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Defense Against the Dark Arts: Splunk Edition

Melisa Napoles | Erika Strano

Wednesday October 23, 2019

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Agenda

1. Why is the magic of Machine Learning (ML) essential to Defense Against the Dark Arts?
2. How are we seeing organizations detect the presence of dark wizards?
3. Let's journey into the dark forest and hunt down the death eaters!
4. Close your spell book and get ready to duel.
5. Concepts behind ML magic

****Muggle version of the agenda in the Appendix****

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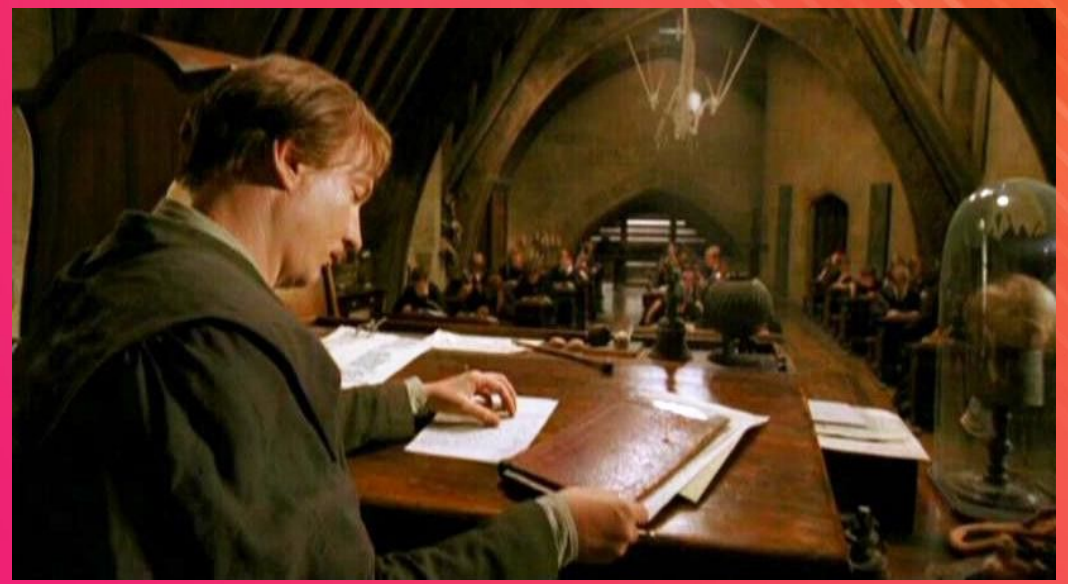
Why is the magic of Machine Learning (ML) essential to Defense Against the Dark Arts?



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Machine Learning can help you ...

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…so you can find your bears!




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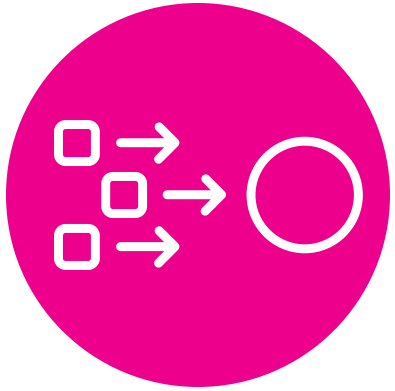
How Does Machine Learning Work?

Do you believe in magic?



Use mathematical models to **learn** patterns in information

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

Use learned patterns to understand and interpret new data or make predictions


According to Gartner, a citizen data scientist uses analytics, but their title is not "data scientist" or similar. They complement data scientists and bring their OWN expertise and unique skills.
https://www.gartner.com/en/documents/3534848
https://blogs.gartner.com/carlie-idoine/2018/05/13/citizen-data-scientists-and-why-they-matter/

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Machine learning doesn’t solve cyber security, but it can help!

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How are we seeing organizations detect the presence of dark wizards?

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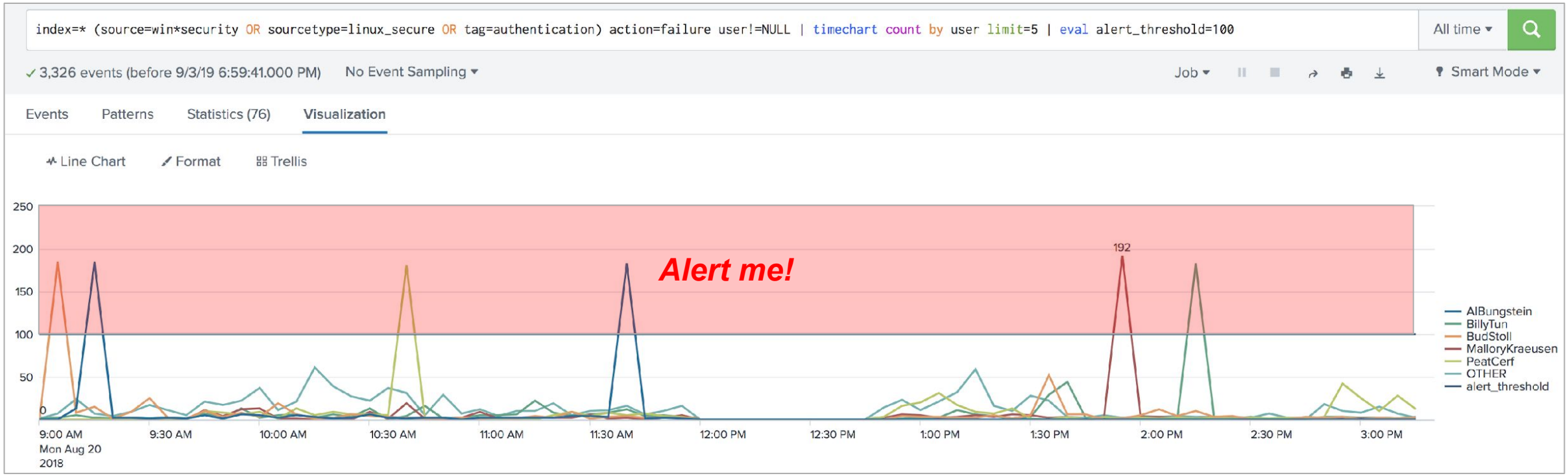
Who Finds Anomalies Like This Today?

One search with a static threshold



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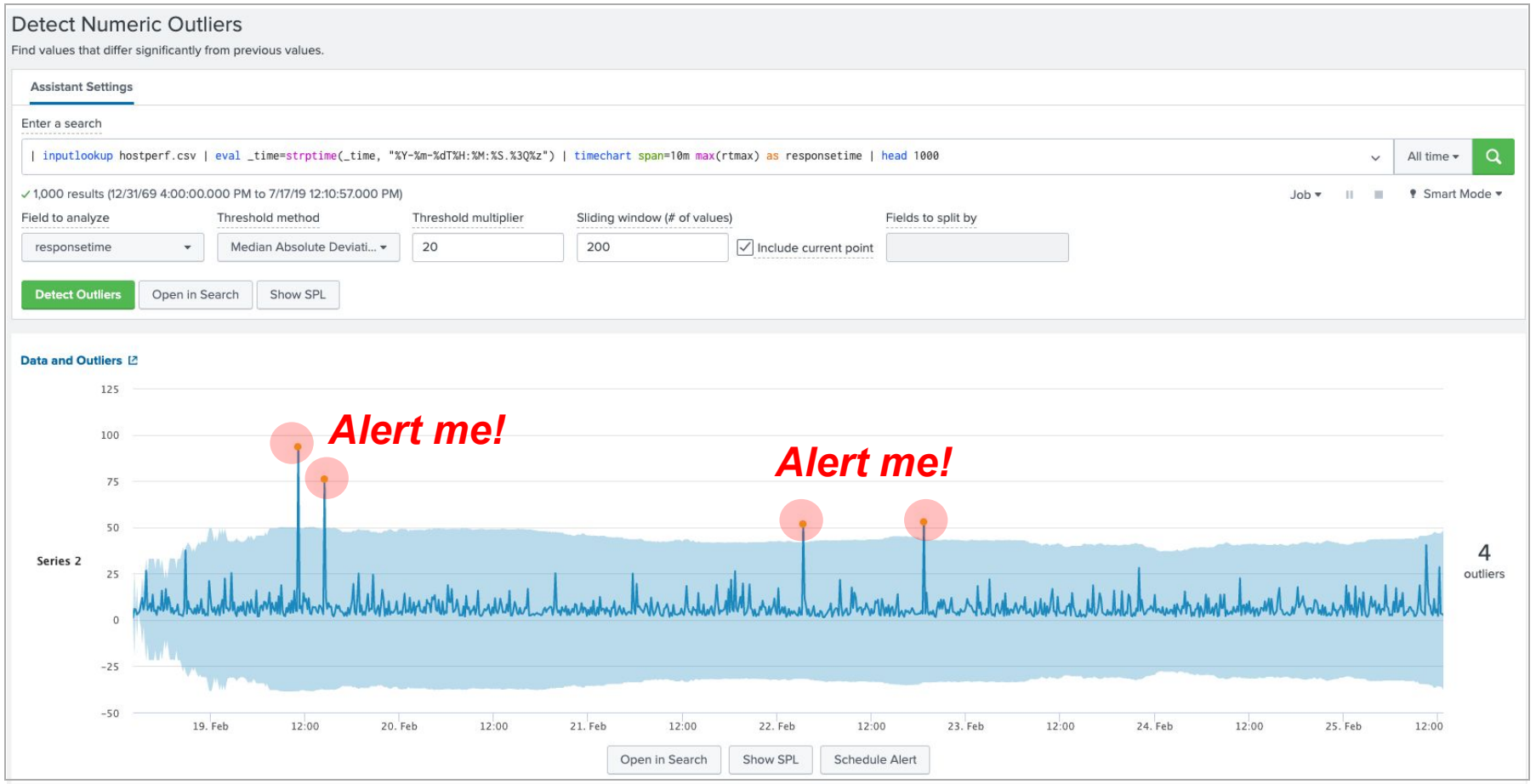
How About Like This?

