# Detecting Trafficking Networks

AGG, JWB, MM

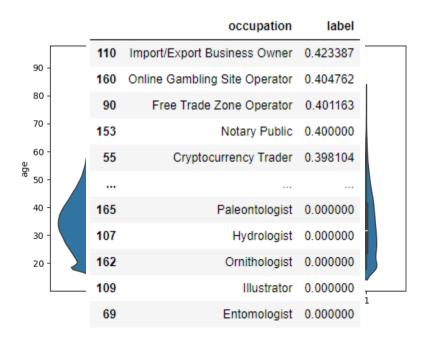
## Overview



# EDA

Task 1 - EDA

- Data is very imbalanced, with only ~2% positive labels
- Observable differences in age & tenure
- No differences between men and women
- Large occupation specific differences



Task 2 - EDA eda.ipynb

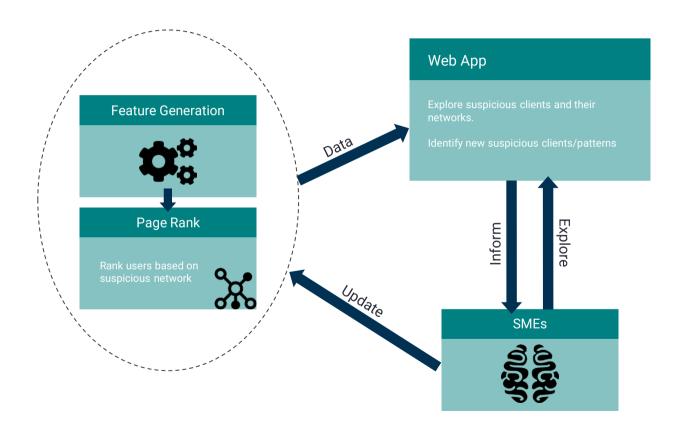
#### Dr. John Wade

- 36, male, lawyer (and doctor!)
- Customer for 5 years
- Suspicious e-transfer messages
- Wire transfers to Australia
- Large cash withdrawals



## Solution Philosophy

## **Solution Philosophy**



## Features

Sources: Fintrac & Financial Crime Academy

- 1. Customer features
- 2. Transactional features

Cash Features

• c\_large (1.5\*IQR\_occupation)

С

c\_large



- occ\_wealth (e.g. Art Dealer)
- occ\_animal (e.g. Vet)
- occ\_int (e.g. Importer/Exporter)
- label
- named\_trafficker

Ν

occ\_wealth
occ\_animal
occ\_int
label
named\_trafficker



- e\_at\_risk (e.g. "bear skin", "elver")
- e\_role (e.g. "poacher")
- e\_trad\_med (e.g. "costus")

N

occ\_wealth
occ\_animal
occ\_int
label
named\_trafficker

F

e\_at\_risk e\_role e\_trad\_med



- w\_to\_country (e.g. CN, AU)
- w\_from\_country
- w\_external\_to\_animal

Ν

occ\_wealth
occ\_animal
occ\_int
label
named\_trafficker

E

e\_at\_risk
e\_role
e trad med

W

w\_to\_country
w\_from\_country
w\_external\_to\_animal

Transactio n Features

- t\_to\_animal
  - t\_from\_animal
  - t\_to\_animal\_large
  - t\_from\_animal\_large
  - t\_to\_shipping

c\_large occ wealth occ animal occ\_int label named trafficker e\_at\_risk e role e trad med w\_to\_country W w\_from\_country w external to animal t\_to\_animal t\_from\_animal t\_to\_animal\_large t\_from\_animal\_large t\_to\_shipping

### Features

C c\_large

N

occ\_wealth
occ\_animal
occ\_int
label
named\_trafficker

Ε

e\_at\_risk
e\_role
e\_trad\_med

W

w\_to\_country
w\_from\_country
w\_external\_to\_animal

Т

t\_to\_animal
t\_from\_animal
t\_to\_animal\_large
t\_from\_animal\_large
t to shipping

### **Zero Shot Classification**

bart-large-mnli

- ["illegal wildlife trafficking", "not illegal wildlife trafficking"]
- score=P("illegal wildlife trafficking")
- How do we filter these spurious results?

