The bots arms race on airlines booking websites

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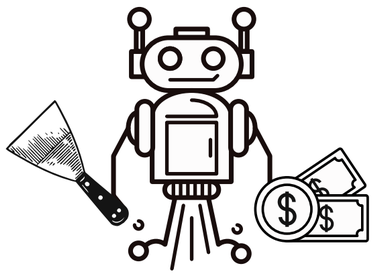
EU MINI AVTECH EXCHANGE
21st September 2022



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Who are we?

Elisa Chiapponi, Phd student Amadeus Global SOC and EURECOM

Finding practical means to defeat scraping bots
Understanding their ecosystem (actors, techniques, infrastructure)

Global SOC members Olivier Thonnard, Mohamed Fangar, Vincent Rigal
Academic supervisor Prof. Marc Dacier

EURECOM
Sophia Antipolis

جامعة الملك عبدالله للعلوم والتقنية
King Abdullah University of Science and Technology

Resilient Computing and Cybersecurity Center

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Agenda

Agenda

1

The battle against scrapers

- Which weapons are they using?
- What can we do now?

Agenda

1

The battle against scrapers

- Which weapons are they using?
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2

WebApp Honeypot

- Is it possible to lure attackers?

Agenda

1

The battle against scrapers

- Which weapons are they using?
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WebApp Honeypot

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3

RESIP detection

- Is it possible to detect scrapers taking advantage of Residential IP addresses?

1 The battle against scrapers

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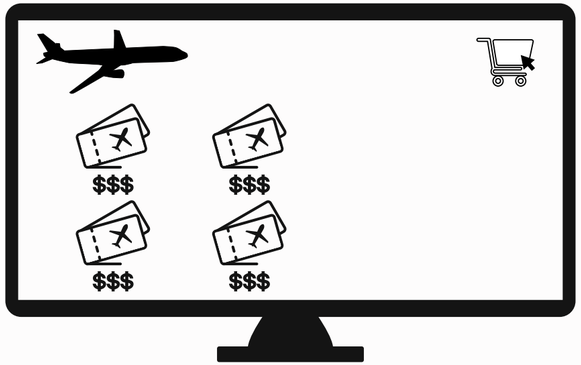
Web scraping is the periodical or continuous retrieval of accessible data and/or processed output contained in web pages.

OWASP automated threats to web applications

Why is scraping a problem?



E-commerce websites

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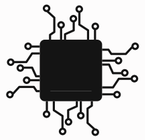
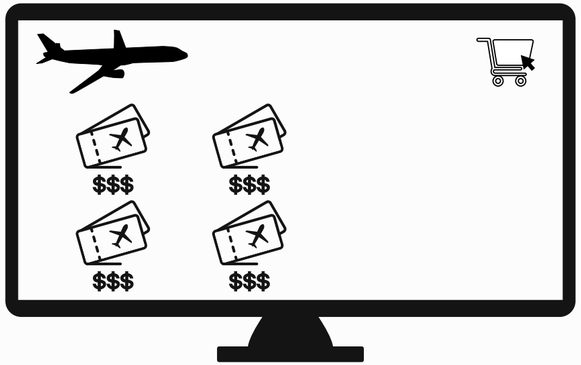


CPU cost



E-commerce websites

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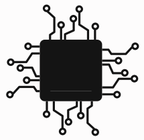
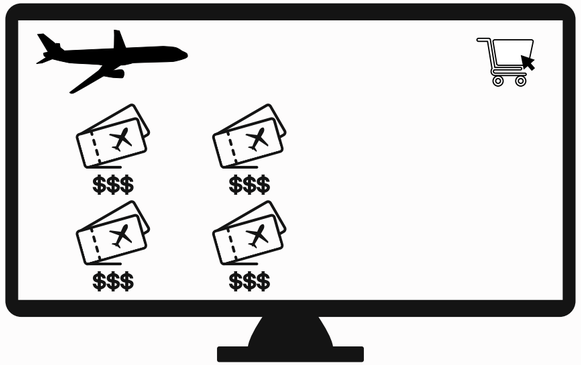


CPU cost

Storage cost



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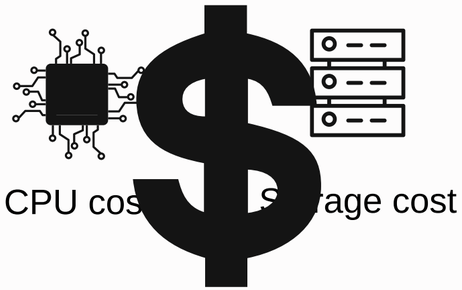

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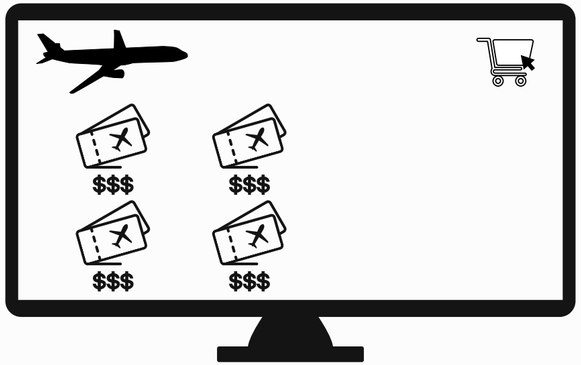

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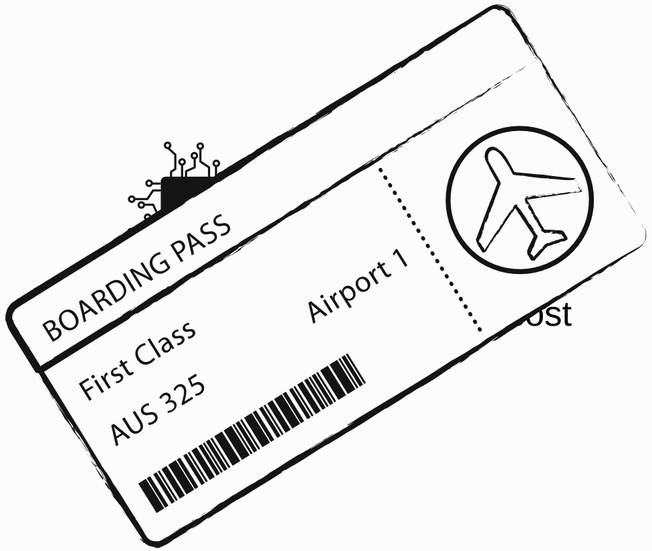

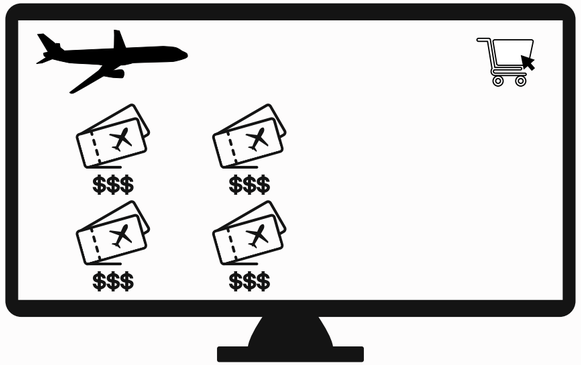

E-commerce websites

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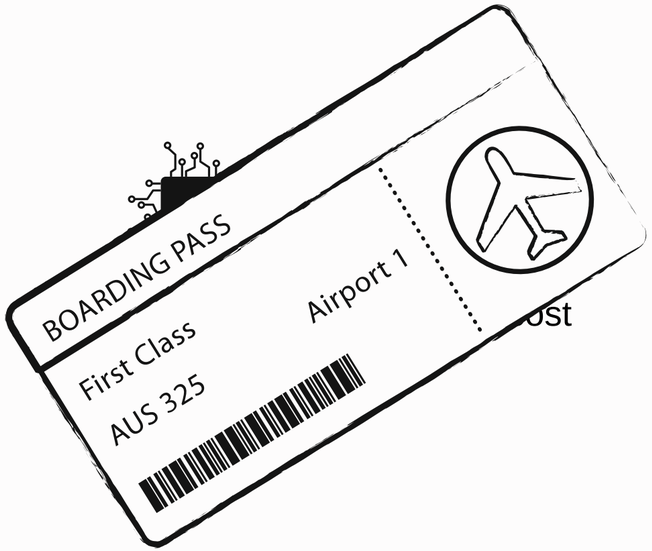
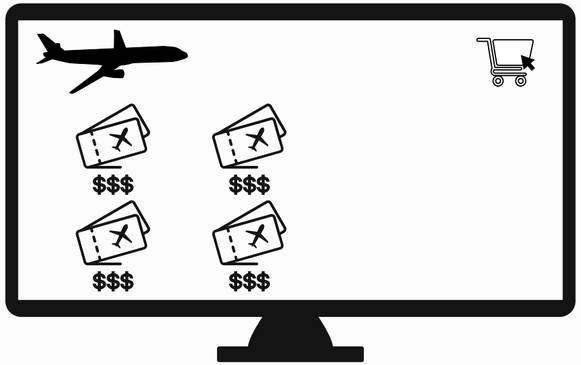
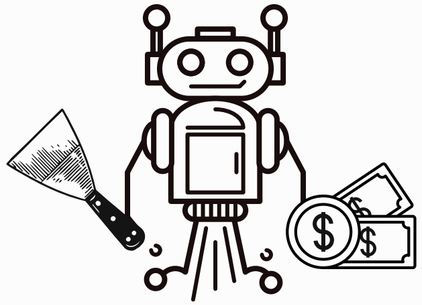




