Cybersecurity
Secure the Vision

TIAA 100 YEARS

Threat Hunting through Data Mining and Analytics

Scott Rodgers & Joel Amick

October 2018

BUILT TO PERFORM.
CREATED TO SERVE.

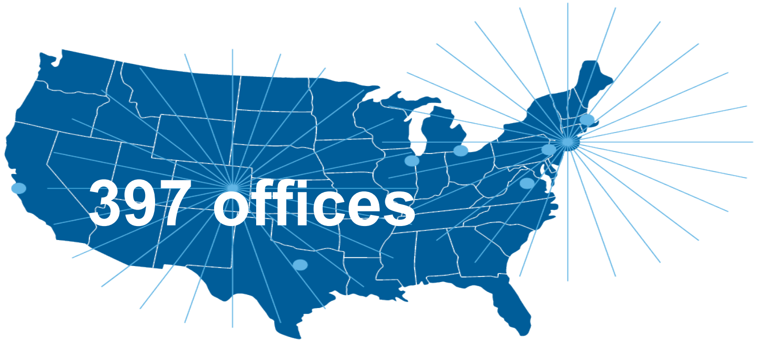
Who We Are

Joel Amick
Director
Cyber Analytics

Scott Rodgers
Sr. Info Security Analyst
Cyber Analytics

About TIAA

The vision of Andrew Carnegie



$1 trillion[1]
assets under management

over
17,500
employees[2]

Serving
5M
individuals

15,000
Institutions serviced by TIAA

1 As of 09.31.2017

What is Threat Hunting?

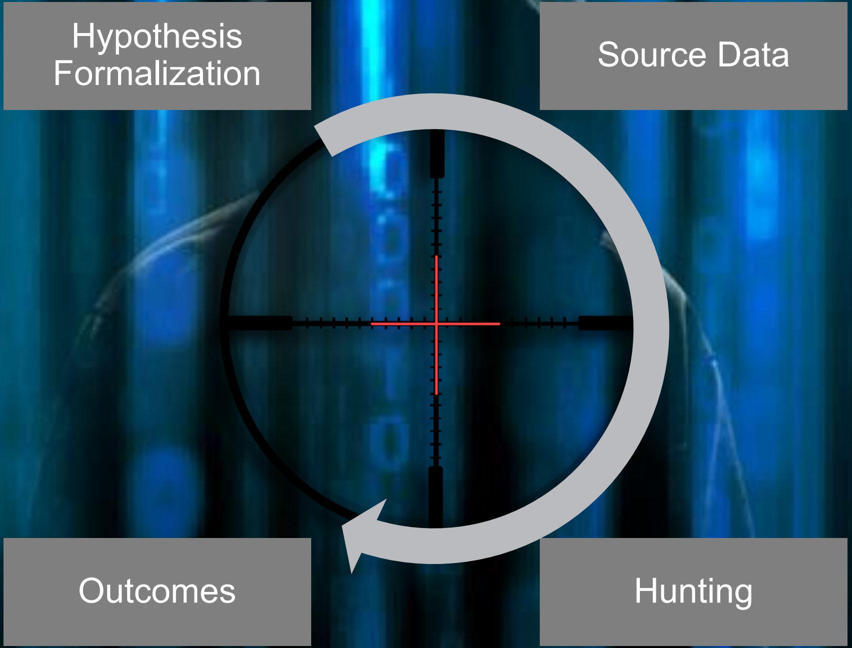
Threat Hunting is NOT:

- Using Static Tools/Black Boxes
- Reacting to a Dashboard or Console
- Monitoring Alerts
- A Single State

Threat Hunting IS:

- Proactive
- Hypothesis Based
- Timed
- Measureable
- Collaborative

Threat Hunting Framework Overview



Threat Hunting Framework
Pre-Hunt

Requirements

- Access to required data
- Adequate understanding of data and data correlation methods

Hypothesis Criteria

- Specific
- Provable/disprovable
- Does not necessarily need to be *if/then* scenario

Ethical Concerns

- Partner with Human Resources and Legal

Hypothesis Creation

Example of Poor Hypothesis

"We have web account registration fraud on our website."

