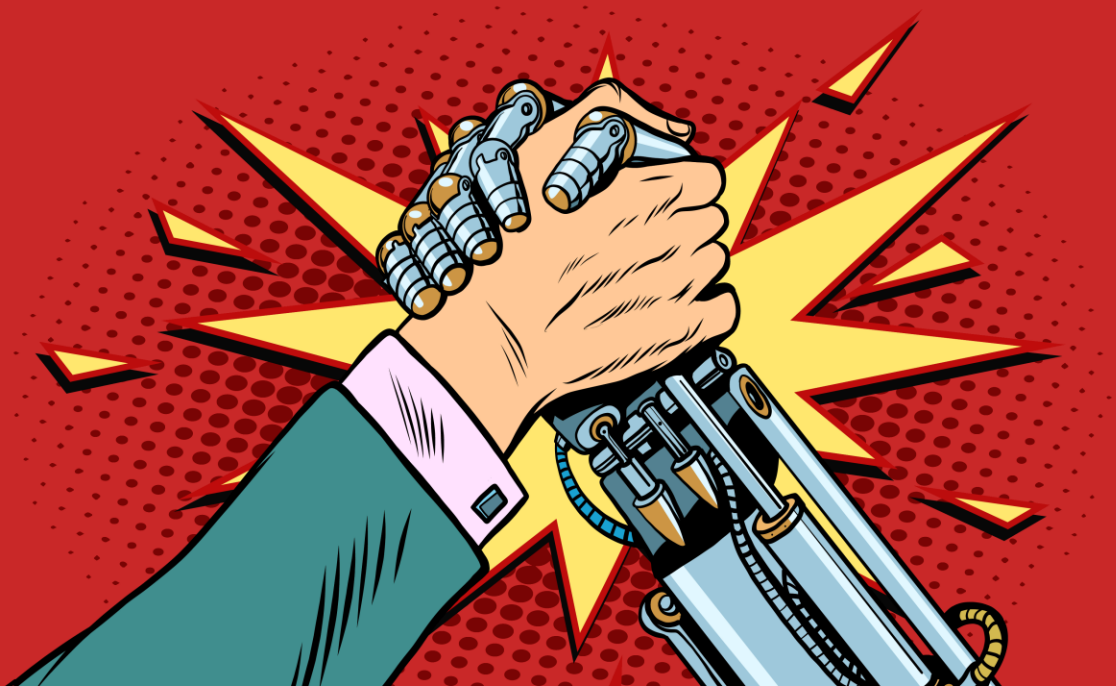
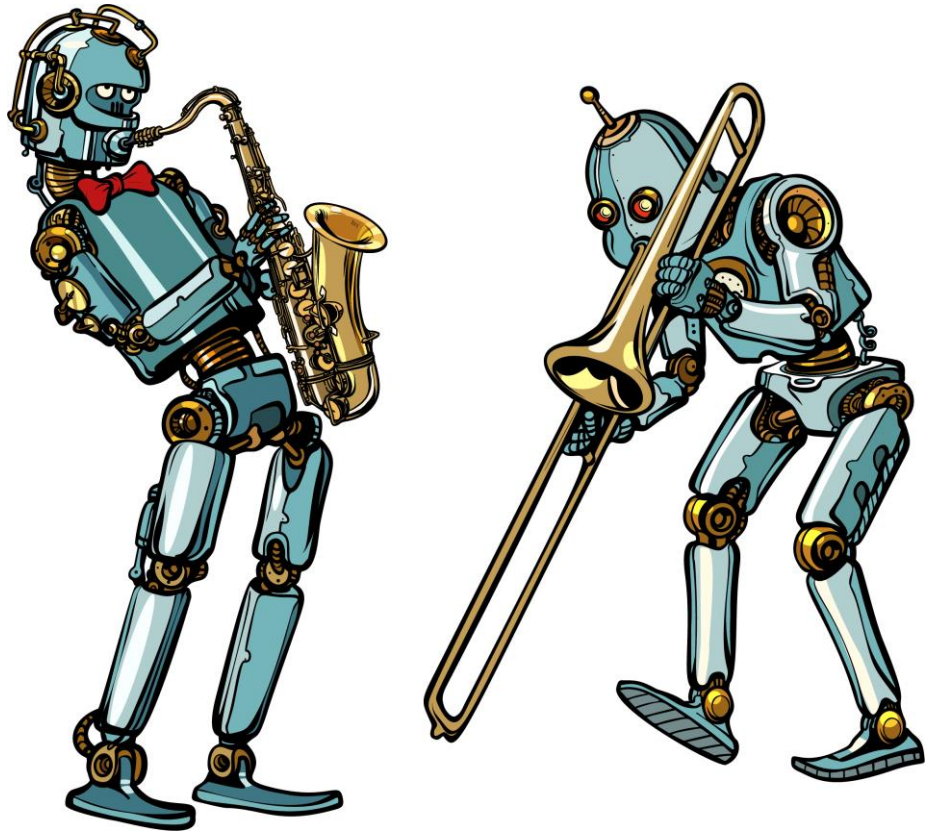
Scheming with Machines

BSides Las Vegas 2019



Who Am I?

- Will Pearce (@moo_hax)
  - Operations
  - Research
  - Training

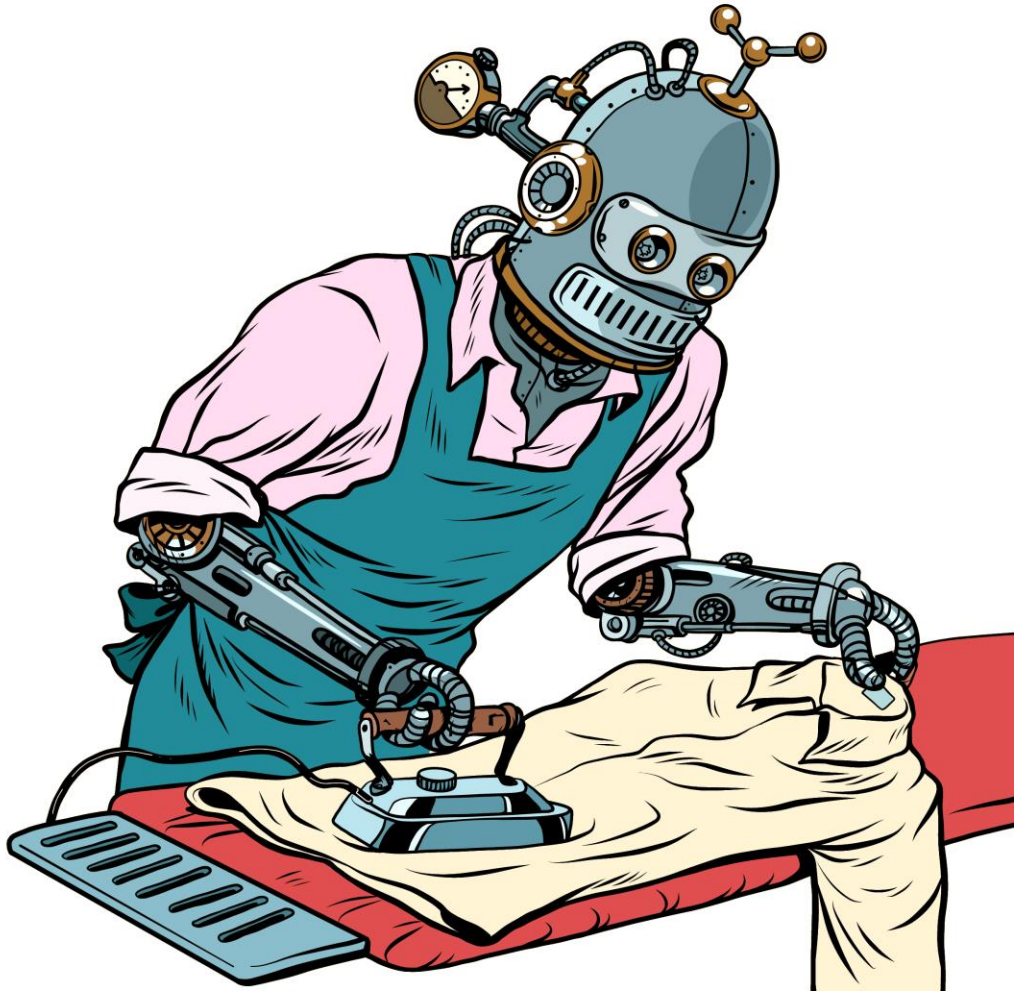


Our Agenda

- ML in InfoSec
- Offensive Tooling

Old Dogs (New Tricks)

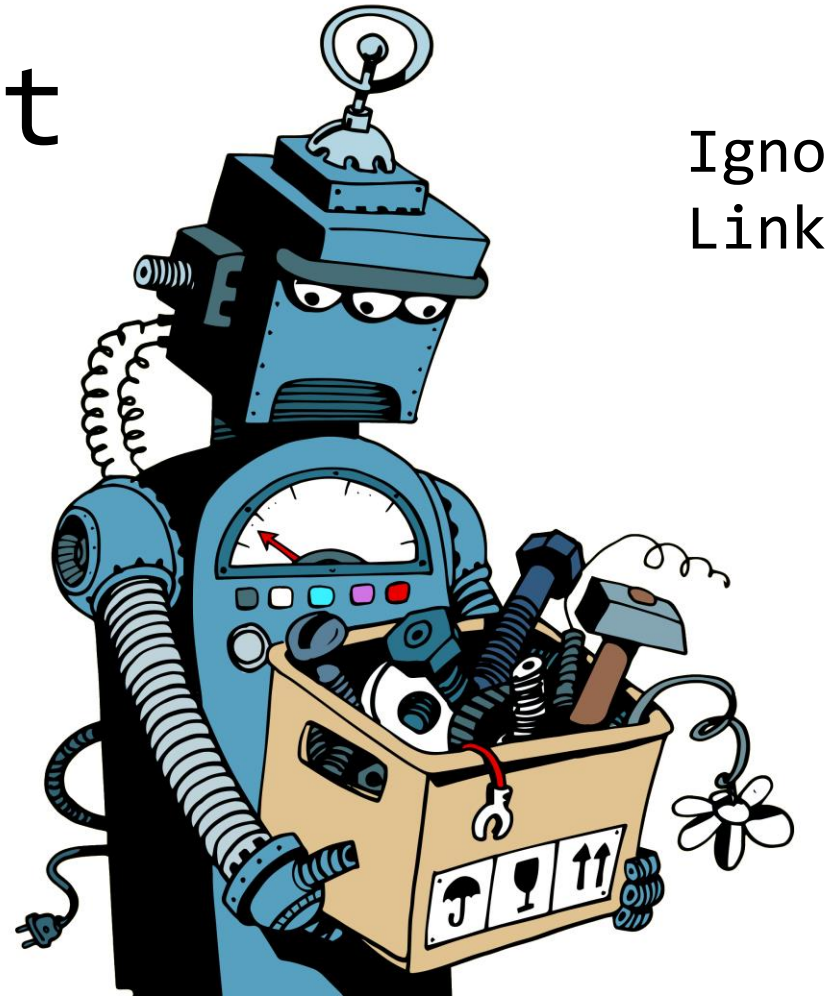
- Math not magic
- Vendor claims
- Data Requirements
- Engineering Challenges
- Data Scientists Running the SIEM?



Modern execution happens
in memory, enclaves?

