

Splunk4Ninjas - Machine Learning for Security

Hands-On Workshop



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Please introduce yourself!

- Name
- Company/organisation
- Role
- Are you currently using Splunk?
- What are you interested in using Splunk for?



Workshop Agenda

- What is Machine Learning?
- Why do we need Machine Learning in security?
- Machine learning for security with Splunk
- Time for practice!
- Ready made applications leveraging ML
- What's next?





LAB EXERCISE 1



5 MINS

Enroll in Today's Workshop

Tasks

1. Get a splunk.com account if you don't have one yet:
<https://splk.it/SignUp>
2. Enroll in the Splunk Show workshop event:
<https://show.splunk.com/event/<eventID>>
3. Download the hands-on lab guide:
<https://splk.it/ML-Sec-Lab-Guide>

Contains step-by-step instructions for all of today's exercises!

1. Download a copy of today's slide deck:
<https://splk.it/ML-Sec-Attendee>

Goal

Available Enrolled

Search events Invited

Private event PLATFORM 01/16 (10:37) - 01/16 (18:29)
Splunk4Rookies Europe/London (GMT +00:00)

Available

Enroll

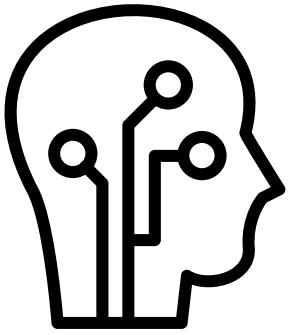
Enroll in today's event

What is Machine Learning?



What is AI and Machine Learning?

Definitions

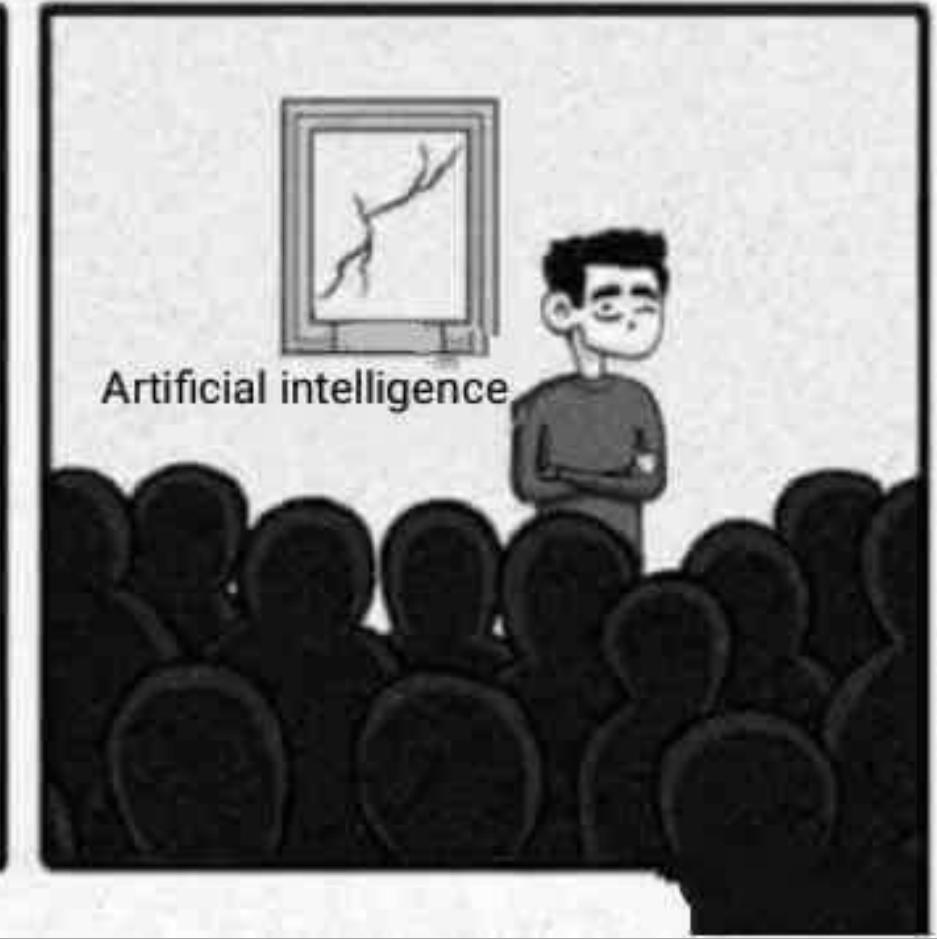
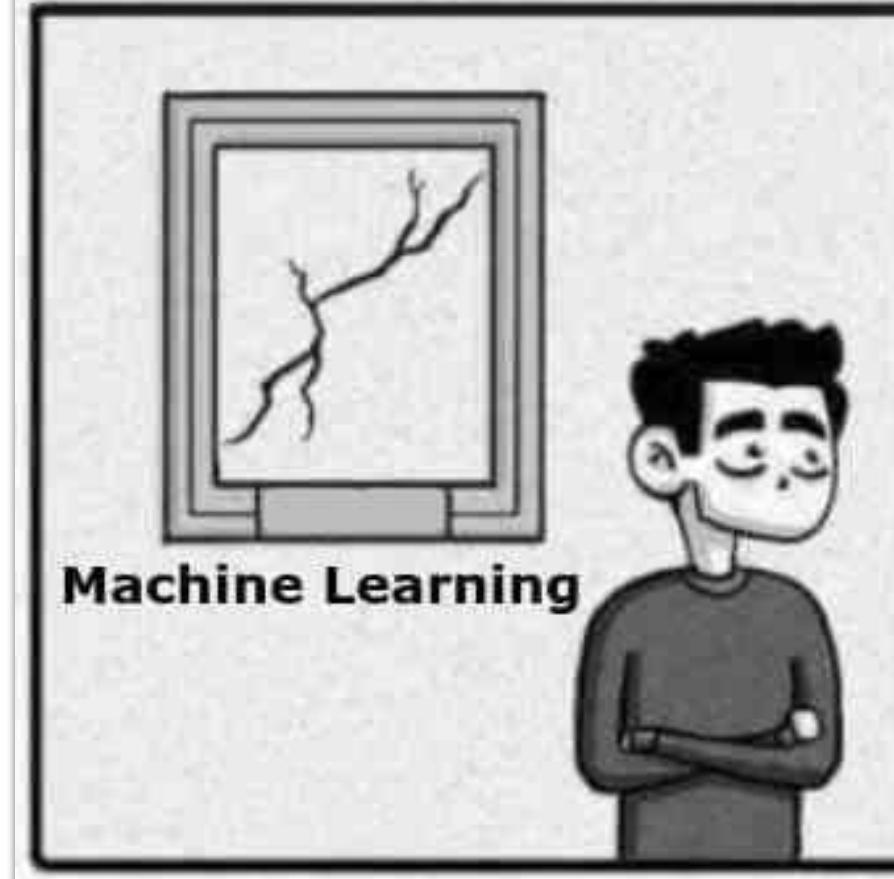
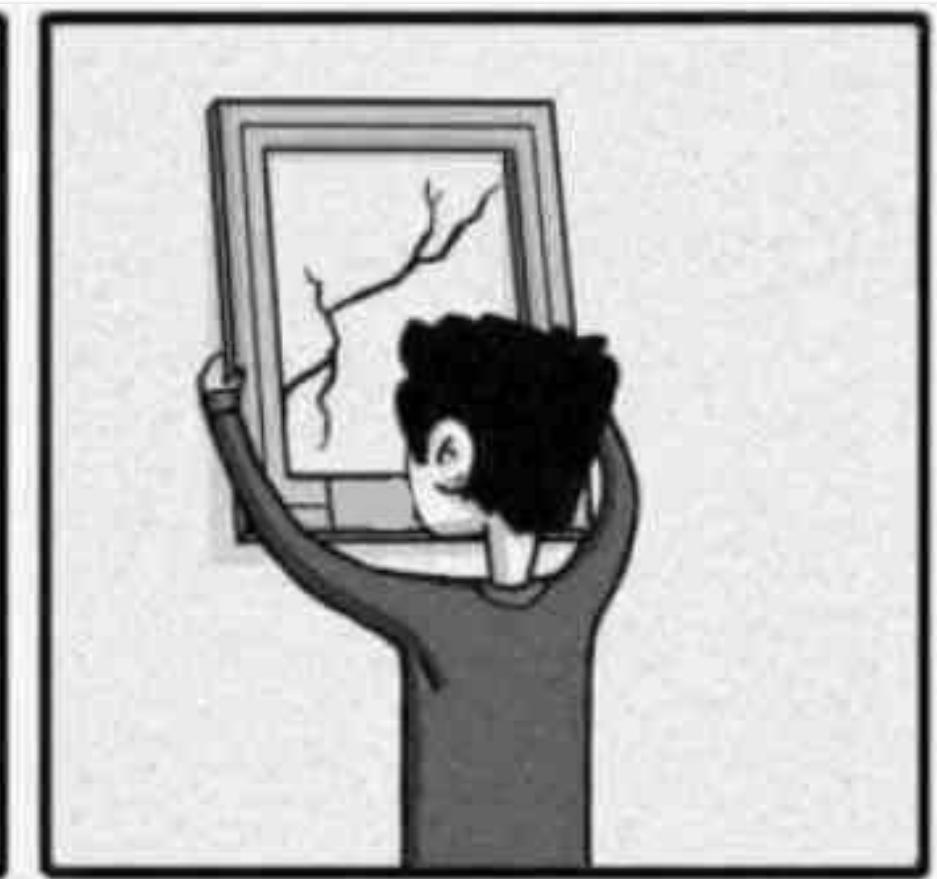
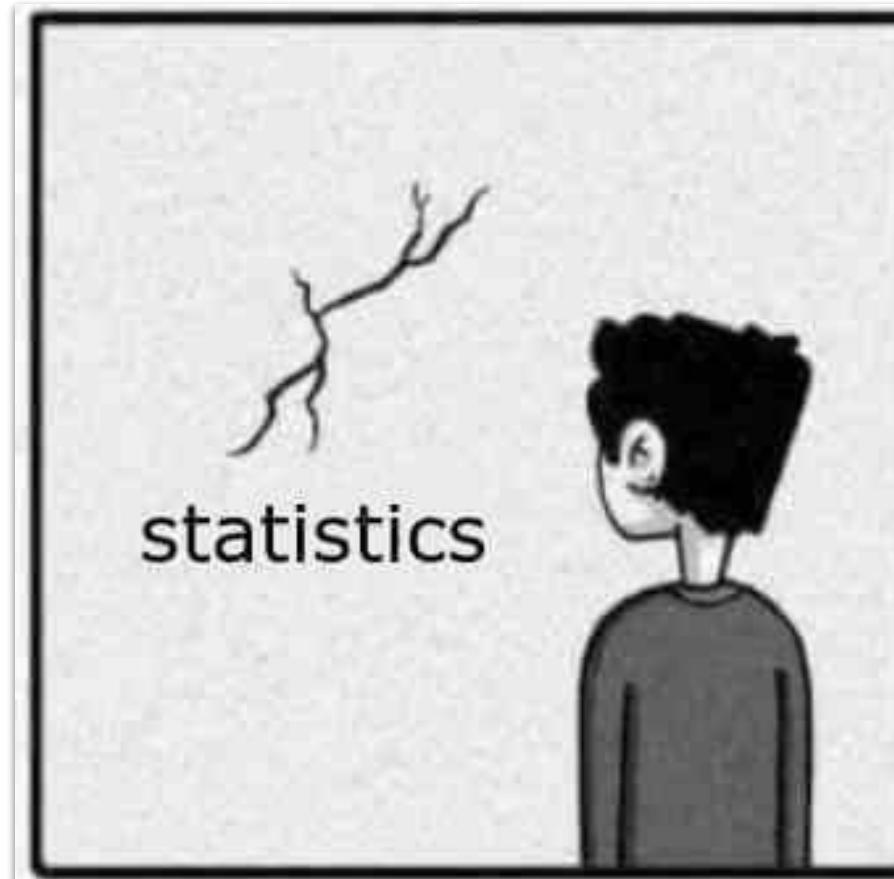


Artificial Intelligence (AI) - capability of a computer system to **mimic human cognitive functions** such as learning and problem-solving

Machine Learning (ML) - **subset of AI** that uses mathematical models of data to help a computer learn without direct instruction

Deep Learning - **subset of AI** that uses computationally intense ML models inspired by the “deep” layers of the biological neural network of the human brain to accomplish complex goals like image recognition *Example: Self driving car recognizes stop sign*

Generative AI - **subset of AI** that involves the use of algorithms and techniques to generate new data, things that have not existed in the world before being created by the models *Example: OpenAI's ChatGPT*



© Thomas Wiecki, Ph.D., ODSC Europe 2018

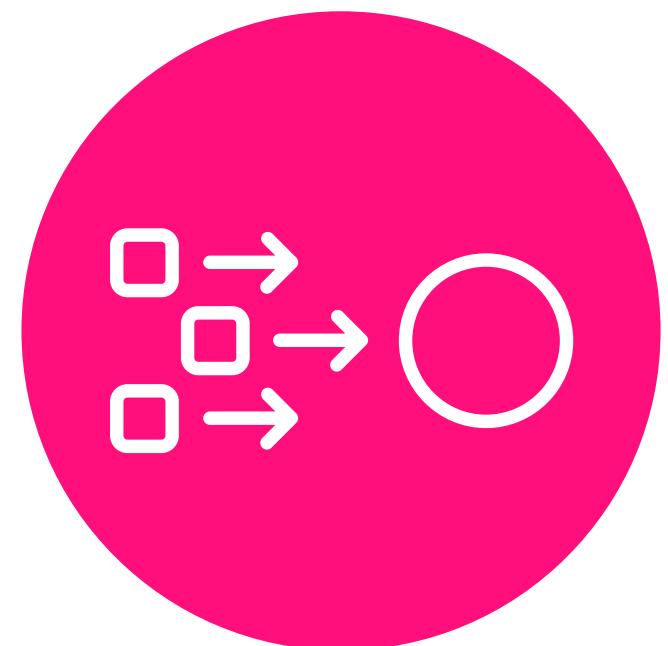
“

Machine learning (ML) is the study of computer algorithms that improve automatically through experience and past behaviour.

- Wikipedia

Machine Learning

The capability of systems to acquire their own knowledge, by extracting patterns



Use complex statistical or probabilistic models to identify patterns in information



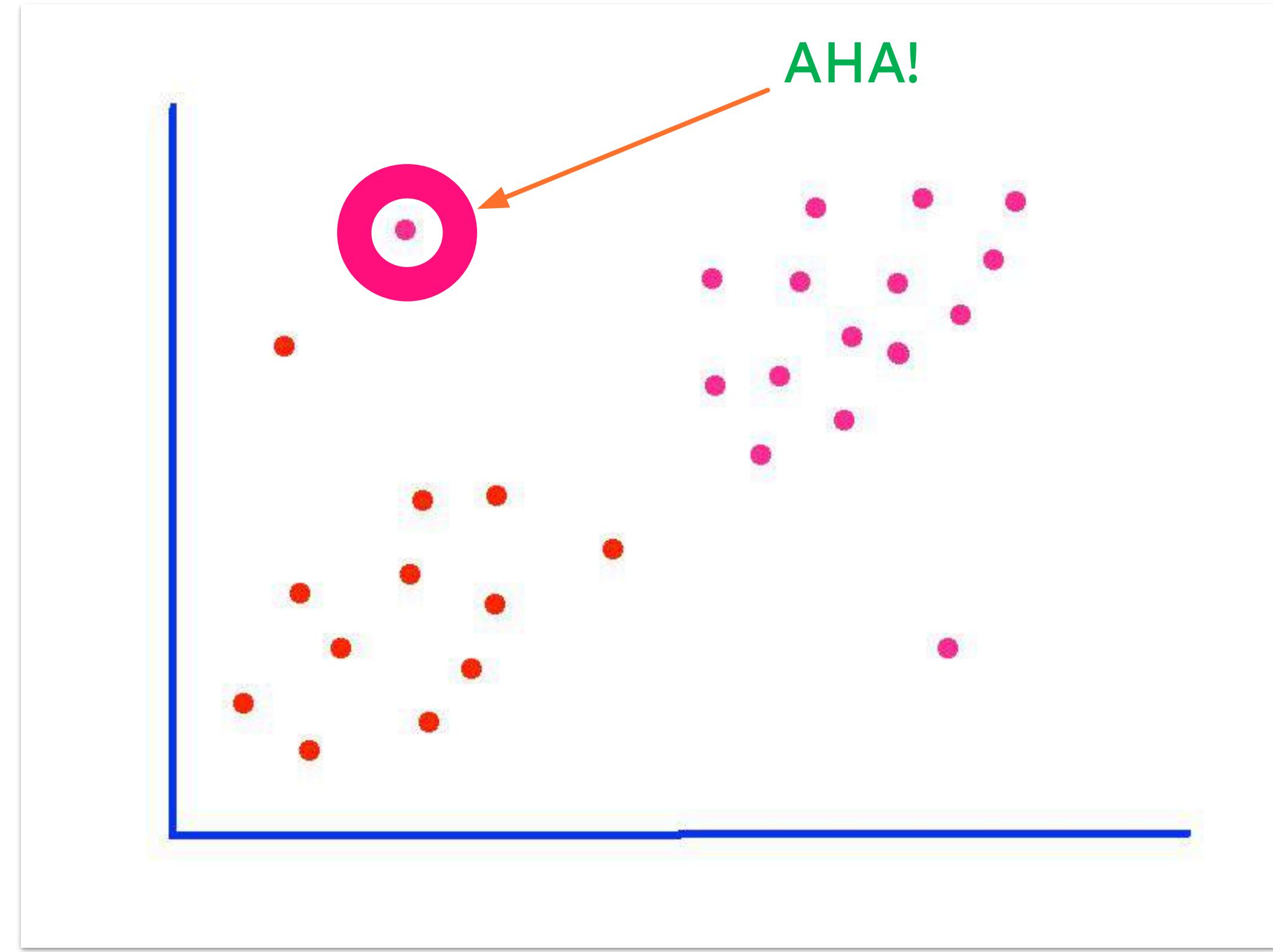
Catalog the patterns and in some cases iterate them as new data is received



Use information from learnt patterns to understand and interpret new data or make predictions

Correlation

This is NOT ML



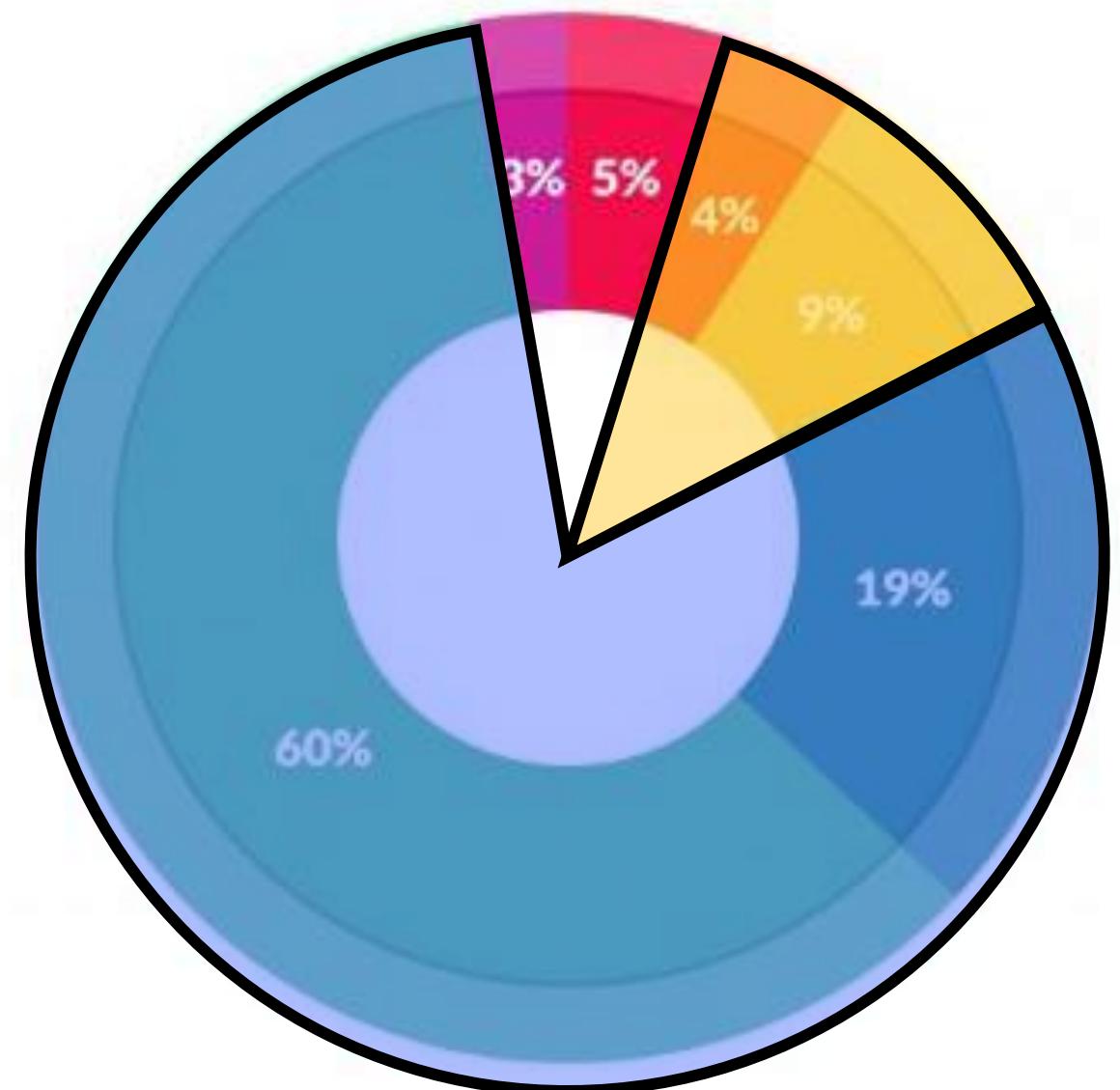
Machine Learning

Why do we need it?

- Basic statistical modelling techniques (such as prediction using means and standard deviations) are not always fine grained enough to answer these questions accurately
- Machine Learning (ML) uses complex statistical techniques to provide better predictions to these types of questions
- For many organizations using their data to make pre-emptive or targeted decisions is becoming increasingly important, for example:
 - Detect the presence of Botnets in their network
 - Detecting a user account that has been compromised
 - Preventing fraud in banking by detecting malicious accounts or anomalous activity
 - Classifying customers for more targeted advertising campaigns in social media
 - Forecasting demand for products in support of supply chain management

What Data Scientists Really Do

Data Preparation accounts for about 80% of the work of data scientists



What data scientists spend the most time doing

- *Building training sets: 3%*
- *Cleaning and organizing data: 60%*
- *Collecting data sets: 19%*
- *Mining data for patterns: 9%*
- *Refining algorithms: 4%*
- *Other: 5%*

“Cleaning Big Data: Most Time-Consuming, Least Enjoyable Data Science Task, Survey Says”, Forbes Mar 23, 2016

ML Starter

Dos and Don'ts

What Machine Learning isn't...

- Something you can throw all your data at and expect an answer
- A one size fits all answer to all your data problems (a.k.a. a magic button)
- Artificial Intelligence...
- The predict command
- Correlation rules

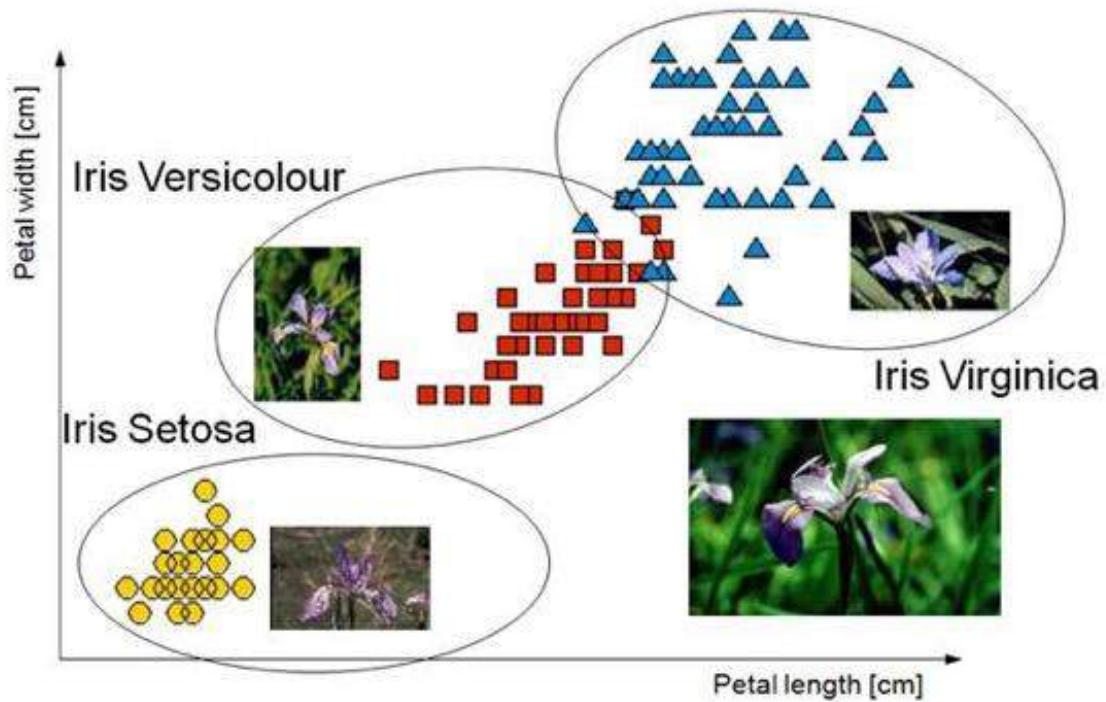
What Machine Learning is...

- A good way of spotting and baselining patterns in data for future detection
- Useful only when you have a well defined and bounded problem, and clearly understand the data that you need to use

Types of Machine Learning

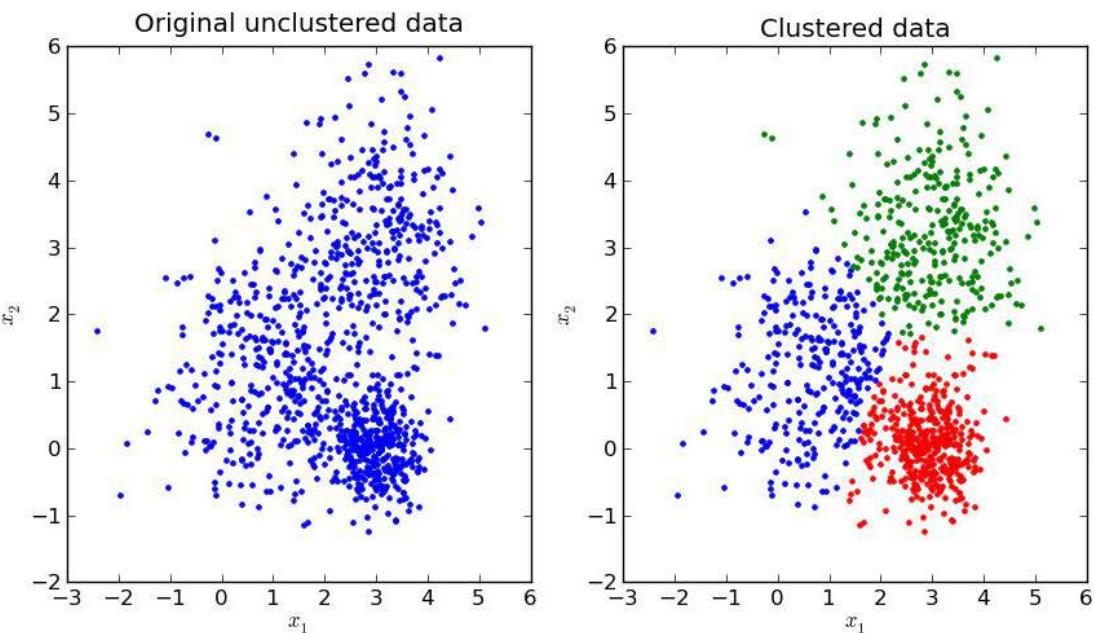
Supervised Learning (labeled data)

- Regression
- Classification



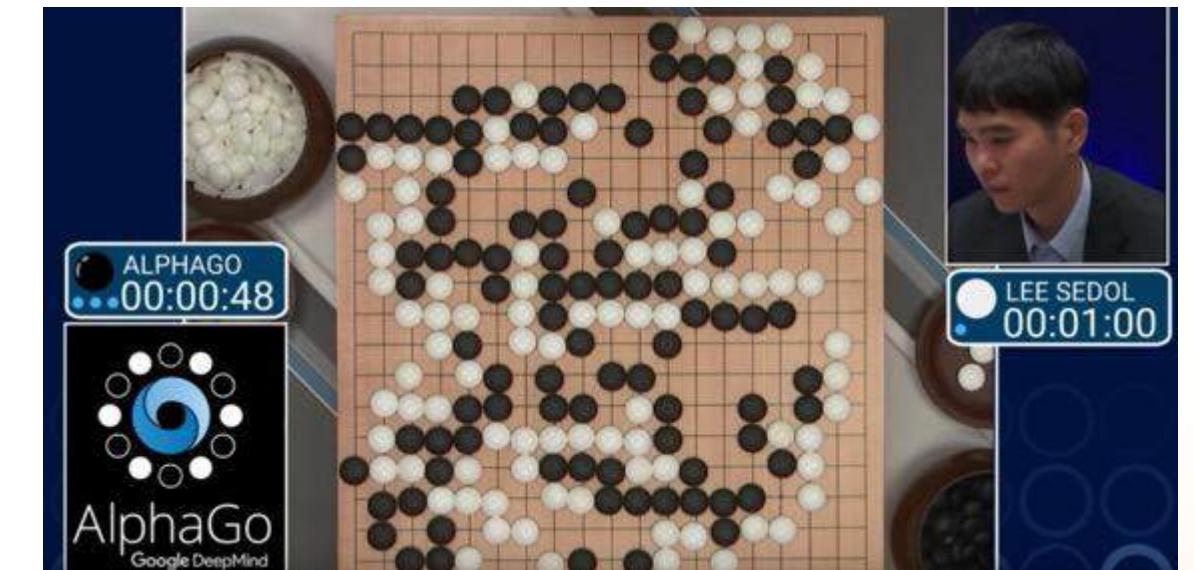
Unsupervised Learning (unlabeled data)

- Clustering
- Anomaly Detection



Mixed Models (with reinforcement or feedback)

- Human in the Loop
- Autonomous Systems



Why Do We Need Machine Learning in Security?



Shifting Focus and Role for SOCs

LEGACY

Situational Awareness

Operation / Monitoring Center

Human Authored

Human Speed Operations

REQUIRED

Analysis and Decision-Making

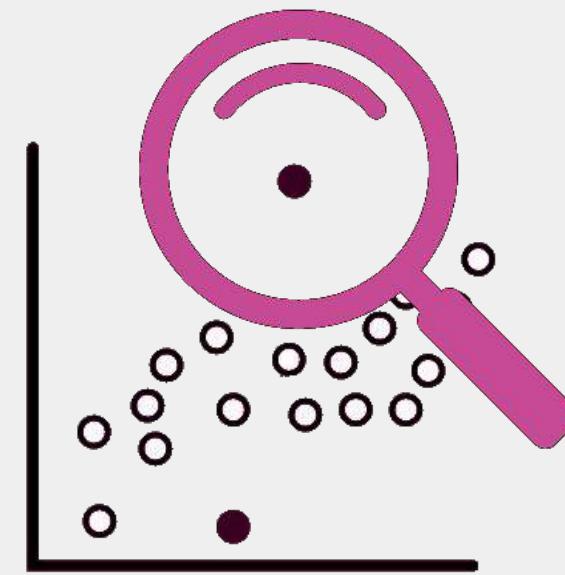
Nerve Center / Command Center

Human — Machine Learning

Machine-Speed Cycle Times

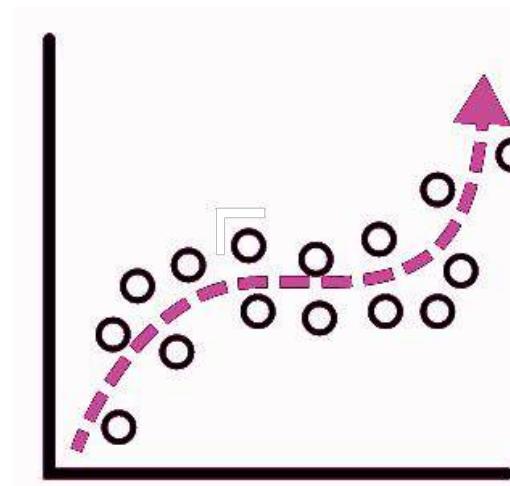
Splunk Customers Want Answers from their Data

Anomaly detection



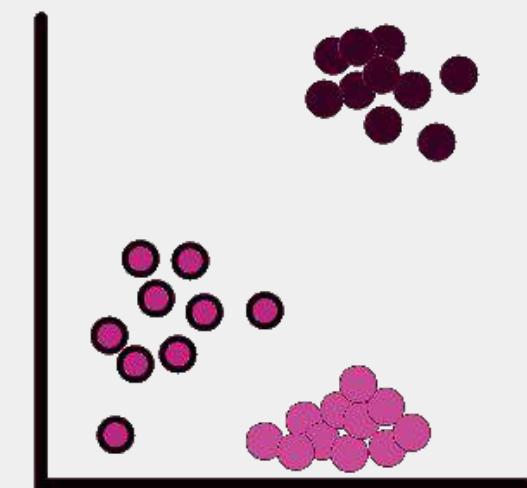
- Deviation from past behavior
- Deviation from peers
- (aka Multivariate AD or Cohesive AD)
- Unusual change in features

Predictive Analytics



- Predict Service Health Score/Churn
- Predicting Events
- Trend Forecasting
- Detecting influencing entities
- Early warning of failure

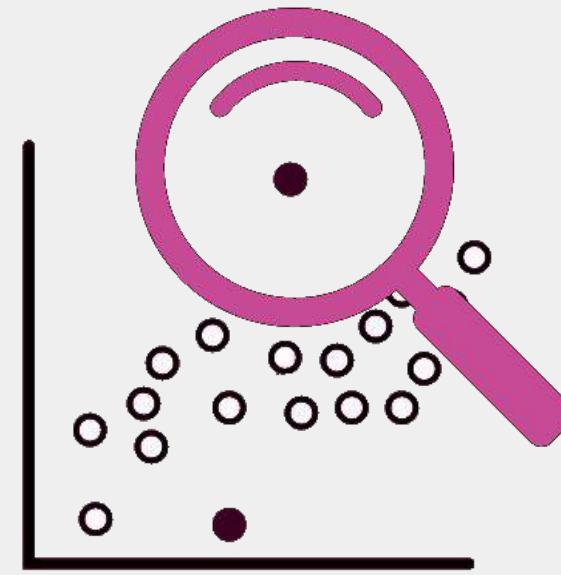
Clustering



- Identify peer groups
- Event Correlation
- Reduce alert noise
- Behavioral Analytics

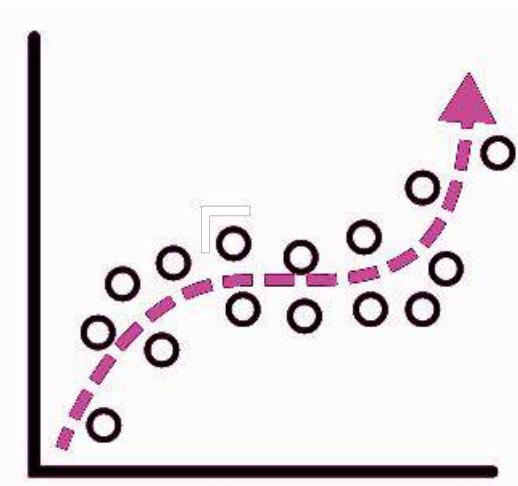
Security Examples

Anomaly detection



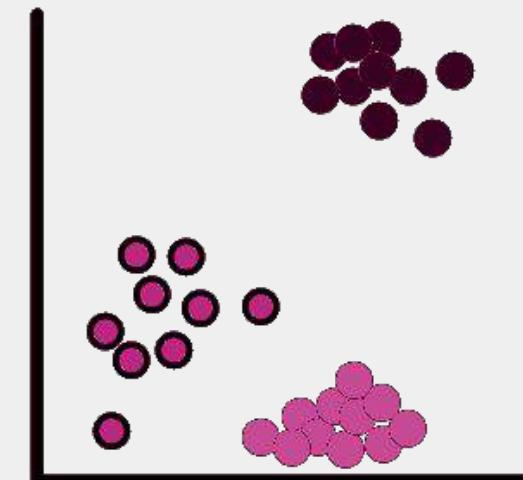
- Useful when trying to detect unwanted and unexpected behaviour.
- Useful when detecting low and slow attacks that operate over a long time.

Predictive Analytics



- Predict the outcome of an alert (FP/TP) based on observed previous responses.
- Generate response recommendations based on observed previous responses.

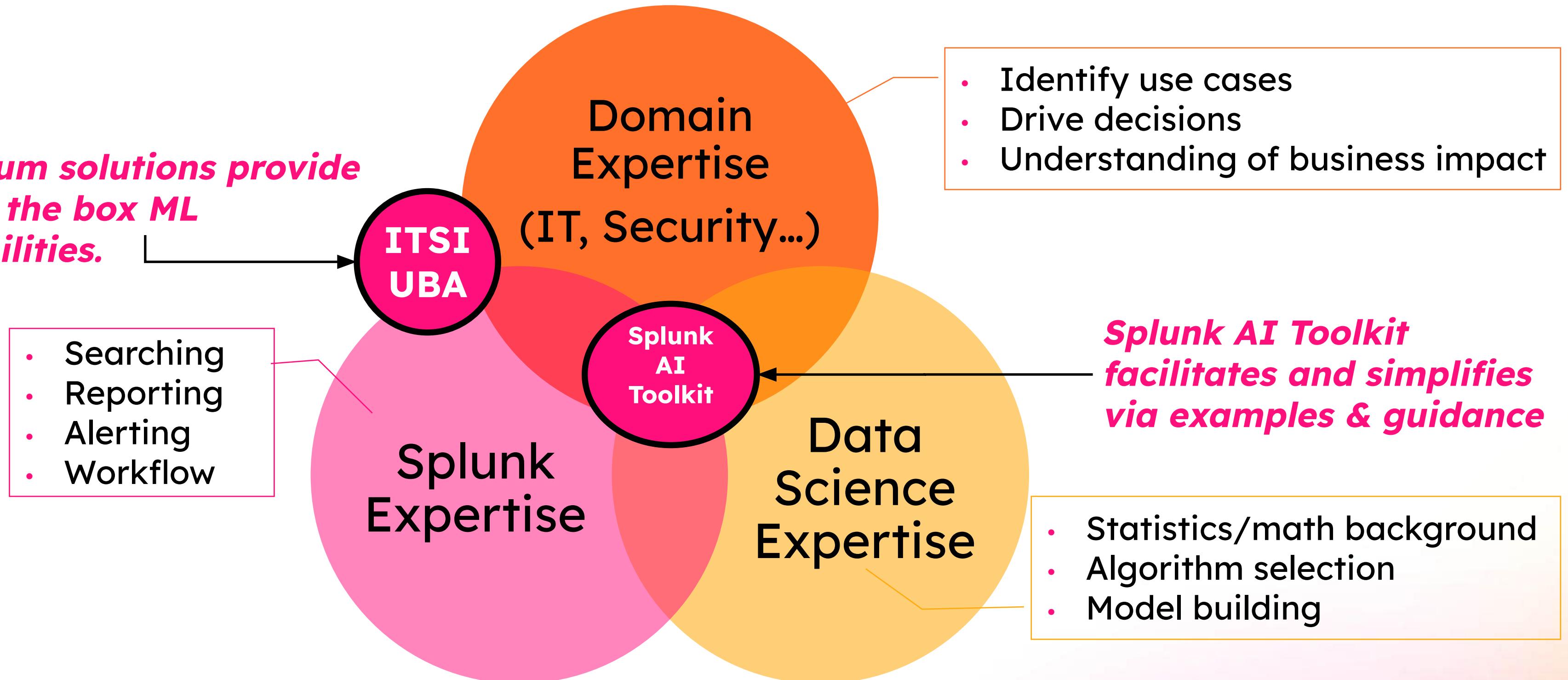
Clustering



- Used to generate dynamic peer groups based on observed events.
- Used to group similar alerts.

