

.conf18

splunk>

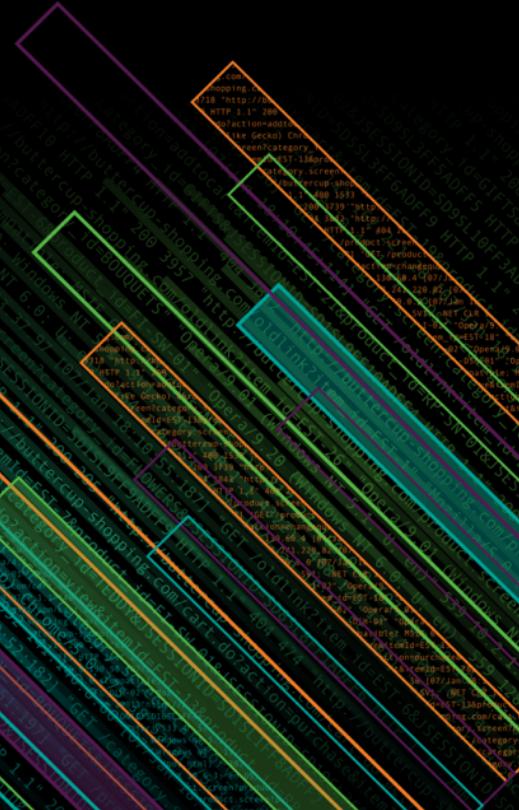
# Experiment Management Framework

## Walkthrough the Splunk Machine Learning Toolkit

Harsh Keswani – Product Management

Iryna Vogler – User Experience Design

October 2018



# Forward-Looking Statements

During the course of this presentation, we may make forward-looking statements regarding future events or the expected performance of the company. We caution you that such statements reflect our current expectations and estimates based on factors currently known to us and that actual events or results could differ materially. For important factors that may cause actual results to differ from those contained in our forward-looking statements, please review our filings with the SEC.

