Busting eCommerce Scammers with Splunk

Measuring Transactional Risk

J.R. Murray | VP Technical Services, Gemini Data
Juan Morales | Industry Professional

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Our Speakers

J.R. MURRAY

VP Technical Services, Gemini Data

@jrzmurray

JUAN MORALES

Industry Professional

@juanmmoralesv

Order Risk Problem Space

eCommerce Risk Mitigation

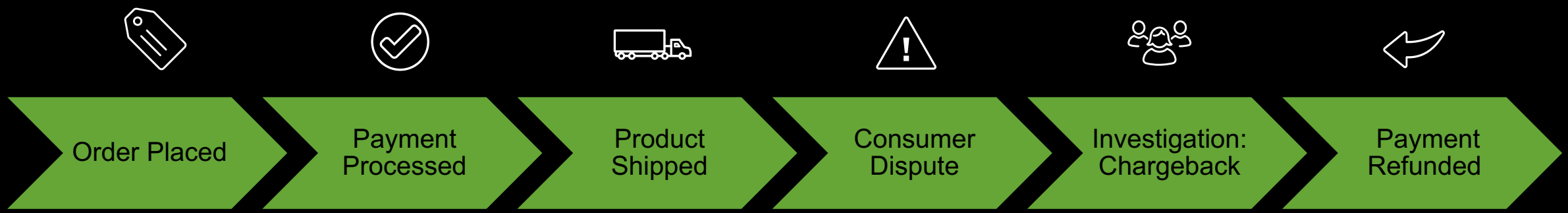
Mission

1. Prevent payment card chargebacks
2. Prevent shipment of goods
3. Prevent campaigns/repeat offenders

What is a Chargeback?

a frustrating threat to your livelihood

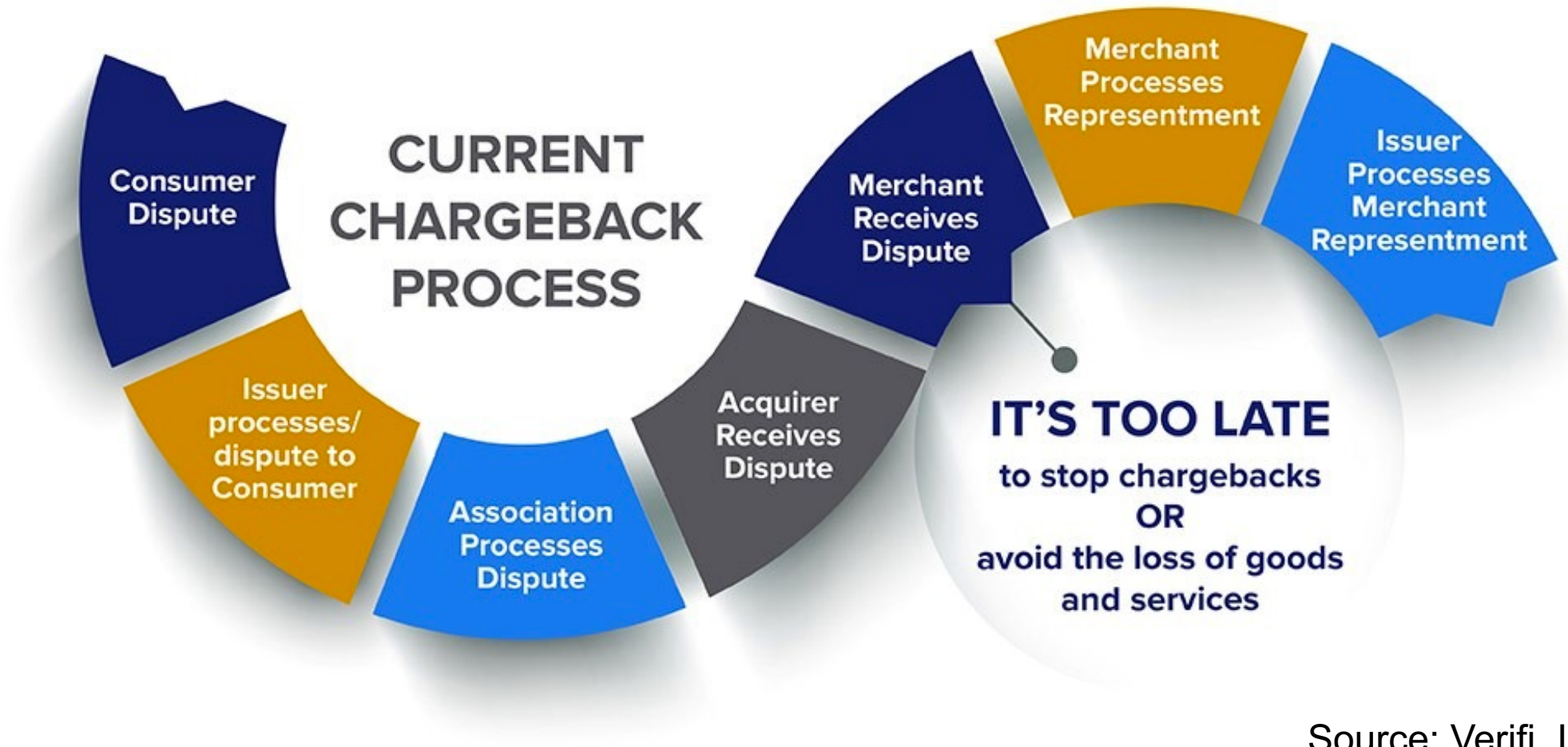
A Chargeback is a reversal of a payment originally from a consumer to a merchant that is forced on the merchant by a financial institution.



Chargebacks were developed and are utilized as a consumer protection control.

How Does the Process Work?

Your stuff becomes their stuff.



Source: Verifi, Inc.

The Problem & The Effects

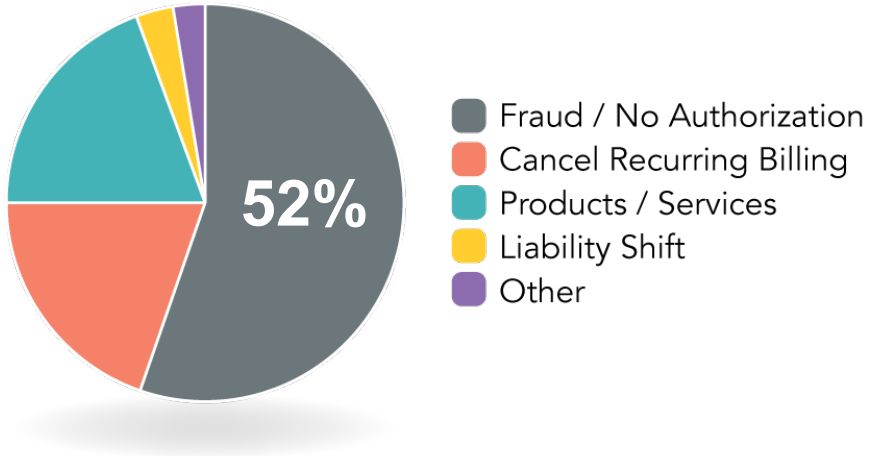
Risks for Payment Reversal

$19B

Merchants chargeback problem in 2017*

+$1.50

Additional cost for merchants and issuers per dollar spent



Overall, "Fraud/No Authorization" chargebacks account for 52% of all disputes**

*Sources: *Javelin Strategy & Research (May 2018) – Published by CNP (Card Not Present)*
**https://chargeback.com/5-chargeback-reason-code-categories/

Not only is cybersecurity a risk for online merchants, but accepting high-risk payments can also affect when having to refund the charges.