E-commerce websites



Scrapers

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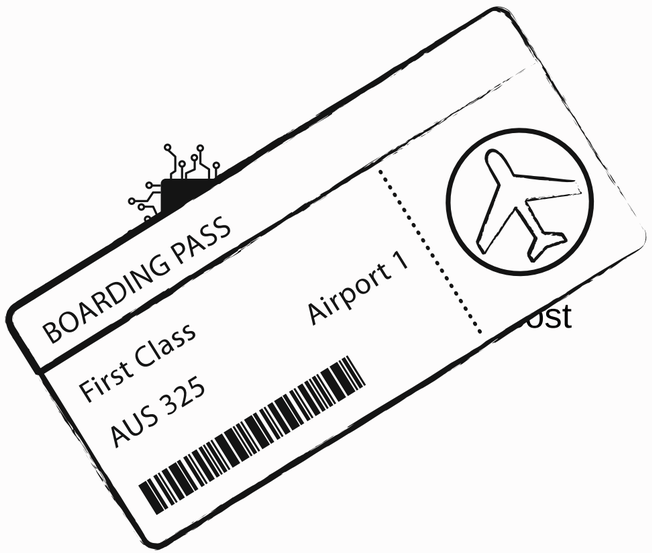

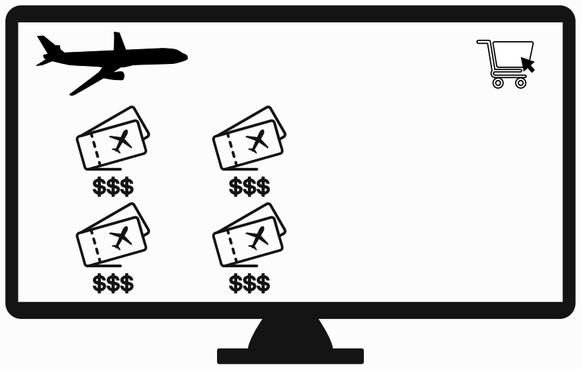

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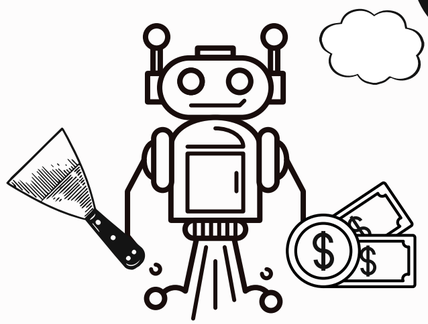

Scrapers

Ticket fares
Seat availability

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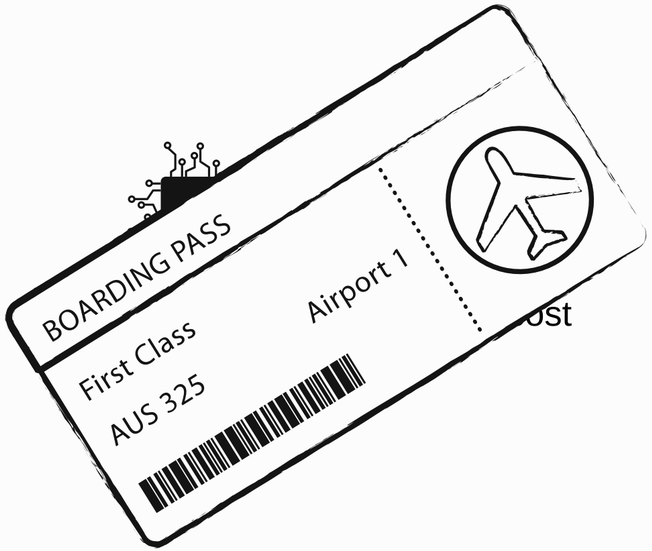

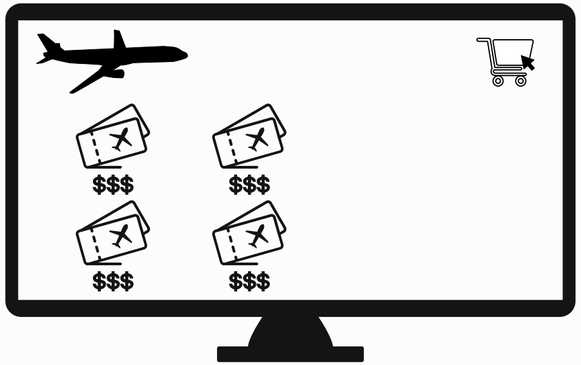

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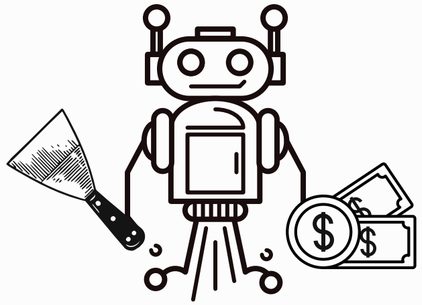

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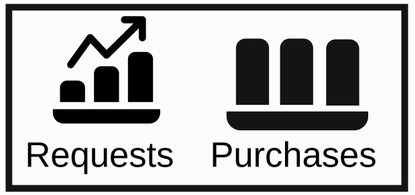

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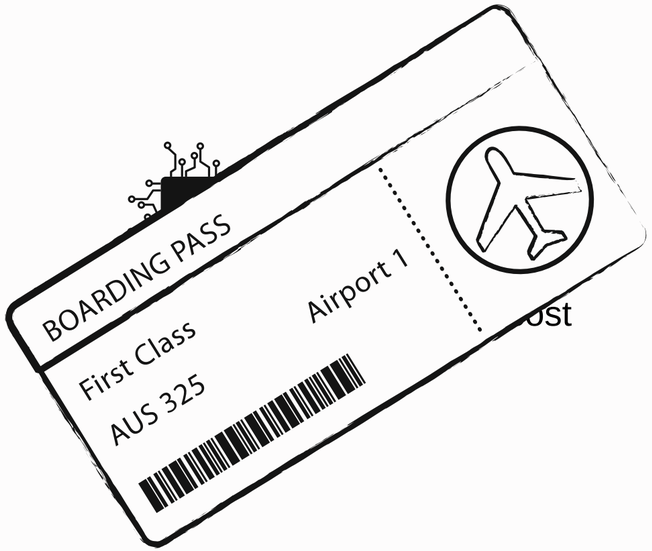

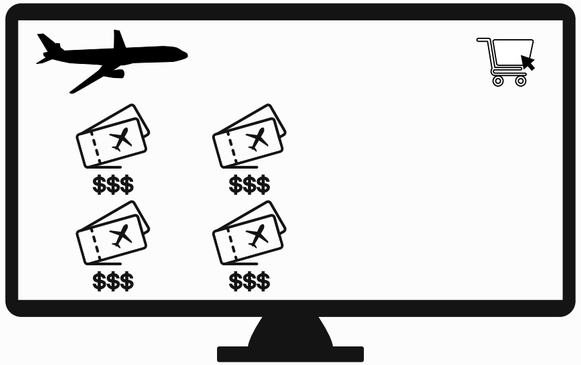

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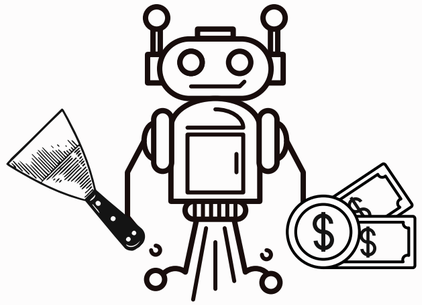

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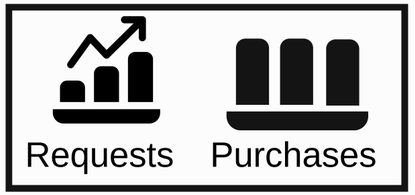

Slow connections

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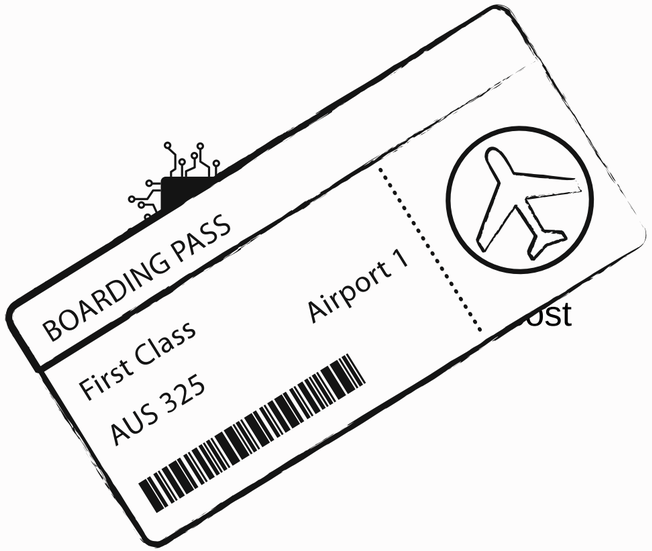

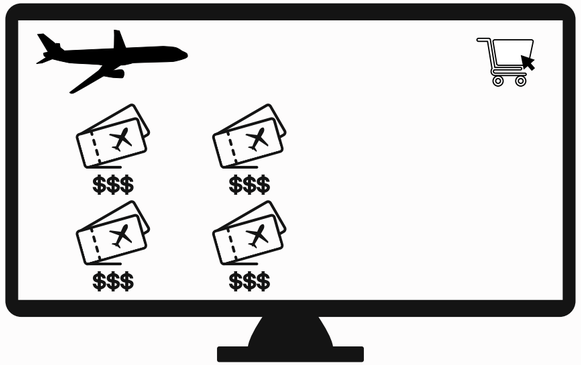

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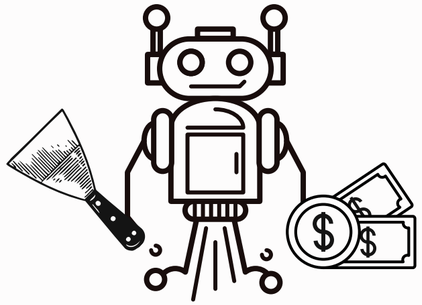

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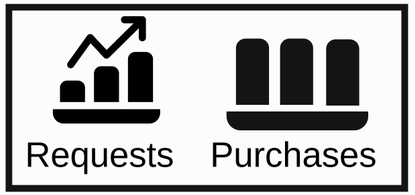