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# Speakers



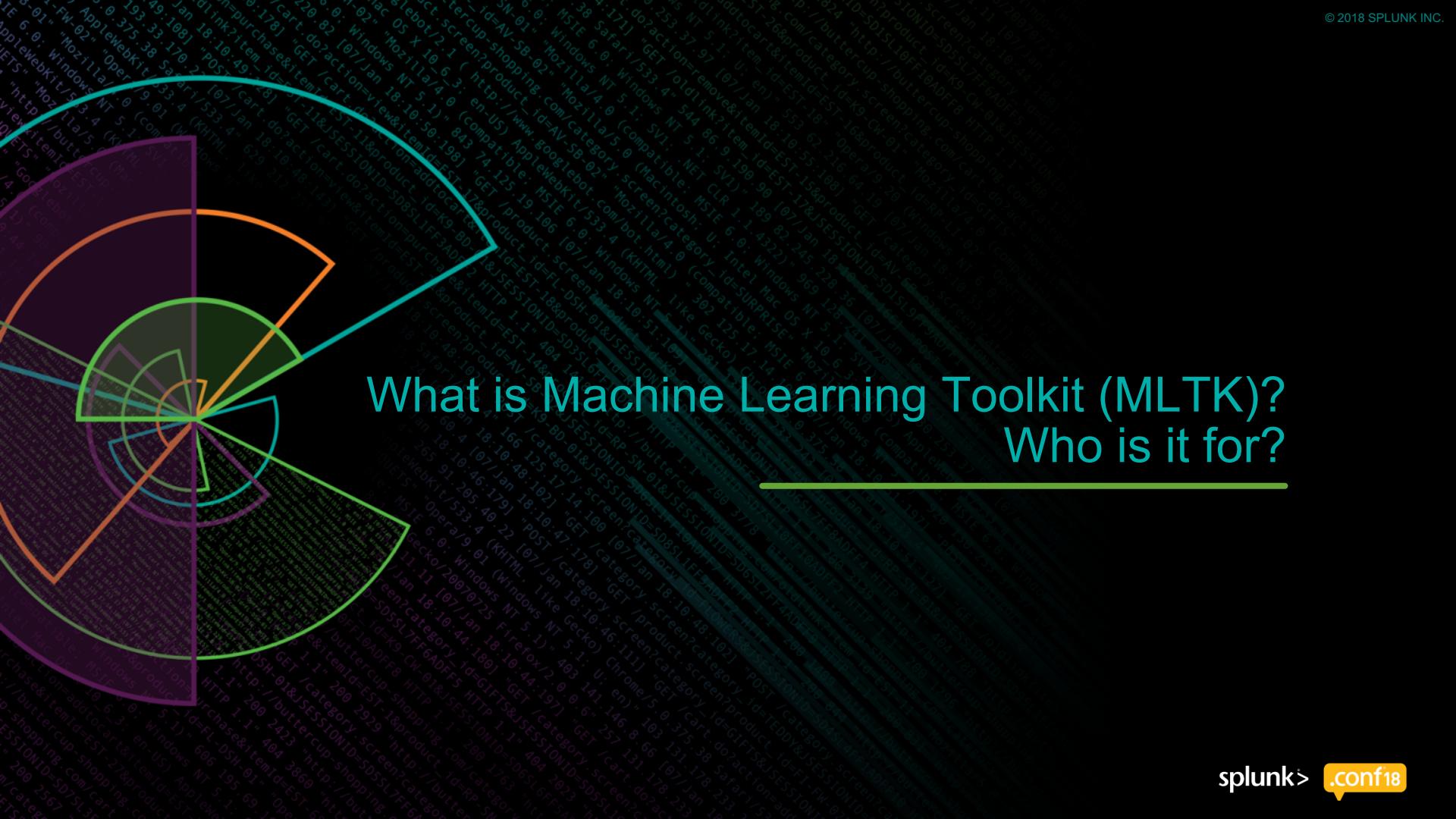
**HARSH KESWANI**

**Product Manager: Machine Learning**



**IRYNA VOGLER**

**Senior Principal UX Designer**



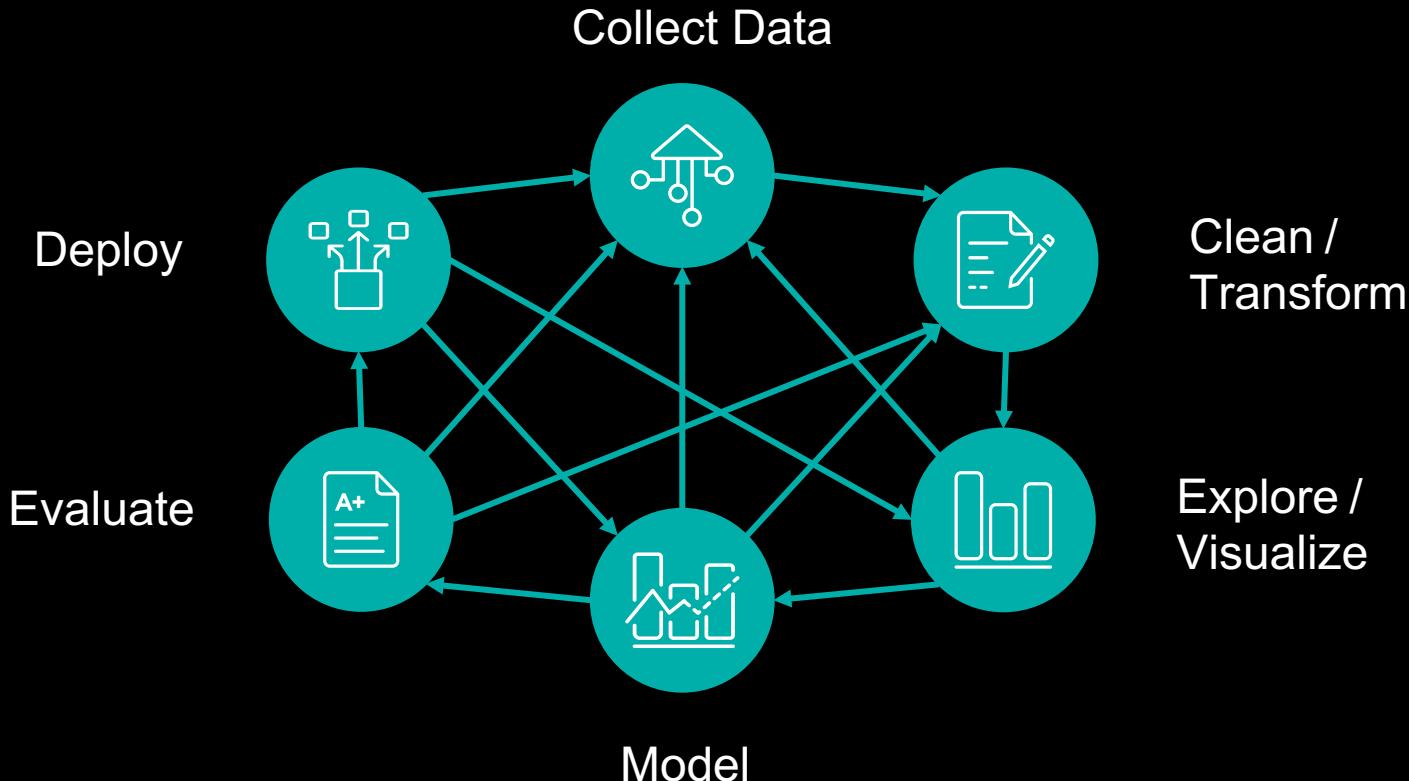
# What is Machine Learning Toolkit (MLTK)? Who is it for?

# Machine Learning

- ▶ A process for generalizing from examples
- ▶ Examples
  - $A, B, \dots \rightarrow \#$  (regression)
  - $A, B, \dots \rightarrow a$  (classification)
  - $X_{\text{past}} \rightarrow X_{\text{future}}$  (forecasting)
  - like with like (clustering)
  - $|X_{\text{predicted}} - X_{\text{actual}}| >> 0$  (anomaly detection)



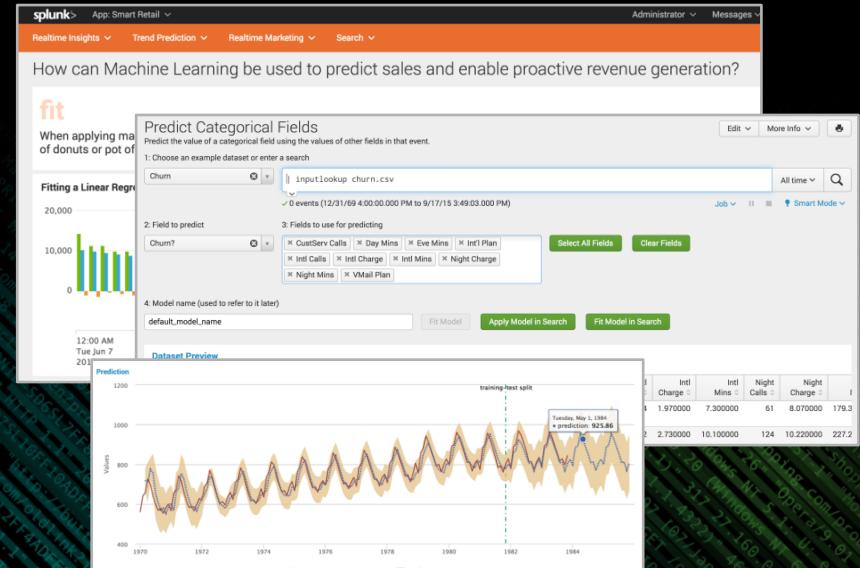
# Machine Learning Process



# Splunk Machine Learning Toolkit (MLTK)

**Extends Splunk platform functions and provides a guided modeling environment**

- ▶ **Assistants:** Guided model building, testing and deployment for common objectives
- ▶ **Showcases:** Interactive examples for typical IT, security, business and IoT use cases -
- ▶ **Algorithms:** 30 standard algorithms (supervised & unsupervised)
- ▶ **ML Commands:** New SPL commands to fit, test 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
- ▶ **Spark MLLib:** Support large scale model training via Spark Add-on for MLTK (Private-Beta)