One search with a dynamic threshold



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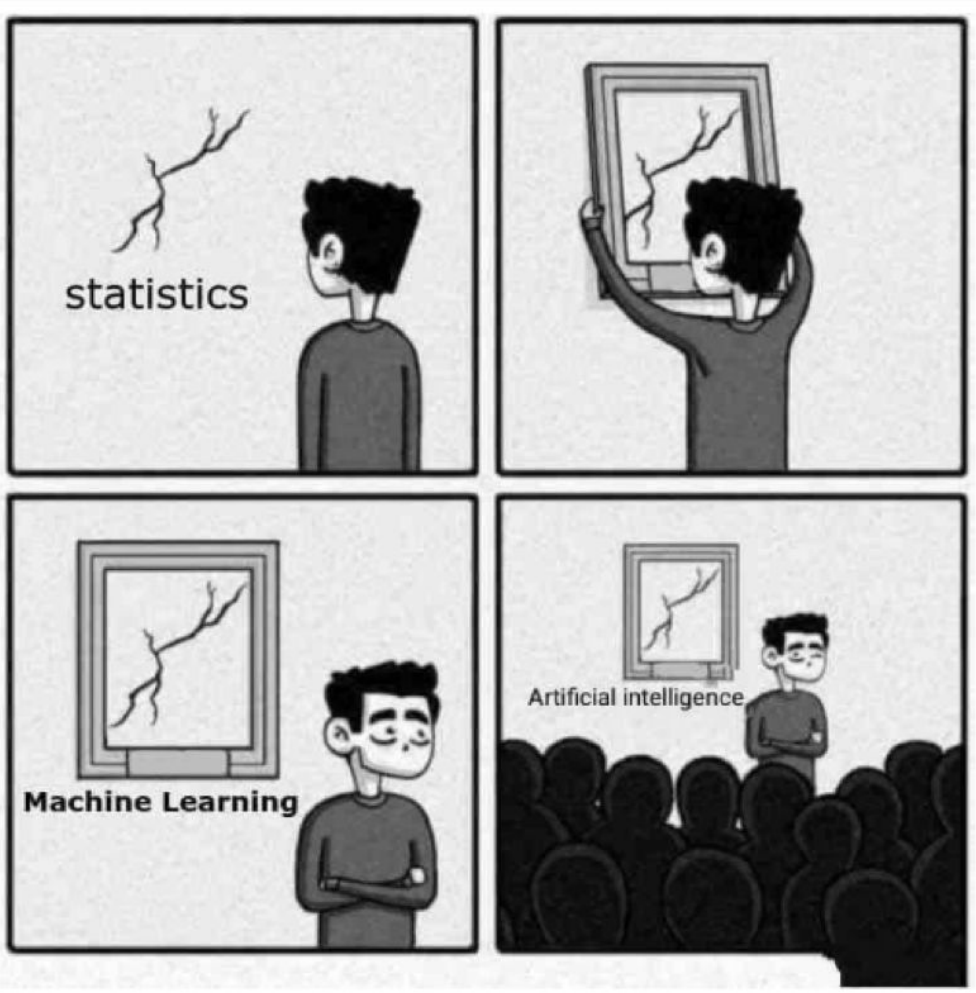
ML = Stats OR ML != Stats?



original comic by sandserif

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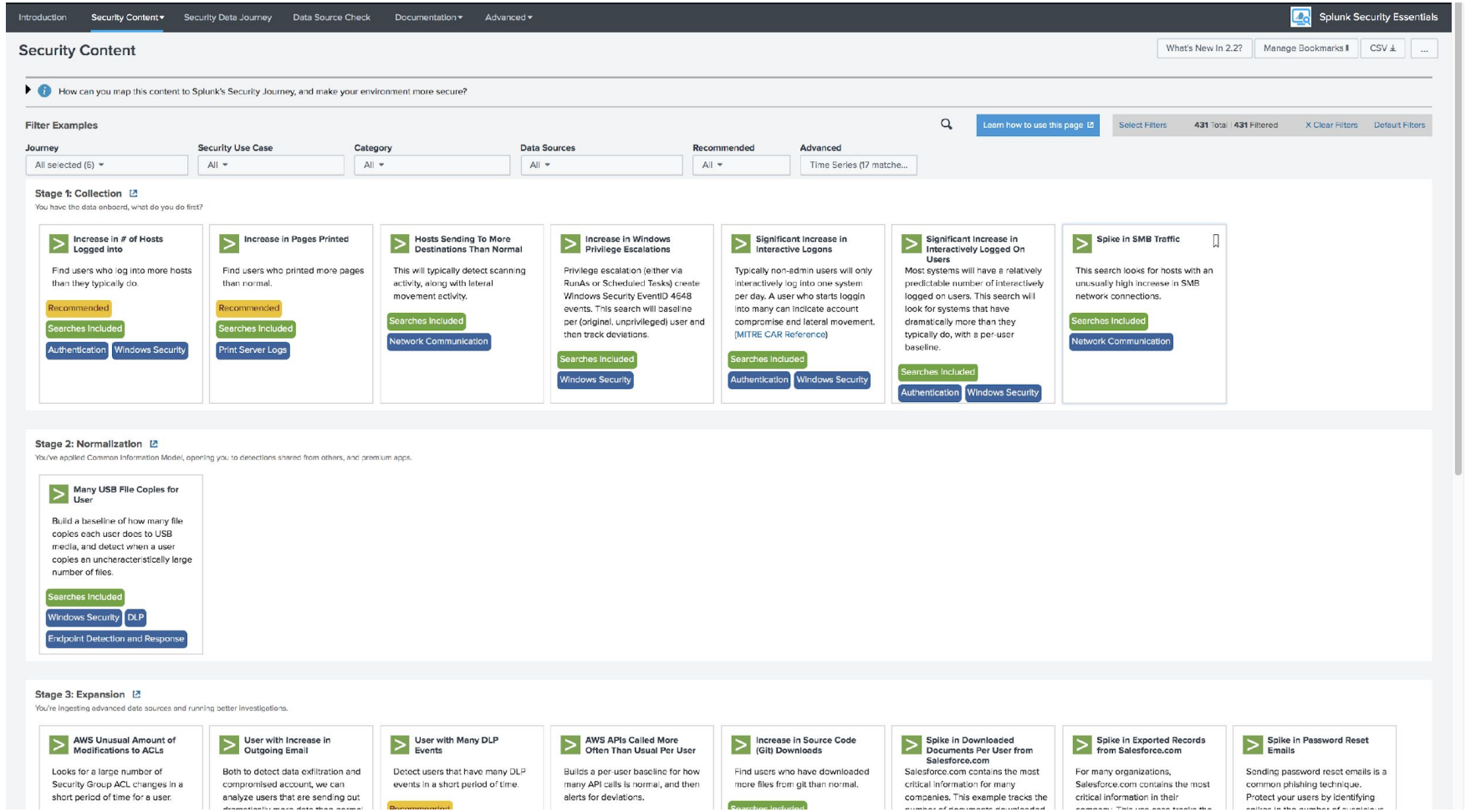
Check Out SSE For a Jump Start with 17 Use-cases

Thanks Splunk Security Essentials (SSE)!



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Is this scalable?

You're running your anomaly search on all your data every time...

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Instead, try...

fit first and then, *apply*

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…and make sure your data fits the model…

not the other way around.

