Innovation center, Washington, D.C.

DATA SCIENCE OPS IN PRACTICE

Learn How Splunk Enables Fast Science for Cybersecurity Operations

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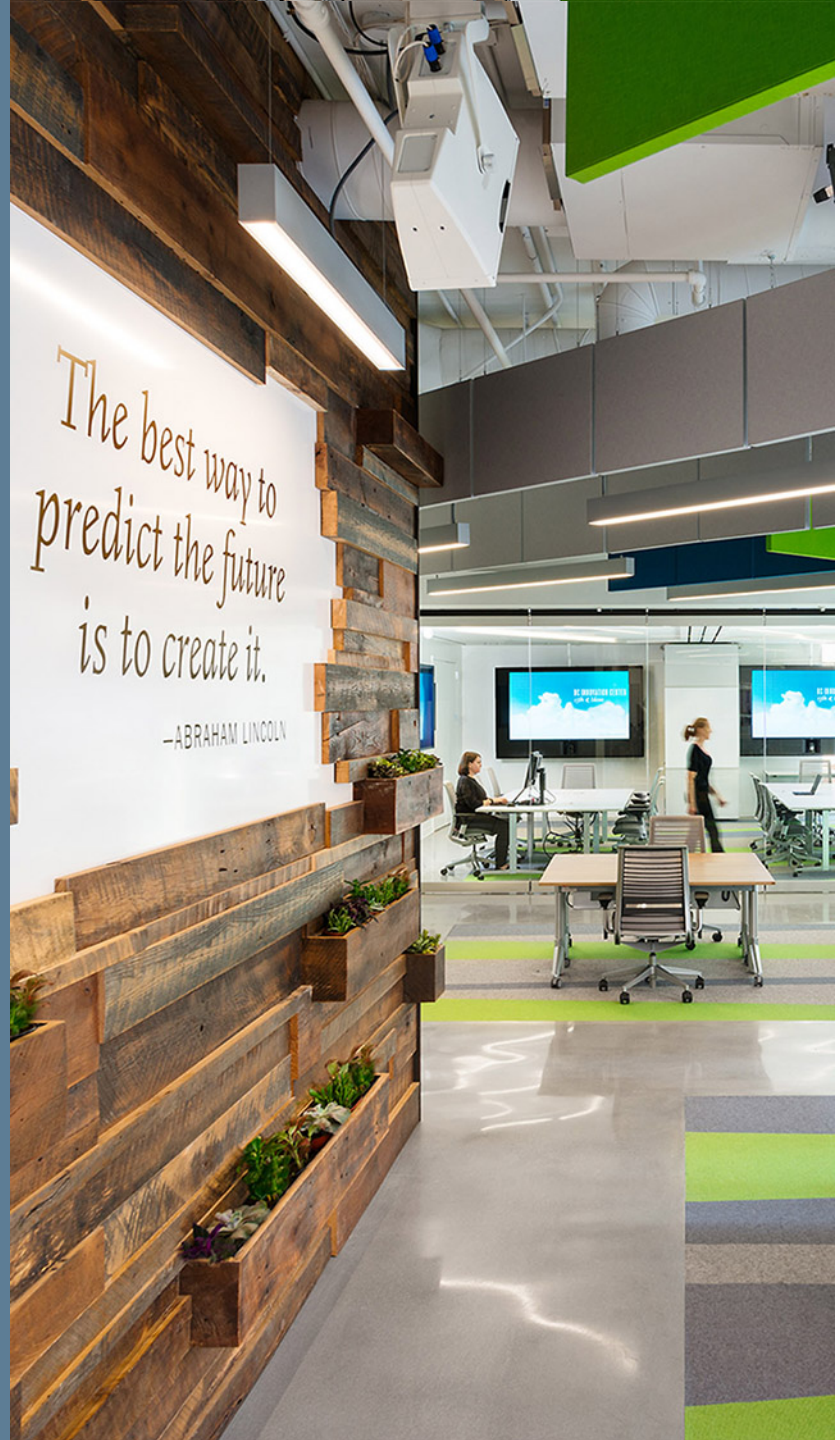


DATA SCIENCE OPS IN PRACTICE

LEARN HOW TO:

ADDRESS CULTURAL CHALLENGES

ENSURE YOUR DATA SCIENCE SOLUTIONS GET USED

HARNESS THE FULL POWER OF PYTHON WITHIN SPLUNK

AGENDA

SECTION 1: UNDERSTANDING THE CORE NEED

SECTION 2: CROSSING THE ANALYSIS CHASM

SECTION 3: ANALYSIS WORKFLOW DEMONSTRATION

SECTION 4: ACTION ITEMS FOR YOUR PROJECTS

UNDERSTANDING THE CORE NEED

THE ROLE OF DATA SCIENCE IN CYBER OPERATIONS

- The rate of data growth is outpacing human capabilities
- We must optimize impact of the people we do have
- Data Science is a powerful tool to reduce the scale of the problem
- In response to these needs, Booz Allen Hamilton was tasked with integrating Data Science into the Watchfloor

[1]

CYBER OPERATIONS ANALYSTS & DATA SCIENTISTS POINTS OF VIEW

Cyber Operations Analysts

- Are evaluated on quantity of output
- Have a clearly defined SOP
- Will lose productivity every time they invest in learning a new tool
- Do not need new tools to be effective
- Are leery of buggy prototype code
- Have a distrust of the black box Machine Learning algorithm

I must meet my quota,
I don't have time for toys

Data Scientists

- Like to understand what the Analyst is trying to do rather than fit existing solution to problem
- Are evaluated on development of novel methods
- Gain honor and reputation from implementing cutting edge algorithms
- Do not like supporting legacy software
- Have an unwavering trust in mathematics

The old way is out of date,
we must improve

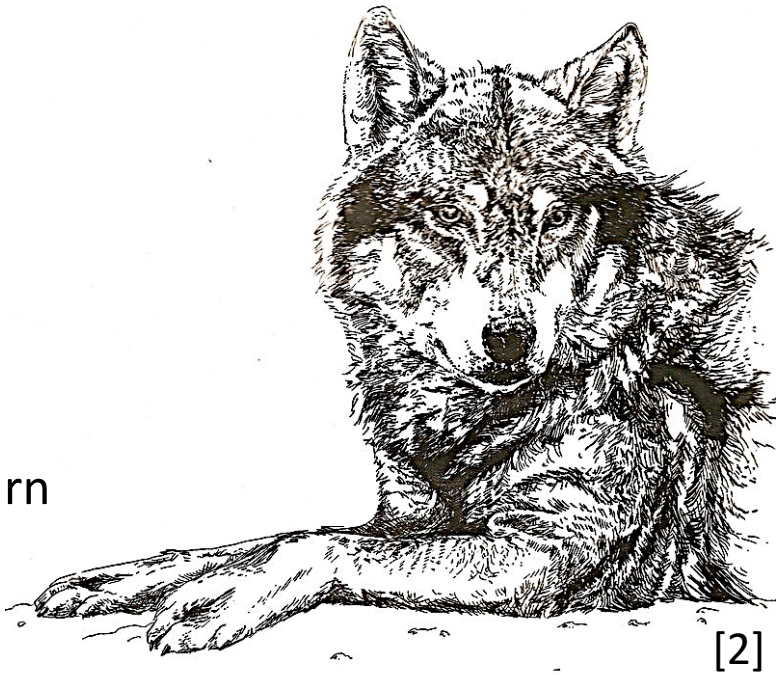
APPRECIATING YOUR ROLE FOUNDATIONAL KEY TO SUCCESS