Slow connections

Server down

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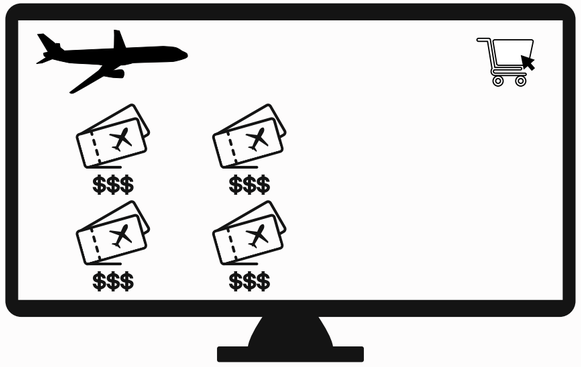

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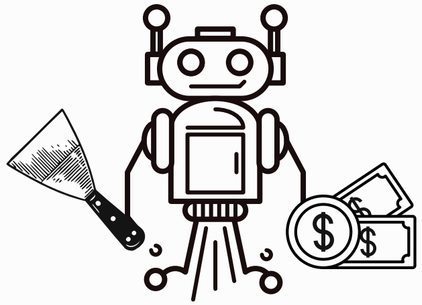

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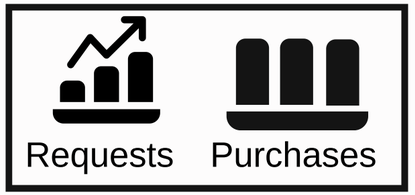

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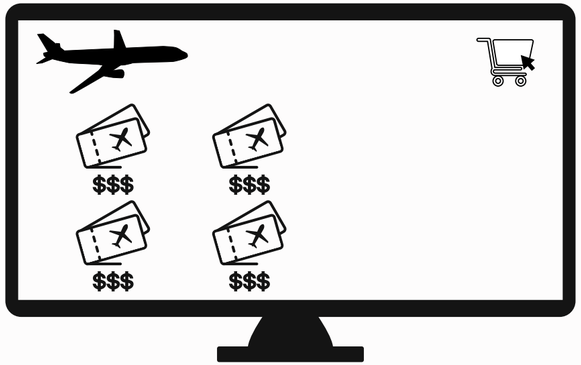

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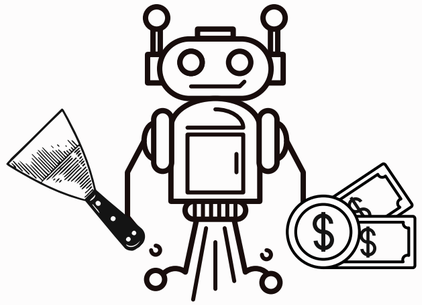

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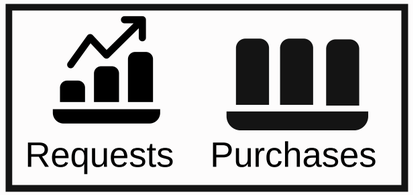

Slow connections

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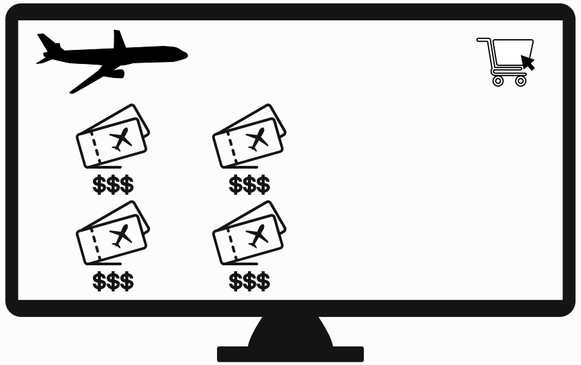

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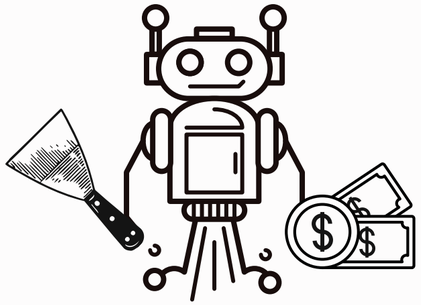

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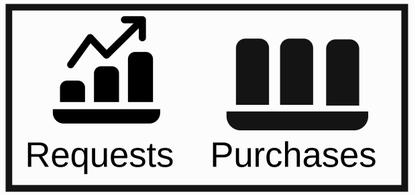

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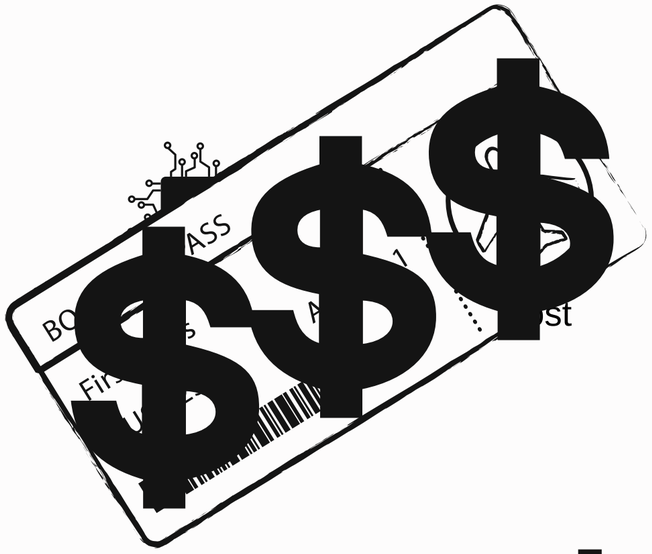

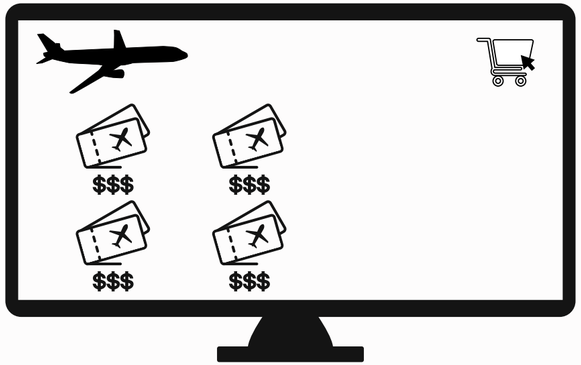

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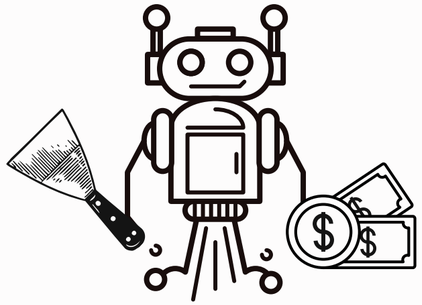

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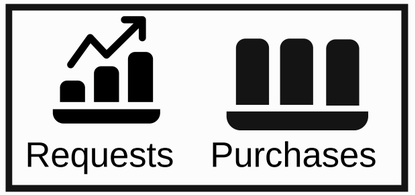

Slow connections

Server down

Cloud migration

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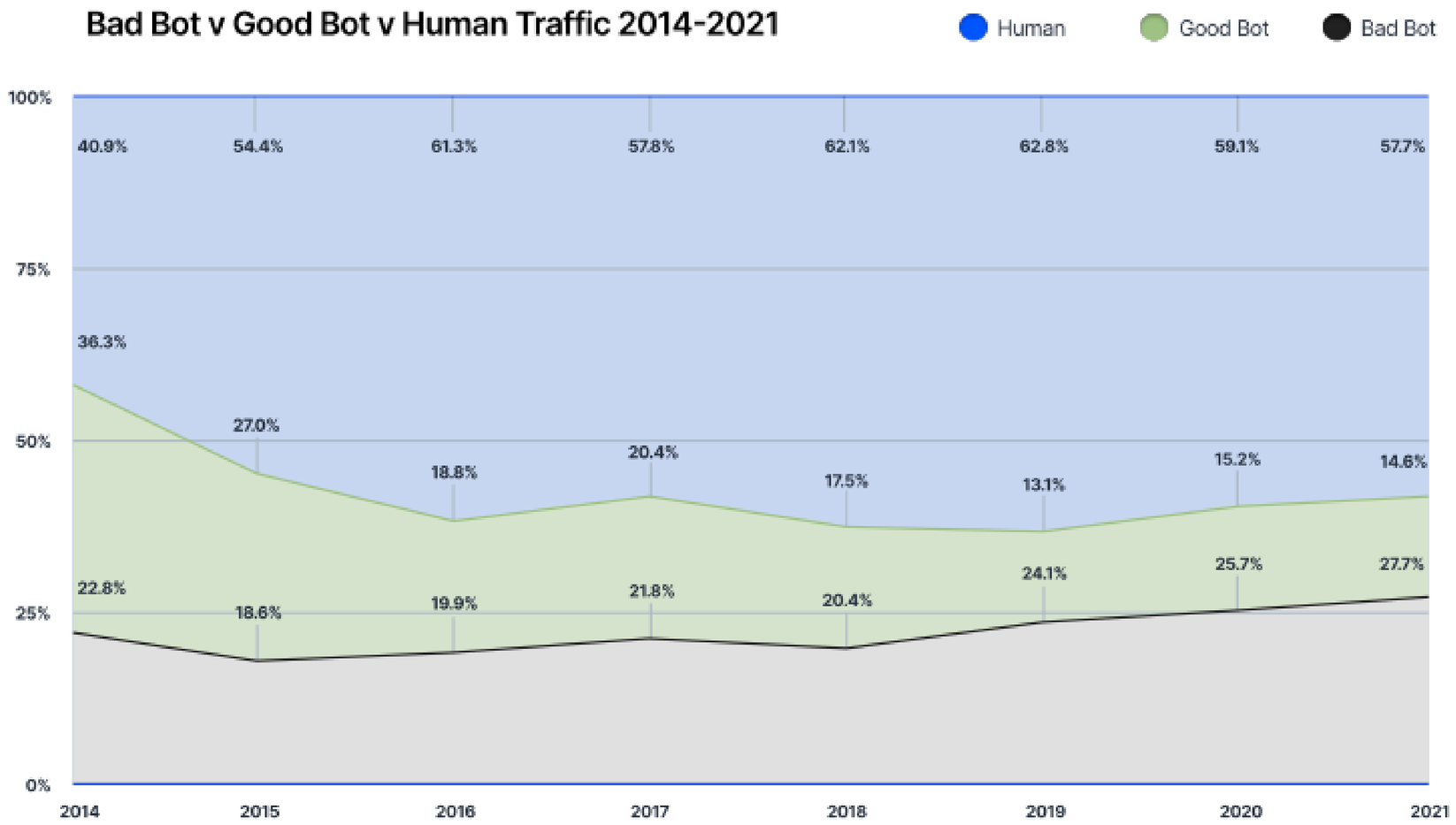
Call to the army