Babys First
Detection

- Malware
- Phishing
- Network



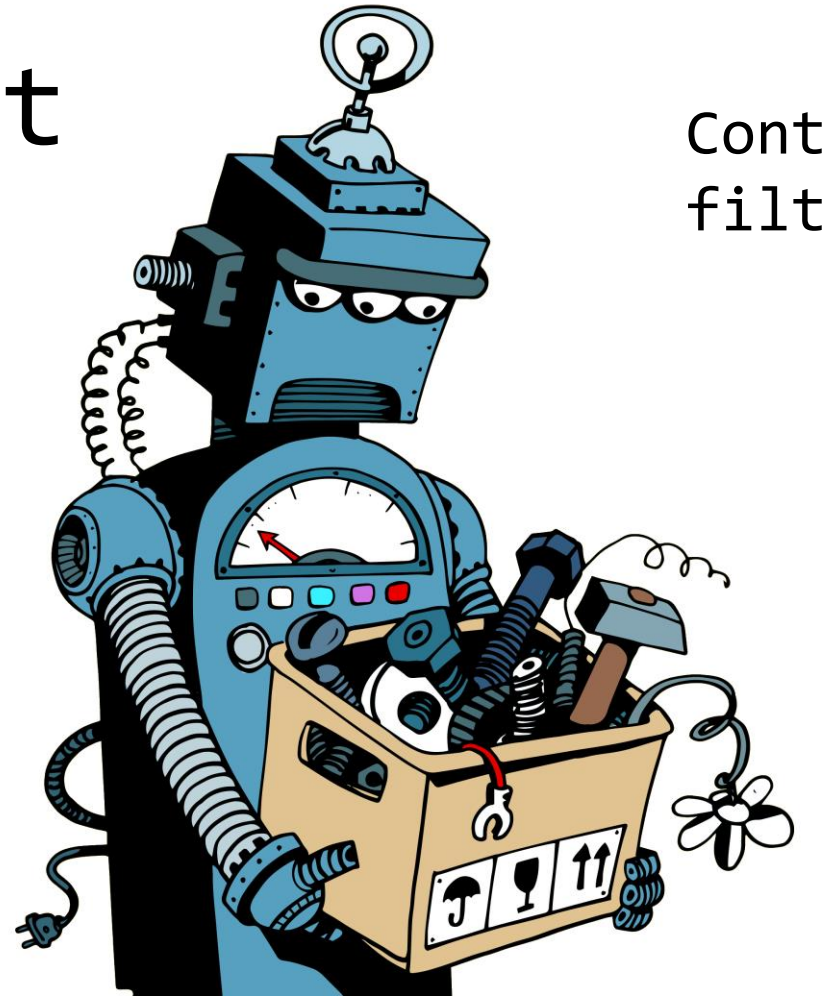
Ignores vectors like
Linkedin, Twitter, …

Malicious dns traffic
looks malicious

Sequence Analysis of function calls. AMSI.

Babys First Detection

- Malware
- Phishing
- Network

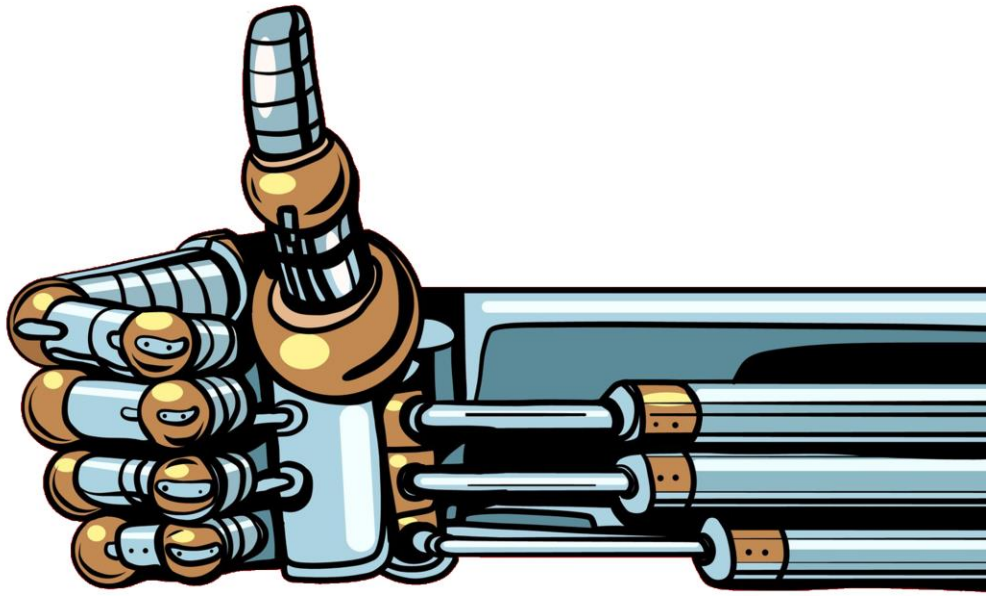


Context aware spam filtering

Anomalous connections look anomalous

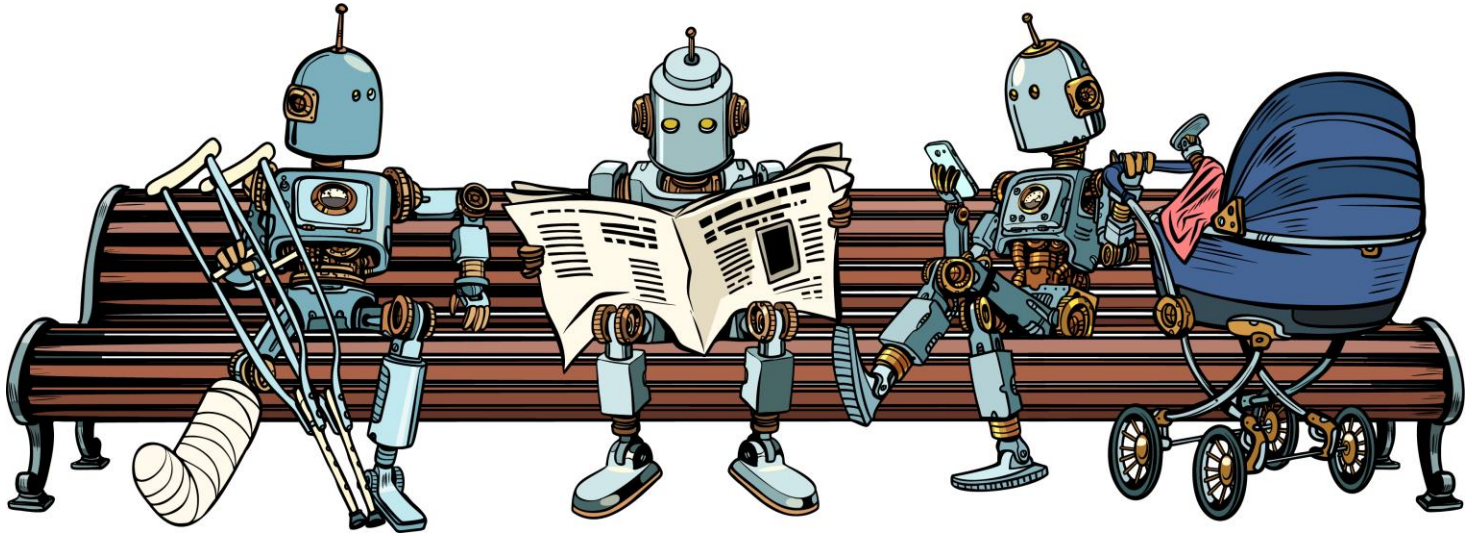
Some Perspective

- Augment decision makers
- Create better tools
- Be better operators



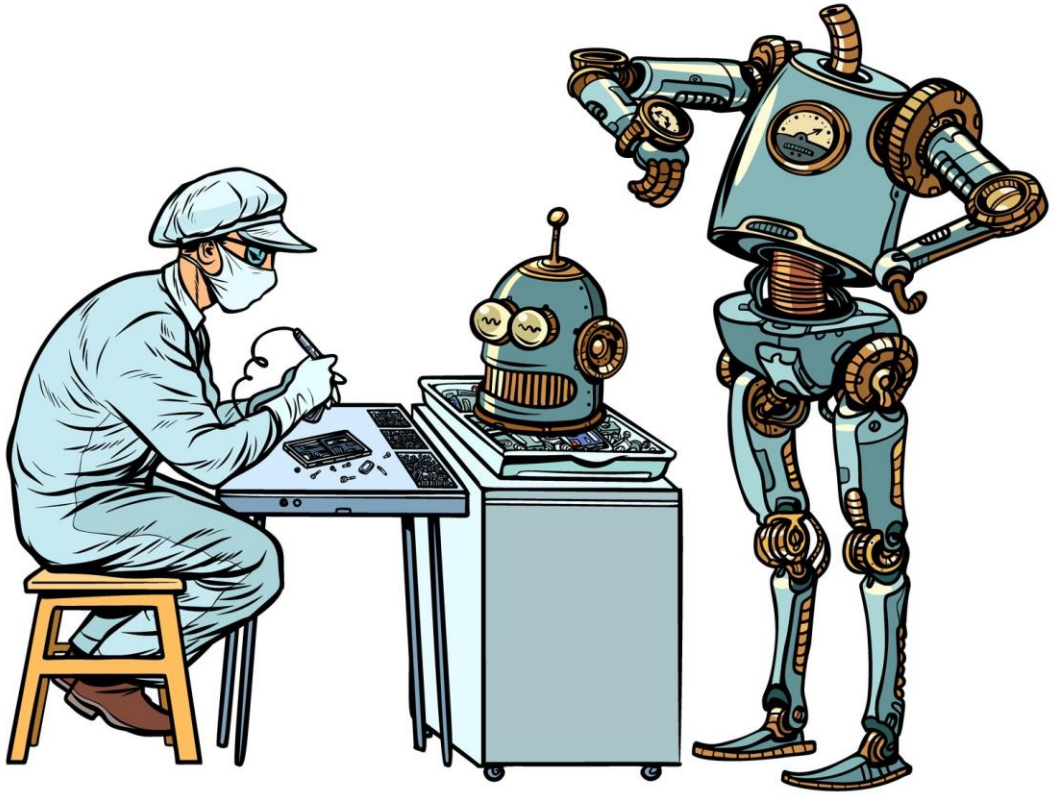
New Kid on the Block

- Offensive ML
- Adversarial ML



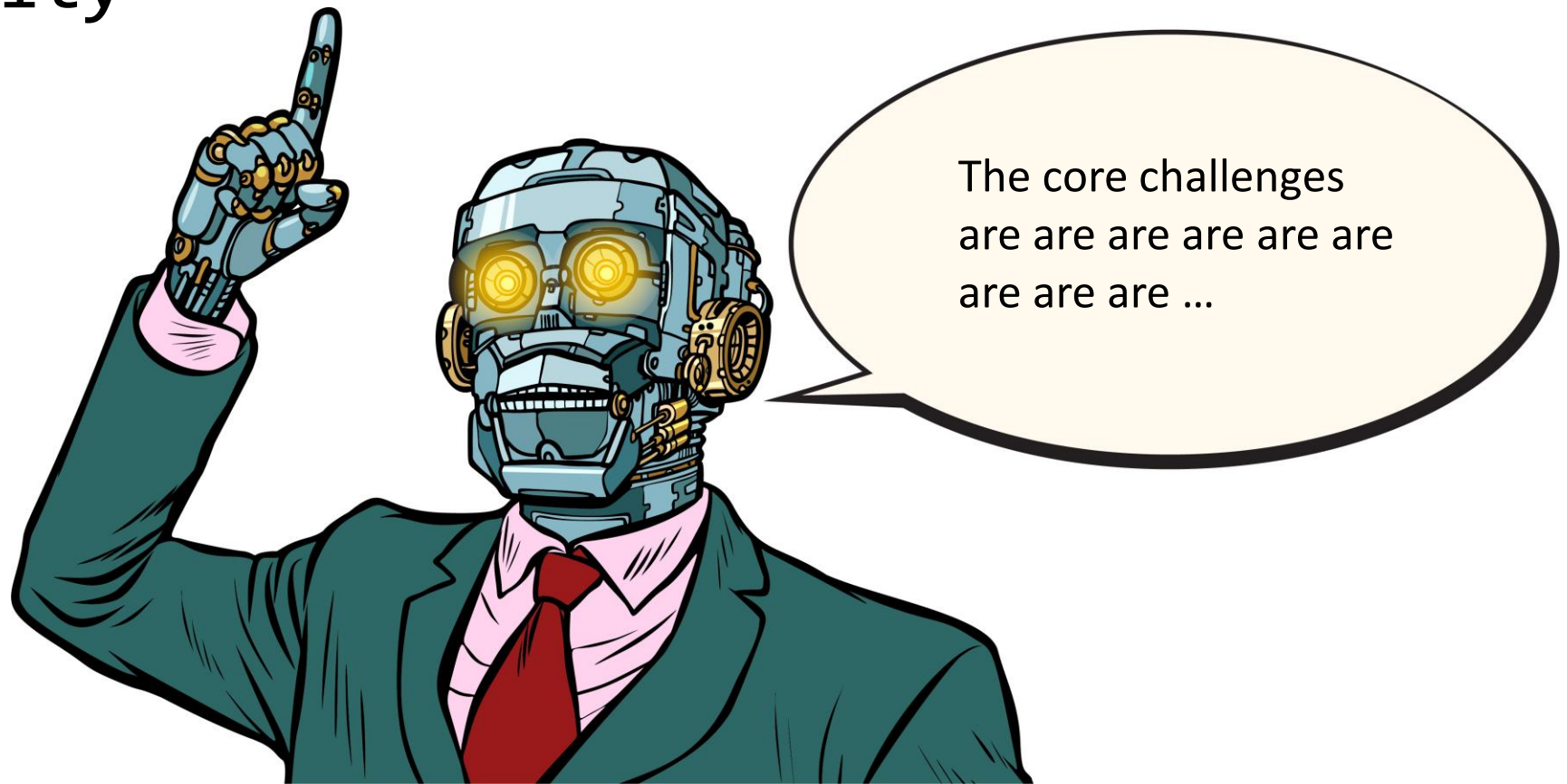
Awesome Research

- Parzel Sec, timing attacks
- Deep Exploit (Metasploit)
- GPT-2 (Big Language Model)
- Markov Obfuscate (C2)
- SNAP_R (Twitter Phishing)
- PassGan (Password Guessing)
- DeepWordBug (Classification)
- RedML Project