- The most important lesson learned

Analysts are fully capable of meeting their current objectives without Data Science

- Analysts are in a power position:
  - They are needed
  - They own the domain knowledge
  - They own the tradecraft
  - They own the accesses
  - They own the data

- It is the responsibility of the Data Scientist to show respect and learn
  - The Data Scientist is intruding into the Analyst's domain



[2]

CROSSING THE ANALYSIS CHASM

BRIDGING THE GAP BETWEEN ANALYSTS & DATA SCIENTISTS IN OPERATIONS

- Many Analysts do not understand applied statistics or machine learning and do not understand how it can be applied to their domain

- Data Scientists wishing to make an impact should:
  - Minimize the number of new widgets an analyst needs to learn
  - Provide all results with meaningful supporting evidence
  - Weight clarity as much as performance in algorithm selection
  - Appreciate that reporting there are no results is far better than false positives

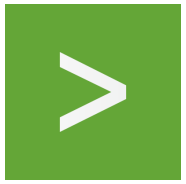
- Host your end-solutions in the tool environment they use

Minimize Number of Tools

Provide Evidence

Ensure Interpretability

Silence Is a Virtue



If Analysts Use Splunk, You Use Splunk

LEVERAGING THE POWER & FLEXIBILITY WITH PYTHON & SPLUNK

Python

- **Pros**
  - Provides developers with access to wide array of data processing libraries
  - Object-Oriented program design
  - Rapid prototype scripting language
- **Cons**
  - Must be able to code
  - Developed projects tend to be individual objects
  - Steep learning gap for users

Splunk

- **Pros**
  - Single unified system for collecting, digesting and querying data
  - Attractive 2D plotting
  - Users able to seamlessly navigate to rawdata behind plots
- **Cons**
  - Query language narrows findings
  - Lacks flexibility of programing language
  - Limited python library within SDK

Combine the development flexibility of Python with the consistency of Splunk to benefit Analysts

STEP #1 - WORK DIRECTLY WITH ANALYSTS TO SOURCE A USE CASE

- Our Data Science team works directly with Analysts to work together on analytic objectives
  - To identify malicious or aberrant behavior within a new batch of log data
  - To detect suspicious URLs

- Their work flow consisted of:
  1. Digest log files into Splunk
  2. Label fields
  3. Explore the data with SMEs and via Splunk queries
  4. Report any new Splunk queries of value

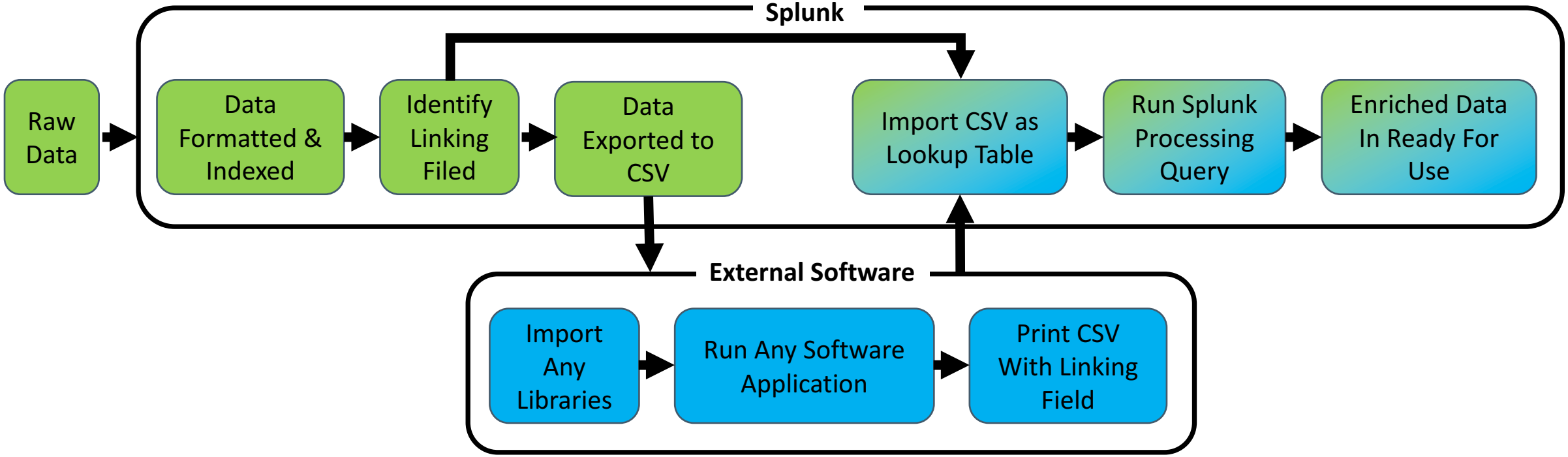
We expedite Analysts' Splunking by
- **Grouping similar observations**
- **Highlighting suspicious outliers**
- **Unlocking new features**

[4]

STEP #2 – SELECT METHOD FOR INTEGRATING DATA SCIENCE CAPABILITIES

METHOD 1

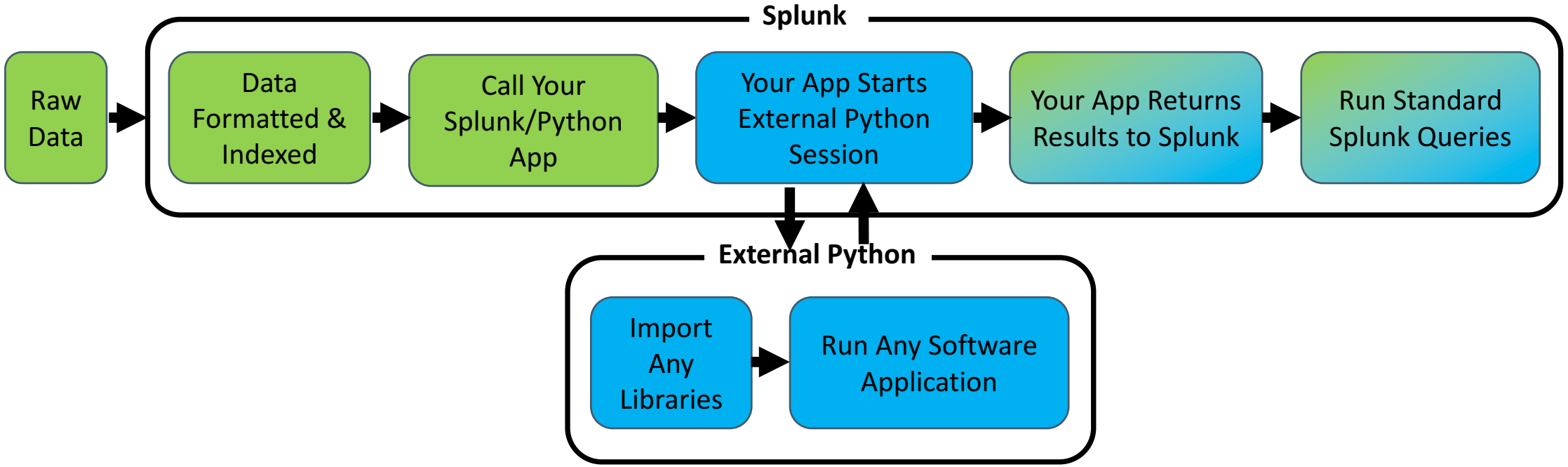
- This method has proven capable in rapid delivery situations
- Identify a linking field and export the data out of Splunk
- Process the data with **any** Data Science Software
- Create a new CSV and use previous linking field to enrich original data