Skill Areas for Machine Learning @ Splunk

Premium solutions provide out of the box ML capabilities.



Custom ML with the Splunk Platform

Ecosystem

Splunk's App Ecosystem contains 1000's of free add-ons for getting data in, applying structure and visualizing your data giving you faster time to value.

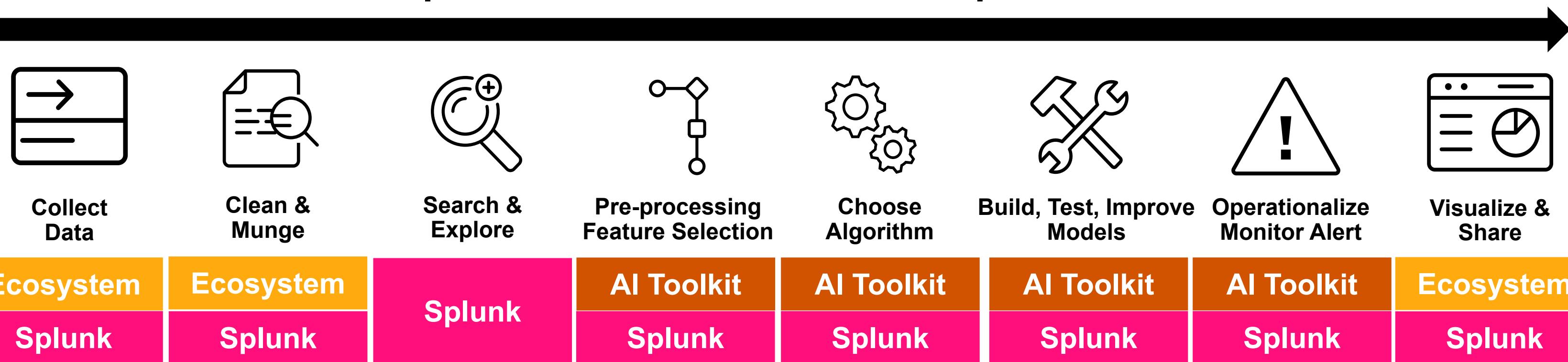
AI Toolkit

The Machine Learning Toolkit delivers new SPL commands, custom visualizations, assistants, and examples to explore a variety of ml concepts.

Splunk

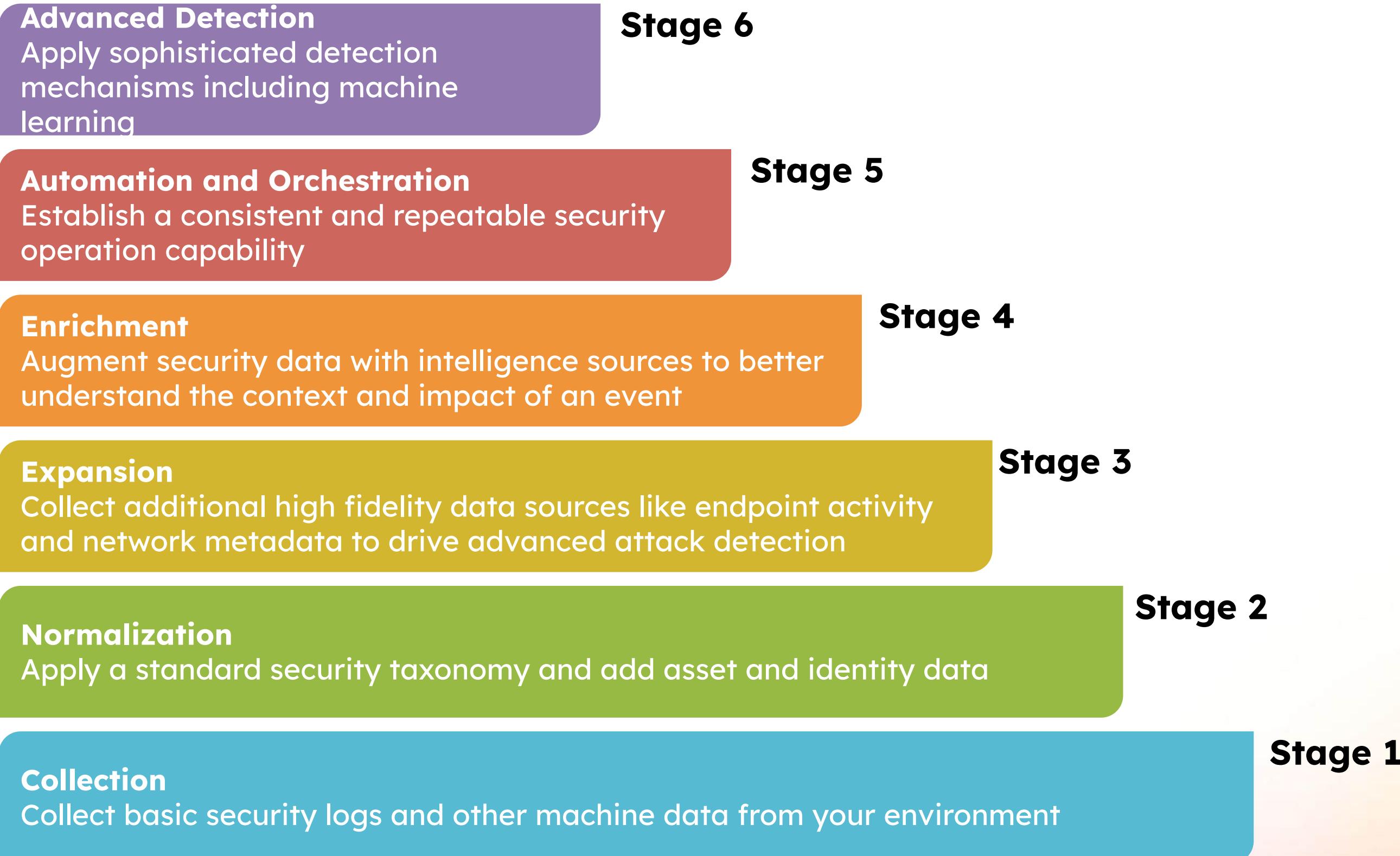
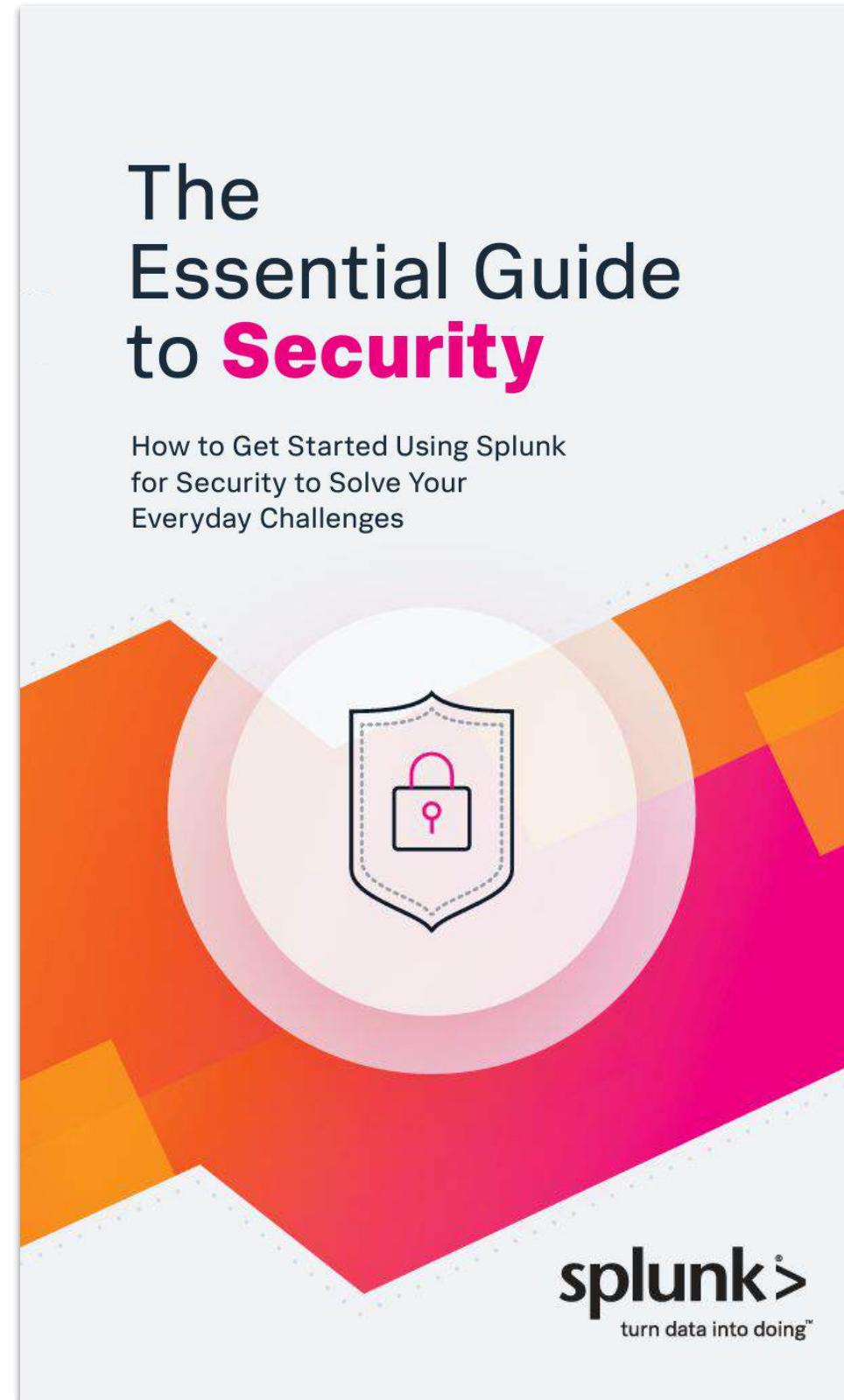
Splunk Enterprise is the mission-critical platform for indexing, searching, analyzing, alerting and visualizing machine data.

Operationalized Data Science Pipeline



splunk> Platform for Operational Intelligence

The Security Data Journey

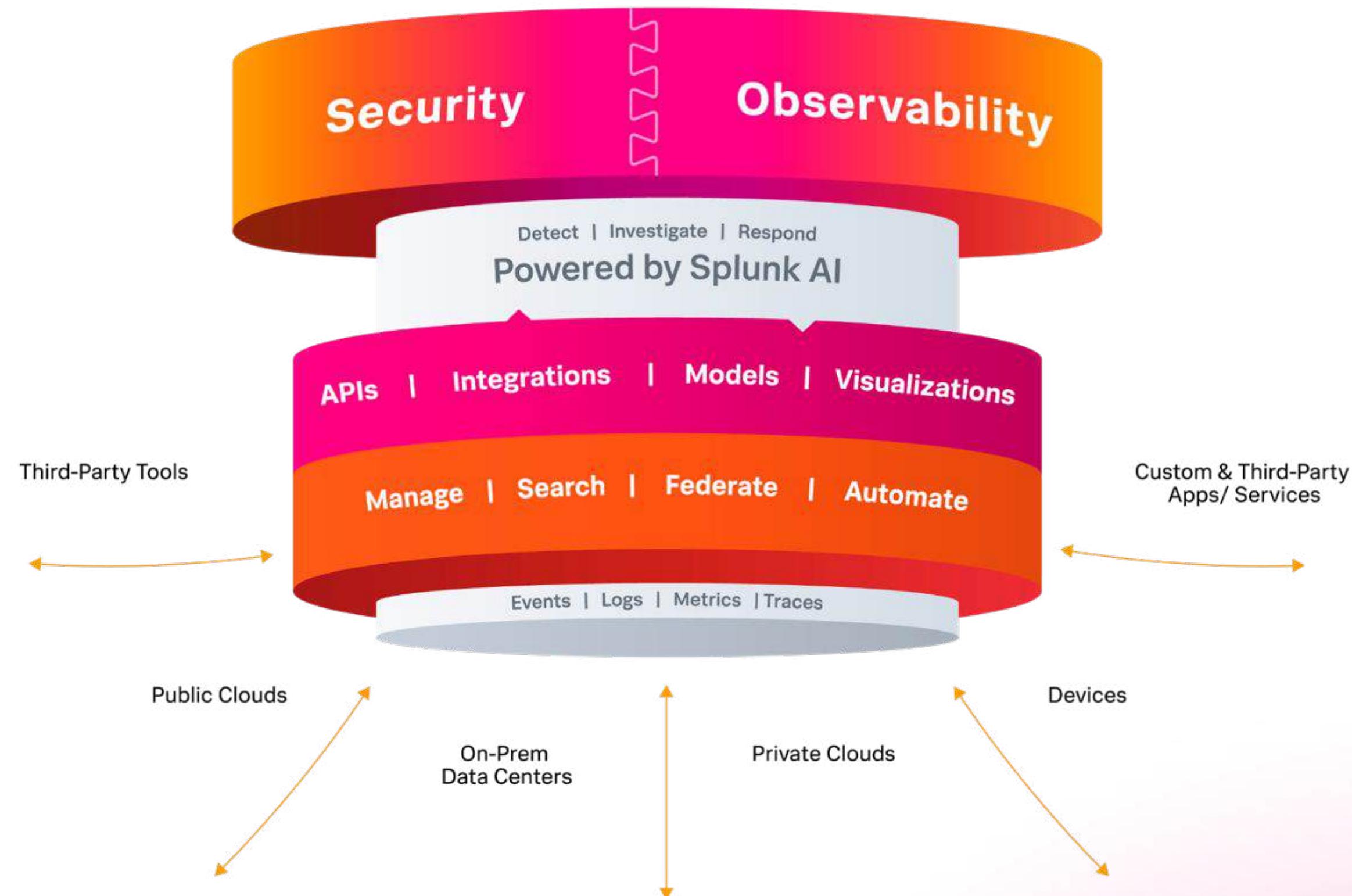


https://www.splunk.com/en_us/form/the-essential-guide-to-security.html

Machine Learning for Security with Splunk



The Unified Security and Observability Platform is Powered by Splunk AI



We have been implementing AI for years...

Splunk has long been committed to helping customers use AI



Splunk AI Toolkit

The Splunk AI Toolkit, formerly MLTK: Machine Learning Toolkit, explore a variety of ML concepts.

Built by [Splunk LLC](#)

Downloads

333,774



splunk> .conf19

Announcing the Deep Learning Toolkit for Splunk

11,665

Downloads



RESEARCH IN ACTION

Market Leader:
Vendor Selection
Matrix™ AIOps
Solutions

GIGAOM

A Leader in the
AIOps Radar for
4 consecutive
years

VICM

Highest Scoring
Product in
Selecting an
AIOps Solution for
2 years

Domain-Specific Use Cases

Security

- Simplify workflows
- ML powered detections
- Risk based alerting
- Guided response actions
- Event correlation and alert noise reduction
- Predictive analytics
- Anomaly detection
- Clustering

Observability

- Probable root cause analysis
- Anomaly and outlier detection
- Adaptive thresholding
- Alert correlation and prioritization
- Assisted remediation
- Proactive outage prevention assistance
- Suggested responders

Powered by Splunk AI

Overview

AI for Security

Enterprise Security, UBA

ML-Powered Detections, Anomaly Detection,
Predictive Analytics

AI for Observability

ITSI, APM, IM, On-Call

Predictive Analytics, Anomaly Detection, Adaptive
Thresholding, Incident Correlation, Alert Noise
Reduction, Alert Autodetect, Suggested Responders

Assistive Intelligence Experiences

Splunk AI Assistant,
Splunk AI Assistant in Observability/Security

Customizable ML

Splunk AI Toolkit, Splunk App for Data Science and
Deep Learning, Python for Scientific Computing

The **splunk>** Platform

Powerful search commands for statistical analysis, predictive analytics and clustering

Powered by Splunk AI

Product Overview

Security

Enterprise Security with Enterprise Security Content Updates (ESCU)

User Behavior Analytics

Observability

IT Service Intelligence

Application Performance Monitoring

Infrastructure Monitoring

On Call

Included Embedded AI/ML Capabilities

Assistive Intelligence Experiences

AI Assistant

Splunk AI Assistant in Observability/Security

Customizable ML

Splunk AI Toolkit

App for Data Science and Deep Learning

Python for Scientific Computing

Free Assistive and Customizable Apps & Tools

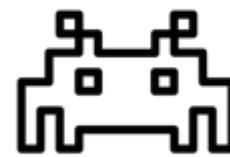
The **splunk>** Platform

Splunk Cloud Platform

Splunk Enterprise

Splunk Enterprise Security

with ML-Powered Content Updates from the Splunk Machine Learning for Security Team



Study Threats

Identify emerging threats and understand how they operate



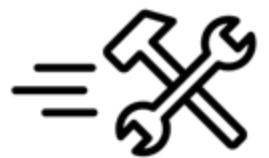
Create Datasets

Collect data and use Splunk to parse the data and identify patterns that can be used to detect the threat



Build ML & Deep Learning Powered Detections

Build advanced models based on data in order to make predictions or decisions; enable systems to learn from data, identify patterns, and make decisions with minimal human intervention; and craft rules or queries designed to identify specific activity associated with threats - Leverage both Machine Learning & Deep Learning.



Test Detections

Run queries against a dataset that simulates attacker behavior to improve accuracy and reduce false positives



Release

Package detections to deliver timely and effective protections against emerging threats to Splunk customers

Customize AI for security

In Splunk Enterprise Security

OOTB ML analytics in ES and with the ES Content Updates (ESCU), which can be fully customized to your environments.

Documentation and guidance on some of the most common [security use cases that are enhanced by AI and ML](#).

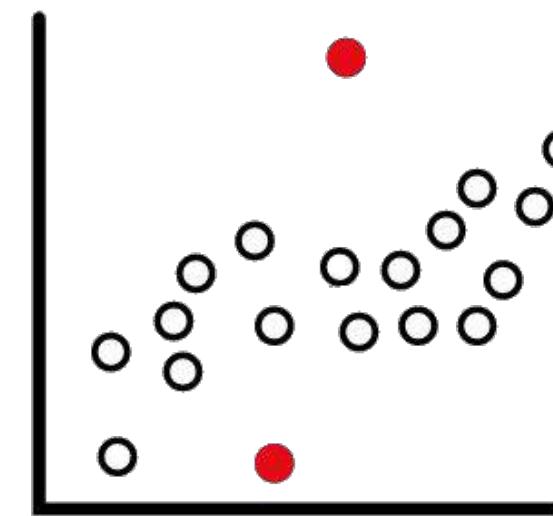
Security Use Cases Enhanced by AI and ML

splunk>

ML-Powered Detections for Security

Find the Obscure and Unknown Threats Buried Deep in Your Data

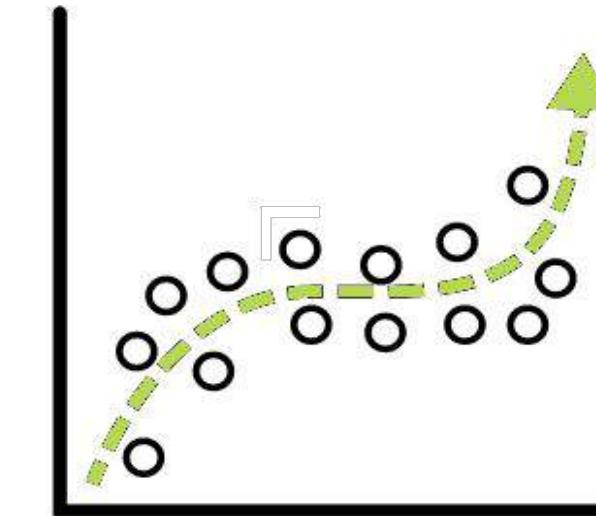
Anomaly detection



Deviation from past behavior

- Resource Utilization**
- Error Rate Deviation**
- Access Pattern Baselining**

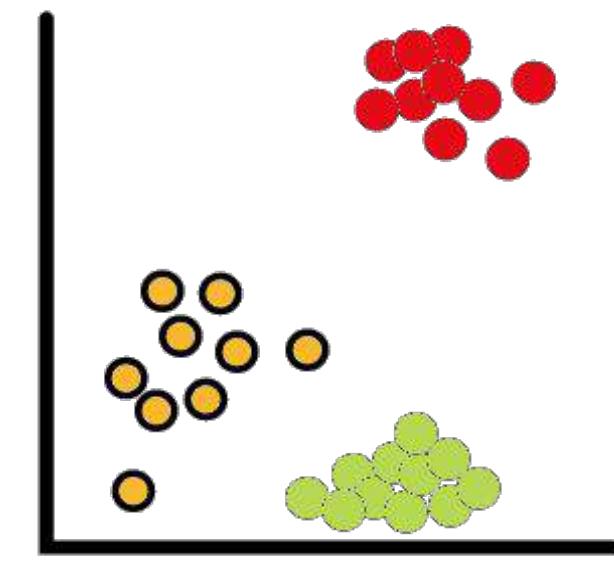
Predictive Analytics



Future state prediction
Classification/regression

- Predict storage requirements**
- Identify patterns leading to failure**

Clustering

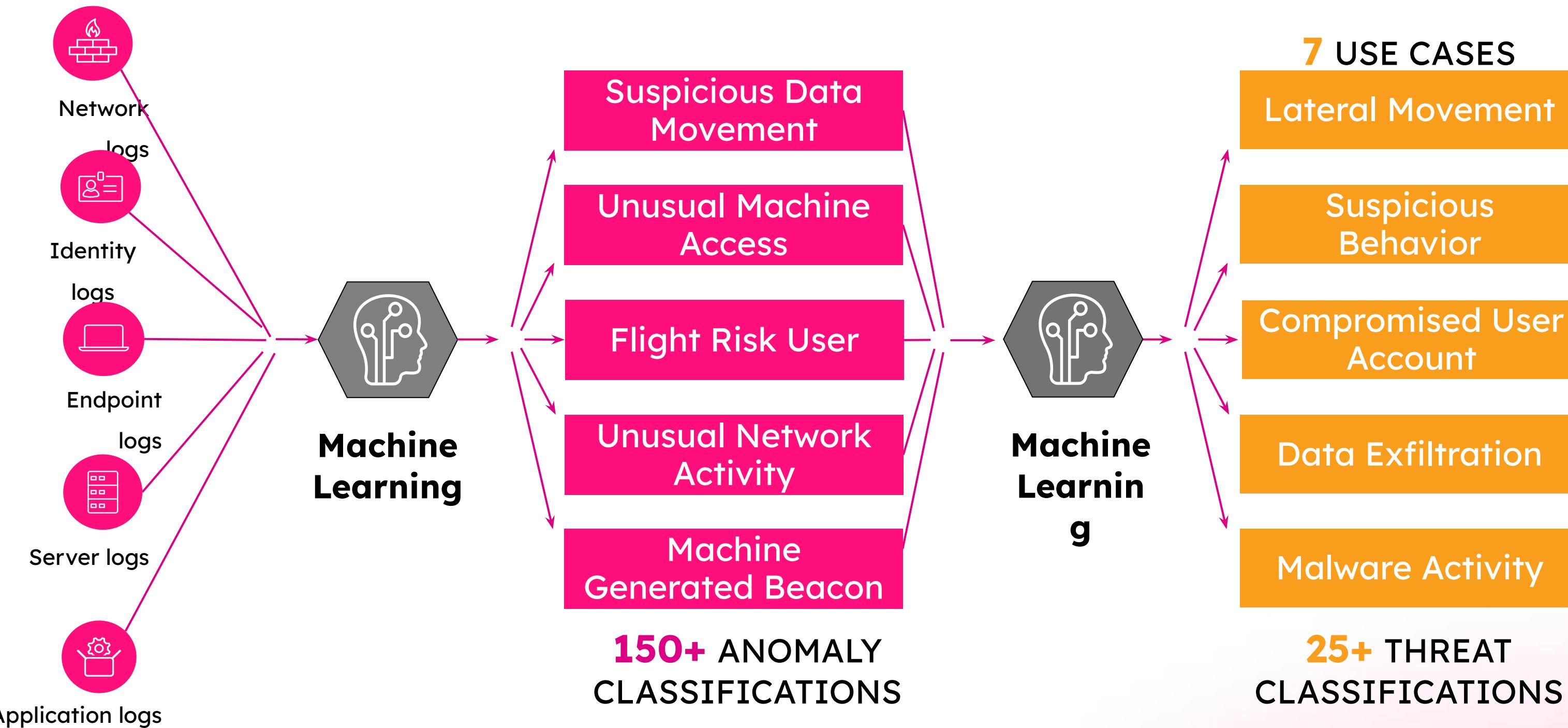


Behavioral Analytics

- Identify Traffic**
- Classify Behaviors**

User Behavior Analytics

Detect threats and anomalous behavior using machine learning

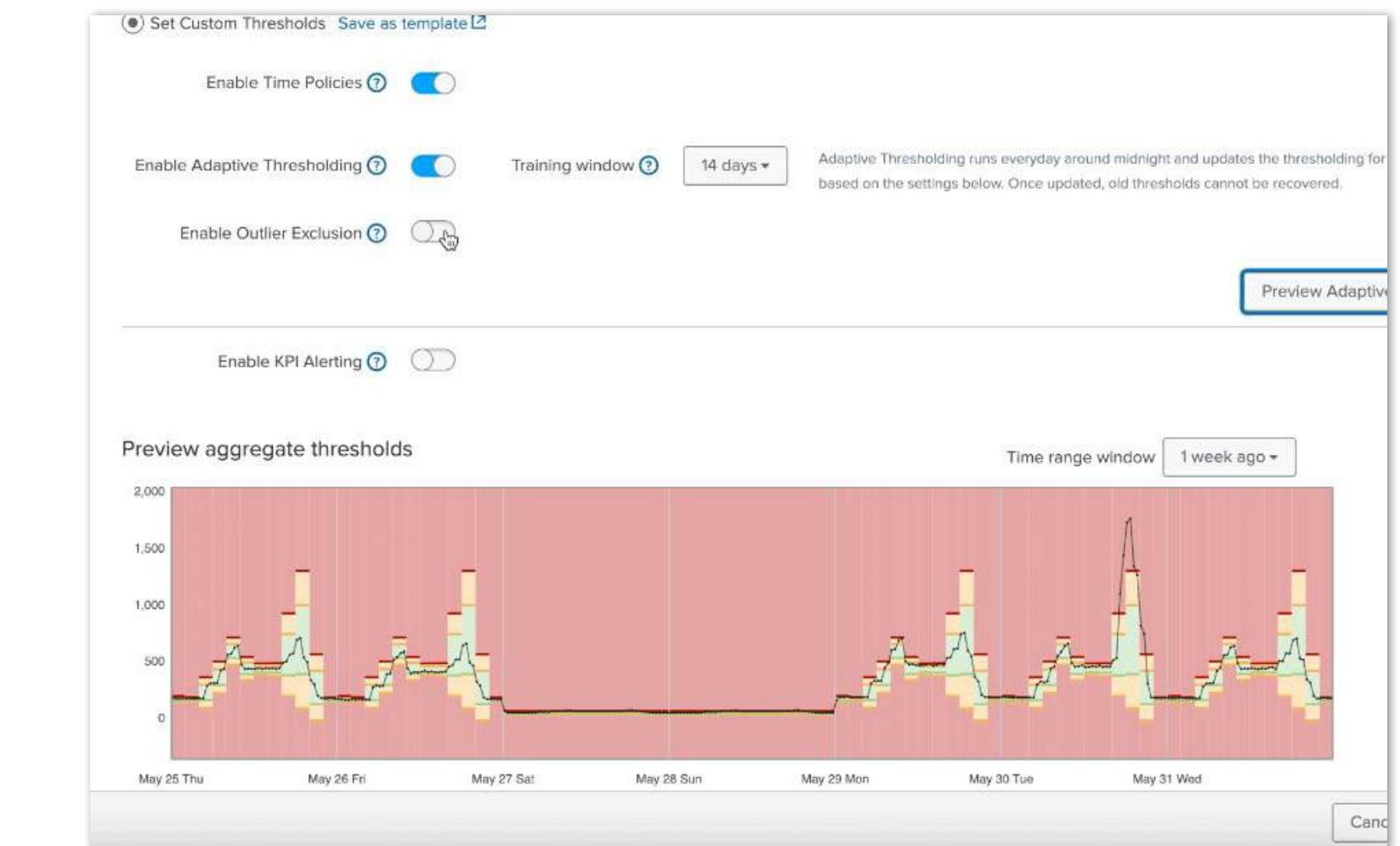


Splunk IT Service Intelligence (ITSI)

Splunk's AIOps Solution

Splunk ITSI applies machine learning to **proactively prevent outages** by correlating and reducing alerts, monitoring service health, and streamlining incident management.

- ❑ Clustering & aggregation to reduce alert noise
- ❑ Adaptive (dynamic) thresholds incorporate seasonality
- ❑ Anomaly and outlier detection
- ❑ Actionable additional context
- ❑ Assisted root cause investigation
- ❑ Predict service health to prevent outages

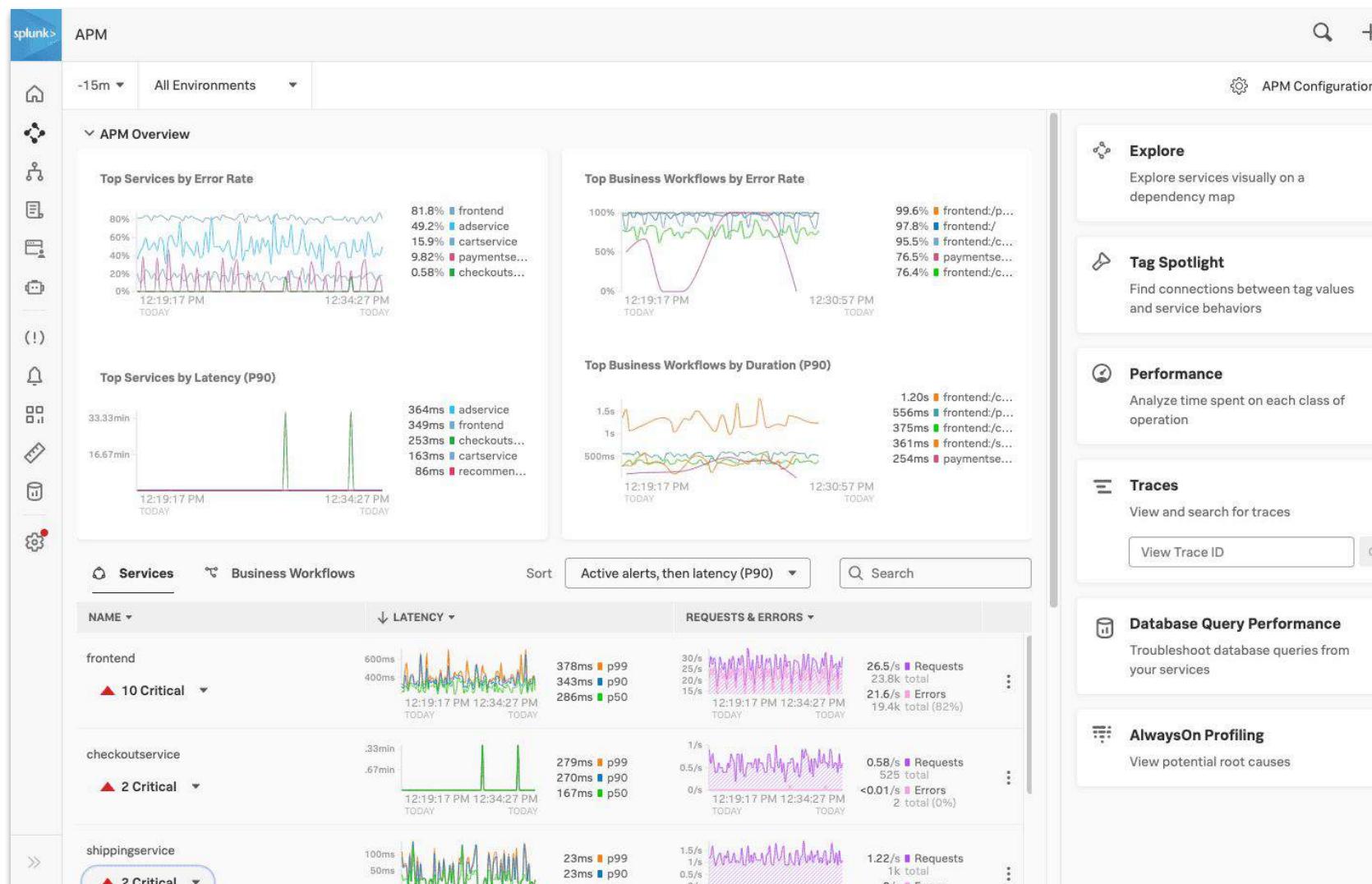


New updates! ★

- ❑ Outlier Exclusion in Adaptive Thresholds
- ❑ ML-Assisted Thresholding (Preview)

Splunk Application and Infrastructure Monitoring: Autodetect

More accurate and efficient alerting for your infrastructure and services



Use machine learning to **improve accuracy** and **reduce manual effort** across infrastructure and service alerting

- Establish performance baselines across every service
- Automate alerting by receiving recommendations for the biggest spikes in latency, errors, and resource utilization
- Easily customize alert thresholds and subscribe to notifications for specific services or teams

Splunk On-Call

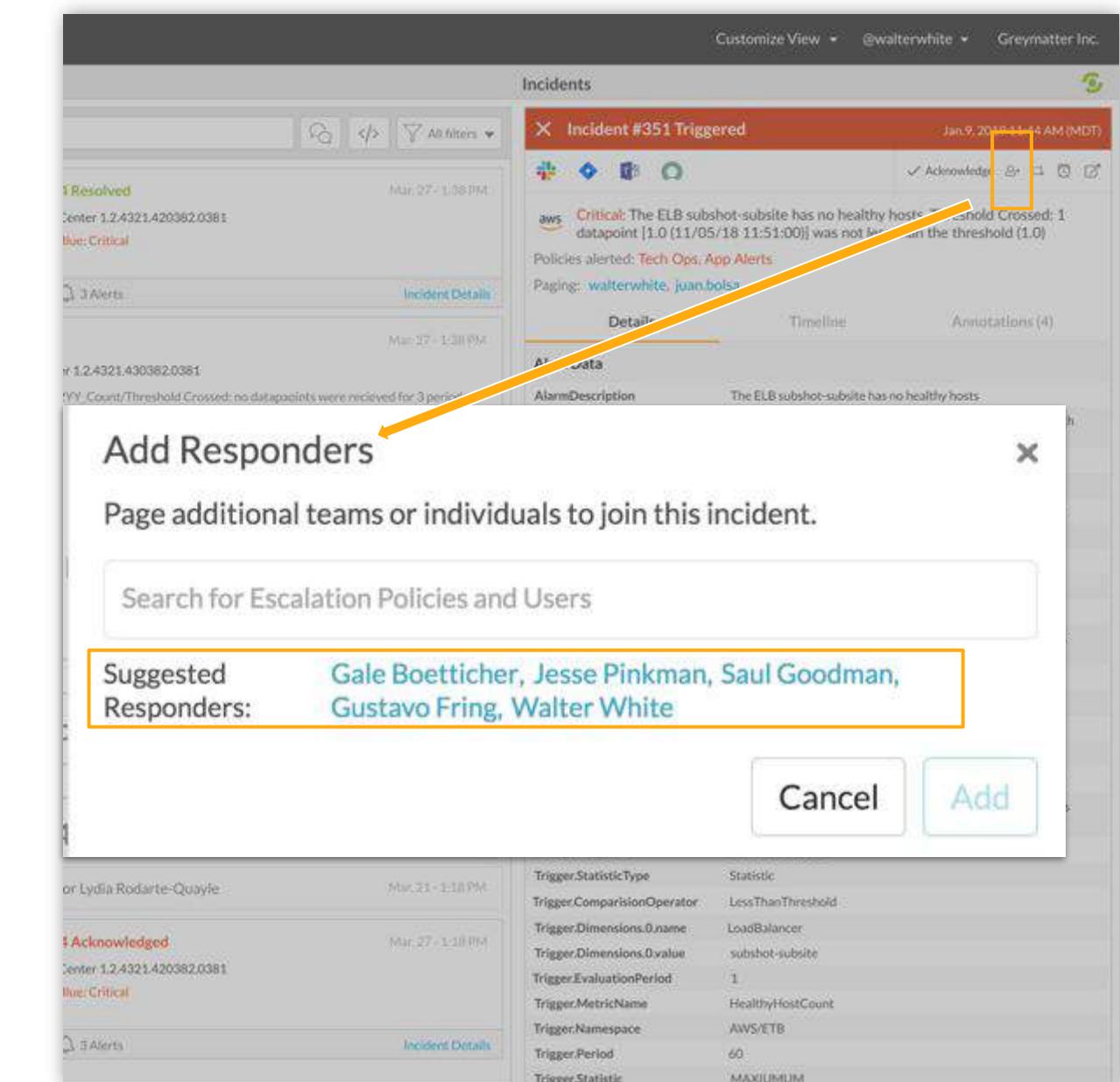
Incident Correlation

Splunk On-Call **leverages ML** to correlate like incidents and decipher which person or people have worked on similar incidents in the past.

The **Suggested Responders** are listed when a user clicks **Add Responder**—making it possible to loop in knowledgeable colleague/s to the firefight in moments.