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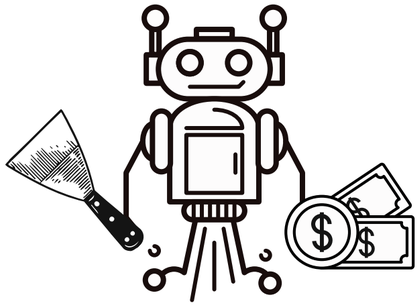
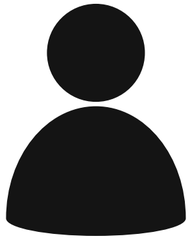
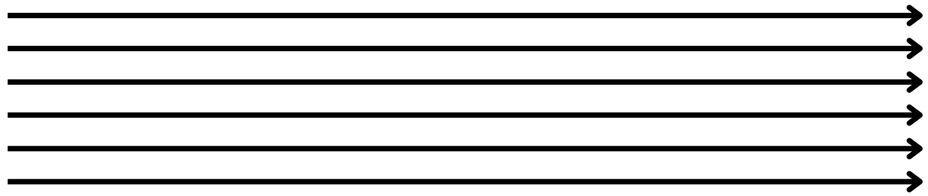
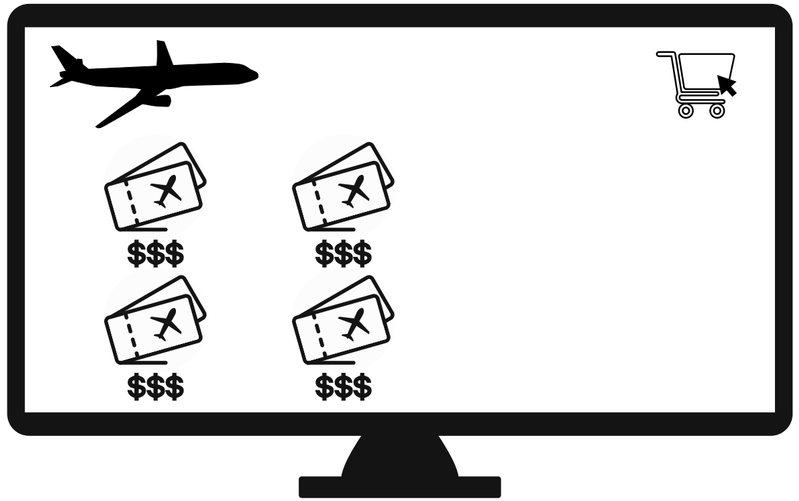


Scrapers



Users





E-commerce websites

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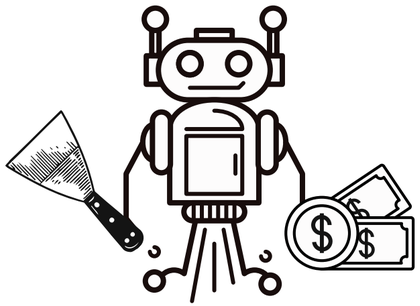
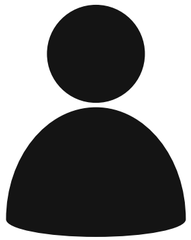


Scrapers



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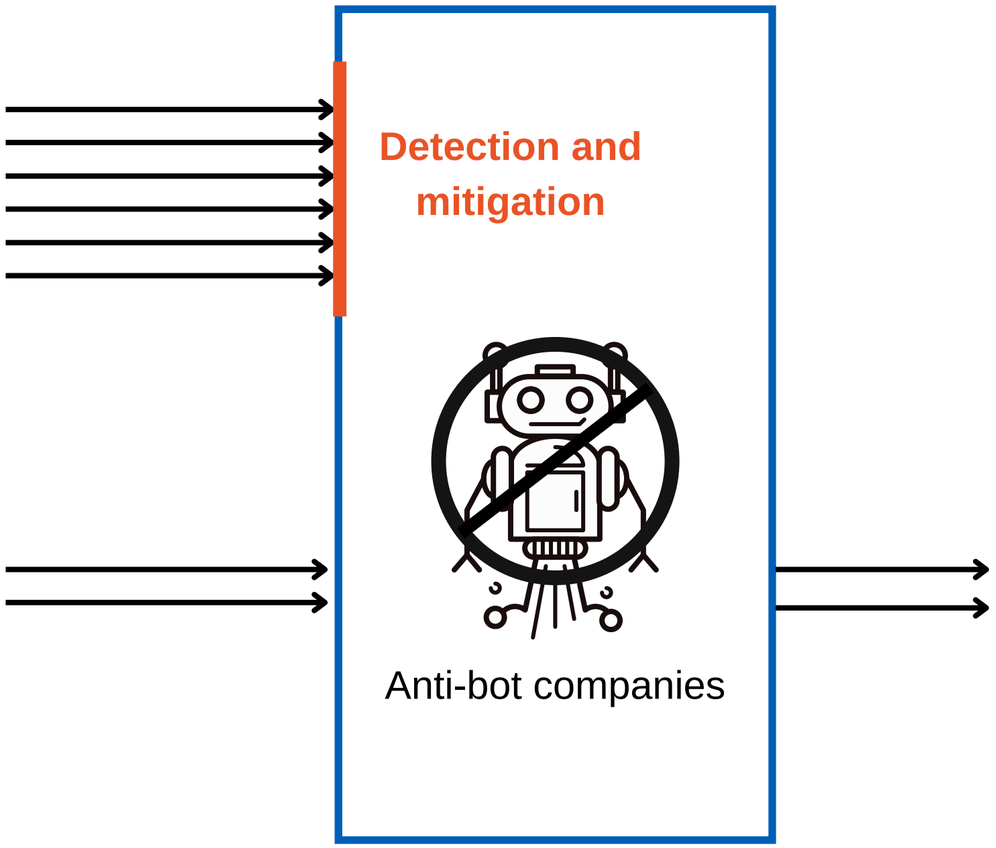

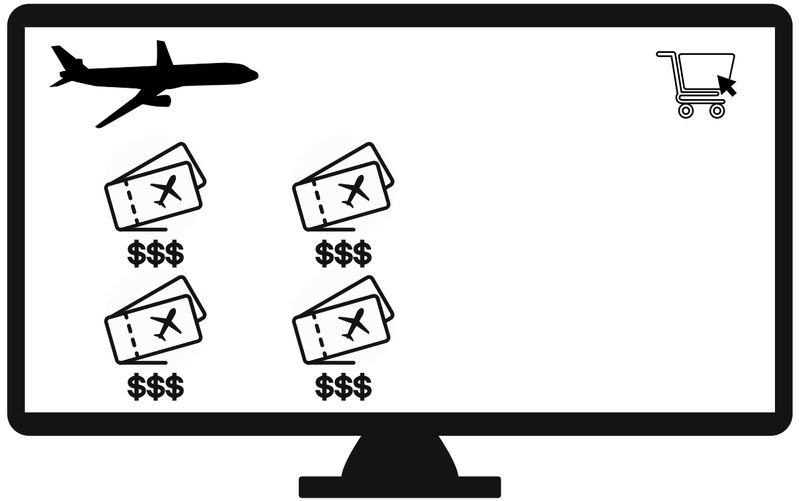

E-commerce websites

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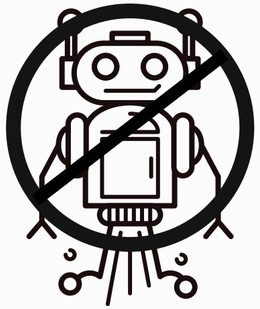
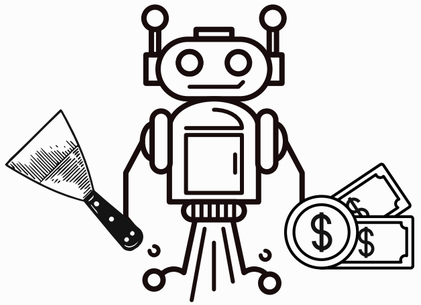
A persistent battle



Anti-bot companies



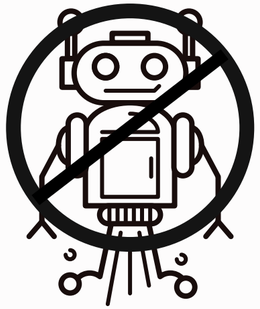
Scrapers

A persistent battle

http

Browser fingerprinting

HTTP header anomaly detection



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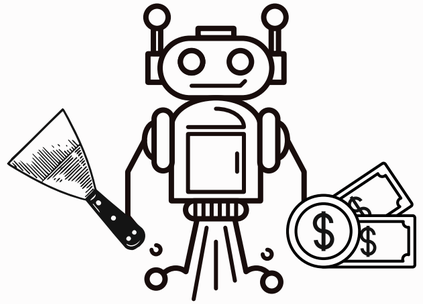