STEP #2 – SELECT METHOD FOR INTEGRATING DATA SCIENCE CAPABILITIES

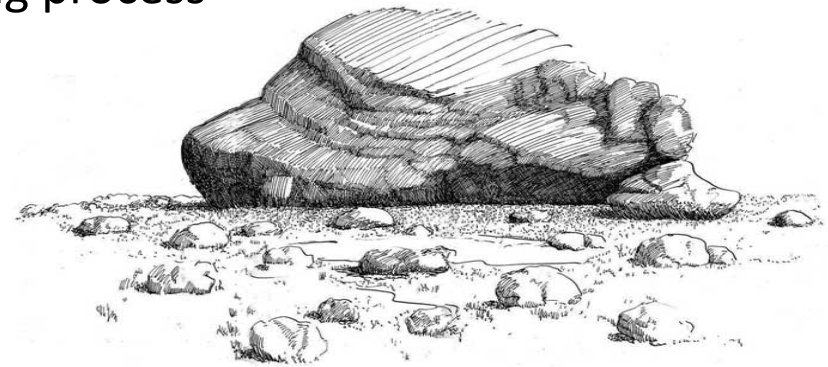
METHOD 2

- Slower to set up first time, but highly effective after that
- Use your own Python environment
- Able to leverage any library; Scikit-Learn, Tensor Flow, Theano, Scrapy, etc.



STEP #3 – EXECUTE MACHINE LEARNING ALGORITHM DEVELOPMENT PROCESS

- Splunk is a powerful asset in many stages of the Machine Learning process



Data Collection & Aggregation

Splunk makes it easy!