Example of Good Hypothesis

"There is a statistically significant amount of web account registration fraud that can be identified by comparing IP geolocation and time zone."

Hunt Team

Data Scientist/Analyst

Statistical Background
Data Mining
Data Access

Cybersecurity Analyst/Investigator

Subject Matter Expert
Develop Hypotheses
Validating Results

Bad Actors

External Threat

Freddy Fraud gathers stolen identity data to try to register fraudulent accounts on various websites.

Freddy has recently discovered your organization and decides to try a cache of stolen identity on your organization's website.

Insider Threat

Ivy Insider works as a developer at your organization.
Recently, she was granted permissions that enables her to log on to any workstation and view the hard drive contents.

Ivy decides to seize this opportunity to log on to a number of executive machines to look for trade secret information to sell.

Hunt Walkthrough – External Threat

Target

Web Account Registration Fraud

Hypothesis

Mismatched attributes observed during web account registration have a statistically significant rate of fraud.

Source Data

Web Account Registration Data

Web Traffic Data

Participant Data

Hunt Steps

Identify Correlating Attributes

Join and Enrich Datasets

Create Additional Fields / Features

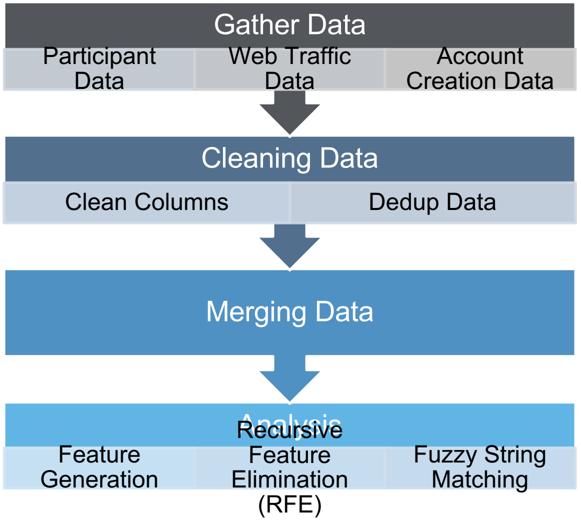
Outcomes

Actionable Intelligence

Rule Creation

Learning

Hunt Process



Hypothesis Formalization | **Source Data** | Hunting | Outcomes

Python Pseudo Code

```
## Read Participant CSV
part_data = pd.read_csv(file_path)

## Get Web Account Registration Data
conn = pyodbc.connect(connection_string)
sql = "Select * from db.account_creation"
acc_data = pd.read_sql(sql, conn)

## Drop Duplicates
acc_data = acc_data.drop_duplicates(subset="user_id" ,keep="first")

## Merge
merged_data = pd.merge(part_data, acc_data, left_index=True, right_index=True, sort=False)

## Calculate Fuzzy String Match Score
matched_data = check_matches(merged_data, merged_col_names)

## Save to CSV
matched_data.to_csv("Merged Data", index_label="user_id")
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Ref: https://pandas.pydata.org/

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```
## Calculate Fuzzy String Match Score
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```

```
## Calculate Fuzzy String Match Score
def check_matches(data, col_names):
    for combo in combinations(cols,2):
        compare_loop(Data, combo[0], combo[1])