Scrapers

A persistent battle

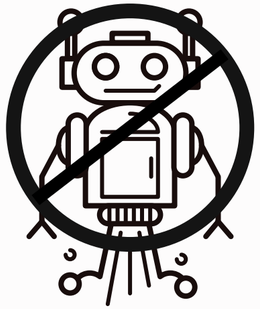
Browser fingerprinting

http

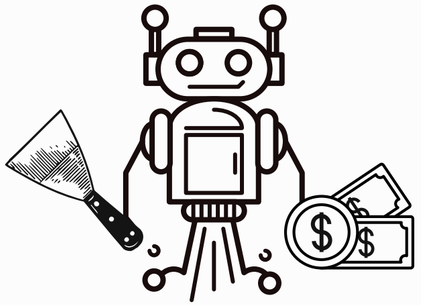
HTTP header anomaly detection

Scrapy PhantomJS

Browser emulation frameworks



Anti-bot companies



Scrapers

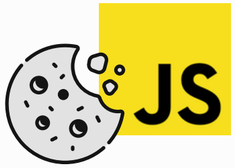
amadeus

A persistent battle

http

HTTP header anomaly detection

Browser fingerprinting



JS and cookies challenges

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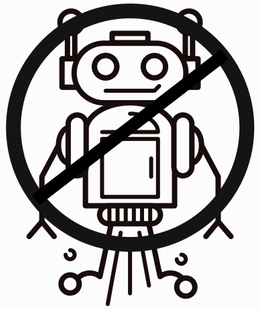

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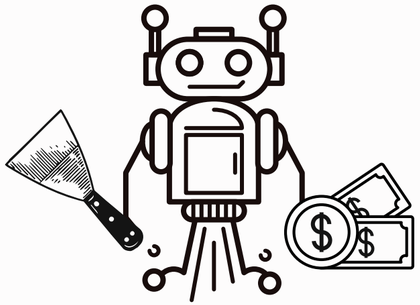

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Scrapy PhantomJS

Browser emulation frameworks

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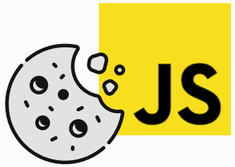

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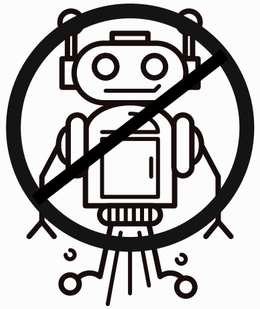

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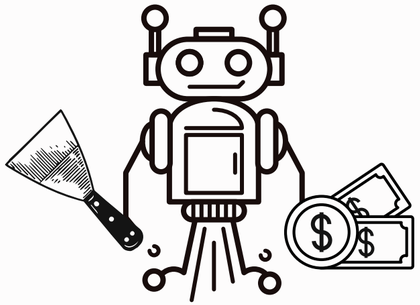

Scrapers

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Automated browsers, cookies and JS support

amadeus

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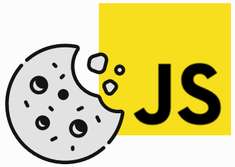

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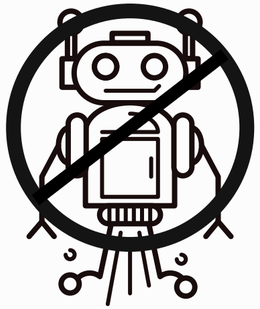

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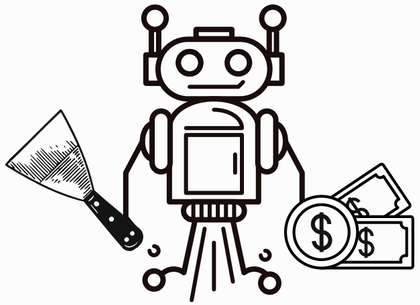

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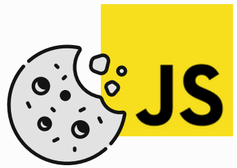

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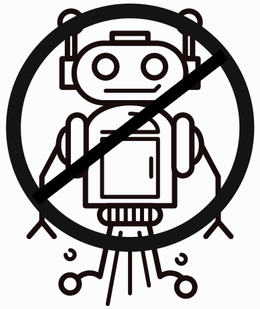

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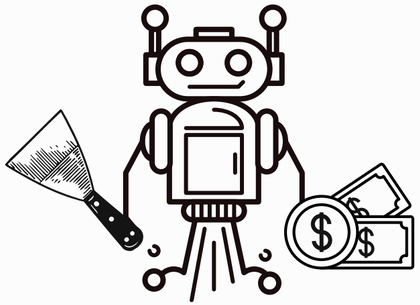

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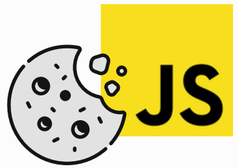

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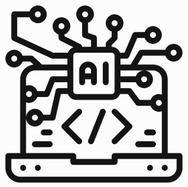
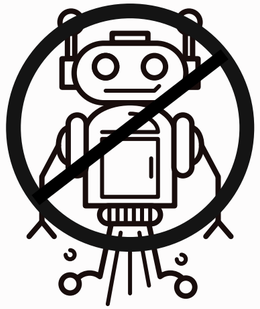


Machine learning

Wasting bots resources



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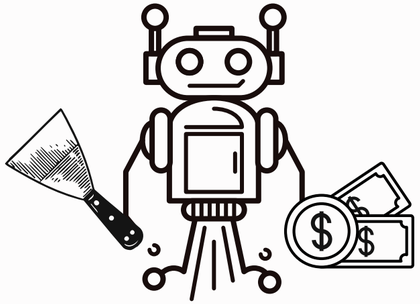

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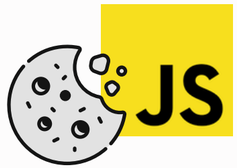

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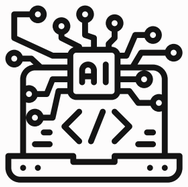

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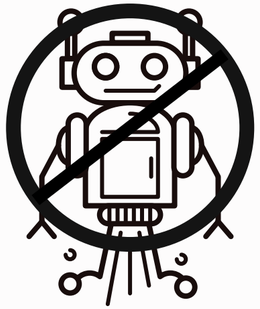

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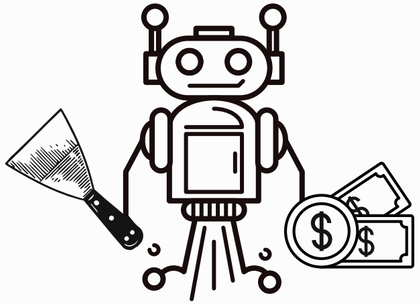

Scrapers

Scrapy PhantomJS

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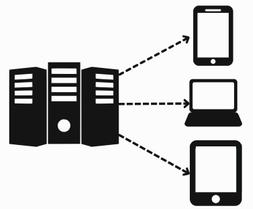

Residential IP (RESIP) proxy

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A persistent battle

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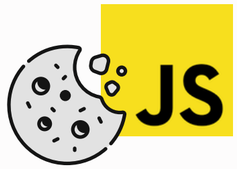

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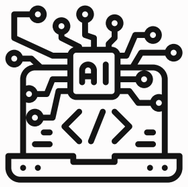

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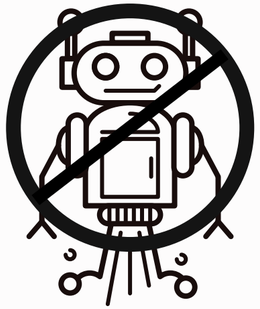

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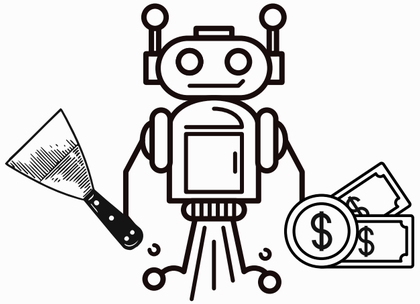

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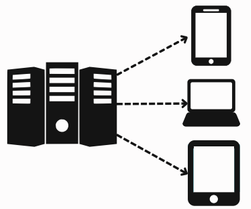

Residential IP (RESIP) proxy

Higher risk to block legitimate users

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Problems

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What can **we** do?

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2 WebApp Honeypot

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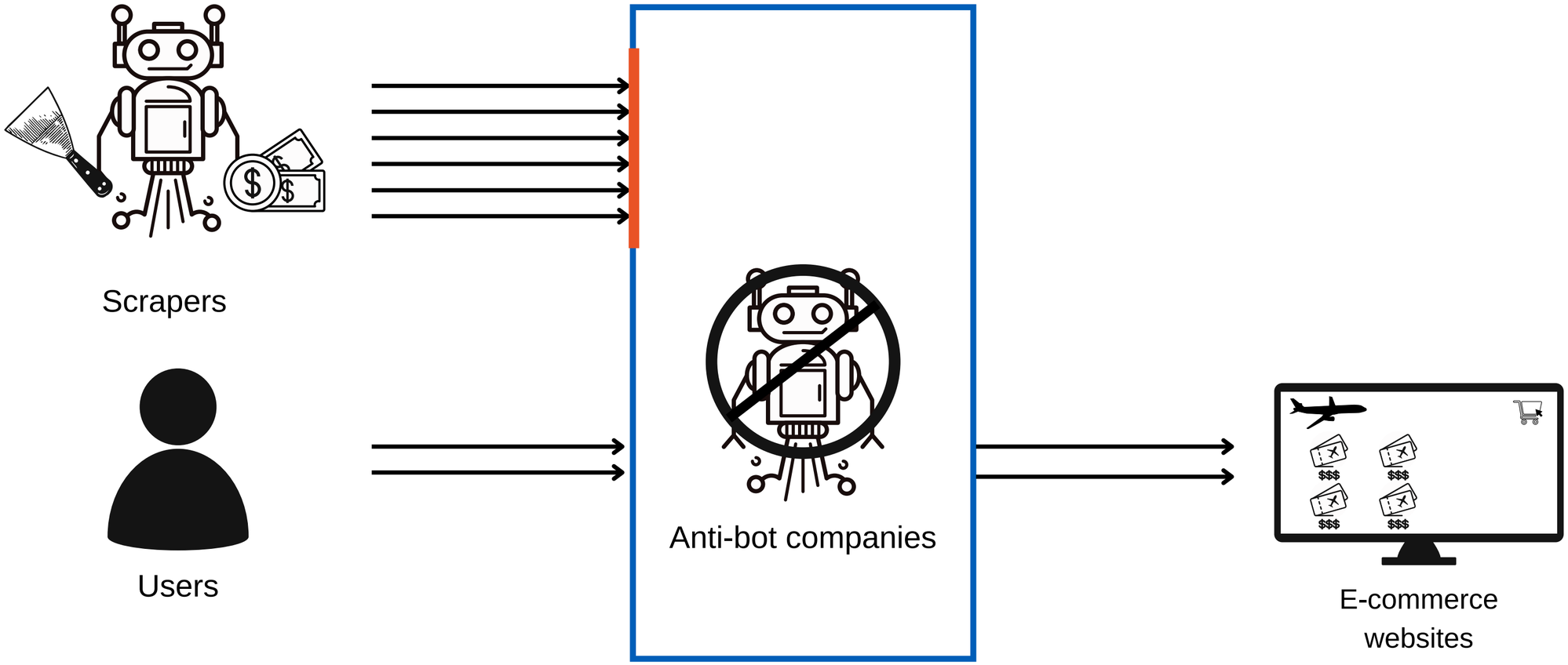
Idea