Raw Data

Raw Data

Raw Data

Pre-Processing & Cleaning

Feature Extraction & Vectorization

External software needed for advanced feature calculations

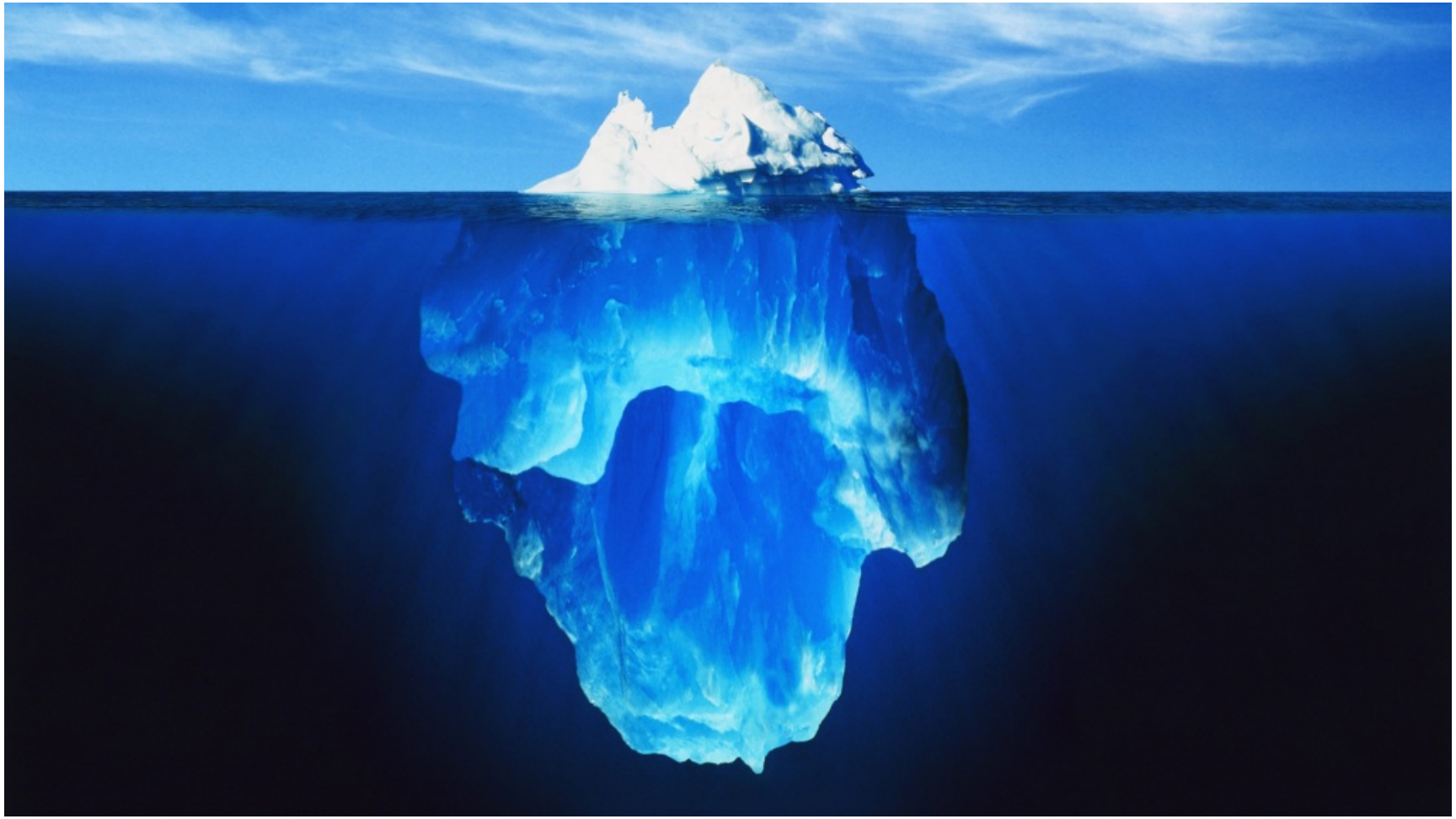
Apply ML Algorithm

Post Analysis of Results

Splunk really shines when it comes time to present your results

ANALYSIS WORKFLOW DEMONSTRATION

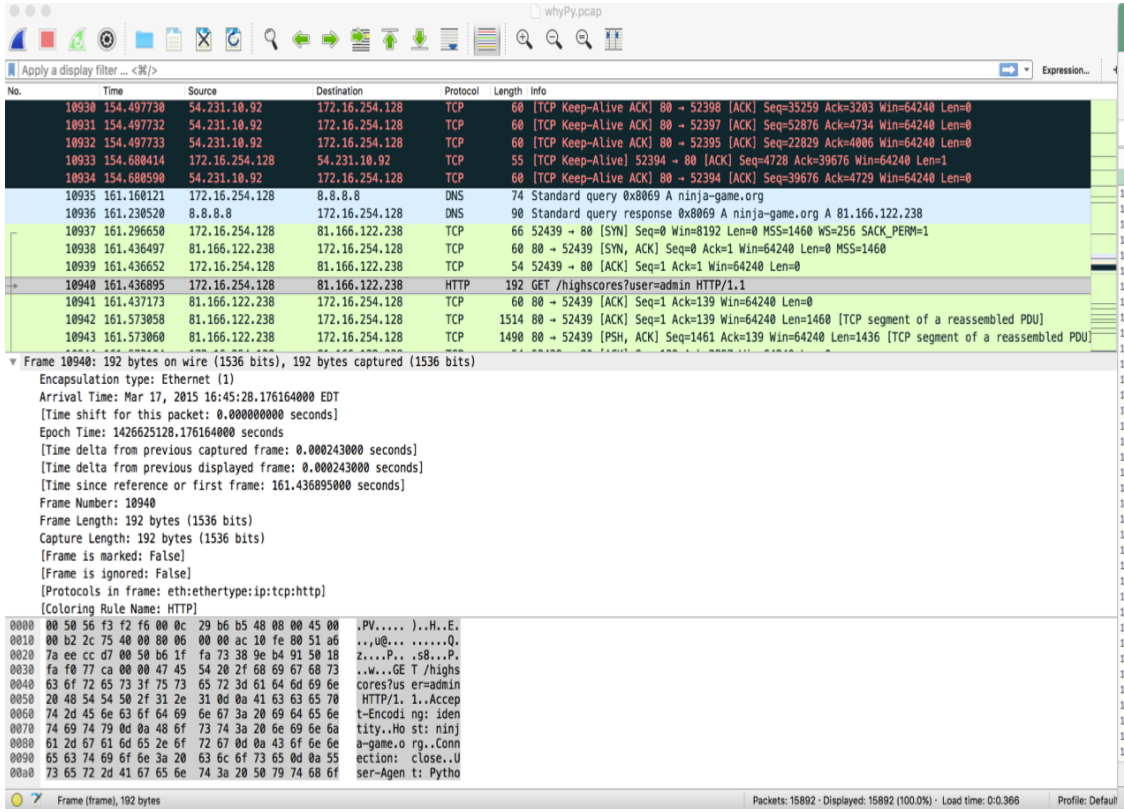
LOOK FAMILIAR?



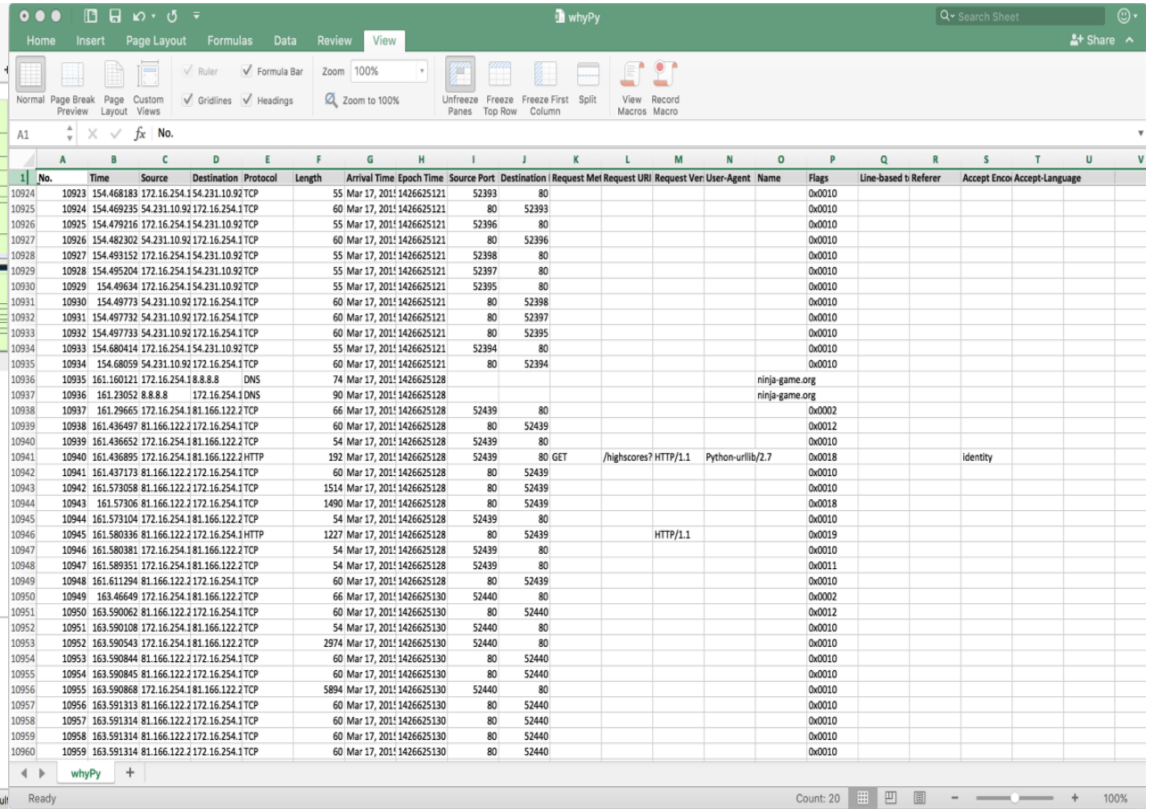
STEP #4 – SHOW EVIDENCE TO SUPPORT ANALYSIS RESULTS