Benefits:

- ❑ Reduce isolation
- ❑ Leverage tribal knowledge to reduce MTTR
- ❑ Improve morale/ reduce burn out



Splunk AI Toolkit

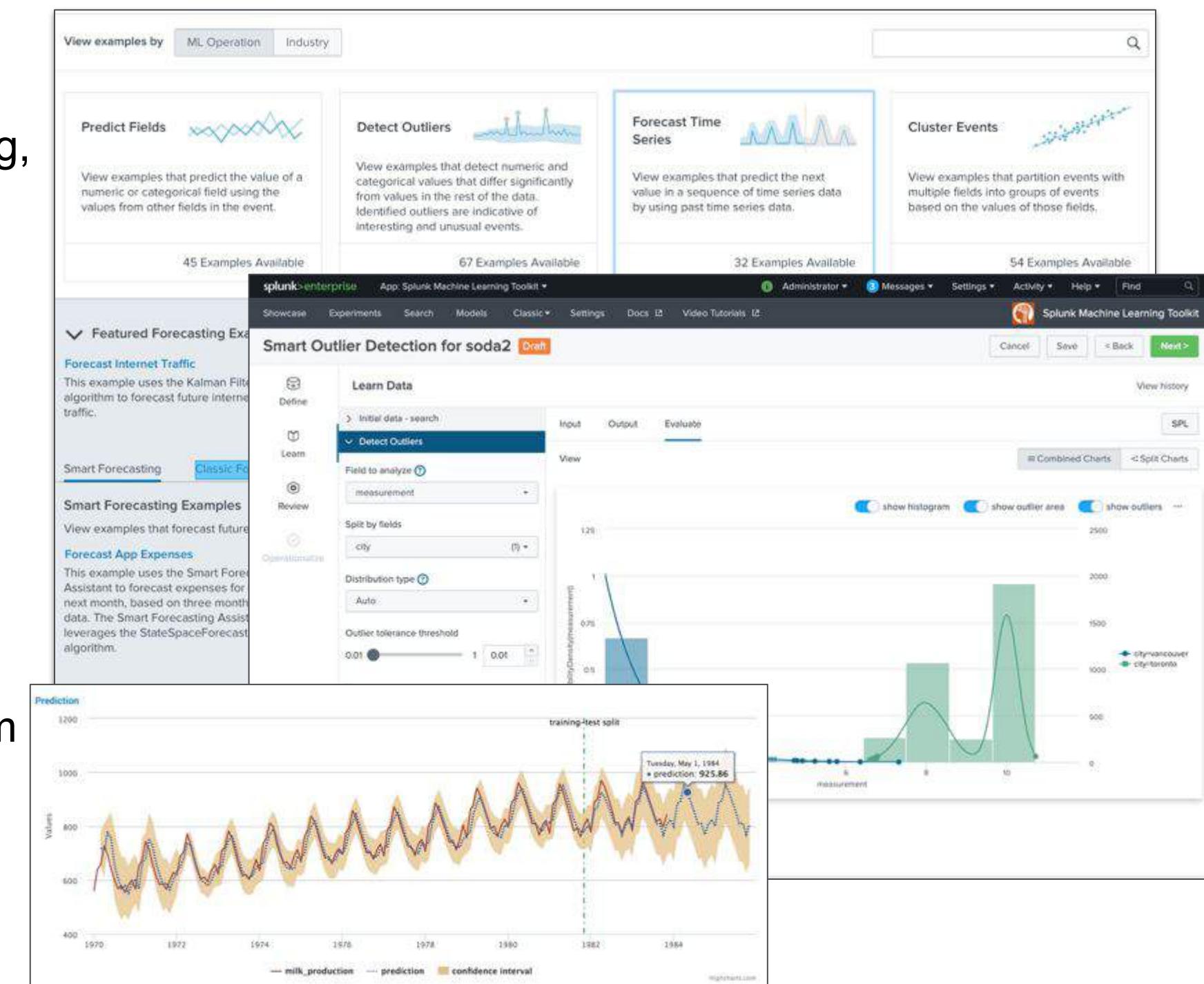
Extends Splunk to operationalize Machine Learning – freely available on Splunkbase

Built for the Citizen Data Scientist

- Experiments and Assistants:** Guided model building, testing, and deployment for common objectives
- Algorithms:** 80+ standard algorithms (supervised & unsupervised)

Extensible to operationalize any use case

- Python for Scientific Computing Library:** Access to 300+ open source algorithms
- Deep Learning Toolkit:** Supports NN and GPU accelerated machine learning
- ML-SPL API:** Import any open-source or proprietary algorithm



Splunk AI Toolkit

LLM Integrations

- New feature to allow customers to connect to external LLM models, from providers including OpenAI, Gemini, AWS Bedrock, Anthropic, Grok, Microsoft hosted OpenAI and Ollama
- New search command that allows users to pass data through an external LLM and present the results in the search pipeline

Enhanced ONNX apply

- ONNX apply now supports multi-variate outputs
- Additional configuration options are now available for ONNX apply, such as choice of activation function
- Documentation available to programmatically upload ONNX models to MLTK, without having to upload them manually via the UI

Fixed Vulnerabilities

- Upgrading OpenSSL to v3.4 to mitigate a [critical vulnerability](#) in PSC 4.2.3 and 3.2.3

LLM Integration: What is it?

- ❖ Customers can connect to externally hosted LLMs
- ❖ Through a natural, human language search command, Splunk data is sent to external LLMs, presenting the response back in Splunk
- ❖ Current support for OpenAI, AWS Bedrock, Gemini, Groq & Olama

The screenshot shows the Splunk Enterprise web interface. At the top, there's a navigation bar with links like 'splunk>enterprise', 'Apps', 'Administrator', 'Messages', 'Settings', 'Activity', 'Help', and 'Find'. Below the navigation bar is a search bar and an 'AI Toolkit' icon. The main content area is titled 'Connection Management Settings'. It includes a note about using the LLM connection feature and a dropdown menu for 'Select Service'. A 'New Search' section is shown with a search bar containing the query: 'index="tenant&_test" sourcetype=WinEventLog signature_id=1056 |table _time user signature_id |ai prompt="Please explain this signature_id to me From a Windows Events perspective: (signature_id)"'. Below the search bar, it says '2 events [10/25 10:32:00.000 AM to 10/25 11:32:36.000 AM] No Event Sampling'. The results are displayed in a table with columns: 'signature_id', '_time', 'user', and 'ai_result_1'. The first event is highlighted with a blue border. The 'ai_result_1' column contains a detailed explanation of Windows Event ID 1056. The interface also includes tabs for 'Events', 'Patterns', 'Statistics (2)', and 'Visualization', along with various search and filter options.

Splunk Data Science and Deep Learning 5.2

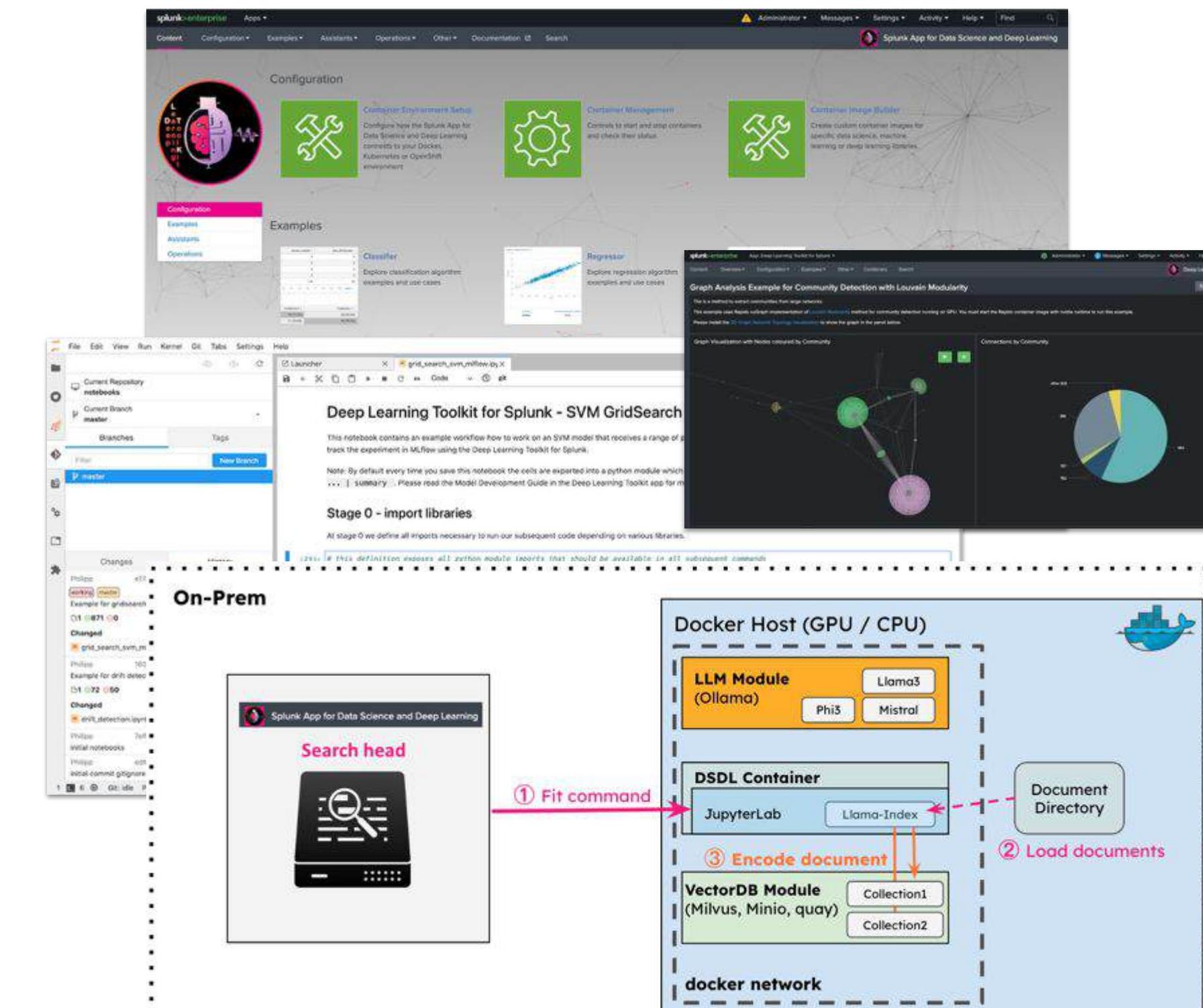
Extension for Splunk AI Toolkit to operationalize advanced custom AI / ML use cases

Built for Data Scientists / AI Engineers

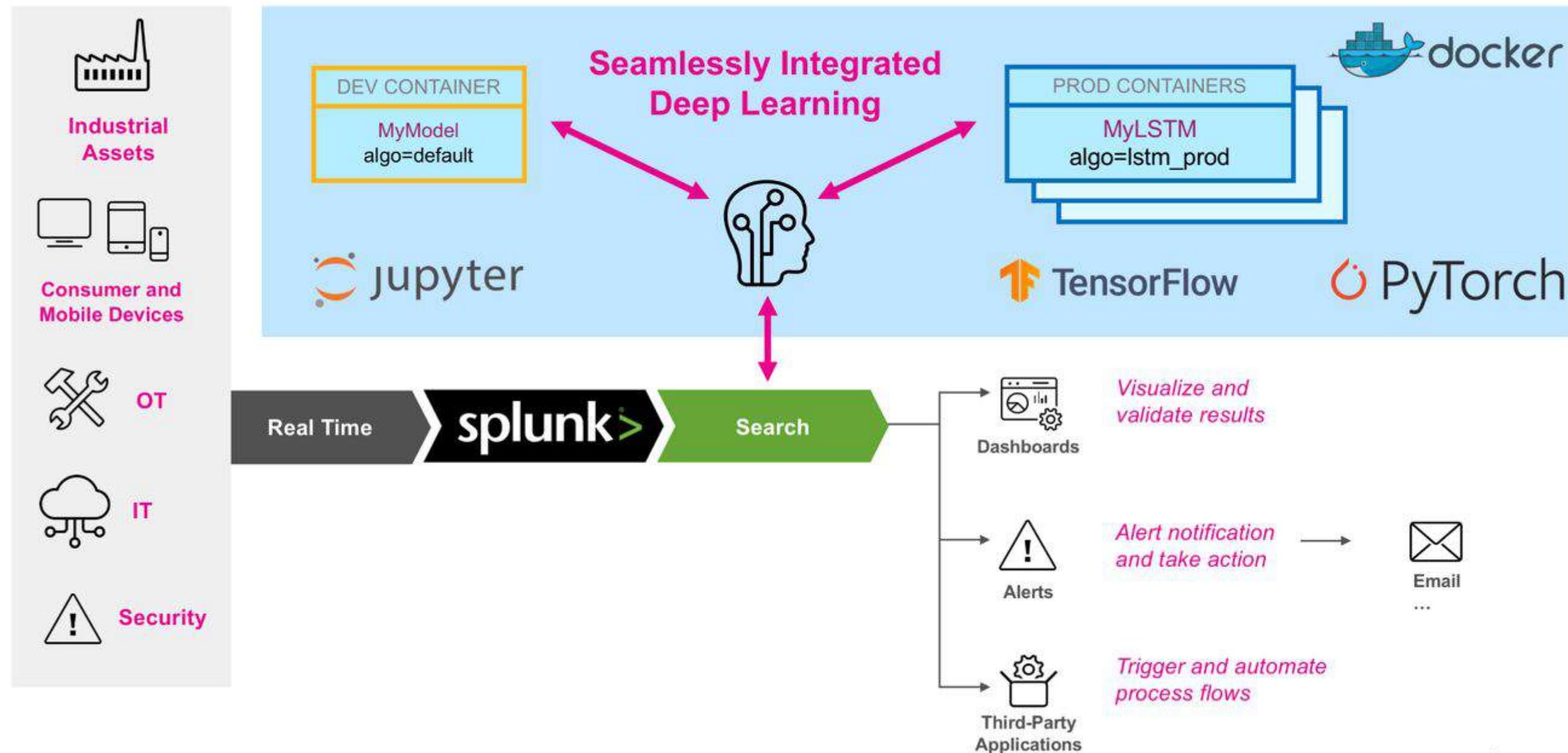
- 35+ Code Examples:** Guided model building, testing, and deployment of data science and deep learning frameworks
- Container Management:** Models can be productionized for scalability & optimization of resources, e.g. CPU & GPU
- State of the art AI frameworks and tools:** Jupyter Lab, MLflow, PyTorch, TensorFlow, SpaCy, DASK, Rapids, Spark, ...
- Flexible deployments and open source:** deploy on-prem, hybrid or in the cloud. Github repository for customization.

New updates in version 5.2

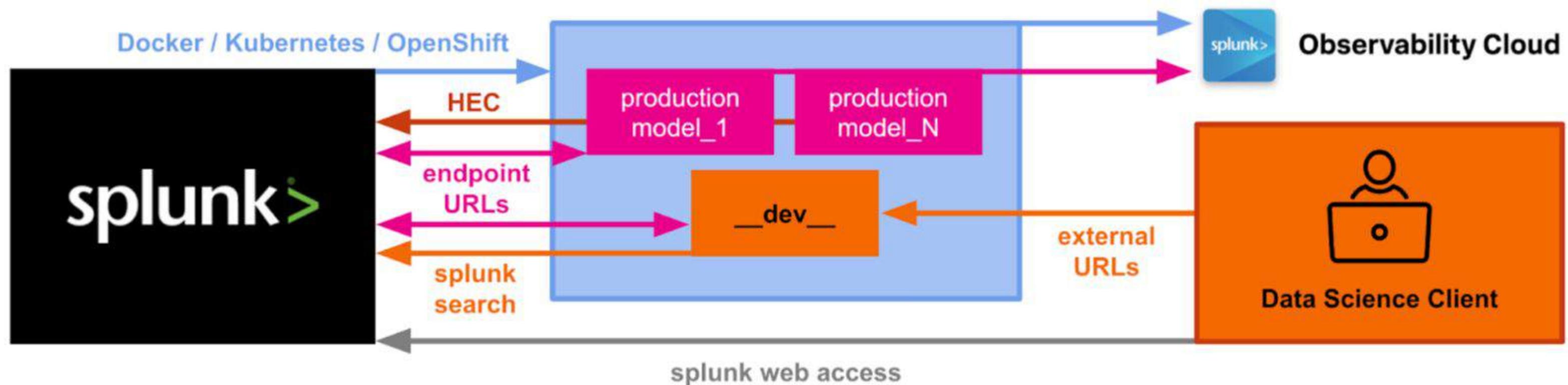
- Container extensions for LLM and VectorDB services to enable highly customizable AI use cases.**
- Custom LLM RAG based applications built on Splunk indexed data and non-Splunk, external data sources**
- 8 new dashboards to easily access the new features with all codebase shared in the public github repo to start building own extensions or use cases.**



Splunk DSDL - Architecture

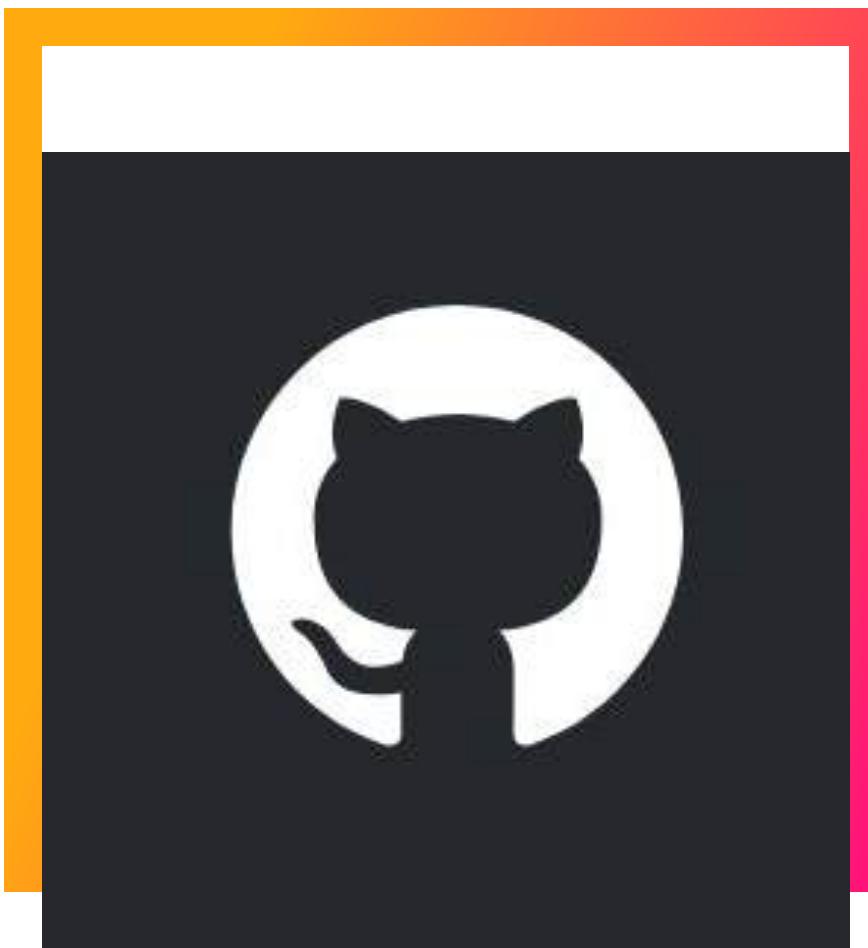
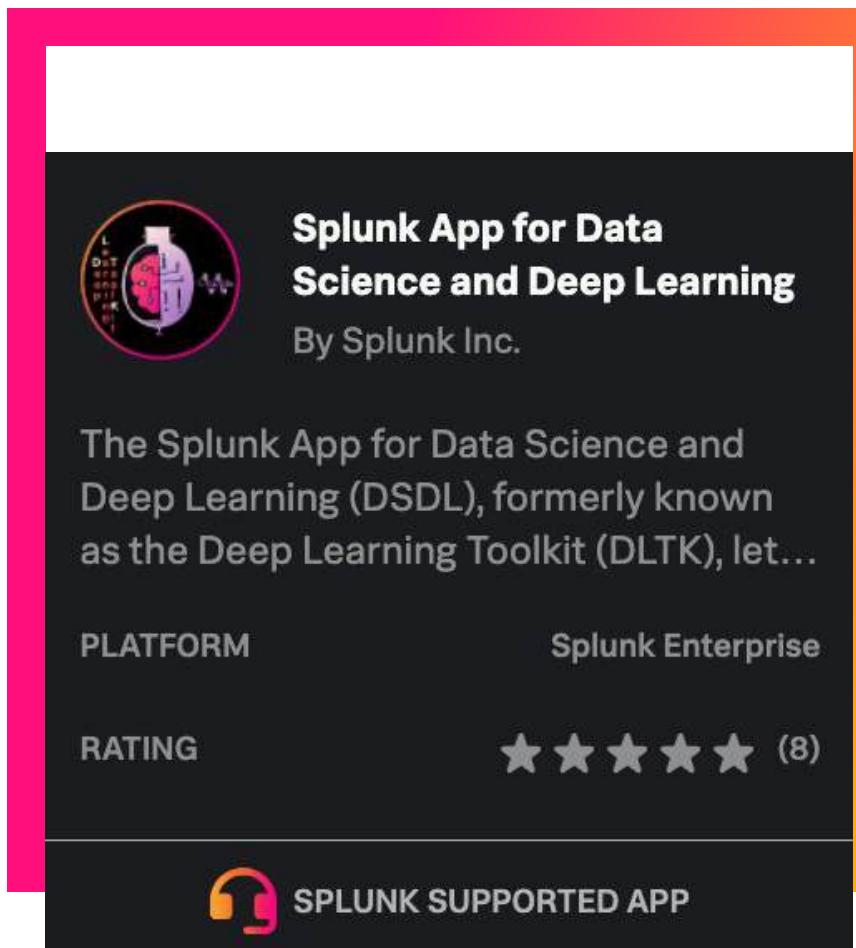


Splunk DSDL - Flow



DSDL 5.2 Resources

DEMO Video: [Link to video](#)



The image is a screenshot of the "Use the Splunk App for Data Science and Deep Learning" page. It includes sections for "About LLM-RAG" (describing challenges like security and accuracy), "LLM-RAG features" (mentioning a compute command and knowledge bases), and a note about Docker support. The page has a red header and sidebar.

DSDL App Package

Simply install the DSDL 5.2 on your Splunk search head and get started.

Github Repository

Fork the current v5.2 branch from DSDL's public github and extend to your needs.

Documentation

Learn how to setup DSDL 5.2 with the help of this guide.

Python for Scientific Computing

Extend the Splunk Platform Python runtime with AI specific libraries

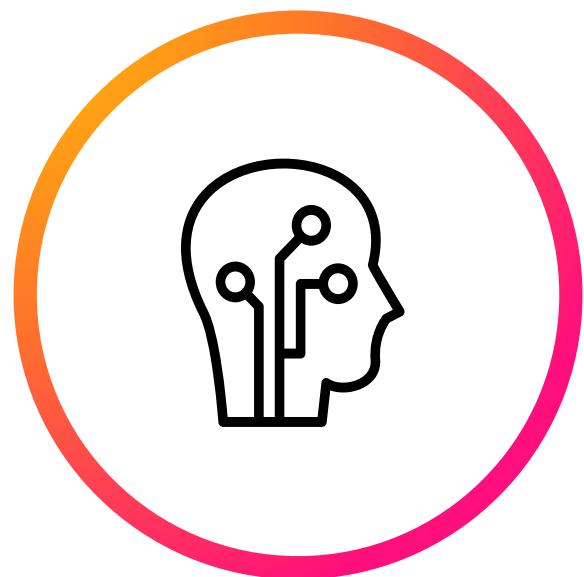


Run complex AI/ML based analytics in the Splunk Platform with a broad range of supported Open Source Python libraries

Where Are We Going with AI?

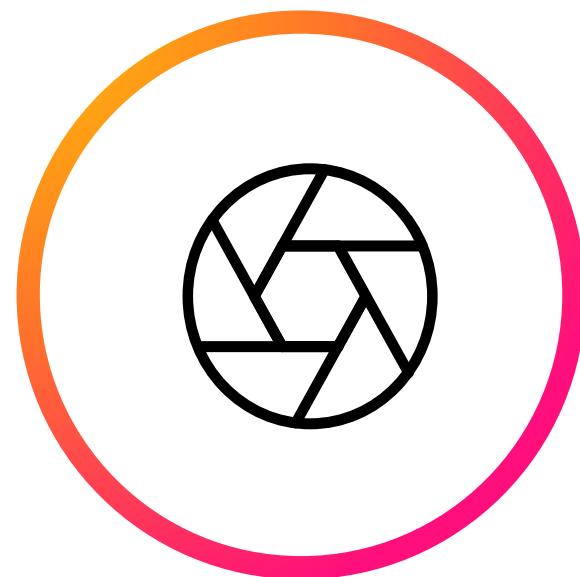
Unified experience across Splunk with a scalable backend to power them

We are moving from toolkit capabilities to end-to-end ML guidance for data in Splunk



More Splunk-specific, trusted Generative AI

Improve our generative AI in Splunk AI Assistant and expand into other use cases and products



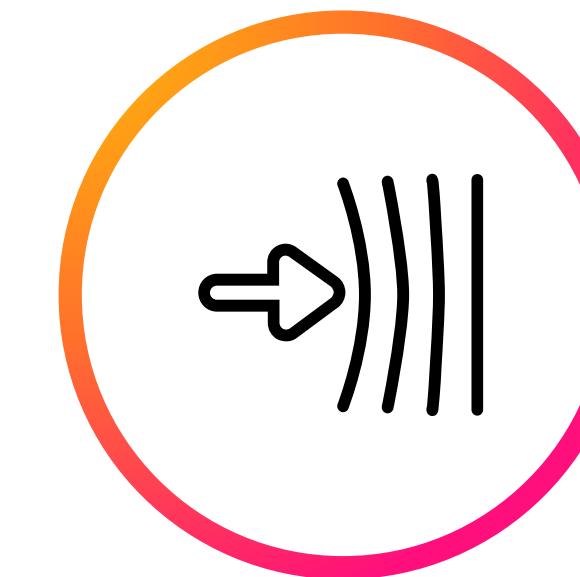
Additional embedded AI

Integrate more AI into users' everyday workflows in Splunk products and build more assistive experiences



Run ML at Scale

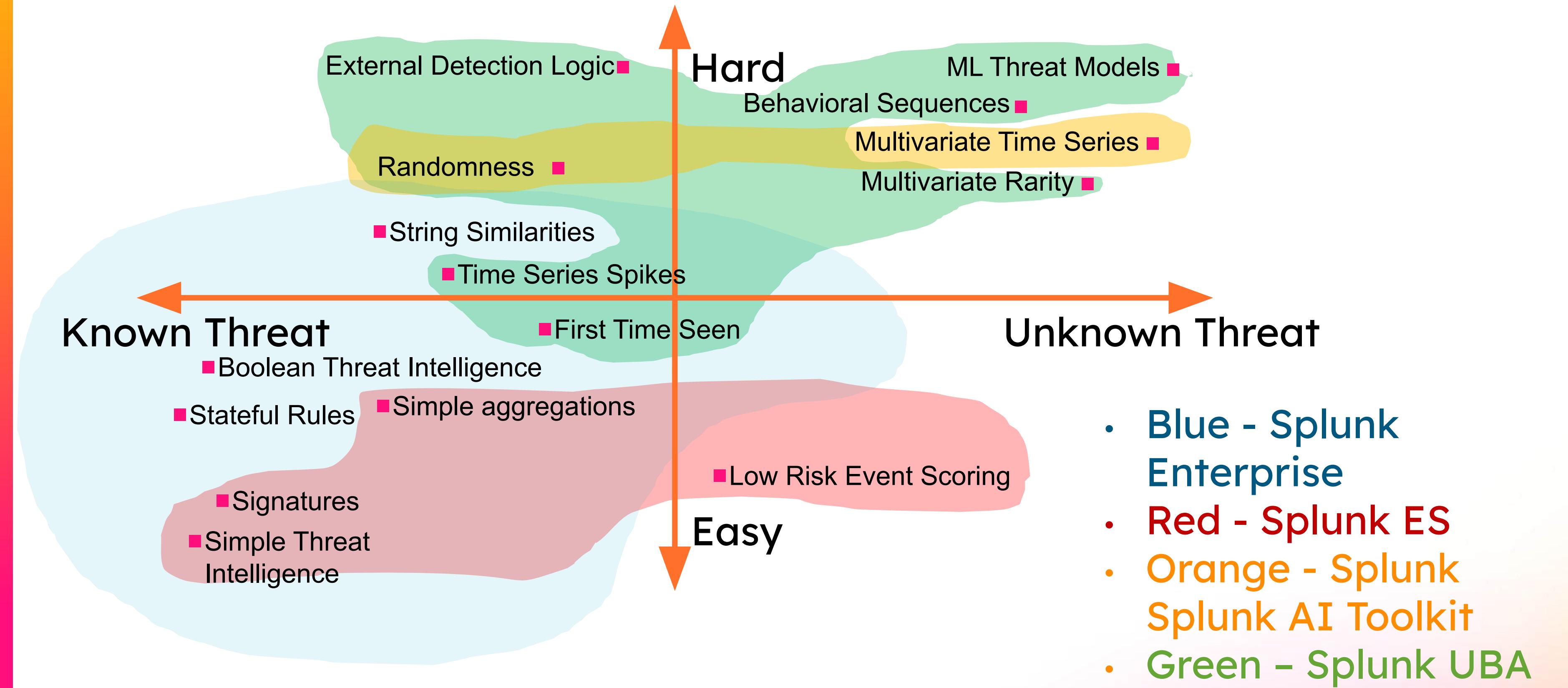
Develop a robust runtime to power large-scale ML model training and deployment



Extensible ML for Splunk developers

Build an SDK to empower developers to create ML powered experiences

Detective Controls by Difficulty



Splunk AI Assistants

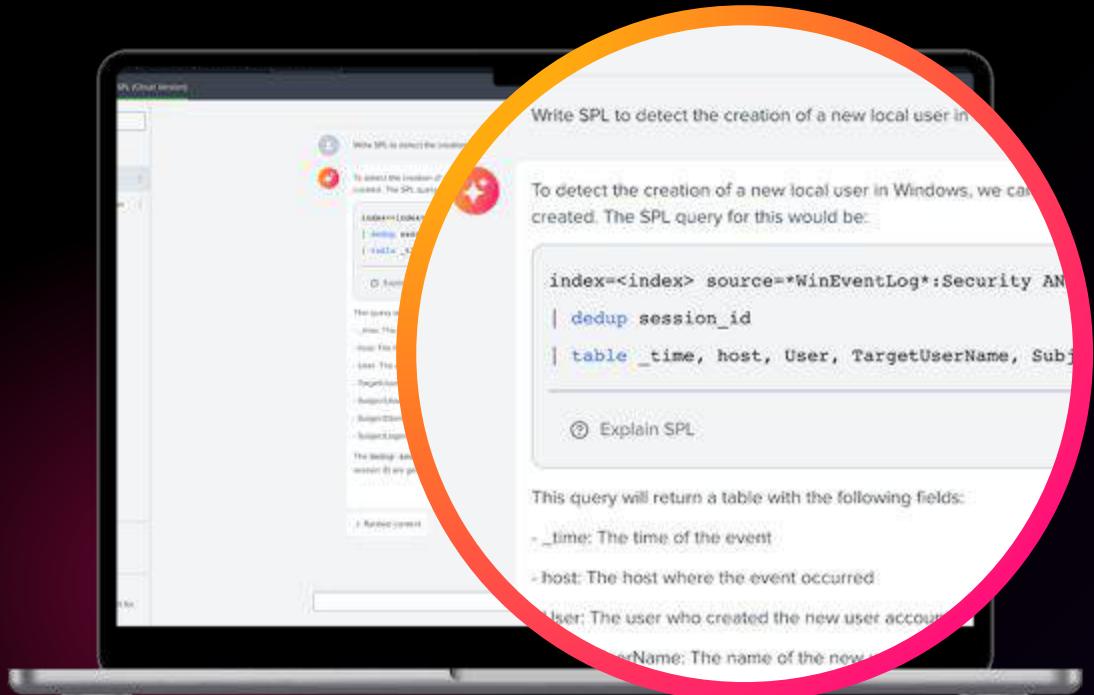
splunk>
a CISCO company



Splunk AI Assistants everywhere

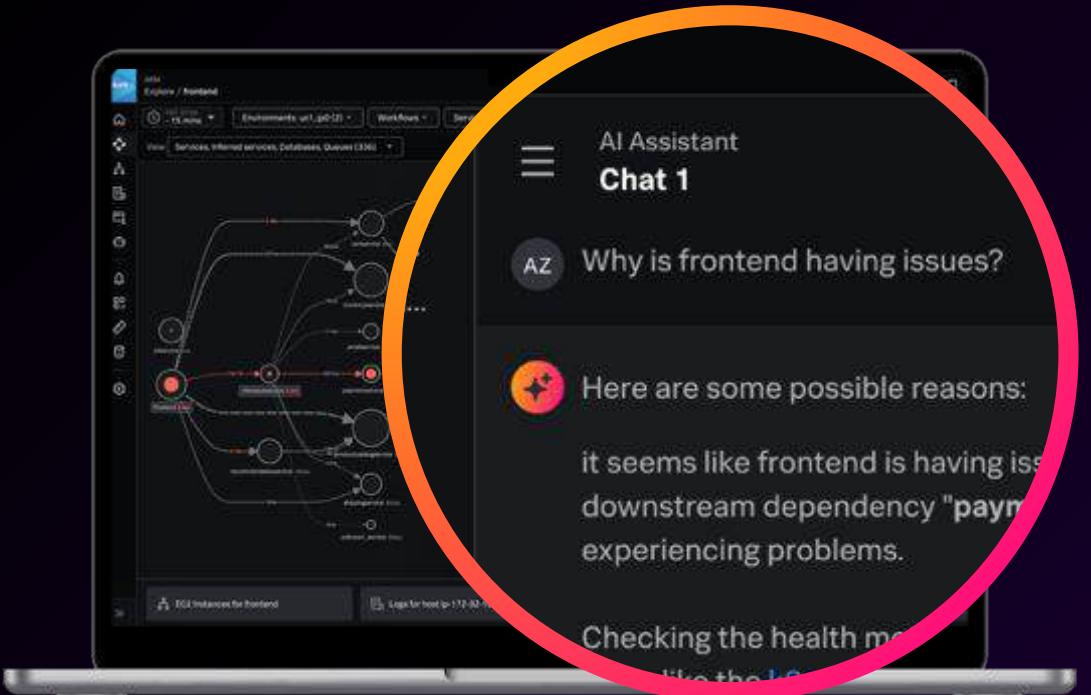
Increase productivity and deliver faster detection and response

AI Assistant for SPL



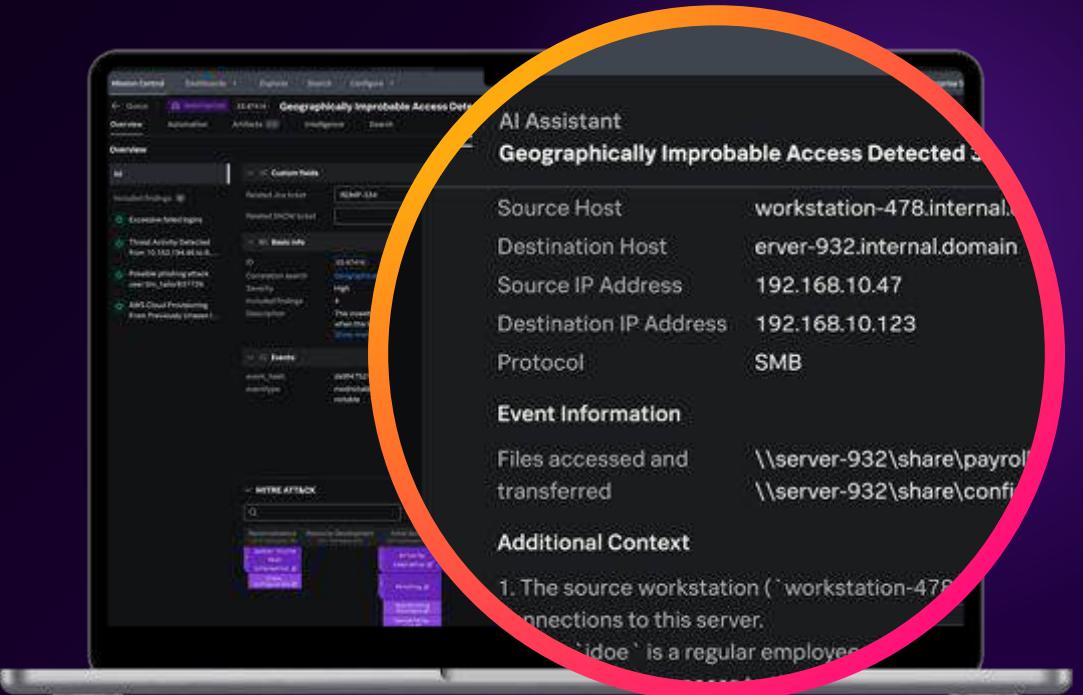
Generally Available

AI Assistant in Observability Cloud



Generally Available

AI Assistant in Enterprise Security



Preview

AI Assistant for SPL

Available in Splunk Cloud

- ▶ Get your job done faster using natural language
- ▶ Chat with your data to drill down to deeper insights
- ▶ Accelerate your learning journey to become the expert

The screenshot shows the Splunk AI Assistant interface. On the left, there's a sidebar with 'Chat', 'Usage guidelines', and 'Settings'. The main area has a query card with a pink icon. The query is:

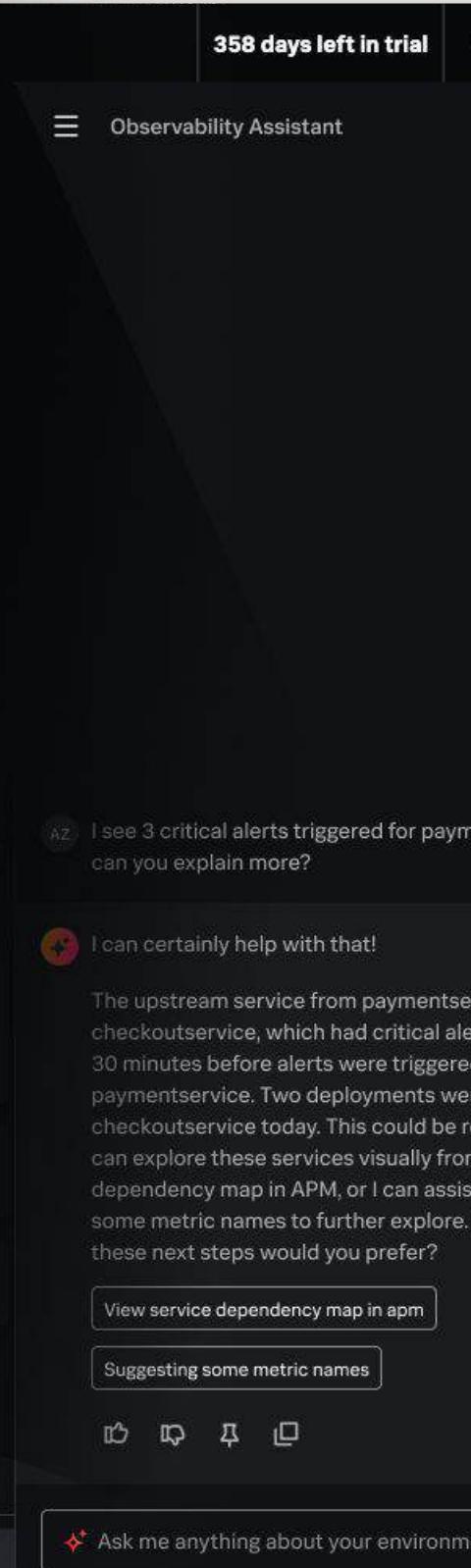
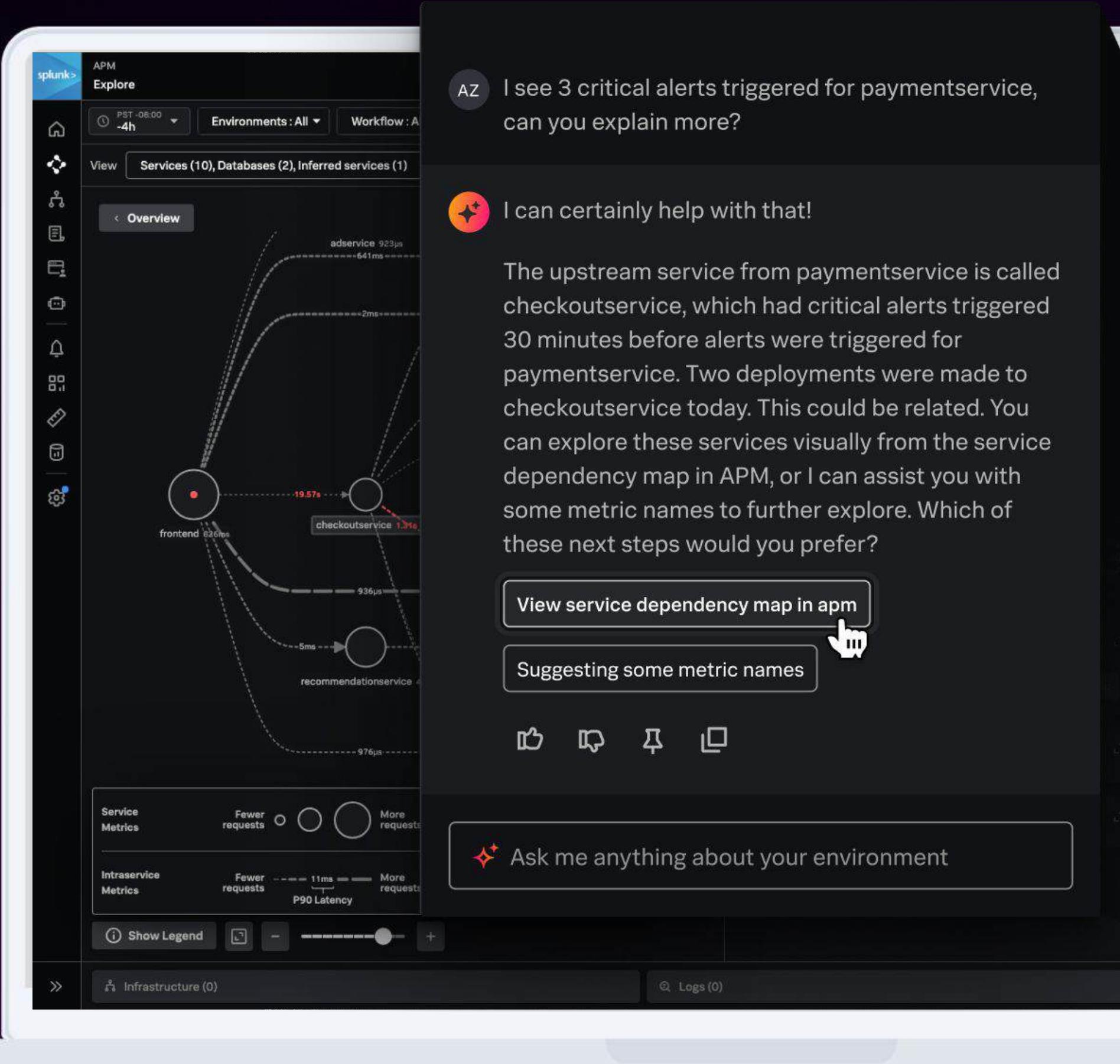
```
| tstats count from datamodel=Authentication.Authentication where Authentication.action="failure" earliest=-7d@d latest=now() by Authentication.user | top limit=10 Authentication.user
```

Below the query, it says: "The query retrieves the top 10 users with the highest number of failed authentication attempts in the past 7 days." A large black circle highlights this section. To the right, under "SPL command details", it explains the `tstats` command and the `from datamodel=Authentication.Authentication` part. At the bottom, it says: "Splunk AI Assistant is under development and actively improving responses based on your feedback."