def compare_loop(data, col1, col2):
    for index, row in Data.iterrows():
        fuzz.token_sort_ratio(row[col1], row[col2])
```

Ref: https://github.com/seatgeek/fuzzywuzzy

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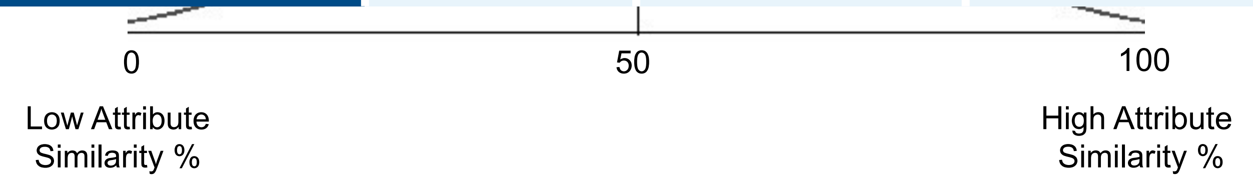
What Are We Looking For?

Customer Provided Email Domain	@zzz.zz	@TIAABank.org	@TIAA.org
Organization Provided Email Domain	@TIAA.org	@TIAA.org	@TIAA.org
Fuzzy String Match Percentage	14%	80%	100%



Hypothesis Formalization | **Source Data** | **Hunting** | **Outcomes**

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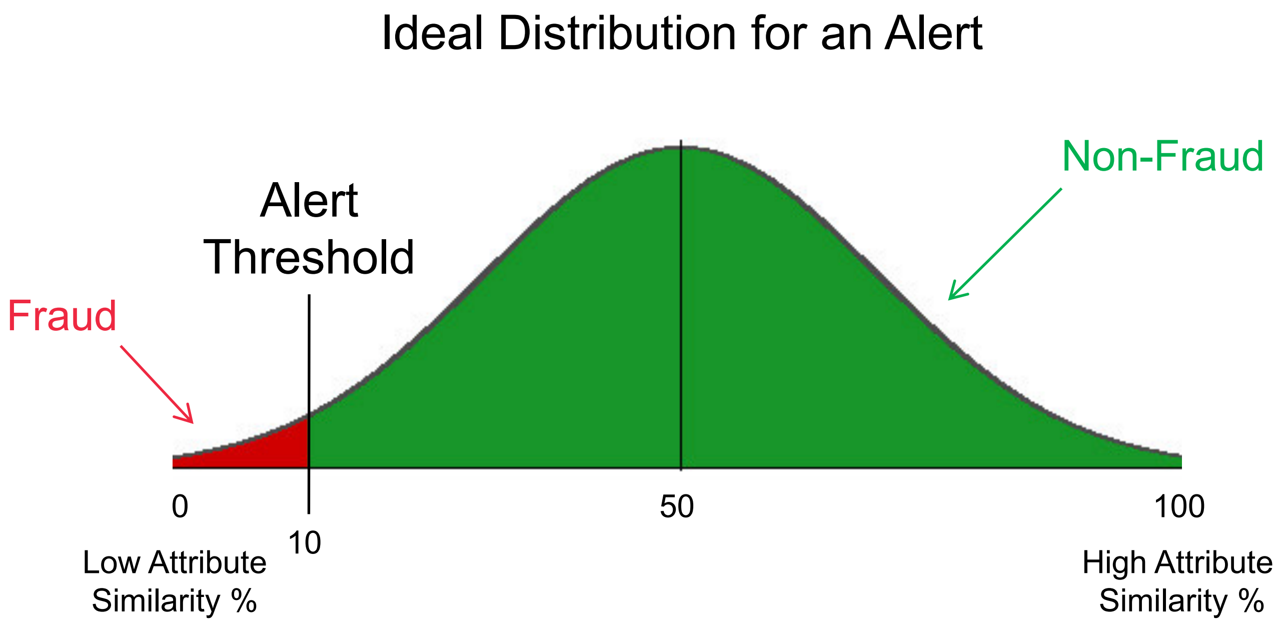
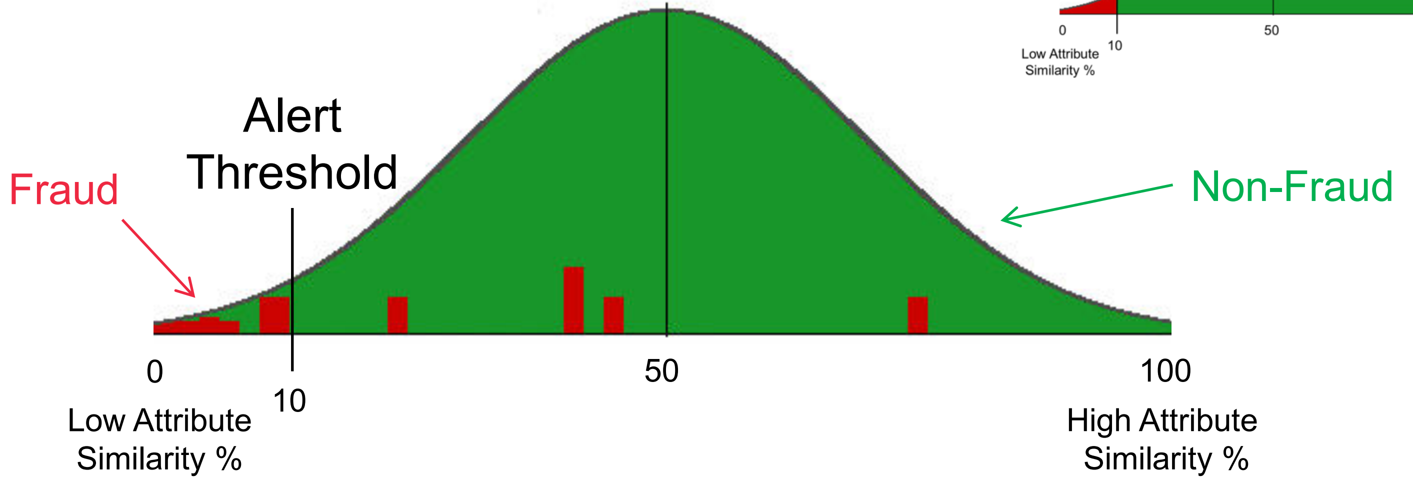