BEFORE BETTER APPS…

Classic Wireshark



Good 'Ol Excel



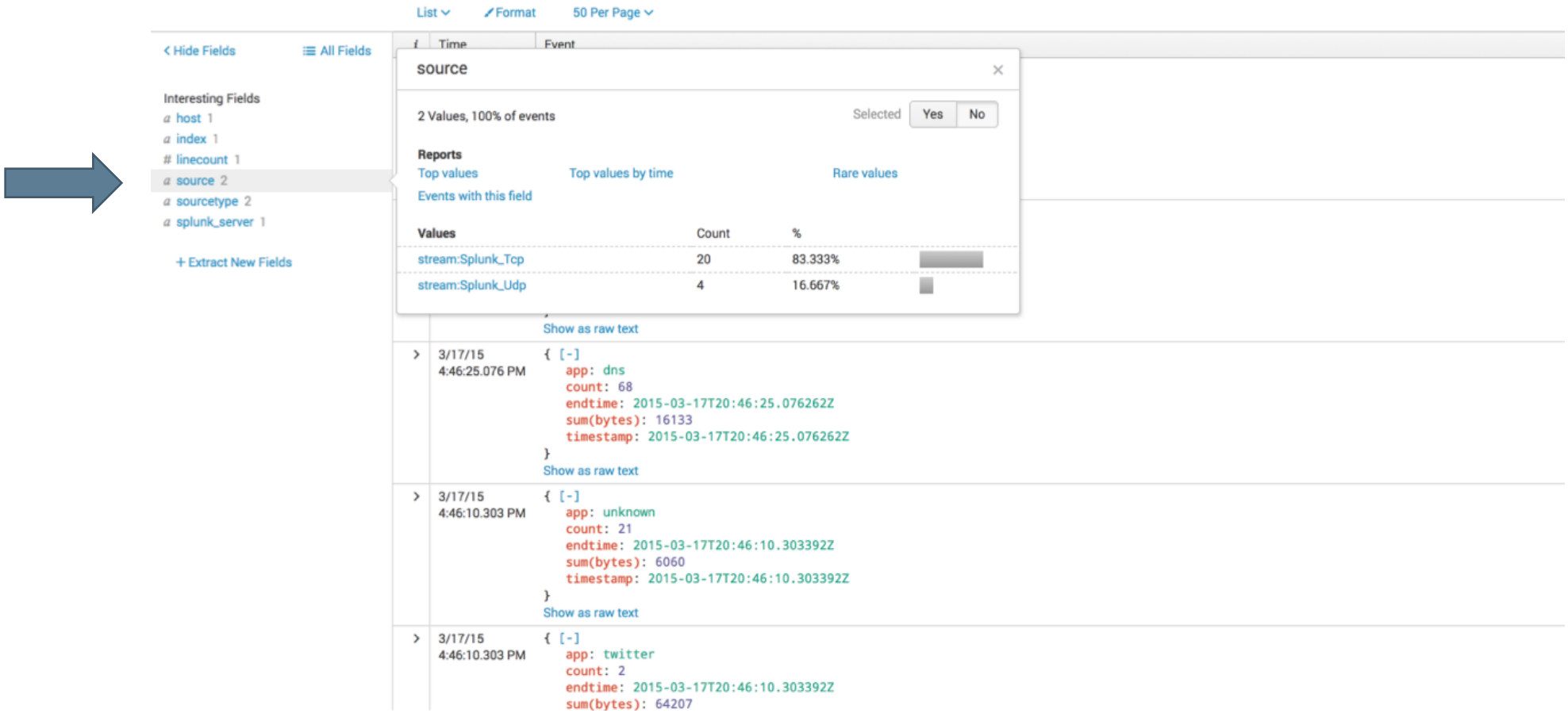
OUR NEW FEATURE EXTRACTION APPLICATION BRINGS NEW INSIGHTS TO ANALYSIS

New Stream App Feature Examples – Avoid Basic Summary Table Overhead	
Avg	IP, port, time
Statistical	sum(bytes), sum(bytes_in), sum(bytes_out), sum(packets_in), sum(packets_out), sum(response_time), sum(time_taken)

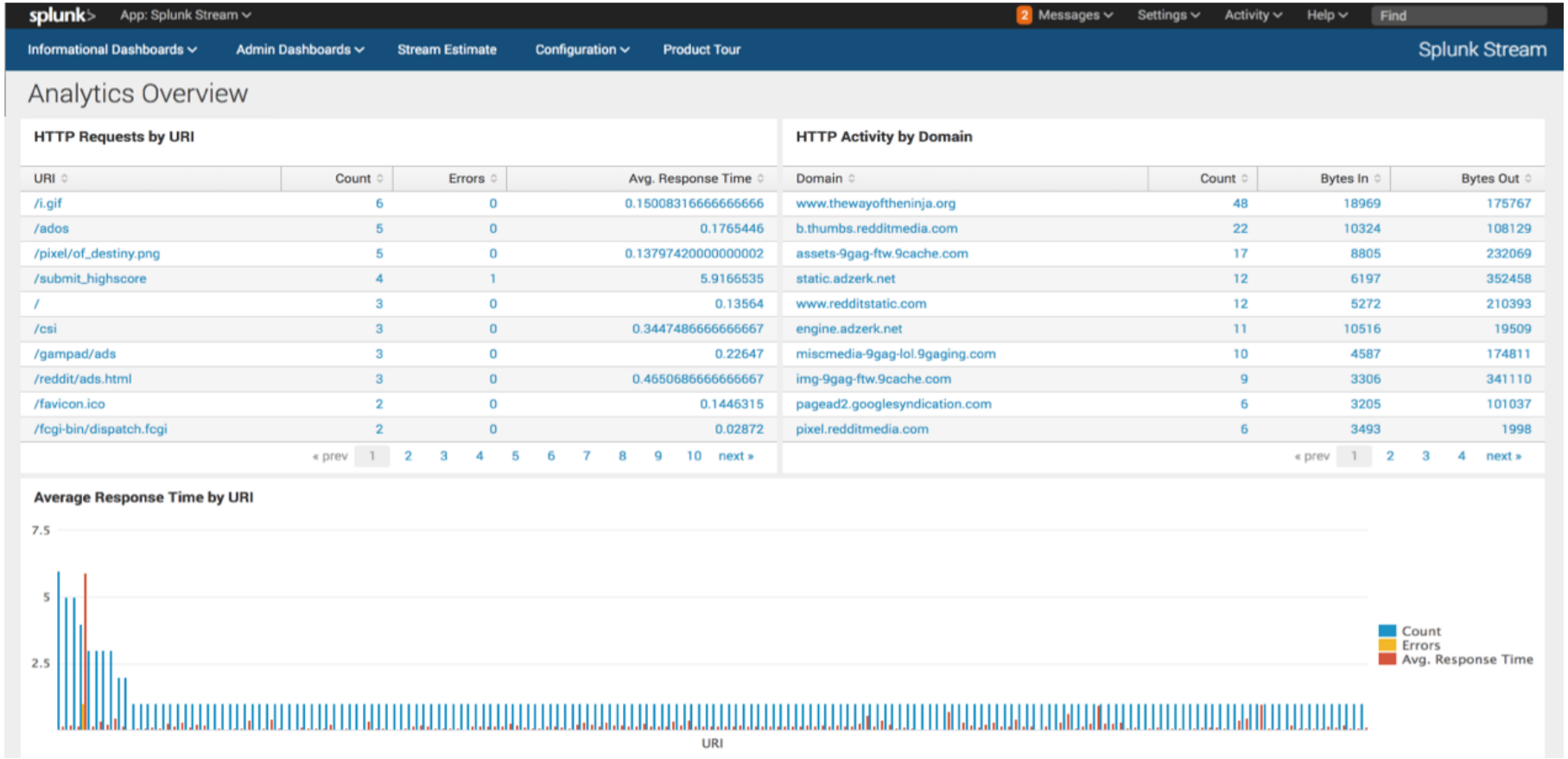
We added 46 new features!!!!

Our New Feature Examples - Make Better Use of ML Toolkit	
Numeric	duration
Statistical	num_bytes_cli2srv, num_bytes_srv2cli, num_packets_cli2srv, num_packets_srv2cli, packet_deltat_avg_cli2srv, packet_deltat_avg_srv2cli, packet_deltat_entropy_2way, packet_deltat_entropy_cli2srv, packet_deltat_entropy_srv2cli