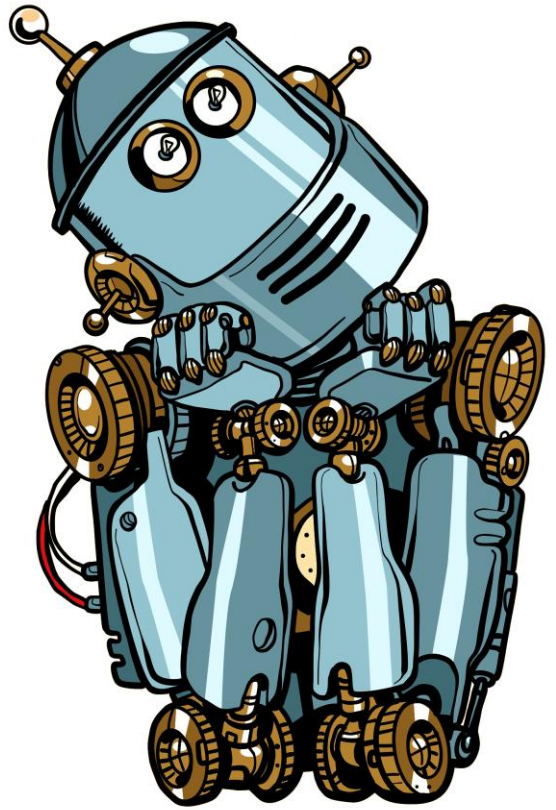
Core Challenges

- Text data
- Transferability
- Sharing Data

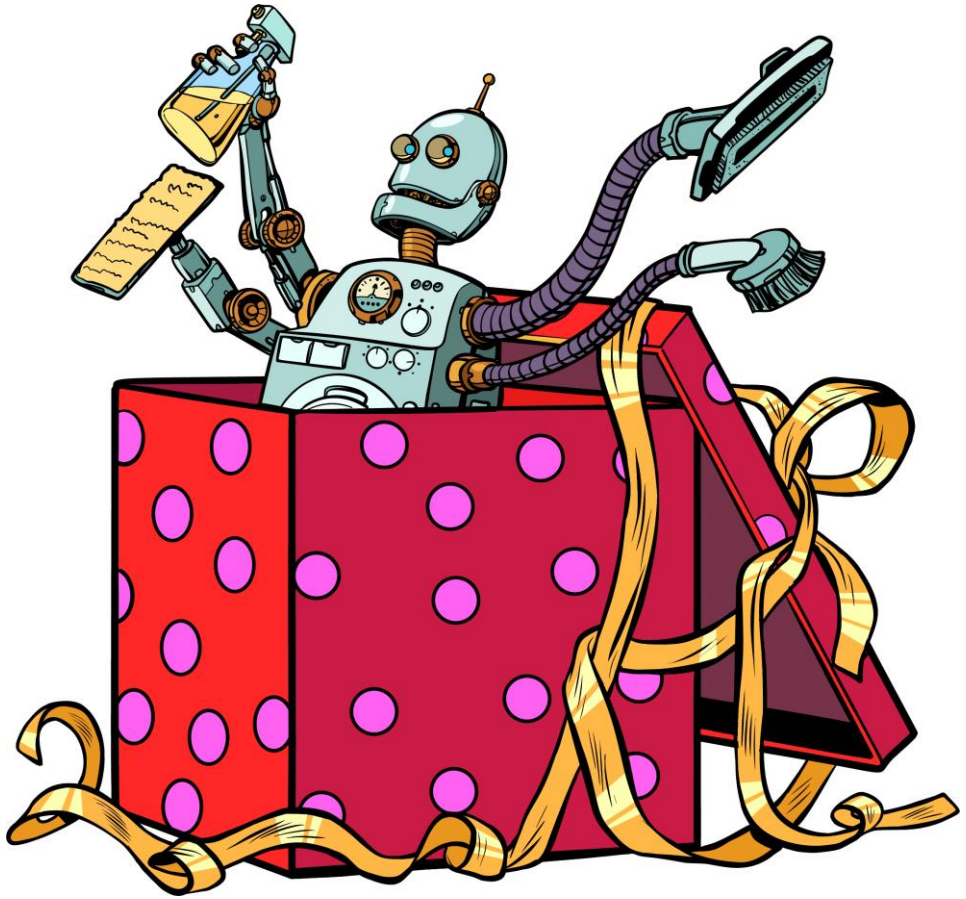


Problem Distillation

- Empirical analysis
- Statistical analysis



Classifying a Sandbox



Playing in a Sandbox

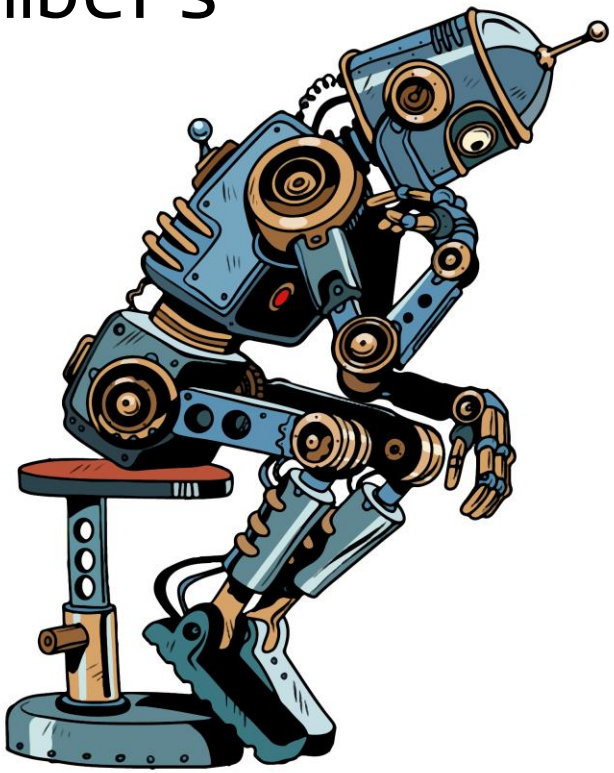
- Decisions, decisions
- Automated analysis

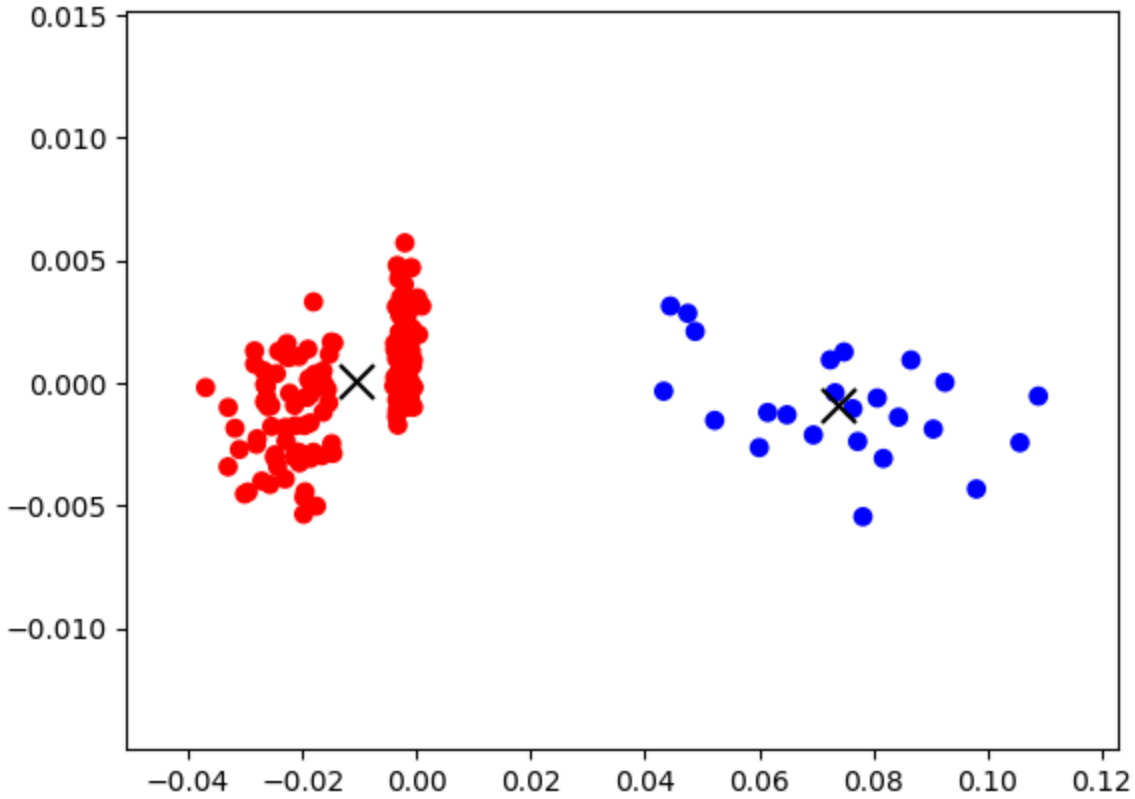
- Protect Payloads
- Alert fatigue

Play Time is Over

Detect A Sandbox

- Clear differences
- By the numbers





Select Features

```
features = np.array([
                    [33, 4, 8.25, 1],
                    [157, 1, 157, 0],
                    [195, 1, 195, 0],
                    [30, 4, 7.5, 1],
                    [34, 4, 8.5, 1],
                    [84, 1, 84, 0]
                ])
```

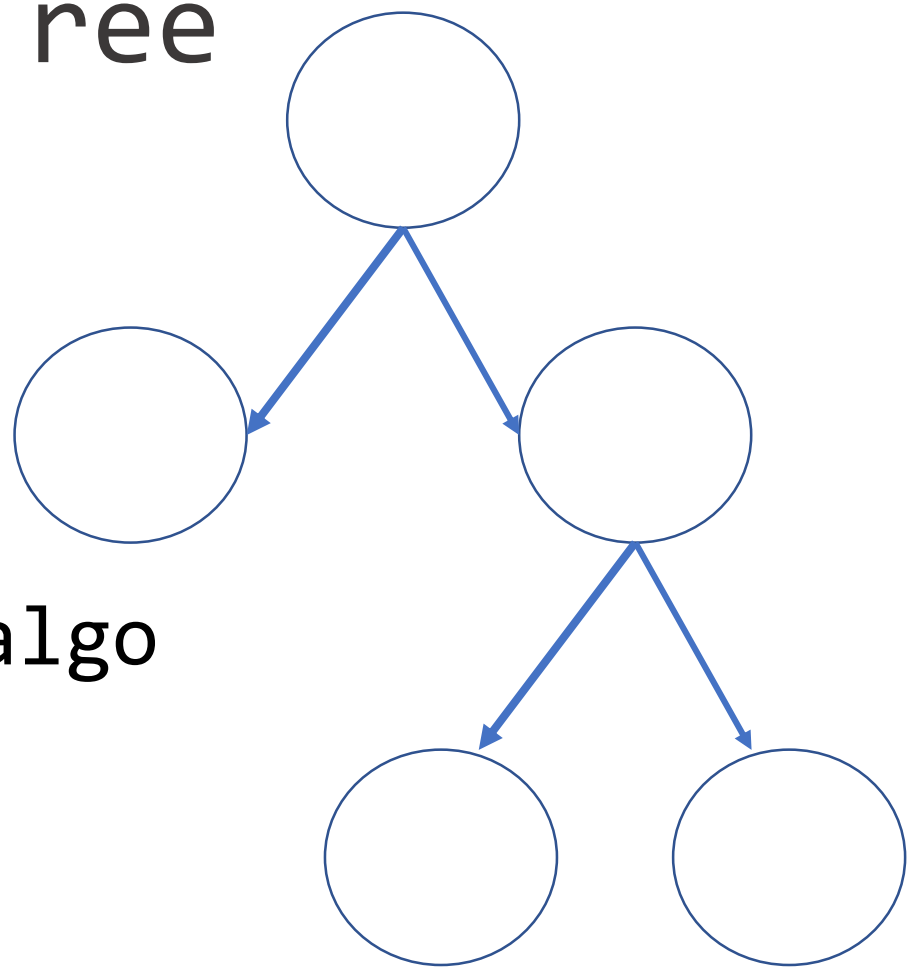
Process Count
User Count
P/U Ratio
Label

