Practical Real-time Detection of IPv4 Record Classical Domain Hijacking at Scale

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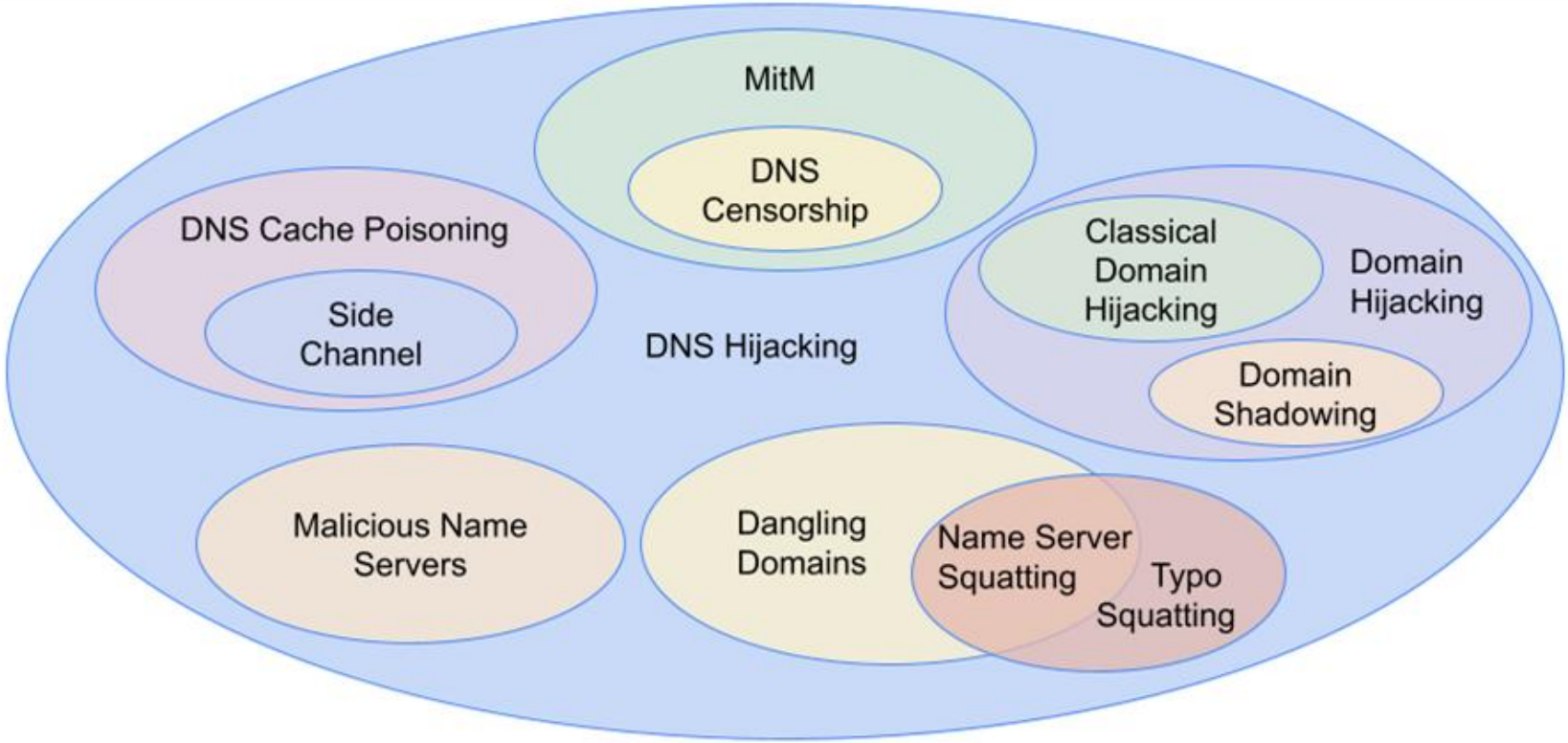
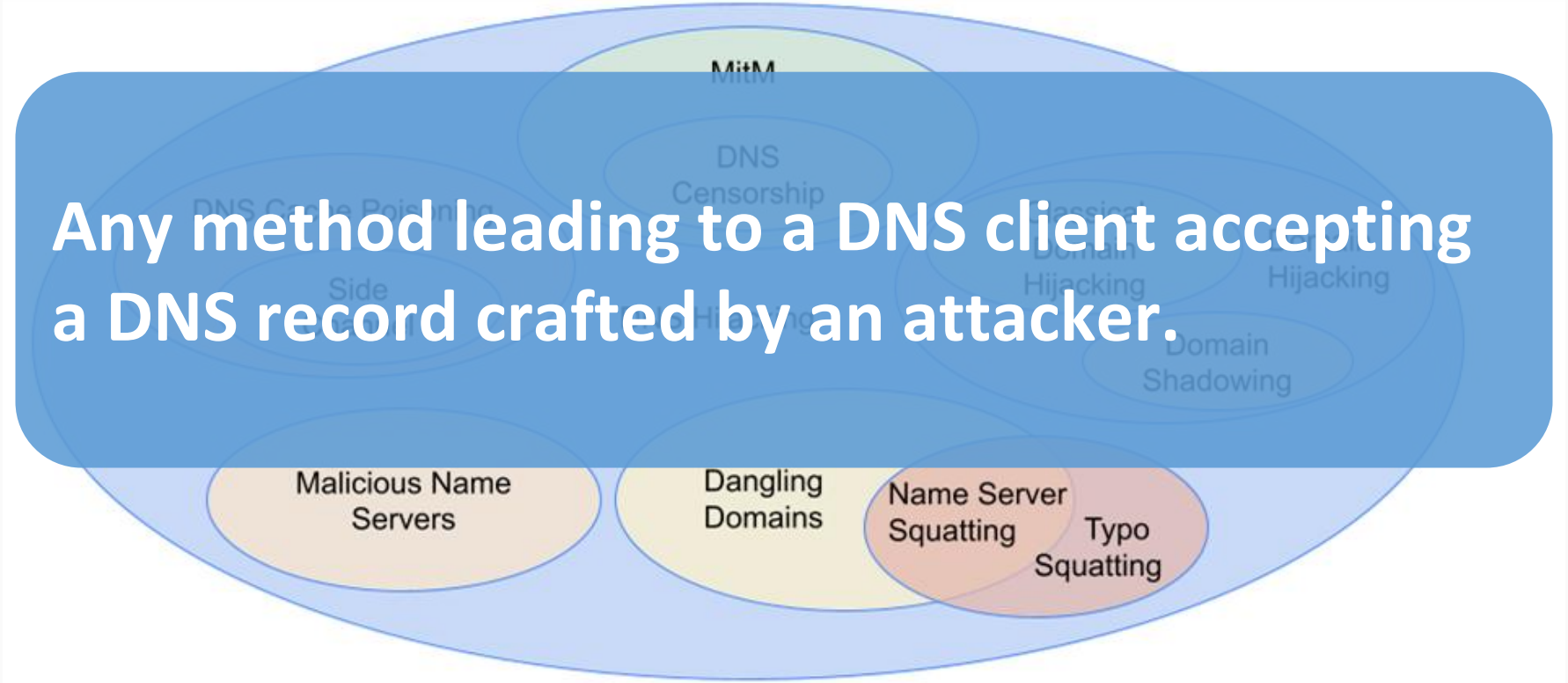
DNS Hijacking