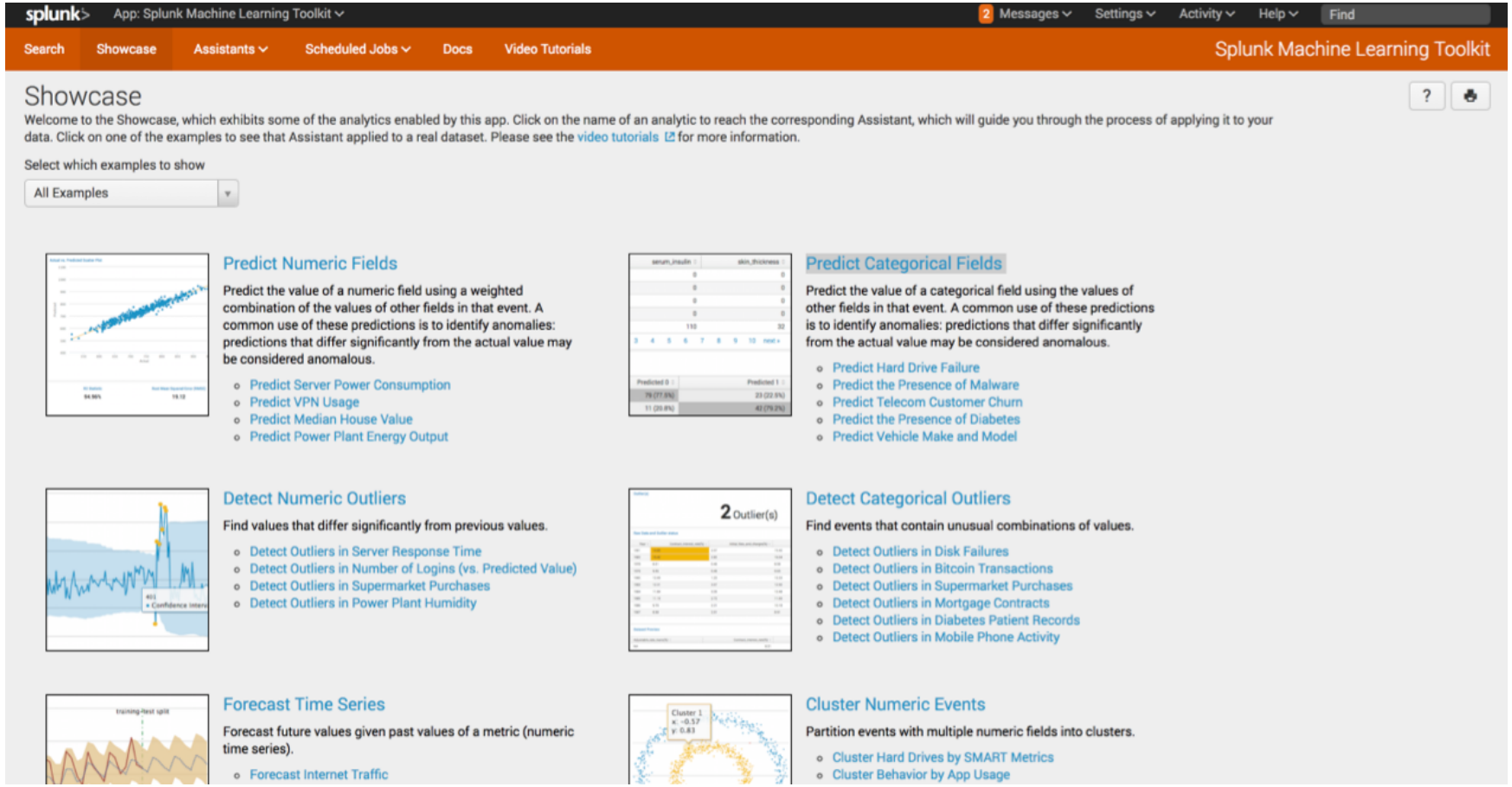
NEW STREAM APP ENABLES DIRECT ACCESS TO RAW PCAP IN SPLUNK



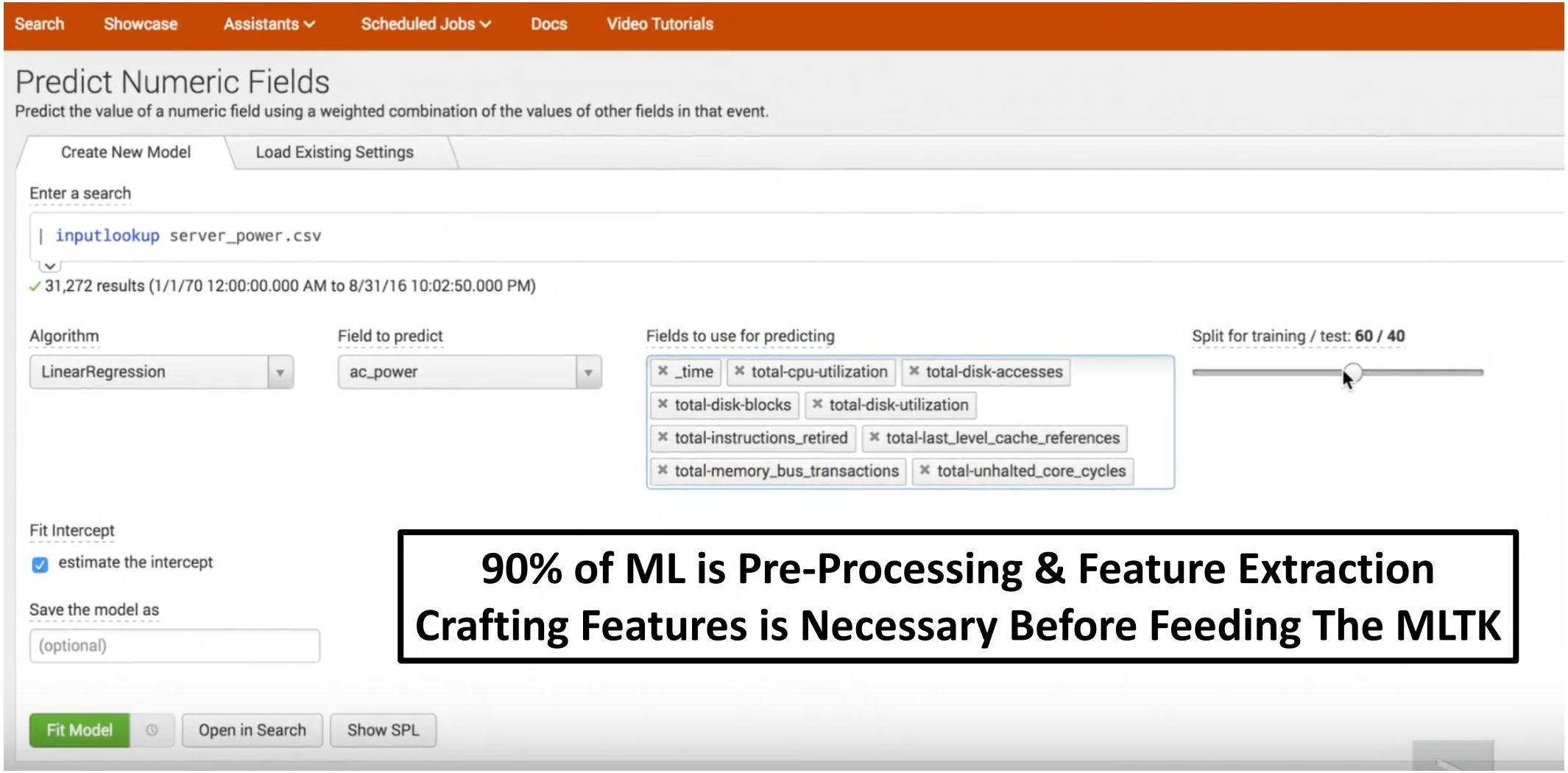
NEW STREAM APP GIVE ANALYSTS MORE INFORMATION