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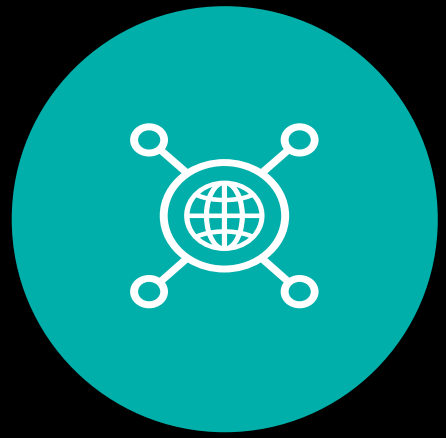
One Response (Among Others)

Using the Power and Extensibility of Splunk

Rule Engine with Workflow Management



Search-Time Data Enrichment with Risk Scoring

Advanced Searches and Visualizations

Rule Engine with Workflow Management

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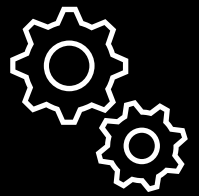
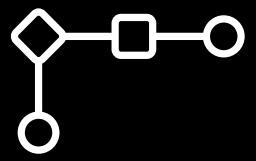
Workflow Management Goals

Pillars of Success



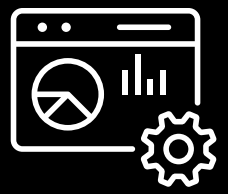
Rule Engine

- Scheduled Alerts
  - **Velocity**
  - **Blacklist matches**
  - **High Risk Score**
- Advanced Macros
  - **Automatic aggregation of overlapping alerts**
  - **Zero duplication**



Interactive Workflow

- Delete orders from cases
- Blacklist order attributes
- Expand table rows
- Add case comments
- Set order flags
  - **Bad Actor**
  - **Stopped shipping/billing**
  - **False positive (et al.)**

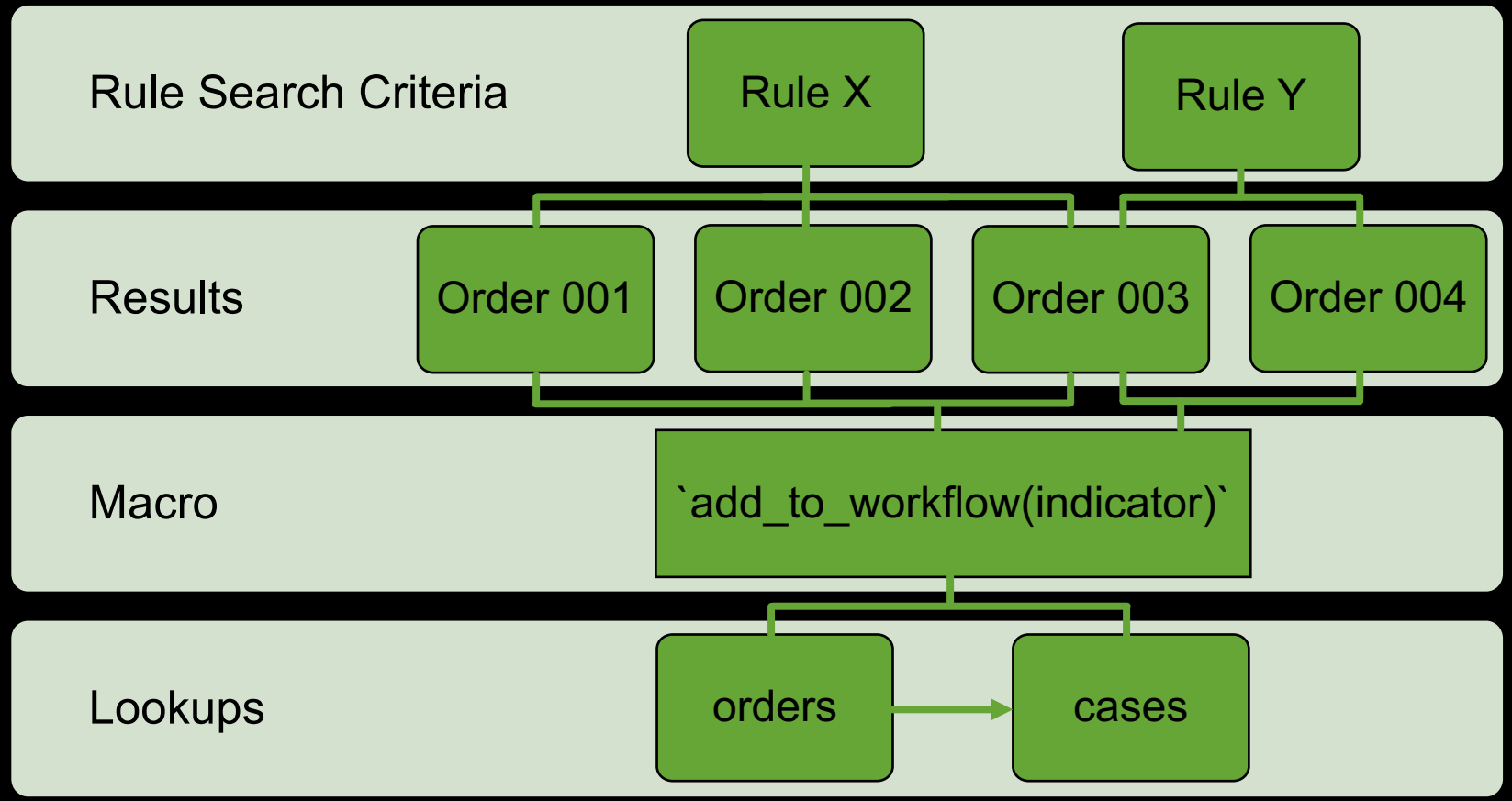


Organization

- Cases with order grouping
- Campaigns with case grouping
- Activity auditing
- Metrics and reports

Rule Engine - Workflow

Status = “It’s Complicated”



Rule Engine - Example

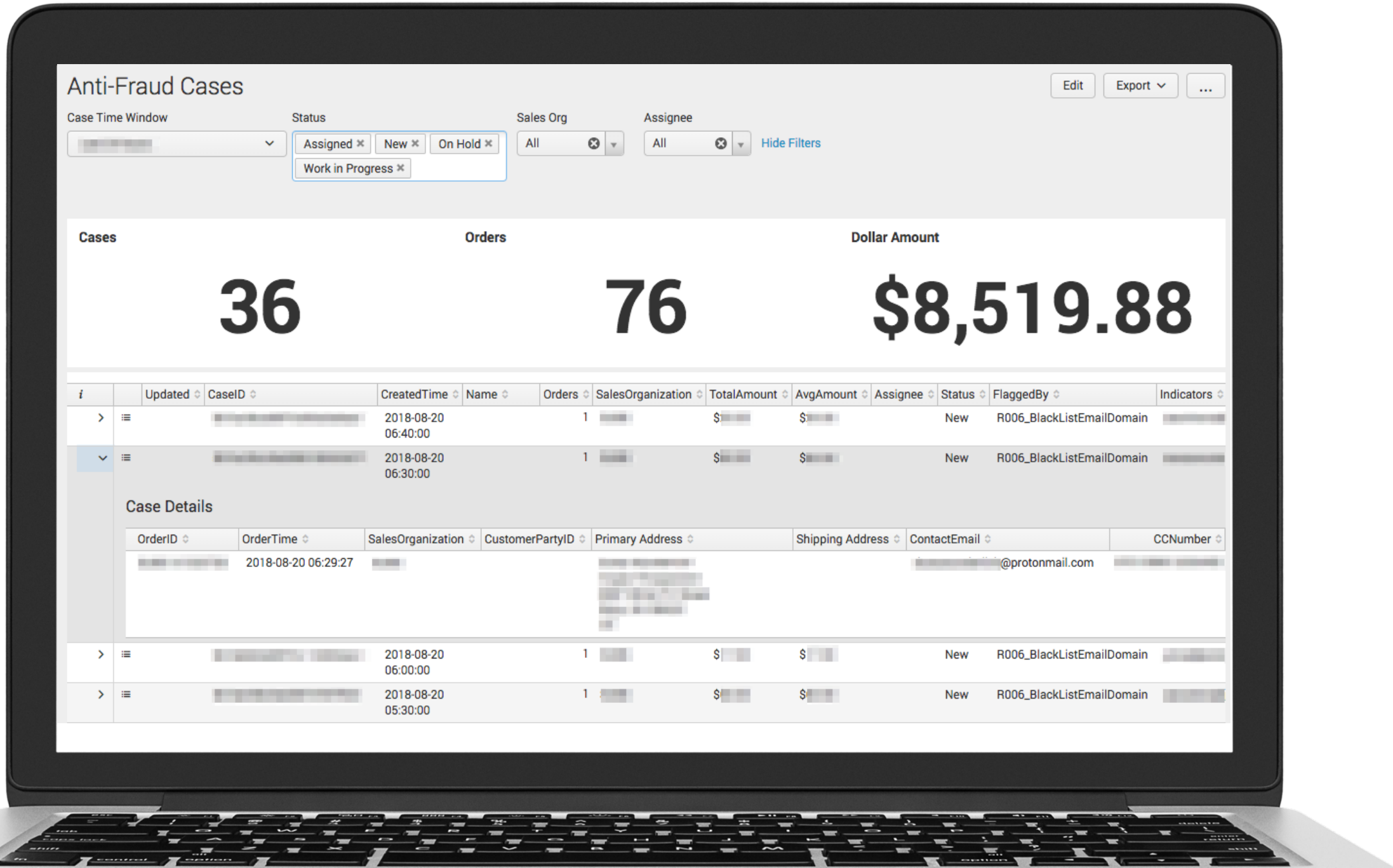
Writing to two lookups in one search

```
index=orders sourcetype=order | lookup orders _key AS OrderID
[ rule filter / logic ]
[ filtered lookup for *open* cases w/matching $indicator ] # output _key=NewCaseID
| eval CaseID=coalesce(CaseID, NewCaseID)
[ add the case fields / set the priority / set default values for CaseID==null() ]
[ append indicator field values (make multi-value if one is set) ]
| appendpipe
    [| stats first(CaseID) first(Priority), first(CampaignID), first(CreatedTime),
first(ResolvedTime), values(IndicatorType1), values(IndicatorType2), first(Assignee),
first(Status), first(CaseName) count by Indicator
    | fields - Indicator
    | rename values(*) AS *, first(*) AS *
    | rename CaseID AS _key
    | outputlookup append=t cases                    # Write to the Cases lookup
    | search NOT * ]                                 # Blank _key = new case
| lookup cases_open $indicator_field$ AS Indicator OUTPUT _key AS CaseIDNew
| eval CaseID=coalesce(CaseID, CaseIDNew)           # Grab the case ID (if newly created)
| fields - Indicator CaseIDNew
| rename OrderID AS _key
| outputlookup append=t orders                      # Write to the Orders lookup
```