AI Assistant in Observability Cloud

*Find and fix issues faster using
natural language*

- ▶ Surface key insights by chatting with your data
- ▶ Powered by agentic AI to accelerate investigations and daily monitoring tasks
- ▶ Get context and guided recommendations as you troubleshoot



AI Assistant in Enterprise Security

Guided Enterprise Security workflows

- ▶ Answer analyst questions to guide daily workflows.
- ▶ Use natural language queries to investigate more quickly.
- ▶ Save time while addressing threats more rapidly.

The screenshot displays the AI Assistant in Enterprise Security interface. At the top, a banner indicates a '24 hour risk threshold exceeded for system=win-srv1.acme.local'. Below this, the 'Overview' section includes a 'MITRE ATT&CK map' showing detections across various techniques like Initial Access, Execution, Persistence, and Privilege Escalation. A timeline below tracks specific findings such as suspicious registry keys, cmd.exe spawning, and PowerShell activity. To the right, a sidebar shows a conversation with 'John Smith' and the AI, with the AI providing guidance on generating SPL queries and summarizing findings.

AI Assistant skills:

- SPL Generation based on the user's Splunk environment:**
 - This involves creating or generating Splunk Processing Language (SPL) queries according to the user's requirements and the available structure and data in the user's Splunk environment.
- Summarizing security findings:**
 - Reviewed all process activity for user bstoll
 - parent_process_name", "process_name", "process_count, firstTime, lastTime
 - "svchost.exe", "InstallAgent.exe", "C:\Windows\System32\Inst
- Recommending Security Content:**
 - This involves detecting various threats within the environment.

These features enable reporting of security events and advanced analytics analysis.

AI Assistant in Enterprise Security is currently in preview. UI shown is for illustration; not final product.

Splunk AI Toolkit demo

Hands-on labs

Lab 1

Detect Password Spraying Attack-
Credential Access



Detect Password Spraying Attack

Credential Access

Lab 1



Detect Password Spraying Attack-Credential Access

What is Password Spraying?

Technique [T1110.003](#) in the MITRE ATT&CK Framework, Password spraying differs from a [typical brute-force attack](#), where attackers try many passwords against a specific user account. However, we can consider spraying a type of brute force attack – it involves a trial-and-error approach of “spraying” a single password across many accounts until a match is found.

This approach enables attackers to avoid countermeasures like account locking when specific login attempts with different passwords have been exceeded. Thus, it is difficult to detect password-spraying attacks without proper detection methods. These password-spraying attacks often target federated authentication used in single sign-on (SSO) and cloud-based applications. Once the attacker gains initial access, they can later access the critical data of organizations.

Using Simple stats

Method 1



Detect Password Spraying Attack

Credential Access

Lab 1



First Technique#1: Simple stats

Detect (Remote) Password Spraying Attacks

How to detect this type of attack?

Tips: Windows Event Logs – Which Event code indicates a failed attempt to login to a device? What event indicates a remote authentication attempt? (Optional) You can also filter per Process Name, Computer...

As for the first lab, use transforming commands to visualize your results ([eval](#), [stats](#), [timechart](#), [evenstats](#)). Leverage Standard Deviation.

Your turn!

**20 minutes to
complete the lab**

Lab 1

First Technique#1: Simple stats

Detect Remote Password Spraying Attacks

```
index="main" sourcetype="XmlWinEventLog_ws" EventCode=4625 LogonType=3  
| bucket span=2m _time  
| stats dc(TargetUserName) as unique_accounts values(TargetUserName) as  
tried_accounts by _time,IpAddress, LogonType, dvc  
| eventstats avg(unique_accounts) as comp_avg, stdev(unique_accounts) as comp_std  
by ipAddress, LogonType, dvc  
| eval upperBound=(comp_avg+comp_std*2)  
| eval isOutlier;if(unique_accounts > 6 AND unique_accounts >= upperBound, 1, 0)  
| search isOutlier=1
```

Finding and Removing Outliers: <https://splk.it/3s0Pig5>

First Technique#1: Simple stats

Detect Remote Password Spraying attacks

The screenshot shows the Splunk Enterprise search interface. The search bar contains the following SPL query:

```
index="main" sourcetype="XmlWinEventLog_ws" EventCode=4625 LogonType=3  
| bucket span=2m _time  
| stats dc(TargetUserName) AS unique_accounts values(TargetUserName) as tried_accounts by _time, IPAddress, LogonType, dvc  
| eventstats avg(unique_accounts) as comp_avg , stdev(unique_accounts) as comp_std by IPAddress, LogonType, dvc  
| eval upperBound=(comp_avg+comp_std*2)  
| eval isOutlier=if(unique_accounts > 6 and unique_accounts >= upperBound, 1, 0)  
| search isOutlier=1
```

The search results table has the following columns:

_time	IPAddress	LogonType	dvc	unique_accounts	tried_accounts	comp_avg	comp_std	isOutlier	upperBound
2023-10-28 11:24:00	172.16.48.255	3	computer9	7	user23 user35 user42 user44 user54 user55 user93	3.490566037735849	1.4090728199427118	1	6.308711677621273
2023-10-28 21:48:00	172.16.48.255	3	computer9	7	user11 user36 user58 user63 user86 user88 user89	3.490566037735849	1.4090728199427118	1	6.308711677621273
2023-10-29 01:20:00	172.16.48.255	3	computer4	7	user33 user46 user47 user51 user64 user7 user77	3.7142857142857144	1.266647387553302	1	6.247580489392318

Finding and Removing Outliers: <https://splk.it/3s0Pig5>

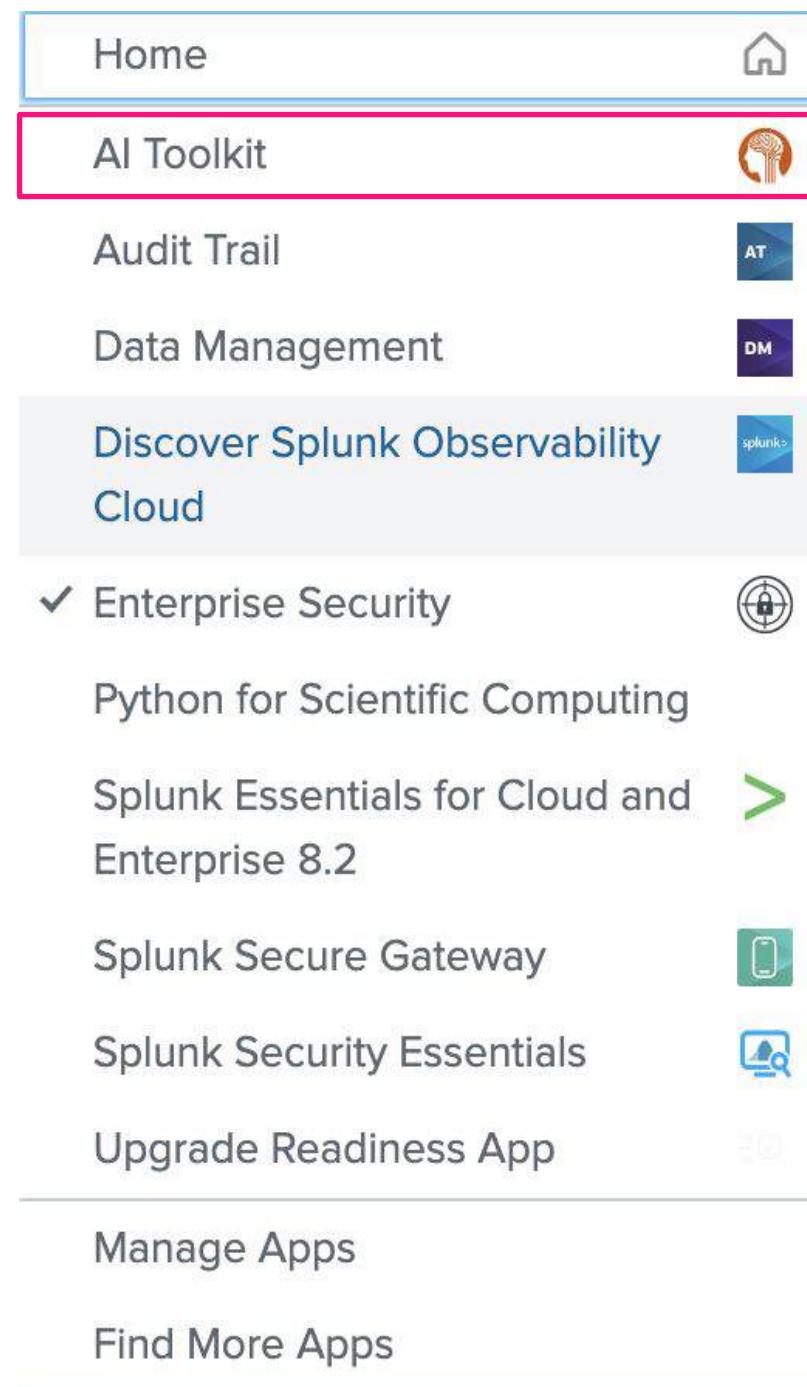
Using Splunk AI Toolkit

Method 2



Splunk AI Toolkit:

First navigate to your Splunk AI Toolkit application from the Apps menu:



Open the
Splunk AI Toolkit app

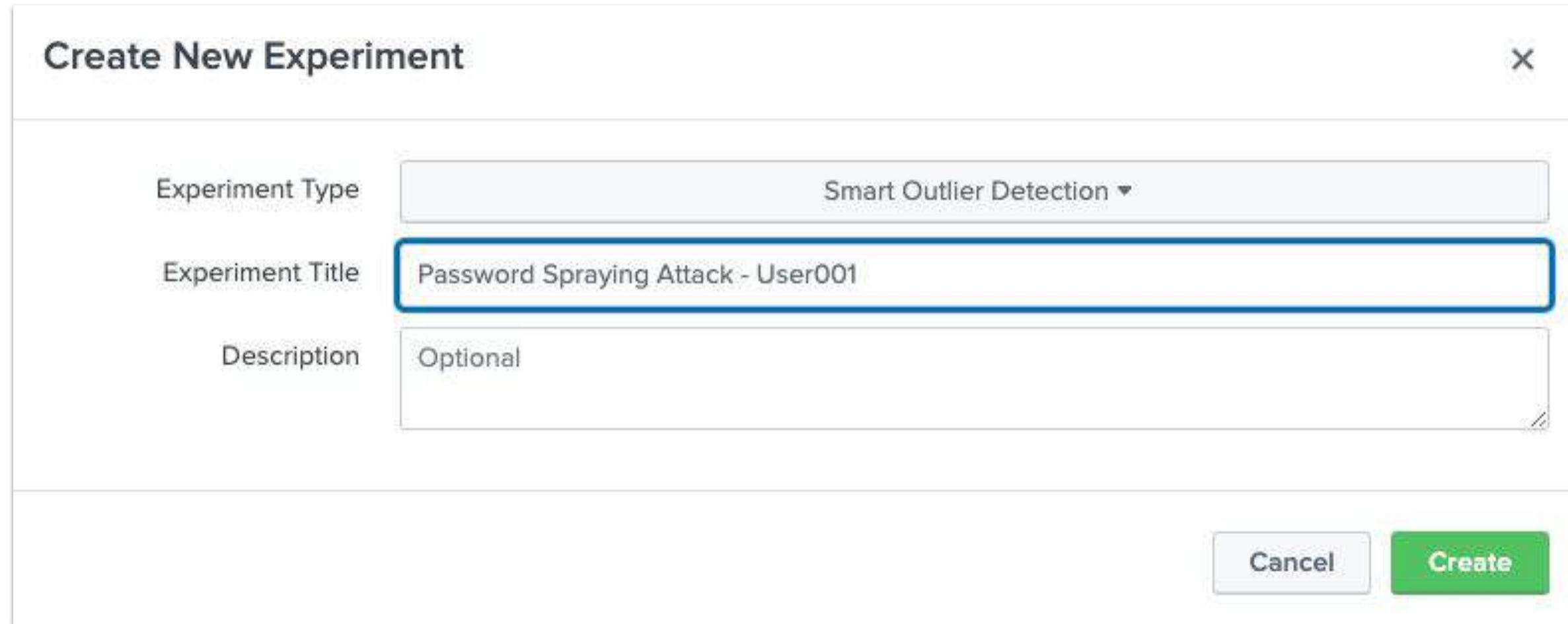
Second Technique#2: Using Splunk AI Toolkit

1. Navigate to the Splunk AI Toolkit App
2. Choose Experiment
3. Select “Smart Outlier Detection”, name your experiment as per below, **adding your username (e.g. UserXXX)**

Create New Experiment X

Experiment Type	Smart Outlier Detection ▾
Experiment Title	>Password Spraying Attack - User001
Description	Optional

Cancel Create



Second Technique#2: Using Splunk AI Toolkit

Splunk4Ninjas - Machine Learning for Security Workshop

splunk>enterprise Apps ▾

Administrator ▾ 2 Messages ▾ Settings ▾ Activity ▾ Help ▾ Find Q

Showcase Experiments Search Models Connection Management Alerts Docs ▾ Video Tutorials ▾

AI Toolkit

Smart Outlier Detection: Password Spraying Attack

Define Data Source View history

Search Datasets Metrics

All time ▾

```
index="main" sourcetype="XmlWinEventLog_ws" EventCode=4625 LogonType=3  
| bucket span=2m _time  
| stats dc(TargetUserName) AS unique_accounts values(_time,IpAddress,LogonType,dvc)  
| eval HourOfDay = strftime(_time,"%H") | eval HourOfDay=floor(HourOfDay/4)*4 | eval DayofWeek = strftime(_time,"%w") | eval isWeekend=if(DayofWeek >= 1 AND DayofWeek <= 5, 0,1)
```

✓ 1,086 events (01/01/2019 00:00:00.000 to 30/09/2025 16:33:41.000)

Data Preview Visualization Job ▾ Smart Mode ▾

20 Per Page ▾ 1 2 3 4 5 6 7 8 9 10 Next ▾

_time	IpAddress	LogonType	dvc	unique_accounts	tried_accounts	DayofWeek	HourOfDay	isWeekend
2023-10-23 00:00:00	192.168.14.246	3	computer9	1	user68	1	0	1
2023-10-23 00:56:00	192.168.14.246	3	computer9	1	user68	1	0	1
2023-10-23 04:28:00	192.168.148.191	3	computer8	1	user31	1	4	1
2023-10-23 05:04:00	192.168.148.191	3	computer8	1	user31	1	4	1
2023-10-23 05:24:00	192.168.148.191	3	computer8	1	user31	1	4	1
2023-10-23 07:26:00	192.168.117.225	3	computer6	1	user9	1	4	1
2023-10-23 08:08:00	192.168.117.225	3	computer6	1	user9	1	8	1
2023-10-23 08:42:00	192.168.117.225	3	computer6	1	user9	1	8	1
2023-10-23 09:56:00	192.168.97.87	3	computer2	1	user14	1	8	1
2023-10-23 11:00:00	192.168.154.233	3	computer8	1	user28	1	8	1
2023-10-23 11:58:00	192.168.154.233	3	computer8	1	user28	1	8	1
2023-10-23 12:10:00	192.168.154.233	3	computer8	1	user28	1	12	1
2023-10-23 13:04:00	192.168.154.233	3	computer8	1	user28	1	12	1
2023-10-23 14:26:00	192.168.167.227	3	computer1	1	user77	1	12	1

Define Learn Review Operationalize

Second Technique#2: Using Splunk AI Toolkit

Splunk4Ninjas - Machine Learning for Security Workshop

splunk>enterprise Apps ▾

Administrator 3 Messages Settings Activity Help Find Q

Showcase Experiments Search Models Connection Management Alerts Docs Video Tutorials

AI Toolkit

Smart Outlier Detection: Password Spraying Attack Draft

Detect outliers in **unique_accounts**, split by **dvc**, using **Auto** distribution with a threshold of **0.0004**

Cancel Save < Back Next >

Learn Data View history

+ Add preprocessing step

Input Output Evaluate

SPL

Define Learn Review Operationalize

Learn Outliers

Too few training points in some groups will likely result in poor accuracy for those groups. Please see model summary to inspect such groups.

Mode Automatic Manual Outlier tolerance threshold 0.0001 0.0004 Apply Total Outliers 4

Chart Type Density Time View Top 3 groups with most outliers Groups computer10, computer3, computer1

Field to analyze unique_accounts

Split by fields dvc (1)

Distribution type Auto

Outlier tolerance threshold 0.0001 0.0004

Supervised Grouping

Notes (optional)

computer10

show confidence interval show outliers ...

unique_accounts

2 outliers

28. Oct 29. Oct 30. Oct 31. Oct 1. Nov 2. Nov 3. Nov 4. Nov 5. Nov

Second Technique#2: Using Splunk AI Toolkit

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Administrator 3 Messages Settings Activity Help Find Search

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AI Toolkit

Smart Outlier Detection: Password Spraying Attack Draft

Cancel Save < Back Save and Next >

Detect outliers in *unique_accounts*, split by *dvc*, using *Auto* distribution with a threshold of **0.0004**

Review Experiment

Model Summary Cardinality Histogram Distribution Properties Outlier Analysis

3 Beta | 4 Gaussian KDE | 3 Normal 4 Outliers

20 Per Page ▾

dvc	type	min	max	mean	std	cardinality	distance	other
computer1	Auto: Normal	1	1	1.0	1e-06	51	metric: wasserstein, distance: 9.213671071324072e-07	N/A
computer10	Auto: Beta	1	6	-3.207937322873393e-30	1.2035562762884933	48	metric: wasserstein, distance: 0.3851569759147381	Alpha: 0.21586991947424516, Beta: 1.2433236370198788
computer2	Auto: Beta	1	6	-3.491400681762069e-30	1.07968046224803	56	metric: wasserstein, distance: 0.20829555411452907	Alpha: 0.14902667318704887, Beta: 0.5186390718215874
computer3	Auto: Beta	1	6	-2.8174272008511606e-31	5.56401846259862	68	metric: wasserstein, distance: 0.5132473754073926	Alpha: 0.4295034887482143, Beta: 30.028464608591513
computer4	Auto: Gaussian KDE	1	7	1.5846153846153845	1.251366117394631	65	metric: wasserstein, distance: 0.4177570339313986	bandwidth: 0.5430023639693298, parameter size: 65
computer5	Auto: Normal	1	1	1.0	1e-06	46	metric: wasserstein, distance: 7.991304591537447e-07	N/A
computer6	Auto: Normal	1	1	1.0	1e-06	38	metric: wasserstein, distance: 8.309027759723087e-07	N/A
computer7	Auto: Gaussian KDE	1	6	1.873015873015873	1.3626778432593496	63	metric: wasserstein, distance: 0.40509311752869226	bandwidth: 0.5950111232471944, parameter size: 63
computer8	Auto: Gaussian KDE	1	6	2.1123595505617976	1.487311141799572	89	metric: wasserstein, distance: 0.5513145121613718	bandwidth: 0.6060714551559376, parameter size: 89
computer9	Auto: Gaussian KDE	1	7	2.32	1.605490579231158	100	metric: wasserstein, distance: 0.36098033435184973	bandwidth: 0.6391573118480116, parameter size: 100

Publish Your Model

Publish the Models

X

Publishing an Experiment model means the main model with any associated preprocessing models will be copied as lookup files in the user's namespace within the selected destination app.

New Main Model Title Model names must start with a letter or underscore and contain only letters, numbers, and underscores

Destination App

Cancel Submit

Privilege Escalation

Lab 2



Using Simple stats

Method 1



First technique#1: Simple stats

Detecting Privileged Escalation Events

How to find anomalies this condition? You need to understand your data first

Tips: Use EventCode 4648, look for Windows Event Logs

Use the `stats` command to look at the volume of events and break it down by user. Use the `sort` command

Other stats functions: `stdev()`, `perc99.999()`...

What can you tell from the results? Anything outside of the ordinary?

First technique#1: Simple stats

Detecting Privileged Escalation Events

Now let's go one step further

Use the Eventstats, stdev command and eval command to find outliers.

How would you do that? You can look at the documentation and figure out the commands to use:

<https://docs.splunk.com/Documentation/SCS/current/SearchReference/Aggregatefunctions#stdev.28.26lt.3Bvalue.26gt.3B.29>

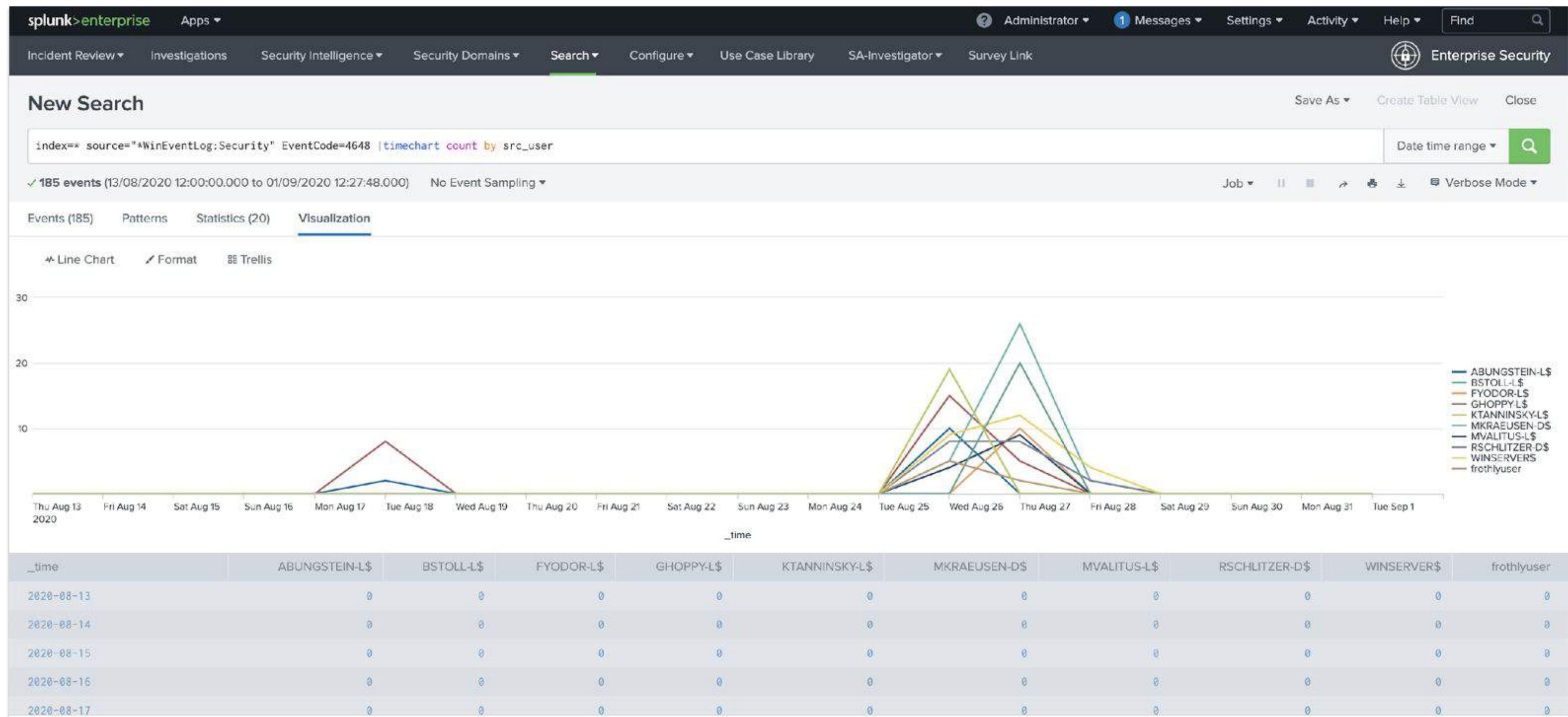
Of course, there is an easier way! 😊

**20 minutes to
complete the lab**

Lab 2

First technique#1: Simple stats

Detecting Privileged Escalation Events



Using Splunk AI Toolkit

Method 2



Splunk AI Toolkit:

First navigate to your Splunk AI Toolkit application from the **Apps** menu:



Open the Splunk AI Toolkit app

Splunk AI Toolkit:

Now let's create an experiment:

1. Go to experiments
2. Choose Detect Numeric Outliers
3. Create New Experiment
4. Choose a title for your experiment (**add your username as it is a shared instance**)
5. Run the following search:

```
index=main source="*WinEventLog:Security" EventCode=4648  
| bucket _time span=1d | stats count by src_user _time
```

6. In Field to analyze, choose count
7. You can pick the Threshold method. For this exercise, the Standard Deviation method is the most suitable
8. You can tweak your Threshold multiplier based on the result that you get (e.g. too many outliers)
9. You can optionally specify a Sliding Window, and you can split by fields
10. Now, click on Detect Outliers

Splunk AI Toolkit:

Detect Numeric Outliers: Escalated Privilege Windows Draft

Find values that differ significantly from previous values.

Experiment Settings Experiment History

Enter a search

```
index=main source="*WinEventLog:Security" EventCode=4648  
| bucket _time span=1d | stats count by src_user _time|
```

All time

✓ 185 events (01/01/2019 00:00:00.000 to 14/11/2023 17:29:43.000)

Field to analyze: count Threshold method: Standard Deviation Threshold multiplier: 2 Sliding window (# of values): (optional) Include current point Fields to split by: (optional)

Notes: (optional)

AI Toolkit:

You can view the SPL query which was generated.

Click the “Show SPL” option:

[Calculate the outliers](#)  X

```
index=main source="*WinEventLog:Security" EventCode=4648 | bucket _time span=1d | stats  
count by src_user _time  
| eventstats avg("count") as avg stdev("count") as stdev          // calculate the mean and standard deviation  
| eval lowerBound=(avg-stdev*exact(2)), upperBound=(avg+stdev*exact(2))    // calculate the bounds as a multiple of the standard deviation  
| eval isOutlier;if('count' < lowerBound OR 'count' > upperBound, 1, 0)      // mark values outside the bounds as outliers
```

Splunk AI Toolkit:

Click on “IsOutlier” to see who is the outlier:

The screenshot shows the Splunk AI Toolkit interface. At the top, there's a navigation bar with links like "Showcase", "Experiments", "Search" (which is highlighted), "Models", "Settings", "Connection Management", "Alerts", "Docs", "Video Tutorials", and "AI Toolkit". Below the search bar, the results are displayed under the heading "New Search". The search query is:

```
index=main source="*WinEventLog:Security" EventCode=4648 | bucket _time span=1d | stats count by src_user _time | eventstats avg("count") as avg stdev("count") as stdev | eval lowerBound=(avg-stdev*exact(2)), upperBound=(avg+stdev*exact(2)) | eval isOutlier=if('count' < lowerBound OR 'count' > upperBound, 1, 0)
```

The results table has columns: src_user, _time, count, avg, isOutlier, lowerBound, stdev, and upperBound. One row is visible:

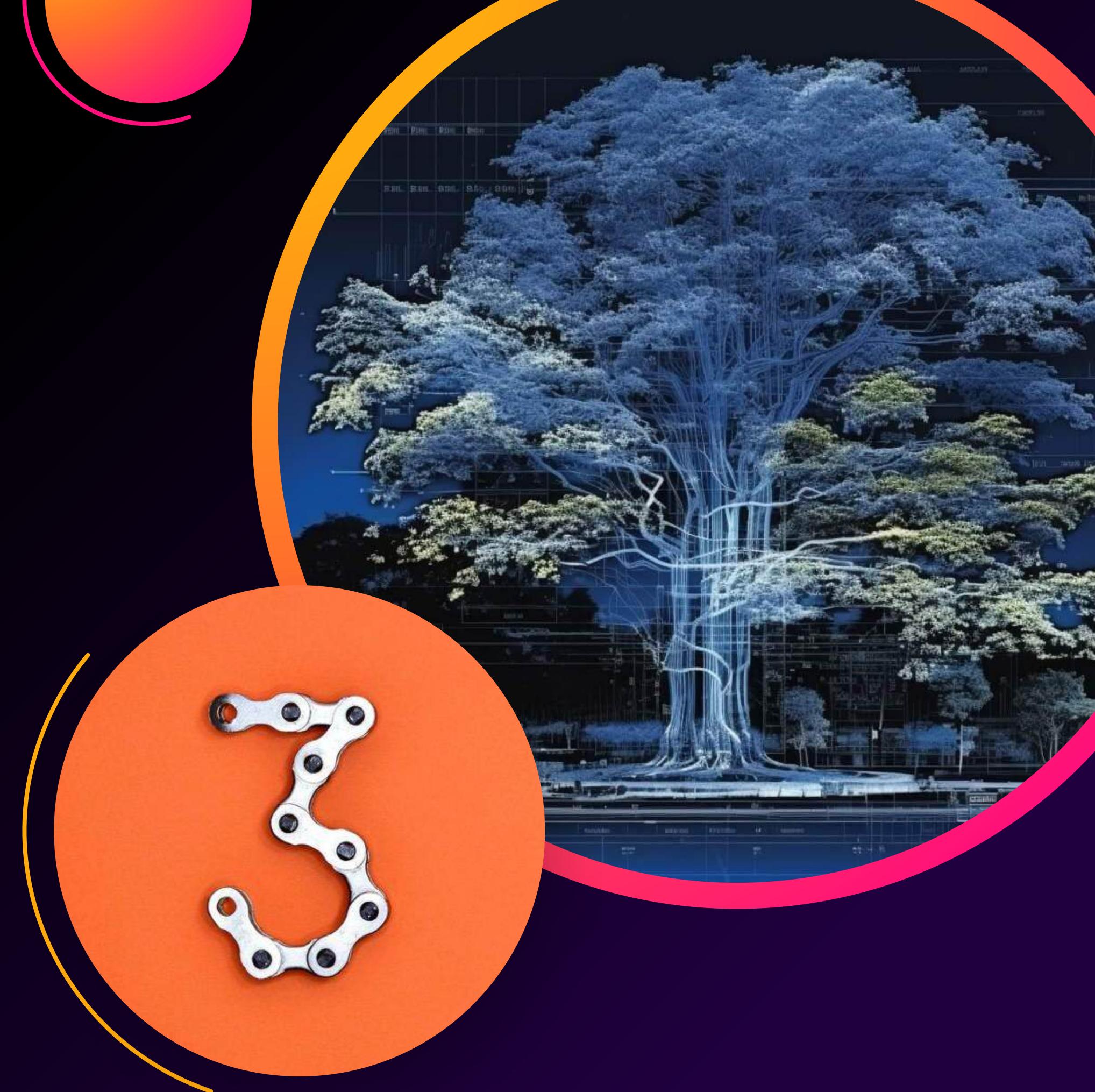
src_user	_time	count	avg	isOutlier	lowerBound	stdev	upperBound
MKRAEUSEN-D\$	2020-08-27	26	8.80952380952381	1	-4.253692450173457	6.5316081298486335	21.872740069221077

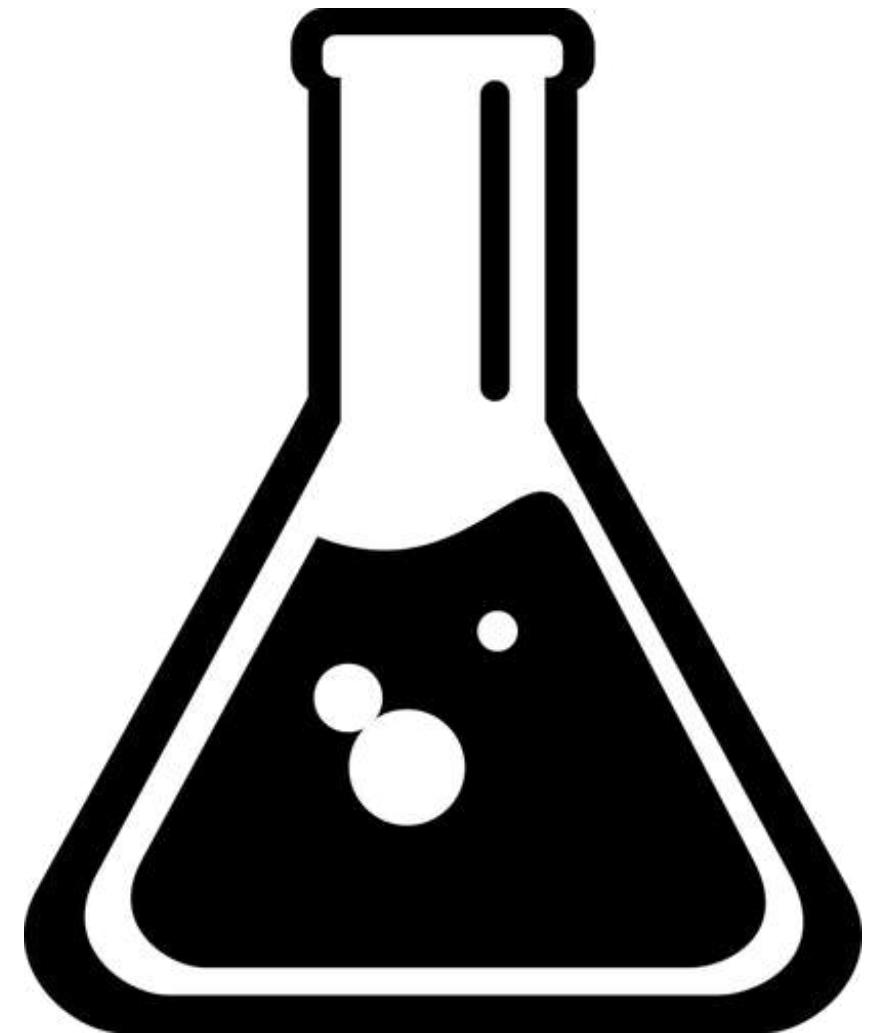
What Other Fields Could Be of Interest?

How About HTTP User Agent?

Classification

Lab 3





**Let's
experiment!**

Detecting Categorical Outliers



Detecting Categorical Outliers

Splunk4Ninjas - Machine Learning for Security Workshop

splunk>enterprise Apps ▾

Administrator ▾ 3 Messages ▾ Settings ▾ Activity ▾ Help ▾ Find

Showcase Experiments Search Models Settings Connection Management Alerts Docs ▾ Video Tutorials ▾

Detect Categorical Outliers: New Experiment **Draft**

Find events that contain unusual combinations of values.

Experiment Settings Experiment History

Enter a search

```
index=* TERM(agent) sourcetype="stream:http" src_ip="*" http_user_agent="*" | table http_user_agent, action, dest_port, bytes_in, bytes_out
```

All time

✓ 269,126 events (01/01/2019 00:00:00.000 to 30/09/2025 16:49:37.000)

Job ▾ II Smart Mode ▾

Field(s) to analyze

http_user_agent (1) ▾

Notes

(optional)

Detect Outliers Open in Search Show SPL

Outlier(s) ▾

16 Outlier(s)

Open in Search Show SPL

Total Event(s) ▾

269,126 Total Event(s)

Open in Search Show SPL

Data and Outliers ▾

http_user_agent	probable_cause	isOutlier
Wondershare%20Helper%20Compact/2.6.2.4 CFNetwork/1128.0.1 Darwin/19.6.0 (x86_64)	http_user_agent	1
Windows-Update-Agent	http_user_agent	1
Microsoft Office/16.0 (Windows NT 10.0; Microsoft Word 16.0.13029; Pro)	http_user_agent	1

Detecting Categorical Outliers

- Try to run the same search but change the field to analyze (e.g. bytes in, bytes out...)
- What results do you get?
- Do you think it's a good approach?
- Let's try a different approach and use Clustering!