Prevent scrapers to know they have been detected
providing **incorrect but plausible**
answers at a cheap cost for the provider

Inserting the WebApp Honeypot



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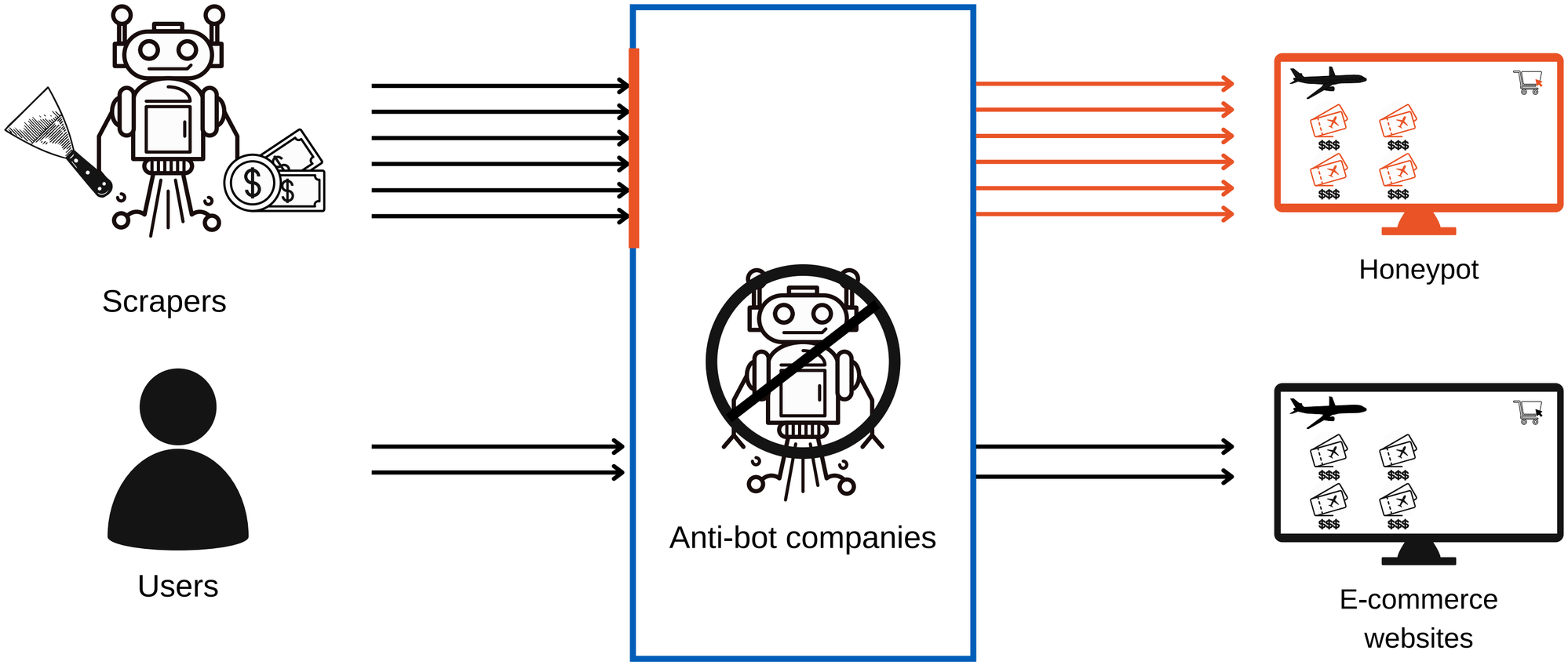

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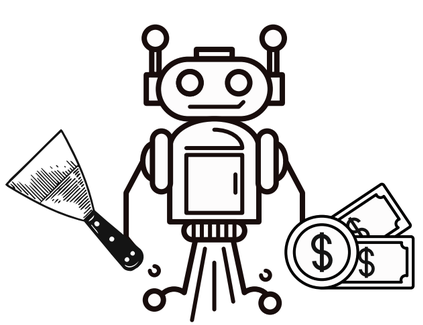

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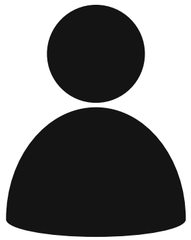
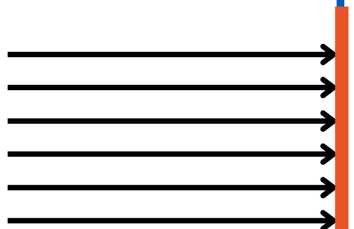
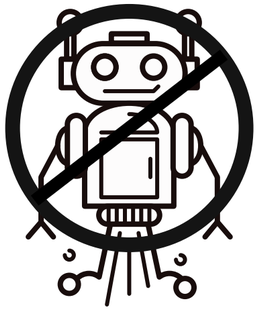


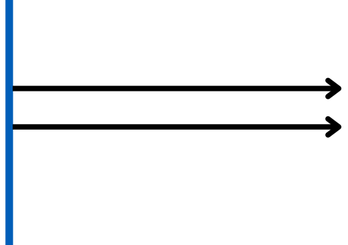
Users





Anti-bot companies

Honeypot



E-commerce websites

Same front-end of the real website

Modified **but** plausible prices

Proof of concept

- Collaboration with an airline company

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- Scrapers plausibility check not sophisticated enough for small changes

Challenges

Advantages

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Challenges

- **Technical:** same front-end w.r.t the original website but different back-ends

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Advantages

- No direct feedback of detection to attackers
- Attackers database poisoning
- Reduce workload for the real website


NEXT

1. Using the WebApp Honeypot as a service, redirecting there persistent bot connections

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2. Serving cache prices

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What can **we** do?

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3 RESIP detection

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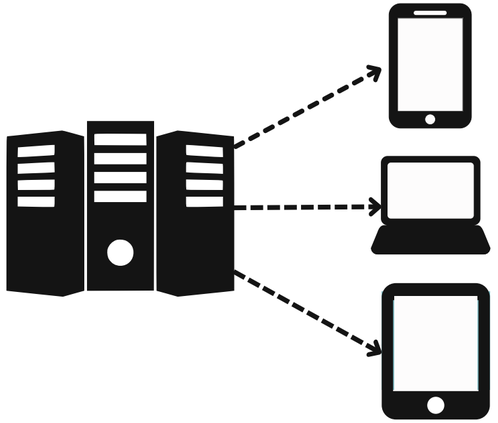
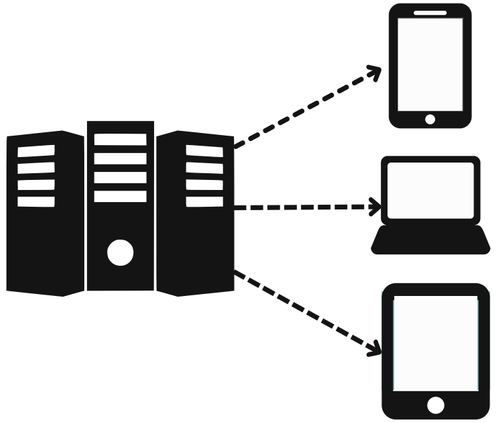
RESIP providers



Residential IP
(RESIP) proxy

RESIP providers

Tens of millions of residential IPs



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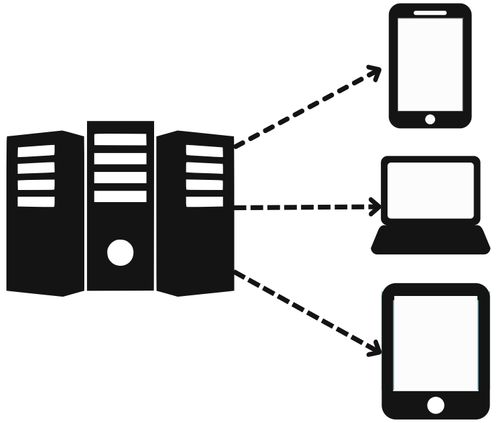

Residential IP (RESIP) proxy

Good reputation IPs

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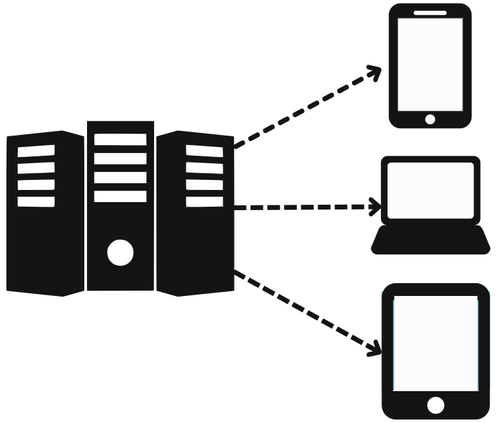

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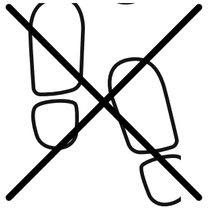