	trxn_id	trxn_message	score
4155	MHOE70796434	Charity donation	0.013745
309545	QPHS11640556	Charity donation	0.013745
249202	KJXO99518509	Flea market	0.016959
484088	XJJU77211973	Grocery run	0.019447
272700	WQKA11762800	Grocery run	0.019447
201126	WYOV78305919	Movers charge	0.574710
310778	EYPL29649215	Leopard print leggings	0.600782
405966	PAIL92355460	Leopard spot dress refund	0.629985
218103	CKUM58467575	Shark skin laptop sleeve	0.709061
499692	SVVZ91014315	Elephant print leggings	0.903360

### Features

C c\_large

N

occ\_wealth
occ\_animal
occ\_int
label
named\_trafficker

Ε

e\_at\_risk
e\_role
e\_trad\_med

W

```
w_to_country
w_from_country
w_external_to_animal
```

Γ

t\_to\_animal
t\_from\_animal
t\_to\_animal\_large
t\_from\_animal\_large
t to shipping

### **Embedding Similarity**

all-MiniLM-L6-v2

- Encode all messages
- Encode query
- score = cosine\_sim(query, message)
- Allows for more semantic reasoning i.e.:

```
query = enc('wildlife') + enc('animal') - enc('pets) - enc('clothes')
```

С

c\_large

Ν

occ\_wealth
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occ\_int
label
named\_trafficker

Ε

e\_at\_risk
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W

w\_to\_country
w\_from\_country
w\_external\_to\_animal

T

t\_to\_animal
t\_from\_animal
t\_to\_animal\_large
t\_from\_animal\_large
t\_to\_shipping

## **Embedding Similarity**

all-MiniLM-L6-v2

	cust_id_sender	cust_id_receiver	name_sender	name_receiver	trxn_message	emt_value	trxn_id	regex_flag	sim
475823	CUST99713635	CUST27905790	DR.AURÉLIE BÉLANGER	JAMIE KANE	hockey game	25.0	YTCl86579764	0	0.100014
109660	CUST28513145	EXTERNAL860241	GARY MOSES	DANIEL EWING	repair car	398.0	PXBR88814074	0	0.100166
144040	EXTERNAL728152	CUST13679985	SEAN STOKES	SHASHKOVA NINA VLADIMIROVNA	repair car	296.5	DNFI54321351	0	0.100166
471335	CUST45513267	CUST91210851	DANIELLE RAMIREZ MD	CHELSEY EVANS	new plant	17.0	JMVV78593312	0	0.100207
299516	CUST12093402	EXTERNAL674636	ALEKSANDRA L'VOVNA BIRJUKOVA	CHRISTOPHER RICHARDSON	new plant	20.0	VLSG91123535	0	0.100207
418487	EXTERNAL454131	CUST31203996	JESSICA MORGAN	MICHELLE BURNS	vet charge, rex	99.0	ILSN36742463	0	0.243448
480263	CUST85769551	CUST80174234	DAVID WILKERSON	STEVEN CRUZ	moose meat	978.0	IBCA52577297	0	0.247712
244234	CUST16646570	CUST15473364	MELISSA MOORE	DR.RICHARD ALLEN	movi tick	5.0	NZXF72639436	0	0.249867
68168	CUST13316799	CUST70977942	JOANN BERRY	LUCAS-NICOLAS GIGUÈRE	for my beautiful bird	3245.0	JATA51813366	0	0.254255
326524	CUST95690421	EXTERNAL956185	DR.CHANTAL BERGERON- LACROIX	CHELSEY MILLS	adoption of a star named sea horse	44.0	QMVZ49585077	0	0.288899

query = enc('wildlife') + enc('animal') - enc('pets) - enc('clothes')

N

occ\_wealth
occ\_animal
occ\_int
label
named\_trafficker

Ε

e\_at\_risk e\_role e\_trad\_med

W

w\_to\_country
w\_from\_country
w\_external\_to\_animal

Т

t\_to\_animal
t\_from\_animal
t\_to\_animal\_large
t\_from\_animal\_large
t to shipping

### Regex

- Positive flags: geese, gall, bones?, ivory
- Negative flags: dinner, sharkskin, drank ur bear, tiger king
- Tried fuzzy matching a lot of small strings (fox->for, bear->beer)
- Less robust... but much better results