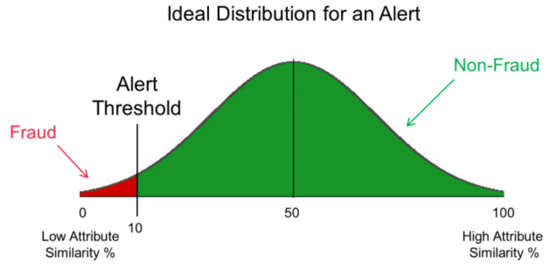


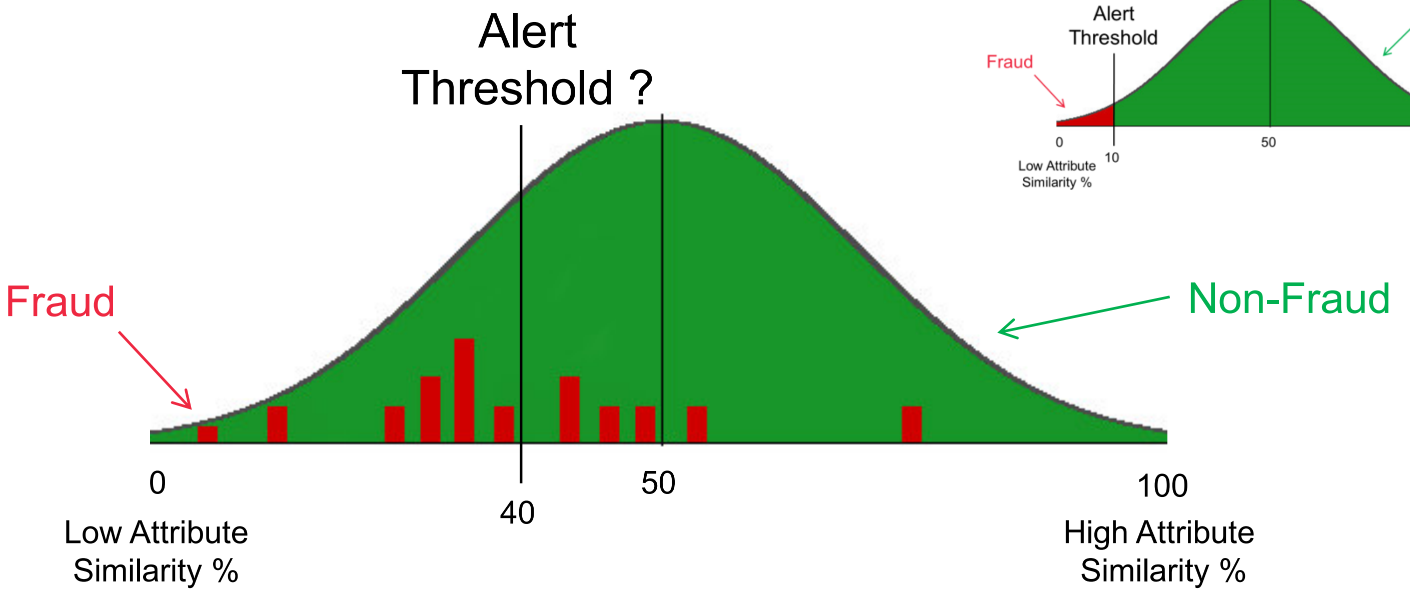
What Did We Find?

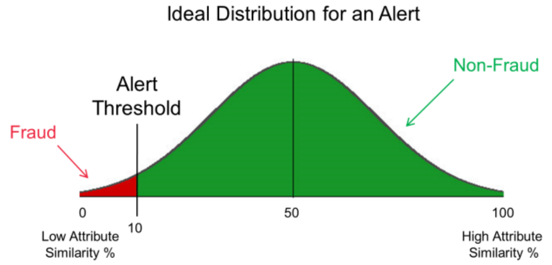
Fraud Identified





What Would a Bad Example Look Like?





External Threat Hunt Results

Hypothesis – Proven

- Mismatched attributes (Email Address Domain – Customer Organization Domain) observed during web account registration have a statistically significant rate of fraud.

Actionable Intelligence

- Additional fraudulent web account registration events identified by mismatched attributes.

Policy Issues Identified

- Why are users allowed to register a new web account with an email domain that does not match their organization?