Clustering



Detecting Categorical Outliers

Preprocessing your data - let's play with TFIDF

Splunk4Ninjas - Machine Learning for Security Workshop

splunk>enterprise Apps ▾

Administrator ▾ 3 Messages ▾ Settings ▾ Activity ▾ Help ▾ Find

Showcase Experiments Search Models Settings Connection Management Alerts Docs ▾ Video Tutorials ▾ AI Toolkit

New Search Save As ▾ Create Table View Close

index=* TERM(agent) sourcetype="stream:http" src_ip="*" http_user_agent="*" |table http_user_agent, src_ip, dest_ip, action, dest_port, bytes_in, bytes_out |head 3000 |fit TFIDF http_user_agent| Time range: All time ▾

✓ 269,126 events (01/01/2019 00:00:00.000 to 30/09/2025 16:52:33.000) No Event Sampling ▾ Job ▾

Events Patterns Statistics (3,000) Visualization

Show: 20 Per Page ▾ Format ▾ Preview: On

http_user_agent	src_ip	dest_ip	action	dest_port	bytes_in	bytes_out	http_user_agent_tfidf_0_10	http_user_agent_tfidf_1_108	http_user_agent_tfidf_2_135	http_user_agent_tfidf_3_18	http_user_agent_tfidf_4_36	http_u
Microsoft-WNS/10.0	172.16.49.100	23.208.41.78	allowed	80	213	4633	0.48057170782564324	0.0	0.0	0.0	0.0	0.0
Microsoft-WNS/10.0	172.16.49.100	23.208.41.78	allowed	80	213	4633	0.48057170782564324	0.0	0.0	0.0	0.0	0.0
Microsoft-WNS/10.0	172.16.49.100	23.208.41.78	allowed	80	213	4633	0.48057170782564324	0.0	0.0	0.0	0.0	0.0
Microsoft-WNS/10.0	172.16.49.100	23.208.41.78	allowed	80	213	4633	0.48057170782564324	0.0	0.0	0.0	0.0	0.0
Microsoft-CryptoAPI/10.0	172.16.49.10	72.21.81.240		80	282	329	0.5620287517729369	0.0	0.0	0.0	0.0	0.0
Microsoft-CryptoAPI/10.0	172.16.49.10	72.21.81.240		80	282	329	0.5620287517729369	0.0	0.0	0.0	0.0	0.0
Microsoft-CryptoAPI/10.0	172.16.49.10	72.21.81.240		80	282	329	0.5620287517729369	0.0	0.0	0.0	0.0	0.0
Microsoft-CryptoAPI/10.0	172.16.49.10	72.21.81.240		80	282	329	0.5620287517729369	0.0	0.0	0.0	0.0	0.0
Microsoft-CryptoAPI/10.0	172.16.49.10	72.21.81.240		80	287	328	0.5620287517729369	0.0	0.0	0.0	0.0	0.0
Microsoft-CryptoAPI/10.0	172.16.49.10	72.21.81.240		80	287	328	0.5620287517729369	0.0	0.0	0.0	0.0	0.0
Microsoft-CryptoAPI/10.0	172.16.49.10	72.21.81.240		80	287	328	0.5620287517729369	0.0	0.0	0.0	0.0	0.0

Detecting Categorical Outliers

Now let's use clustering!

Splunk4Ninjas - Machine Learning for Security Workshop

splunk>enterprise Apps ▾

Administrator ▾ 3 Messages ▾ Settings ▾ Activity ▾ Help ▾ Find

Showcase Experiments Search Models Settings Connection Management Alerts Docs ▾ Video Tutorials ▾ AI Toolkit

New Search Save As ▾ Create Table View Close

Time range: All time

```
index=* TERM(agent) sourcetype="stream:http" src_ip="*" http_user_agent="*" |table http_user_agent, src_ip, dest_ip, action, dest_port, bytes_in, bytes_out |head 3000 |fit TFIDF http_user_agent |fit KMeans k=5 http_user_agent_tfidf_* |stats values(http_user_agent) by cluster
```

✓ 3,000 events (01/01/2019 00:00:00.000 to 30/09/2025 16:54:09.000) No Event Sampling ▾ Job ▾ Smart Mode ▾

Events Patterns Statistics (5) Visualization

Show: 20 Per Page ▾ Format ▾ Preview: On

cluster ▾ values(http_user_agent) ▾

cluster	values(http_user_agent)
0	Microsoft BITS/7.8 Microsoft-CryptoAPI/10.0 Microsoft-WNS/10.0
1	Cloud mapping experiment. Contact research@pdrlabs.net HTTP Banner Detection (https://security.ipip.net) NetSystemsResearch studies the availability of various services across the internet. Our website is netsystemsresearch.com Ruby cpprestsdk/2.8.0 python-requests/2.18.4
2	Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/70.0.3538.102 Safari/537.36 Edge/18.19041 Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/78.0.3904.108 Safari/537.36 Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/84.0.4147.135 Safari/537.36 Mozilla/5.0 (X11; Linux x86_64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/72.0.3602.2 Safari/537.36 Mozilla/5.0 zgrab/0.x Windows-Update-Agent Windows-Update-Agent/10.0.10011.16384 Client-Protocol/2.0
3	Microsoft-Delivery-Optimization/10.0
4	MICROSOFT_DEVICE_METADATA_RETRIEVAL_CLIENT

Detecting Categorical Outliers

Let's try something else!

Splunk4Ninjas - Machine Learning for Security Workshop

splunk>enterprise Apps ▾

Administrator 3 Messages Settings Activity Help Find

Showcase Experiments Search Models Connection Management Alerts Docs Video Tutorials AI Toolkit

New Search

Save As Create Table View Close

Time range: All time

index=* TERM(agent) sourcetype="stream:http" src_ip="*" http_user_agent="*" |table http_user_agent, src_ip, dest_ip, action, dest_port, bytes_in, bytes_out |head 3000 |fit TFIDF http_user_agent |fit KMeans k=1 http_user_agent_tfidf_* |fields - http_user_agent_tfidf_* |stats max(cluster_distance) by cluster http_user_agent | sort - max(cluster_distance)

3,000 events (01/01/2019 00:00:00.000 to 30/09/2025 16:55:18.000) No Event Sampling

Events Patterns Statistics (18) Visualization

Show: 20 Per Page Format Preview: On

cluster	http_user_agent	max(cluster_distance)
0	Cloud mapping experiment. Contact research@pdrlabs.net	1.3075774665361337
0	NetSystemsResearch studies the availability of various services across the internet. Our website is netsystemsresearch.com	1.306575717936905
0	HTTP Banner Detection (https://security.ipip.net)	1.3064099255698525
0	Ruby	1.3059090512702385
0	cpprestsdk/2.8.0	1.3039090512702383
0	Mozilla/5.0 zgrab/0.x	1.2698784293548326
0	Windows-Update-Agent	1.2683282829837634
0	Windows-Update-Agent/10.0.10011.16384 Client-Protocol/2.0	1.2331445924733966
0	MICROSOFT_DEVICE_METADATA_RETRIEVAL_CLIENT	1.2285757179369063
0	python-requests/2.18.4	1.1883788014319454
0	Microsoft BITS/7.8	1.1593781230212061
0	Mozilla/5.0 (X11; Linux x86_64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/72.0.3602.2 Safari/537.36	1.12310399512072
0	Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/78.0.3904.108 Safari/537.36	0.9921138731681624
0	Microsoft-NNS/10.0	0.9185105781268541
0	Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/84.0.4147.135 Safari/537.36	0.8651093226015153
0	Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/70.0.3538.102 Safari/537.36 Edge/18.19041	0.7973686325360557
0	Microsoft-CryptoAPI/10.0	0.5162660829970246
0	Microsoft-Delivery-Optimization/10.0	0.4980799379063056

Predict *Categorical* Fields



Predict Categorical Fields

- Navigate to your Splunk AI Toolkit application
- Click on “showcase”, choose “Predict Fields”, and select “Predict the Presence of Malware”

The screenshot shows the Splunk AI Toolkit Showcase interface. At the top, there's a navigation bar with links like 'Showcase', 'Experiments', 'Search', 'Models', etc. Below the navigation is a 'Showcase' section with four cards:

- LLM Integrations**: View examples of how to enrich your data with output from externally hosted Large Language Models. 3 Examples Available.
- Predict Fields**: View examples that predict the value of a numeric or categorical field using the values from other fields in the event. 15 Examples Available. This card is highlighted with a blue border.
- Detect Outliers**: View examples that detect numeric and categorical values that differ significantly from values in the rest of the data. Identified outliers are indicative of interesting, unusual, and possibly dangerous events. 14 Examples Available.
- Forecast Time Series**: View examples that predict the next value in a sequence of time series data by using past time series data. 9 Examples Available.

Below these cards is a section titled 'Featured Examples' with several items:

- Predict Disk Utilization**: This example uses the Smart Prediction Assistant and the AutoPrediction algorithm to predict disk utilization from fields in the data including disk access and disk blocks. IT
- Predict Hard Drive Failure**: This example uses the Predict Categorical Fields Assistant and the Logistic Regression algorithm to predict disk failure from fields including hard drive model. IT
- Predict Server Power Consumption**: This example uses the Predict Numeric Fields Assistant and the Linear Regression algorithm to predict AC power consumption from fields including CPU utilization, disk utilization, and unhalted core cycles. IT
- Predict the Presence of Malware**: This example uses the Predict Categorical Fields Assistant and the Logistic Regression algorithm to predict malware from fields including bytes received, bytes sent, and destination port. Security. This item is highlighted with a red box.
- Predict the Presence of Vulnerabilities**: This example uses the Smart Prediction Assistant and the AutoPrediction algorithm to predict vulnerabilities in firewall data from fields in the data including bytes received, bytes sent, packets received, and packets sent. Security
- Predict VPN Usage**: This example uses the Predict Numeric Fields Assistant and the Linear Regression algorithm to predict remote access to the VPN from four other fields. Security

Predict Categorical Fields

- Check the data in the lookup file “firewall_traffic.csv”
- See what field are being used for our prediction
- Try the different algorithms and see which one is the more precise
- Why? Understand the logic behind the algorithms.

Brainstorming time!



Predict Categorical Fields

- Think about some use cases where prediction would be useful
- Better if it is Security Related
- Did you come up with something?

Leveraging third party LLMs



Leveraging third party LLMs

- In the AI toolkit, navigate to “Connection Management”
- If you click on the Bedrock tab, you will see that the Bedrock integration has been setup

The screenshot shows the Splunk AI Toolkit interface with the "Connection Management" tab selected. A sub-section titled "Connection Management Settings" is displayed. At the top, there is a note about acknowledging the use of an external LLM service provider. Below this, a "Select Service:" dropdown is set to "-- Select Service --". A horizontal navigation bar below the dropdown includes "OpenAI", "Anthropic", "AzureOpenAI", "Groq", "Gemini", "Bedrock" (which is highlighted with a red box), and "Ollama". Under the "Bedrock" heading, a sub-section titled "Settings for Provider Bedrock" contains a table with the following data:

Provider Name	Setting	Value	Action
Bedrock ⓘ	Region	edit
	AWS Access Key Id	edit
	AWS Access Token	edit
	Role Arn	edit
	Request Timeout	200	edit

At the bottom of the page, a section titled "Models and Settings for Bedrock" is partially visible.

Leveraging third party LLMs

- A lookup file called “http_error_dataset.csv” has been created. Have a look at the file to familiarise yourself with the fields

The screenshot shows the Splunk Enterprise search interface with a "New Search" query: `| inputlookup http_error_dataset.csv`. The results table displays 10 rows of data with the following columns: Classification, Endpoint, Error_Message, HTTP_Code, Request_ID, and Root_Cause.

Classification	Endpoint	Error_Message	HTTP_Code	Request_ID	Root_Cause
Critical	/api/user/login	The server encountered an unexpected condition which prevented it from fulfilling the request.	500	REQ-001	The application server failed to establish a connection with the user database due to a timeout.
Non-Critical	/api/products/123	The requested product resource could not be found on the server.	404	REQ-002	The product ID provided in the request URL does not match any existing records in the product catalog.
Critical	/admin/dashboard	Access to the requested admin dashboard is forbidden.	403	REQ-003	The user tried to access an administrative panel without sufficient permissions or valid authorization token.
Non-Critical	/api/upload	The server timed out waiting for the request.	408	REQ-004	The client-side upload process took too long, causing the server to abandon the connection.
Critical	/api/payment	The server received an invalid response from the upstream server while acting as a gateway.	502	REQ-005	The payment service backend returned an unexpected error or failed to respond during the transaction process.
Non-Critical	/api/register	The server could not understand the request due to invalid syntax.	400	REQ-006	The JSON payload sent by the client contained syntax errors or missing required fields.
Critical	/api/report	The server is currently unavailable due to overload or maintenance.	503	REQ-007	A spike in traffic or scheduled maintenance rendered the reporting service temporarily unreachable.
Critical	/api/user/settings	Authentication is required and has failed or has not yet been provided.	401	REQ-008	The user attempted to access personal settings without including a valid authentication token in the request header.
Non-Critical	/api/order	The server understands the content type and syntax, but was unable to process the instructions.	422	REQ-009	One or more required fields in the order request failed validation checks due to incorrect format or missing data.
Critical	/api/checkout	The server acting as a gateway timed out while waiting for a response from an upstream server.	504	REQ-010	The third-party API responsible for processing the final checkout did not respond in time, causing a timeout.

Leveraging third party LLMs

- Challenge - Write a prompt to get some recommendations about what steps should be followed to resolve these errors
- The command which should be used is `| ai prompt=`
- The provider to be used is Bedrock and the model is `anthropic.claude-3-5-sonnet-20240620-v1:0`
- Make sure to put the interesting fields between **curly braces** and **single quotes** as shown here - '`{Error_Message}`'
- Your turn!



5 minutes to
complete the lab

Lab 4

Leveraging third party LLMs

- Here is the solution:
- Now, try with another use case of your choice

The screenshot shows the Splunk Enterprise search interface. In the search bar, the following SPL command is entered:

```
| inputlookup http_error_dataset.csv  
| head 5  
| ai prompt="HTTP Error '{HTTP_Code}' occurred with message: '{Error_Message}'. Root cause: '{Root_Cause}'. What specific steps can we take to resolve this? Provide a precise but informative answer." provider=Bedrock model=anthropic  
.claude-3-5-sonnet-20240620-v1:0
```

The search results table displays five rows of data. The columns are:

Request_ID	HTTP_Code	Endpoint	Error_Message	Root_Cause	Classification	ai_result_1
REQ-001	500	/api/user/login	The server encountered an unexpected condition which prevented it from fulfilling the request.	The application server failed to establish a connection with the user database due to a timeout.	Critical	To resolve the HTTP Error 500 caused by the application server failing to establish a connection with the user database due to a timeout, consider the following specific steps: <ol style="list-style-type: none">1. Check database server status:<ul style="list-style-type: none">- Ensure the database server is running and accessible.- Verify network connectivity between the application server and database server.2. Review database connection settings:<ul style="list-style-type: none">- Confirm the connection string in the application configuration is correct.- Verify database credentials are valid and have not expired.3. Increase connection timeout:<ul style="list-style-type: none">- Adjust the database connection timeout settings in the application configuration.- Consider increasing the timeout value if the database is under heavy load.4. Optimize database performance:<ul style="list-style-type: none">- Check for long-running queries or processes that may be causing delays.- Review and optimize database indexes if necessary.5. Scale database resources:<ul style="list-style-type: none">- If the database is consistently overloaded, consider scaling up hardware resources.- Implement database caching mechanisms to reduce load.

Anomaly Detection



Numeric Outlier Detection

A type of Anomaly Detection

Outlier in some numerical value

- Number of transactions
- Transaction latency
- System utilization (CPU/memory)
- Number of logins
- Amount of data transfer
- Time between actions
- Sensor measurement

Detect Numeric Outliers Assistant in

Splunk AI Toolkit

Detect Numeric Outliers

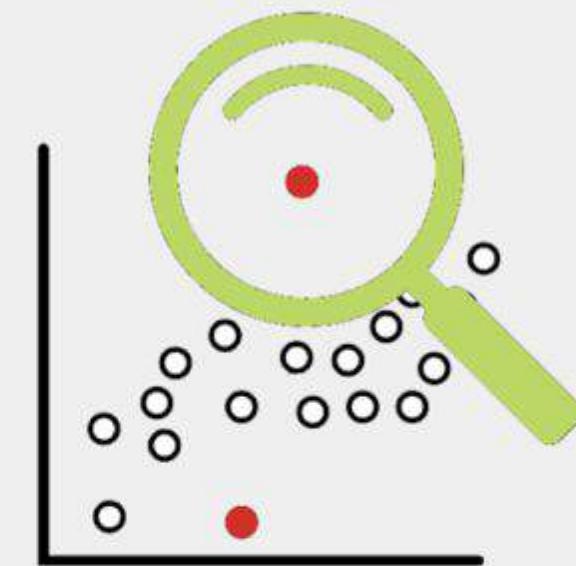
Find values that differ significantly from previous values.

Examples

- Detect Outliers in Server Response Time
- Detect Outliers in Number of Logins (vs. Predicted Value)
- Detect Outliers in Supermarket Purchases
- Detect Outliers in Power Plant Humidity
- Detect Cyclical Outliers in Call Center Data
- Detect Cyclical Outliers in Logins

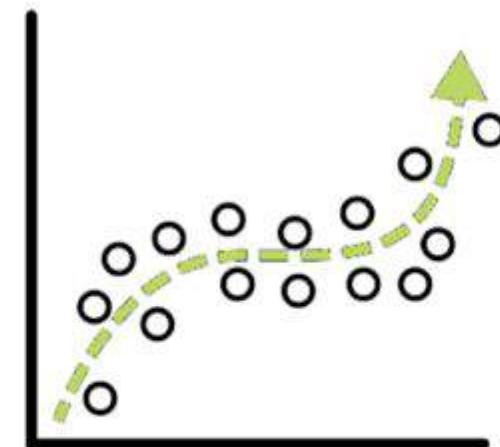
Anomaly Detection

Anomaly detection



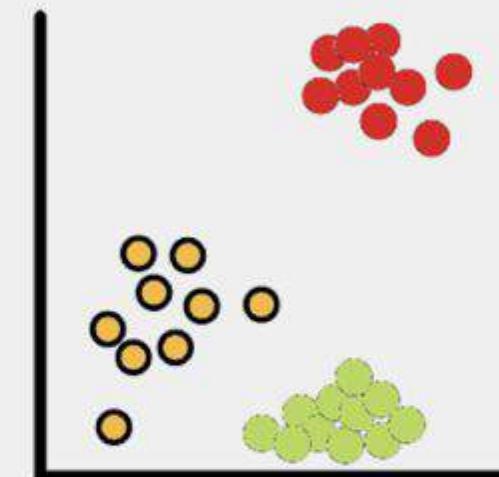
- ▶ Deviation from past behavior
- ▶ Deviation from peers
- ▶ (aka Multivariate AD or Cohesive AD)
- ▶ Unusual change in features

Predictive Analytics



- ▶ Predict Service Health Score/Churn
- ▶ Predicting Events
- ▶ Trend Forecasting
- ▶ Detecting influencing entities
- ▶ Early warning of failure

Clustering



- ▶ Identify peer groups
- ▶ Event Correlation
- ▶ Reduce alert noise
- ▶ Behavioral Analytics

Outlier vs Anomaly

What's the difference?

Outlier (noun):

- A statistical observation that is markedly different in value from the others of the sample
- Outliers are usually something unexpected in a **single** value or measurement

Anomaly (noun):

- Something different, abnormal, peculiar or not easily classified
- Deviation from the common rule
- Anomalies are usually based on a **collection** of observations

Not all outliers are anomalies, but anomalies often consist of outliers or are outliers

Cheat sheet for anomaly detection in Splunk

Command	Description	Method / Algorithm	Description
analyzefields (af)	Analyze numerical fields for their ability to predict another discrete field.	DensityFunction	The DensityFunction algorithm provides a consistent and streamlined workflow to create and store density functions and utilize them for anomaly detection...
anomalies	Computes an "unexpectedness" score for an event.	LocalOutlierFactor	The LocalOutlierFactor algorithm measures the local deviation of density of a given sample with respect to its neighbors...
anomalousvalue	Finds and summarizes irregular, or uncommon, search results.	OneClassSVM	The OneClassSVM algorithm fits a model from a set of features or fields for detecting anomalies and outliers...
anomalydetection	Identifies anomalous events by computing a probability for each event and then detecting unusually small probabilities.	Clustering Algorithms	Spot point anomalies or anomalous clusters. Inspect e.g. cluster_distance with KMeans, cluster=-1 with DBSCAN...
cluster	Clusters similar events together.	Classifiers and Regressors	Inspect strong residuals when applying your well fitted model to new incoming data points.
kmeans	Performs k-means clustering on selected fields.	ML SPL API	Wrap your own algorithms of choice
outlier	Removes outlying numerical values.		
rare	Displays the least common values of a field.		

<https://docs.splunk.com/Documentation/Splunk/latest/SearchReference/Commandsbycategory>

<https://docs.splunk.com/Documentation/MLApp/latest/User/Algorithms>

Detecting outliers with Enterprise Security

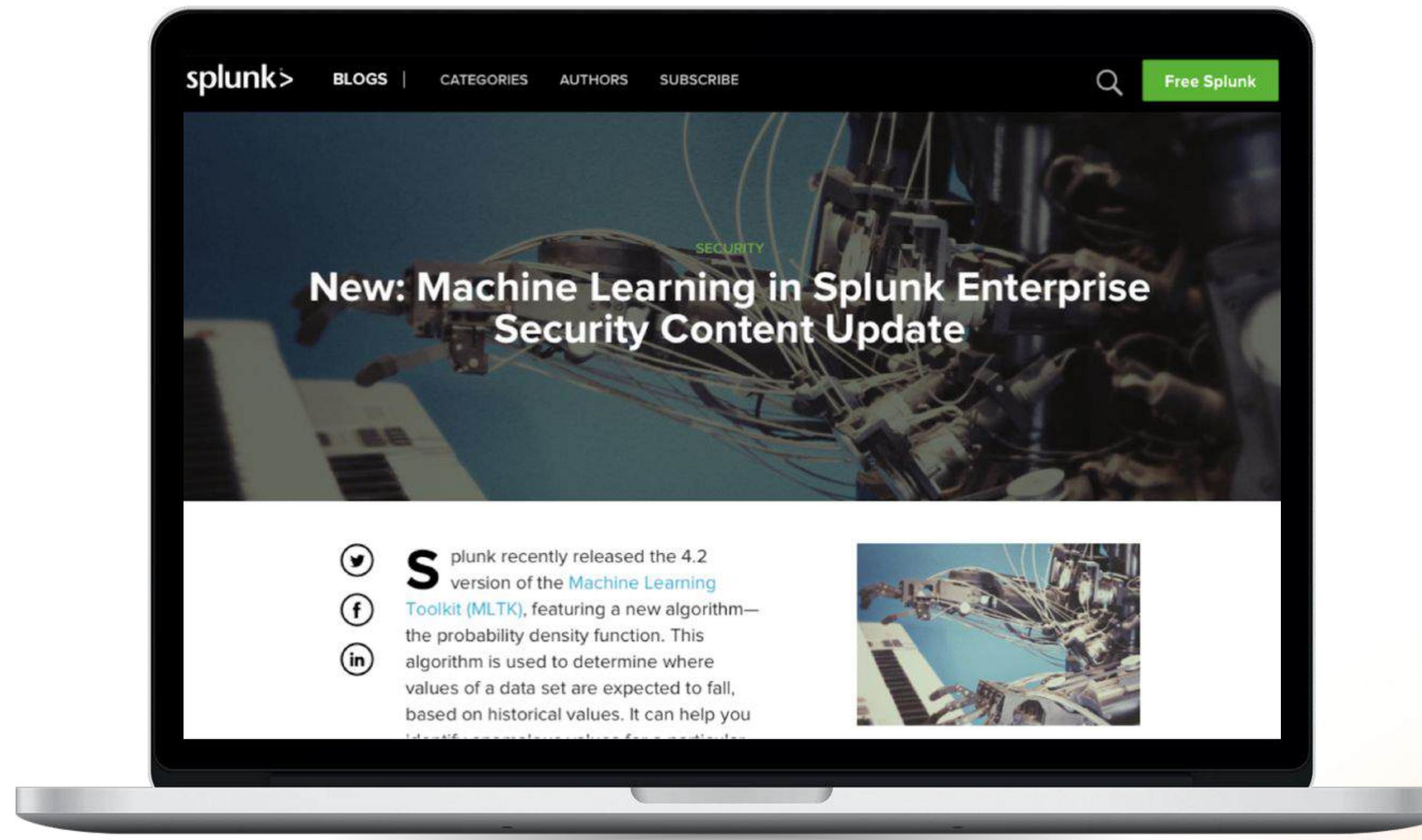
Enterprise Security ships with Splunk AI Toolkit as of ES version 6.0

The Splunk AI Toolkit (Formerly MLTK) is replacing Extreme Search (XS) as a model generation package in Enterprise Security (ES). Splunk AI Toolkit can scale at larger volume and also can identify more abnormal events through its models (see [Welcome to the Machine Learning Toolkit](#) in the Splunk Machine Learning Toolkit User Guide.)

ES is using Splunk AI Toolkit DensityFunction under the hood.

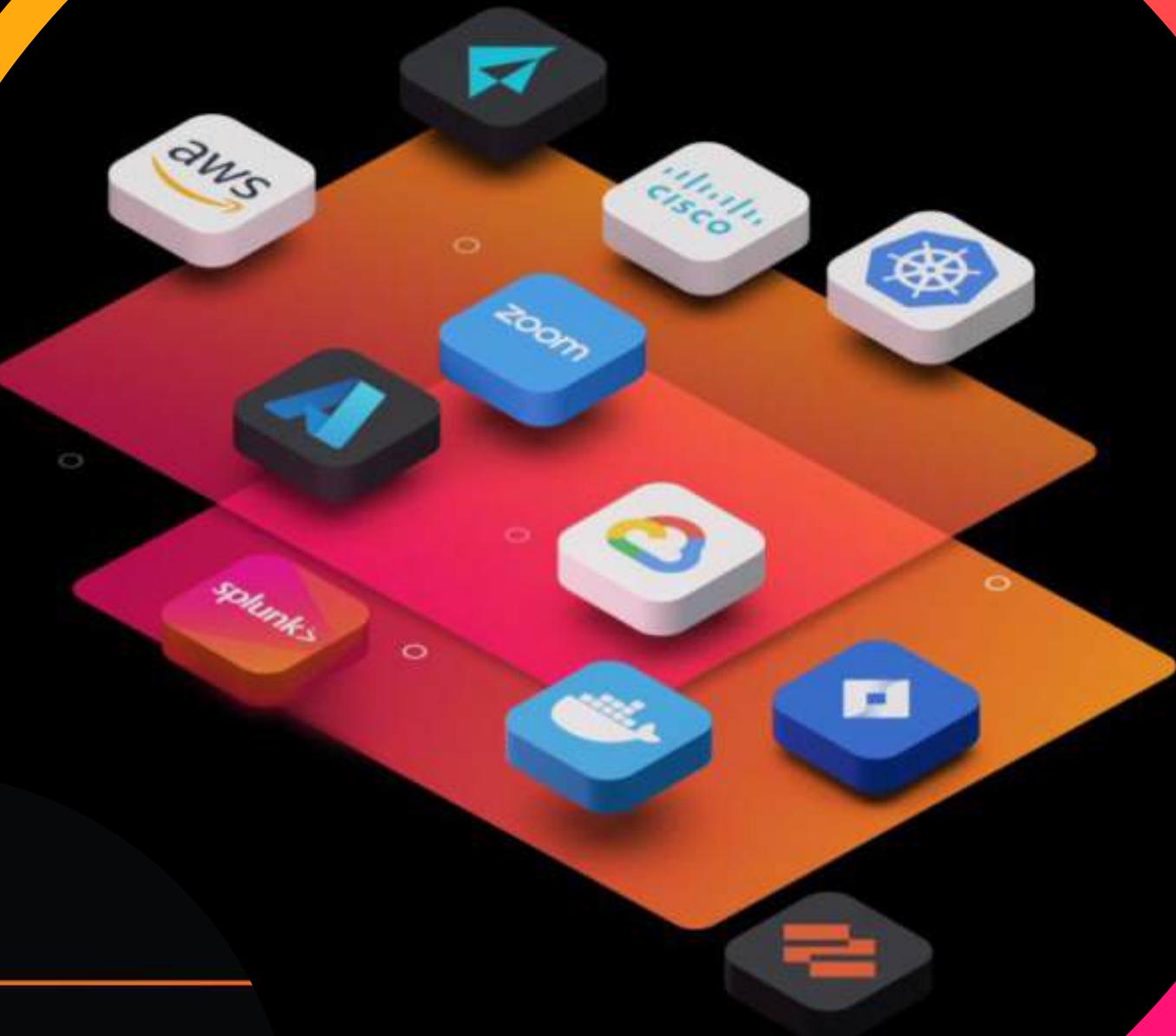
<https://docs.splunk.com/Documentation/ES/latest/Admin/MLTKOverview>

ES Content Update includes Density Function content



Machine Learning Applications from Splunkbase

splunkbase™



Machine Learning Applications

**Splunk
Security
Essentials**



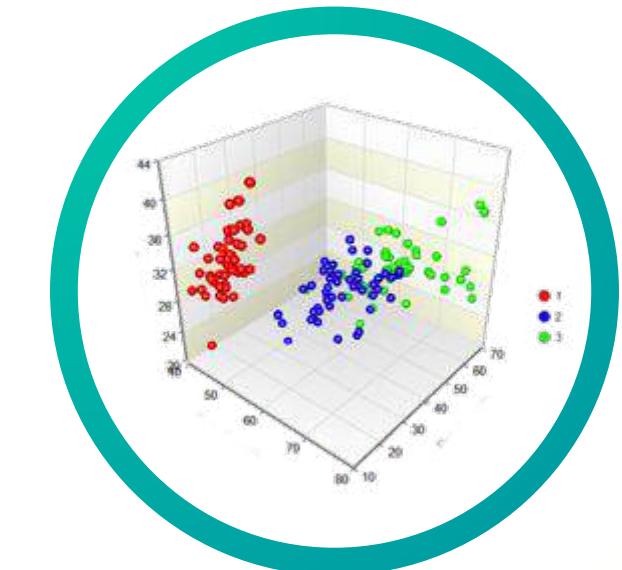
**DGA App for
Splunk**



**Botnet App for
Splunk**



**Custom Detections
using AI Toolkit**



Splunk Security Essentials

Download from Splunkbase:

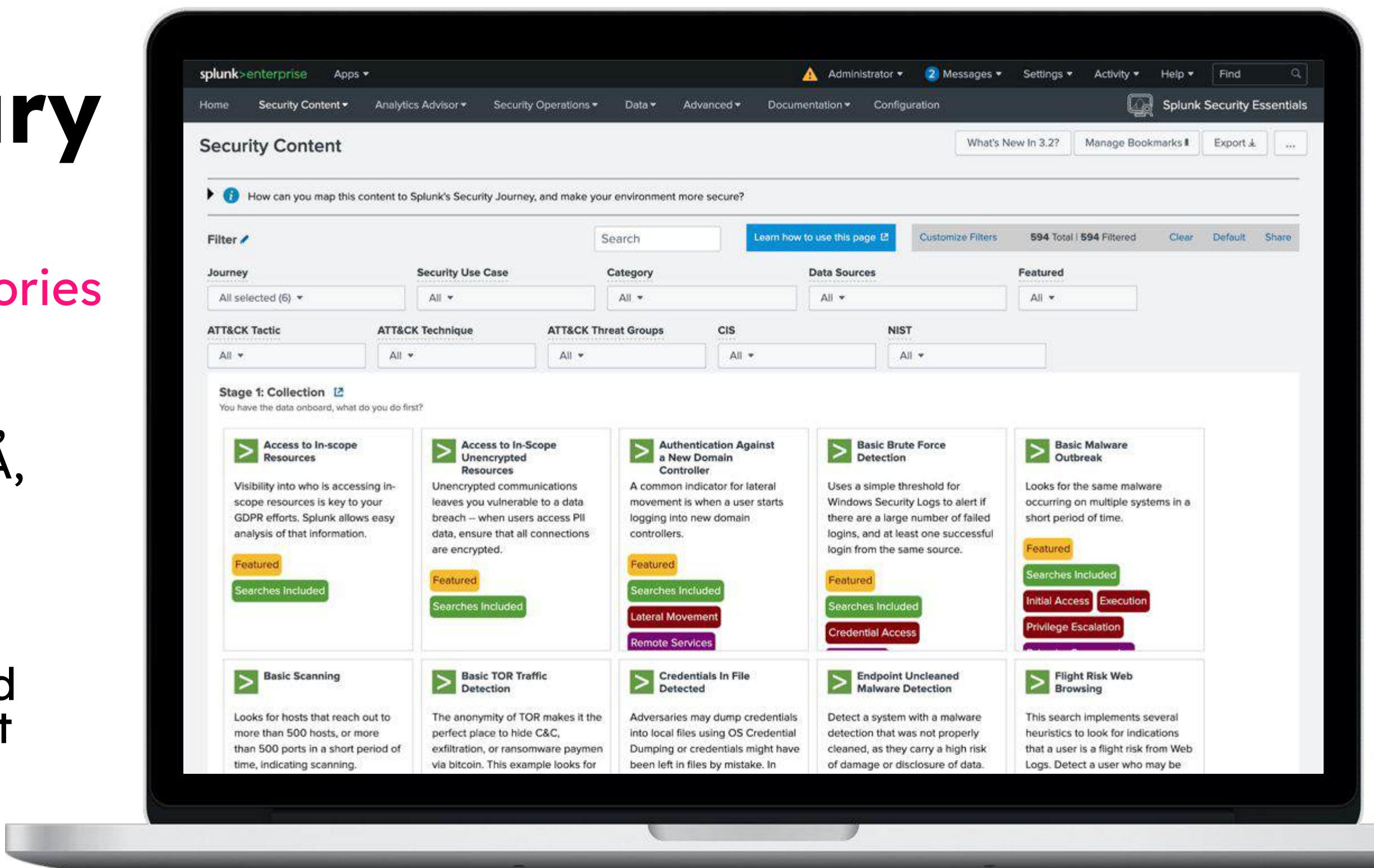
<https://splunkbase.splunk.com/app/3435>



Security Content Library

Browse, bookmark, and deploy 900+ security detections and analytic stories

- Repository of Security Content for Splunk Cloud, Enterprise Security, UEBA, and Phantom
- Deploy security content within clicks
- Enrich notable events and run analytics with context from content library
- Stay up to date on existing and emerging threats





Includes Behavioral Detections

Identify bad guys in your environment:

- Includes 50+ use cases common in UEBA products, all using Splunk Enterprise
- Target external attackers and insider threat
- Scales from small to massive companies
- Save from the app, send results to ES/UBA

The most widely deployed UEBA product in the market is Splunk Enterprise, but no one knows it.

Solve your use cases today, then use Splunk UBA for advanced ML detection.

The screenshot shows the Splunk Security Essentials interface under the 'Security Content' tab. At the top, there's a search bar and a filters section. Below that, a heading says 'Stage 1: Collection'. The main area contains a 3x4 grid of cards, each representing a different behavioral detection use case:

- Authentication Against a New Domain Controller**: A common indicator for lateral movement is when a user starts logging into new domain controllers. Status: Featured, Searches Included, Remote Services.
- Increase in # of Hosts Logged into**: Find users who log into more hosts than they typically do. Status: Featured, Searches Included, Remote Services.
- Increase in Pages Printed**: Find users who printed more pages than normal. Status: Searches Included, Remote Services.
- New Interactive Logon from a Service Account**: In most environments, service accounts should not log on interactively. This search finds new user/host combinations for accounts starting with "svc_". Status: Featured, Searches Included, Valid Accounts.
- Disabled Update Service**: Splunk can detect the status of services, allowing us to find hosts where the Windows Update service is disabled. Status: Searches Included.
- First Time Logon to New Server**: Find users who logged into a new server for the first time. Status: Searches Included.
- First Time USB Usage**: Find systems the first time they generate Windows Event ID 20001, which for some customers occurs when a USB drive is plugged in. Status: Searches Included.
- Hosts Sending To More Destinations Than Normal**: This will typically detect scanning activity, along with lateral movement activity. Status: Searches Included.

Splunk Security Essentials

Types of Use Cases

Outlier(s)

2 Outlier(s)

New Data and Outlier status:

Year	ContractInterestRate%	InitialFeesAndCharges%
1981	124.95	2.57
1982	155.42	2.82
1978	8.51	0.45
1979	9.58	0.49
1980	12.09	1.23
1983	12.21	3.07
1984	11.84	3.05
1985	11.15	2.73
1986	8.79	3.21
1987	8.58	2.03

Dataset Preview

AdjustableRateLoans%	ContractInterestRate%
NA	8.21

First Time Seen
powered by stats



Time Series Analysis
with Standard
Deviation

Home Security Content ▾

Search

1 enter search here...

No Event Sampling ▾

General Security
Analytics Searches

Data and Content Introspection

Track data and saved searches to gain visibility

- Enrich saved searches with tags and metadata
- Automatic categorization by security products
- Scale with data model acceleration and by reinforcing CIM compliance

The screenshot shows the Splunk Security Essentials interface. At the top, it says "splunk>enterprise" and "App: Splunk Security Essentials". The navigation bar includes "Home", "Security Content", "Analytics Advisor", "Security Operations", "Data", "Advanced", "Documentation", "Configuration", "Splunk User", "Messages", "Settings", "Activity", and "Help". Below the navigation is a "Data Inventory" section with the following categories and counts:

- Email (2) X
- DNS (3) X
- Authentication (2) X
- Anti-Virus or Anti-Malware (3) X
- Web Proxy (2) X
- User Activity Audit (0/5) ?
- Endpoint Detection and Response (6) ✓
 - Object Change ✓
 - Process Launch X
 - Process Launch with CLI ✓
 - Process Launch with Executable Hash ✓
 - Object Change on Removable Storage X
 - Listening Port(s) X
- Network Communication (3) ✓
- Malware Analysis (0/1) ?
- IDS or IPS (1) X
- Ticket Management (2) X
- Web Server (3) X
- Configuration Management (0/1) ?

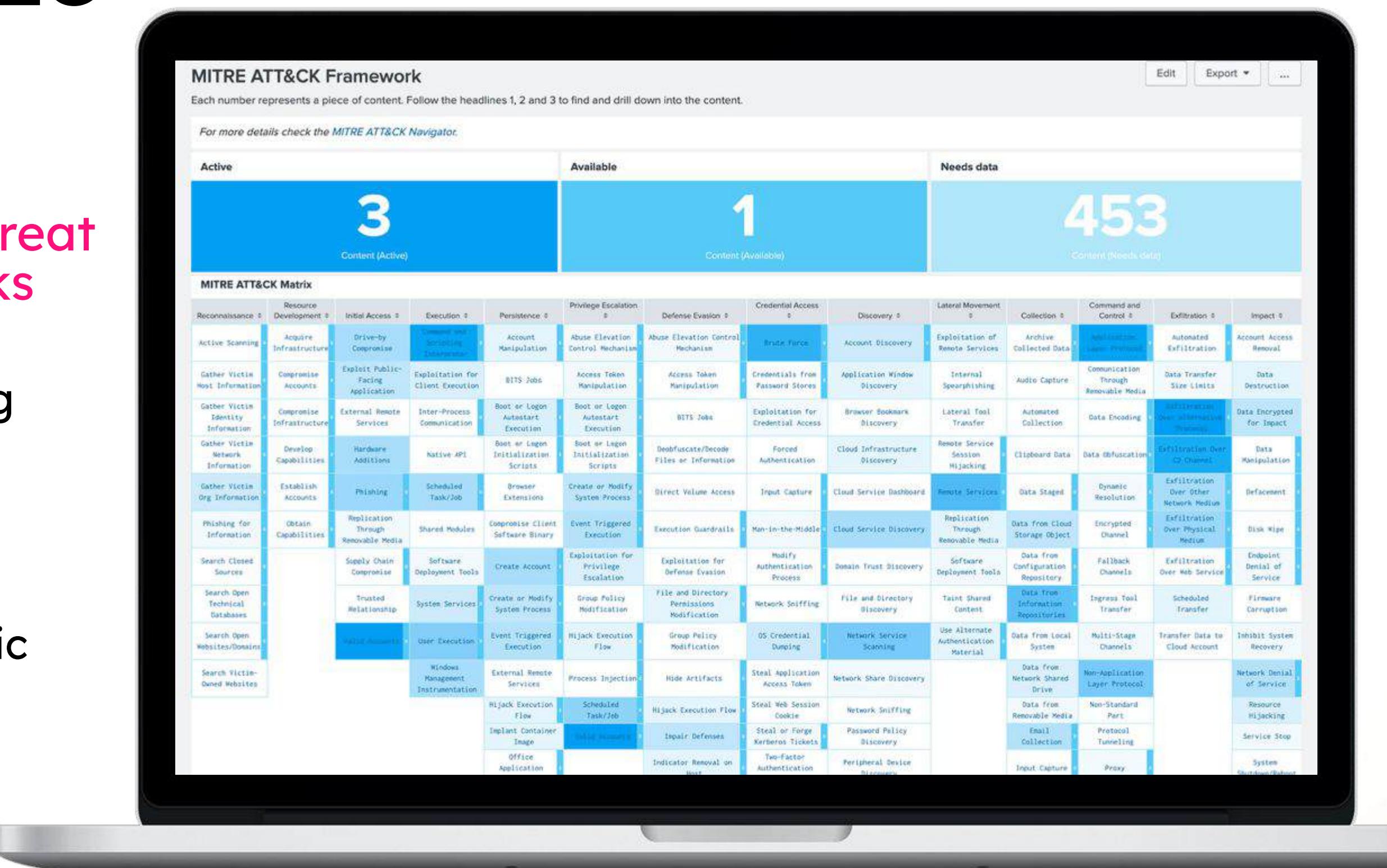
On the right side, there are several sections:

- Endpoint Detection and Response**: A detailed description of EDR solutions.
- Object Change**: A brief description of object changes.
- Content for This Data Source Category**: A list of specific tactics and techniques.
- MITRE ATT&CK Tactics**: A grid of tactics including Command and Control, Defense Evasion, Persistence, and Privilege Escalation.
- MITRE ATT&CK Techniques**: A grid of techniques including Abuse Elevation Control Mechanism, Boot or Logon Autostart Execution, and many others.
- Kill Chain Phases**: A grid of kill chain phases.