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Enter Splunk Machine Learning Toolkit (MLTK)

Extends Splunk with new tools and guided modeling environment

Experiments and Assistants: Guided model building, testing, and deployment for common objectives

Showcases: Interactive examples for typical IT, security, business, and IoT use cases

Algorithms: 80+ standard algorithms (supervised & unsupervised)

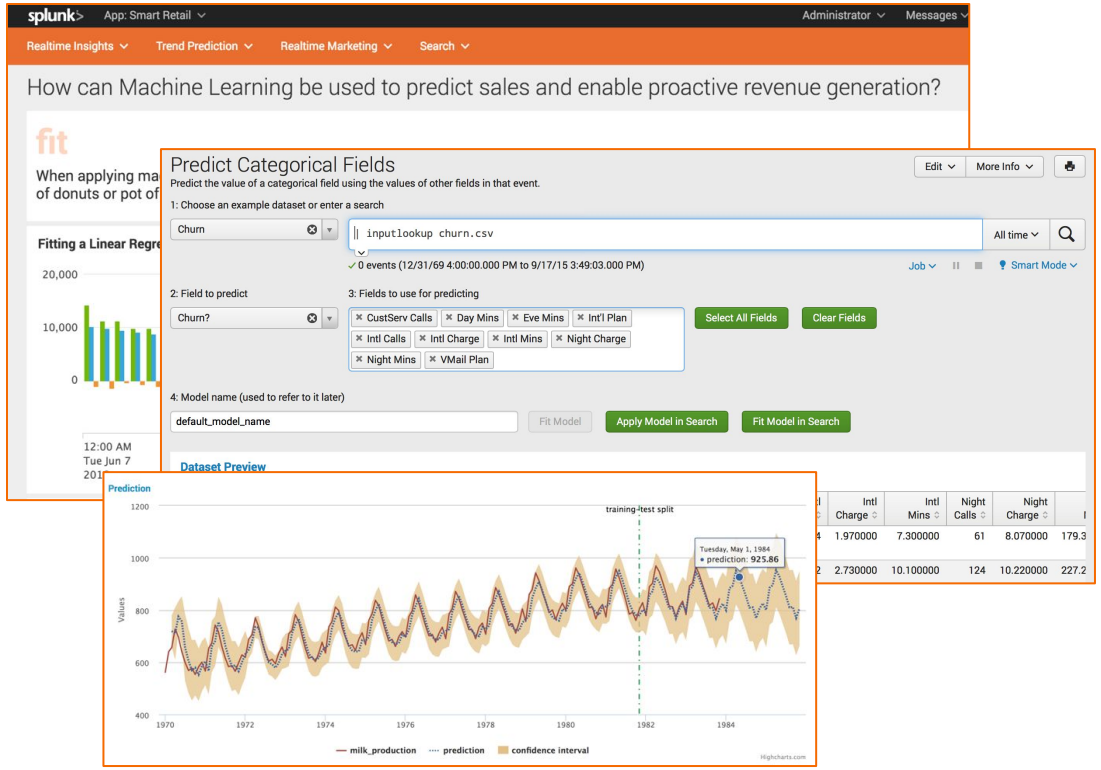
ML Commands: New SPL commands to fit, test, score and operationalize models

ML-SPL API: Extensibility to easily import any algorithm (proprietary / open source)

Python for Scientific Computing Library: Access to 300+ open source algorithms

Apache Spark MLLib: Support large scale model training via Spark Add-on for MLTK (LAR)

Tensorflow Container: Supports NN and GPU accelerated machine learning



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In Fact, ESCU is Now Doing This with MLTK!

Check out the "New: Machine Learning in Splunk Enterprise Security Content Update" blog!

DNS Query Length Outliers

SMB Traffic Spike

Unusually Long Command Line

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Anomalies in the Context of MITRE

Initial Access	Execution	Persistence	Privilege Escalation	Defense Evasion	Credential Access	Discovery	Lateral Movement	Collection	Command And Control	Exfiltration	Impact
11 items	33 items	59 items	28 items	67 items	19 items	22 items	17 items	13 items	22 items	9 items	14 items
Drive-by Compromise	AppleScript	.bash_profile and .bashrc	Access Token Manipulation	Access Token Manipulation	Account Manipulation	Account Discovery	AppleScript	Audio Capture	Commonly Used Port	Automated Exfiltration	Data Destruction
Exploit Public-Facing Application	CMSTP	Accessibility Features	Accessibility Features	Binary Padding	Bash History	Application Window Discovery	Application Deployment Software	Automated Collection	Communication Through Removable Media	Data Compressed	Data Encrypted for Impact
External Remote Services	Command-Line Interface	Account Manipulation	AppCert DLLs	BITS Jobs	Brute Force	Browser Bookmark Discovery	Distributed Component Object Model	Clipboard Data	Connection Proxy	Data Encrypted	Defacement
Hardware Additions	Compiled HTML File	AppCert DLLs	AppInit DLLs	Bypass User Account Control	Credential Dumping	Domain Trust Discovery	Exploitation of Remote Services	Data from Information Repositories	Custom Command and Control Protocol	Data Transfer Size Limits	Disk Content Wipe
Replication Through Removable Media	Control Panel Items	AppInit DLLs	Application Shimming	Clear Command History	Credentials in Files	File and Directory Discovery	Logon Scripts	Data from Local System	Custom Cryptographic Protocol	Exfiltration Over Alternative Protocol	Disk Structure Wipe
Spearphishing Attachment	Dynamic Data Exchange	Application Shimming	Bypass User Account Control	CMSTP	Credentials in Registry	Network Service Scanning	Pass the Hash	Data from Network Shared Drive	Data Encoding	Exfiltration Over Command and Control Channel	Endpoint Denial of Service
Spearphishing Link	Execution through API	Authentication Package	DLL Search Order Hijacking	Code Signing	Exploitation for Credential Access	Network Share Discovery	Pass the Ticket	Data from Removable Media	Data Obfuscation	Exfiltration Over Other Network Medium	Firmware Corruption
Spearphishing via Service	Execution through Module Load	BITS Jobs	Dylib Hijacking	Compile After Delivery	Forced Authentication	Network Sniffing	Remote Desktop Protocol	Data Staged	Domain Fronting	Exfiltration Over Physical Medium	Inhibit System Recovery
Supply Chain Compromise	Exploitation for Client Execution	Bootkit	Exploitation for Privilege Escalation	Compiled HTML File	Hooking	Password Policy Discovery	Remote File Copy	Email Collection	Domain Generation Algorithms	Scheduled Transfer	Network Denial of Service
Trusted Relationship	Graphical User Interface	Browser Extensions	Extra Window Memory Injection	Component Firmware	Input Capture	Peripheral Device Discovery	Remote Services	Input Capture	Fallback Channels		Resource Hijacking
Valid Accounts	InstallUtil	Change Default File Association	File System Permissions Weakness	Component Object Model Hijacking	Input Prompt	Permission Groups Discovery	Replication Through Removable Media	Man in the Browser	Multi-hop Proxy		Runtime Data Manipulation
	Launchctl	Component Firmware	Hooking	Control Panel Items	Kerberoasting	Process Discovery	Shared Webroot	Screen Capture	Multi-Stage Channels		Service Stop
	Local Job Scheduling	Component Object Model Hijacking	Image File Execution Options Injection	DCShadow	Keychain	Query Registry	SSH Hijacking	Video Capture	Multiband Communication		Stored Data Manipulation
	LSASS Driver	Create Account	Launch Daemon	Deobfuscate/Decode Files or Information	LLMNR/NBT-NS Poisoning and Relay	Remote System Discovery	Taint Shared Content		Multilayer Encryption		Transmitted Data Manipulation
	Mshta	DLL Search Order Hijacking	New Service	Disabling Security Tools	Network Sniffing	Security Software Discovery	Third-party Software		Port Knocking		
	PowerShell	Dylib Hijacking	Path Interception	DLL Search Order Hijacking	Password Filter DLL	System Information Discovery	Windows Admin Shares		Remote Access Tools		
	Regsvcs/Regasm	External Remote Services	Plist Modification	DLL Side-Loading	Private Keys	System Network Configuration Discovery	Windows Remote Management		Remote File Copy		
	Regsvr32	File System Permissions Weakness	Port Monitors	Execution Guardrails	Securityd Memory	System Network Connections Discovery			Standard Application Layer Protocol		
	Rundll32	Hidden Files and Directories	Process Injection	Exploitation for Defense Evasion	Two-Factor Authentication Interception	System Owner/User Discovery			Standard Cryptographic Protocol		
	Scheduled Task	Hooking	Scheduled Task	Extra Window Memory Injection		System Service Discovery			Standard Non-Application Layer Protocol		
	Scripting	Hypervisor	Service Registry Permissions Weakness	File Deletion		System Time Discovery			Uncommonly Used Port		
	Service Execution	Image File Execution Options Injection	Setuid and Setgid	File Permissions Modification		Virtualization/Sandbox Evasion			Web Service		
	Signed Binary Proxy Execution	Kernel Modules and Extensions	SID-History Injection	File System Logical Offsets							
	Signed Script Proxy Execution	Launch Agent		Gatekeeper Bypass							
	Source	Launch Daemon		Group Policy Modification							
	Space after Filename			Hidden Files and Directories							
	Third-party Software			Hidden Users							
				Hidden Window							

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Let’s journey into the dark forest and hunt down the death eaters!

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Who In My Network is Executing Unusual DNS Query Lengths?