Core Views/Dashboards

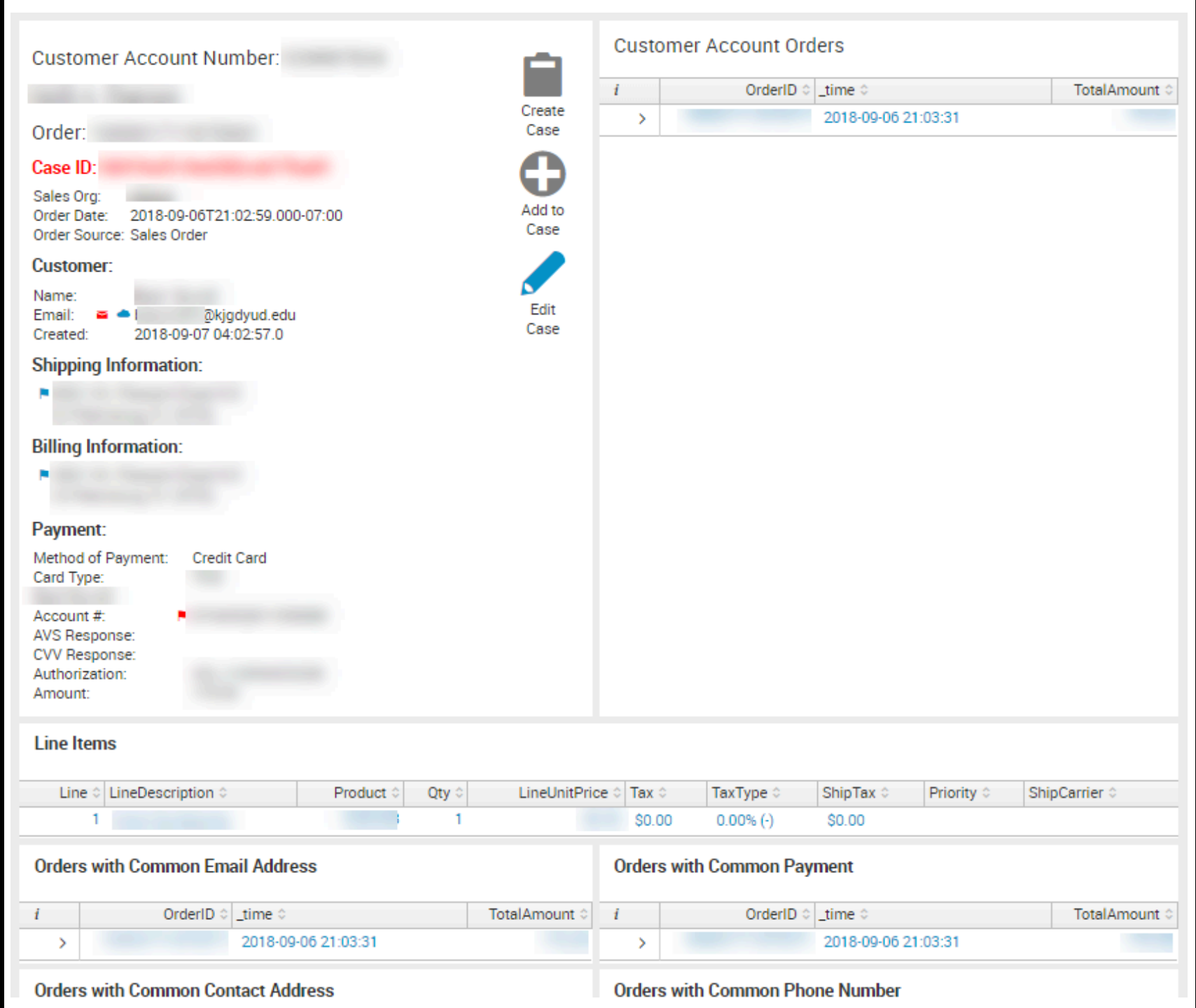
Bread and Butter

- Order Search
  - Filter by index/sourcetype/keywords
  - Includes Create Case button for matching orders
- Recursive (Multi-Level) Search
  - Digs for linked orders with up to 3 degrees of separation
- Velocity Search
  - Finds orders with a common field value X times over Y hours
- Order View
  - Custom HTML view of a single order
  - Case functions (add/edit/delete)
  - Related order searches
- Case View
  - Manage cases, included orders, related attributes, and see graph relationships