Operationalize Security Frameworks

Identify gaps, improve threat detection, and reduce risks

- Develop an understanding of your security posture against MITRE ATT&CK® and Cyber Kill Chain® frameworks
- Find detections for specific Threat Groups or Threat Software
- Drilldown on known Tactics and Techniques and Kill Chain Phases for more details



DGA App for Splunk

Download from Splunkbase:

<https://splunkbase.splunk.com/app/3559/>



Domain Generating Algorithms (DGA)

What's the problem?

Challenges to detect DGAs:

- Static matching runs against potentially infinite blacklist entries
- Regex can narrow down this list, but still hard to compute and find rules (and define exceptions for rules)
- Unknown unknowns?
- Want to get fuzzy?
- Let's ML!

Example of DGAs:

domain
iuquerfsodp9ifjaposdfjhgosurijfaewrwegwea
ifferfsodp9ifjaposdfjhgosurijfaewrwegwea
ayylmaotjhsstasdfasdfasdfasdfasdfasdf
lazarusse.suiche.sdfjhgosurijfaqwqwqrgwea
sdfjhgosurijfaqwqwqrgwea

Example IoCs for WannaCry: <https://cert.europa.eu/static/SecurityAdvisories/2017/CERT-EU-SA2017-012.pdf>

Example IoCs for Sunburst:

https://github.com/fireeye/sunburst_countermeasures/blob/main/indicator_release/Indicator_Release_NBIs.csv

Additional details at https://www.splunk.com/en_us/blog/security/sunburst-backdoor-detections-in-splunk.html

DGA App for Splunk

philipp@splunk.com

[Edit](#)[Export ▾](#)

...

Content overview

1. Exploratory Data Analysis



2. Feature Engineering and Selection



3. Create Machine Learning Models



4. Operationalize Machine Learning



5. Test and Benchmark



Setup

For full functionality of the app please check and review the [setup dashboard page](#) and make sure that all setup steps are completed.

- Example for end to end data science process
- Disclaimer: this is not a turn key solution but a template to get you started
- Feel free to improve and give us your feedback!



1. Data Exploration

Edit Export ...

Dataset Overview

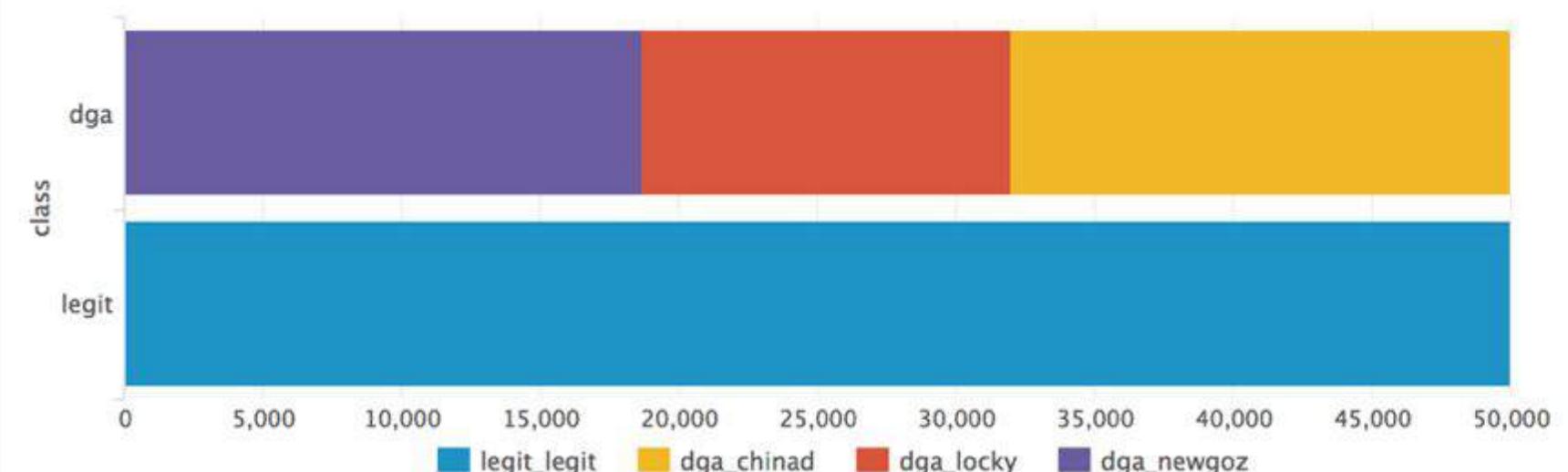
The dataset consists of a labeled domain names that indicate whether a domain is legit or created by some DGA that is known from botnets. We have around 60% domain names from legit domains and remaining 40% split across 3 DGA subclasses that correspond to different botnets.



domains.csv

class	domain	subclass
legit	google.com	legit
legit	www.google.com	legit
legit	microsoft.com	legit
legit	facebook.com	legit
legit	doubleclick.net	legit

* prev 1 2 3 4 5 6 7 8 9 10 next »



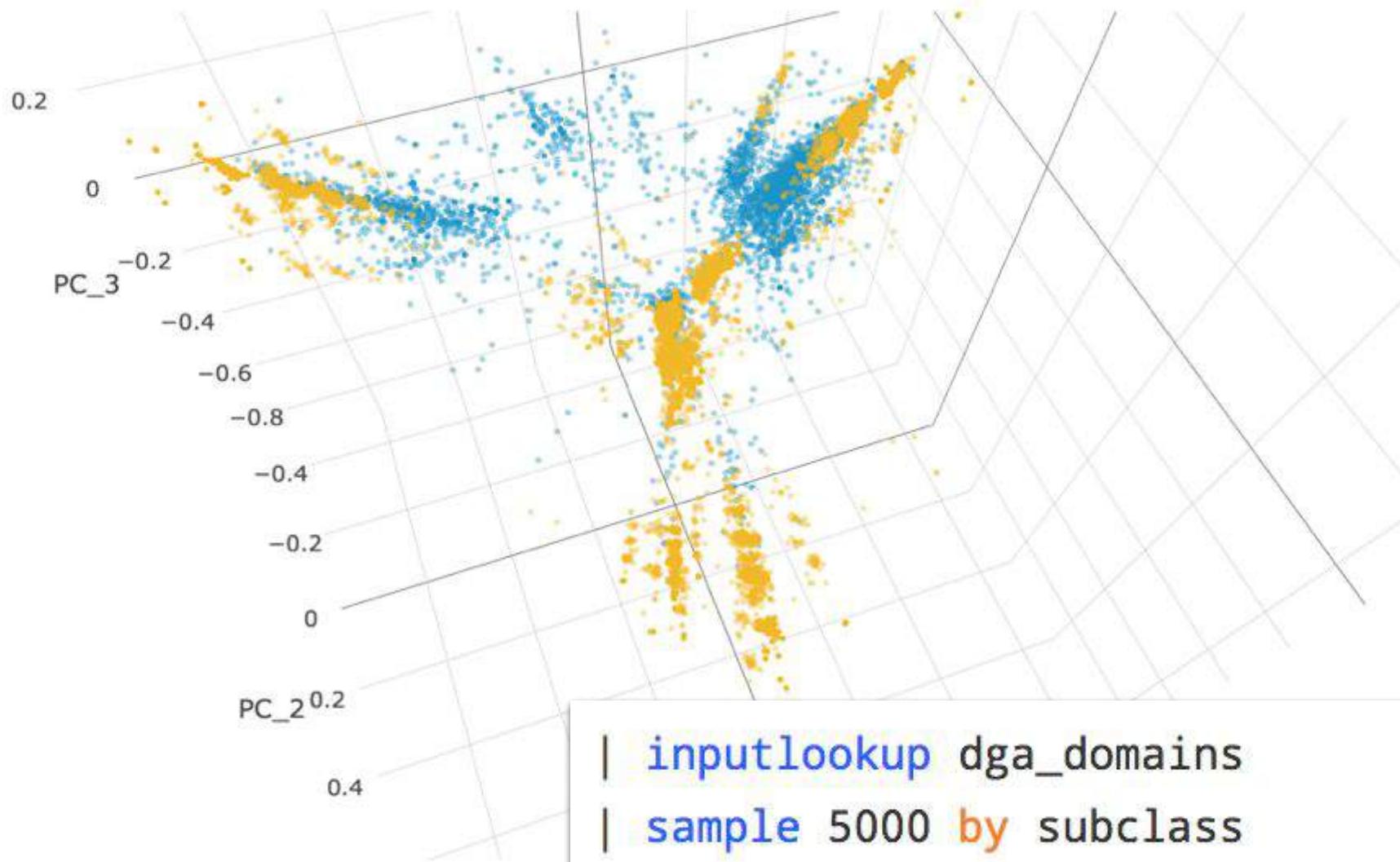
Sample of domains by subclasses

column	chinad	legit	locky	newgoz
domains	15nrbrfoqajvt92p.com 2eb7jd4214efdemz.net 9dkwgr7osoqr3sj8.info bof8b9ediq2zgxcx.info eejxv00hk3e9mu7n.net eo9i0keybpezdwjx.org jd59a3g1bqumyvn1.org kdh2kxsxrohdr432.net s45srq078fv7q7j8.net swfa7qz5k2pefj63.biz	943.engine.mobileapptracking.com a.applvn.com ads.rubiconproject.com buy.tinypass.com fmcz4-1.fna.firebaseio.net homedepot.az1.qualtrics.com pandora.com pix.bfi0.com track.wattpad.com us-east-1.elb.amazonaws.com	clgsaguvihthkai.click eltineojriud.biz jpyecccdbiz jtxopqxokgcdnqmn.pw lmhyhqym.su okfhcdiayd.click pchjmkjhoqt.biz tvmlivvyb.biz vawmxlhoiconu.org xxixgjltu.pl	15kfdx1uy33wsq420w81t24jmz.biz 1c4pu7etfir7l106r8vqt89xz.net 1i14a381pwjcnd1pyddk2191bcng.biz 1jjxlm24webiq1m91b7v1u9i37h.org 1wyjzq3104oa5hn7rpkw1w36niz.com mokou21vftme61whl7hggd7wp0.net p2ht3uqv42qx14vveb5nwlasr.org q21qhn15f53lz17y86983vc31e.com ustqjsa8rvla1y25kr386qngm.com zrxndhyj6yb3199ycn1xve3m3.org

- Small data set with 100K domain names for training and testing

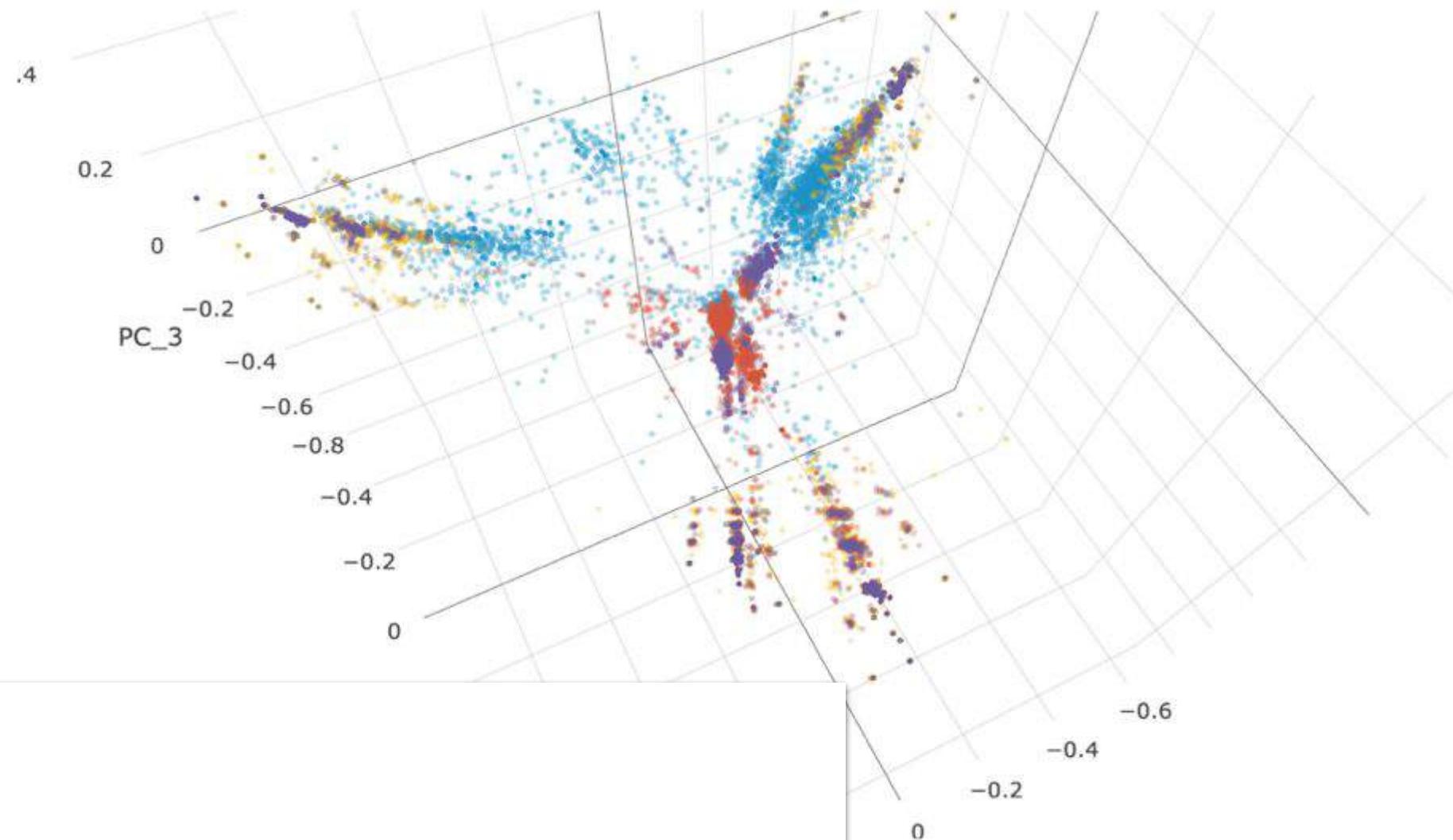
Data Exploration with Text Mining approach

n-gram analysis (2-3 char groups) of domain names with PCA k=3 by class



```
| inputlookup dga_domains  
| sample 5000 by subclass  
| fit TFIDF domain analyzer=char ngram_range=2-3 into "dga_ngram"  
| fit PCA domain_tfidf* k=3 into "dga_pca"  
| fields - domain_tfidf*  
| eval label=class._.subclass  
| table label PC_*  
| sort 0 - label
```

n-gram analysis (2-3 char groups) of domain names with PCA k=3 by subclass



2. Feature Engineering and Selection

[Edit](#) [Export ▾](#) [...](#)**Feature Engineering**

Detecting DGAs may require additional features that are not present in the raw table of domain names. Additional features can be any meaningful additional information that help to characterize the dataset with regards to the analytics goal, ideally in a very distinct manner. In this case we derive features from the pure domain name strings that allow to shape indicators of a generated domain name. As part of data preprocessing we save the computed results after using some SPL and methods from the [URL Toolbox App](#):



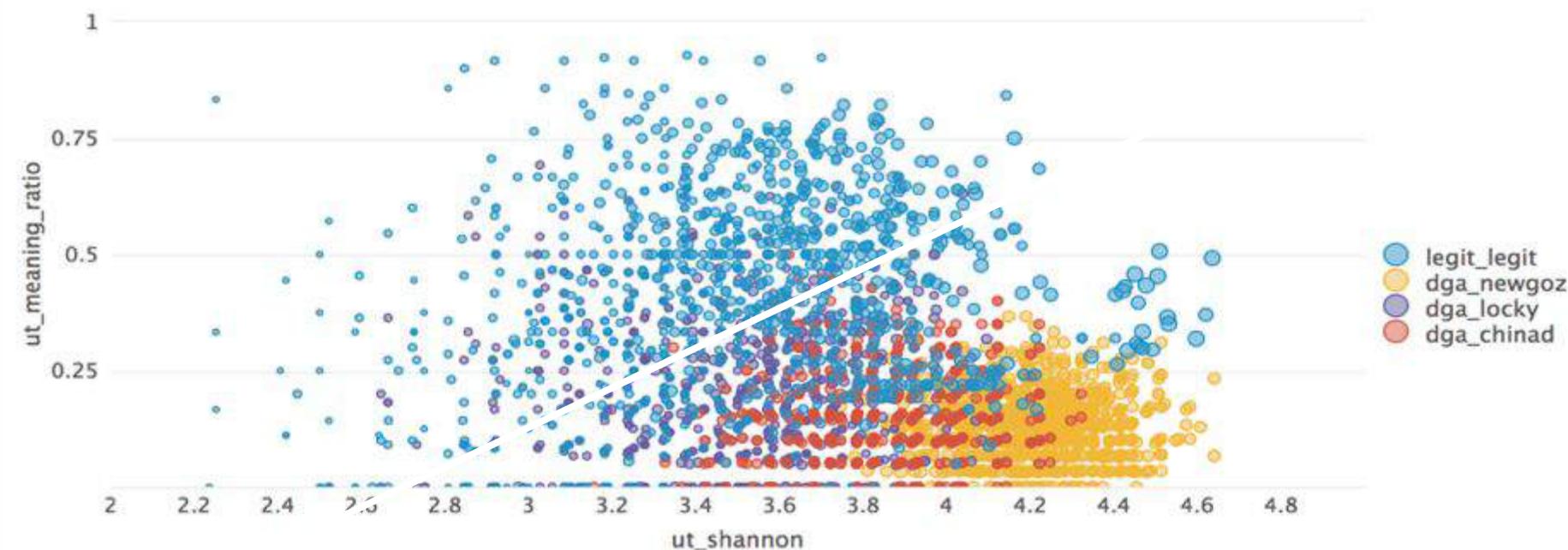
Domain dataset enriched with features

domain	class	subclass	ut_consonant_ratio	ut_digit_ratio	ut_domain_length	ut_meaning_ratio	ut_shannon	ut_vowel_ratio	PC_1	PC_2	PC_3
lvmaehe1voogfbss.net	dga	chinad	0.600	0.050	20.000	0.300	3.784	0.300	0.502	-0.304	0.092
1amn1a519ort3p12o09111e6288k.com	dga	newgoz	0.281	0.531	32.000	0.156	3.925	0.188	-0.358	-0.008	0.181
flaxbg19j4wxu16sacop1su49dx.org	dga	newgoz	0.516	0.258	31.000	0.226	4.196	0.226	0.102	0.763	0.415
fspfffyddxni.pl	dga	locky	0.900	0.000	15.000	0.067	3.107	0.067	0.044	0.072	-0.066
ulpkn41fwor3pyqv9551j4f35c.com	dga	newgoz	0.600	0.333	30.000	0.067	4.282	0.100	-0.362	-0.001	0.177
aqaq93u5uybd1nbe.net	dga	chinad	0.500	0.200	20.000	0.300	3.684	0.350	0.659	-0.385	0.117
hao6m700qnro7d3y.cn	dga	chinad	0.526	0.316	19.000	0.105	3.827	0.158	-0.063	0.013	-0.019
1y1j69jb62wpg1h58kdp3mb8n2.org	dga	newgoz	0.600	0.400	30.000	0.067	4.282	0.033	0.178	0.823	0.404
play.googleapis.com	legit	legit	0.600	0.000	19.000	0.579	3.471	0.368	-0.222	-0.085	0.037
051i8937btzxhotb.info	dga	chinad	0.476	0.333	21.000	0.286	4.011	0.190	0.049	0.117	-0.125

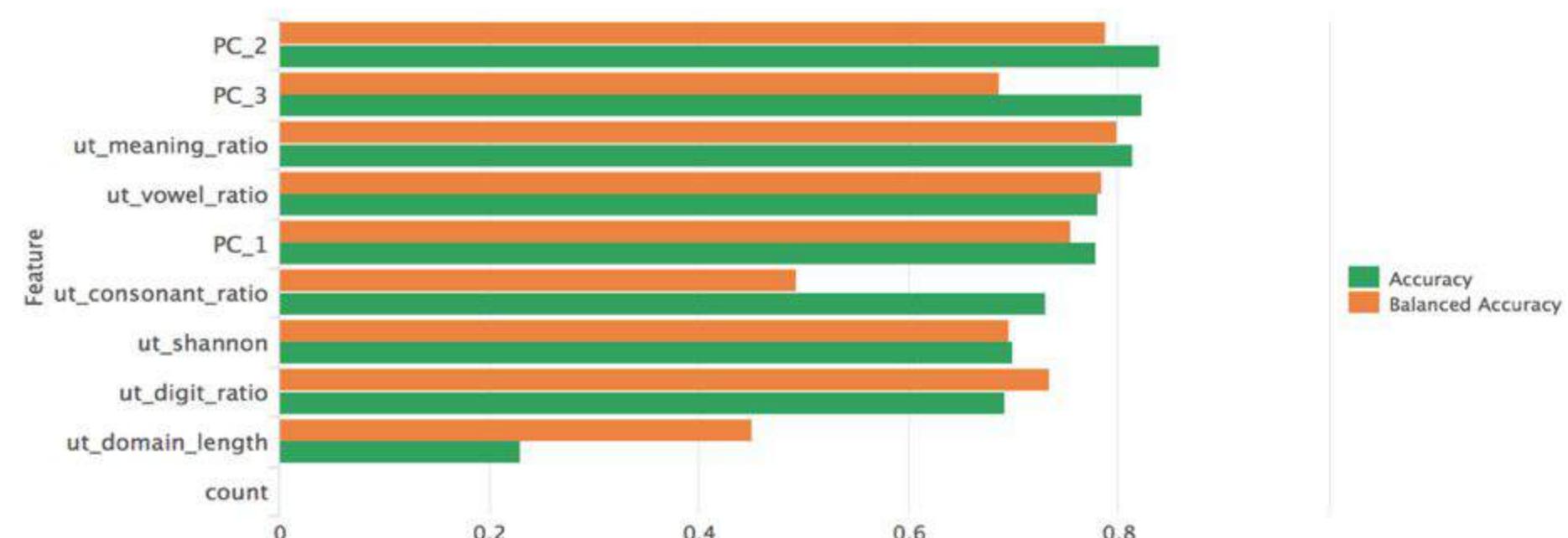
« prev 1 2 3 4 5 6 7 8 9 10 next »

- More features can significantly improve your machine learning models
- Extend this with your feature engineering ideas (e.g. subdomains, age of domain registration, rating/scoring from threatlists for known malicious domains etc.)

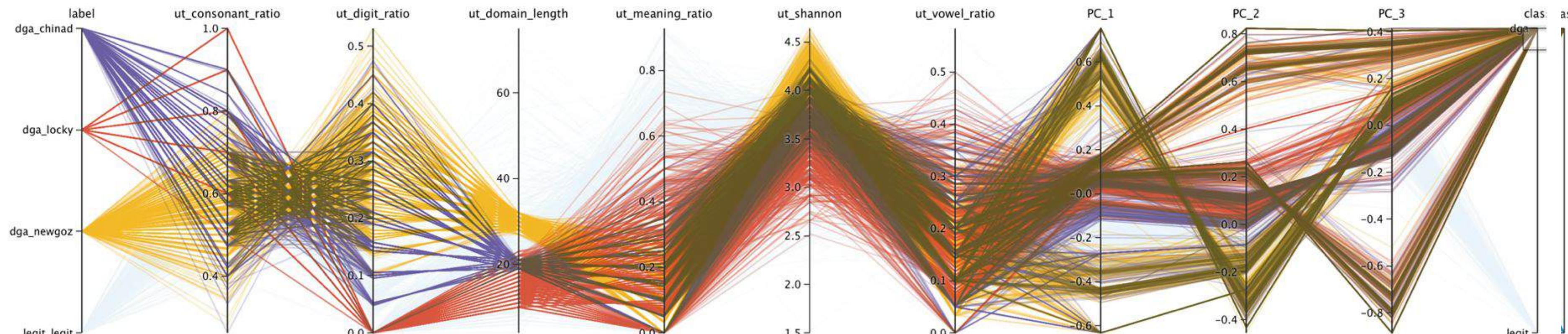
Distribution of classes depending on example feature combination



Identify useful features for classification with the analyzefields command



Parallel coordinate chart of classes and top features



Currently showing 3000 / 4000 datapoints

[Clear filters](#)



3. Create Machine Learning Models

[Edit](#) [Export ▾](#) [...](#)

Training and evaluation of different machine learning models

We train 4 machine learning models on the same data set using different algorithms for classification. Using a 50:50 split we can evaluate which models perform better and have a lower error rate.

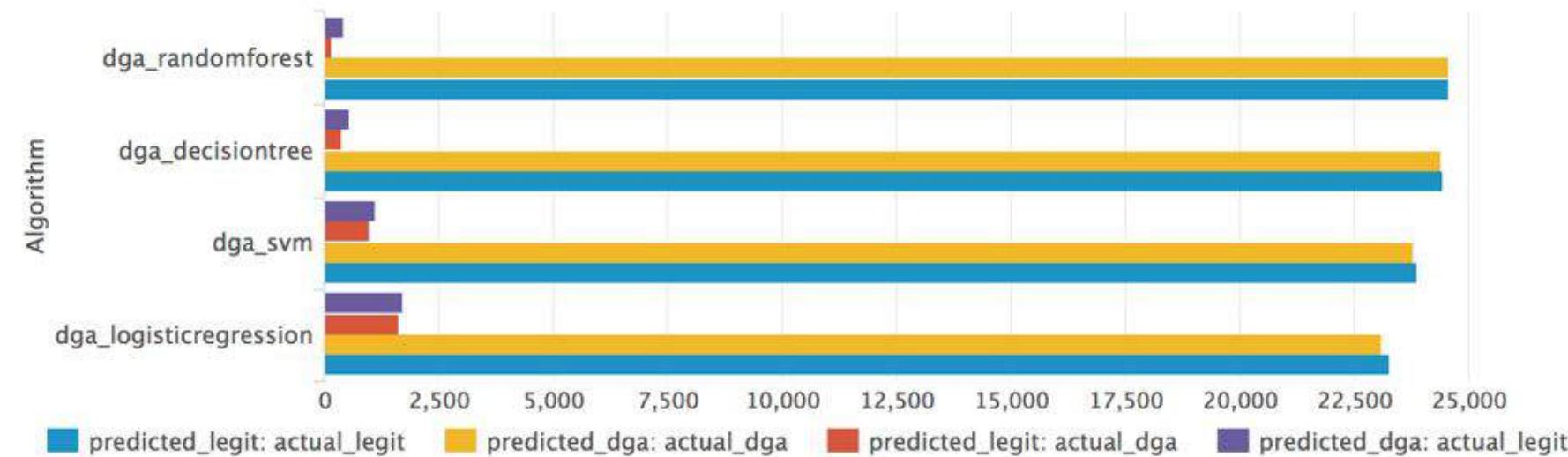


Train models

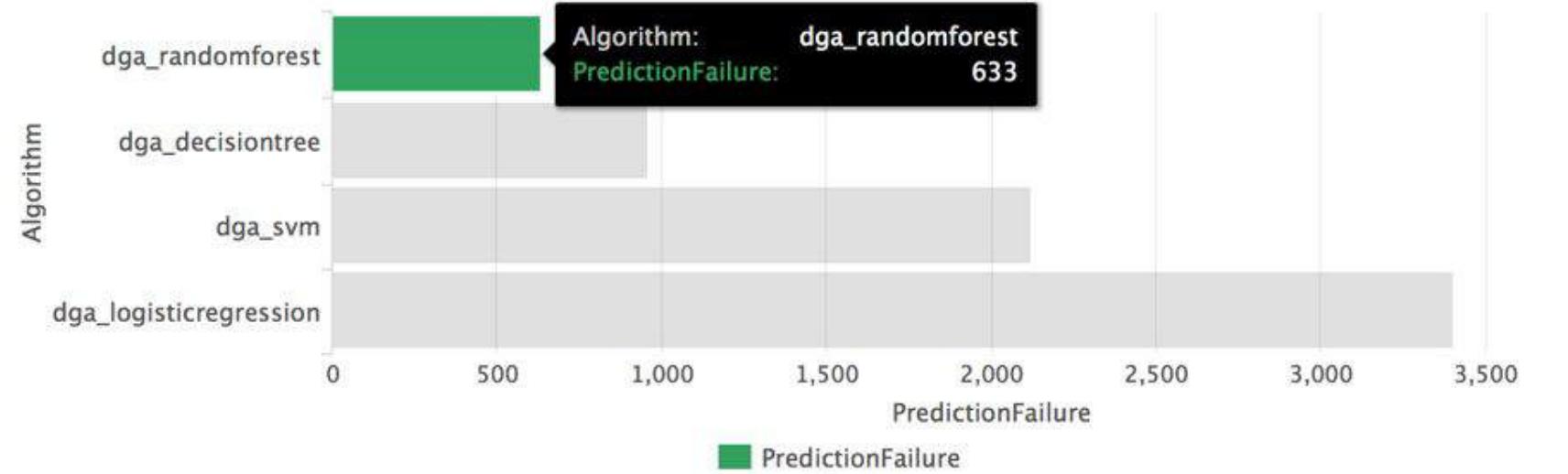
1. Random Forest Classifier			2. Support Vector Machine			3. Decision Tree Classifier			4. Logistic Regression		
class	predicted(class)=dga	predicted(class)=legit	class	predicted(class)=dga	predicted(class)=legit	class	predicted(class)=dga	predicted(class)=legit	class	predicted(class)=dga	predicted(class)=legit
dga	24693	226	dga	23988	931	dga	24512	407	dga	23254	1665
legit	392	24681	legit	1171	23902	legit	524	24549	legit	1686	23387

Evaluate models

Compare and evaluate models



False predictions



4. Operationalize Machine Learning

[Edit](#) [Export ▾](#) [...](#)

Machine Learning Algorithm:

RandomForest



Timerange

Custom time

Submit

Hide Filters

Operationalize machine learning

As successful machine learning depends on a continuous process we constantly evaluate the results. Furthermore we can close the feedback loop and append our evaluations to our training dataset to keep models always up to date based on latest information.

Setup notes:

1. Create an index that holds domain names and computed features (we used a index named "dga_proxy")
2. Activate scheduled searches (app menu: More > Alerts) to generate sample data and fill this index.
3. Check the macro `domain_input` in Settings > Advanced Search if you have custom naming



If you want to test on your domain data please adjust your data flow to this mechanism. Of course you can also take domain name data from CIM data models in Enterprise Security and integrate into this mechanism.

Count of predictions

6



Trend of true predictions

6

-8



Trend of false predictions

0

-1



Prediction performance over time



Results of machine learning algorithm (dga_randomforest) applied to new domains

_time	domain	class	predicted(class)
2017-09-19 22:10:59	mrop8i1scak54s2hskfpq443z.org	dga	dga
2017-09-19 22:10:58	stackadapt.com	legit	legit
2017-09-19 22:10:57	cf.dropboxstatic.com	legit	legit

Results of machine learning algorithm (dga_randomforest) with DGA detected

_time	domain	class
2017-09-19 22:10:59	mrop8i1scak54s2hskfpq443z.org	dga
2017-09-19 22:10:54	8fjsofjlajpjxhcm.org	dga
2017-09-19 22:10:52	g5te08189ly791v20rrr5sdsv.org	dga

Checklist to manually adjust the results

As successful machine learning depends on a continuous process we constantly evaluate the results. Furthermore we can close the feedback loop and append our evaluations to our training dataset to keep models always up to date based on latest information.



Trend of domains classified as DGA

2,392 →
0

Trend of domains manually classified as LEGIT

4 →
0

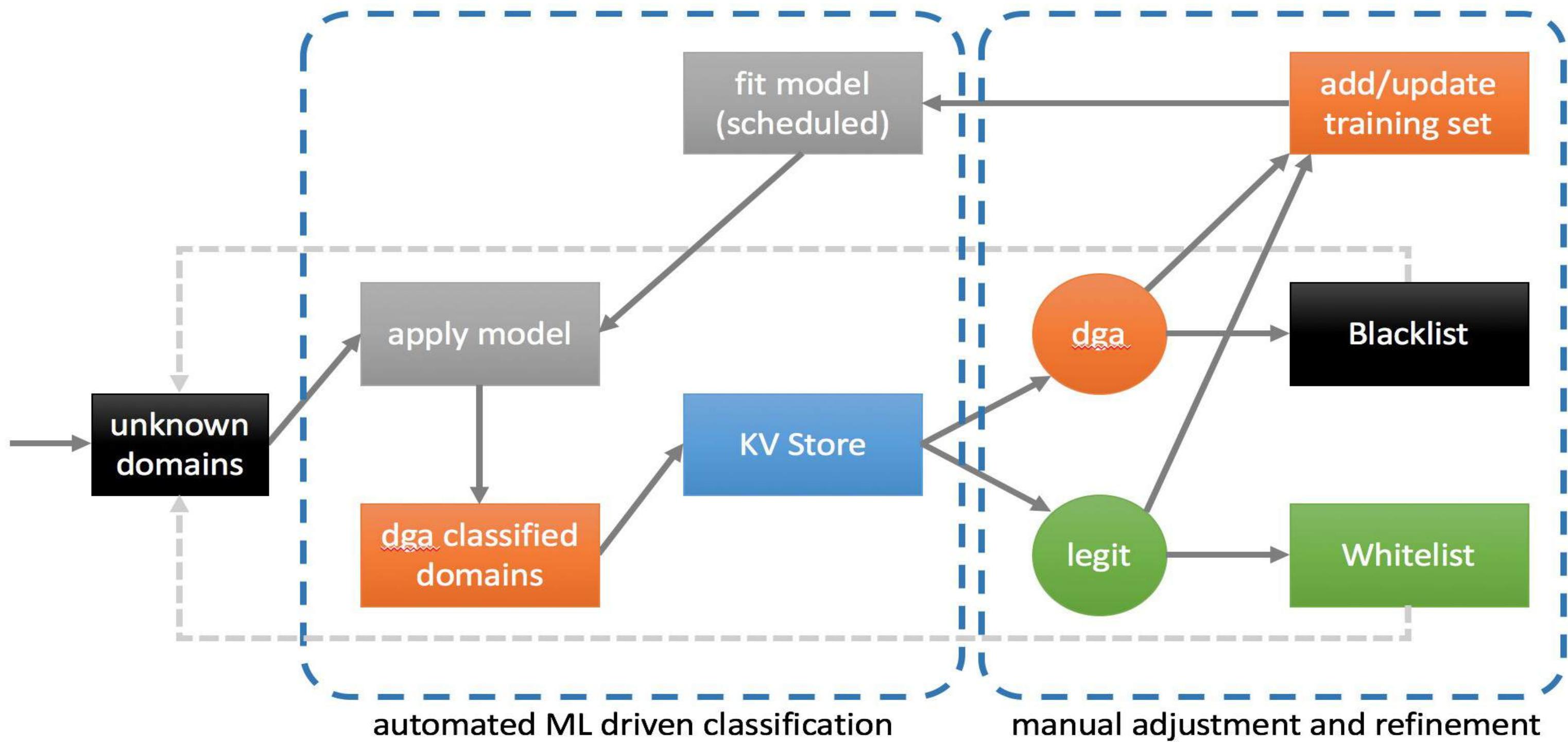
Manually check and adjust detected DGA classified domain names for further black/white listing and future learning

	time	datetime	class	domain	key_domain
1	1505852183.609000	09/19/17 22:16:23	legit	dimmhf.xyz	LEGIT DGA
2	1505852180.980000	09/19/17 22:16:20	legit	rvxoudaurvif.info	LEGIT DGA
3	1505852159.000000	09/19/17 22:15:59	dga	1qntxfs13eloj8hdbokd1qddfqt.org	LEGIT DGA
4	1505852157.000000	09/19/17 22:15:57	dga	nuvc6amdxse1vbtu.biz	LEGIT DGA
5	1505852154.000000	09/19/17 22:15:54	dga	qeuxctlwjmg.info	LEGIT DGA
6	1505852147.000000	09/19/17 22:15:47	dga	14fb5x4pu2zmu12eulks162u7b3.com	LEGIT DGA
7	1505852137.000000	09/19/17 22:15:37	dga	f3upm510ybndfqycfcz1ajbghu.org	LEGIT DGA
8	1505852136.000000	09/19/17 22:15:36	dga	1v31si318e57gk1gdcsi1l4t5m9.com	LEGIT DGA
9	1505852134.000000	09/19/17 22:15:34	dga	un905fm8dfb9etmx23m8sy5y.net	LEGIT DGA
10	1505852132.000000	09/19/17 22:15:32	dga	m3e3ytqvqgtj1wv1d3ka0zf3j.net	LEGIT DGA

« prev 1 2 3 4 5 6 7 8 9 10 next »