# MLTK Customer Success



Network Optimization  
Detect & Prevent Equipment Failure



Security / Fraud Prevention



Prevent Cell Tower Failure  
Optimize Repair  
Operations



Prioritize Website Issues  
and Predict Root Cause



Entertainment  
Company

Predict Gaming Outages  
Fraud Prevention



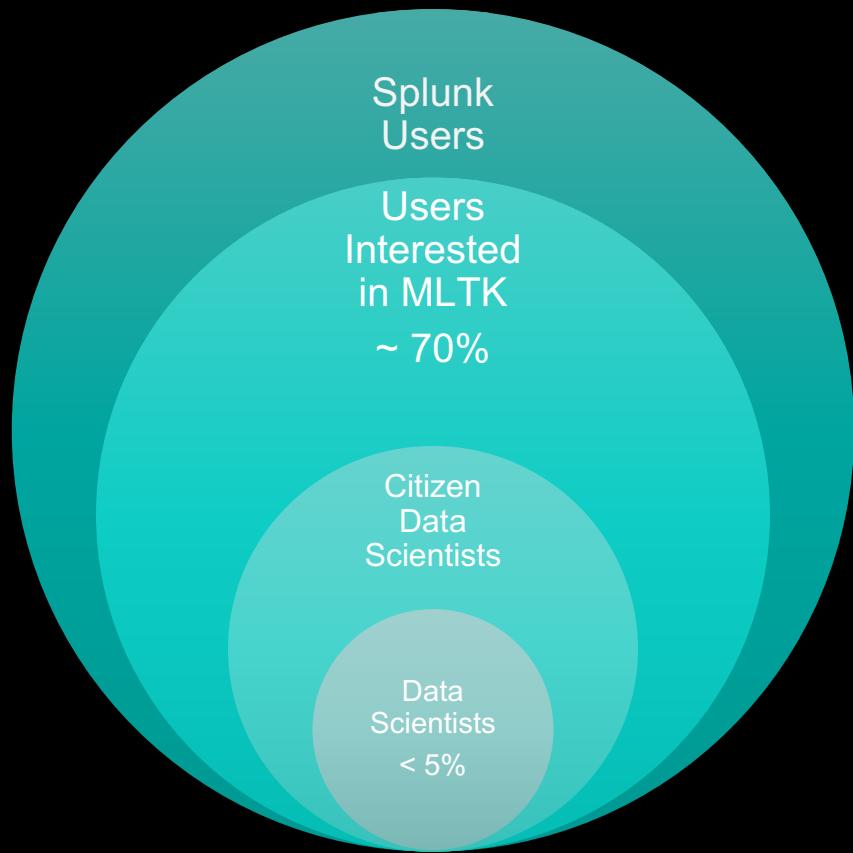
Machine Learning Consulting  
Services



Analytics App built on ML Toolkit

# Our Users

- ▶ IT and security practitioners with no data science knowledge
  - Out-of-the-box AI and ML experiences
- ▶ Advanced users with data science background and analytics expertise
  - Customizable AI and ML experiences



# What MLTK Problems Are We Solving?

External Feedback

splunk>enterprise App: Splunk Machine Learn... H Administrator ▾ Messages ▾ Settings ▾ Activity ▾ Help ▾ Find 

Search Showcase Assistants ▾ Scheduled Jobs ▾ Docs Video Tutorials  Splunk Machine Learning Toolkit

## Alerts

Scheduled Training

✓ Alerts

Alerts set a condition that triggers an action. This bins the results of the triggering search to a list of people. Click the name to view the alert. Open the alert in Search to refine the parameters.

14 Alerts All Yours This App's filter 

i	Title ▾	Actions		Owner ▾	App ▾	Sharing ▾	Status ▾
>	Alert 1	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	Private	Enabled
>	Alert 05-26 MDS SysLog	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	App	Enabled
>	Alert Housing Development	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	App	Enabled
>	Alert when Housing Zoning Violation	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	Global	Enabled
>	Alert when Housing value is above 0	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	Private	Enabled
>	Breakage Percentage Surge on AWS	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	App	Enabled
>	Housing Alert 1	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	Private	Enabled
>	Power For Servers	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	Private	Enabled
>	Power Generators Upgrade Failures	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	App	Enabled
>	Range Alert	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	Private	Enabled
>	Server Power Alert 1	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	Private	Enabled
>	Session Time-outs	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	Global	Enabled
>	Unidentified user logings	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	Global	Enabled
>	VPN Break-ins	<a href="#">Open in Search</a>	<a href="#">Edit ▾</a>	admin	Splunk_ML_Toolkit	App	Enabled