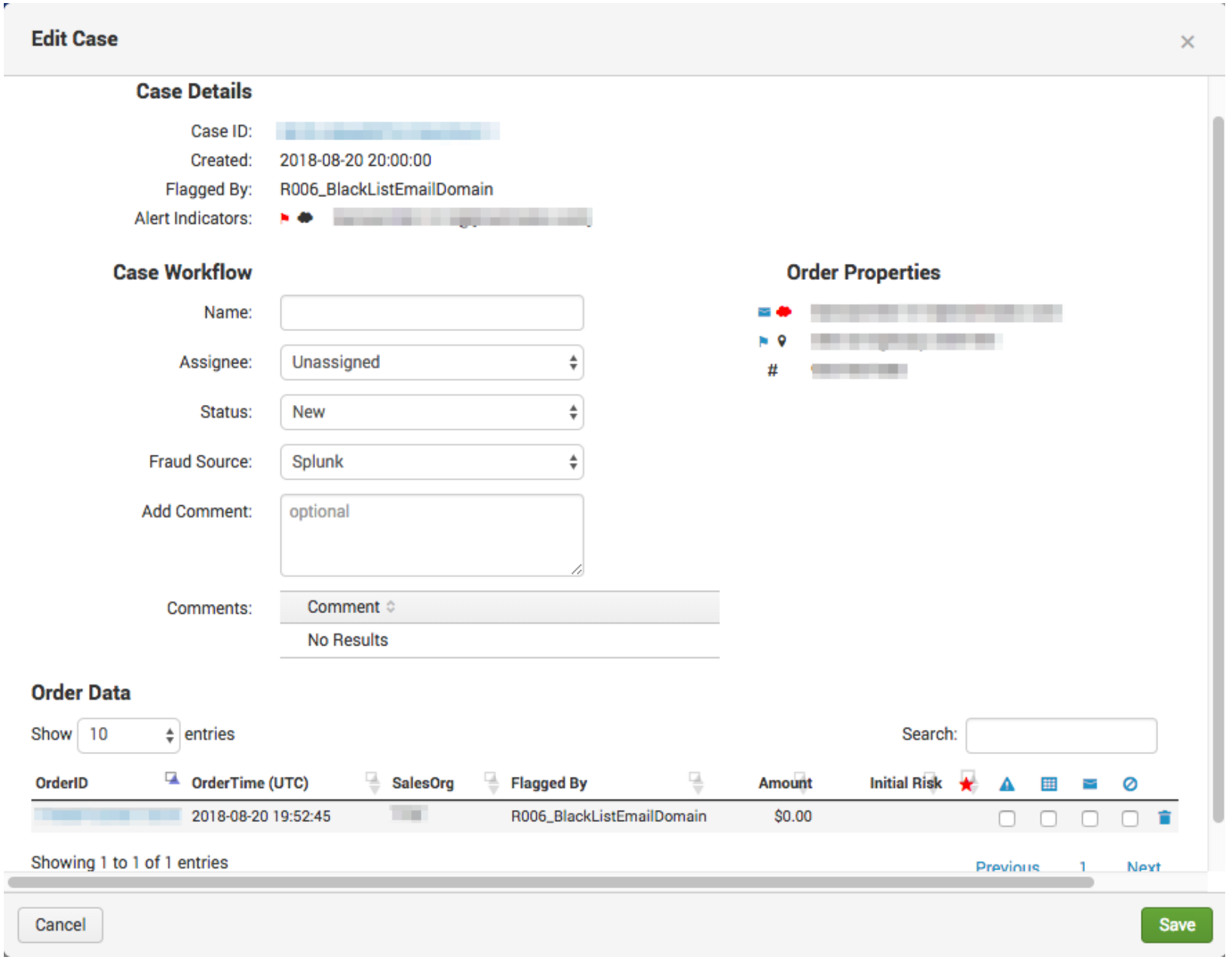
Order View

For when it's all about the details



Edit Cases

Set extended case attributes, comments, and order flags



Search-Time Data Enrichment with Risk Scoring

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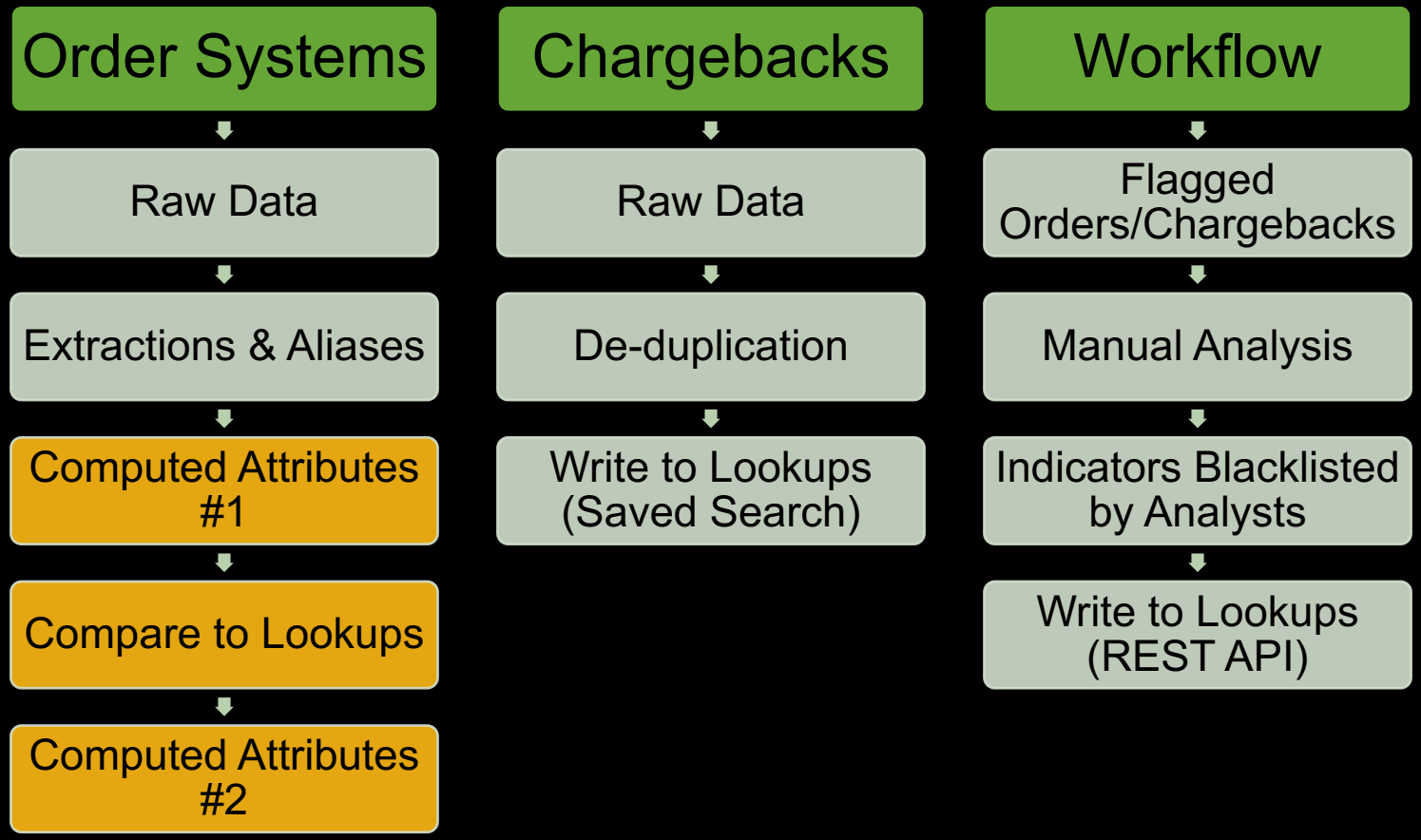
Search-Time Risk Attributes – Concept

Calculating Badness at Search-Time



Search-Time Risk Attributes – Examples

What is bad? Start with suspicious.

Intelligence

- Blacklist Attributes
- Attributes Matching Chargeback Orders
- DNS Domain Validation

Email

- Contains Contact Name
- Abnormal # of Digits in Address
- Foreign Email Domain TLDs
- Free Email Domains
- Invalid Email Domains
- Email Subdomains

Suspicious

- New Customer & Large Order
- Multiple Payment Cards per Customer
- Other/Secret Sauce