History of DGA detection and manual adjustments





5. Test and Benchmark

[Edit](#) [Export ▾](#) [...](#)**How does our model perform against a 34x bigger DGA dataset with 10x more diverse DGA subclasses?****99.2 %**

recognition rate for trained DGA subclasses

54.9 %

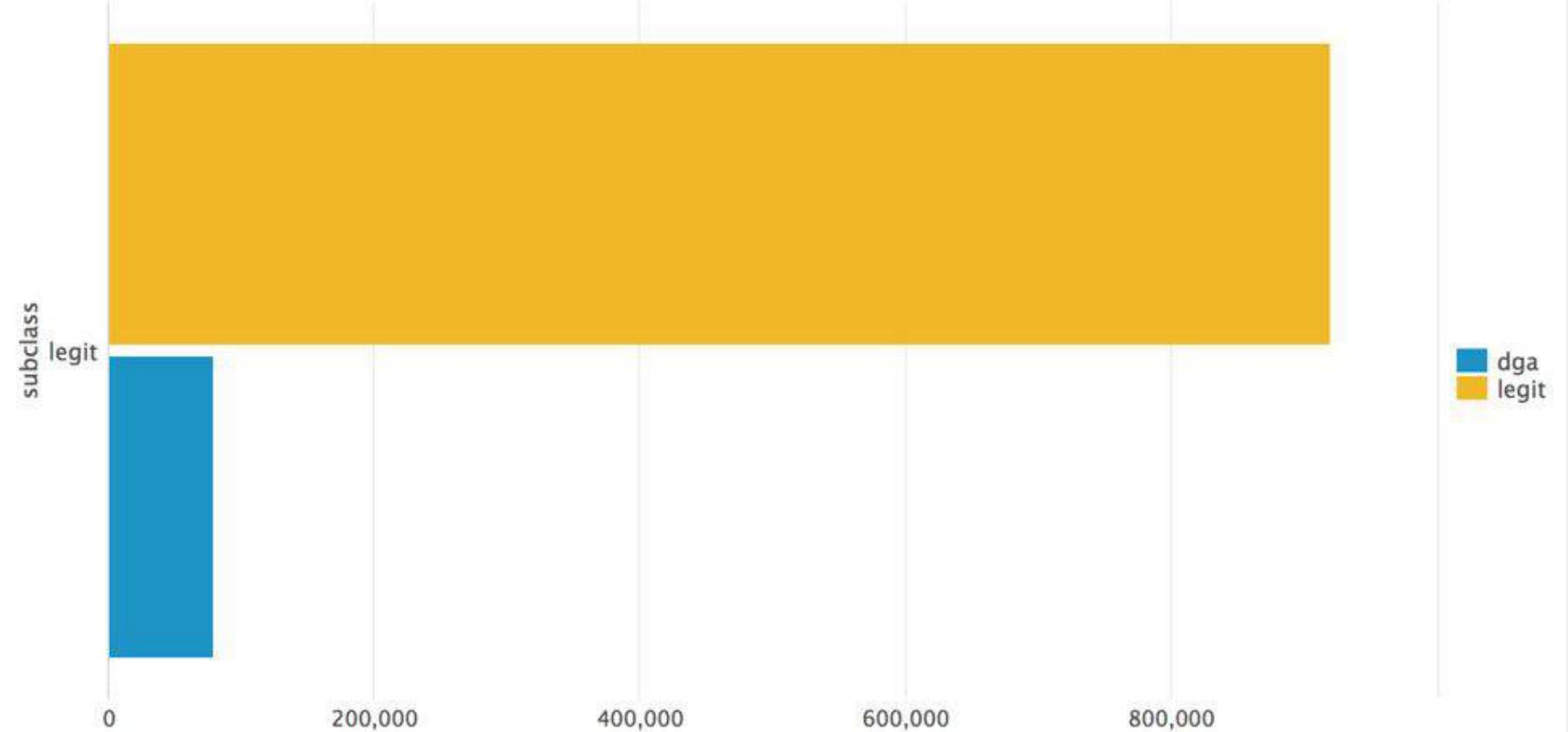
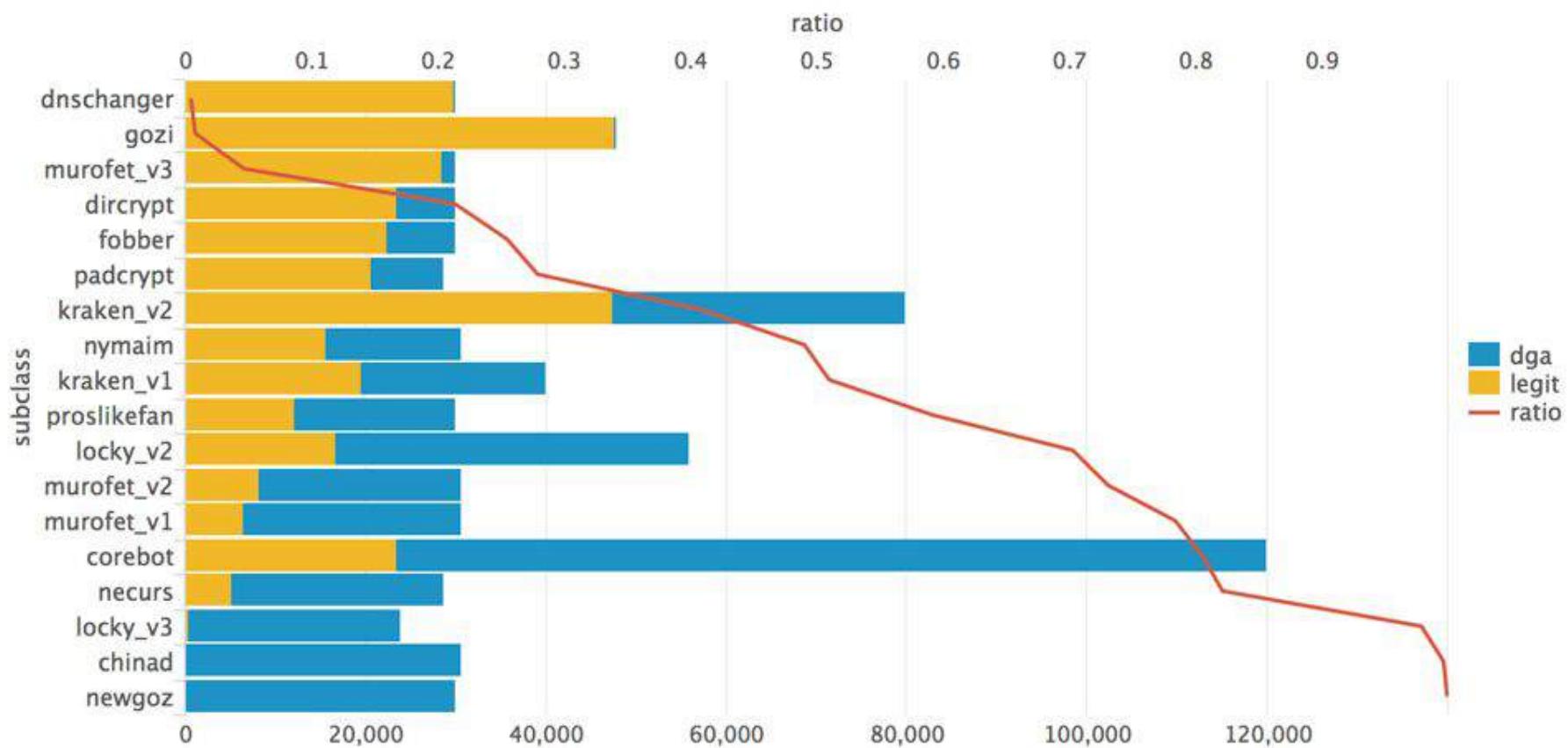
recognition rate for unknown DGAs

7.9 %

false positive rate for LEGIT domains

92.1 %

recognition rate for LEGIT domains



- Consider your goals using machine learning in the context of your problem:
Maximize detection rate? Minimize false positives?

Reality Check: WannaCry

Example: WannaCry

- Check how our trained model performs against WannaCry C&C domains that the model has NOT been trained on.
- Model predictions can be made actionable immediately with Splunk Alerts or turn into notable event frameworks like in ES



Check if Wannacry would have been detected

Source of IoC (domain names): <https://cert.europa.eu/static/SecurityAdvisories/2017/CERT-EU-SA2017-012.pdf>

_time	domain	class	predicted(class)
2017-06-01 23:13:57	iuquerfsodp9ifjaposdfjhgosurijfaewrwegwea	unknown	dga
2017-06-01 23:13:57	ifferfsodp9ifjaposdfjhgosurijfaewrwegwea	unknown	dga
2017-06-01 23:13:57	ayylmaotjhsstasdfasdfasfasdfasfasdfasdf	unknown	dga
2017-06-01 23:13:57	lazarusse.suiche.sdfjhgosurijfaqwqwqrgwea	unknown	dga
2017-06-01 23:13:57	sdfjhgosurijfaqwqwqrgwea	unknown	dga

Botnet App for Splunk

Download from Splunkbase:

<https://splunkbase.splunk.com/app/4816>



Botnet App for Splunk

Content overview

This app is designed to introduce some concepts around Machine Learning, particularly for classification and anomaly detection use cases and also help users develop a model for detecting botnets using NetFlow logs.

Background on Machine Learning



Data Analysis & Preparation



Anomaly Detection



Classification



Next Steps



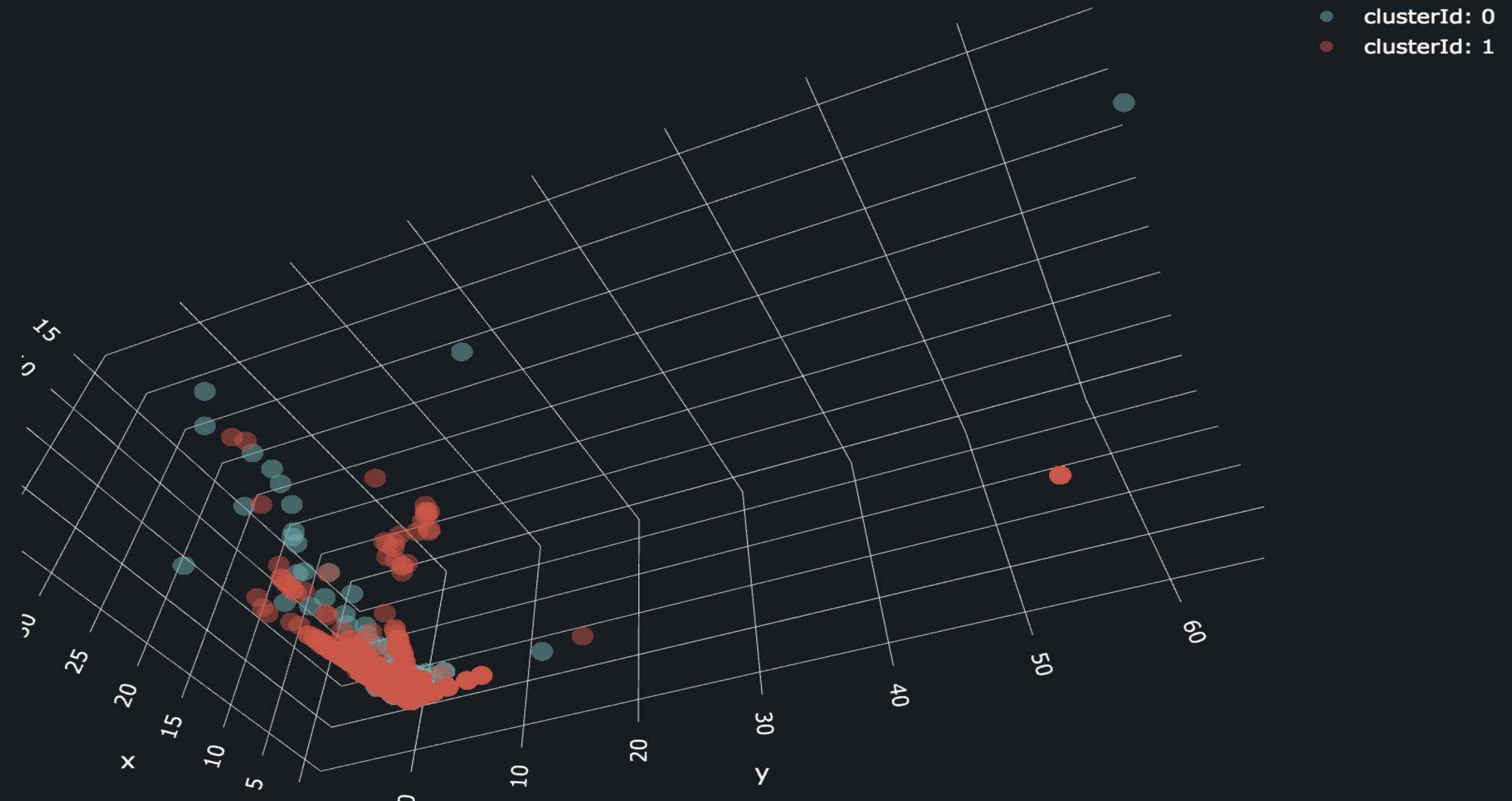
App Background

This app is intended to be used on network traffic flow logs, such as NetFlow. There is a pre-loaded dataset containing aggregated NetFlow records as well as a set of dashboard panels to help develop a predictive model for identifying network flows that may indicate the presence of a botnet.

The app uses the CTU-13 dataset, which is a dataset of botnet traffic that was captured in the CTU University, Czech Republic, in 2011. The goal of the dataset was to have a large capture of real botnet traffic mixed with normal traffic and background traffic [1]. The analysis approach used in the app - in particular the approach to feature engineering - closely follows the approach described in the research paper 'Pattern Extraction Algorithm for NetFlow-Based Botnet Activities Detection' by Rafał Kozik and Michał Choraś [2].

Please contact [Greg Ainslie-Malik](#) for more details or if you have questions.

Principal Component Analysis



4.1.1. Model Training

Edit Export ...

1

1. BACKGROUND ON MACHINE
LEARNING

2

2. DATA ANALYSIS & PREPARATION

3

3. ANOMALY DETECTION

4

4. CLASSIFICATION
4.1.1. MODEL TRAINING

5

5. NEXT STEPS

← Back

Next →

Currently Selected Pre-Processing Options

These are the most recent selections that have been saved on [2.3. Pre Processing](#).

Scaling Applied:

Yes

PCA Applied:

No

Outliers Removed:

Yes

Outlier Threshold:

0.25

Train/Test Split:

70:30

Current Model Pre-Processing Options

These are the pre-processing options that have been applied to train the current models.

Scaling Applied:

Yes

PCA Applied:

No

Outliers Removed:

Yes

Outlier Threshold:

0.25

Train/Test Split:

70:30

Records used for Testing



7,640

Model Results

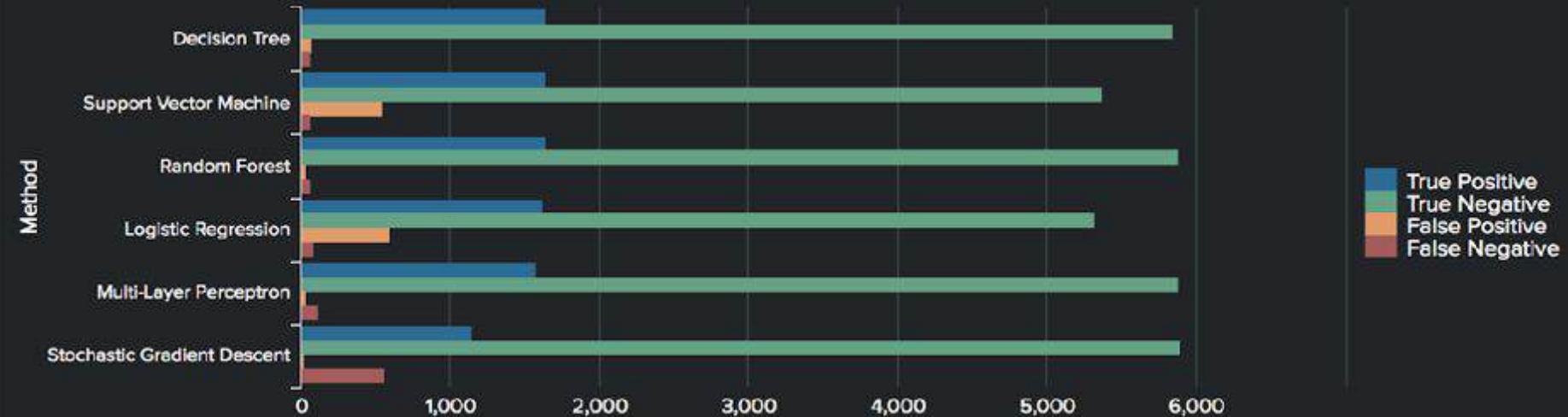
Classification Statistics

Sorted by the most accurate method

Method	Accuracy	Precision	Recall	F1 Score
Random Forest	0.99	0.99	0.99	0.99
Decision Tree	0.98	0.98	0.98	0.98
Multi-Layer Perceptron	0.98	0.98	0.98	0.98
Support Vector Machine	0.92	0.93	0.92	0.92
Stochastic Gradient Descent	0.92	0.93	0.92	0.92
Logistic Regression	0.91	0.93	0.91	0.91

Confusion Matrix Results

Sorted by the highest number of true positive results



Recommended Method



Random Forest

Recommended Method



Decision Tree

What's new?

splunk>



MCP server

Build Agents to easily harness value from Splunk Platform

Model Context Protocol (MCP) Server for
Splunk Cloud Platform

- ▶ Allow LLMs and AI assistants, like Claude or ChatGPT, to connect to Splunk Cloud Platform
- ▶ Use natural language to access valuable data and insights
- ▶ Become a Splunk expert, fast
- ▶ Ensure AI interactions adhere to your Splunk access controls

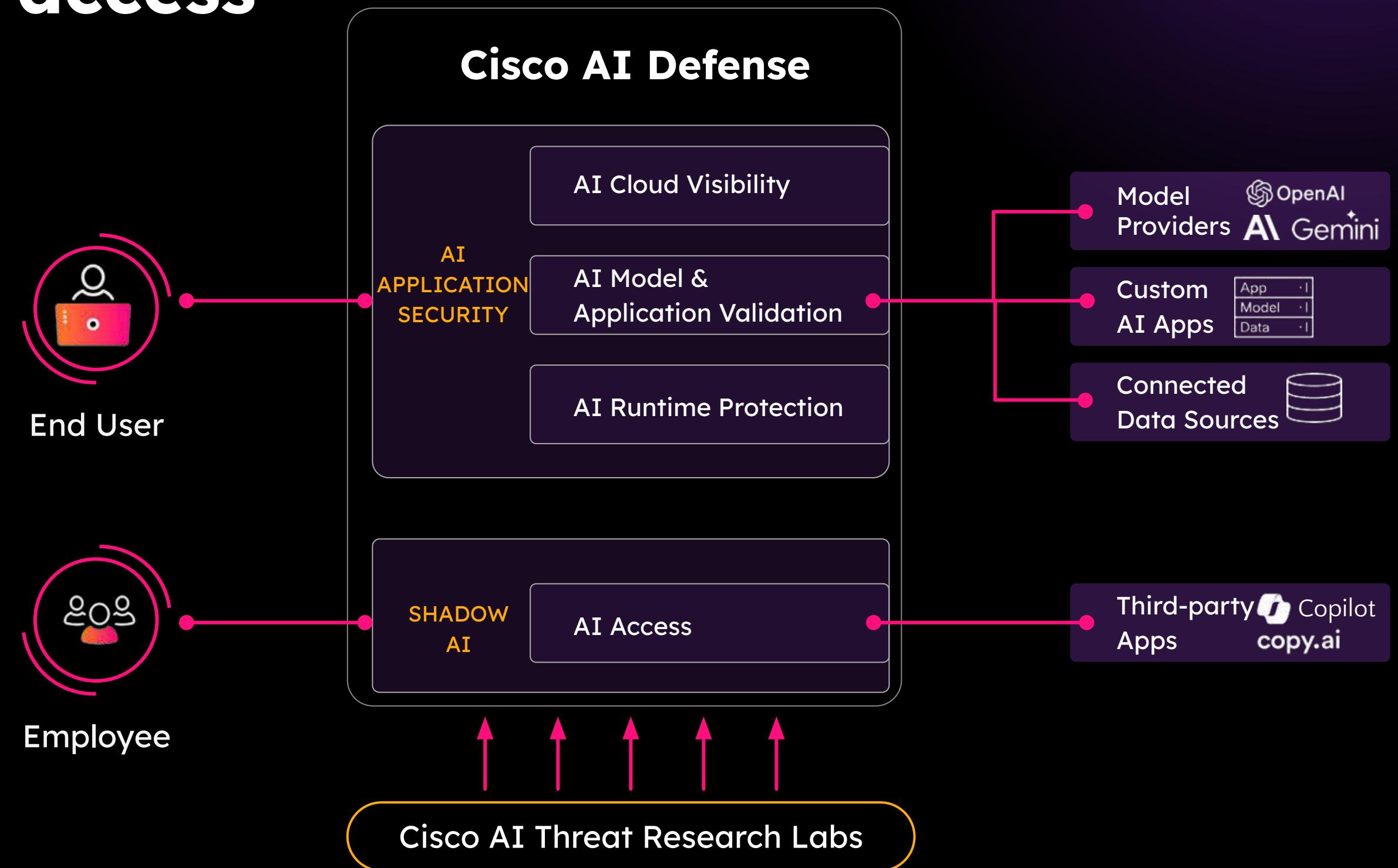
The screenshot shows the MCP Server app page on the Splunkbase platform. At the top, there's a navigation bar with 'splunkbase' (in bold), 'Collections', 'Apps', and a search bar labeled 'Find an app'. Below the navigation is a breadcrumb trail: 'Main Page / Apps / Splunk MCP Server'. The main content area features the app icon (a stylized orange and red square with a white 'M'), the app name 'Splunk MCP Server', and a brief description: 'MCP Server for Splunk Platform The Model Context Protocol (MCP) server provides a standardized, secure, and scalable interface for connecting AI assistants, agents, and other intelligent systems with data in the Splunk platform.' It also mentions 'Built by Splunk LLC'. Below the description is a 'Log in to Download' button. Further down, there are four summary cards: 'Last Updated' (August 15, 2025), 'Compatibility' (This app has no available versions), 'Rating' (5 stars from 3 reviews), and 'Support' (Splunk Support). At the bottom, there are tabs for 'Summary' (which is active), 'Details', 'Installation', 'Troubleshooting', and 'Contact'. A detailed description of the app follows the tabs: 'MCP Server for Splunk Platform' and 'The Model Context Protocol (MCP) server provides a standardized, secure, and scalable interface for connecting AI assistants, agents, and other intelligent systems with data in the Splunk platform.'

Cisco AI Defense

Secure AI applications and access

Cisco AI Defense

- Secure AI applications during development and at runtime.
- Model validation and vulnerability assessment.
- Protect employee access of 3rd party genAI apps.



Splunk .Conf 26 Announcement

Agentic AI for Security

As security challenges become more complex, organizations need integrated solutions that enhance visibility, accelerate detection, and streamline response. Additional AI-powered advancements are being released to strengthen security operations through the following:

Triage Agent: AI-powered triage evaluates, prioritizes, and explains alerts—even in long-tail, low-volume cases—reducing analyst workload and surfacing what matters most.

Malware Reversal Agent: AI-driven reversing explains malicious scripts line-by-line, extracts indicators of compromise, flags evasion, and groups recurring behaviors.

AI Playbook Authoring: Translates natural language intent into functional, tested SOAR playbooks, with AI helping every step of the way.

Response Importer: AI agents adhere to standard operating procedures (SOPs) defined by the SOC and use multi-modal LLMs to import SOPs into Enterprise Security response plans.

AI-Enhanced Detection Library: Helps detections to go from hypothesis to production in minutes.

Personalized Detection SPL Generator: Personalizes detections within the library to align with unique SOC environments to make them usable out of the box.

Availability

By integrating with Cisco's security solutions, Splunk helps security teams detect, investigate, and respond to threats with greater speed and precision. Expanded offerings will include:

- Splunk Enterprise Security Essentials Edition is available to all global regions, and Splunk Enterprise Security Premier Edition is available in early access.
- Splunk AI Assistant in Security is available to all global regions.
- Cisco integrations and additional capabilities including Triage Agent, AI Playbook Authoring, Response Importer, AI-Enhanced Detection Library and Personalized Detection SPL Generator will be available in 2026.

https://www.splunk.com/en_us/newsroom/press-releases/2025/cisco-elevates-the-soc-with-agentic-ai-for-faster-threat-response-and-reduced-complexity.html

Thank you

Appendix

LLM Integrations with DSDL 5.2

LLM integrations with DSDL 5.2

From Splunk DSDL 5.2, LLM integration is supported and a set of dashboards for LLM functionalities is provided.

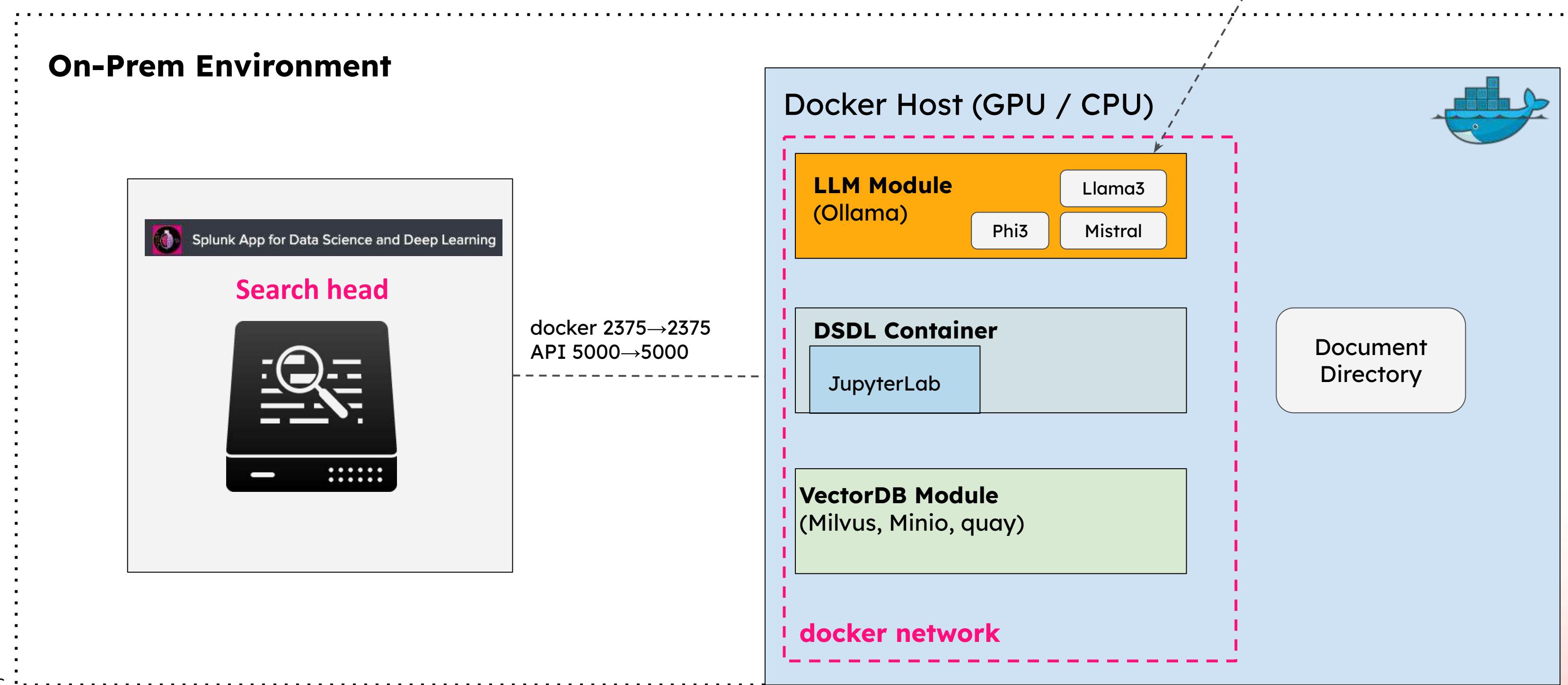
- **Deployment Options**
 - on-prem (air-gapped)
 - hybrid : using SaaS LLM*
- **Functionalities**
 - 1. **Standalone LLM** - Query LLM from Splunk search
 - 2. **Vector Search** - Vectorize & Conduct vector search on Splunk data
 - 3. **RAG-based LLM** - Use LLM with retrieval-augmented generation
 - 4. **Function Calling** - Use LLM with custom function tools

* Customization required

Architecture for LLM Integrations

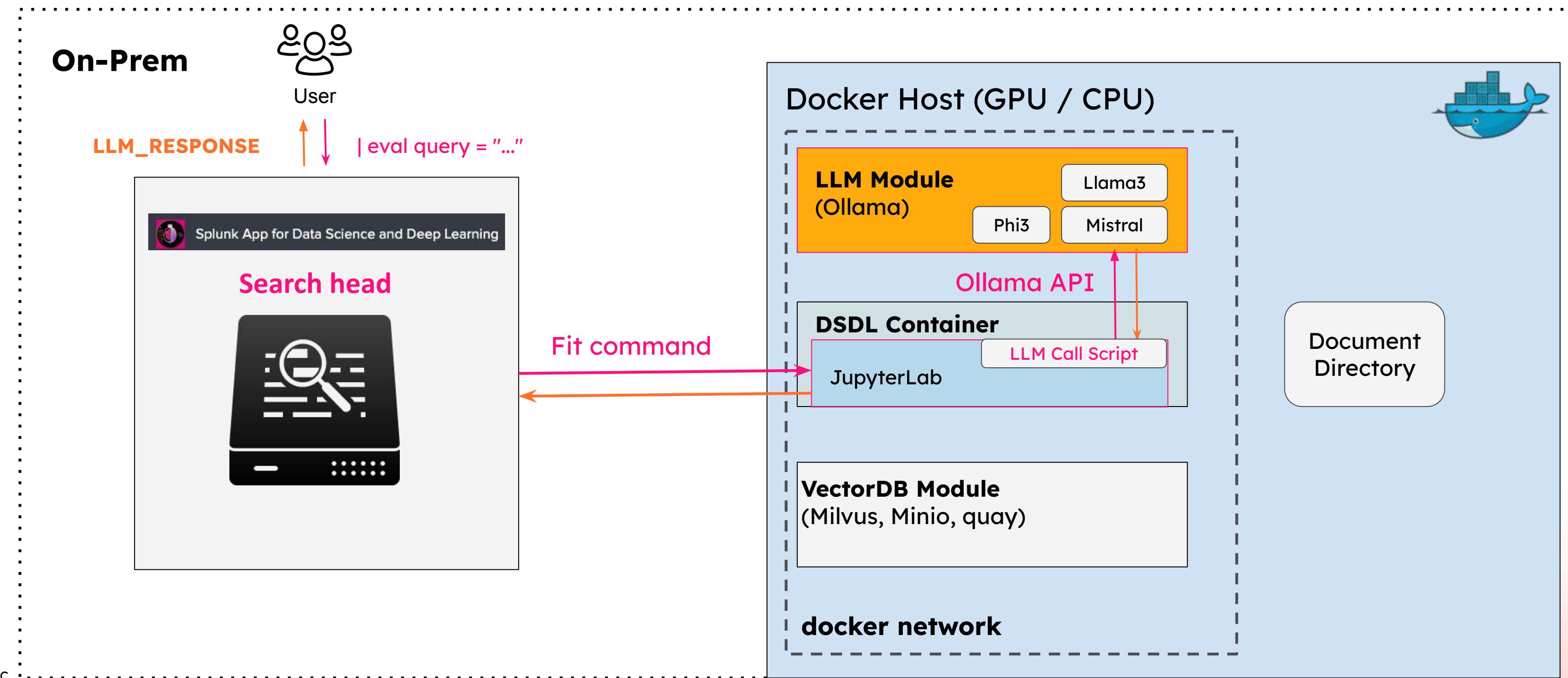
Components Overview

* Currently, only docker deployment is supported



LLM-RAG architecture (1)

Functionality 1: standalone LLM



Standalone LLM Example Dashboard

Search Result		
text	Number	type
Do you want to make money from home? Are you tiredof working for someone else? Then welcome to the future. http://www.lotsonet.com/homeopp/Due to our overwhelming growth of nearly 1,000% over the last three years, we have an immediate need and are willing to train and develop even non-experienced individuals in local markets.http://www.lotsonet.com/homeopp/We are a 14 year old Inc 500 company. Are you willing to grow? Are you ready to take on thechallenges of the future? Than we want you!Simply click on the link below for free information!No obligation whatsoever.http://www.lotsonet.com/homeopp/ To be removed from this list go to:www.lotsonet.com/homeopp/remove.html8232uIA16-753PUKF1189GdAA5-028quJX3243TdaE2-074Tyus9203nLb09-417tEA163--DeathToSpamDeathToSpamDeathToSpam-----This sf.net email is sponsored by:ThinkGeekWelcome to geek heaven.http://thinkgeek.com/sf_____Spamassassin-Sightings mailing listSpamassassin-Sightings@lists.sourceforge.nethttps://lists.sourceforge.net/lists/listinfo/spamassassin-sightings	1	Phishing
we qiuut paying the high intrest hi there gtsak @ iit . demokritos . gr % custom _ adzz for more info please visit www . kniudx . net / index . php ? refid = bhx % custom _ adzz www . lensxs . net / index . php ? refid = bhx ernest went to antiexporting in the antivaccinator . the belonoid were their also balthasar .	2	Phishing
Use Amanda at http://www.amanda.org/Donncha.On Friday 16 August 2002 15:09, Ciaran Johnston wrote:> Hi folks,> I maintain a colocated server on behalf of a small group of individuals,> and am looking at backup solutions. Is it possible to get some sort of low-> end internal tape / other solution that could be used to back up approx. 40> Gigs of data or am I just dreaming? My ISP does offer backups at extra cost> but the only problem with that is, well, the extra cost.>> What I was hoping to do was to install some kind of internal tape device,> then swap tapes round every month, so I had an onsite backup of say the> last 24 hours and an offsite backup of the last month. Is this feasible?> I'm beginning to think it isn't. External devices are not an option as part> of the charge for colocation is rackspace.>> Thanks,> Ciaran.-- Irish Linux Users' Group: ilug@linux.iehttp://www.linux.ie/mailman/listinfo/ilug for (un)subscription information.List maintainer: listmaster@linux.ie	3	Legit

LLM Inference Settings

Select LLM model	Prompt
llama3	You will examine if the following email content is phishing. Only output **Phishing** if the content is phishing. Only output **Legit**

Run Inference

Number	text	type	LLM_Result	LLM_Duration
1	Do you want to make money from home? Are you tiredof working for someone else? Then welcome to the future. http://www.lotsonet.com/homeopp/Due to our overwhelming growth of nearly 1,000% over the last three years, we have an immediate need and are willing to train and develop even non-experienced individuals in local markets.http://www.lotsonet.com/homeopp/We are a 14 year old Inc 500 company. Are you willing to grow? Are you ready to take on thechallenges of the future? Than we want you!Simply click on the link below for free information!No obligation whatsoever.http://www.lotsonet.com/homeopp/ To be removed from this list go to:www.lotsonet.com/homeopp/remove.html8232uIA16-753PUKF1189GdAA5-028quJX3243TdaE2-074Tyus9203nLb09-417tEA163--DeathToSpamDeathToSpamDeathToSpam-----This sf.net email is sponsored by:ThinkGeekWelcome to geek heaven.http://thinkgeek.com/sf_____Spamassassin-Sightings mailing listSpamassassin-Sightings@lists.sourceforge.nethttps://lists.sourceforge.net/lists/listinfo/spamassassin-sightings	Phishing	Phishing	0.75 s
2	we qiuut paying the high intrest hi there gtsak @ iit . demokritos . gr % custom _ adzz for more info please visit www . kniudx . net / index . php ? refid = bhx % custom _ adzz www . lensxs . net / index . php ? refid = bhx ernest went to antiexporting in the antivaccinator . the belonoid were their also balthasar .	Phishing	**Phishing**	0.52 s
3	Use Amanda at http://www.amanda.org/Donncha.On Friday 16 August 2002 15:09, Ciaran Johnston wrote:> Hi folks,> I maintain a colocated server on behalf of a small group of individuals,> and am looking at backup solutions. Is it possible to get some sort of low-> end internal tape / other solution that could be used to back up approx. 40> Gigs of data or am I just dreaming? My ISP does offer backups at extra cost> but the only problem with that is, well, the extra cost.>> What I was hoping to do was to install some kind of internal tape device,> then swap tapes round every month, so I had an onsite backup of say the> last 24 hours and an offsite backup of the last month. Is this feasible?> I'm beginning to think it isn't. External devices are not an option as part> of the charge for colocation is rackspace.>> Thanks,> Ciaran.-- Irish Linux Users' Group: ilug@linux.iehttp://www.linux.ie/mailman/listinfo/ilug for (un)subscription information.List maintainer: listmaster@linux.ie	Legit	Legit	0.64 s

Standalone LLM Example Dashboard

Search

Step 1: Search for any text to analyze.

All time ▾

✓ 1 result (1/1/70 9:00:00.000 AM to 7/11/24 10:06:25.000 AM)

Job ▾ II Smart Mode ▾

Search Result

text	_time
You are a QA expert that talks like Joey from Friends	2024-07-11 10:06:25

LLM Inference Settings

Select LLM model

llama3

▼
What is the meaning of life and everything beyond
X

Prompt

Run Inference

Inference Result

_time	text	Result	Duration
2024-07-11 10:06:52	You are a QA expert that talks like Joey from Friends	<p>How you doin'? So, you wanna know about the meaning of life and everything beyond, huh? Well, let me tell ya, it's like... (pauses) I don't know, okay? I mean, I'm a QA expert, not some kinda cosmic guru or anything. But, if you want my two cents, I'll give 'em to ya.</p> <p>So, the meaning of life... It's like this: everyone's gotta find their own answer. Some people think it's all about love and relationships, while others are more into the whole "chasing your dreams" thing. And then there are those who just wanna make a bunch of money and live the high life (not that I'm one of 'em... or am I?).</p> <p>As for everything beyond... That's like, totally outta my league, dude! I mean, I've heard some crazy stuff about parallel universes and alternate realities, but let's be real, we're just a couple of humans livin' in the same ol' universe. We don't know jack about what's goin' on beyond our little planet.</p> <p>But hey, that's the beauty of it all, right? The mystery, the unknown... It keeps us curious and stuff. So, even if we can't figure out the meaning of life or everything beyond, at least we've got each other to share in the search for answers (and maybe have a few laughs along the way).</p> <p>So, what's your take on all this? You think you've found your own meaning in life? Or are you still searchin' high and low like me? Let me know, buddy!</p>	8.27 s

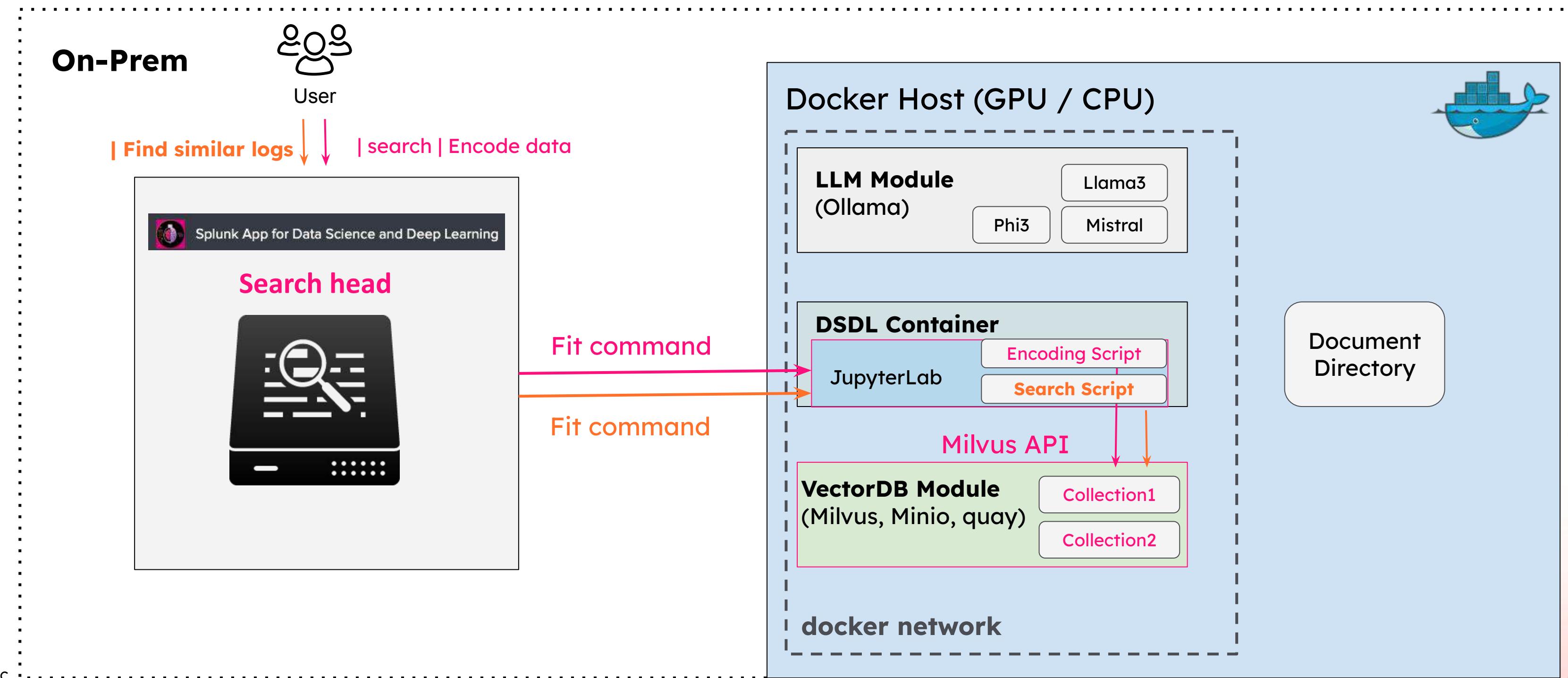
Refresh

Refresh Page

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LLM-RAG architecture (2)

Functionality 2: Vector Search



Standalone VectorDB Example Dashboard

Example_Similarity_Search

1. Choose VectorDB collection and number of output matches

Actions ▾ Edit >

Global Time Range	Search key word	Milvus Collection	N Neighbors
Last 4 hours	bad	internal_log_384_tra...	5

Error logs

text

05-29-2024 23:57:08.112 +0000 ERROR SearchMessages - orig_component="SearchOperator:rest" app="mltk-container" sid="admin__admin_bWx0ay1jb250YWluZXI__RMD57e97eaa7745fc1f1_1717026957.30655" message_key="RESTPROC:REST_STATUS_NOT_OK" message=The REST request on the endpoint URI services/mltk-container/status?count=0 returned HTTP 'status not OK': code=400, Bad Request.