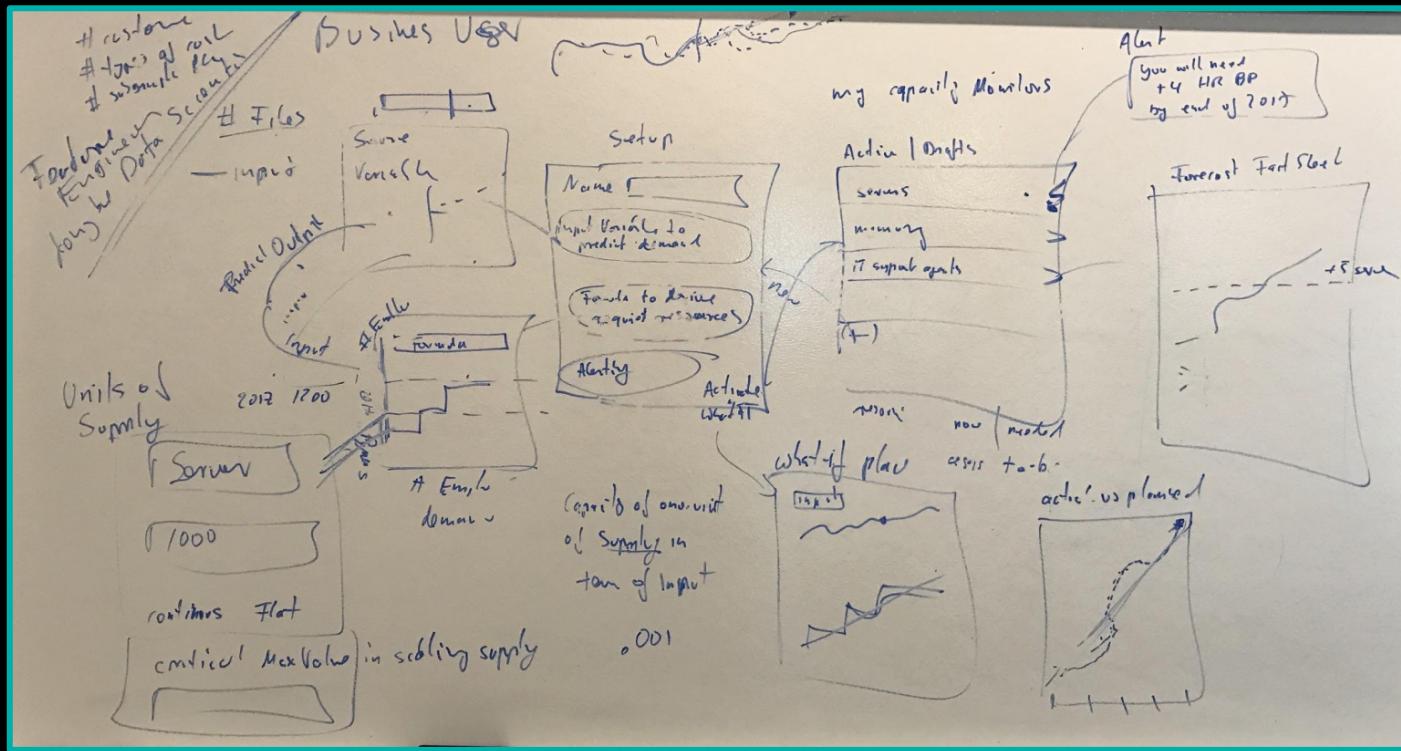
# Better MLTK

## Greater user satisfaction

- ▶ More usable and accessible by a larger number of users
- ▶ More relevant for IT professionals, security analysts and business users alike
- ▶ More intention-based and guide a user through their specific workflow

# Rethinking MLTK

## Addressing user pain points



# Multifaceted Feedback



## Customers



# Partners



# Splunk Customer-Facing Professionals

# Prototype Feedback

# What Our Users Are Saying...

“It’s nice to record stats for the same model, so that we find out what changes are there in the results after a new configuration.”

- *Experiment History*
  - *Splunk Data Science Champion*

“When expanding one experiment in the table, I want to see some more information about it, and would suggest a 2-column layout for better readability.”

- ***Experiment Summary Details***
  - ***EMEA Sr. Sales Engineer***

“I like having fast and prominent access to the experiment’s alerts and scheduled training. Don’t want to waste my time.”

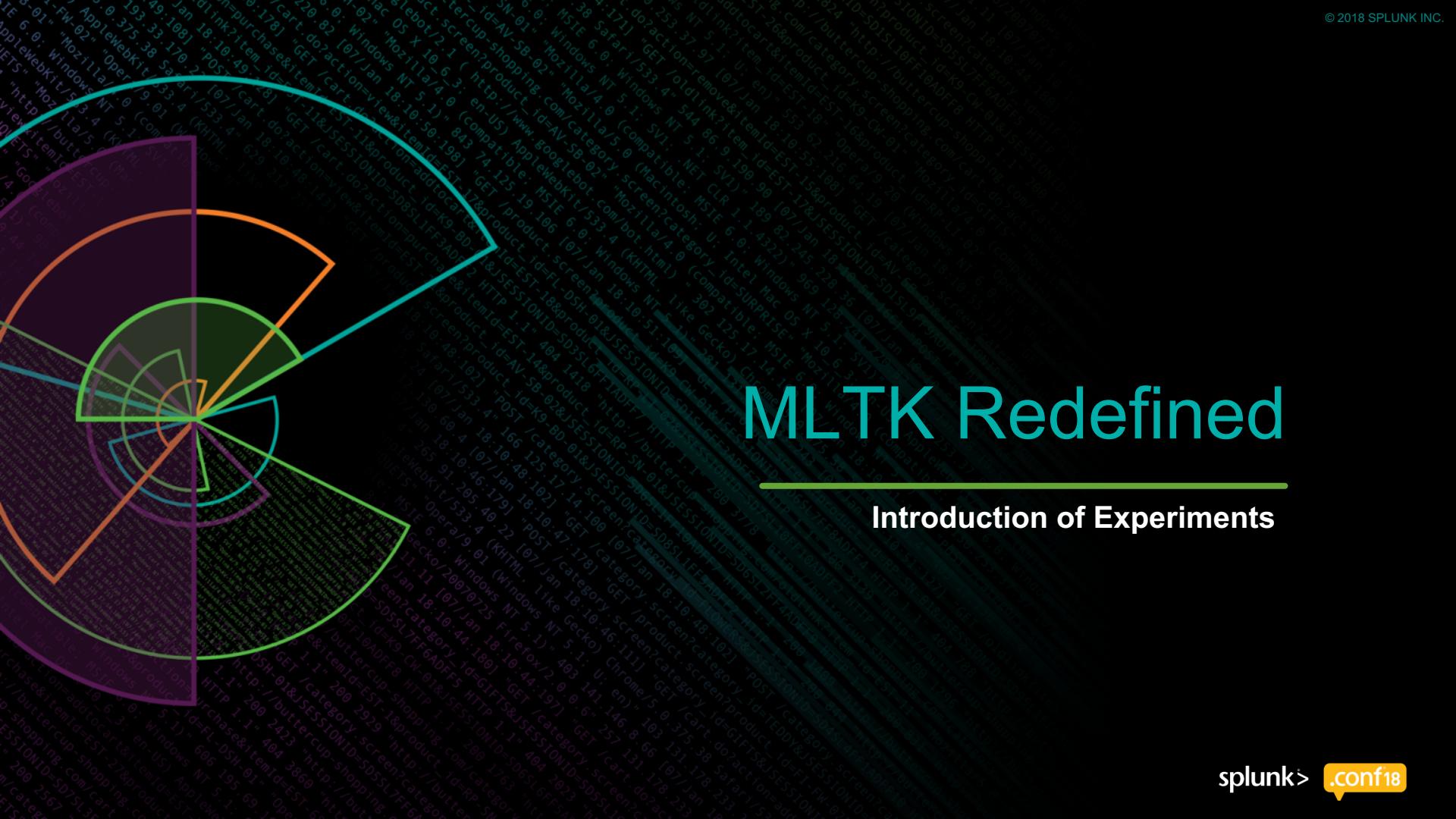
- ***Experiment Alerts / Scheduled Training***
  - ***Splunk Implementation Partner***