Explore Features

```
features = np.array([
                    [33, 4, 8.25, 6, 1],
                    [157, 1, 157, 26, 0],
                    [195, 1, 195, 7, 0],
                    [30, 4, 7.5, 0, 1,],
                    [34, 4, 8.5, 2, 1,],
                    [84, 1, 84, 16, 0,]
            ])
```

Process Count
User Count
P/U Ratio
Recent Files
Label

Model - Decision Tree



- Like 20 questions for an algo

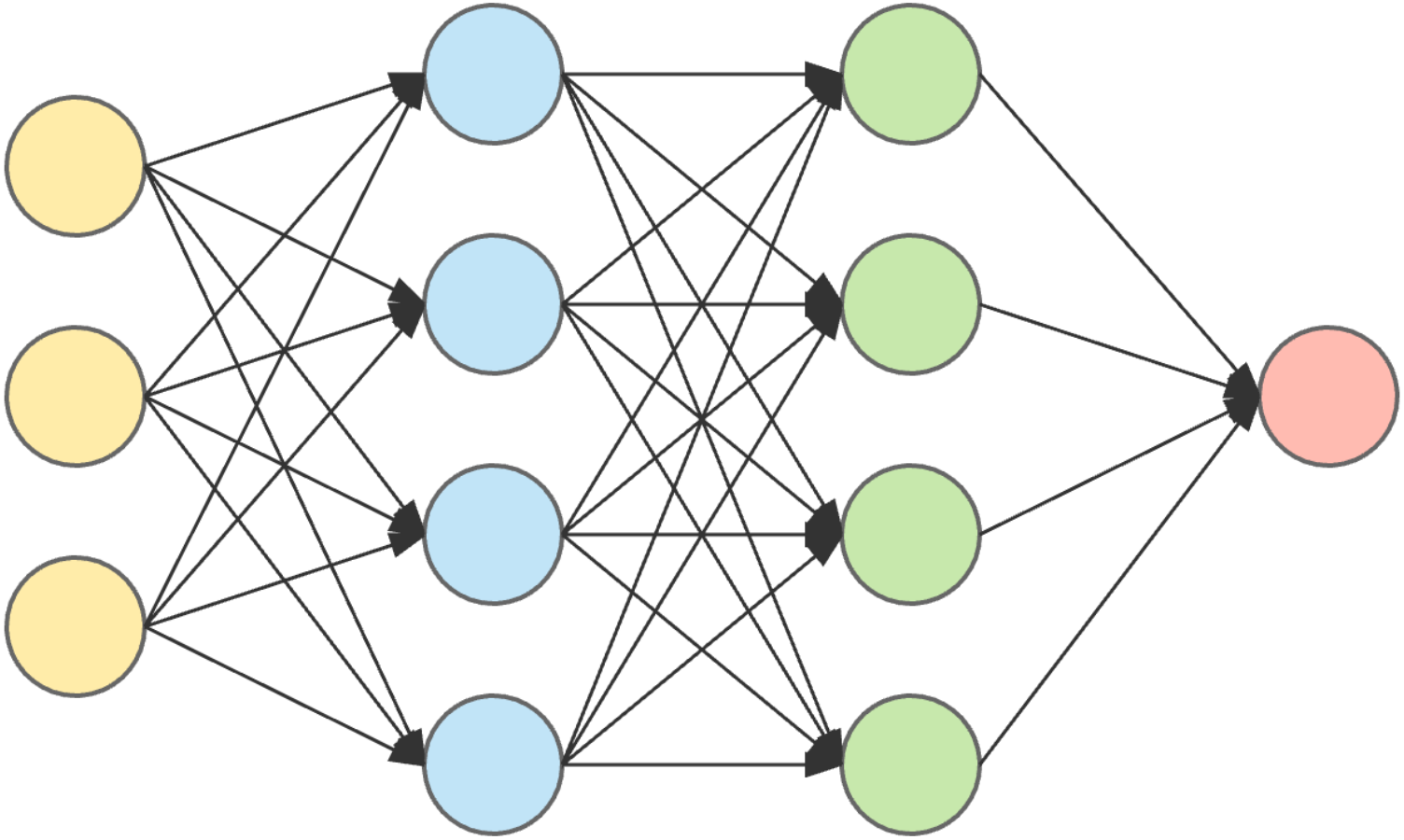
Code - Decision Tree

```
dataset = np.loadtxt("features.txt")
features = dataset[:,0:3]
labels = dataset[:,3]
classifier = DecisionTreeClassifier()

…

classifier.fit(features, labels)
classifier.predict(new_features)
```

Model – Neural Network



Code – Neural Network

```
import keras
dataset = np.loadtext(features.txt)
features = dataset[:,0:3]
labels = dataset[:,3]

model = models.Sequential()
model.add(layers.Dense(3, activation="relu",input_dim=3))
model.add(layers.Dense(3, activation="relu"))
model.add(layers.Dense(1, activation="relu"))
model.compile(loss="binary_crossentropy", optimizer="adam“)
model.fit(min_max_data, labels, epochs=epoch, batch_size=batch)
```

Deploy Models

```
def process_callback(callback):
    parsed_process_list = parse_process_list(callback)
    collected_features = gather_features(parsed_process_list)
    decision_tree_prediction = make_prediction(collected_features)

    if decision_tree_prediction < 1 :
       logging.success('Dropping payload’)
       return 'payload’

    else:
       logging.success('Not dropping payload’)
       return 'Safety first'
```

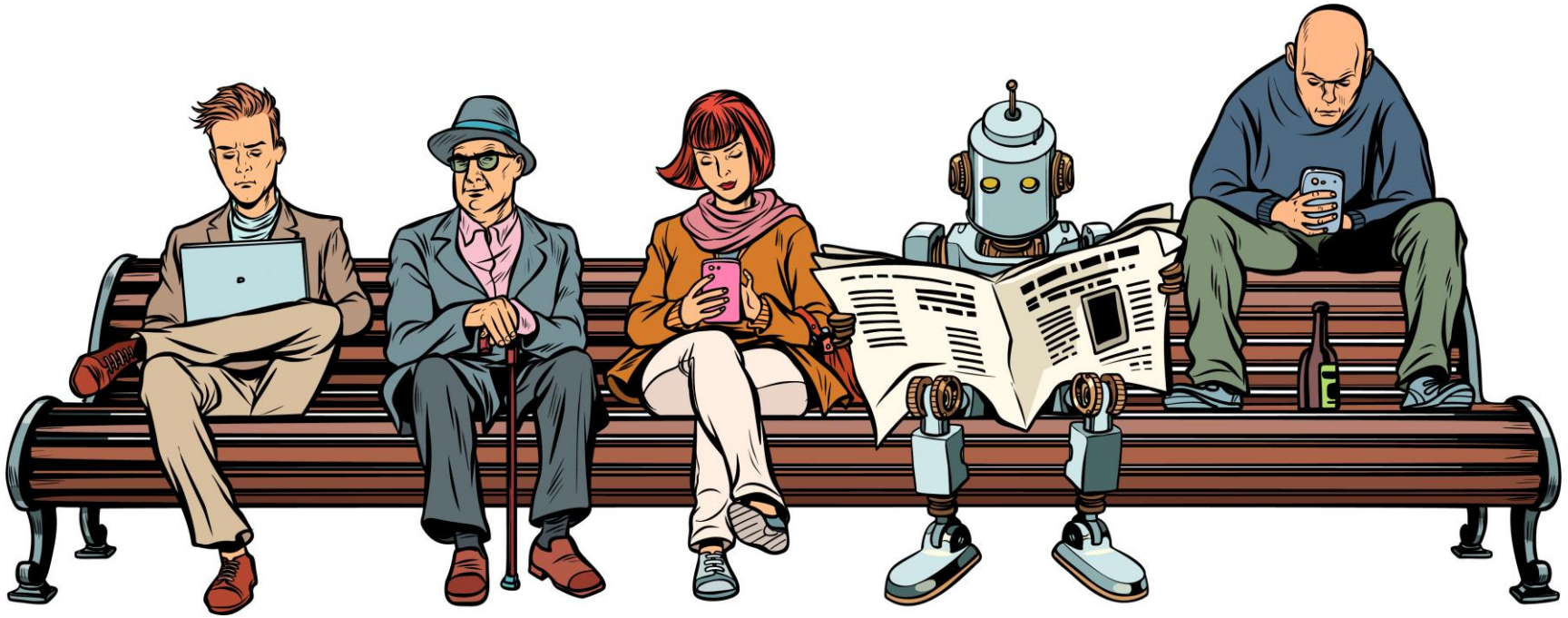
Maintenance

- Model drift
- Network Defenses
- Data collection phishing campaigns
- Adversarial inputs