Which looks more unusually long to you?

ec2-13-193-103-139.us-west-1.compute.amazonaws.com

OR

p4-csddrc45xqiym-xmvtplcdqchjqs5r-322917-i2.anycast-stb.metric.gstatic.com

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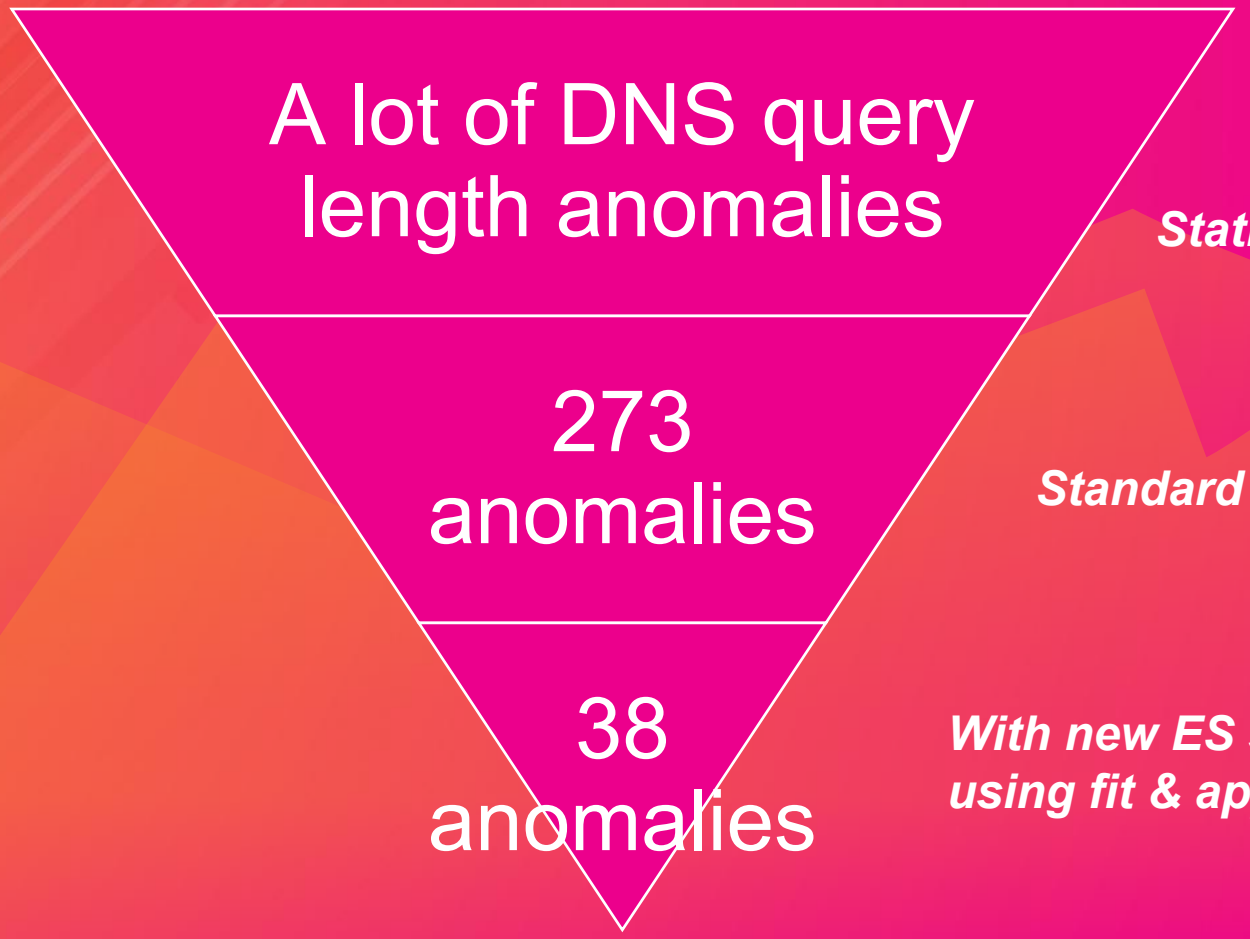
Why Should You Care?

A look at our sample dataset



Static threshold

Standard Deviation

With new ES searches using fit & apply

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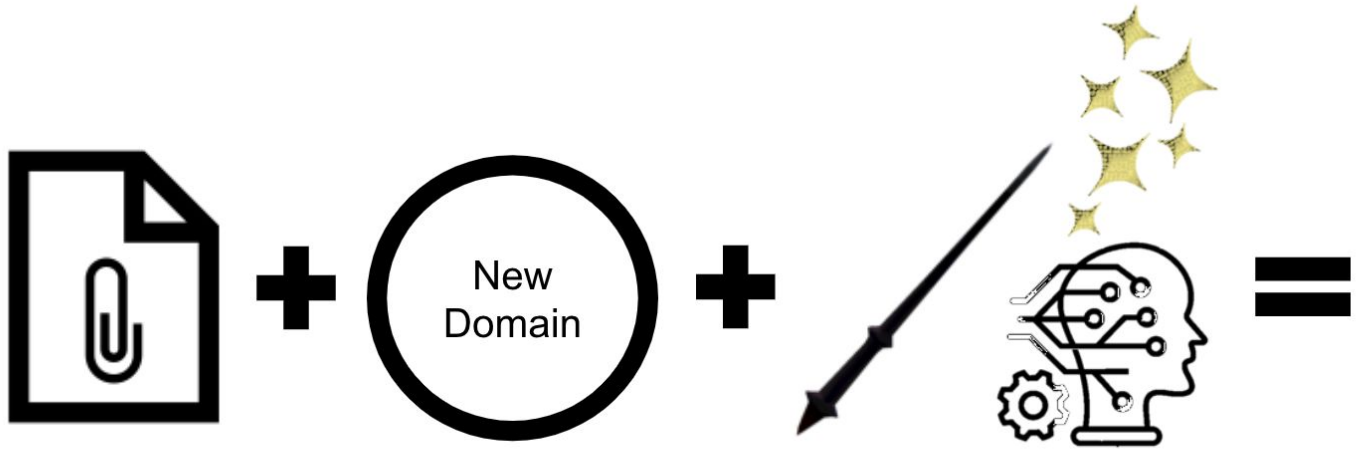
ML Can Help Add Context to Events



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Close your spell book and get ready to duel.

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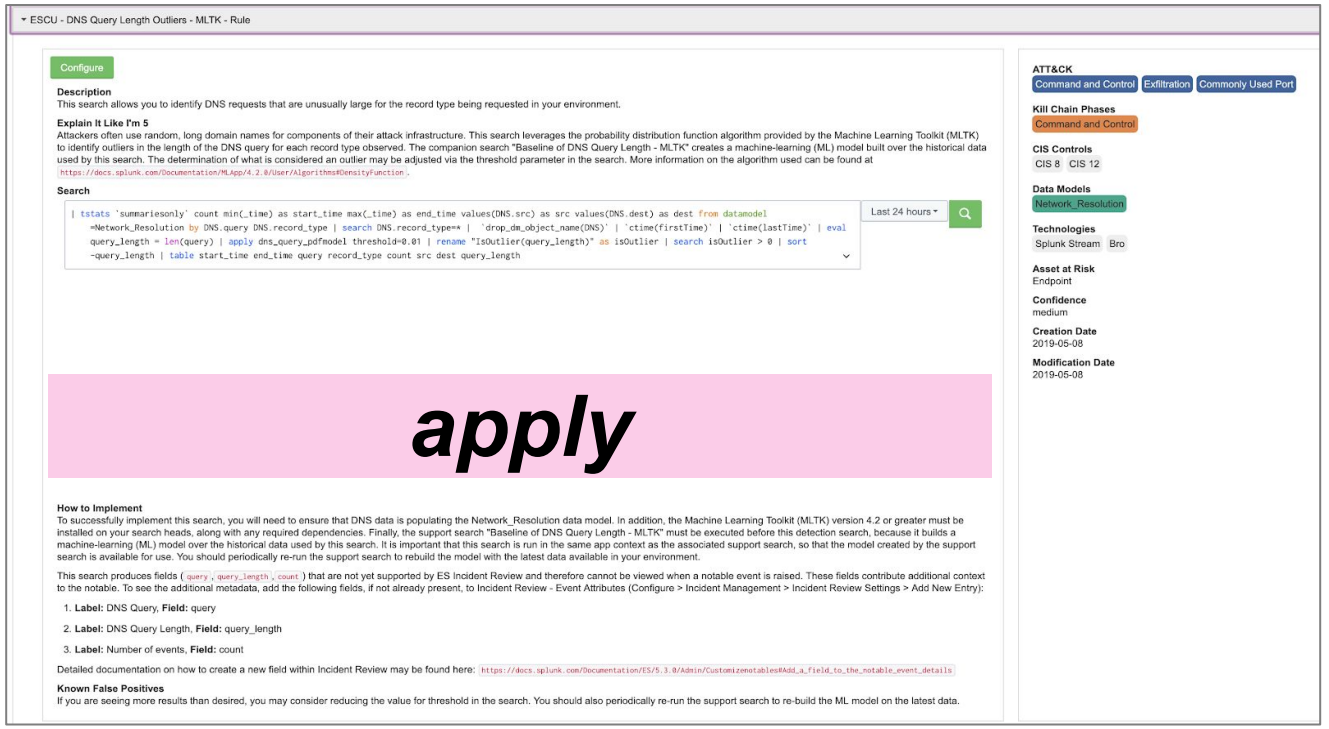
Trusty ESCU Has Us Covered