“ Oh, this is nice! I definitely like the visuals here. It really stands out when you try to look at each type of these experiments.”

## Experiments Listing Page Splunk Customer, Content Developer

# MLTK Redefined

## Introduction of Experiments



# Introducing Experiments

It all comes together!

## Experiment ABC

Preprocessing  
Model 1

Preprocessing  
Model 2

Model A

Alert 1

Scheduled  
Training

## Experiment XYZ

Preprocessing  
Model 3

Preprocessing  
Model 4

Model B

Alert 2

Alert 3

# Deep Dive

Detailed look at the implemented features



splunk>enterprise App: Splunk Machine Learning Toolkit ▾

Messages ▾ Settings ▾ Activity ▾ Help ▾ Find 

Showcase Experiments Search Models Legacy ▾ Docs Video Tutorials

Splunk Machine Learning Toolkit

Select an Assistant to Create an Experiment

### Predict Numeric Fields

Predict the value of a numeric field using a weighted combination of the values of other fields in that event. For example,

- Predict Server Power Consumption
- Predict VPN Usage
- Predict Median House Value
- Predict Power Plant Energy Output

### Detect Numeric Outliers

Find values that differ significantly from previous values. For example,

- 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

### Forecast Time Series

Forecast future values given past values of a metric (numeric time series). For example,

- Forecast Internet Traffic
- Forecast the Number of Employee Logins
- Forecast Monthly Sales
- Forecast the Number of Bluetooth Devices

### Predict Categorical Fields

Predict the value of a categorical field using the values of other fields in that event. For example,

- Predict Hard Drive Failure
- Predict the Presence of Malware
- Predict Telecom Customer Churn
- Predict Vehicle Make and Model

### Detect Categorical Outliers

Find events that contain unusual combinations of values. For example,

- Detect Outliers in Disk Failures
- Detect Outliers in Bitcoin Transactions
- Detect Outliers in Mortgage Contracts
- Detect Outliers in Diabetes Patient Records
- Detect Outliers in Mobile Phone Activity

### Cluster Numeric Events

Partition events with multiple numeric fields into clusters. For example,

- Cluster Hard Drives by SMART Metrics
- Cluster Behavior by App Usage
- Cluster Neighborhoods by Properties
- Cluster Vehicles by Onboard Metrics
- Cluster Power Plant Operating Regimes

splunk>enterprise App: Splunk Machine Learning Toolkit ▾

4 Messages ▾ Settings ▾ Activity ▾ Help ▾ Find

Showcase Experiments Search Model

## Create New Experiment

Experiment Type Predict Numeric Fields

Experiment Title Buttercup games server power consumption

Description Optional

Predict Numeric Fields

Predict the value of a numeric field using the values of other fields in that event. For example,

- o Predict Power Plant Energy Output
- o Detect Outliers In Supermarket Purchases
- o Detect Outliers In Power Plant Humidity
- o Forecast Monthly Sales
- o Forecast the Number of Bluetooth Devices

Predict Categorical Fields

Predict the value of a categorical field using the values of other fields in that event. For example,

- o Predict Hard Drive Failure
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Cluster Numeric Events

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- o Cluster Hard Drives by SMART Metrics
- o Cluster Behavior by App Usage
- o Cluster Neighborhoods by Properties
- o Cluster Vehicles by Onboard Metrics
- o Cluster Power Plant Operating Regimes

The image shows a laptop screen with the Splunk Machine Learning Toolkit application open. The title bar reads "splunk>enterprise App: Splunk Machine Learning Toolkit". The main page is titled "Predict Numeric Fields for Buttercup games server power consumption" and describes the task of predicting the value of a numeric field using a weighted combination of other fields. The interface includes sections for "Experiment Settings" (with tabs for "Experiment Settings" and "Experiment History"), a search bar with a query "inputlookup server\_power.csv", and a results table showing 31,272 results from July 16, 2018. Below the search is a "Preprocessing Steps" section stating "No steps added." and a link "+ Add a step". The "Algorithm" section shows "LinearRegression" selected for "Field to predict" (set to "ac\_power") and "Fields to use for predicting" (set to "total-cpu-utilization, t... (8)"). The "Split for training / test" is set to "50 / 50". Under "Fit Intercept", there is a checked checkbox "estimate the intercept". A callout box highlights the "Notes" section, which contains the annotation "Selected all secondary fields". At the bottom of the main panel are buttons for "Fit Model", "Open in Search", and "Show SPL". A "Raw Data Preview" section shows a table with columns: \_time, ac\_power, total-cpu-utilization, total-disk-accesses, total-disk-blocks, total-disk-utilization, total-instructions\_retired, total-last\_level\_cache\_references, and total-mem. The first row of data is partially visible. The top right of the screen shows a navigation bar with "Messages", "Settings", "Activity", "Help", and a search bar. On the far right, there are "Manage", "Cancel", and "Save" buttons.