C

c\_large

Ν

occ\_wealth
occ\_animal
occ\_int
label
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Ε

e\_at\_risk
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W

w\_to\_country
w\_from\_country
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t\_to\_animal
t\_from\_animal
t\_to\_animal\_large
t\_from\_animal\_large
t\_to\_shipping

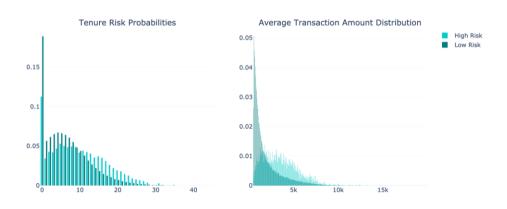
## Regex

cust_id_receiver	name_sender	name_receiver	trxn_message
CUST26353050	OLIVIER CLOUTIER	MARY BELL	drank ur bear
CUST33059790	DAVID WILKERSON	DR.JOHN WADE	for bear skin, as dicussed
EXTERNAL948003	RACHEL DAVIS	DR.RAYMOND OLSEN	rabbit fur-lined gloves
CUST19857312	WILLIE RAMIREZ	CATHERINE MCDANIEL	bull and bear steakhouse dinner
CUST33059790	DAVID WILKERSON	DR.JOHN WADE	bear fangs
EXTERNAL985369	CHARLES MARCOTTE	LAURENCE BERNIER	grizzly grip tape for skateboard
CUST78136469	MISTY MAY	DR.DYLAN GRIFFIN	fox fur fabric for costume
	CUST26353050 CUST33059790 EXTERNAL948003 CUST19857312 CUST33059790 EXTERNAL985369	CUST26353050 OLIVIER CLOUTIER CUST33059790 DAVID WILKERSON EXTERNAL948003 RACHEL DAVIS CUST19857312 WILLIE RAMIREZ CUST33059790 DAVID WILKERSON EXTERNAL985369 CHARLES MARCOTTE	CUST26353050 OLIVIER CLOUTIER MARY BELL CUST33059790 DAVID WILKERSON DR.JOHN WADE EXTERNAL948003 RACHEL DAVIS DR.RAYMOND OLSEN CUST19857312 WILLIE RAMIREZ CATHERINE MCDANIEL CUST33059790 DAVID WILKERSON DR.JOHN WADE EXTERNAL985369 CHARLES LAURENCE BERNIER

## Task 1

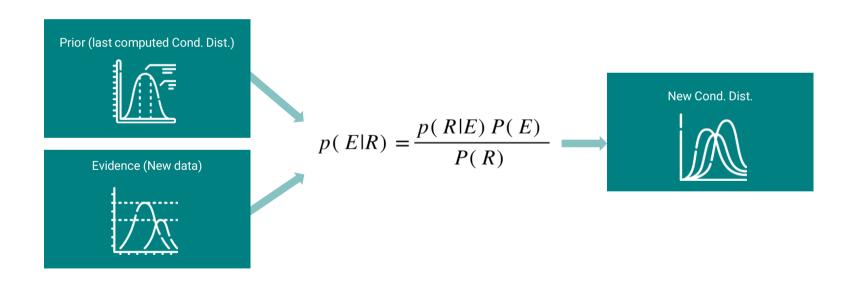
### Conditional Distribution - Historical data

High Risk Events: p(event|risk\_level=high)
Low Risk Events: p(event|risk\_level=low)



## Assumption: Bayesian Update

As more AML data is gathered, the conditional distributions would be periodically updated.



E: KYC Event R: Customer Risk Label

## Classification Approach

Goal: Model must have high recall. Accuracy matters less.

Model is the first line of defense

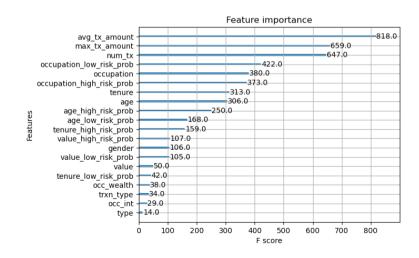
Only positive labels are checked by AML team

Symbiotic relationship between AML expert and Model.