Exfiltration Use Cases at our Fingertips



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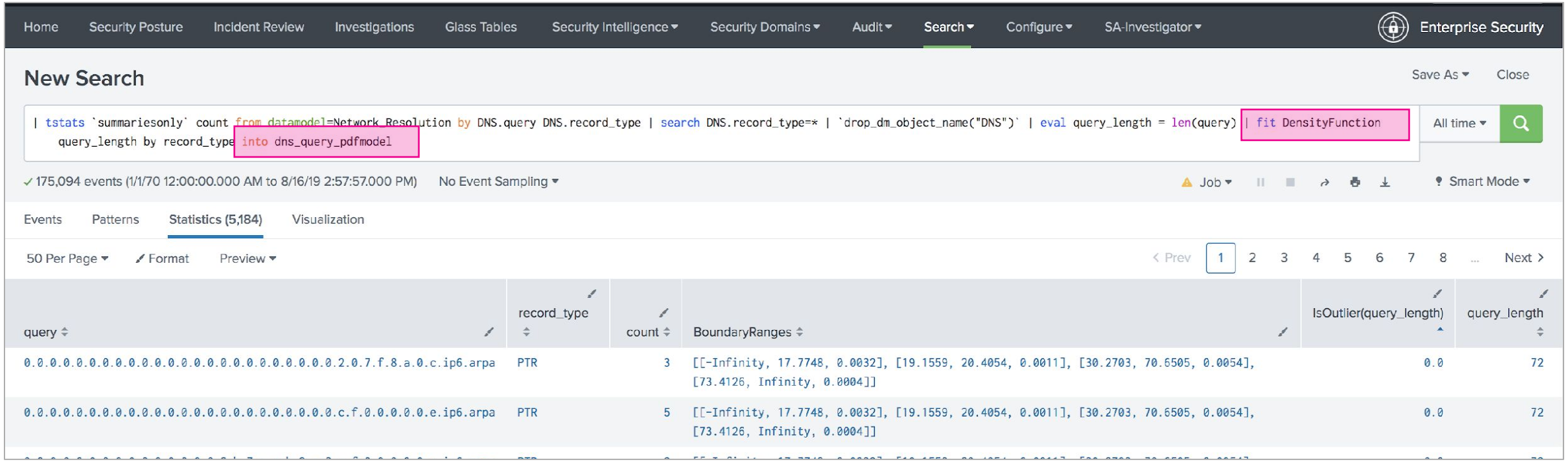
Creating a Model For Our Dataset

First the fit...



Notice we're building a model called "dns_query_pdfmodel"

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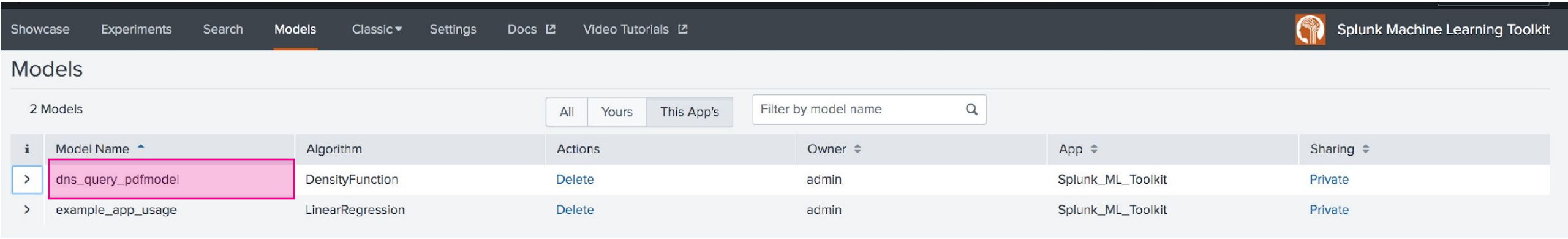
Notice Your Model is Saved In MLTK!

Bigger, stronger models to scale



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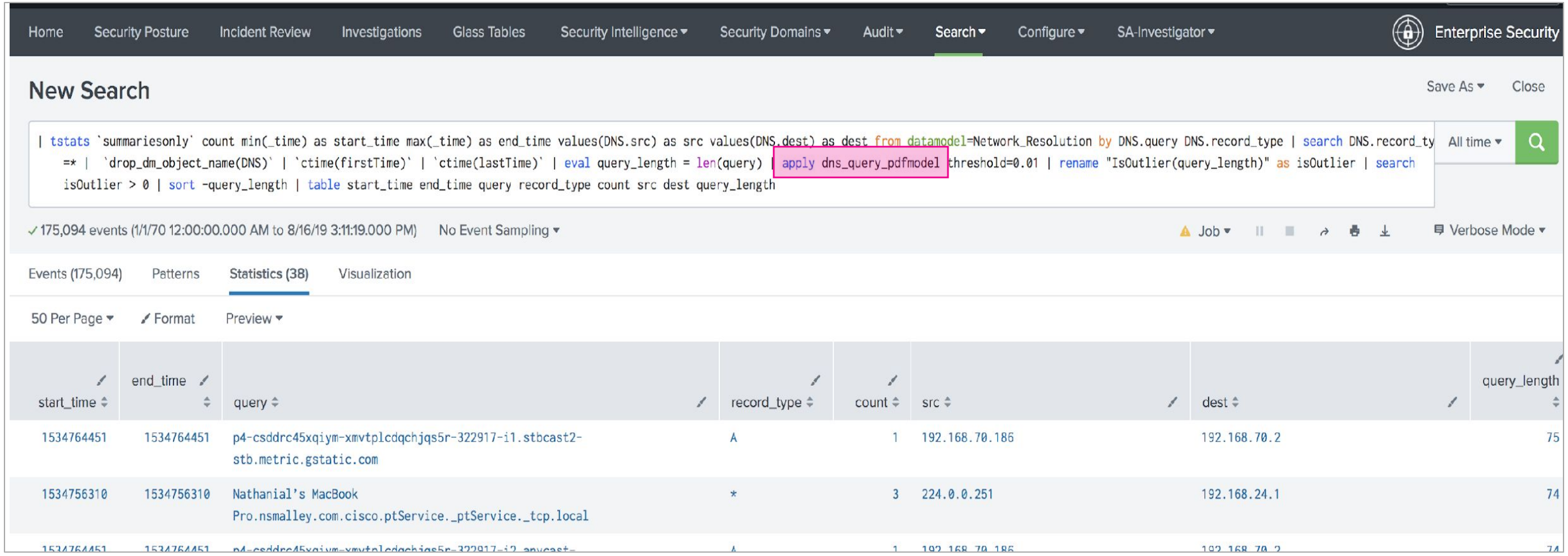
Applying the Model to Our Dataset

...then the apply!



Notice our 38 anomalies

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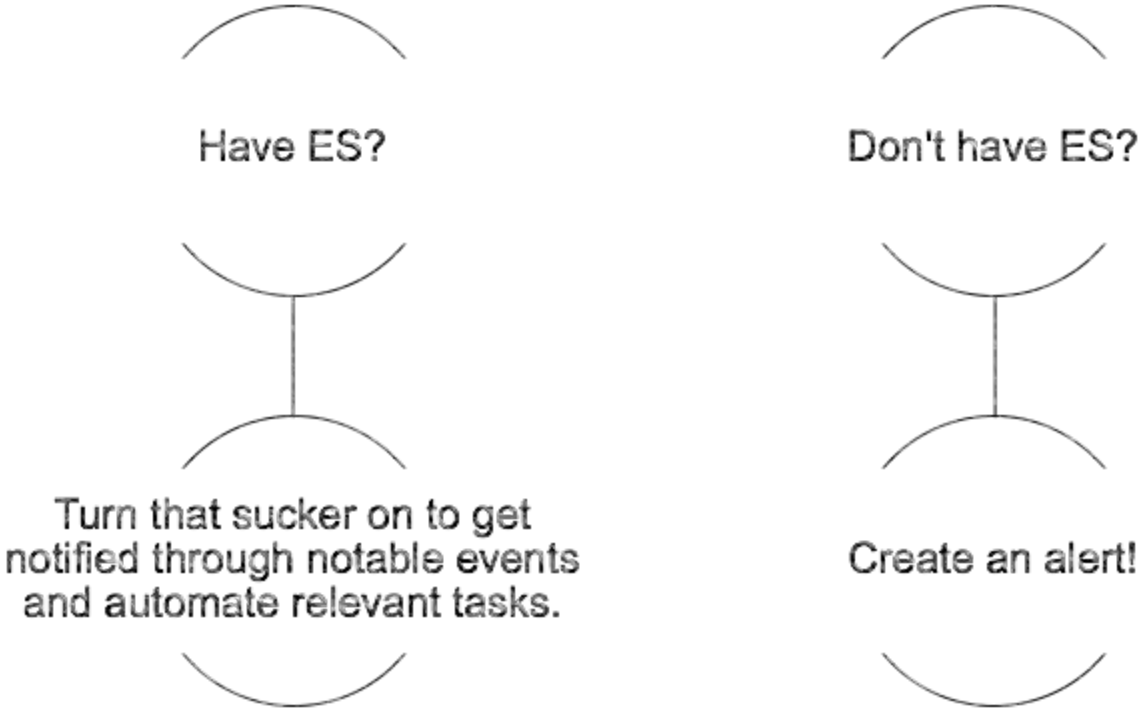
Operationalize It!