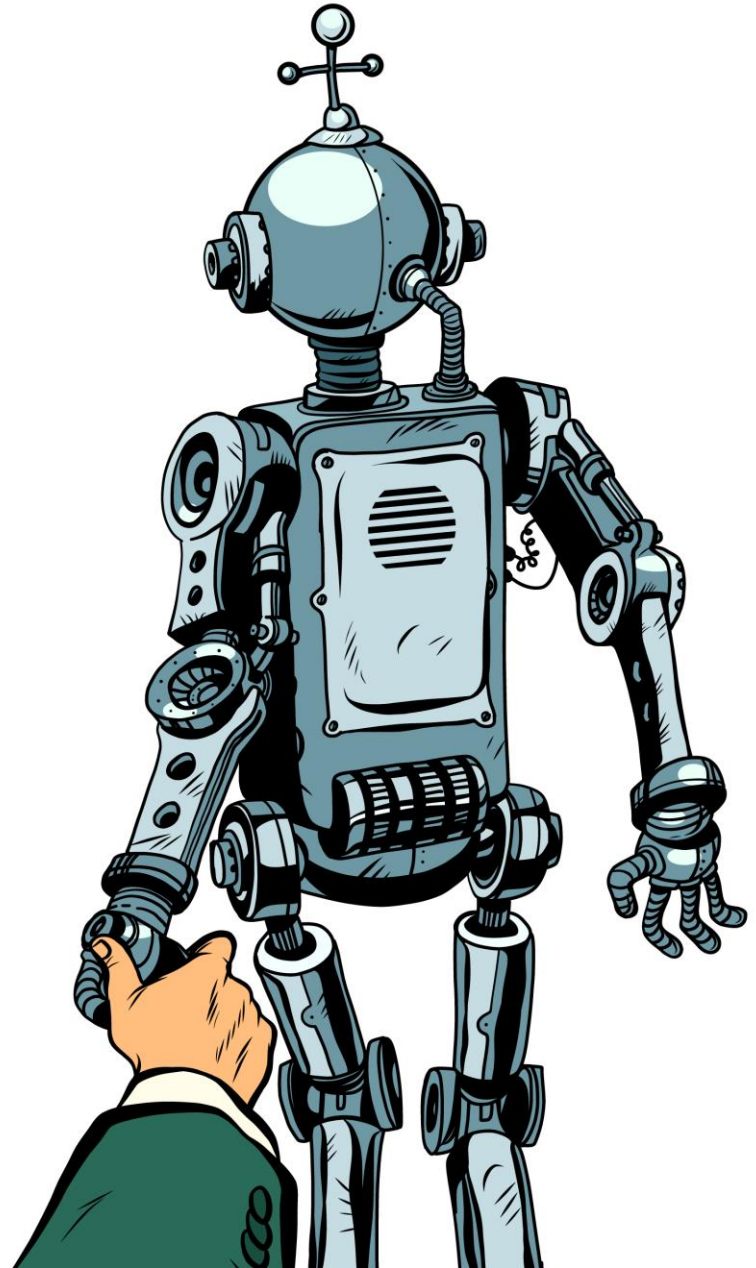
Client-Side Models

- Push intelligence client-side
- Lose the ability to troubleshoot

Demo



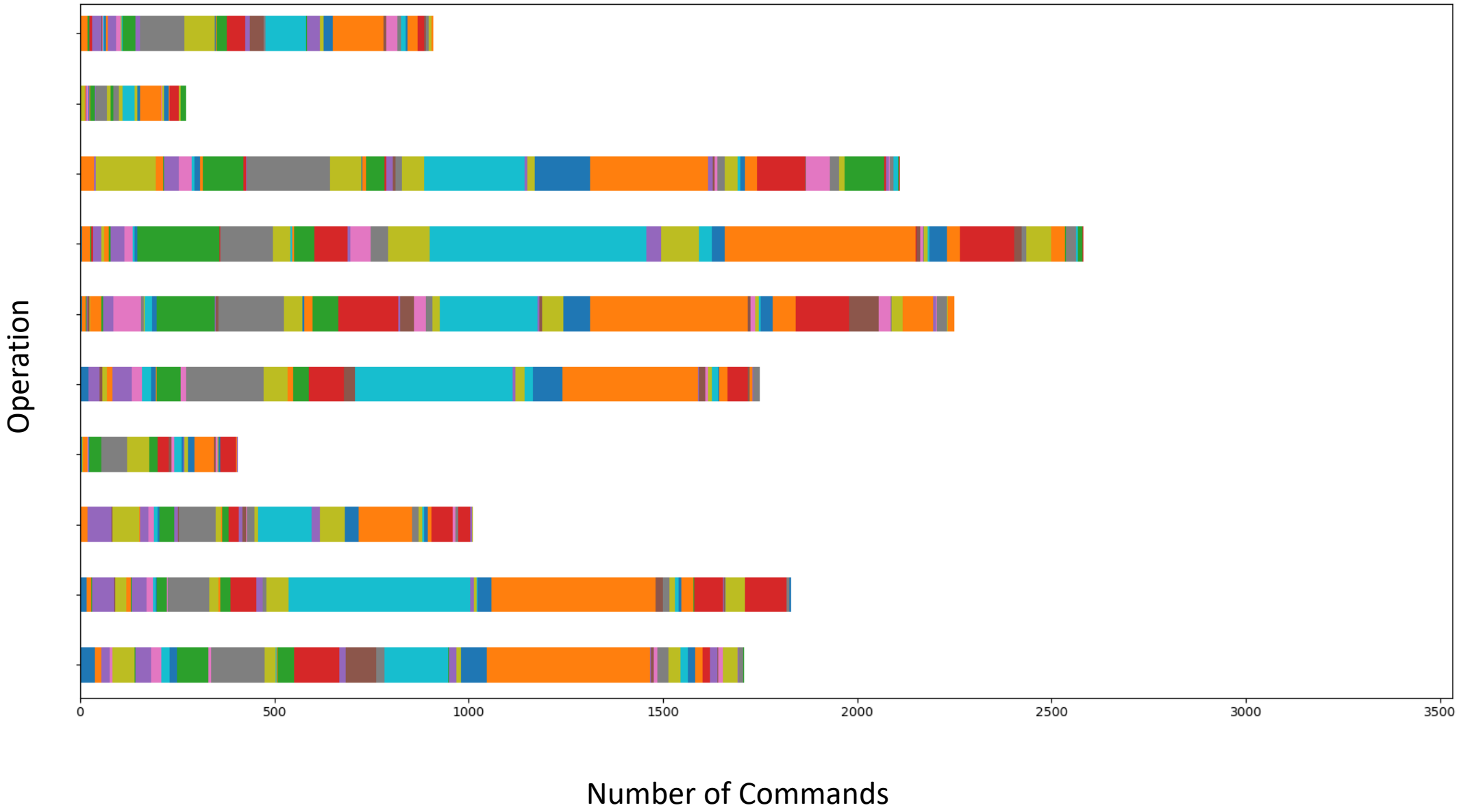
Command Recommendations



Case Study 2

Old Habits

- Existing knowledge
- Sequences of commands
- Sub-phases of an op
- Subtle hints of transitions

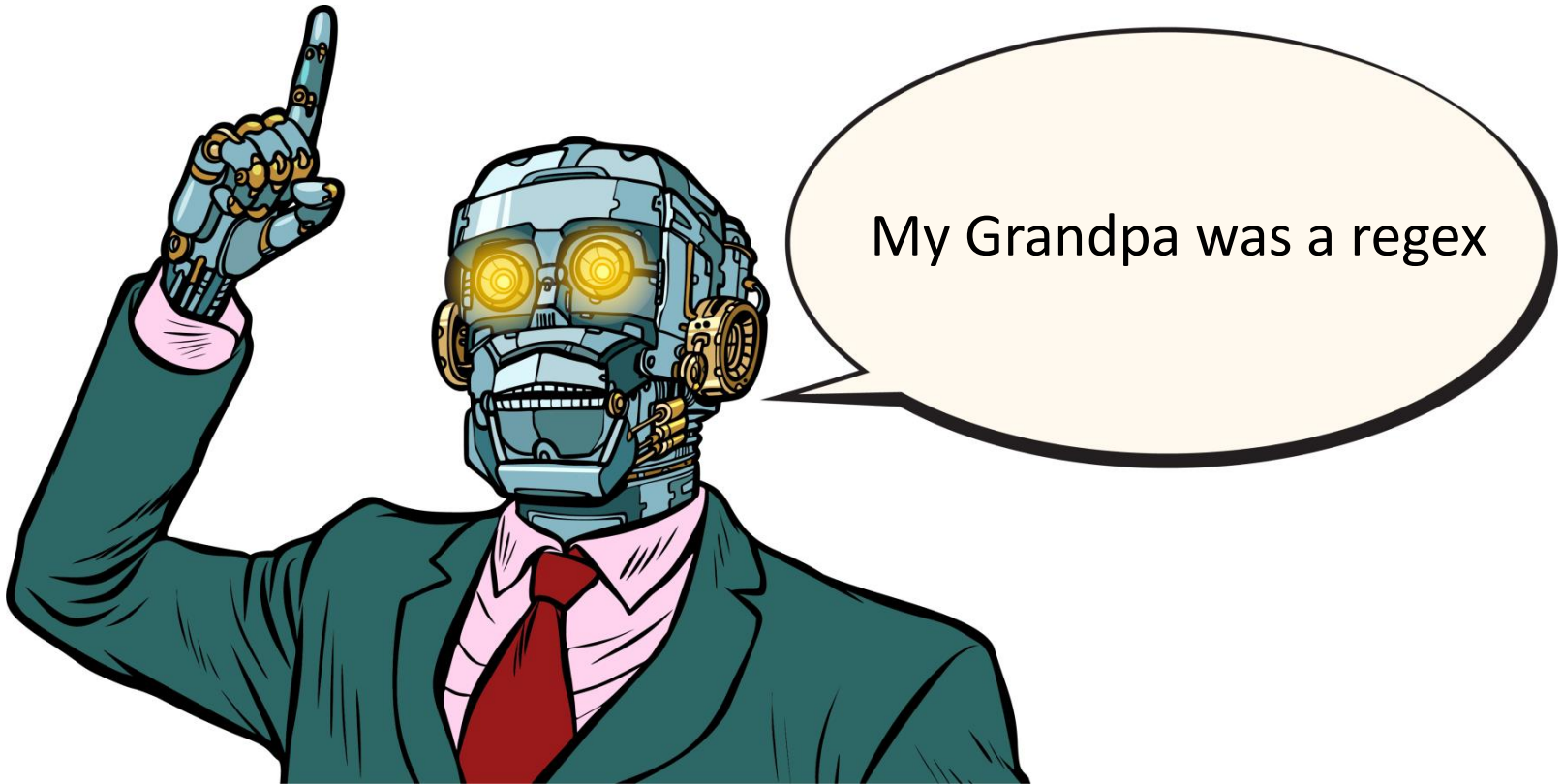

Operation
0
500
1000
1500
2000
2500
3000
3500
Number of Commands

```
------Metrics----------
Number of logs:                    30
Total commands:                    57527
Average number of commands:        1918.0
Breadth of commands:               84/99
Most commands:                     8628
Fewest commands:                   58
Longest command:                   28657
Average length of a command:       35.0
```

Top Commands					
1-5		6-10		11-14	
ls (dir)	11253	ps	2273	link	1283
powershell	10317	run	1943	Download	1205
interact	4763	ping	1651	connect	1138
getuid	2513	mimikatz	1529	lps	1052
list	2295	cat	1362	Total: 44577	