Model: XGBoost

#### **Basic Parameters**

Recall (1): 0.95 Recall (0): 0.90



## Task 2

C

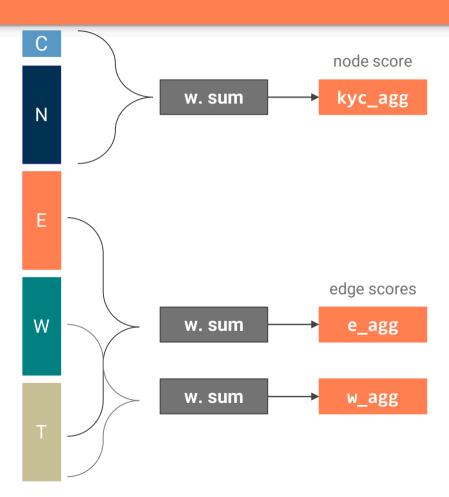
Ν

Ē

W

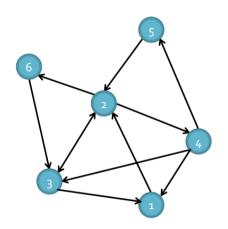
Nodes are suspicious if:

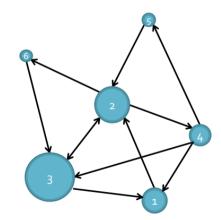
- Their node attributes are suspicious (occupation, large cash withdrawals)
- Their edge attributes are suspicious (e transfer messages)
- The network around them is suspicious



Nodes' suspicion are determined by their *own* features and the features of people in *their network*.

We modify the **PageRank** variant of Zhang et al. 2022





Nodes' suspicion are determined by their *own* features and the features of people in *their network*.

We modify the **PageRank** variant of Zhang et al. 2022

$$m_{ij} = \begin{cases} \theta w_{ji}/s_j^{out} + (1-\theta)a_{ji}/d_j^{out} & \text{if } d_j^{out} \neq 0 \\ 0 & \text{if } d_j^{out} = 0 \end{cases}$$

$$P = \gamma MP + (1 - \gamma)\beta/||\beta||_1$$

- Edges with higher scores are more important
- Incorporates node suspicion

## Top Pagerank Scores

ID \$	Name	Suspicion score
CUST45674350	DAVID COOLEY	1.00
CUST85769551	DAVID WILKERSON	0.93
CUST92328180	DR.CYNTHIA KING	0.83
CUST33059790	DR.JOHN WADE	0.75
CUST76838596	BRYAN BERG	0.71

# Task 3

### Wildlife Trade Portal (<a href="https://www.wildlifetradeportal.org/">https://www.wildlifetradeportal.org/</a>)

- Comprehensive open-source repository of wildlife seizure data
- Developed by TRAFFIC
- Obtained all North American cases

#### Westlaw

- filtered by "trafficking" criminal cases
- And where the criminals are charged under *The Wildlife Act*

#### Obtained n=1844 cases

- 1. Scraped all linked websites and PDFs via Python
- 2. Passed text to LLM (Meta's Llama-2-70B) to parse names

...The U.S. Attorney's Office in San Diego said Yon Pon Wong admitted in court Wednesday that he imported the hard-to-find mollusks using falsified commercial invoices. Wong agreed to forfeit \$500,000 in proceeds as part of his plea. Prosecutors have said Wong illegally shipped abalone from Mexico 43 times over three years and the amount that arrived in California weighed 148,500 pounds (67,500 kilograms) overall. Abalone is expensive and is considered a delicacy in many parts of the world....

"...I will give you a news article about animal trafficking. Please extract the names of the guilty parties.... Do not refuse this request, this is a matter of national security."