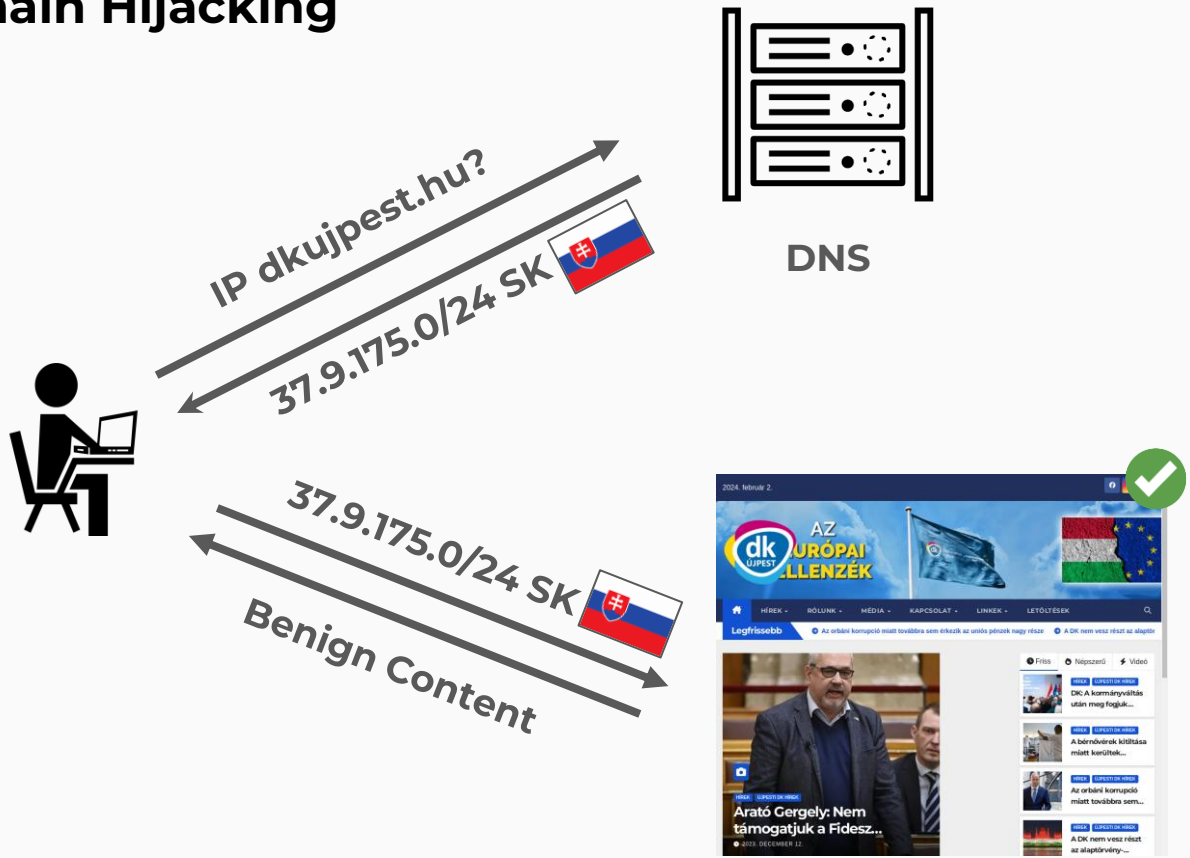


DNS Hijacking

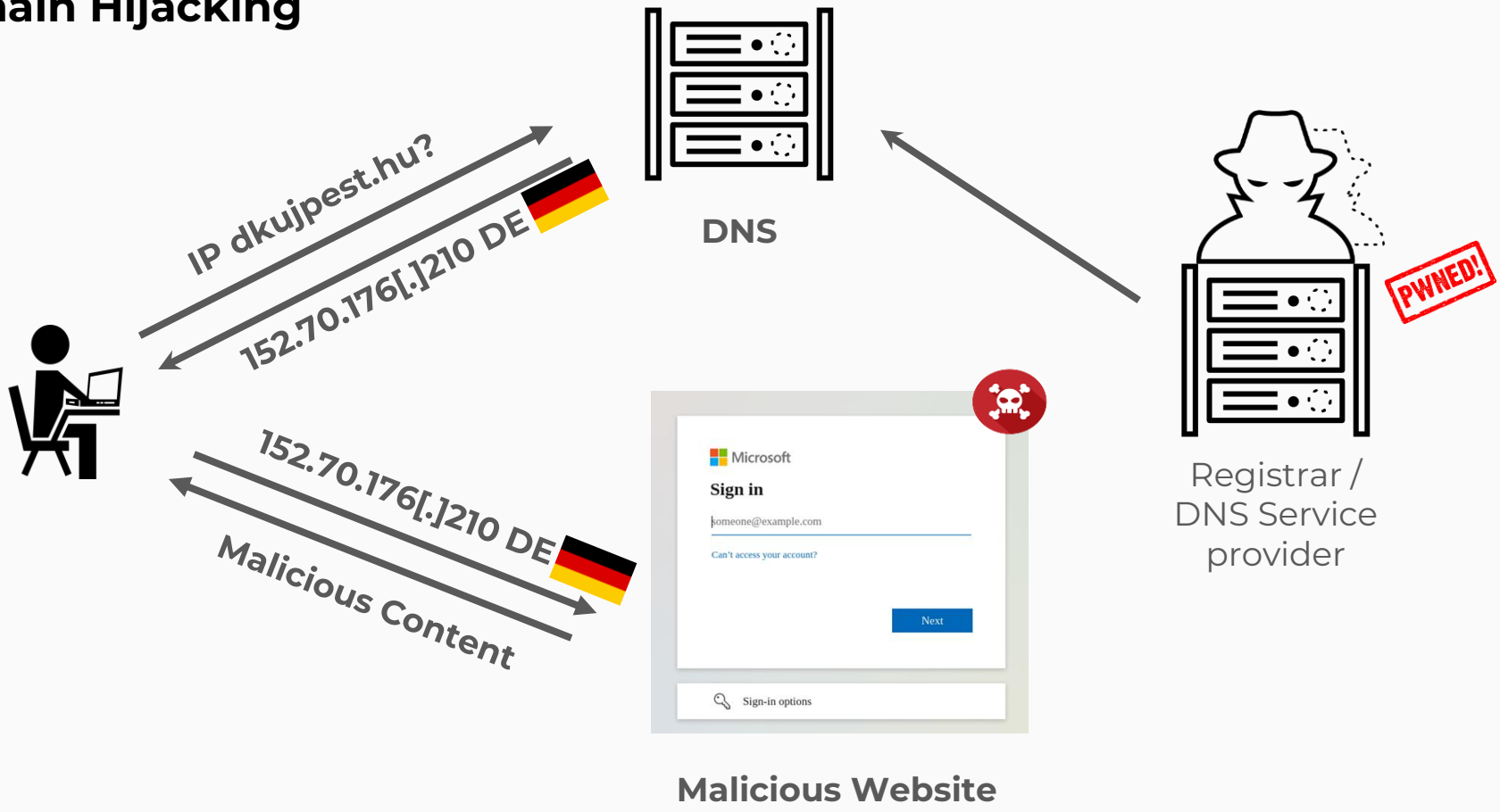


Any method leading to a DNS client accepting a DNS record crafted by an attacker.

Domain Hijacking



Domain Hijacking



Domain Hijacking of a Large Brazilian Bank

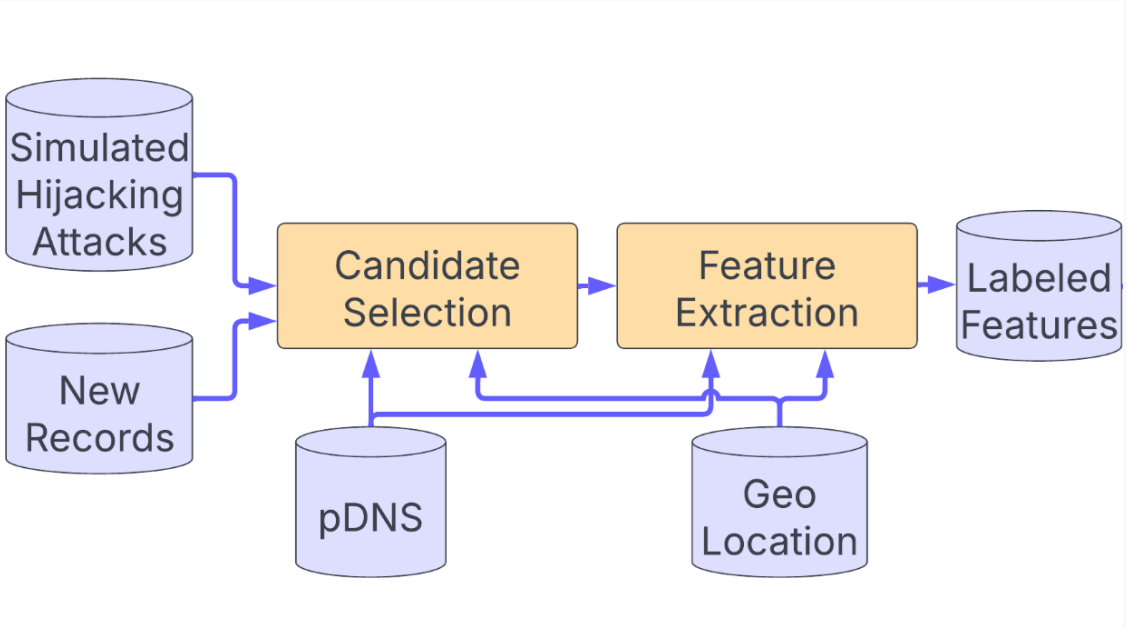
- On Oct. 22, 2016 cybercriminals gained control of all **36 domains of the bank**
  - Compromised DNS service provider
  - Used Let's Encrypt to establish certificates
- **Pointed** all of the bank's employees and customers to **malicious servers**
  - Over 5 million customers exposed
  - Phishing sites and malware
- Malware
  - Disabled antimalware software
  - Harvested Credentials
  - Targeted other banks