Shipping

- Billing State != Shipping State
- Rush Shipment
- Shipping Distance > # miles

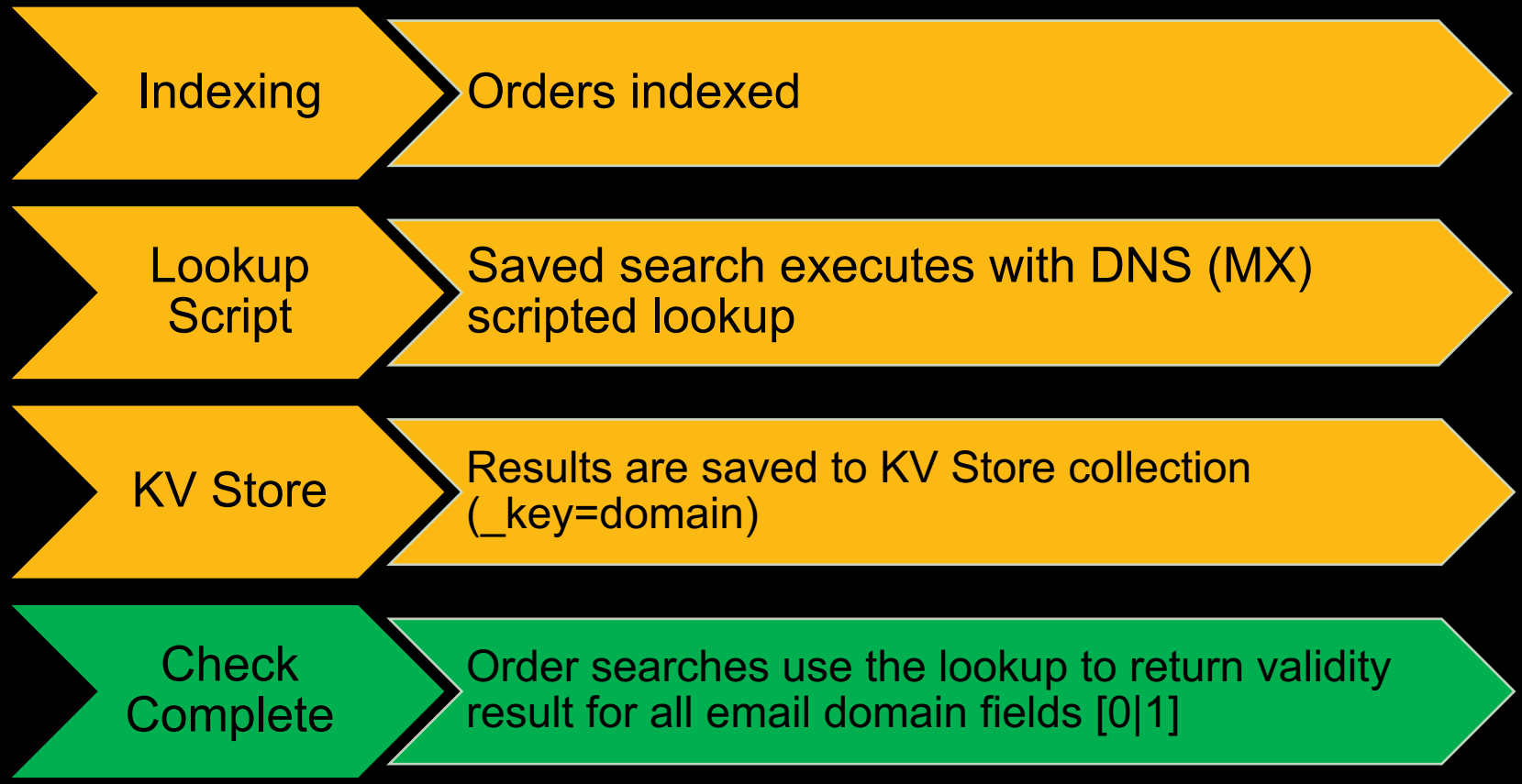
Search-Time Risk Attributes – Examples

Configuration Details

```
# Phone/Payment Method/Address/etc.
LOOKUP-[attribute] = af_[attribute] _key AS [attribute] OUTPUT BL_[attribute] FA_CB_[attribute]

# Multi-level (4) email domains / foreign domain
EVAL-FA_ContactEmailDomain_4Levels = if(match(ContactEmail, "@[^.]+\.[^.]+\.[^.]+\.[^.]+$"), 1, 0)
LOOKUP-email_foreign_tld = foreign_domain_suffix DomainSuffix AS ContactEmailTLD OUTPUT Foreign AS
    FA_Email_Foreign_TLD

# Email Address does not include the Contact Name
EVAL-FA_Email_NotIncludes_Name = if(like(lower(Email), "%"+lower(FirstName)+"%") OR like(lower(Email),
    "%"+lower(LastName)+"%"), 0, 1)

# Billing and shipment states are different
EVAL-FA_Bill_Ship_State_Diff = if(upper(PrimaryAddressState)!=upper(ShipAddressState) AND
    isnotnull(ShipAddressState) AND isnotnull(PrimaryAddressState), 1, 0)

# Rush shipment (not ground)
EVAL-FA_Rush_Shipping = if(like(ShipCarrier, "%Day%") OR like(ShipCarrier, "%Overnight%"), 1, 0)

# High dollar amount on the order
EVAL-FA_HDA1 = if(TotalAmount>#####, 1,0)
```

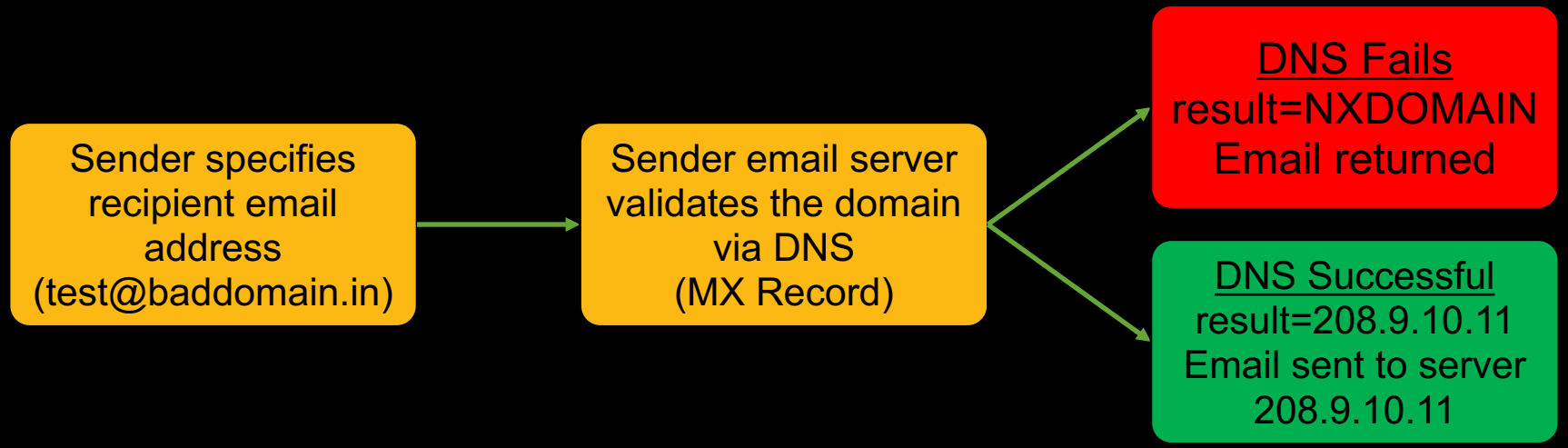
Email Domain Validation – Concept

Validation Process



How Email Works

Email Validation Process Review (Simplified)



- Scammers use bad email addresses to avoid being traced.
- We prove the bad email domains are invalid and store the result.
- We can reference all observed domains to validate orders.
- Only 1.5% of orders with invalid email domains result in a chargeback.