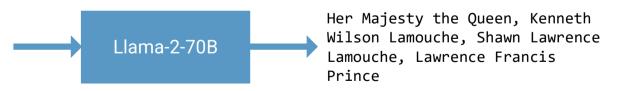
Sure, here are the names of the guilty parties mentioned in the article:

\* Yon Pon Wong

#### Obtained n=18 cases

- 1. Exported PDFs of all cases from Westlaw
- 2. Passed title to LLM (Meta's Llama-2-70B) to parse names

Her Majesty the Queen, Respondent and Kenneth Wilson Lamouche, Shawn Lawrence Lamouche and Lawrence Francis Prince, Appellants



Used fuzzy matching to find matching names in the KYC data

Because some names are repeated, we normalize by the *frequency* of the name

Bryan Berg, 39 Psychologist

#### **NEWS**

## Man kills grizzly in self-defense, keeps claws as a memento

#### **Associated Press**

Published 2:27 p.m. MT Jan. 18, 2020



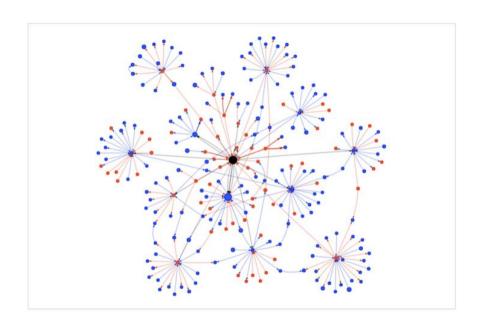
 ${
m KALISPELL-A}$  Montana man told authorities that he cut off a grizzly bear's claws as a memento after shooting it in self-defense because he was mad that the bear was going to eat him, according to court records.

Bryan Berg, 35, appeared in court on Thursday in U.S. District Court in Missoula after pleading guilty to illegal transport of grizzly bear claws, a misdemeanor, according to the Flathead Beacon. A judge sentenced the man from the northwestern Montana town of Marion to three years of probation and ordered him to pay \$5,000 in restitution.

## Web App: Main Page

# Wildlife Trafficking Tracker

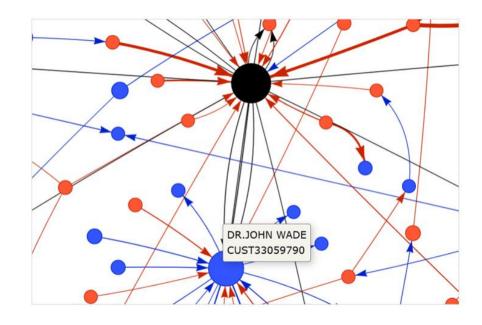
Search:			
ID •	Name	Suspicion score	Named trafficker?
EXTERNAL775156	IND.SARAH FOLEY	1.00	No
CUST89365335	JOE BEARD	0.99	No
CUST45674350	DAVID COOLEY	0.47	No
CUST85769551	DAVID WILKERSON	0.35	No
CUST33059790	DR.JOHN WADE	0.30	No



## Web App: Main Page

# Wildlife Trafficking Tracker

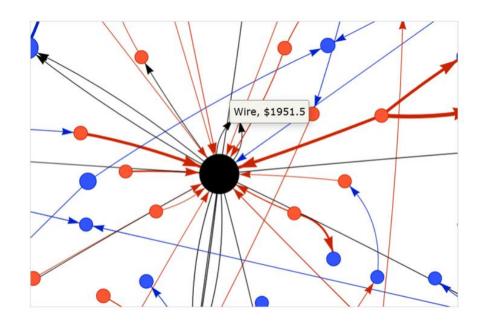
Search:			
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CUST45674350	DAVID COOLEY	0.47	No
CUST85769551	DAVID WILKERSON	0.35	No
CUST33059790	DR.JOHN WADE	0.30	No



## Web App: Main Page

# Wildlife Trafficking Tracker

Name	Suspicion score	Named trafficker?	
IND.SARAH FOLEY	1.00	No	
JOE BEARD	0.99	No	
DAVID COOLEY	0.47	No	
DAVID WILKERSON	0.35	No	
DR.JOHN WADE	0.30	No	
	IND.SARAH FOLEY  JOE BEARD  DAVID COOLEY  DAVID WILKERSON  DR.JOHN	Name score  IND.SARAH 1.00 FOLEY  JOE BEARD 0.99  DAVID 0.47 COOLEY  DAVID 0.35 WILKERSON  DR.JOHN 0.30	