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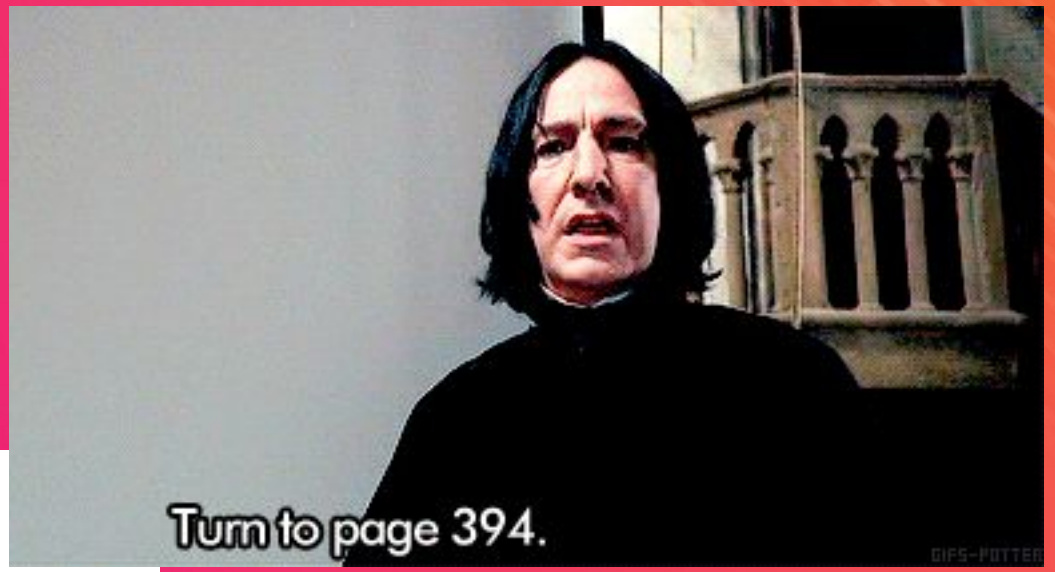
Concepts behind ML magic



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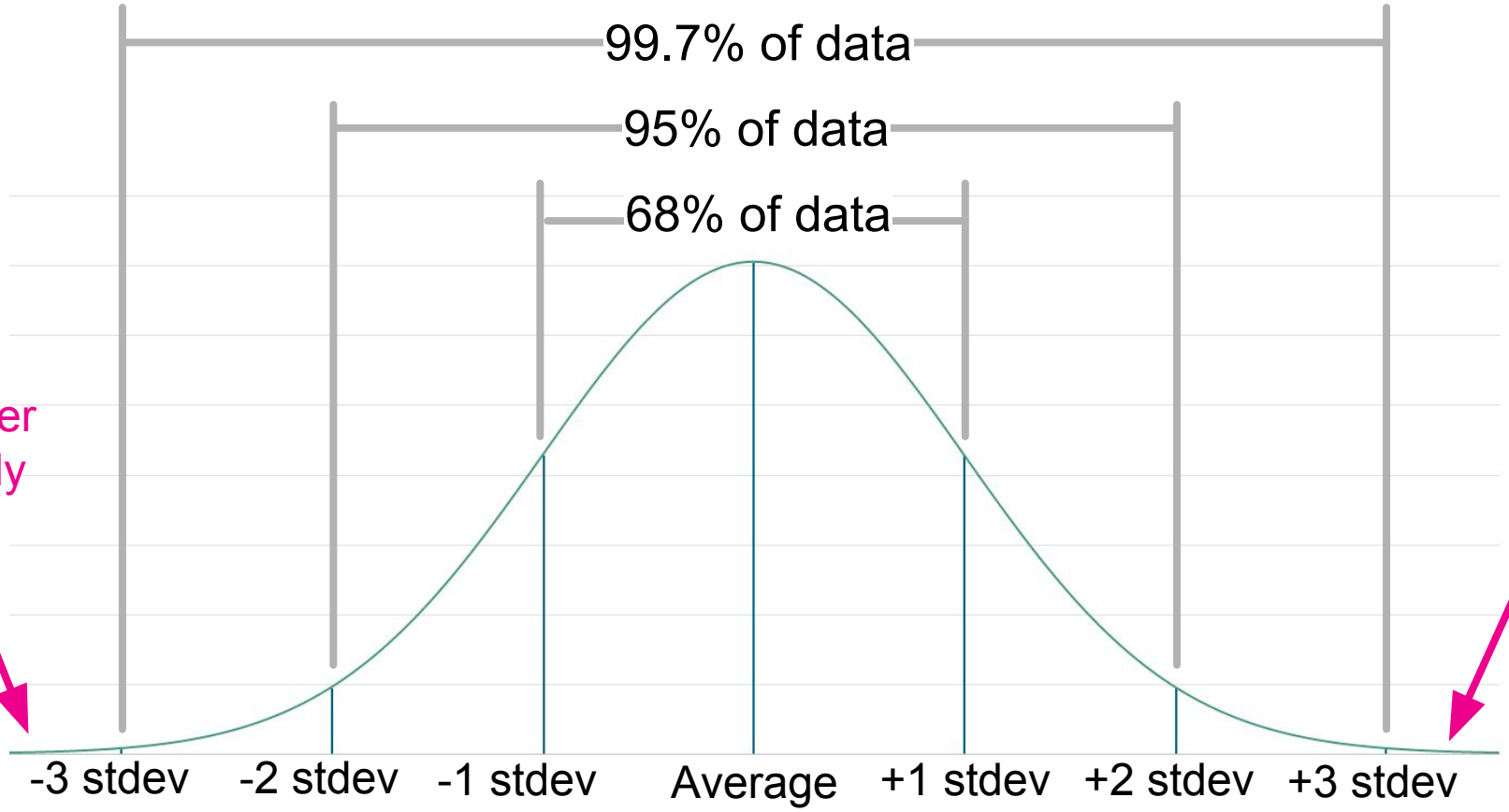
Normal Distribution

How likely is the data found within a population?



Values found over here are probably outliers

Values found over here are probably outliers

The percentages designate the area under the curve

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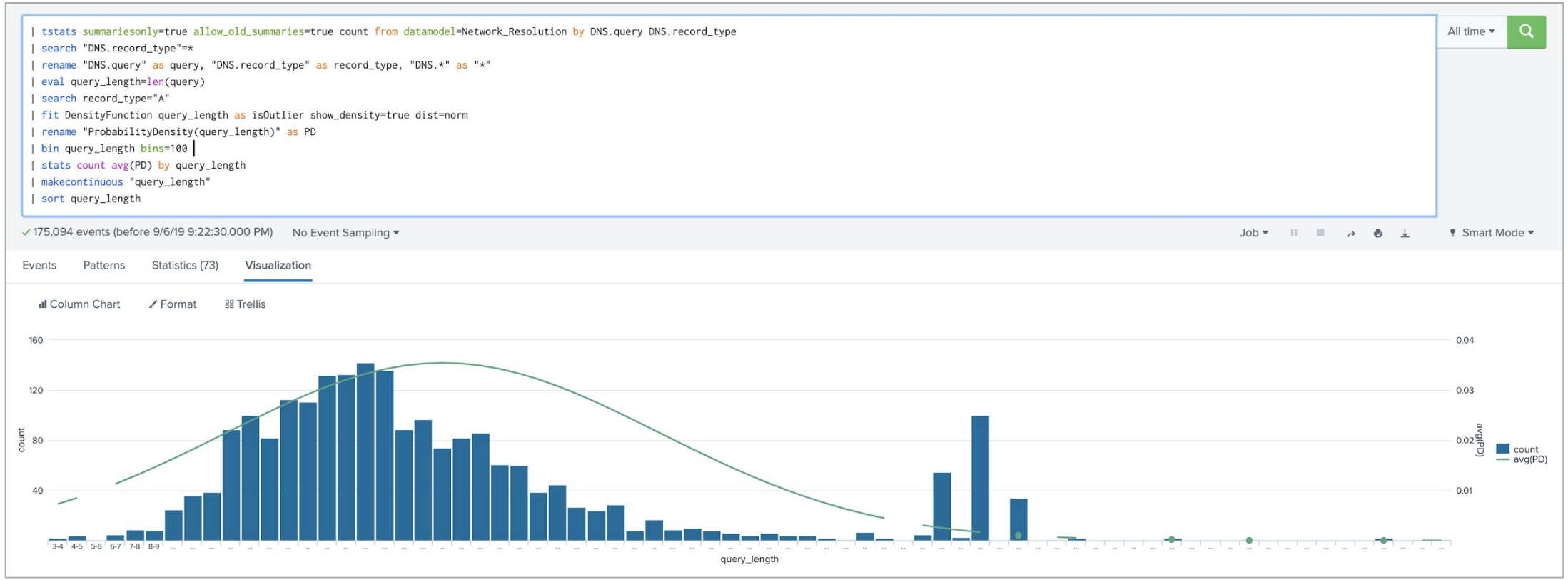
Look What Happens When We Assume Our Data is Normally Distributed...