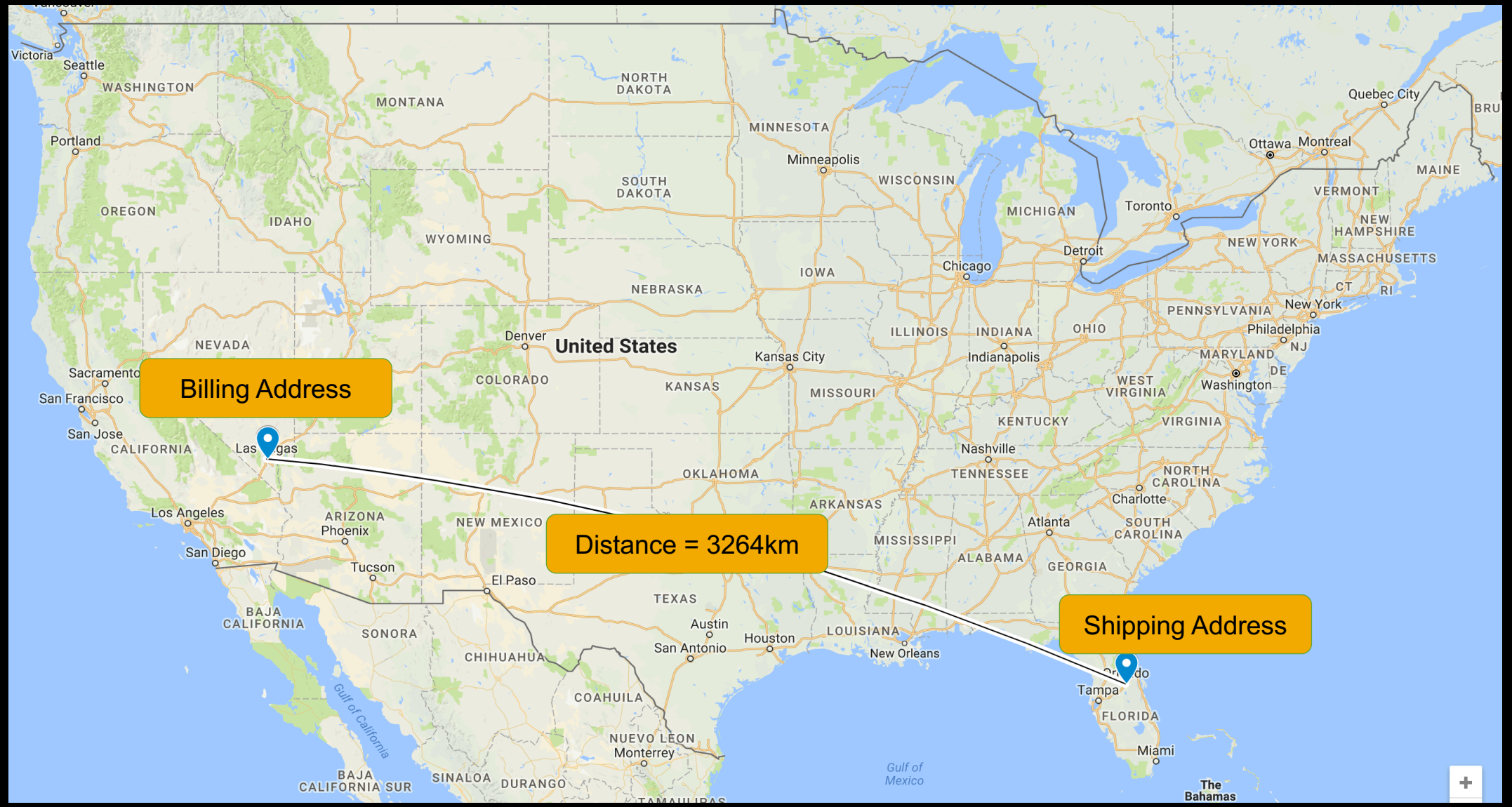
Email Domain Validation – Example

This Isn't the Email You're Looking For

```
LOOKUP-contact_email_domain = af_email_domain _key AS ContactEmailDomain OUTPUT
    BL_EmailDomain AS BL_ContactEmailDomain          # Blacklist flag
    FA_CB_EmailDomain AS FA_CB_ContactEmailDomain    # Previous chargeback
    WL_EmailDomain AS WL_ContactEmailDomain          # Whitelist flag
    FA_Email_Error AS FA_ContactEmail_Error          # DNS MX Error
    FA_Email_Invalid AS FA_ContactEmail_Invalid      # DNS MX Invalid
```

FA_ContactEmail_Error	1	
FA_ContactEmail_Invalid	1	

Geographic Distance – Billing vs. Shipping



Geographic Distance – Billing vs. Shipping

Configuration Details

props.conf:

```
[order]
# Normalize the postal codes to 5-digit numbers
EVAL-PrimaryAddressZip = replace(PrimaryAddressPostalCode, "^(\d{5}).*", "\1")
EVAL-ShipAddressZip = replace(ShipAddressPostalCode, "^(\d{5}).*", "\1")

# Perform a lookup against the zipcode table for latitutde/longitude
LOOKUP-primary_zip_geo = zipcode_geo Zipcode AS PrimaryAddressZip OUTPUTNEW Lat AS
PrimaryAddressZipLat Long AS PrimaryAddressZipLong
LOOKUP-ship_zip_geo = zipcode_geo Zipcode AS ShipAddressZip OUTPUTNEW Lat AS ShipAddressZipLat
Long AS ShipAddressZipLong
```

Search:

```
index=orders sourcetype=order
| `globedistance(AddressDistance, PrimaryAddressZipLat, PrimaryAddressZipLong,
ShipAddressZipLat, ShipAddressZipLong, "m", "0")`
| eval FA_ShipAddress_Far=if(AddressDistance>####, 1, 0)
```

Search-Time Risk Scoring

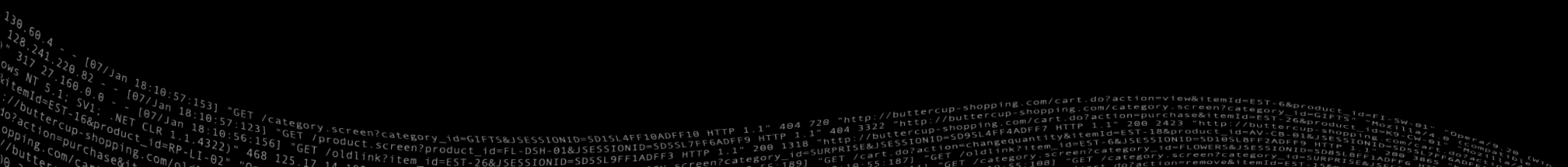
You can too, in 5 easy steps!

Create Attributes → Create Risk Scores Lookup → Import Scores into Search → Multiply Attributes (0|1) x Scores → Total All Scores

Create all Risk Attributes (calculated fields and/or lookups) to produce a Boolean value for each (0 or 1).

props.conf:

```
# Email Address does not include the Contact Name
EVAL-FA_Email_NotIncludes_Name = if(like(lower(Email), "%"+lower(FirstName)+"%") OR
    like(lower(Email), "%"+lower(LastName)+"%"), 0, 1)

# Credit card is blacklisted
LOOKUP-cc = cc _key AS CCNumber OUTPUT FA_BL_cc FA_CB_cc
```



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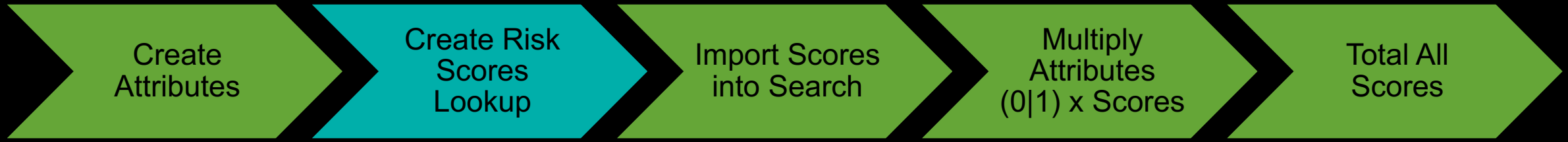
Search-Time Risk Scoring

You can too, in 5 easy steps!



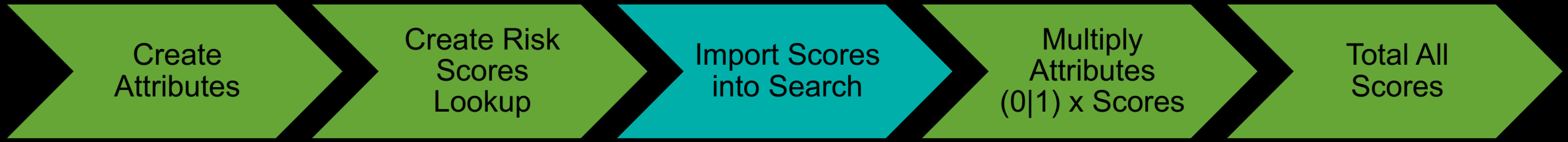
Each app has a different risk profile (per-attribute) for chargebacks. These scores are stored in a lookup.