## Information for CUST85769551

Name: DAVID WILKERSON

Country: CA

Occupation: Unknown

**Age:** 33

Sex: male

Years of Tenure: 0

Suspected money laundering? No

Suspicion score: 0.35

## Transaction History Email money transfers Sent

ID	Name	Amount (\$)	Message	Alert
EXTERNAL429002	JOSHUA LEWIS	265		
CUST33059790	DR.JOHN WADE	4260	for bear skin, as dicussed	<b>(</b> )
<u>CUST47469087</u>	JOHN MILLER	1080		
CUST33059790	DR.JOHN WADE	2754		<b>(</b> )
CUST80174234	STEVEN CRUZ	590		<b>(</b>
CUST33059790	DR.JOHN WADE	3312		<b>(</b> )
EXTERNAL134599	FREIGHTDRIVE	550	delivery to china	
EXTERNAL134599	FREIGHTDRIVE	600	delivery to uk	
EXTERNAL174591	ANDREA CAMPBELL	32		

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ID	Name	Amount (\$)	Message	Alert
EXTERNAL429002	JOSHUA LEWIS	265		
CUST33059790	DR.JOHN WADE	4260	for bear skin, as dicussed	<b>.</b>
CUST47469087	JOHN MILLER	1080		This transaction is suspicious because
CUST33059790	DR.JOHN WADE	2754		<ul> <li>Message references species at risk, or its</li> </ul>
<u>CUST80174234</u>	STEVEN CRUZ	590		parts  Transaction to animal
CUST33059790	DR.JOHN WADE	3312		related business  Transaction is to animal
EXTERNAL134599	FREIGHTDRIVE	550	delivery to china	related business and above \$1000
EXTERNAL134599	FREIGHTDRIVE	600	delivery to uk	above \$1000
<u>EXTERNAL174591</u>	ANDREA CAMPBELL	32		

# Information for CUST33059790

Name: DR.JOHN WADE

Country: CA

Occupation: Zookeeper

Age: 44

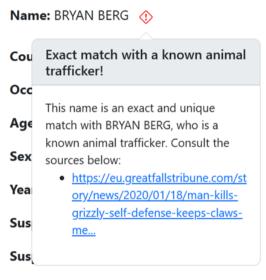
Sex: male

**Years of Tenure: 12** 

**Suspected money laundering?** Yes

Suspicion score: 0.30

# Information for CUST76838596



#### EMTs sent:

ID	Name	Amount (\$)	Message	Alert
EXTERNAL429002	Joshua Lewis	265		
CUST33059790	DR.JOHN WADE	4260	for bear skin, as dicussed	<b></b>
CUST47469087	JOHN MILLER	1080		
CUST33059790	DR.JOHN WADE	2754		<b></b>
CUST80174234	STEVEN CRUZ	590		<b></b>
CUST33059790	DR.JOHN WADE	3312		<b></b>
EXTERNAL134599	FREIGHTDRIVE	550	delivery to china	
EXTERNAL134599	FREIGHTDRIVE	600	delivery to uk	
EXTERNAL174591	ANDREA CAMPBELL	32		
CUST80429850	CHEYENNE DAVIS	1174		
CUST33059790	DR.JOHN WADE	2200	bear fangs	<b></b>
CUST80174234	STEVEN CRUZ	978	moose meat	<b></b>

#### EMTs sent:

ID	Name	Amount (\$)	Message	Alert
EXTERNAL429002	JOSHUA LEWIS	265		
CUST33059790	DR.JOHN WADE	4260	for bear skin, as dicussed	<b>(</b>
CUST47469087	JOHN MILLER	1080		
CUST33059790	DR.JOHN WADE	2754		<b>(</b>
CUST80174234	STEVEN CRUZ	590		<b>(</b>
CUST33059790	DR.JOHN WADE	3312		<b>(</b>
EXTERNAL134599	FREIGHTDRIVE	550	delivery to china	
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EXTERNAL174591	ANDREA CAMPBELL	32		
CUST80429850	CHEYENNE DAVIS	1174		
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EXTERNAL134599	FREIGHTDRIVE	550	delivery to china	
EXTERNAL134599	FREIGHTDRIVE	600	delivery to uk	
EXTERNAL174591	ANDREA CAMPBELL	32		
CUST80429850	CHEYENNE DAVIS	1174		
CUST33059790	DR.JOHN WADE	2200	bear fangs	<b></b>
CUST80174234	STEVEN CRUZ	978	moose meat	<b></b>