Challenges

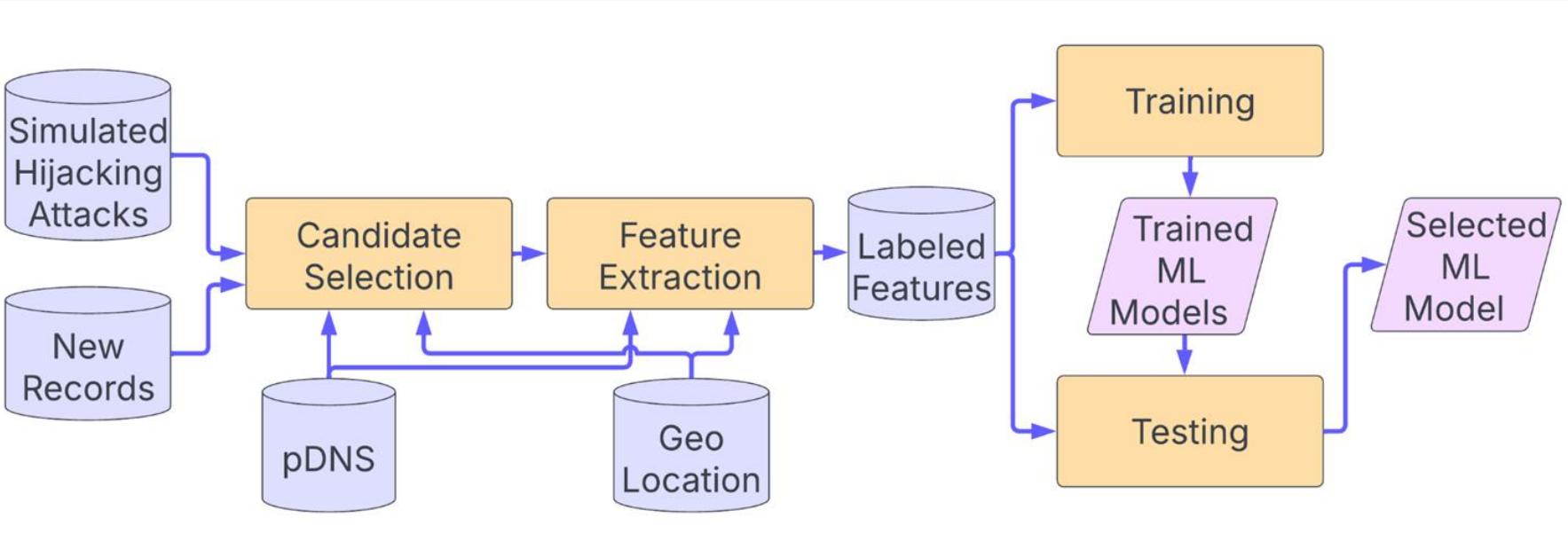
- Hundreds of millions of new DNS records every day
- Only a few domain hijacking records expected
- Hundreds of terabytes of historical data to process
- Very few cases of known hijacking DNS records for training an ML model