*"It's great that I can annotate every model fit!"*

splunk>enterprise App: Splunk Machine Learning Toolkit ▾

4 Messages ▾ Settings ▾ Activity ▾ Help ▾ Find

Showcase Experiments Search Models Legacy ▾ Docs ▾ Video Tutorials ▾

Splunk Machine Learning Toolkit

## Predict Numeric Fields for Buttercup games server power consumption Draft

Predict the value of a numeric field using a weighted combination of the values of other fields in that event.

Manage ▾ Cancel Save

Experiment Settings		Experiment History					
i	R <sup>2</sup> ▾	RMSE ▾	Algorithm ▾	Notes ▾	User ▾	_time ▾	Actions ▾
>	0.9834	3.12	DecisionTreeRegressor	different algorithm	admin	2018-07-16 11:27:01.285	<a href="#">Fit Model</a> <a href="#">Load Settings</a>
>	0.99	2.4	RandomForestRegressor	different algorithm	admin	2018-07-16 11:26:30.043	<a href="#">Fit Model</a> <a href="#">Load Settings</a>
>	0.9361	6.16	RandomForestRegressor	Selected the utilization only	admin	2018-07-16 11:25:50.959	<a href="#">Fit Model</a> <a href="#">Load Settings</a>
>	0.9346	6.26	LinearRegression	Selected first 5 secondary fields, changed the split	admin	2018-07-16 11:25:02.299	<a href="#">Fit Model</a> <a href="#">Load Settings</a>
>	0.9482	5.5	LinearRegression	Selected all secondary fields	admin	2018-07-16 11:23:55.597	<a href="#">Fit Model</a> <a href="#">Load Settings</a>

### Prediction Results ▾

ac_power ▾	predicted(ac_power) ▾	residual ▾	total-cpu-utilization ▾	total-disk-utilization ▾	total-disk-accesses ▾	total-disk-blocks ▾	total-instructions_retired ▾	total-last_level_cache_references ▾
220.0	221.67	-1.7	0.99	0.0	0.0	0.0	3924639.0	75140.0
220.0	222.12	-2.1	1.15	3.66	5.49	214.63	2843358.0	590082.0
220.0	220.14	-0.1	0.0	0.0	0.0	0.0	3985700.0	80619.0
221.0	221.78	-0.8	0.0	0.0	0.0	0.0	4252939.0	96290.0
220.0	220.70	-0.7	0.0	0.0	0.0	0.0	4080229.0	90326.0
221.0	220.14	0.9	0.0	0.0	0.0	0.0	3949818.0	80603.0
221.0	220.00	1.0	3.7	17.3	35.14	540.54	3835019.0	80308.0
220.0	223.00	-3.0	0.0	0.0	0.0	0.0	3835010.0	75736.0

splunk>enterprise App: Splunk Machine Learning Toolkit ▾

Messages ▾ Settings ▾ Activity ▾ Help ▾ Find ▾

Showcase Experiments Search Models Legacy ▾

## Predict Numeric Fields for Buttercup games

Predict the value of a numeric field using a weighted combination of other fields.

Experiment Settings Experiment History

Enter a search

```
| inputlookup server_power.csv
```

✓ 31,272 results (12/31/69 4:00:00.000 PM to 7/16/18 10:53:09.000 PM)

Preprocessing Steps

No steps added.

+ Add a step

Algorithm Field to predict Fields to use for predicting Split for training / test: 50 / 50

Lasso ac\_power total-cpu-utilization, t... (9) 50 / 50

Alpha (optional)

Notes

different algorithm

Fit Model Open In Search Show SPL

Prediction Results ⓘ

ac\_power predicted(ac\_power) residual total-cpu-utilization total-disk-utilization total-disk-accesses total-disk-blocks total-instructions\_retired total-last\_level\_cache\_references

### Saving Experiment

**⚠ Saving your experiment will update any scheduled training and alerts associated with this experiment.**

Experiment Title

Description

Cancel Save

Manage ▾ Cancel Save

All time ▾

Job ▾ Smart Mode ▾

splunk>enterprise App: Splunk Machine Learning Toolkit ▾

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

Showcase Experiments Search Models Legacy ▾ Docs Video Tutorials

Splunk Machine Learning Toolkit

## Experiments

[Create New Experiment](#)

Predict Numeric Fields Predict Categorical Fields Detect Numeric Outliers Detect Categorical Outliers Forecast Time Series Cluster Numeric Events

4 3 1 2 5 0

4 Experiments

i	Experiment Name ▾	Algorithm	Actions
>	Buttercup games VPN usage	LinearRegression	<a href="#">Manage ▾</a>
▼	Buttercup games server power consumption	Lasso	<a href="#">Manage ▾</a>
Dataset .....   inputlookup server_power.csv Modified ..... Jul 16, 2018 11:33:14 PM		<b>EXPERIMENT SETTINGS</b> Algorithm ..... Lasso Field to predict ..... PC_1 Fields to use for predicting ..... _time, ac_power, total-cpu-utilization, total-disk-accesses, total-disk-blocks, total-disk-utilization, total-instructions_retired, total-last_level_cache_references, total-memory_bus_transactions, total-unhalted_core_cycles, SS_ac_power Split for training/test ..... 50/50 Model Name ..... _exp_97481de0fce34fecad239b1540f4fb8b_Lasso_0	
PREPROCESSING STEPS			
Algorithm ..... StandardScaler Model Name ..... _exp_97481de0fce34fecad239b1540f4fb8b_StandardScaler_0 Algorithm ..... PCA Model Name ..... _exp_97481de0fce34fecad239b1540f4fb8b_PCA_1			
>	Buttercup games server response time	RandomForestRegressor	<a href="#">Manage ▾</a>
>	Predict number of in-game purchases	DecisionTreeRegressor	<a href="#">Manage ▾</a>