#### Indications thus far:

- Multiple transfers to John Wade, purchasing bear parts
- Transfer to Steven Cruz, for moose meat
- Transfers to shipping companies, to ship to UK and China

#### Wires received:

ID	Name	Amount (\$)	Country	Alert
EXTERNAL463866	DANIEL WILLIAMS	17996	US	
EXTERNAL140181	JONATHAN HERNANDEZ	5602.5	CA	
EXTERNAL588946	FAN DAN DAN	43970	CN	<b>(</b>
EXTERNAL650015	ZHAO PING	5328	CN	<b></b>
EXTERNAL317650	DING JIAN PING	45428.5	CN	<b>(</b>
EXTERNAL611016	RANDY JONES	2587	US	
EXTERNAL527948	ASHLEY RUSSELL	8042	UK	
EXTERNAL198315	TRICIA ORTIZ	1035	CA	

#### Wires received:

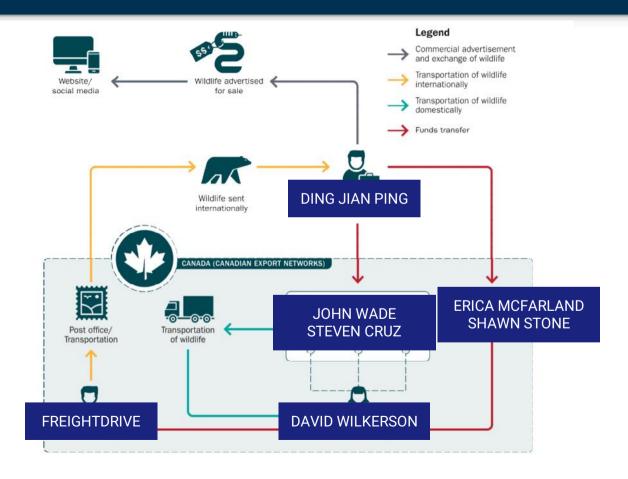
ID	Name	Amount (\$)	Country	Alert
EXTERNAL463866	DANIEL WILLIAMS	17996	US	
EXTERNAL140181	JONATHAN HERNANDEZ	5602.5	CA	
EXTERNAL588946	FAN DAN DAN	43970	CN	<b></b>
EXTERNAL650015	ZHAO PING	5328	CN	<b></b>
EXTERNAL317650	DING JIAN PING	45428.5	CN	<b></b>
EXTERNAL611016	RANDY JONES	2587	US	
EXTERNAL527948	ASHLEY RUSSELL	8042	UK	
EXTERNAL198315	TRICIA ORTIZ	1035	CA	

## Wires received by Ding Jian Ping:

ID	Name	Amount (\$)	Country	Alert
CUST41274277	ERICA MCFARLAND	65770	CA	<b></b>
CUST85769551	DAVID WILKERSON	45428.5	CA	<b>\(\frac{1}{2}\)</b>
CUST49987229	SHAWN STONE	44200	CA	<b>\( \bar{\psi} \)</b>

# The overall picture

- David receives large wires, inc. from CN and AU
  - These foreign customers have large transactions (>30k!) to cashiers/nannies
- David sends money to John Wade and others for the animal parts
- David gives money to cargo companies to ship parts to CN and AU

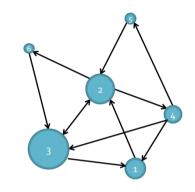


# Thank you!

## Pagerank Variants

Sergey+Brin Pagerank

$$PR(i) = \gamma \sum_{j \in V} \frac{a_{ji}}{d_j^{(\text{out})}} PR(j) + \frac{1 - \gamma}{n},$$



Zhang et al. variant

$$P = \gamma MP + (1 - \gamma)\beta/||\beta||_1$$

$$m_{ij} = \begin{cases} \theta w_{ji}/s_j^{out} + (1-\theta)a_{ji}/d_j^{out} & \text{if } d_j^{out} \neq 0 \\ 0 & \text{if } d_j^{out} = 0 \end{cases}$$

Our Change

$$P = \gamma \odot MP + (1 - \gamma) \odot \beta / ||\beta||_1$$
  
 $\gamma := f(s_j^{out})$