Run a search to compute the probability for each attribute that it results in a chargeback. Split by application or business unit.

- **((#CB/#Non-CB)-1)*100**
- **-100 score = no (or negative) correlation. Normalize to 0**
- **Normalize to 0-100 range by adding the totals for each row and dividing each field by that total**
- **Output the results to a lookup**

Search-Time Risk Scoring

You can too, in 5 easy steps!



Run a search and reference the Risk Scores Lookup values for each attribute based on that business unit or application.

```
| lookup scores app AS app OUTPUT Score_FA_Email_NotIncludes_Name
Score_FA_CB_cc …
```

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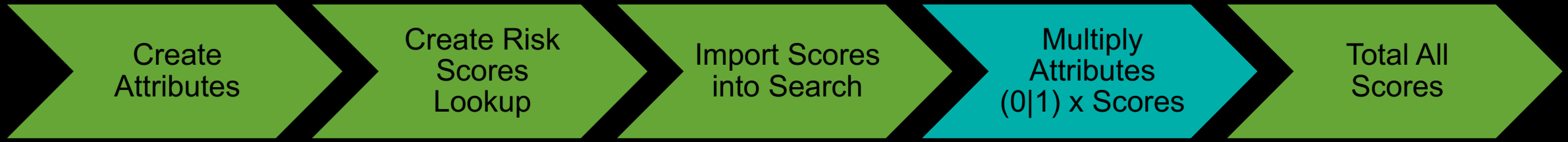
Search-Time Risk Scoring

You can too, in 5 easy steps!

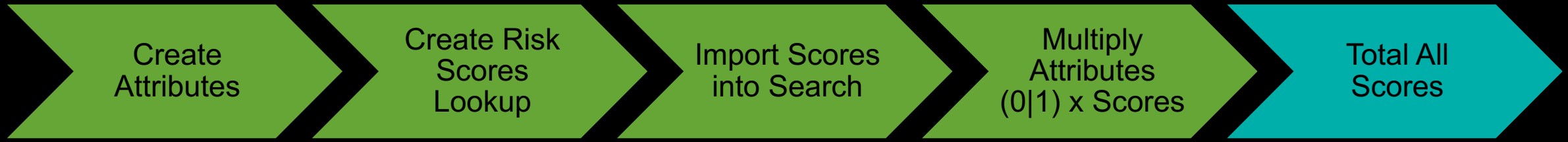


For each risk attribute, multiply the value of the attribute (0 or 1) by the Risk Score Lookup value.

```
| foreach Score_* [eval <<FIELD>>=FA_<<MATCHSTR>>*<<FIELD>>]
```

Search-Time Risk Scoring

You can too, in 5 easy steps!



Add all of the resulting values together for the Order Risk Score.

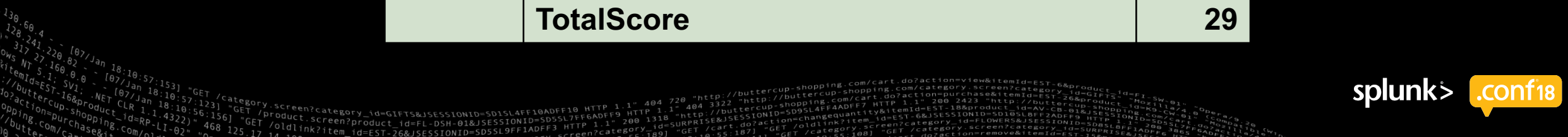
```
| eval TotalScore=0
| foreach Score_* [eval TotalScore=TotalScore+<<FIELD>>]
```

Search-Time Risk Scoring

Example Results

Order ID	App	FA_Example1	FA_Example2	Score_FA_Example1	Score_FA_Example2	Risk_Score
ABC1	ABC	0	1	20	30	30
ABC2	ABC	1	1	20	30	50
XYZ3	XYZ	1	0	5	60	5

Order ID	Field	Value
ABC1	Score_FA_Bill_Ship_State_Diff	10
	Score_FA_CB_cc	15
	Score_FA_ContactEmailDomain_4Levels	0
	Score_FA_Email_NotIncludes_Name	4
	Score_FA_Rush_Shipping	0
	Score_FA_ShipAddress_Far	0
	TotalScore	**29**



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Advanced Searches & Visualizations

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Recursive (Multi-Level) Search – Concept

How deep does the rabbit hole go?

Order IDs 1000-1002	
Customer ID	12345
Order Email	triples@graph.net
Payment Method	CC# XXXXXX…1554
Billing Address	22 Courtless Ln|99991
Shipping Address	5 Curve Cir|80808

Order ID 301	
Customer ID	12001
Order Email	cool@theschool.edu
Payment Method	CC# XXXXXX…9999
Billing Address	9 Bendy Way|19809
Shipping Address	5 Curve Cir|80808

Order ID 542	
Customer ID	8969
Order Email	cool@theschool.edu
Payment Method	CC# XXXXXX…3951
Billing Address	5720 Round Dr|80521
Shipping Address	6 Drive Pkwy|80808

Order IDs 806-807	
Customer ID	9111
Order Email	third@fourth.net
Payment Method	CC# XXXXXX…3951
Billing Address	5720 Round Dr|80521
Shipping Address	N/A

Recursive (Multi-Level) Search – Example

Configuration Details

Search:

```
| tstats summariesonly=t values(Orders.CCNumber) AS Orders.CCNumber … values([ all order fields]) AS
Orders.[fieldX] …
    from datamodel=Orders where $index$ Orders.SalesOrganization=$sales_org$
    [| tstats summariesonly=t values(Orders.CCNumber) AS Orders.CCNumber … values([ key fields only]) AS
Orders.[fieldX] from datamodel=Orders where $index$ Orders.SalesOrganization=$sales_org$
        [| tstats summariesonly=t values(Orders.CCNumber) AS Orders.CCNumber … values([ key fields only])
AS Orders.[fieldX] from datamodel=Orders where $index$ Orders.SalesOrganization=$sales_org$
            [ search $index$ eventtype=order SalesOrganization=$sales_org$ $base_search$
            | stats values(CCNumber) AS CCNumber  … values([ key fields only]) AS Orders.[fieldX]
            | fields CCNumber field1 field2 field3 field4
            | rename * AS Orders.*
            | format "(" "" "OR" "" "OR" ")"
            | fields search]
        | format "" "" "OR" "" "OR" ""]
    | format "" "" "OR" "" "OR" ""] by _time span=1s Orders.OrderID Orders.SalesOrganization
| `remove_dm_name(Orders)`
```