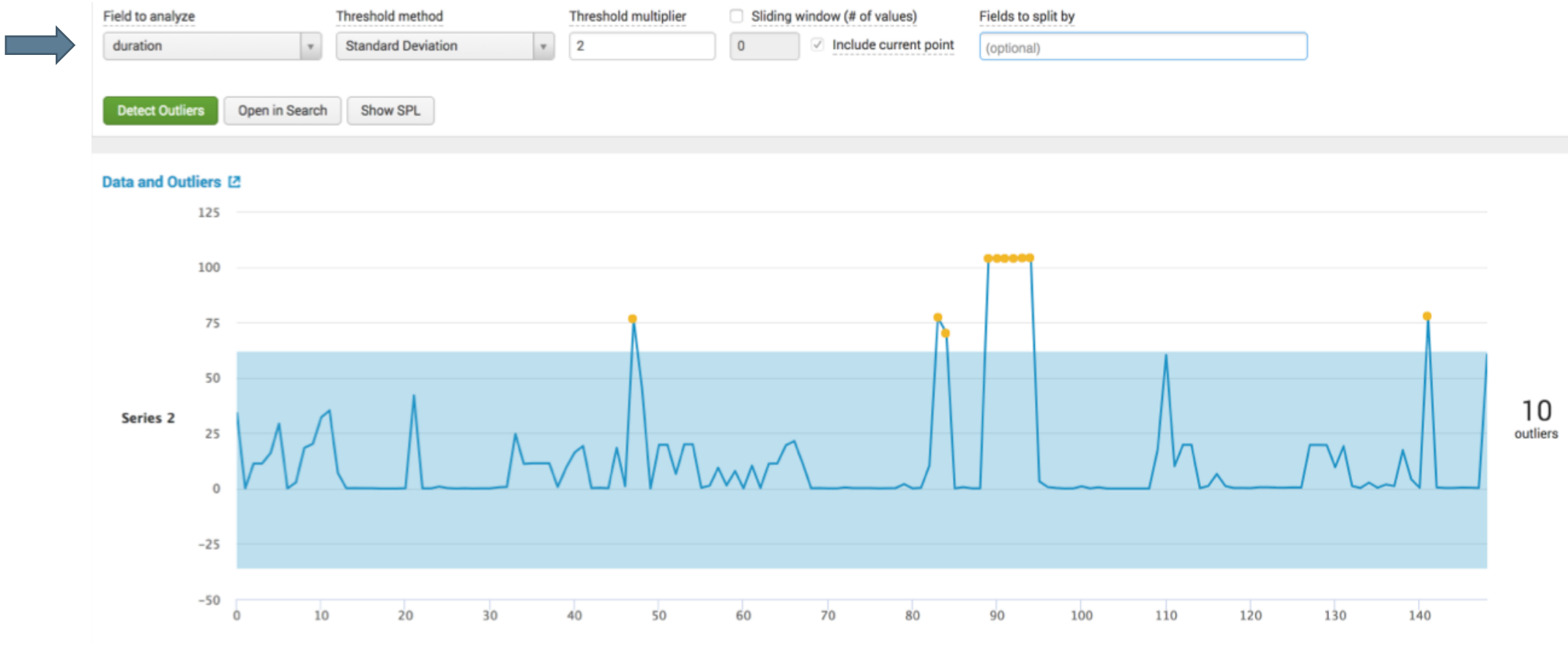
ML TOOLKIT ENABLES EXPLORATORY DATA ANALYSIS IN SPLUNK