Training a Machine Learning Model

Training a Machine Learning Model



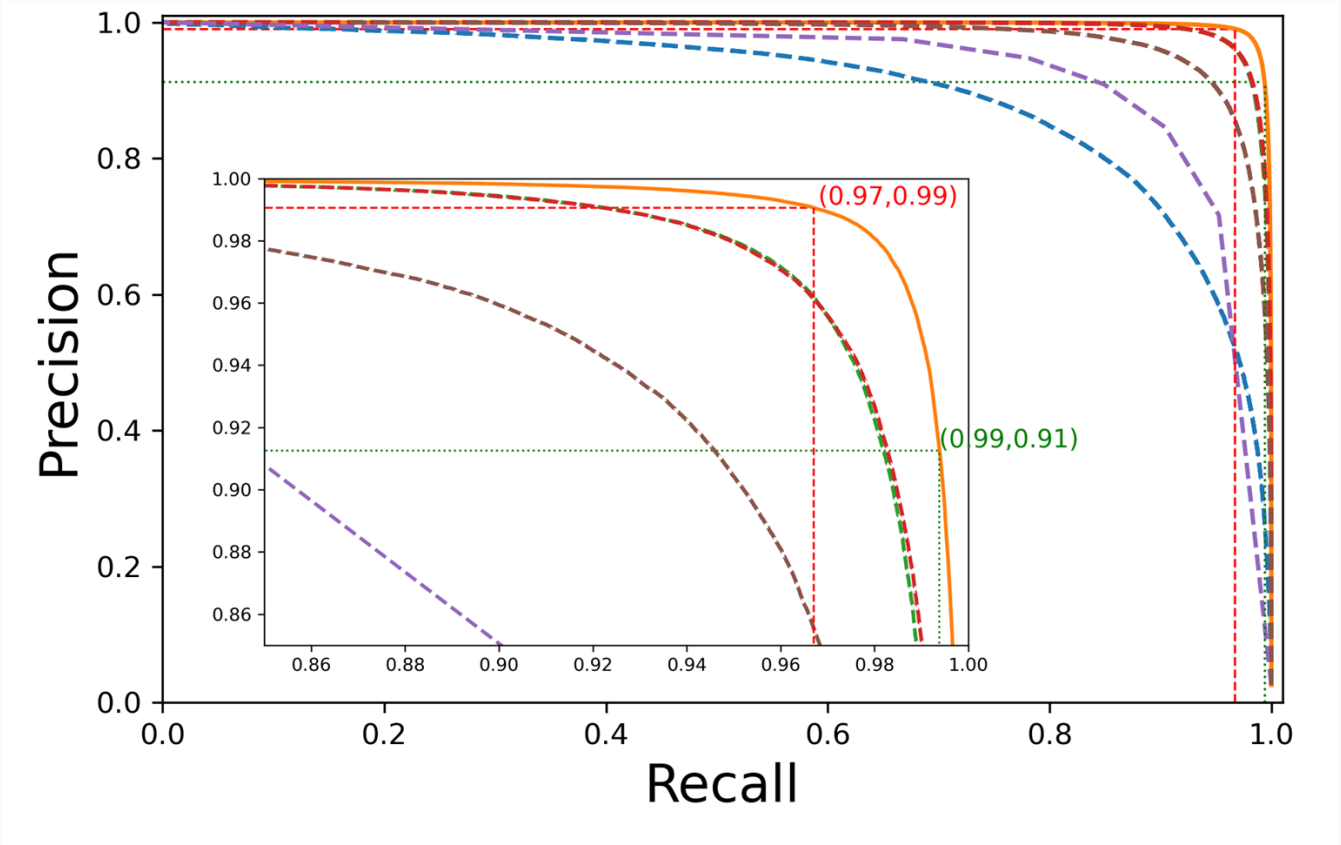
Training a Machine Learning Model



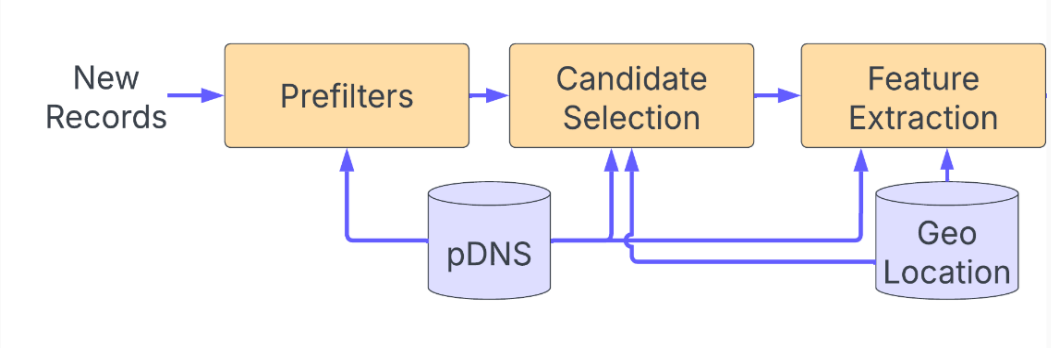
Features used

- Comparison of **DNS History** of new IP and old IP addresses
  - Average DNS record age
- **DNS History** of new IP
  - # domains where IP address is new
- Comparison of **geolocation** of new IP and old IP addresses
  - Is country, ISP, ASN new?
- **DNS History** of the compromised domain
  - # IP addresses, # of IP countries
  - # of new record types

Precision Recall Tradeoff



Offline ML Pipeline in Production



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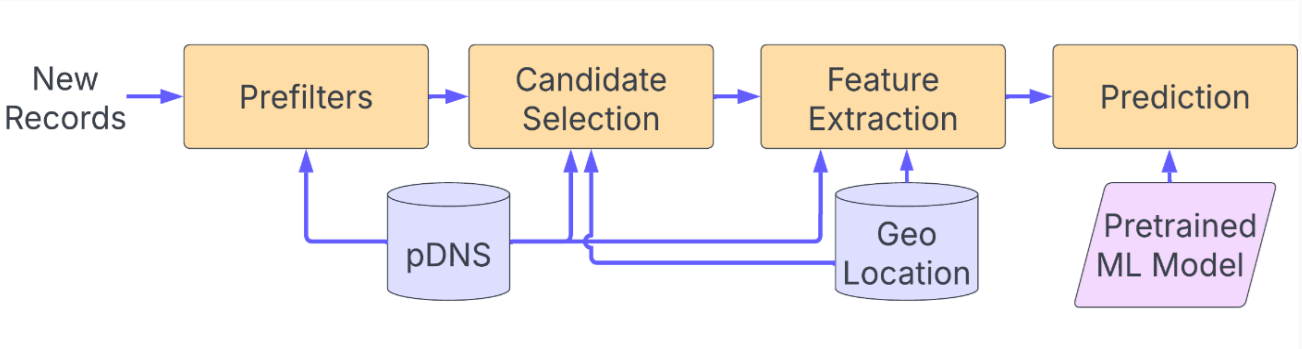