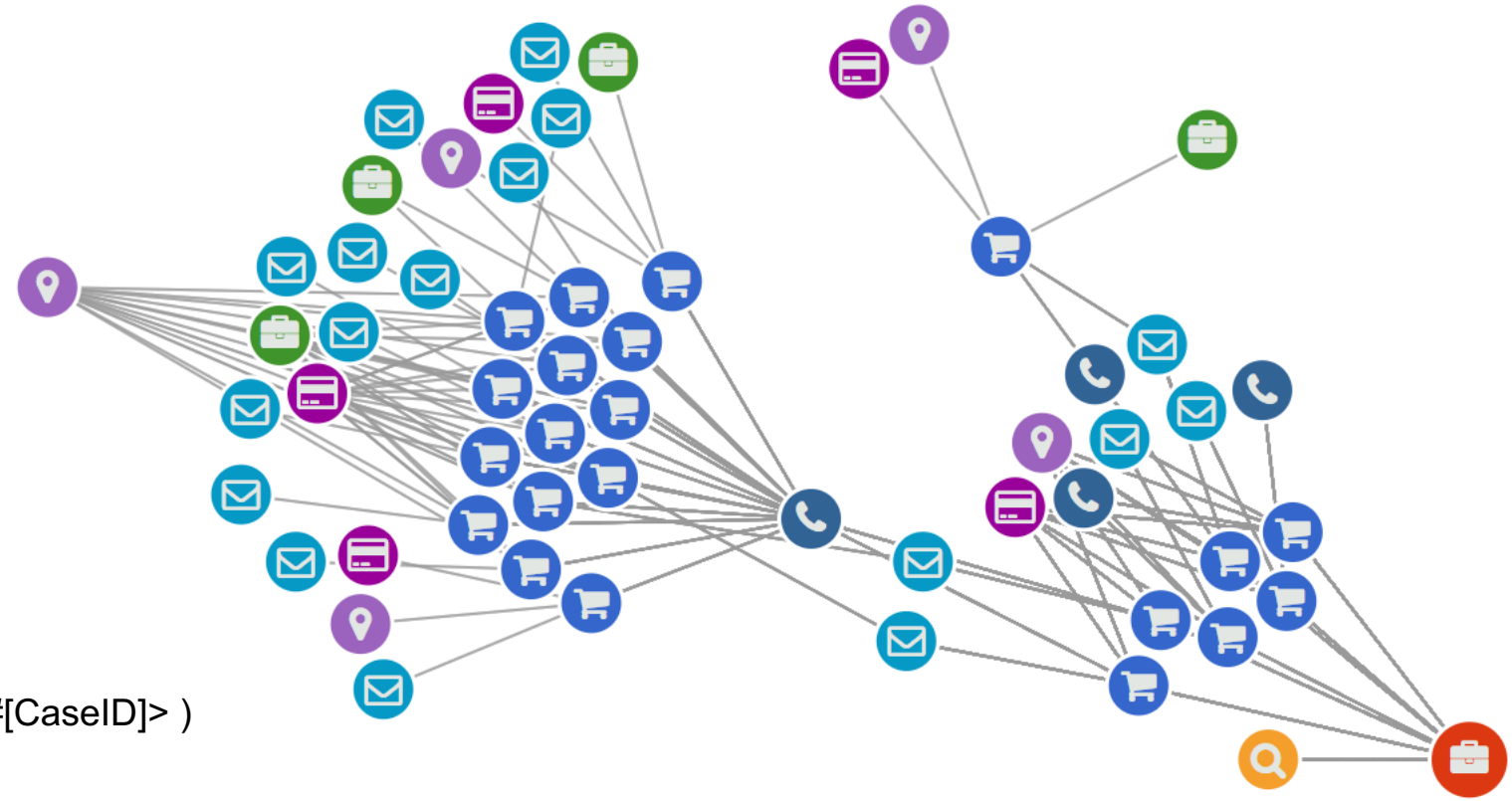
Level 1 Level 2 Level 3 Level 4 (Root Search)

Recursive (Multi-Level) Search – Graph Version

Splunk doesn't speak Graph (natively)

Search (Custom to RDF):

```
| triples query="SELECT * WHERE {
?s rdfs:label ?sLabel .
?s rdf:type ?sType .
?s ?p ?o .
?o rdfs:label ?oLabel .
?o rdf:type ?oType .
?o ?p2 ?o2 .
?o2 rdfs:label ?o2Label .
?o2 rdf:type ?o2Type .
?o2 ?p3 ?o3 .
?o3 rdfs:label ?o3Label .
?o3 rdf:type ?o3Type .
?o3 ?p4 ?o4 .
?o4 rdfs:label ?o4Label .
?o4 rdf:type ?o4Type .
FILTER (?s = <http://www.customer.com/ns/case#[CaseID]> )
}"
```



Predictive Analysis via Machine Learning

Using the Splunk Machine Learning Toolkit to Predict Chargeback Outcome

Prediction Results

BadOrder	predicted(BadOrder)	fs_SalesOrganization=	fs_SalesOrganization=	fs_SalesOrganization=	fs_SalesOrganization=	fs_SS_TotalAmount	fs_SalesOrganization=
Y	N	0.0	0.0	1.0	0.0	1.26011654042	
Y	N	0.0	0.0	1.0	0.0	0.99708302206	
Y	Y	0.0	0.0	1.0	0.0	3.73426686204	
Y	N	0.0	0.0	1.0	0.0	3.10915576648	
Y	N	0.0	0.0	1.0	0.0	1.09055236839	
Y	N	0.0	0.0	1.0	0.0	2.17186077063	
Y	N	0.0	0.0	1.0	0.0	0.297642426425	
Y	N	0.0	0.0	1.0	0.0	2.97554849011	
Y	N	0.0	0.0	1.0	0.0	0.987606010801	
Y	N	0.0	0.0	1.0	0.0	0.477984375963	

« prev 1 2 3 4 5 6 7 8 9 10 next »

Open in Search | Show SPL

Precision	Recall	Accuracy	F1
1.00	1.00	1.00	1.00

Open in Search | Show SPL

Classification Results (Confusion Matrix)

Predicted actual	Predicted N	Predicted Y
N	1337931 (99.8%)	3033 (0.2%)
Y	370 (92%)	32 (8%)

Open in Search | Show SPL

* Work-in-progress: Not yet operationalized

Machine Learning

Starter Guidelines for Implementation

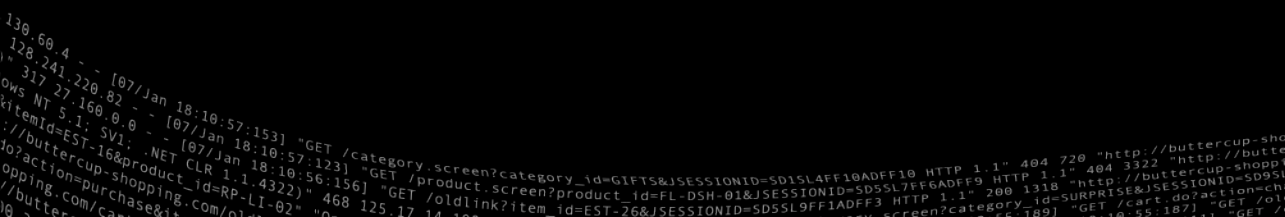
- Use Case = Predict Categorical Fields (i.e. Chargeback Y/N).
- Select or create Boolean or numeric metadata fields (like the risk attributes).
  - Starter apps for string field metadata ideas: URL Toolbox, DGA, Jellyfisher.
- Remove string fields with too many unique values (>150).
- Use fillnull for any fields that may have null values.
- Push numeric values through StandardScaler.
- Use FieldSelect to narrow down your fields.
- Start with tried & true, old-school LogisticRegression. Branch out from there to get more advanced.
- Increase limits in mlspl.conf.
  - Memory limits, categorical values, runtime, event count

Conclusion

Results

Did we make a dent?

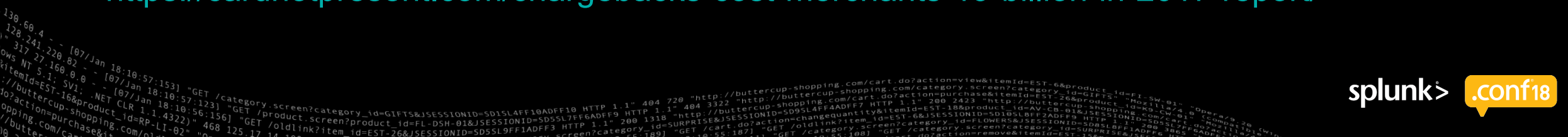
- Analyst time per incident was reduced by 50%.
  - More stopped shipments and payments
  - Reduced chargebacks by preventing charges to credit cards and banks
- Analyst team is able to identify/respond to new patterns within hours, instead of days or weeks
- Senior leadership reporting visibility for year-over-year performance is 100% improved
- Customer stakeholders have approved more investment in Splunk
- The work continues…



Additional Resources

- Gemini Data Web Site
  https://www.geminidata.com/
- Gemini Data on Twitter
  @geminidataco
- Gemini KV Store Tools App for Splunk
  https://splunkbase.splunk.com/app/3536/
- Gemini Data Quality App for Splunk
  https://splunkbase.splunk.com/app/3481/

- Chargebacks Cost Merchants $19 Billion in 2017: Report
  https://cardnotpresent.com/chargebacks-cost-merchants-19-billion-in-2017-report/



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Thank You

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