Learning

- Hunters gained hands-on experience using and correlating web account registration data.

Hunt Walkthrough – Insider Threat

Target

Executive Computers

Hypothesis

Users with elevated permissions are accessing executive workstations without business justification.

Source Data

Windows Event Logs

Employee Titles

Workstation Data

Support Ticketing Data

Hunt Steps

Identify Correlating Attributes

Join and Enrich Datasets

Investigate Results

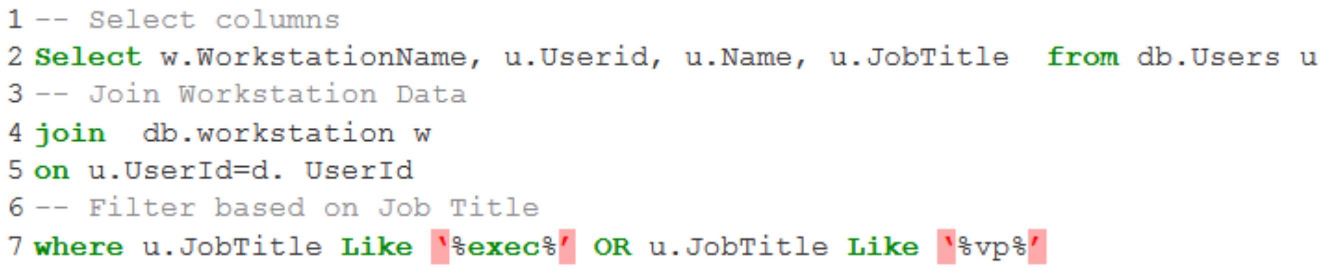
Outcomes

Report Actionable Intelligence

Identified Policy Issue

Developed Mitigating Alerting Strategy

Employee and Workstation Data