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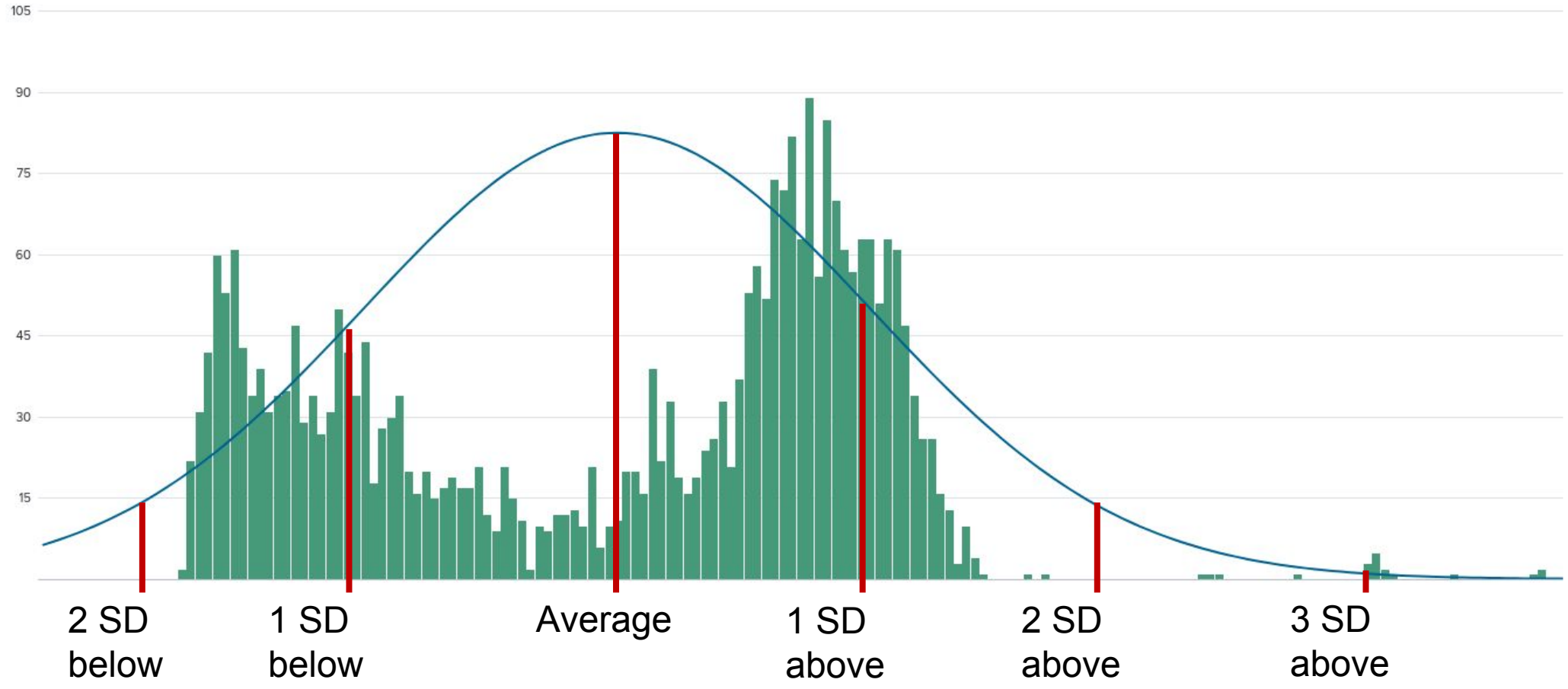
Your Data May Not Always be So "Normal"



When viewing our data as a histogram, the average may not be so "average"

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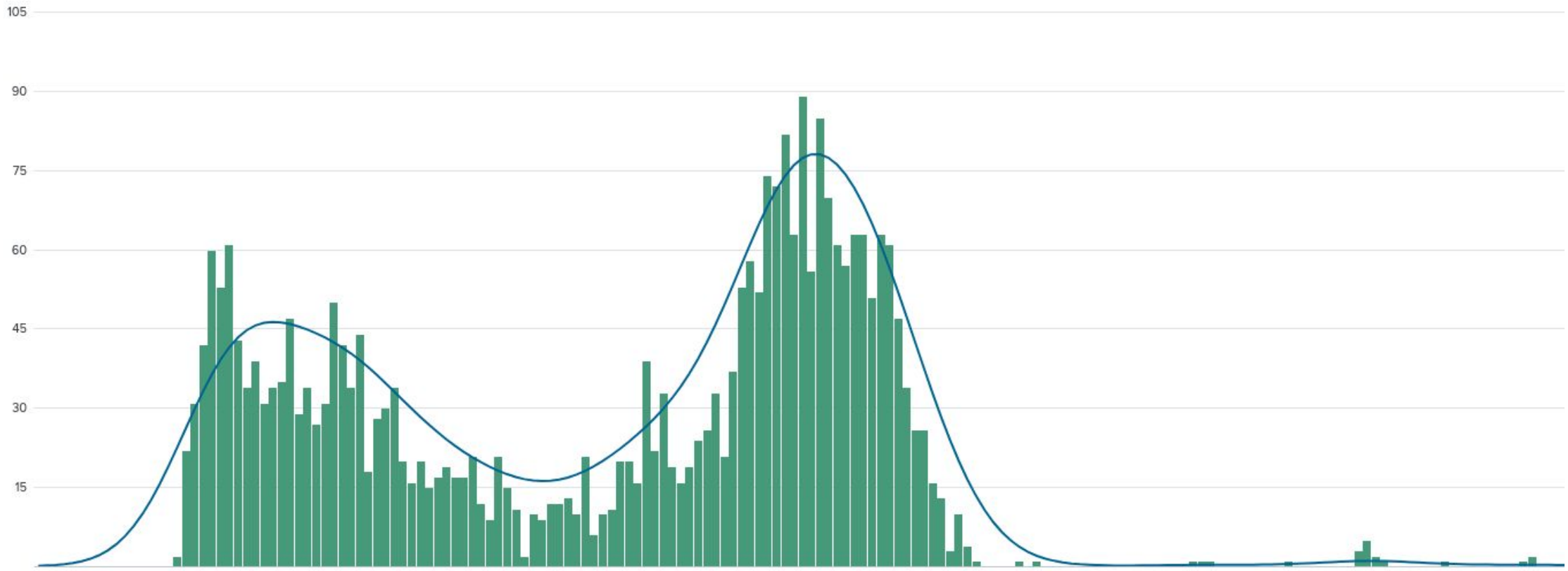
What If We Could Follow the Shape of Our Data?

We can with the DensityFunction algorithm!



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Want to know more about the density function?

Go check out Eurus Kim's .conf19 talk:

The Two Most Common Machine Learning Solutions Everyone Needs to Know

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Which is Why ESCU is Upgrading Some Numeric Outlier Detection Use-cases!

The **DNS Query Length with High Standard Deviation** search

turned into

the fit **ESCU - Baseline of DNS Query Length -MLTK** search

+

the apply **DNS Query Length Outliers - MLTK** search

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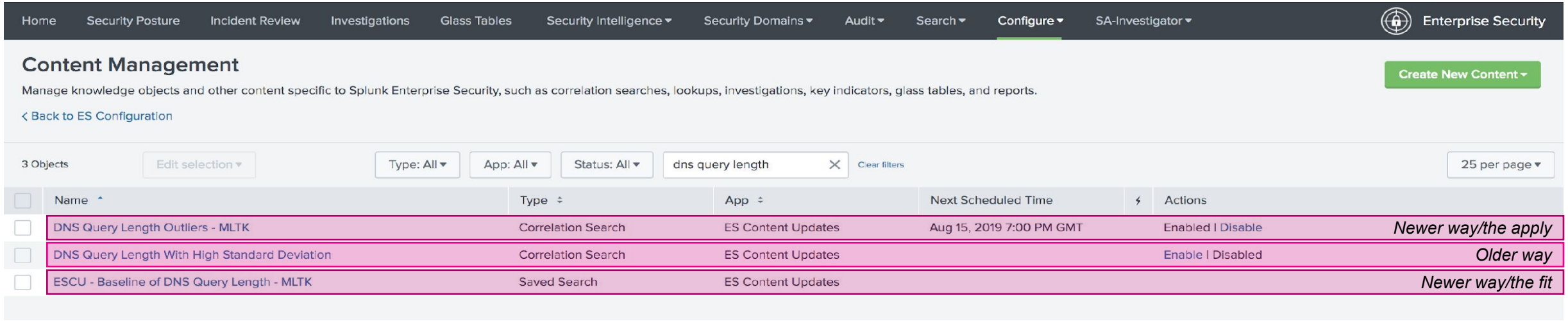
If You Have ES, It Looks Like This