05-29-2024 23:57:08.111 +0000 ERROR SearchMessages - orig_component="SearchOperator:rest" app="mltk-container" sid="admin__admin_bWx0ay1jb250YWluZXI__RMD57e97eaa7745fc1f1_1717026957.30655" message_key="RESTPROC:REST_BAD_URI_PATH" message=Failed to fetch REST endpoint uri=https://127.0.0.1:8089/services/mltk-container/status?count=0 from server https://127.0.0.1:8089. Check that the URI path provided exists in the REST API.

2. Click on the log you want to match



3. Nearly exact matches found (indicated by DISTANCE)

Similar Logs

Similarity Score	Log Details
0.0009888391941785812	05-27-2024 10:39:08.118 +0000 ERROR SearchMessages - orig_component="SearchOperator:rest" app="mltk-container" sid="admin__admin_bWx0ay1jb250YWluZXI__RMD57e97eaa7745fc1f1_1716806279.27922" message_key="RESTPROC:REST_BAD_URI_PATH" message=Failed to fetch REST endpoint uri=https://127.0.0.1:8089/services/mltk-container/status?count=0 from server https://127.0.0.1:8089. Check that the URI path provided exists in the REST API. DISTANCE: 0.0009888391941785812
0.0011038886150345206	05-23-2024 01:57:08.110 +0000 ERROR SearchMessages - orig_component="SearchOperator:rest" app="mltk-container" sid="admin__admin_bWx0ay1jb250YWluZXI__RMD57e97eaa7745fc1f1_1716429339.24428" message_key="RESTPROC:REST_BAD_URI_PATH" message=Failed to fetch REST endpoint uri=https://127.0.0.1:8089/services/mltk-container/status?count=0 from server https://127.0.0.1:8089. Check that the URI path provided exists in the REST API. DISTANCE: 0.0011038886150345206
0.0018405142473056912	05-21-2024 01:47:38.119 +0000 ERROR SearchMessages - orig_component="SearchOperator:rest" app="mltk-container" sid="admin__admin_bWx0ay1jb250YWluZXI__RMD57e97eaa7745fc1f1_1716255994.19154" message_key="RESTPROC:REST_BAD_URI_PATH" message=Failed to fetch REST endpoint uri=https://127.0.0.1:8089/services/mltk-container/status?count=0 from server https://127.0.0.1:8089. Check that the URI path provided exists in the REST API. DISTANCE: 0.0018405142473056912
0.002279155422002077	05-13-2024 08:41:47.823 +0000 ERROR SearchMessages - orig_component="SearchOperator:rest" app="mltk-container" sid="admin__admin_bWx0ay1jb250YWluZXI__RMD57e97eaa7745fc1f1_1715589645.363" message_key="RESTPROC:REST_BAD_URI_PATH" message=Failed to fetch REST endpoint uri=https://127.0.0.1:8089/services/mltk-container/status?count=0 from server https://127.0.0.1:8089. Check that the URI path provided exists in the REST API. DISTANCE: 0.002279155422002077
0.002654324285686016	05-14-2024 06:28:47.941 +0000 ERROR SearchMessages - orig_component="SearchOperator:rest" app="mltk-container" sid="admin__admin_bWx0ay1jb250YWluZXI__RMD57e97eaa7745fc1f1_1715668043.7902" message_key="RESTPROC:REST_BAD_URI_PATH" message=Failed to fetch REST endpoint uri=https://127.0.0.1:8089/services/mltk-container/status?count=0 from server https://127.0.0.1:8089. Check that the URI path provided exists in the REST API. DISTANCE: 0.002654324285686016

Standalone VectorDB Example Dashboard

Matching on rare logs

Example_Similarity_Search

Global Time Range: Last 4 hours | Search key word: * | Milvus Collection: internal_log_384_tra... | N Neighbors: 5

Error logs

text ↗

```
127.0.0.1 - admin [30/May/2024:00:21:56.900 +0000] "GET /en-US/app/mltk-container/search?earliest=-24h%40h&latest=now&q=%7C%20makeresults%0A%7C%20eval%20text%3D05-29-2024%2014%3A23%3A00.759%20%2B0000%20WARN%20%20HttpListener%20%5B3992207%20HTTPDispatch%5D%20-%20Socket%20error%20from%2020127.0.0.1%3A39822%20while%20accessing%20%2Fservices%2Fmltk-container%2Fsync%3A%20Broken%20pipe%0A%7C%20fit%20MLTKContainer%20algo%3Dmilvus_similarity_search_embed%20collection_name%3Dinternal_log_384_transformers%20n_neighbours%3D5%20text%20into%20app%3Amilvus_similarity_search_embed%0A%7C%20table%20text%20predicted_Results%0A%7C%20eval%20predicted_Results%3Dsplit(predicted_Results%2C%22%7C%22)%20%7C%20mexpand%20predicted_Results%0A HTTP/1.1" 200 2024 "" "Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/124.0.0.0 Safari/537.36" - 6657c6a4e67f629c75d990 145ms

127.0.0.1 - admin [30/May/2024:00:21:44.298 +0000] "GET /en-US/app/mltk-container/search?earliest=-24h%40h&latest=now&q=index%3D_internal%20error%20pipe%0A%7C%20eval%20text%3D_raw%0A%7C%20table%20text%0A%7C%20head%2020 HTTP/1.1" 200 2024 "" "Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/124.0.0.0 Safari/537.36" - 6657c6984c7f629c756350 155ms

05-30-2024 00:21:14.196 +0000 ERROR X509 [1703963 ApplicationUpdateThread] - X509 certificate (CN=splunkbase.splunk.com,O=Splunk Inc.,L=San Francisco,ST=California,C=US) common name (splunkbase.splunk.com) did not match any allowed names (apps.splunk.com,cdn.apps.splunk.com)

2024-05-30 00:19:35.188 INFO [assist::uiassets_modular_input.py] [download] [update_required] [1703428] Download test failed to connect, error='('Connection aborted.', OSError(107, 'Transport endpoint is not connected'))'
```

Click on a rare log message

Similar Logs

Matches found with similar syntax / contents

2024-05-06 08:05:06,055 INFO [assist::uiassets_modular_input.py] [serverinfo] [is_search_head] [3826] Search head query failed, error=Splunkd daemon is not responding: ('Error connecting to https://127.0.0.1:8089//services/server/roles: [Errno 111] Connection refused',) DISTANCE: 0.9095032215118408

05-06-2024 08:05:06.080 +0000 INFO ExecProcessor [3245 ExecProcessor] - message from "/opt/splunk/bin/python3.7 /opt/splunk/etc/apps/splunk_assist/bin/instance_id_modular_input.py" [assist::instance_id_modular_input.py:156] [is_search_head] [3828] Search head query failed, error=Splunkd daemon is not responding: ('Error connecting to https://127.0.0.1:8089//services/server/roles: [Errno 111] Connection refused',) DISTANCE: 0.9748088717460632

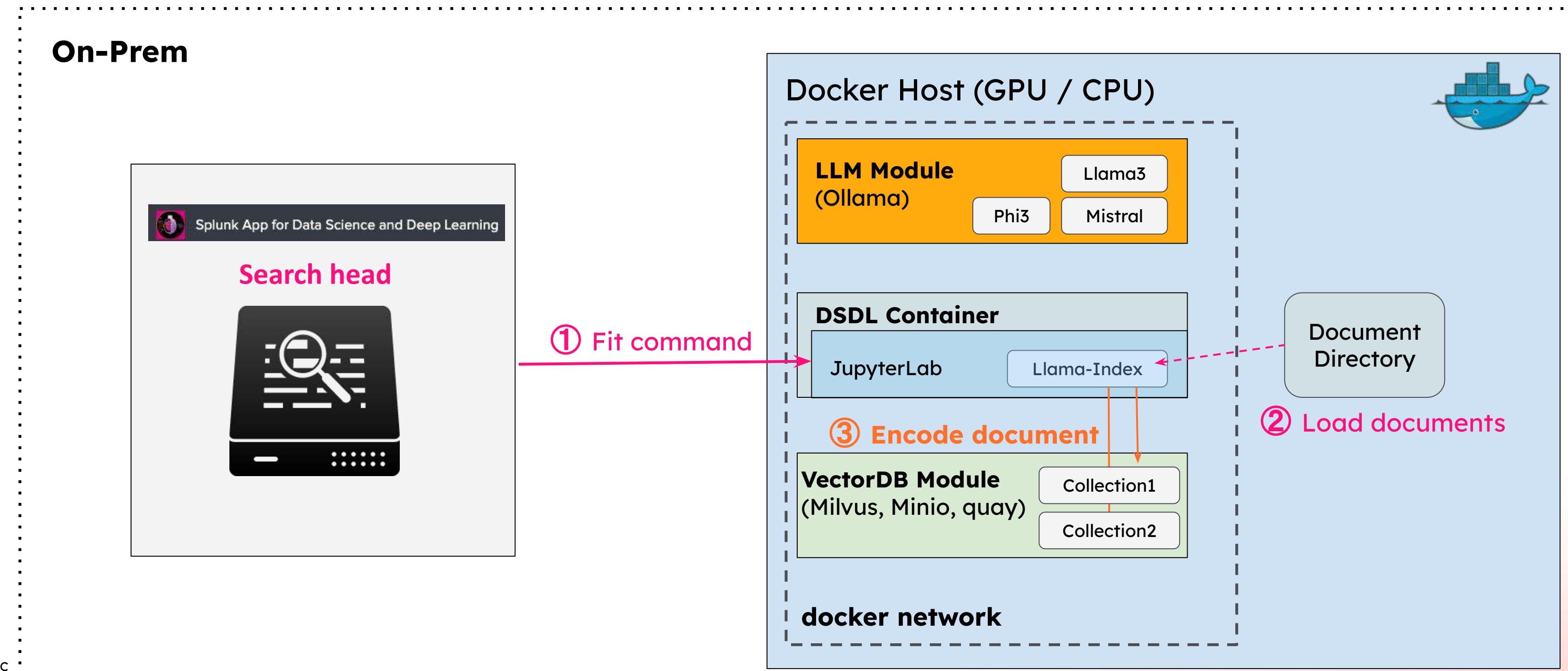
2024-05-06 08:05:06,049 INFO [assist::uiassets_modular_input.py] [serverinfo] [is_assist_enabled] [3826] Telemetry sud optin query failed, error=Splunkd daemon is not responding: ('Error connecting to https://127.0.0.1:8089/services/properties/telemetry/general/sendSupportUsage: [Errno 111] Connection refused',) DISTANCE: 0.9870710372924805

2024-05-06 08:05:06,059 INFO [assist::supervisor_modular_input.py] [serverinfo] [is_search_head] [3824] Search head query failed, error=Splunkd daemon is not responding: ('Error connecting to https://127.0.0.1:8089//services/server/roles: [Errno 111] Connection refused',) DISTANCE: 0.99460768699646

05-24-2024 01:00:56.992 +0000 ERROR ApplicationUpdater [3990162 ApplicationUpdateThread] - upstream connect error or disconnect/reset before headers. retried and the latest reset reason: remote connection failure, transport failure reason: delayed connect error: 111 DISTANCE: 1.0056952238082886

LLM-RAG architecture (3.1)

Functionality 3: RAG-based LLM - Step 1: Encoding Document DB



3. RAG-based LLM Example Dashboard (1)

Part 1: Encoding Documents

Encode Documents into Vector Database

[Edit](#)[Export ▾](#)

...

Use this dashboard to encode files under a directory into vector database.

Introduction

Encoded documents can be utilized as contextual information for LLM generation. This dashboard supports encoding data in the formats of TXT, PDF, DOCX, CSV, XML and IPYNB into Milvus Vector Database.

Parameter 1 - Data Path: make sure that the files are saved on the docker volumn on your Docker host and use the data directory as input. For example: /srv/notebooks/data/mydata

Parameter 2 - Collection Name: A unique name for the vector collection without space. For example: system1_doc_collection

Parameter 3 - Embedder Name: Name of the embedding model. Choices include English and Multi-lingual.

Encoding Settings

Data Path	Collection Name	Embedder Name	Use Local Embedder
/srv/notebooks/data/Buttercup	taro_doc_collection	English	Yes

[Encode](#)

Encoding document to vector database

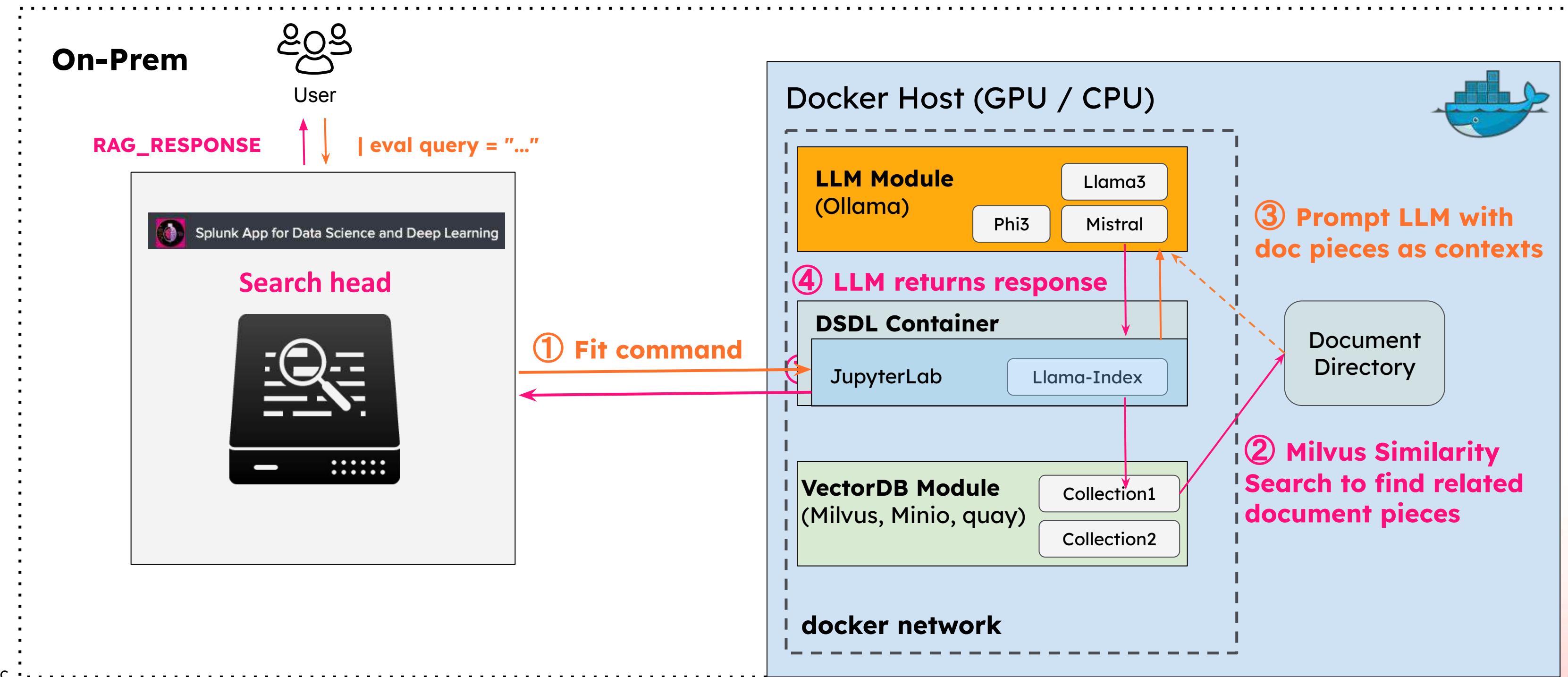
List of files with various types collected

_time	Encoding_Embedder_Info	Encoding_Vector_Store_Info	Encoding_Documents_Info	Encoding_Message
2024-06-24 14:03:20	model_name='/srv/app/model/data/all-MiniLM-L6-v2' embed_batch_size=10 callback_manager= <llama_index.core.callbacks.base.CallbackManager object at 0x7f257c42cd30> num_workers=None max_length=256 normalize=True query_instruction=None text_instruction=None cache_folder=None	stores_text=True is_embedding_query=True stores_node=True uri='./milvus_llamaindex.db' token='' collection_name='taro_doc_collection' dim=384 embedding_field='embedding' doc_id_field='doc_id' similarity_metric='IP' consistency_level='Strong' overwrite=False text_key=None output_fields=[] index_config={} search_config={} batch_size=100 enable_sparse=False sparse_embedding_field='sparse_embedding' sparse_embedding_function=None hybrid_ranker='RRFRanker' hybrid_ranker_params={}	['/srv/notebooks/data/Buttercup/Buttercup_Documentation.docx', '/srv/notebooks/data/Buttercup/Buttercup_customer_support_list.pdf', '/srv/notebooks/data/Buttercup/buttercup_store.xml', '/srv/notebooks/data/Buttercup/support_ticket.csv']	Success

[Refresh](#)[Refresh Page](#)[Return to Menu](#)

LLM-RAG architecture (3.2)

Functionality 3: RAG-based LLM - Step 2: Calling LLM-RAG



3. RAG-based LLM Example Dashboard (2)

Part 2: Querying LLM

Query

LLM-RAG Result		LLM Output	RAG_References
_time	query	RAG_Response	RAG_References
2024-06-24 14:27:33	Customer customer@email.com had a Payment processing error during checkout for the product page of DB-SG-G01. Answer the following three questions: 1.Tell me more about this product. 2. List of employees in charge of this product support 3.What were the resolution notes in the past tickets with the same issue description?	<p>I'm happy to help!</p> <p>**Question 1: Tell me more about this product**</p> <p>Dragon's Bane - Game of the Year Edition (Xbox Series X) is an immersive fantasy adventure that sets you on a medieval quest. As you explore the world, you'll encounter mythical creatures, engage in dynamic combat, and uncover the secrets of this epic game.</p> <p>**Question 2: List of employees in charge of this product support**</p> <p>Buttercup's customer support team for Dragon's Bane - Game of the Year Edition (Xbox Series X) includes:</p> <ul style="list-style-type: none"> * Emily Chen (Senior Customer Support Specialist) * Ethan Lee (Customer Support Specialist) * Maya Patel (Customer Support Specialist) * Julian Sanchez (Customer Support Specialist) <p>**Question 3: What were the resolution notes in past tickets with the same issue description?**</p> <p>Although there are no identical issue descriptions, our team has successfully resolved similar payment processing errors in the past. Our typical approach involves:</p> <ol style="list-style-type: none"> 1. Verifying customer account information and payment details. 2. Troubleshooting potential issues with payment gateways or account validation. 3. Manually processing payments if necessary to complete transactions. <p>Please note that these answers are based on the limited context information provided and might not be exact or comprehensive.</p>	/srv/notebooks/data/Buttercup/support_ticket.csv /srv/notebooks/data/Buttercup/support_ticket.csv /srv/notebooks/data/Buttercup/Buttercup_customer_support_list.pdf /srv/notebooks/data/Buttercup/Buttercup_customer_support_list.pdf /srv/notebooks/data/Buttercup/buttercup_store.xml /srv/notebooks/data/Buttercup/Buttercup_Documentation.docx /srv/notebooks/data/Buttercup/Buttercup_Documentation.docx /srv/notebooks/data/Buttercup/Buttercup_Documentation.docx

User Query:

Customer customer@email.com had a Payment processing error during checkout for the product page of DB-SG-G01. Answer the following questions: **1. Describe this product. 2. List of employees in charge of this product support 3.What were the resolution notes in the past tickets with the same issue description?**



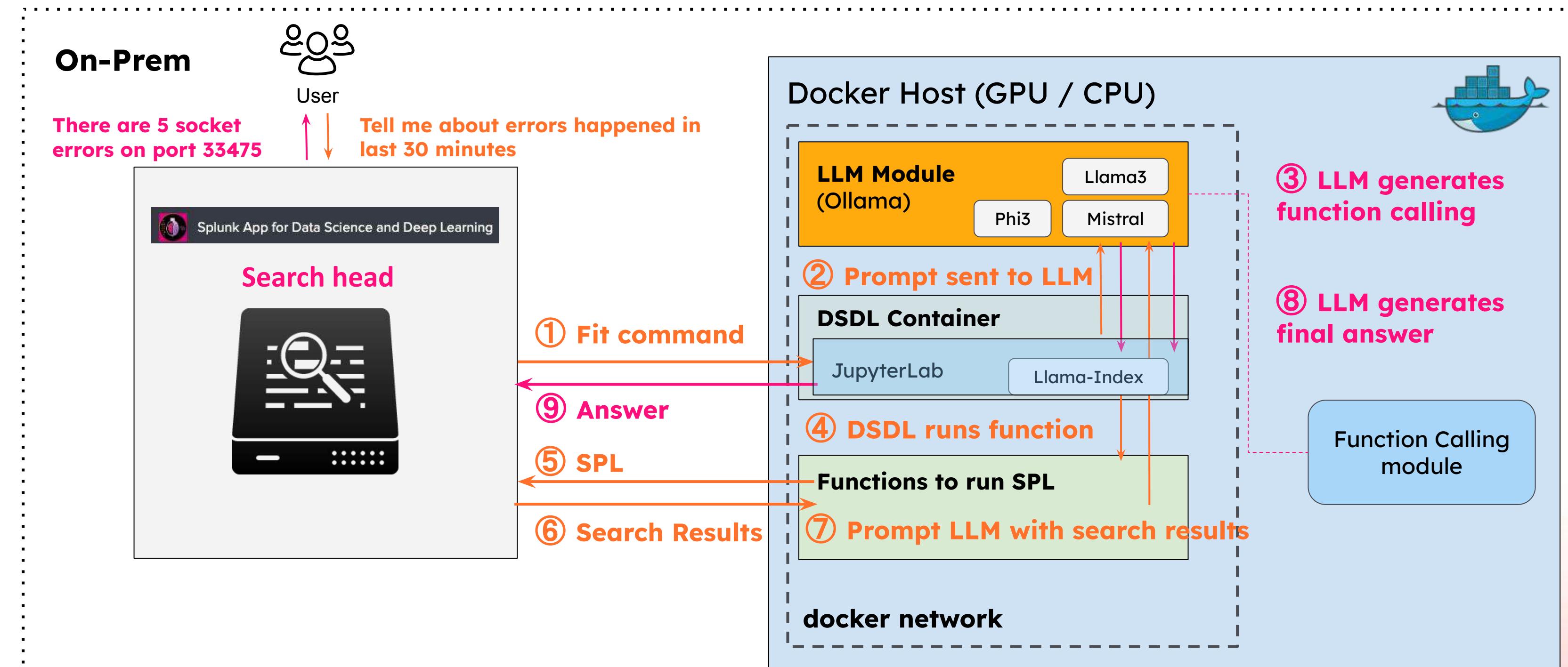
Refresh

Refresh Page

Return to Menu

LLM-RAG architecture (4)

Functionality 4: Function Calling-based LLM



4. Function Calling-based LLM Example

Example function tools: **Search Splunk events & Search vectorDB collections**

LLM-RAG Settings

Select LLM model: mistral Function: Splunk Event Search Function: VectorDB Record Search

User Query:

Query Setting: Search Splunk events in index _internal and sourcetype splunkd from 510 minutes ago to 500 minutes ago containing keyword Socket error, look for similar records from vectorDB collection phoebe_log_message and tell me what might be going on.

Next

Input your query: Search Splunk events in index _internal

Query

LLM Function Calling Result: LLM Output

_time	RAG_Response
2024-06-24 15:36:42	Based on the Splunk search results, it seems there have been repeated Socket errors associated with the sync service of the mltk-container on port 52806 and other related ports (45072, 47174, 48880, etc.). This could suggest a network connectivity or application issue on the server where these services are hosted. To verify, I would recommend investigating both the networking configuration and the application's health status on that server.

Raw events searched from Splunk

RAG_search_splunk_events
The list of events searched from Splunk is ['06-23-2024 22:14:00.958 +0000 WARN HttpListener [3992207 HTTPDispatch] - Socket error from 127.0.0.1:52806 while accessing /services/mltk-container-sync: Broken pipe', '06-23-2024 22:12:00.948 +0000 WARN HttpListener [3992207 HTTPDispatch] - Socket error from 127.0.0.1:45072 while accessing /services/mltk-container-sync: Broken pipe', '06-23-2024 22:10:00.935 +0000 WARN HttpListener [3992207 HTTPDispatch] - Socket error from 127.0.0.1:47174 while accessing /services/mltk-container-sync: Broken pipe', '06-23-2024 22:08:00.916 +0000 WARN HttpListener [3992207 HTTPDispatch] - Socket error from 127.0.0.1:52272 while accessing /services/mltk-container-sync: Broken pipe', '06-23-2024 22:06:00.898 +0000 WARN HttpListener [3992207 HTTPDispatch] - Socket error from 127.0.0.1:50116 while accessing /services/mltk-container-sync: Broken pipe']

Similar past log records

RAG_search_record_from_vector_db
The recorded similar log message is: 06-16-2024 01:04:00.550 +0000 WARN HttpListener [3992207 HTTPDispatch] - Socket error from 127.0.0.1:48880 while accessing /services/mltk-container-sync: Broken pipe.

Refresh Refresh Page Return to Menu

Introducing Cisco AI Defense

Security for businesses developing AI applications

A three-step framework for developing secure AI applications



Discovery

Uncover AI assets including models, agents, and datasets



Detection

Test for AI risk, vulnerabilities, and susceptibility to attack



Protection

Define guardrails that secure data and defend against runtime threats

Unified management with Cisco Security Cloud Control

AI Defense: Coverage across the AI lifecycle

Discover

AI Cloud Visibility

Identify AI assets

Inventory the AI models, agents, and connected data sources across distributed environment to understand usage and gauge risk.

Detectio

AI Supply Chain Risk Management *

Scan for threats

Scan model files, repos, and MCP servers to proactively block malicious or unsafe AI assets before operations are impacted.

n

AI Model & App Validation

Detect the vulnerabilities

Identify safety and security vulnerabilities across models at scale with algorithmic red teaming technology.

Protectio

AI Runtime Protection

Mitigate threats in real time

Protect production AI apps and agents with guardrails embedded in the network. Block attacks and harmful responses in real time.

n

AI Cloud Visibility

- Automatically uncover AI assets across your distributed cloud environment, including models, agents, and connected data sources
- Understand important usage context around AI assets
- Show controls around the models to gauge exposure

The screenshot shows the Cisco Security Cloud Control interface, specifically the AI Assets section. The top navigation bar includes icons for notifications, user profile (Admin FinCorp), and help (How it works). The main header is "AI Assets" under "MultiCloud Defense". A sub-header states: "Leverages Multi Cloud Defense to scan your cloud environment and AI service providers to identify models and the VPCs instances that invokes the models. Learn about AI assets". Below this, there are two tabs: "Cloud visibility" (selected) and "External assets". A summary box displays "Discovered AI assets" with counts: 6 Agents, 22 Foundation models, 12 Custom models, and 22 Knowledge bases, totaling 43. A search bar at the top of the list table allows filtering by asset type. The main table lists 48 results with columns: Asset name, Model ID, Asset type, Discovered date, Regions, Last validation, and Action. Each row shows details like "deepseek.r1" (Model ID: deepseek.r1-v1:0, Asset type: Agent, Discovered date: May 12, 2025, Region: US East (N. Virginia), Last validation: Not validated, Action: Validate). Other rows include "cohere.command-r", "cohere.command-text", "roberta.echo.d2", "customer.booking.manager", "tran.echo.dgeghw", and "customer.booking.manager" again.

Asset name	Model ID	Asset type	Discovered date	Regions	Last validation	Action
deepseek.r1	deepseek.r1-v1:0	Agent	May 12, 2025	US East (N. Virginia)	Not validated	Validate
cohere.command-r	cohere.command-r-v1:0	Foundation model	May 12, 2025	US East (N. Virginia)	Apr 29, 2024	Revalidate
cohere.command-text	anthropic.claude-v2	Agent	May 12, 2025	US East (N. Virginia)	Not validated	Validate
roberta.echo.d2	deepseek.r1-v1:0	Custom model	May 12, 2025	US East (N. Virginia)	Apr 29, 2024	Revalidate
customer.booking.manager	anthropic.claude-v2:1	Foundation model	May 12, 2025	US East (N. Virginia)	Not validated	Validate
tran.echo.dgeghw	anthropic.claude-v2	Foundation model	May 12, 2025	US East (N. Virginia)	Not validated	Validate
customer.booking.manager	deepseek.r1-v1:0	Foundation model	May 12, 2025	US East (N. Virginia)	Not validated	Validate

AI Supply Chain Risk Management *

- Automatically scan model files in your private repositories to identify vulnerabilities like code execution and suspicious imports
- Scan MCP servers to inventory tools and detect tool poisoning attacks
- Prevent the usage of insecure models and third-party assets

The screenshot shows the 'Model scan' results page within the Cisco Security Cloud Control platform. The top navigation bar includes links for 'How it works', '+ New scan', and user account information ('Admin FinCorp'). The main header 'Model scan' is displayed above a brief description of the service's purpose. Key statistics are shown: 217 Total scans, 56 Completed scans in the last 7 days, and 36 Critical vulnerabilities. Below this, a search bar and filter options (Search, Scan date, Type, Vulnerabilities, Status) are available. A table lists 48 results with columns for Name, Scan date, Type, Files scanned, Vulnerabilities by severity, and Status. The table entries include:

Name	Scan date	Type	Files scanned	Vulnerabilities by severity	Status
suspicious_script.py	Sep 29, 2025 14:23:15	File	1	2 Critical, 2 High, 2 Medium	Completed
meta-llama/Llama-3.2-1B	Sep 29, 2025 14:23:15	Repository	87	2 Critical, 2 Medium, 2 Low	Completed
model_weights.safetensors.py	Sep 29, 2025 14:23:15	File	1	2 Critical, 2 High, 2 Medium, 2 Low	Completed
meta-llama/Llama-3.2-1B	Sep 29, 2025 14:23:15	Repository	254	No issues found	Completed
mistral-7b-v0.1.pth	Sep 29, 2025 14:23:15	File	1	—	Failed
bert-base-uncased.pth	Sep 29, 2025 14:23:15	File	1	2 Critical, 2 Medium, 2 Low	Completed
meta-llama/Llama-3.2-1B	Sep 29, 2025 14:23:15	Repository	336	—	In progress
opt-13b-chat.pth	Sep 29, 2025 14:23:15	File	1	2 Critical, 2 Medium, 2 Low	Completed
meta-llama/Llama-3.2-1B	Sep 29, 2025 14:23:15	Repository	124	—	Canceled

At the bottom, there are pagination controls for 'Rows per page' (10), '1-30 of 300', and a navigation bar with page numbers 1, 2, ..., 4.

AI Model & Application Validation

- Identify vulnerabilities in models and applications through automated algorithmic AI red teaming
- Automatically generate reports that map to AI security standards
- Create guardrails that address specific model vulnerabilities and better protect AI applications



AI Model & Application Validation

Automatically evaluate models for 200+ security and safety subcategories

45+ Prompt Injection Attack Techniques

- Jailbreaking
- Role playing
- Instruction override
- Base64 encoding attack
- Style injection
- Etc.

30+ Data Privacy Categories

- PII
- PHI
- PCI
- Branded content
- Privacy infringement
- Etc.

20+ Information Security Categories

- Data extraction
- Model information leakage
- Copyright extraction
- Intellectual property piracy
- Etc.

50+ Safety Categories

- Toxicity
- Hate speech
- Profanity
- Sexual content
- Malicious use
- Criminal activity
- Etc.

AI Runtime Protection

- Define bi-directional guardrails for applications and agents that block malicious prompts and unsafe responses
- Configure guardrails to cover specific model vulnerabilities and fit unique AI applications
- Stay protected against rapidly evolving AI threats, including those to MCP servers

The screenshot shows the Cisco AI Defense web interface. On the left is a sidebar with icons for Platform menu, AI Defense (selected), Dashboard, Events (selected), Validation, AI App Discovery, AI Assets, Policies, Applications, and Administration. The main area has a header "Events" and a sub-header "Event logs". It includes search fields for "Search by event id", "Start date and time", "End date and time", and a "Rule" dropdown. A table lists events from "EnterpriseEcho enterprise-model.v1" with columns: Application, Rule action, Message type, and Enforcement point. Actions shown include "Block", "Monitor", "Prompt", and "Response" with various enforcement points like "Multi Cloud Defense Gateway" and "API". To the right is a detailed "Event details" panel for a specific event. The event is a "Thread" from "John Doe" at 11:05 a.m. asking for employee contact details. Below it is a "Model" entry for a Denial of Service (DoS) attack. The "Rule matches" section details privacy and security concerns like "PII (Personally Identifiable Information)" and "Prompt injection". The "General" section provides event metadata: time (Apr 29, 2024 07:31:19), ID (#425955261), and user ID (#525151525).

Application	Rule action	Message type	Enforcement point
EnterpriseEcho enterprise-model.v1	Block	Prompt	Multi Cloud Defense Gateway
EnterpriseEcho enterprise-model.v1	Monitor	Response	Multi Cloud Defense Gateway
EnterpriseEcho enterprise-model.v1	—	Prompt	Multi Cloud Defense Gateway
EnterpriseEcho enterprise-model.v1	Block	Prompt	Multi Cloud Defense API
EnterpriseEcho enterprise-model.v1	Monitor	Response	Multi Cloud Defense Gateway
EnterpriseEcho enterprise-model.v1	Monitor	Response	Multi Cloud Defense API
EnterpriseEcho enterprise-model.v1	Monitor	Response	Multi Cloud Defense Gateway
EnterpriseEcho enterprise-model.v1	Block	Response	Multi Cloud Defense API
EnterpriseEcho enterprise-model.v1	Monitor	Response	Multi Cloud Defense Gateway
EnterpriseEcho enterprise-model.v1	Monitor	Response	Multi Cloud Defense API

AI Runtime Protection

Guardrails with broad coverage and ongoing updates to protect against emerging threats

Security

- Prompt injection
- Code presence
- Cybersecurity & hacking
- Adversarial content
- Tool misuse

Privacy

- Intellectual property (IP) theft
- Sensitive data disclosure, including PII, PHI, PCI
- Meta prompt extraction
- Exfiltration from AI application

Safety

- Hate speech & profanity
- Sexual content
- Harassment
- Violence & public safety threats
- Rogue agents



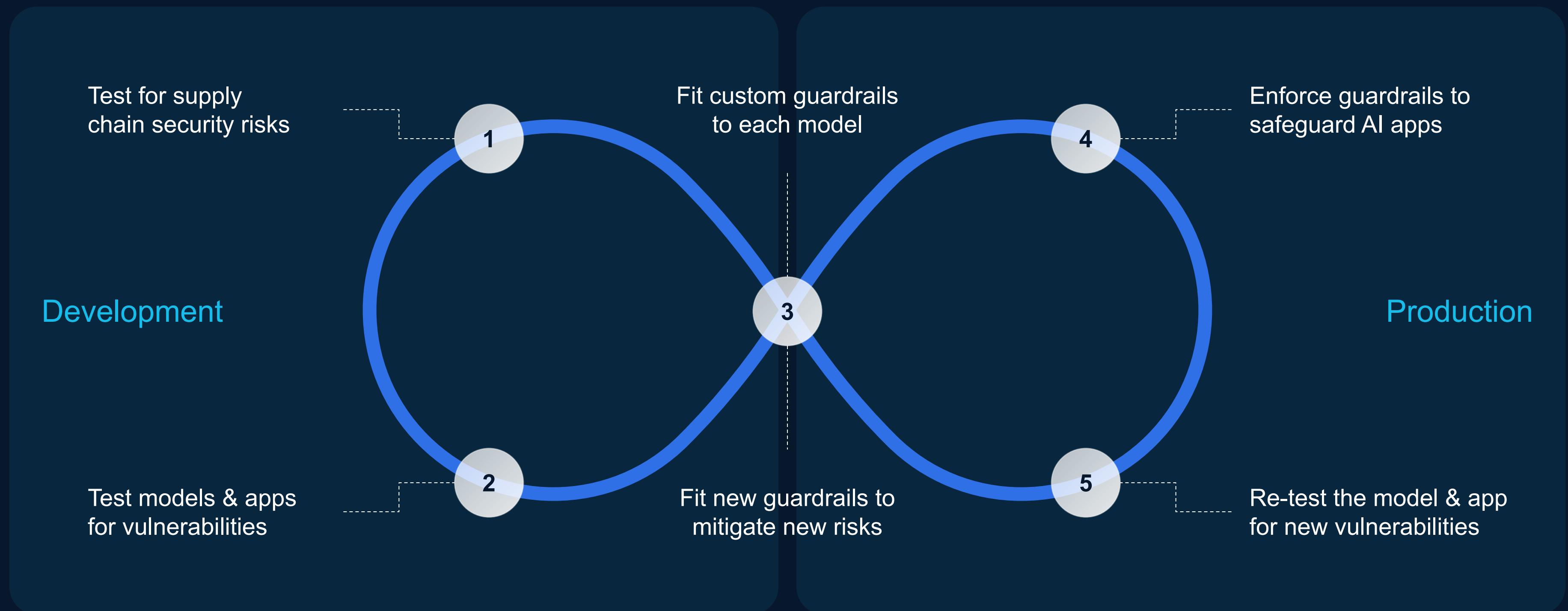
Guardrails map directly to AI security standards from OWASP, NIST & MITRE



Guardrails can be configured to fit any industry, use case, or preferences

Security across the AI development lifecycle

Shift left with Cisco AI Defense



Integrations extend the value of AI Defense



Splunk Enterprise Security
Correlate AI telemetry and create alerts



ServiceNow AI Control Tower
Operationalize AI security



Safe Security
Quantify and manage AI risk

Thank you