamlining and automating enterprise wide effort to gain the efficiency
SAIC Approach
Technology Platform – Splunk

Solution: Splunk, The Engine For Machine Data

Real-Time Machine Data

References – Coded fields, mappings, aliases
Dynamic information – Stored in non-traditional formats
Environmental context – Human maintained files, documents
System/application – Available only using application request
Intelligence/analytics – Indicators, anomaly, research, white/blacklist
SAIC Approach
Data Management Methodology – SAIC DSE™

SAIC’s Data Management Model enables innovation of analysis

- Data Science Edge™ (DSE) is SAIC’s proprietary data lifecycle model geared toward the efficient planning and execution of enterprise data planning and analytics.
- Model includes four phases of execution; Assess, Design, Build, and Improve. DSE Improve focuses on the performance and optimization of existing data and analytic systems.
- SAIC has successfully used this process model to design a big data lake for our clients, and perform real-world testing of airport check-in biometrics devices.
SAIC Approach
Data Protection – SAIC CSE™

CyberSecurity Edge Three Phase Methodology

1. **Discover** offers highly trained objective experts to identify real-world security risk and validate the implementation and effectiveness of an organization’s existing security controls against industry recognized best practices and adversarial threats.

2. **Mitigation** is a highly tailored offering designed to help a customer design, plan, and implement solutions to meet specific goals and improve overall cybersecurity.

3. **Manage** provides cost efficient, low risk options for ongoing and continuous monitoring support by certified cybersecurity experts.
   - Three options include managed, staff, and hybrid.

**Advantages of SAIC’s Approach**

**Verified | Recognized**
- Proven methodologies that have been developed and refined over countless engagements.

**Automated | Optimized | Balanced | Tailored**
- Offers customer-tailored solutions without the customization price tag.
- Optimizes current customer toolset.
- Fills gaps to strengthen ecosystem.
- Automates information assurance tasks.
- Balances tools, risk tolerance, and budget.

**Packaged | Defined**
- Clearly defines scope across all three phases with a fixed-priced model.
SAIC Approach
SAIC Big Data Analytics Solutions

Repeatable Solutions

• **Big Data Assessment and Roadmap** – templates and processes to assess an organization’s big data maturity and devise a roadmap.

• **Big Data Platform Accelerator** – reference architecture, blueprints, conops and security guidance to accelerate development and deployment of a big data platform.

• **Big Data Analytics Sandbox** – an SAIC cloud-based platform enabling client organizations to “play” with big data tools and technologies and develop advanced analytic products. Augmented for Deep Learning tools.

• **Big Data as a Service** – a scalable “as a service” offering allowing streaming analysis, batch analytics and data exploration in a secure fashion. Augmented for logical data analytics solution to handle the *Variety* problem of big data.
Solution Examples
SAIC Internal Splunk UBA Implementation

- SAIC Splunk UBA implementation based on machine data and our existing SIEM infrastructure.
- Objectives
  - Detect hidden security threats
  - Monitor networking, system, application, user and device anomalous behavior
  - Provide threat visualization
  - Increase SOC response to threats efficiently and effectively

Integrating with currently Splunk infrastructure include ES, ITSI, and SAIC capabilities in DSE, CSE and big data analytics services.

Aaron Bishop, @SAICinc
A CISO’s Perspective on User Behavior Analytics: Setting the Right Expectations for All Stakeholders
Solution Example
Machine Learning – Threat Analysis

Need:
▶ Support studies on emerging threats and impacts. Manage and coordinate over 30 TB of raw data and processed products between multiple sites

Solution:
▶ Use of SQL databases as well as NoSQL (MongoDB)
▶ Developed and modeled advanced threat discrimination algorithms using Neural Networks, and Bayesians classifiers
▶ Automated tools to run simulations, generate KPIs, and create briefings
▶ Variety of tools used for visual displays including GIS and 3-D plots

Benefits:
▶ Eliminates laborious manual effort on part of analysts
▶ Provides frequent insights to leadership
Contact

- For additional information please contact us

- Splunk .conf 2017 SAIC booth M36

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Overview

▶ Introduction

▶ Challenges

▶ Platform

▶ Programmability (SDK)

▶ Conclusions Q/A
Why use Machine Learning (ML)?