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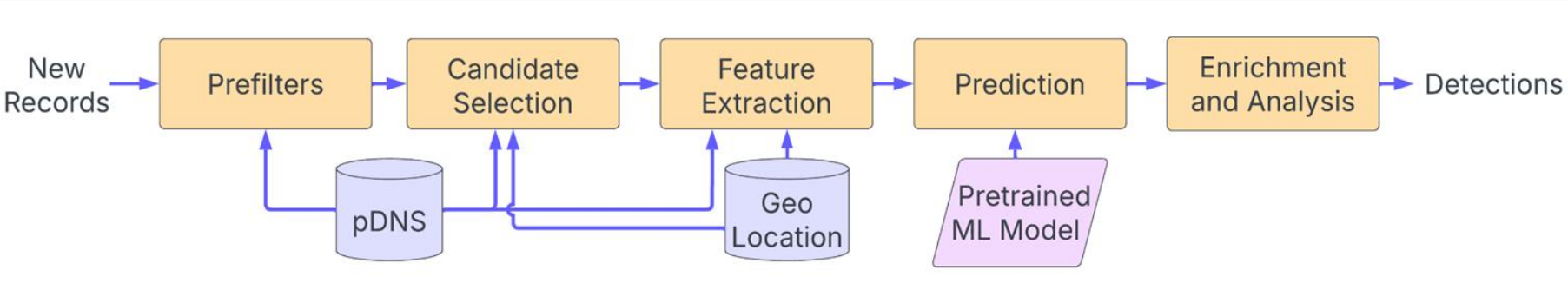
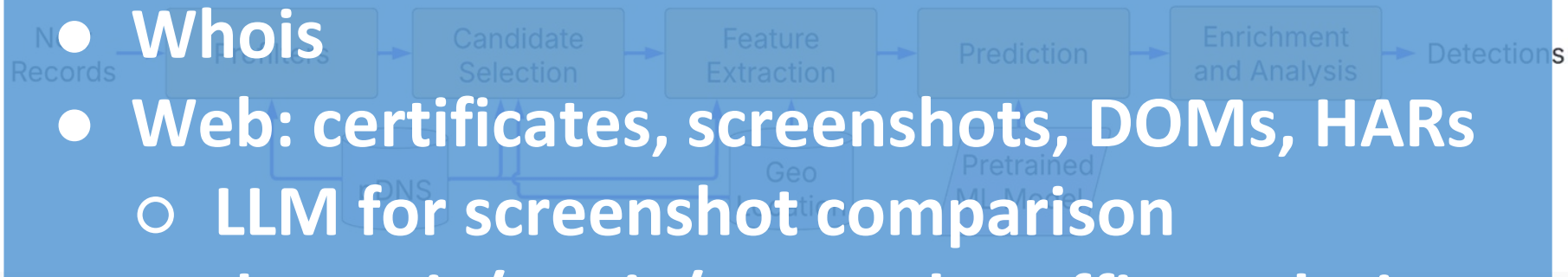