No traceback

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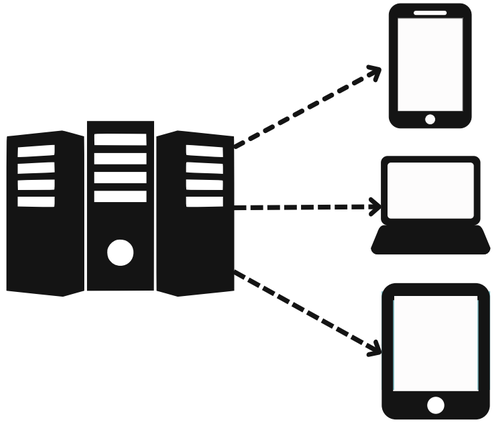

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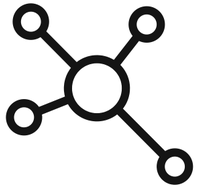
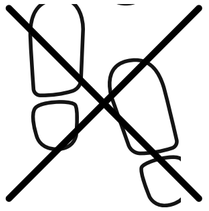


No private distributed infrastructure



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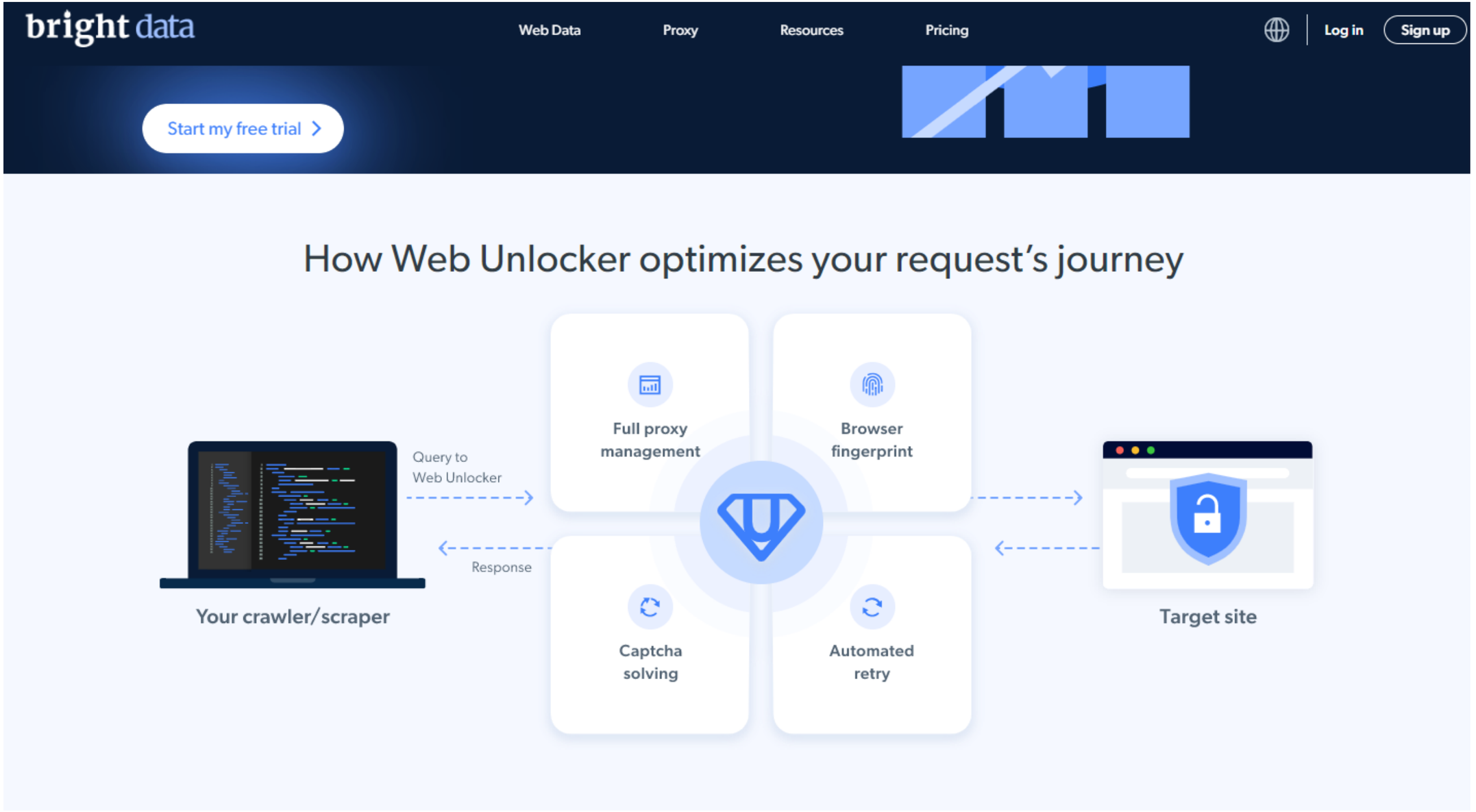

Automated services!

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DATADOME PRODUCTS SOLUTIONS PRICING RESOURCES Start Free Trial Schedule Demo

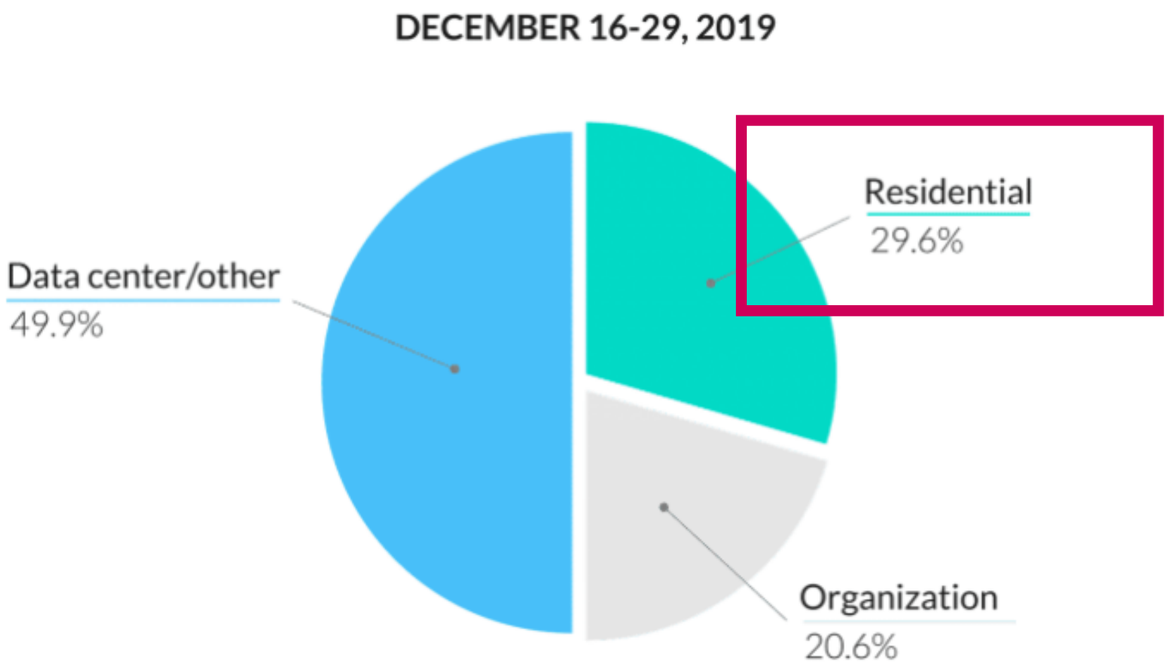
Residential IPs represented nearly 30% of bot requests

As more and more websites and applications are setting up some form of protection against malicious automated traffic, bot developers are turning to residential IPs to camouflage their bots as legitimate traffic.

While residential IP addresses are more expensive than data center IPs, due to a more limited supply, they can be obtained easily enough through companies such as Geosurf or Luminati that provide **residential IP proxies**.

Out of the billions of bad bot requests we registered during the 2019 end-of-year holiday period, **29.55% were using a residential IP address**. This means that nearly **one in three** bad bots requests would pass for human traffic if you were looking at the IP address only.

We also found that **20.55% of bad bots came from an organizational IP address**. For the most part, these are probably infected devices that are exploited unbeknownst to the IP address owner. Poorly secured IoT devices, for example, are very popular among bad bot operators.



Scenario

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- Residential IPs are shared between legitimate customers and scrapers: threat for e-commerce to have **false positives** during detection

- There is a need for specific detection when device is used **directly or through RESIP services**

- Both types of connection are similar at the application layer **but** present differences at the transport layer