▶ You are probably trying to solve one of these problems:

• Insider threats

• Malware/hackers

• Fraud

What they all have in common? Simplistic solutions don’t work!
Complete Solutions are More than Just ML

- Machine learning capabilities
  - Supervised, Unsupervised

- Ability to quickly analyze lots of data (Big Data)
  - Need to use a cluster of machines

- Quick response to new events (automation)
  - Cannot have a Data Scientist look and analyze the data manually (takes too long!)

Productizing (Big data + ML + Automation) = HARD
Why Productizing a Solution is Hard?

1. ETL – Parsing, normalizing, cleaning
2. Platform – Scalability, performance, monitoring, orchestration
3. Programmability – Change/add new logic, test, develop (SDK)
4. Presentation – UI/UX, exploration/investigation

Any of the four pillars being weak the solution will fail!
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Goal: Manage Multiple ML Models

Model = “Training and scoring of ML models plus utility tasks”

- Isolate models (processes)
  - Out of memory
  - Out of disk space
  - High CPU usage
Model Isolation With Docker

Without Docker

Model 1

OS

Model 2

16 cores

64 GB

With Docker

Model 1

OS1

Model 2

OS2

2 cores

12 GB

14 cores

52 GB

If “Model 2” takes all the resource, “Model 1” is not affected
Elastic Resource Allocation for Models

- Deploy models over multiple nodes

- A critical model runs too slow
  - Give it more resources

- A model holds resources without utilizing them
  - Give the resources to the ones that need them

- New models are loaded into the system
Multi Node Containers with Kubernetes

Scenarios

- A model is struggling
  - Spin more instances of the model and balance the load

- New model is added
  - Create new containers and assign them to a node

- When cluster gets overloaded
  - Add extra nodes
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Programmability: From Ideas to Production

Research
- Explore initial idea, visualize data, understand the problem, choose the best algorithm

Develop
- Program solution, evaluate tradeoffs

Test
- Test that the solution works well in terms of performance and accuracy

Deploy
- Run the model on the production cluster
Realistic Model Development Life-Cycle

Data Exploration

Best solution at the time

Coding/Unit testing local in your IDE

Tuning?

Works Great?

No

Yes

Deploy in Test Environment

SDK should support all of these steps!
Different Use Cases Require Different Model Types

- **Streaming**
  - Single pass over the data
  - Quick response to events
  - Run continuously

- **Batch**
  - Multiple passes over the data
  - Can run expensive correlations (joins)
  - Run at scheduled intervals (think Linux Cron jobs)

Events ➔ map() ➔ reduce() ➔ Anomalies

Events ➔ Batch ➔ Anomalies
Option [Anomaly] analyzeData (DataEvent currentEvent)

- State is checkpointed internally
  - Serialization (Protocol Buffers, Kryo)

- Streaming models choose
  a) Pivot (e.g., per user or device)
  b) Input types (e.g., HTTP traffic data)
splunk> UBA: Batch Model APIs

- Apache Spark

- Apache 2.0.x full set of APIs are supported
  - RDD, Dataset, DataFrames, Spark SQL

```python
httpData.groupBy('userId').agg(sum('bytesOut'), unique('dstIP'))
```
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Conclusions

- Productizing ML solutions has many challenges
  - Orchestration (fault tolerance, isolation, elasticity)
  - Friendly developer environment

- splunk> UBA addresses all of these challenges
  - ETL: Normalizes all data and attributes events to actual users/devices
  - Platform: Scaling, monitoring, orchestration
  - SDK: UBA 4.0 comes with SDK support
  - UI: Integrated experience
Thank You

Don't forget to rate this session in the .conf2017 mobile app
Show the top destinations in terms of number of events

```
sql
select destination, sum(numEvents) as totalEvents
from EventsPerDest
group by 1
order by totalEvents desc limit $(top-10)
```
Notebook Driven Development

▶ Zeppelin notebook example
Different Model Types and Challenges

- **Streaming:** Quick response to events (Kafka)
  - State explosion
  - Slow EPS

- **Batch:** Stronger correlations (Apache Spark)
  - Job execution time (timeout)

- **Common challenges**
  - Scaling up/down
  - CPU/Memory/IO fairness (one task interfering with another)