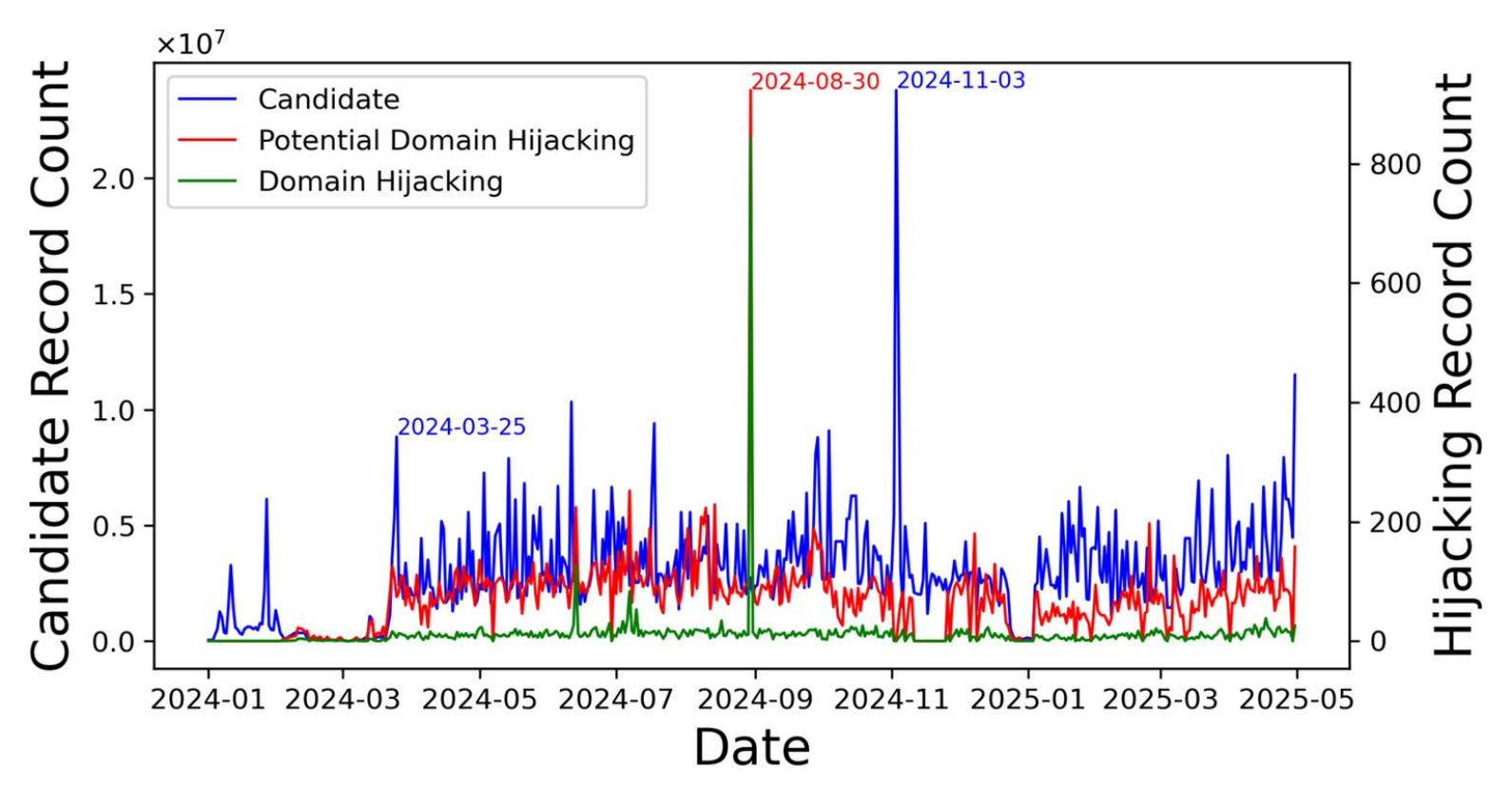
Offline ML Pipeline in Production

Enrichment and Analysis:

- Whois
- Web: certificates, screenshots, DOMs, HARs
  - LLM for screenshot comparison
  - dynamic/static/network traffic analysis



Numbers in Production



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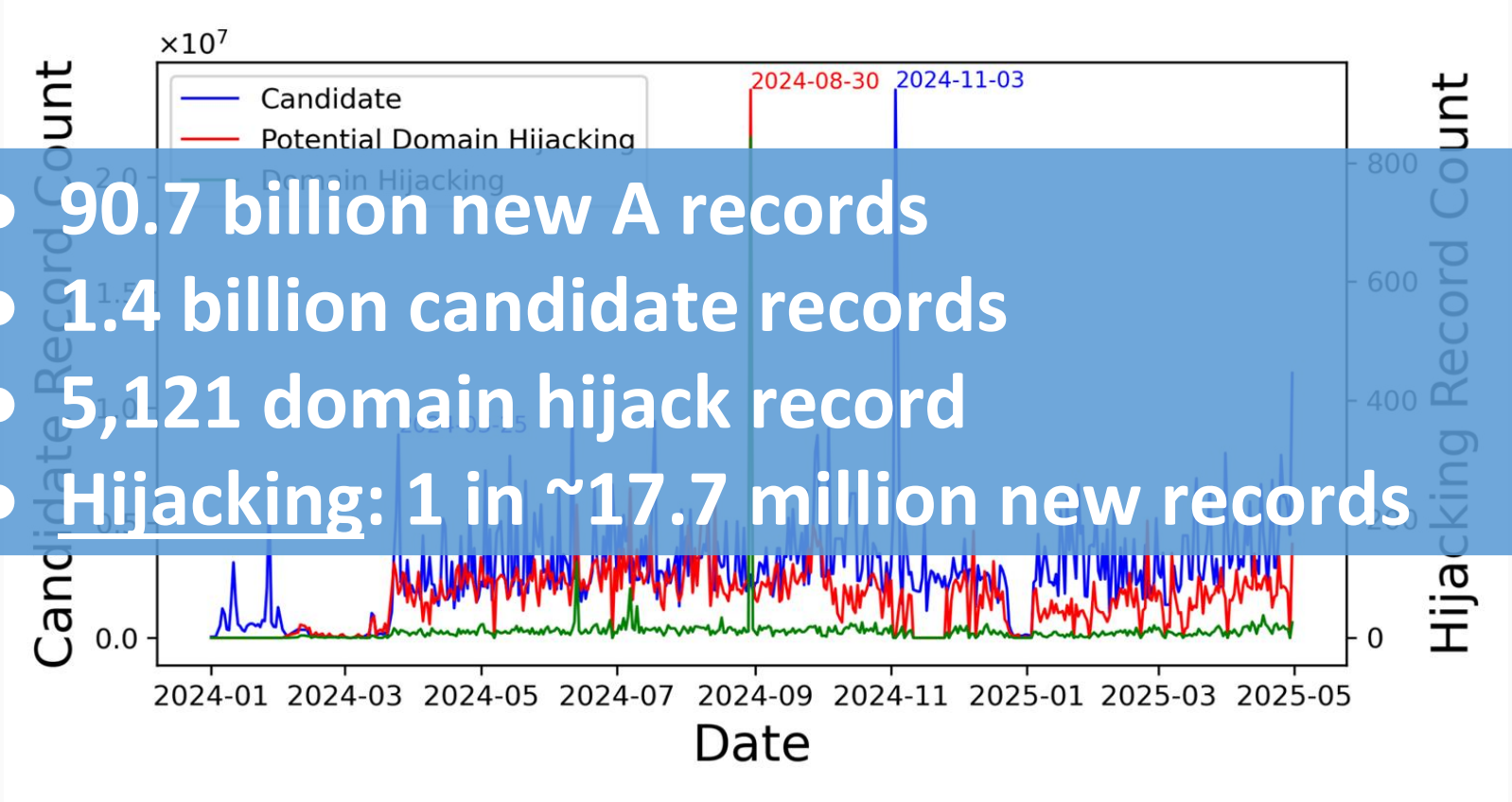
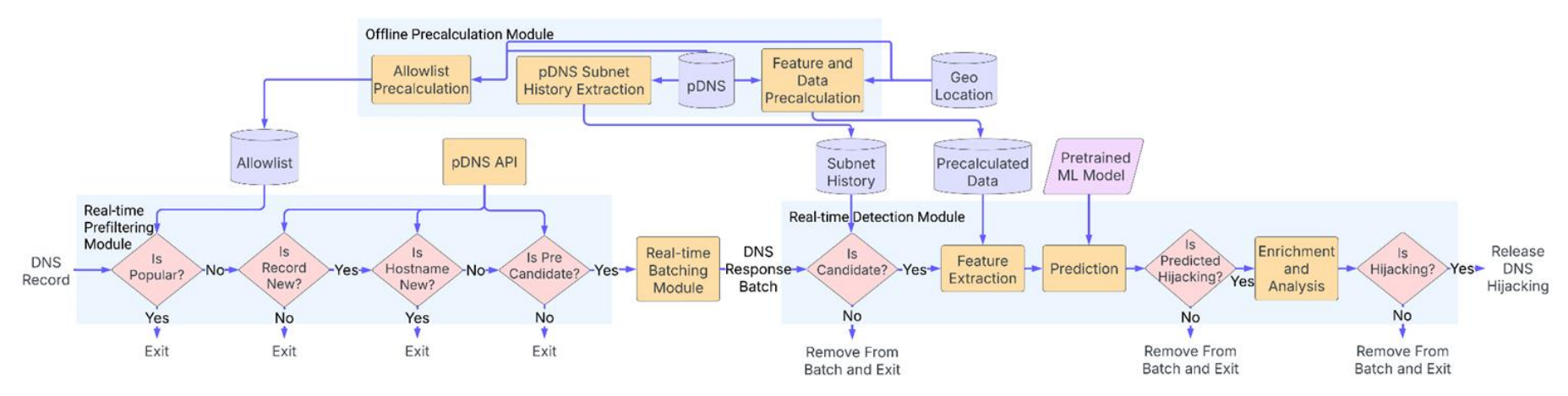