[Create Alert](#)

Manage Alerts  
Edit Title and Description  
Schedule Training  
Delete

splunk>enterprise App: Splunk Machine Learning Toolkit

Administrator Messages Settings Activity Help Find

Showcase Experiments Search Model

## Experiments

Predict Numeric Fields 4

4 Experiments

Experiment Name ▾

- Buttercup games VPN usage
- Buttercup games server power consumption

Dataset ..... | inputlookup server\_power.csv  
Modified ..... Jul 16, 2018 11:33:14

PREPROCESSING STEPS

- Algorithm ..... StandardScaler
- Model Name ..... \_exp\_26e2d28da7094b2b87ecb06d83a847a1
- Algorithm ..... PCA
- Model Name ..... \_exp\_97481de0fce3

- Buttercup games server response time
- Predict number of in-game purchases

RandomForestRegressor

DecisionTreeRegressor

Create New Experiment Cluster Numeric Events

Actions Manage Manage

Alert on In-Game Purchases

Optional

Private Shared in App

Scheduled Real-time

Run every week ▾

On Monday at 6:00

Trigger Conditions

Trigger alert when Number of Results ▾

Cancel Save

The image shows a laptop screen displaying the Splunk Machine Learning Toolkit interface. The title bar reads "splunk>enterprise App: Splunk Machine Learning Toolkit". The top navigation bar includes links for "Showcase", "Experiments", "Search", "Models", "Legacy", "Docs", and "Video Tutorials". On the right side of the top bar are "Administrator", "Messages", "Settings", "Activity", "Help", "Find", and a search icon. Below the top bar, there is a secondary header with a brain icon and the text "Splunk Machine Learning Toolkit". The main content area is titled "Alerts for Experiment: Buttercup games server power consumption". A sub-instruction below it says: "Alerts set a condition that triggers an action, such as sending an email that contains the results of the triggering search to a list of people. Click the name to view the alert. Open the alert in Search to refine the parameters." A table titled "4 Alerts" is displayed, showing four entries:

	Title	Alert Type	Trigger Conditions	Trigger Actions	Status	Actions
>	Server Power Consumption Alert	Scheduled. Weekly, Monday at 6:00.	Number of Results is > 0.	3 Actions Add to Triggered Alerts Send email Log Event	Enabled	Edit
>	Buttercup games server power criti...	Scheduled. Weekly, Monday at 6:00.	Number of Results is > 0.	3 Actions Add to Triggered Alerts Send email Run a script	Enabled	Edit
>	Server Balancing Alert	Scheduled. Weekly, Monday at 6:00.	Number of Results is > 0.	3 Actions Add to Triggered Alerts Send email Log Event	Enabled	Edit
>	Server malfunction alert	Scheduled. Weekly, Monday at 6:00.	Number of Results is > 0.	3 Actions Add to Triggered Alerts Output results to lookup Webhook	Enabled	Edit

*"It's great that I can easily see a list of alerts for an experiment, and conditions and statistics about each alert."*

Experiments

Predict Numeric Fields 4

4 Experiments

- Experiment Name ▾
  - Buttercup games VPN usage
  - Buttercup games server power consumption
  - Buttercup games server response time
  - Predict number of in-game purchases

## Schedule Training

Schedule: Run every week ▾  
On: Monday at 6:00  
Time Range: All time ▾  
Schedule Priority: Default  
Schedule Window: No window

**Trigger Actions**

+ Add Actions ▾

When triggered:

- Send email Remove

To:   
Priority:   
Subject:   
Message:   
The email subject, recipients and message can include tokens that insert text based on the results of the search.  
[Learn More](#)

Include  Link to Report  Link to Results

splunk>enterprise App: Splunk Machine Learning Toolkit ▾

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

Showcase Experiments Search Models Classes

## Experiments

Predict Numeric Fields Predict Categorical Fields

4 3

4 Experiments

Experiment Name ▾

- > Buttercup games VPN usage
- > Buttercup games server power consumption
- > Buttercup games server response time
- > Predict number of in-game purchases