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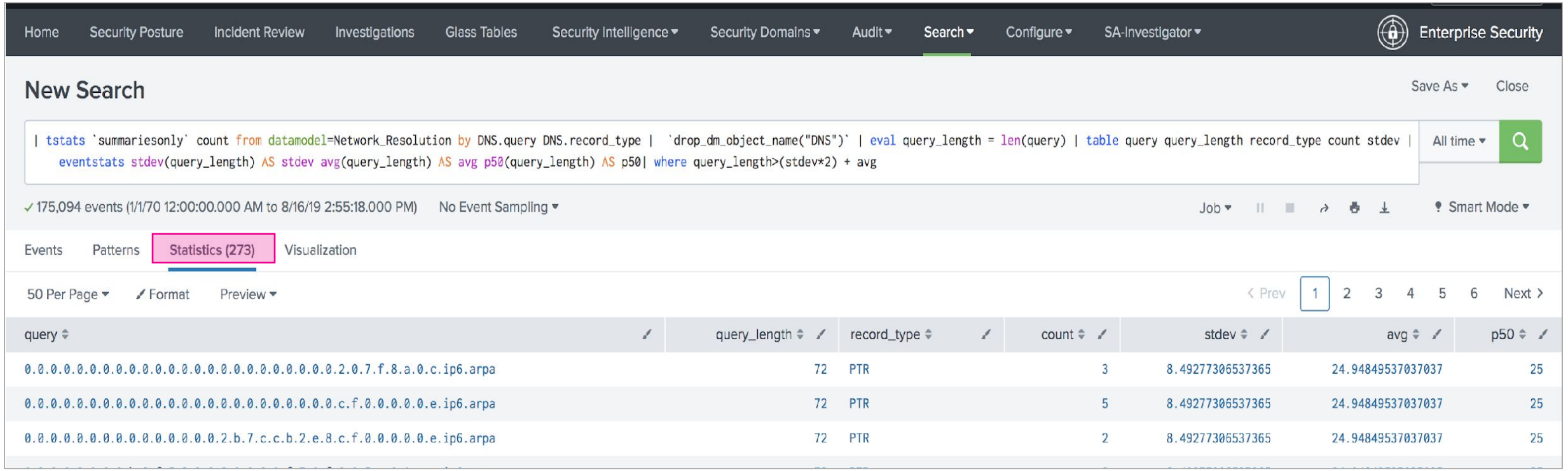
Anomalies Using High Standard Deviation Search



Notice our 273 anomalies

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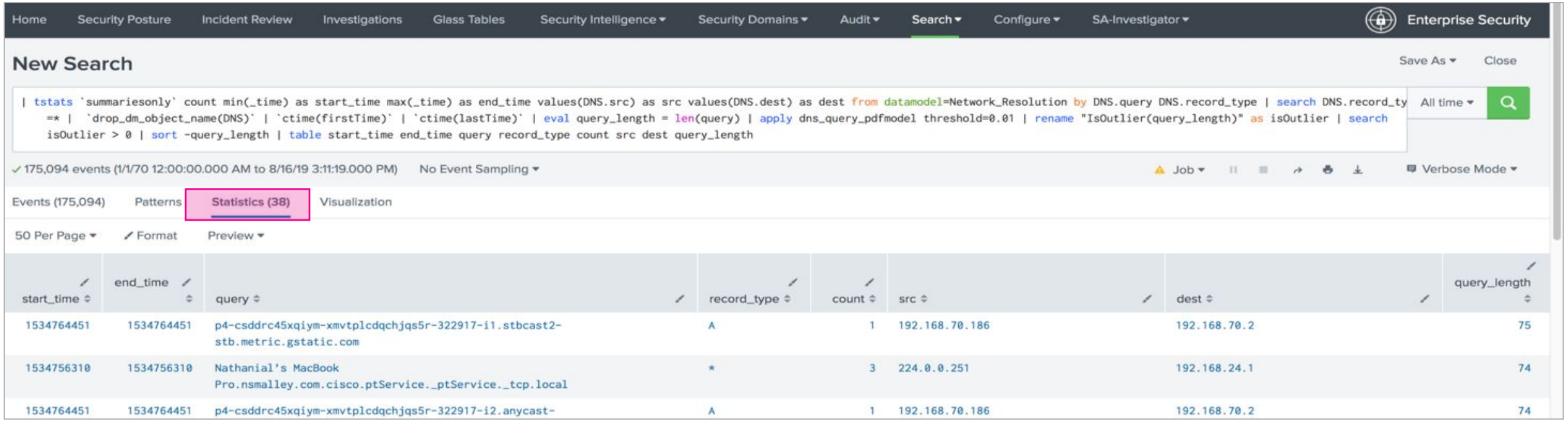
Anomalies Using Density Function



Notice our 38 anomalies

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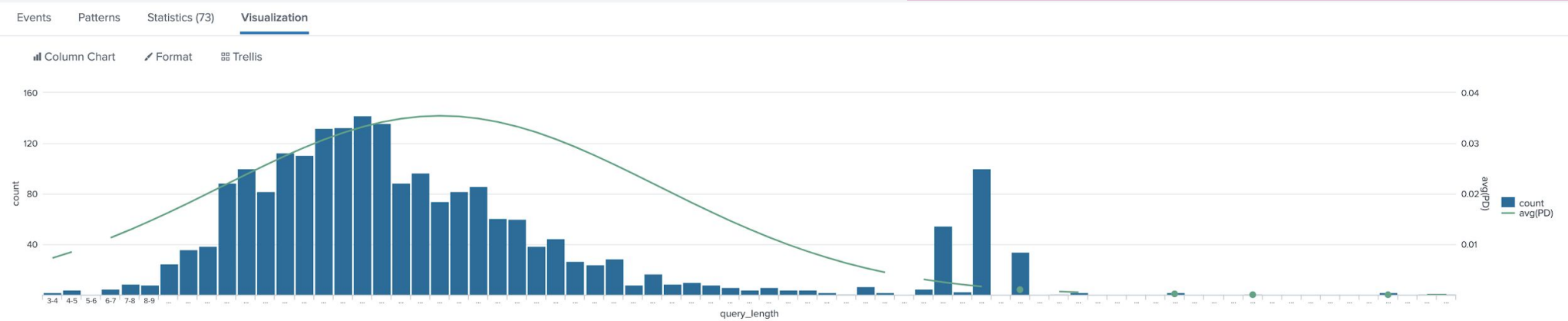
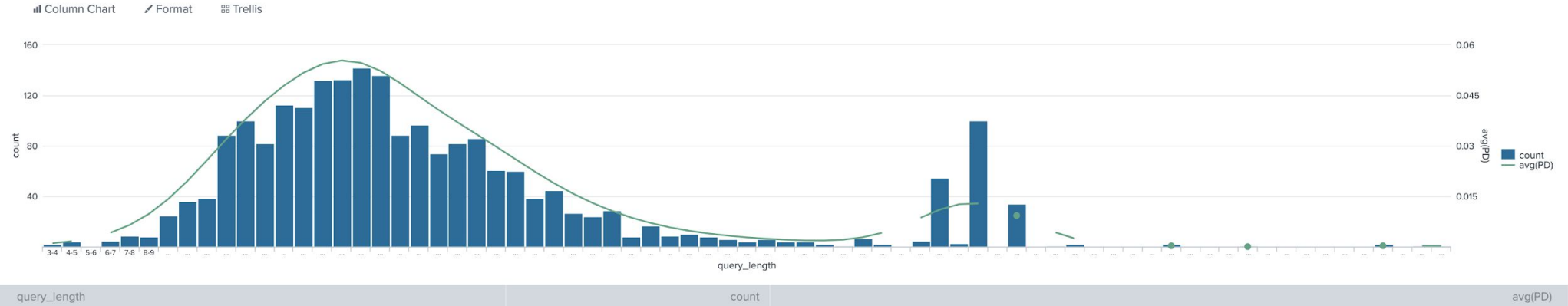
Oculus Reparo!

Fit the model to your data.

Normal curve



KDE curve



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Key Takeaways

Hogwarts has served you well!

1. ML can positively impact your security practice!
2. You too can do data science; be a citizen data scientist.
3. Split one search into two with fit and apply concepts to make ML scale.
4. Download ESCU, MLTK and SSE for free!

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Special Thanks!

Ryan Kovar
Splunk Principal Security Strategist

David Veuve
Splunk Principal Security Strategist

Rico Valdez
Splunk Principal Security Research Engineer

Eurus Kim
Splunk ML Architect

“Datasciencery by the Splunk Field” DEFCON AI Village presentation.

“New: Machine Learning in Splunk Enterprise Security Content Update” blog.

“The Two Most Common Machine Learning Solutions Everyone Needs to Know”.conf19 session.

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Q&A

Melisa Napoles | Splunk Sales Engineer
Erika Strano | Splunk Sales Engineer

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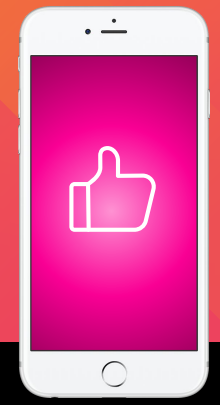

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Agenda

1. What is Machine Learning (ML) and why talk about it in Security?
2. How are organizations detecting anomalies today?
3. Example ML Security Detection in ESCU
4. How can you try this at home?
5. Concepts behind anomaly detection