- 90.7 billion new A records
- 1.4 billion candidate records
- 5,121 domain hijack record
- Hijacking: 1 in ~17.7 million new records

Real-time ML Pipeline in Production



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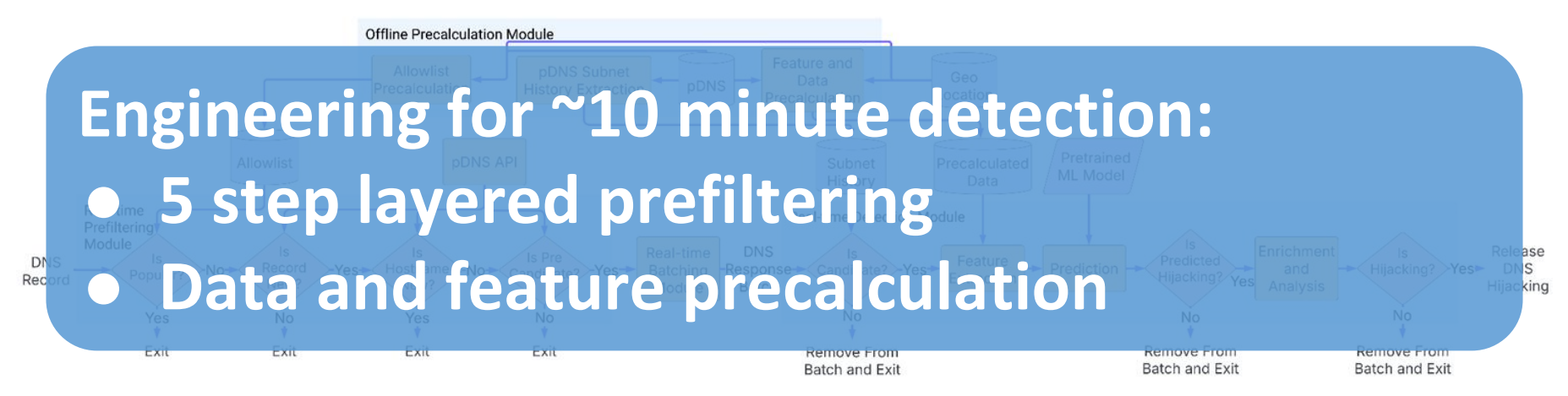

Engineering for ~10 minute detection:

- 5 step layered prefiltering
- Data and feature precalculation

Large U.S. utility management company - defaced webpage

Large U.S. utility management company - hijacked DNS record

Hijacked A record

IP	Geolocation/ASN	Last Seen	First Seen
[redacted]	[redacted] US) **ISP name:** [redacted] **Subnet:** [redacted] **ASN:** [redacted]	07/02/2024 18:45 PDT	02/03/2014 20:28 PST
176.9.24.28	Falkenstein, Sachsen, Germany (DE) **ISP name**: Hetzner Online GmbH **Subnet**: 176.9.21.128 - 176.9.49.55 **ASN**: ASNumber: 24940 ASName: "HETZNER-AS, DE")	05/07/2024 08:45 PDT	05/07/2024 08:45 PDT

Large internet service provider - hijacked DNS record

Name Server	Last Seen	First Seen
[redacted]	07/03/2024 16:56 PDT	12/19/2013 22:44 PST
[redacted]	07/03/2024 16:56 PDT	12/19/2013 22:44 PST
ns1.csit-host.com	05/25/2024 20:47 PDT	05/24/2024 11:29 PDT
ns2.csit-host.com	05/25/2024 20:47 PDT	05/24/2024 11:29 PDT

Name server hijacked

Summary

- **Detecting Domain Hijacking from pDNS is possible**
  - In production
  - At scale
  - Real-time
- **Domain hijacking is rare but a regular occurrence**
  - More frequent than previous known hijacking
  - Potentially him impact but most often not as sophisticated: Defacement, phishing, malware, ...

Q&A

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