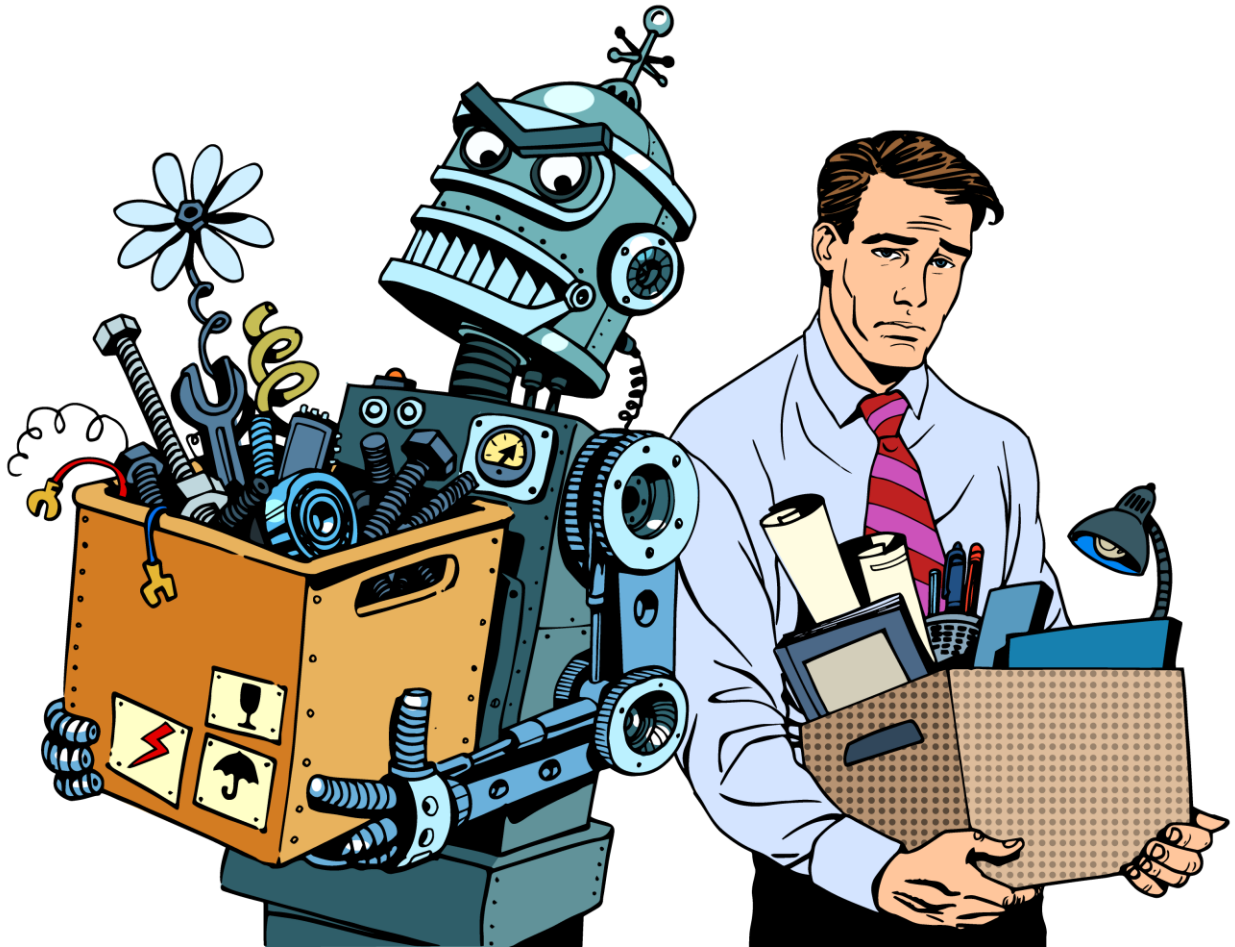
Getting to the Data

- Extract commands
- Deal with the arguments
- Model Users



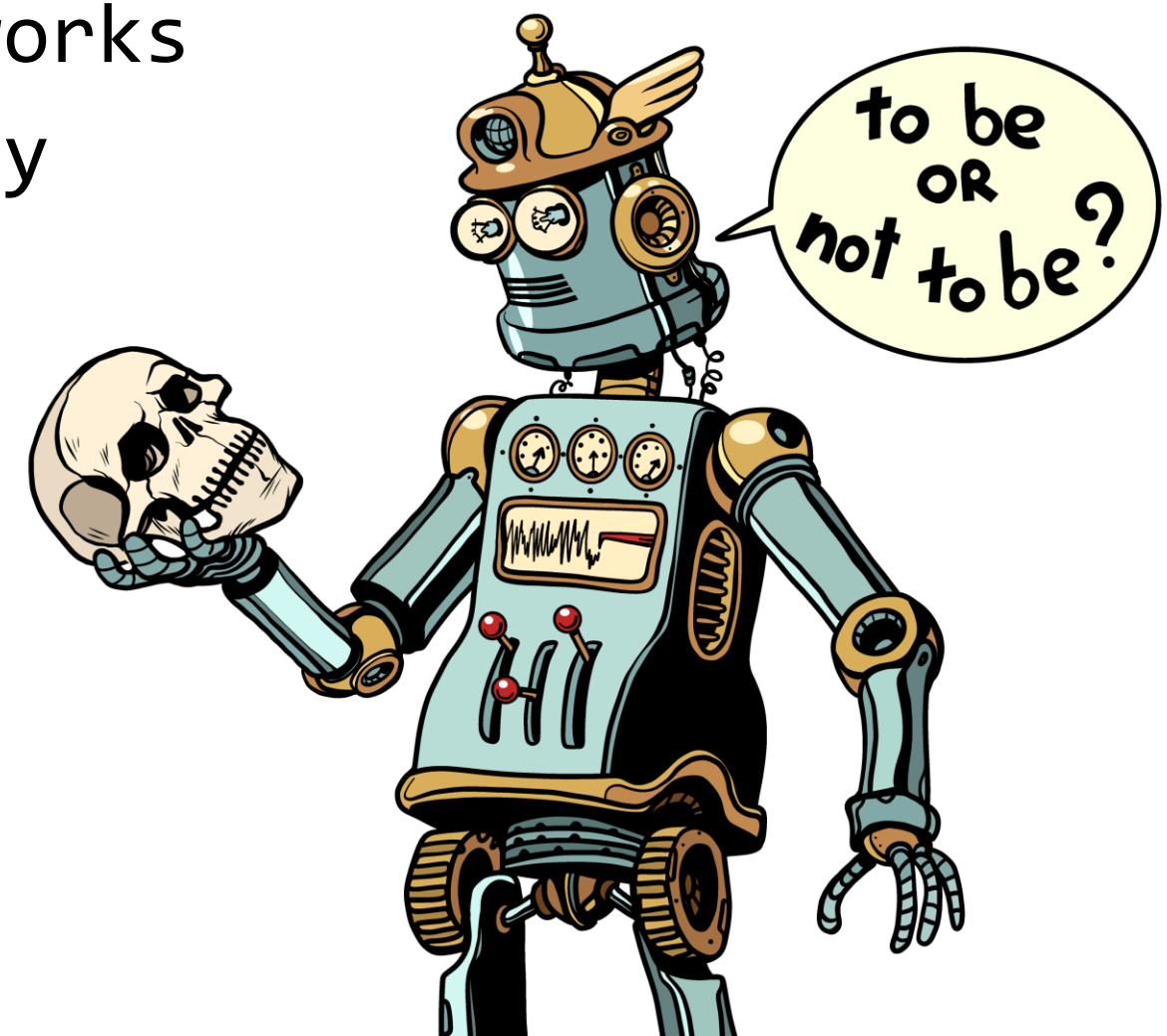
Sequence Analysis

Based on the previous sequence of commands, what is the next most probable command?

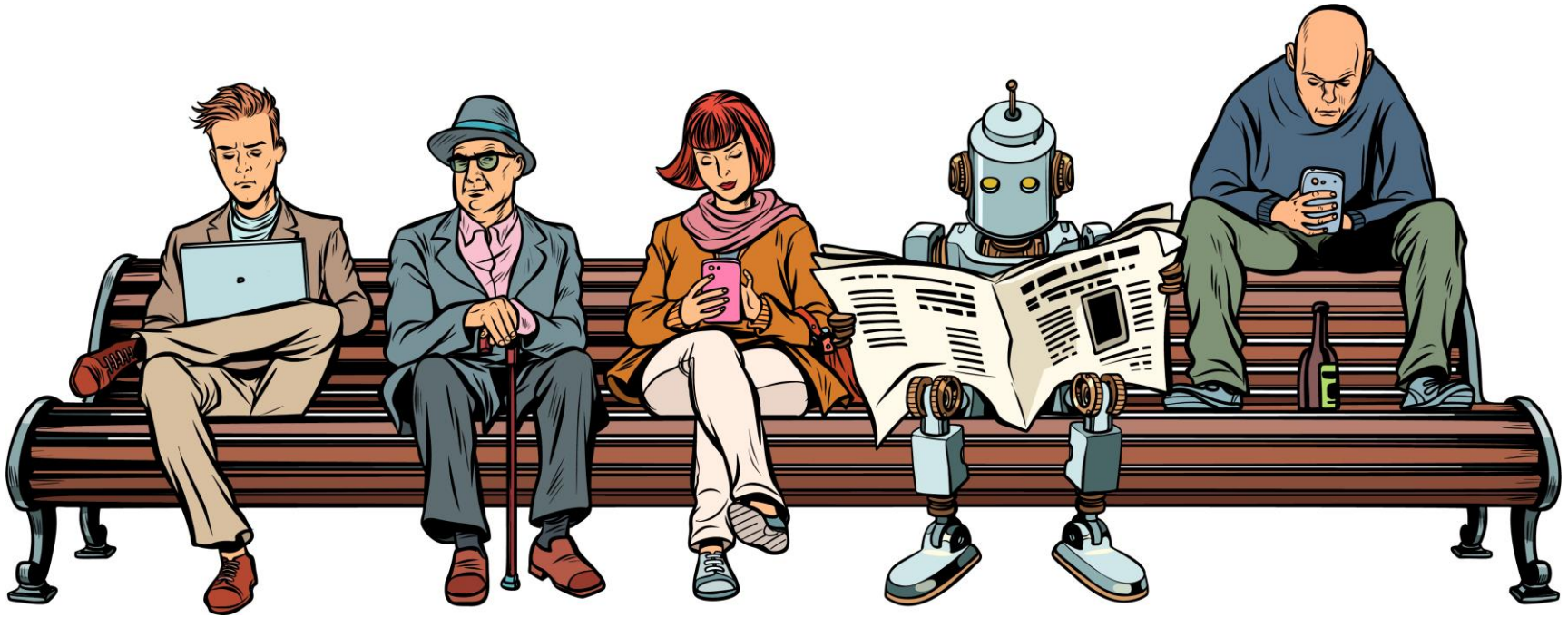


Models

- Recurrent Neural Networks
- Long Term Short Memory

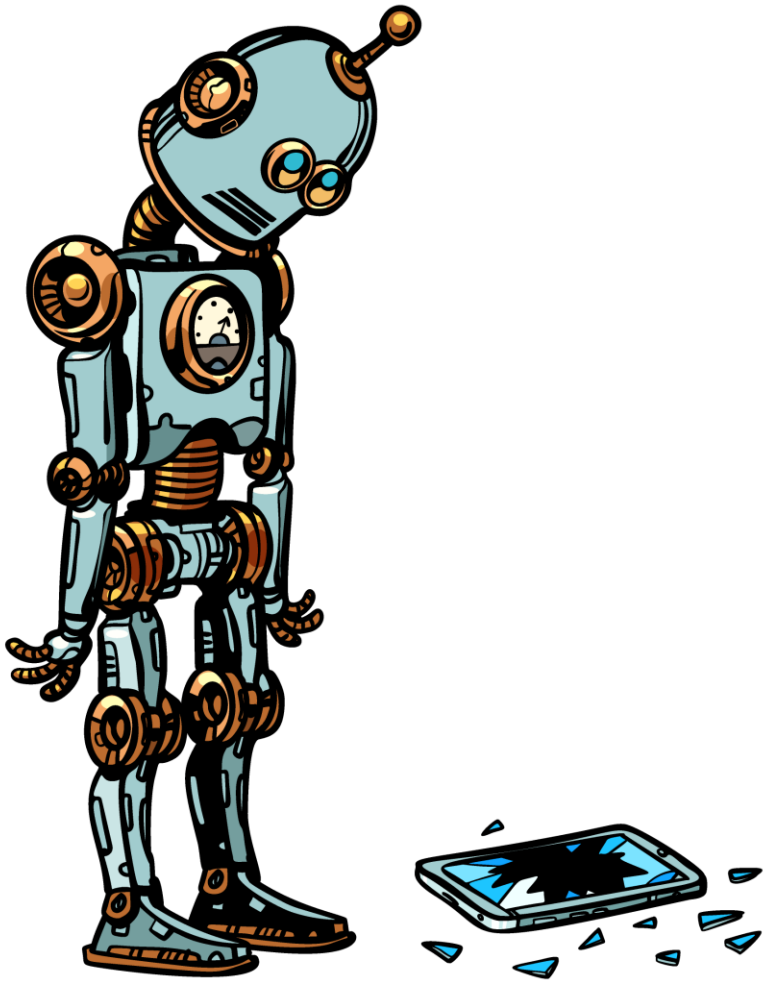


Demo



Challenges

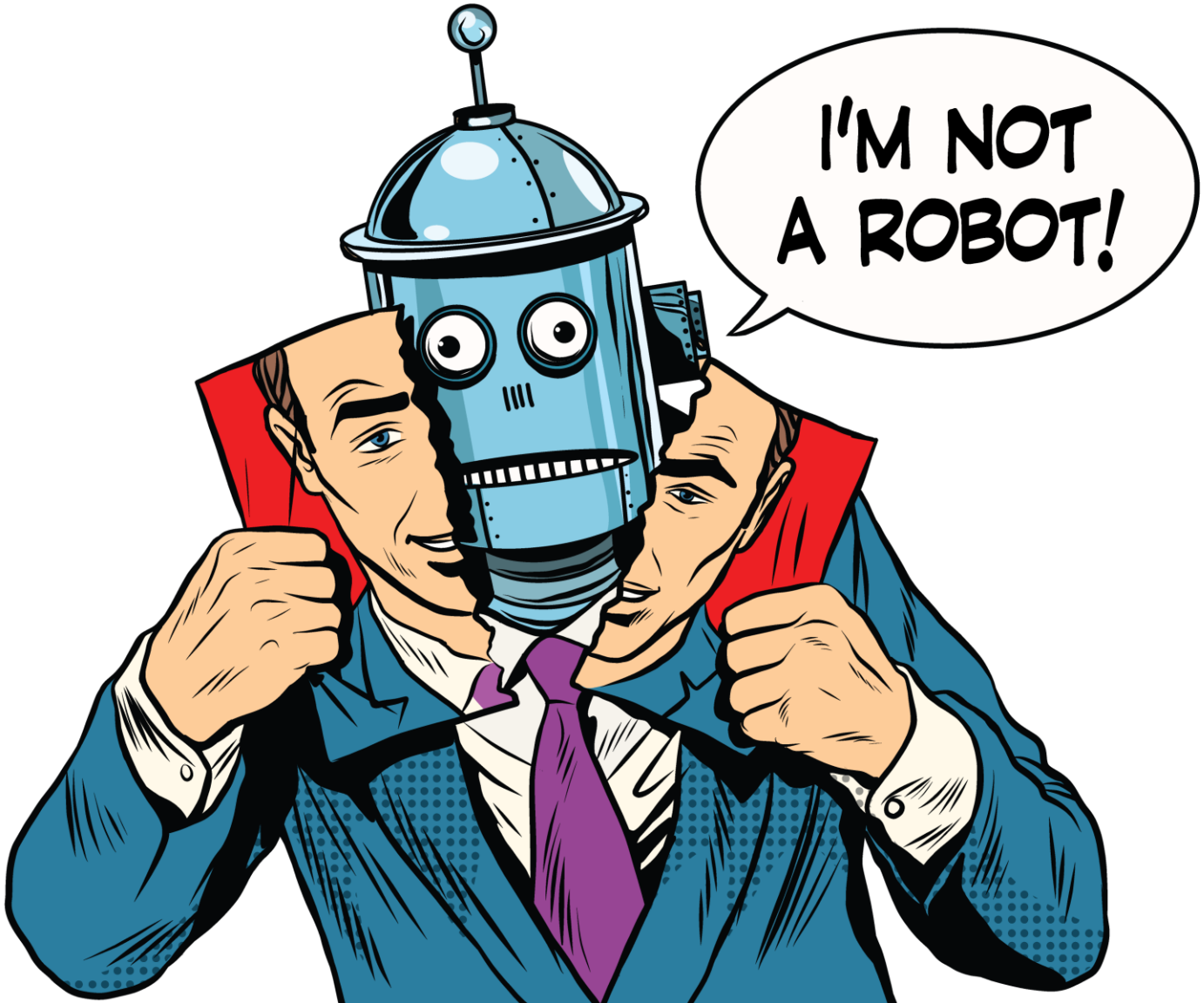
- Arguments
- Assuming a human expert
  - Troubleshooting
  - Dumb commands
  - Fat fingers