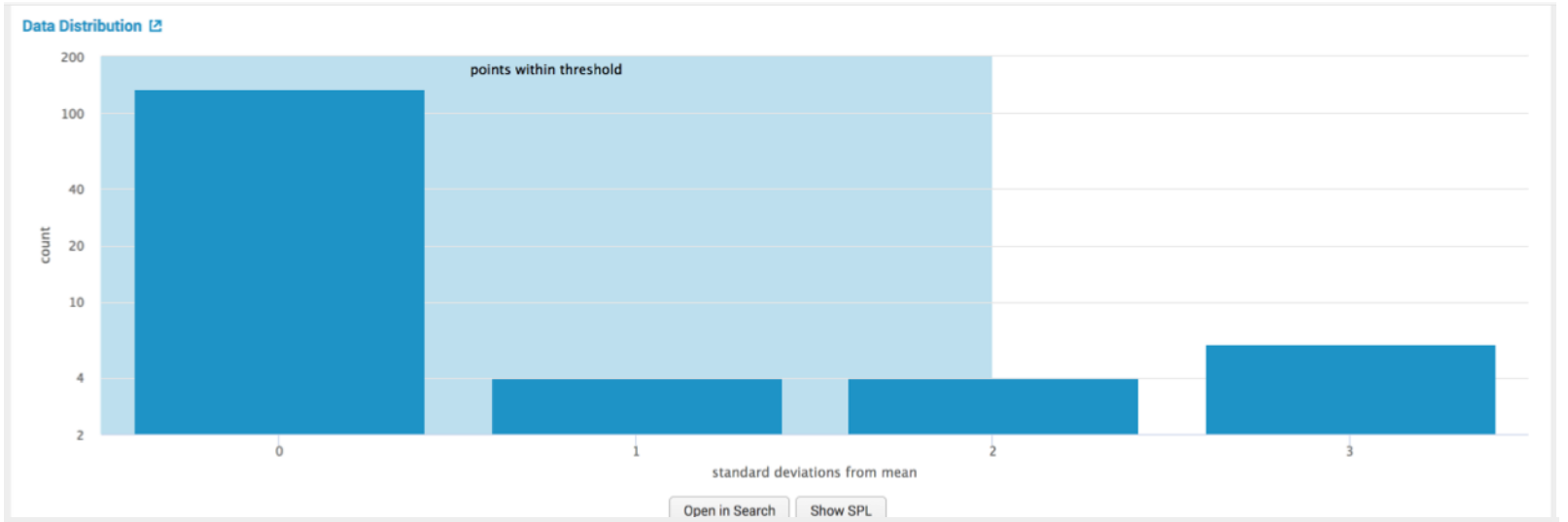
STOCK SPLUNK ML TOOLKIT HAS LIMITED FEATURES AVAILABLE FOR ANALYSIS



DATA SCIENTISTS CAN ADD NEW FEATURES DIRECTLY INTO SPLUNK FOR EDA



USER EXPERIENCE AND SUPPORTING EVIDENCE FOR DATA SCIENTISTS



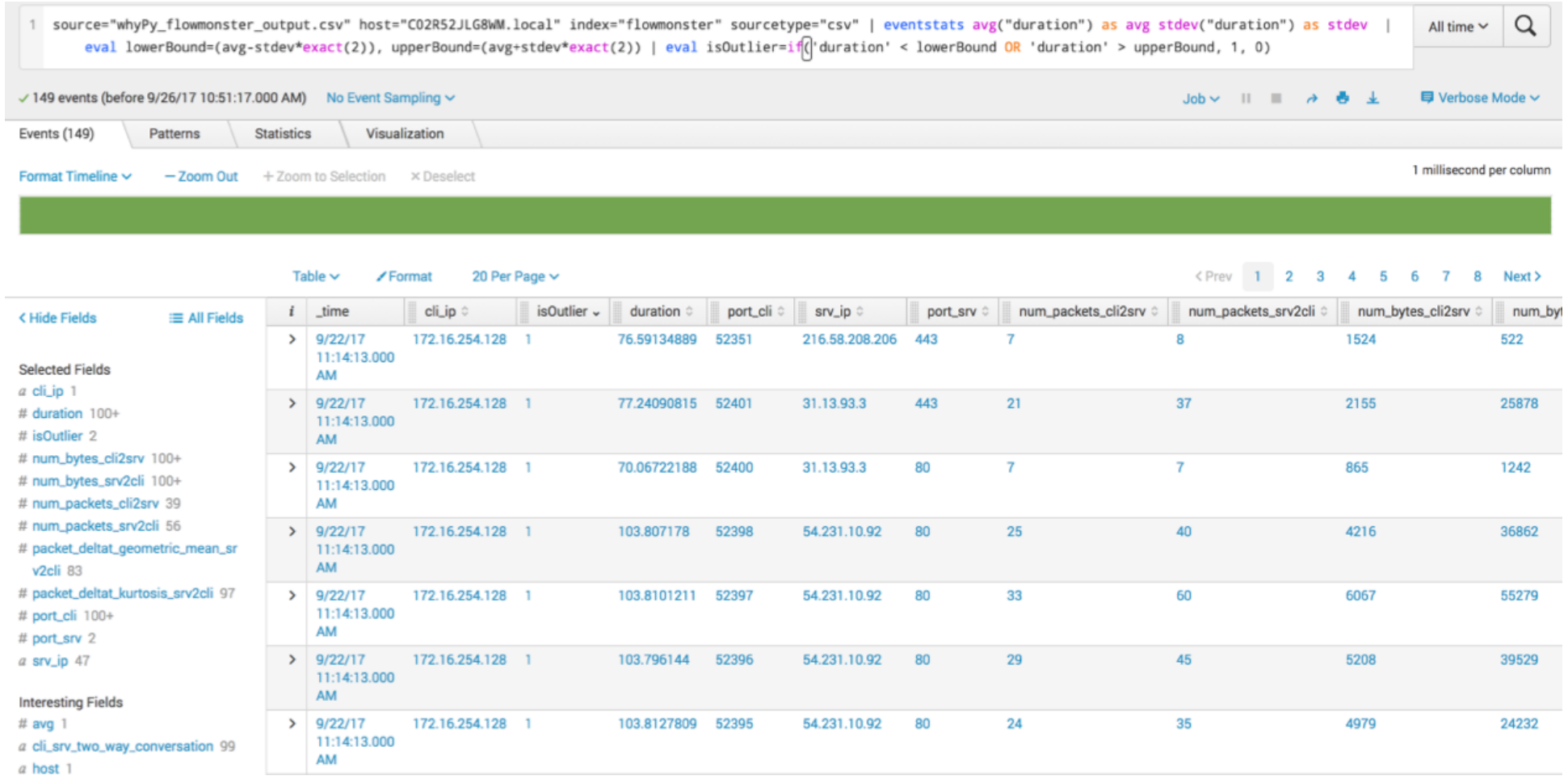
Data and Outliers

duration	lowerBound	upperBound	isOutlier	_time
76.59134889	-36.189956803408165	61.661112150777300	⚠ 1	2017-09-22T11:14:13.000-04:00
77.24090815	-36.189956803408165	61.661112150777300	⚠ 1	2017-09-22T11:14:13.000-04:00
70.06722188	-36.189956803408165	61.661112150777300	⚠ 1	2017-09-22T11:14:13.000-04:00
103.807178	-36.189956803408165	61.661112150777300	⚠ 1	2017-09-22T11:14:13.000-04:00
103.8101211	-36.189956803408165	61.661112150777300	⚠ 1	2017-09-22T11:14:13.000-04:00
103.796144	-36.189956803408165	61.661112150777300	⚠ 1	2017-09-22T11:14:13.000-04:00
103.8127809	-36.189956803408165	61.661112150777300	⚠ 1	2017-09-22T11:14:13.000-04:00
103.9973719	-36.189956803408165	61.661112150777300	⚠ 1	2017-09-22T11:14:13.000-04:00
104.0938311	-36.189956803408165	61.661112150777300	⚠ 1	2017-09-22T11:14:13.000-04:00
77.79905701	-36.189956803408165	61.661112150777300	⚠ 1	2017-09-22T11:14:13.000-04:00

« prev 1 2 3 4 5 6 7 8 9 10 next »

Open in Search Show SPL

USER EXPERIENCE AND SUPPORTING EVIDENCE FOR ANALYSTS



```
source="whyPy_flowmonster_output.csv" host="C02R52JLG8WM.local" index="flowmonster" sourcetype="csv" | eventstats avg("duration") as avg stdev("duration") as stdev |
    eval lowerBound=(avg-stdev*exact(2)), upperBound=(avg+stdev*exact(2)) | eval isOutlier=if('duration' < lowerBound OR 'duration' > upperBound, 1, 0)
```

All time

✓ 149 events (before 9/26/17 10:51:17.000 AM) No Event Sampling

Job | Verbose Mode

Events (149) | Patterns | Statistics | Visualization

Format Timeline | − Zoom Out | + Zoom to Selection | × Deselect | 1 millisecond per column

Table | Format | 20 Per Page | < Prev 1 2 3 4 5 6 7 8 Next >

< Hide Fields | All Fields

Selected Fields
- a cli_ip 1
- # duration 100+
- # isOutlier 2
- # num_bytes_cli2srv 100+
- # num_bytes_srv2cli 100+
- # num_packets_cli2srv 39
- # num_packets_srv2cli 56
- # packet_deltat_geometric_mean_srv2cli 83
- # packet_deltat_kurtosis_srv2cli 97
- # port_cli 100+
- # port_srv 2
- a srv_ip 47

Interesting Fields
- # avg 1
- a cli_srv_two_way_conversation 99
- a host 1

i	_time	cli_ip	isOutlier	duration	port_cli	srv_ip	port_srv	num_packets_cli2srv	num_packets_srv2cli	num_bytes_cli2srv	num_byt
>	9/22/17 11:14:13.000 AM	172.16.254.128	1	76.59134889	52351	216.58.208.206	443	7	8	1524	522
>	9/22/17 11:14:13.000 AM	172.16.254.128	1	77.24090815	52401	31.13.93.3	443	21	37	2155	25878
>	9/22/17 11:14:13.000 AM	172.16.254.128	1	70.06722188	52400	31.13.93.3	80	7	7	865	1242
>	9/22/17 11:14:13.000 AM	172.16.254.128	1	103.807178	52398	54.231.10.92	80	25	40	4216	36862
>	9/22/17 11:14:13.000 AM	172.16.254.128	1	103.8101211	52397	54.231.10.92	80	33	60	6067	55279
>	9/22/17 11:14:13.000 AM	172.16.254.128	1	103.796144	52396	54.231.10.92	80	29	45	5208	39529
>	9/22/17 11:14:13.000 AM	172.16.254.128	1	103.8127809	52395	54.231.10.92	80	24	35	4979	24232

LIVE DEMO

ACTION ITEMS FOR YOUR PROJECTS

CULTURAL HURDLES & SUCCESSES

- **Tactics used to overcome cultural barriers**
  - You must go to the analyst; they will show you their analysis process AND grant you keys to their data troves
  - You must be willing to explain what analysis techniques you are using simply using their terminology as much as possible
  - Someone on your team has to be willing to talk to the customers and their customers- this helps establish a new, collaborative tribe
  - Your work must role up into a story that tells the why and so what of the work- sometimes this is the closest one gets to ROI
  - Marketing & branding extremely important for breaking entrenched thinking and coaxing participation to something new & shiny

- **Build an interdisciplinary team**
  - Unicorns are hard to find and the best solutions often are a product of divergent thought
  - Data analysis is a pipeline, journey of sorts…it takes domain experts from fields other than just computer science or mathematics
  - Having data scientists that have expertise in Cyber Operations mission space will accelerate success

FOUR STEPS TO APPLYING DATA SCIENCE WITHIN CYBER OPERATIONS

- STEP #1 - WORK DIRECTLY WITH ANALYSTS TO SOURCE A USE CASE
- STEP #2 – SELECT METHOD FOR INTEGRATING DATA SCIENCE CAPABILITIES
- STEP #3 – EXECUTE MACHINE LEARNING ALGORITHM DEVELOPMENT PROCESS
- STEP #4 – SHOW EVIDENCE TO SUPPORT ANALYSIS RESULTS

TAKE AWAYS

1) Your data science team must go to the analyst

2) Populate your results where the user checks

3) Develop self-contained limited size products that can be iteratively updated and delivered

4) Data Scientists must be concerned with justifying their claims

5) Splunk can be enhanced by leveraging external scripting

INNOVATING THE CYBER DOMAIN THROUGH THE APPLICATION OF DATA SCIENCE