```
-- Select columns
Select w.WorkstationName, u.Userid, u.Name, u.JobTitle  from db.Users u
-- Join Workstation Data
join  db.workstation w
on u.UserId=d. UserId
-- Filter based on Job Title
where u.JobTitle Like ‘%exec%’ OR u.JobTitle Like ‘%vp%’
```

Workstation Name	User ID	Name	Job Title
exec-pc-001	exec001	Eric Exec	Executive
exec-pc-002	exec002	Eddie Exec	Executive
exec-pc-003	exec003	Erin Exec	Executive
vp-pc-005	vp005	Val VP	Vice President

Windows Event Log 4624 – Successful logon

```
An account was successfully logged on.

Subject:
    Security ID: SYSTEM
    Account Name: EXEC-PC-001$
    Account Domain: WORKGROUP
    Logon ID: 0x3E7

Logon Information:
    Logon Type: 3
    Restricted Admin Mode: -
    Virtual Account: No
    Elevated Token: No

Impersonation Level: Impersonation

New Logon:
    Security ID: AzureAD\exec001
    Account Name: exec001@org.com
    Account Domain: AzureAD
    Logon ID: 0xFD5113F
    Linked Logon ID: 0xFD5112A
    Network Account Name: -
    Network Account Domain: -
    Logon GUID: {00000000-0000-0000-0000-000000000000}

Process Information:
    Process ID: 0x30c
    Process Name: C:\Windows\System32\lsass.exe

Network Information:
    Workstation Name: EXEC-PC-001
    Source Network Address: -
    Source Port: -

Detailed Authentication Information:
    Logon Process: Negotiate
    Authentication Package: Negotiate
    Transited Services: -
    Package Name (NTLM only): -
    Key Length: 0
```

Fields used in hunt

Ref: https://www.ultimatewindowssecurity.com

Elastic Search Syntax

```
## Look for successful windows login events
eventtype=microsoft-windows-events AND eventcode=4624

## Filter logins to executive workstations
AND (workstation_name=exec-pc-* OR workstation_name=vp-pc-005)

## Aggregate login events by workstation
| stats count(EventCode) as “Login Count”, dc(Security_ID) as “User Count”, values(Security_ID) as
“Users”, values(Logon_Type) as “Logon Type” by workstation_name

## Only show workstations with more than 1 distinct user
| where “User Count” > 1
```

Elastic Search Results

Computer Name	User Count	Login Count	Users	Title	Logon Type	Logon Type Description
exec-pc-001	2	1	admin_ivy_insider	Developer	3	Network
		9	exec001	Executive	2	Interactive
exec-pc-002	2	2	admin_ivy_insider	Developer	3	Network
		38	Exec002	Executive	2	Interactive
exec-pc-003	3	1	admin_service_desk_ron	Sr. Desktop Support	10	Remote Interactive
		2	service_desk_elliot	Desktop Support	10	Remote Interactive
		15	exec003	Executive	2	Interactive
vp-pc-005	2	2	service_desk_elliot	Desktop Support	10	Remote Interactive
		23	vp005	Vice President	2	Interactive

Actionable Intelligence

Insider Threat Hunt Results

Hypothesis – Proven

- Users with elevated permissions are accessing executive workstations without business justification.

Actionable Intelligence

- User Ivy Insider abusing privileges and logging into executive systems.

Policy Issues Identified

- Is least privilege being applied to user permissions?

Learning

- Correlated disparate data & built understanding of data

Hypothesis Formalization	Source Data	Hunting	**Outcomes**

Hunt Ideas

External Threat

- Web Account Creation
  - Web Channel
  - Phone Channel
- Account Takeover
- Cross-Channel Fraud
- One Time Pin (OTP) Abuse

Insider Threat

- Unapproved or Portable Applications
- Personal VPN Clients to avoid Data Loss Prevention Tools
- File Sharing
- Remote Desktop / Access Tools

Key Takeaways

Delivering Actionable Intelligence

Validating Investigators Hypotheses

Iterating with Investigators to Improve

Driving Policy Changes

Proactive vs Reactive

Q&A

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