**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

Splunk Machine Learning Toolkit

Create New Experiment

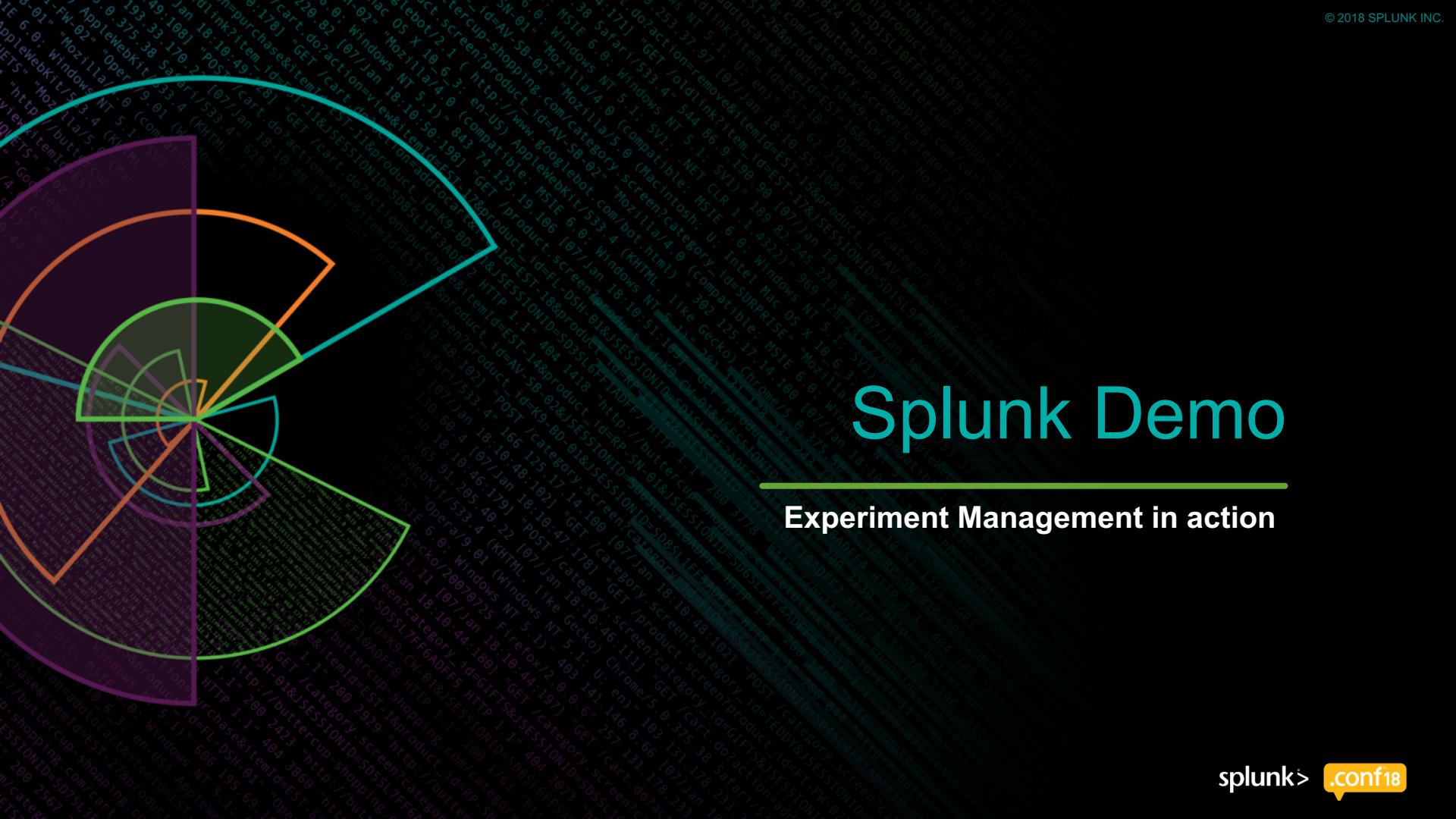
Forecast Time Series Cluster Numeric Events

5 0

Actions	Manage ▾	Publish
Manage ▾	Manage ▾	Publish
Manage ▾	Manage ▾	Publish
Manage ▾	Manage ▾	Publish
Manage ▾	Manage ▾	Publish

# Splunk Demo

Experiment Management in action



# Key Takeaways

1. Experiment Management Listings Page
  - Filter by the experiment type
  - View the experiment summary details
  - Initiate the actions one location
2. Alerts and Scheduled Training per an experiment
3. Model annotation



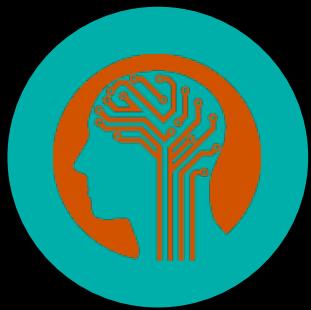
The latest release of Splunk Machine Learning Toolkit makes it significantly easier to process large amounts of data and find patterns to see what's right or wrong. Splunk's continued evolution of the Experiment Management Framework, including new tools to help validate our machine learning models, streamlines the complicated process of operationalizing machine learning.

---

**Sundaresh Ramanathan, Director, IT Operations Analytics, Kinney Group, Inc.**

## Major Highlights

(since .conf 2017)



# Splunk Machine Learning Toolkit Updates

# **FN1429 - Using the Splunk Machine Learning Toolkit to Create Your Own Custom Models**

**Thursday, Oct 04, 12:15 p.m. - 1:00 p.m.**



# Python for Scientific Computing 1.3 Update

# **FN1398 - Splunk and the Machine Learning Toolkit in Action: Customer Use Cases**

**Wednesday, Oct 03,  
12:45 p.m. - 1:30 p.m.**



# Splunk MLTK Connector for Apache Spark™

# FN1364 - Using Spark and MLLib for Large Scale Machine Learning With Splunk Machine Learning Toolkit

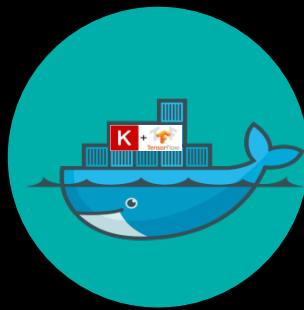
**Thursday, Oct 04, 11:00  
a.m. - 11:45 a.m.**



GitHub MLTK  
Community

# FN1409 - Extending Splunk MLTK using GitHub Community

Thursday, Oct 04,  
11:00 a.m. - 11:45 a.m.



# Splunk MLTK Container for Tensor Flow

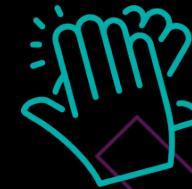
# **FN1478 - Exciting, To-Be-Announced Platform Session**

**Wednesday, Oct 03,  
4:30 p.m. - 5:15 p.m.**

# Q&A

Harsh Keshwani | Product Manager: Machine Learning  
Iryna Vogler | Sr. Principal UX Designer

# Thank You



Don't forget to **rate this session**  
in the **.conf18** mobile app

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