National Treasure

- Predicting UNIX Command Lines (Korvemaker and Greiner)
- User Modeling in Human Computer Interaction (Fisher)

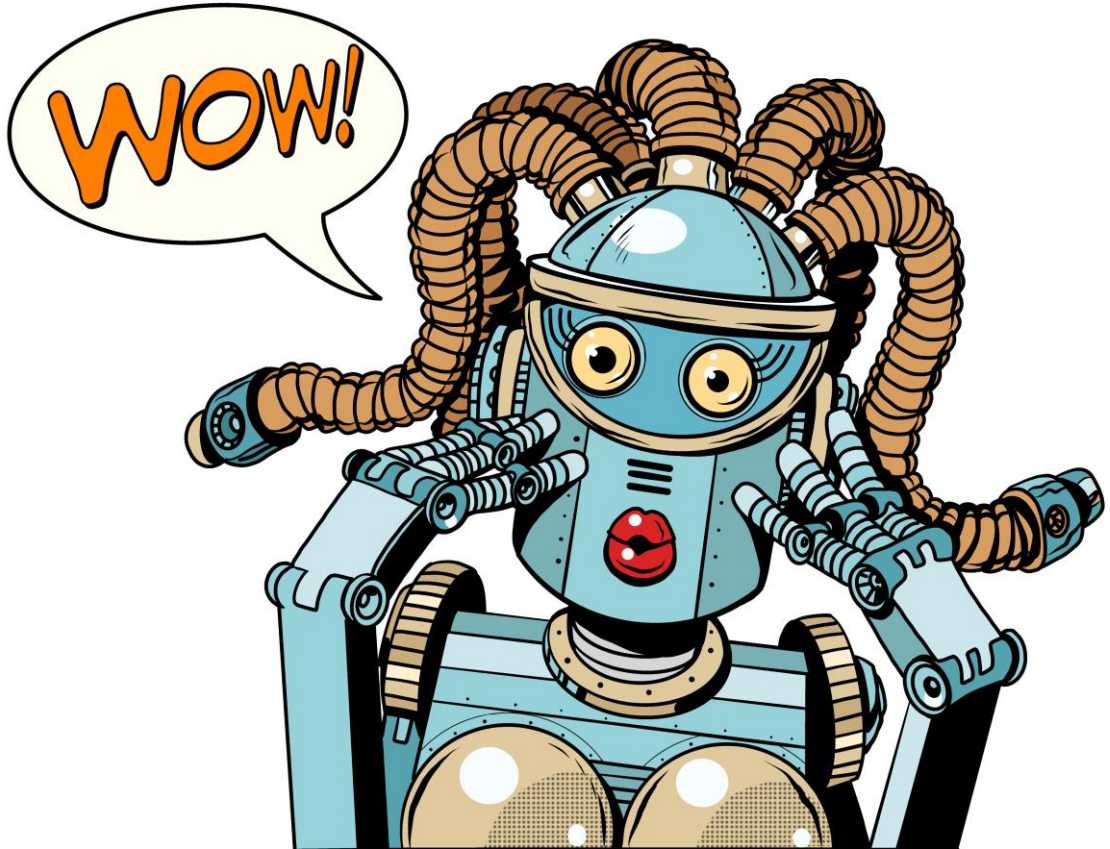
Teaching Malware



Case Study 3

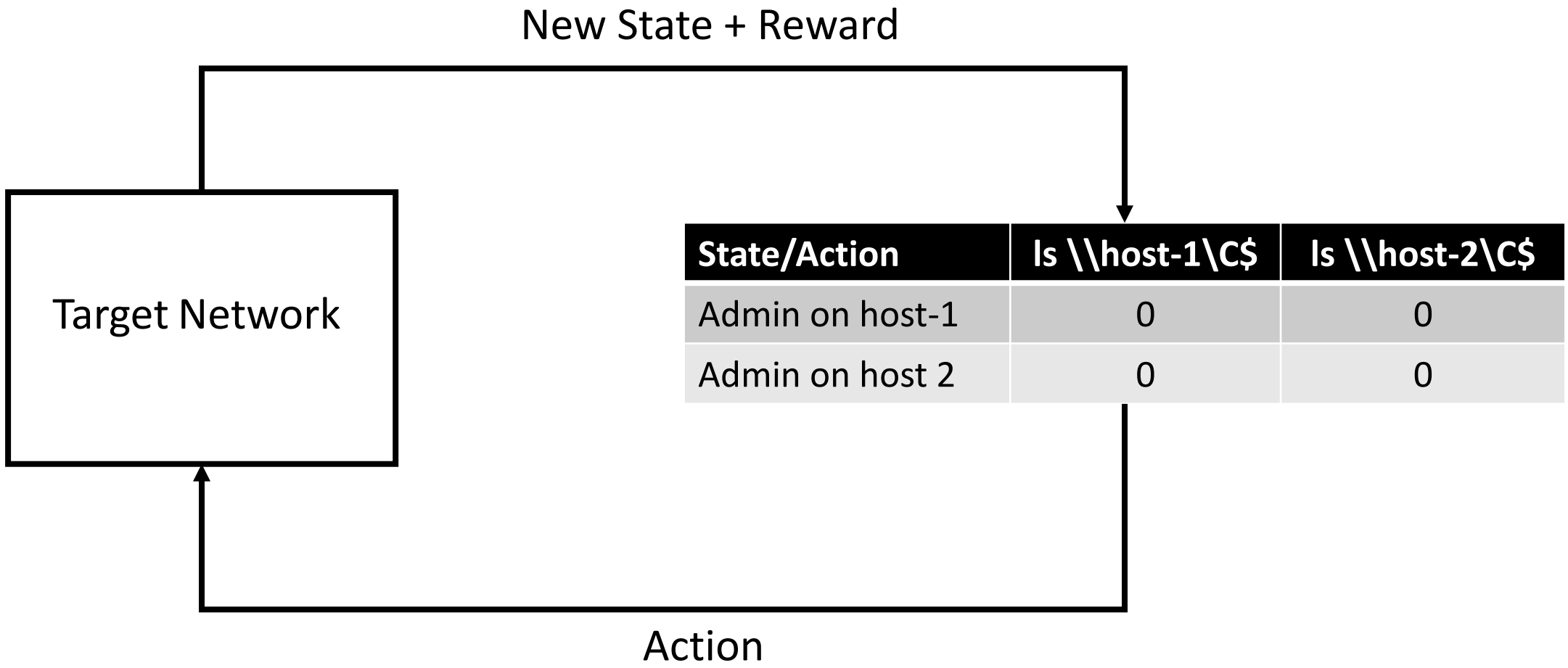
Cotton Candy

- Auto-Hack-Bot
- Adversary Simulation Products

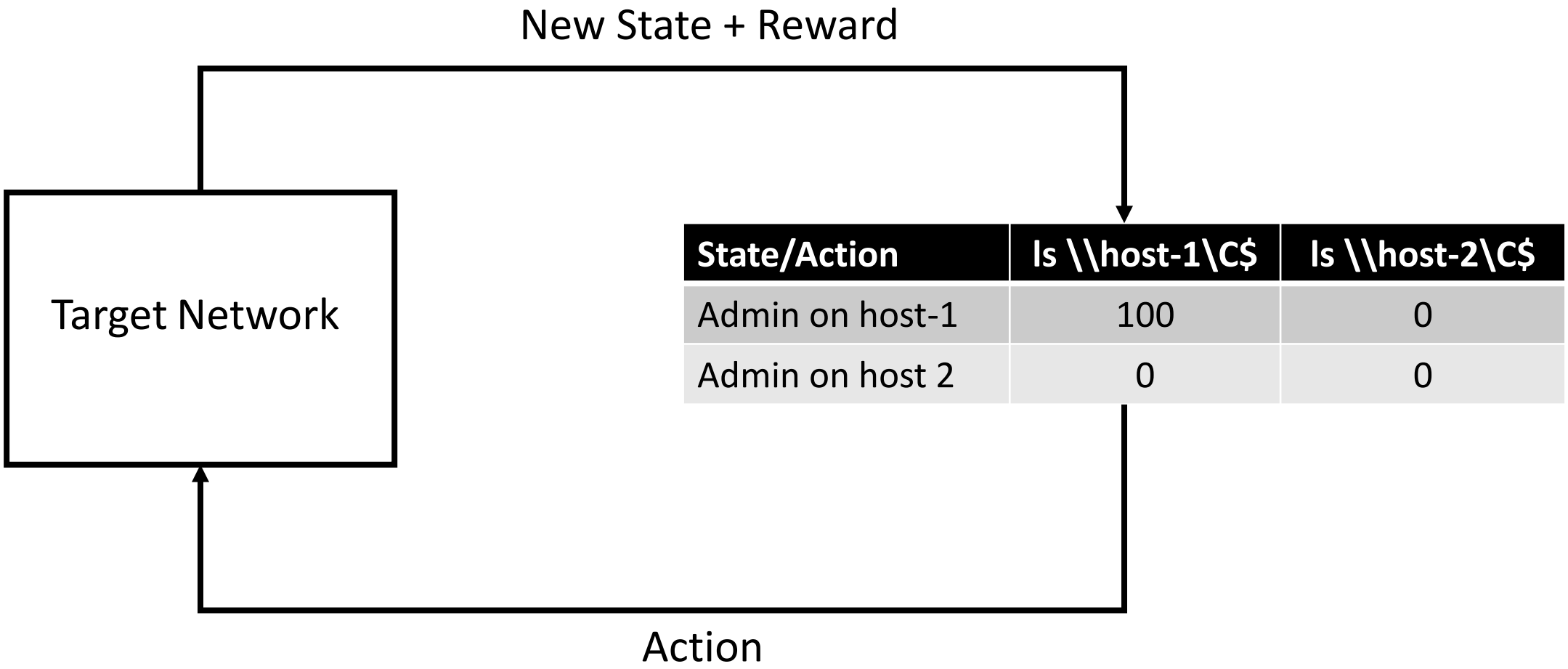


So Sweet

For a given action in a given state, the environment returns a new state, and a reward..



State/Action	Is \\host-1\C$	Is \\host-2\C$
Admin on host-1	0	0
Admin on host 2	0	0



State/Action	Is \\host-1\C$	Is \\host-2\C$
Admin on host-1	100	0
Admin on host 2	0	0

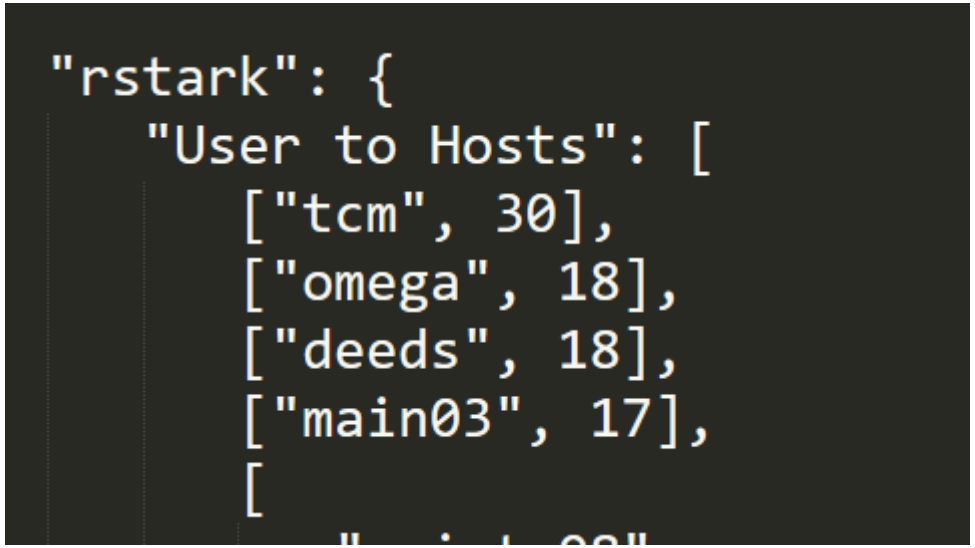
```
[+] Running dir \\host2\C$ ...The network path was not found.
    [-] Score: 280.4918032786885

[+] Running dir \\host2\C$ ...The network path was not found.
    [-] Score: 280.4918032786885

Trained Q matrix
-----------------
[[100.         ]
 [ 75.90163934]
 [ 75.90163934]
 [ 28.68852459]]
Testing Q matrix
-----------------
Step: 2
Step: 0
```

So Fuzzy

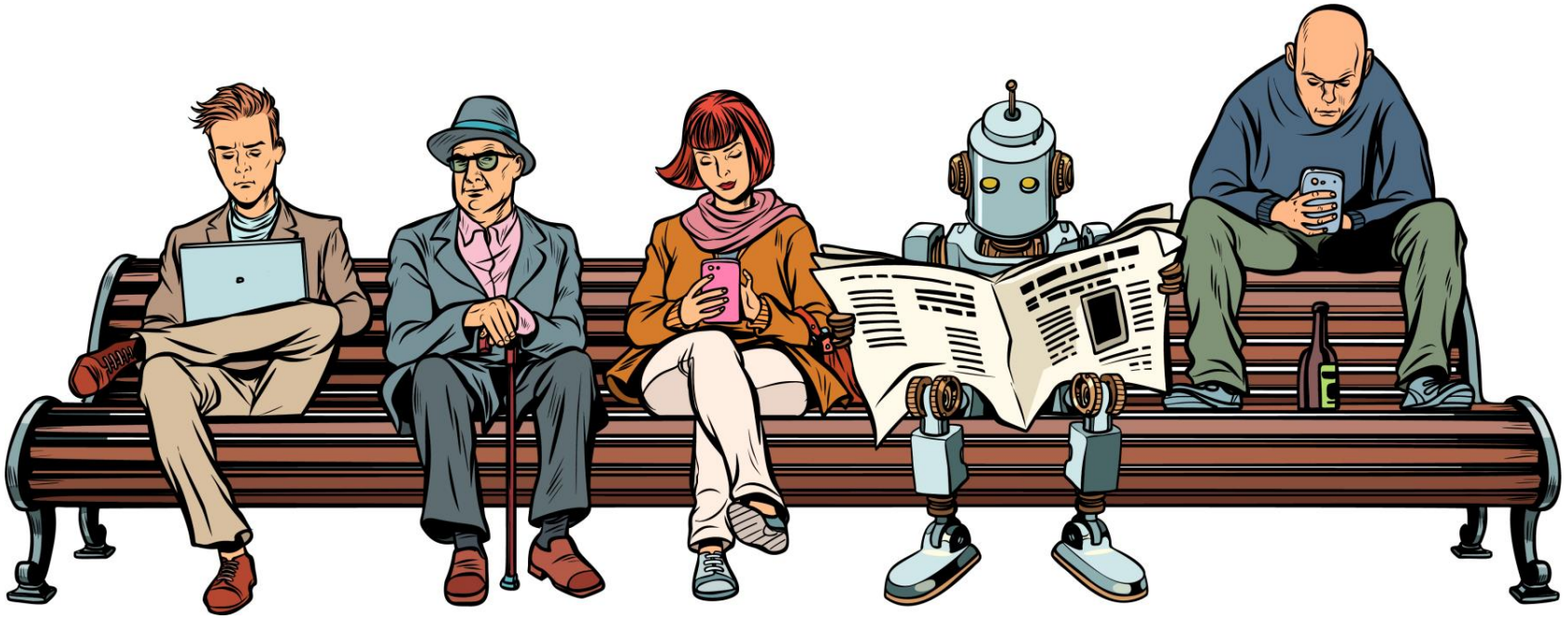
- Fuzzy Logic
  - Fuzzy/Crisp sets
  - Degrees of truth
- String metrics
  - Levenstein Distance



Process

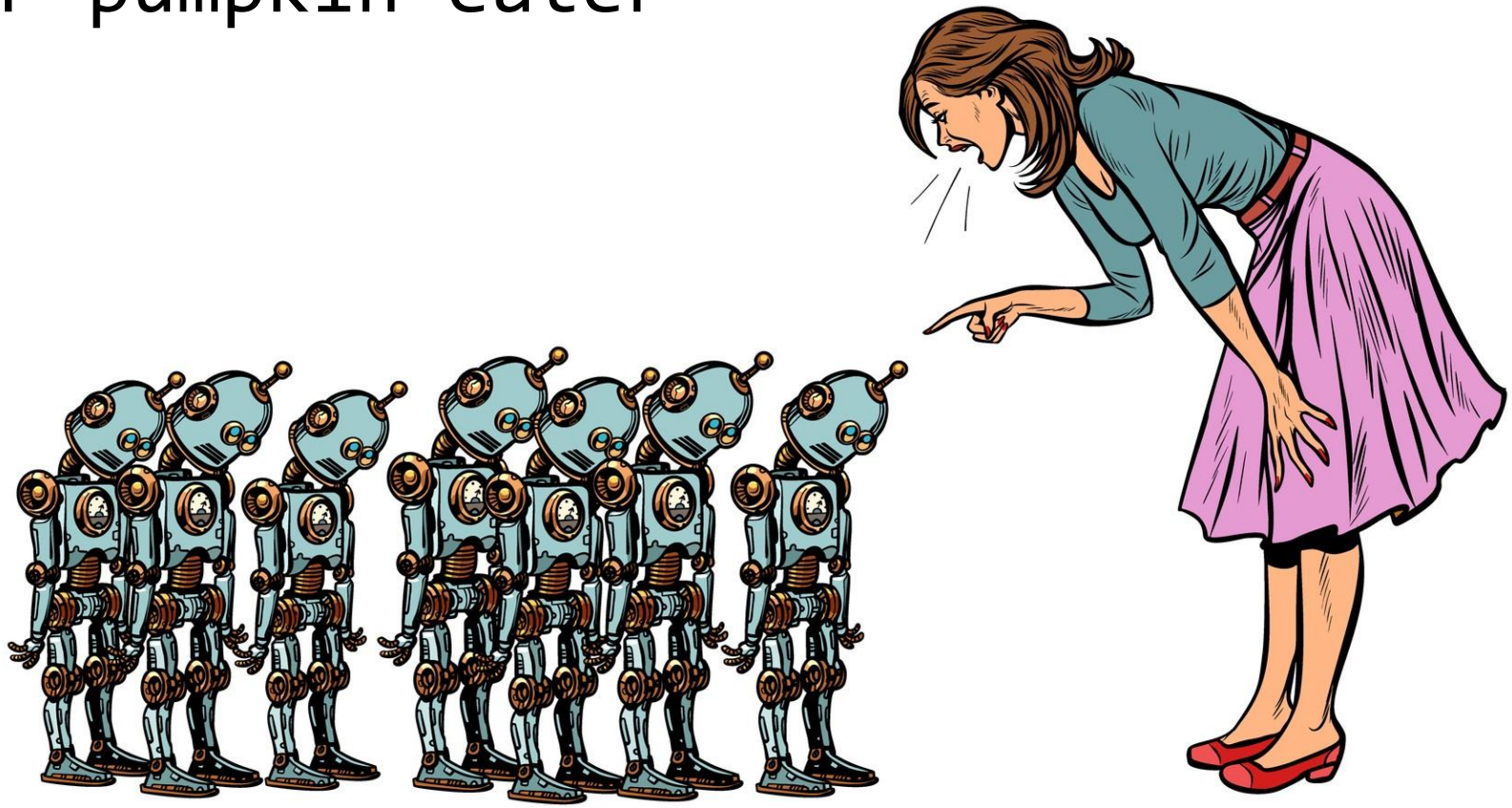
- Collect network information
- Run fuzzy string metrics on combos of users and hosts
- Select next action based on string metric score
  - Better than random
  - Better than an if statement

Demo

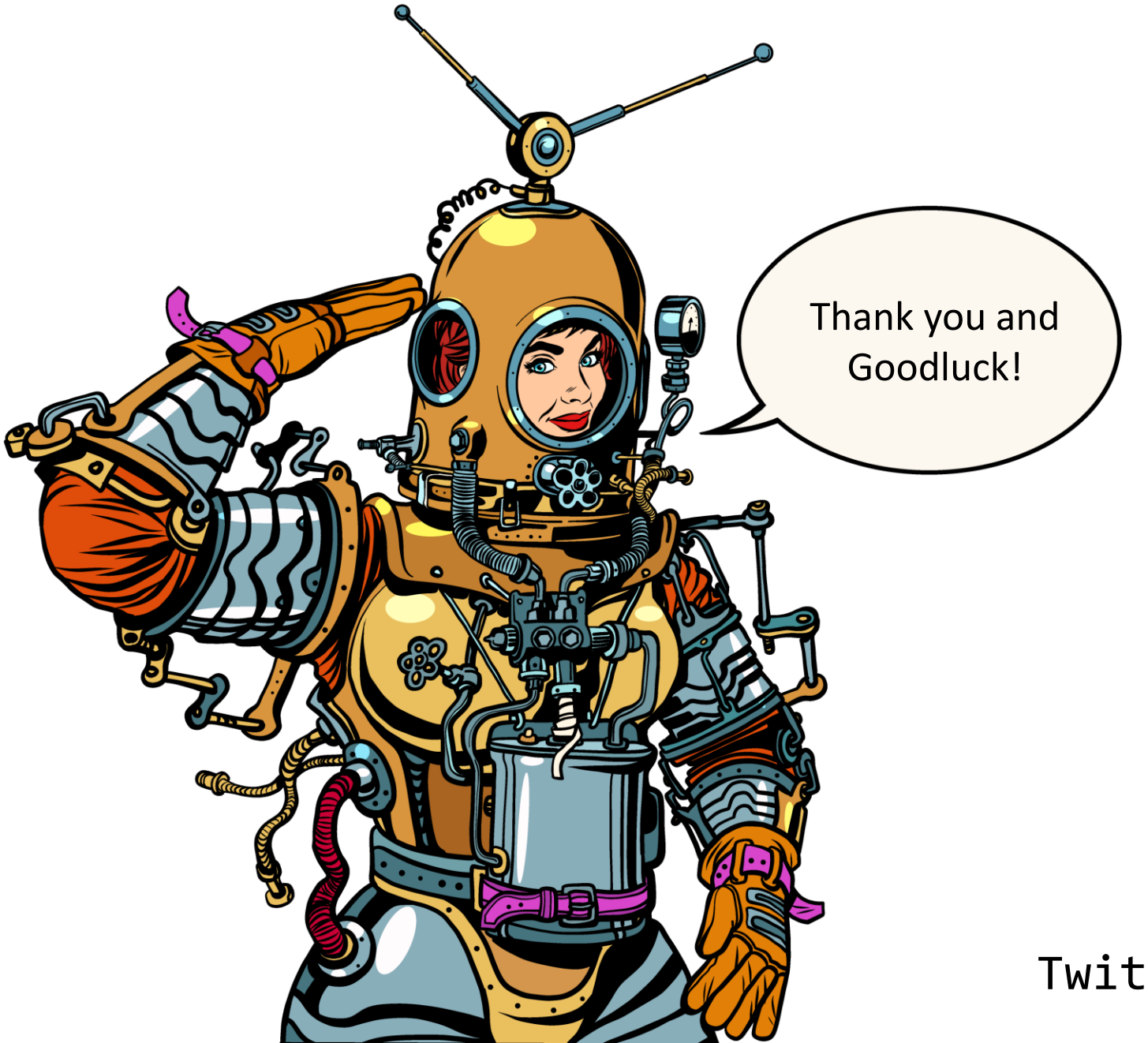


Challenges

- Networks, unknown but discrete
- Cheater cheater pumpkin eater



Big Thank you to Nancy Fulda of BYU



Twitter: @moo_hax