Direct Connection

RESIP Connection

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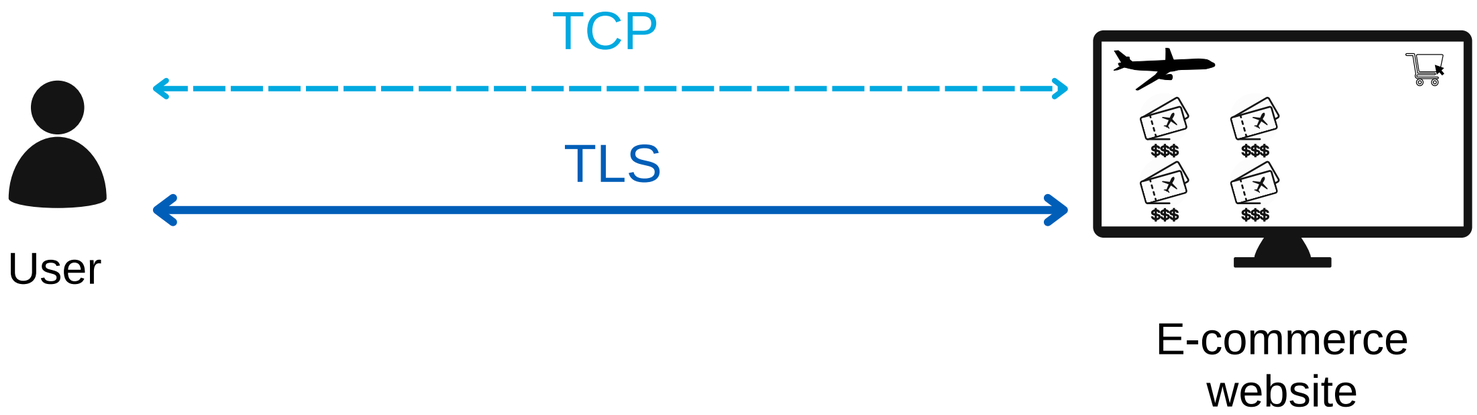
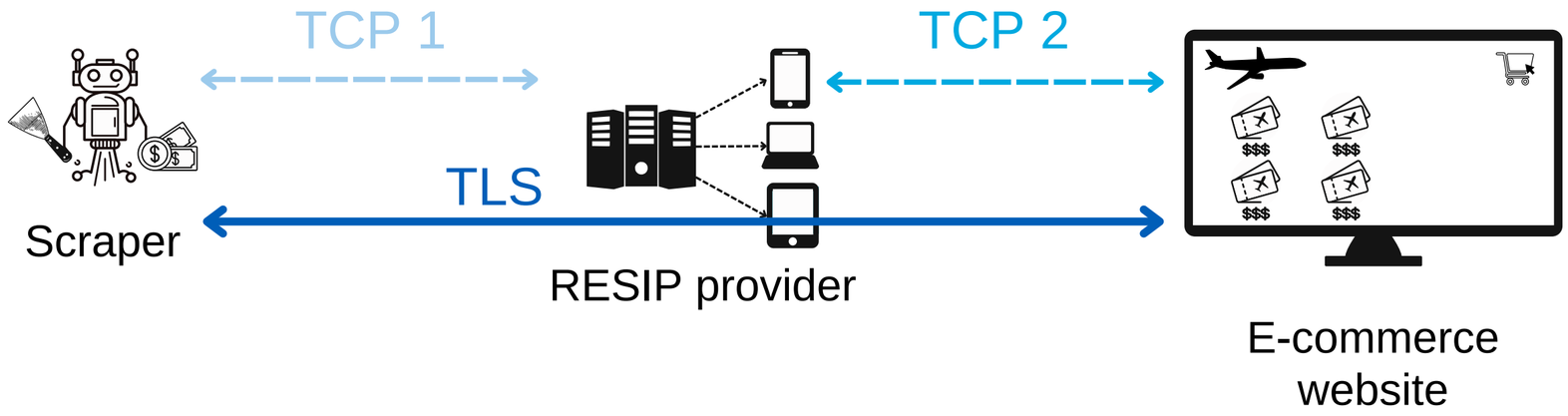
Direct Connection



RESIP Connection

Direct Connection



RESIP Connection

How can we check this?

The Round Trip Time gives an "approximation" of the physical distance between sender and receiver [1]

[1] Landa, R., Clegg, R.G., Araujo, J.T., Mykoniati, E., Griffin, D., Rio, M.: Measuring the Relationships between Internet Geography and RTT. In: 2013 22nd International Conference on Computer Communication and Networks (ICCCN).

How can we check this?

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We can use the RTT among the TCP packets against the one among the TLS ones to see if there is a difference in the setup and spot RESIP connections

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TLS RTT ~ TCP RTT

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TLS RTT ~ TCP RTT  Direct connection

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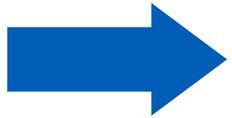
TLS RTT ~ TCP RTT  Direct connection

TLS RTT >> TCP RTT

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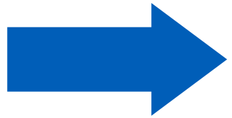
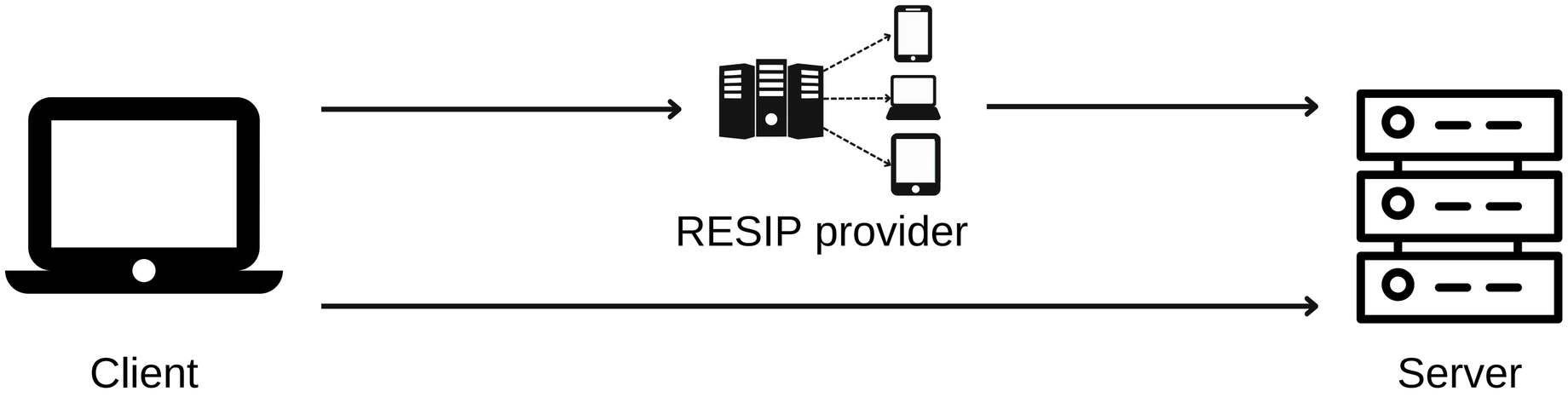
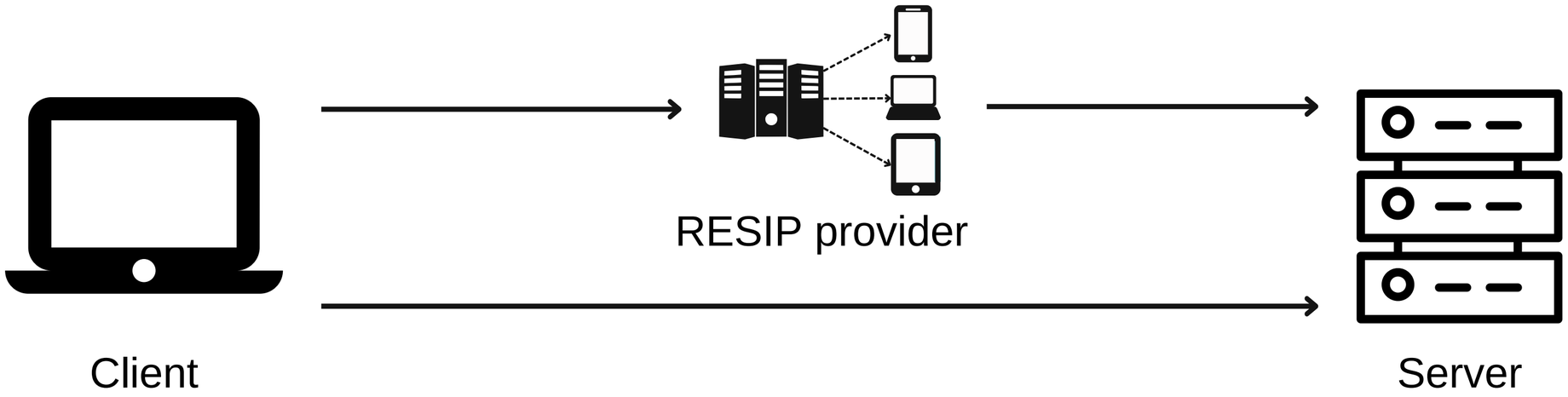
TLS RTT ~ TCP RTT  Direct connection

TLS RTT >> TCP RTT  Proxied connection

Experiment

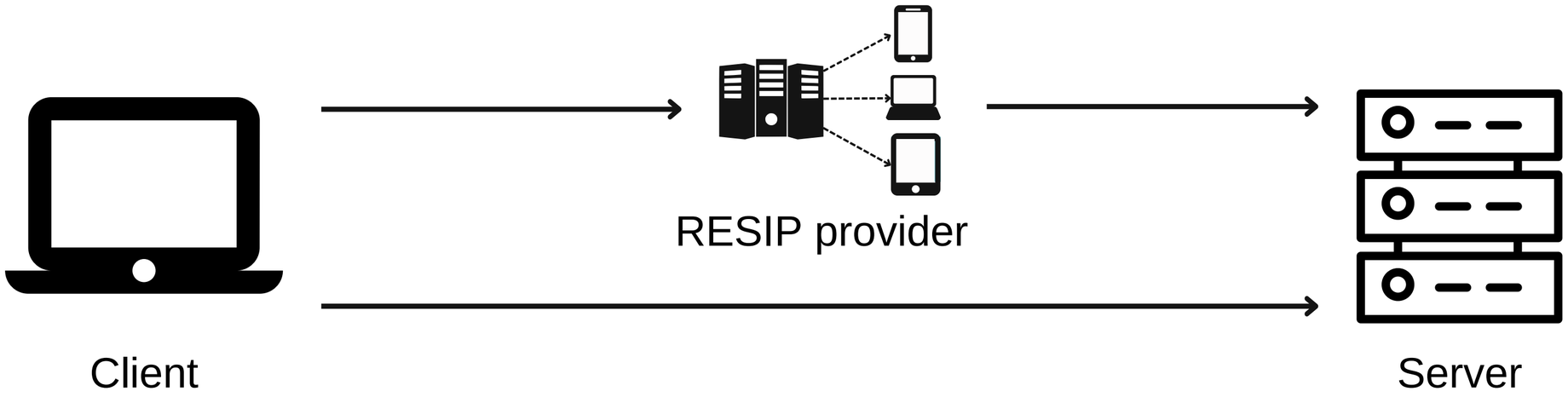


Experiment



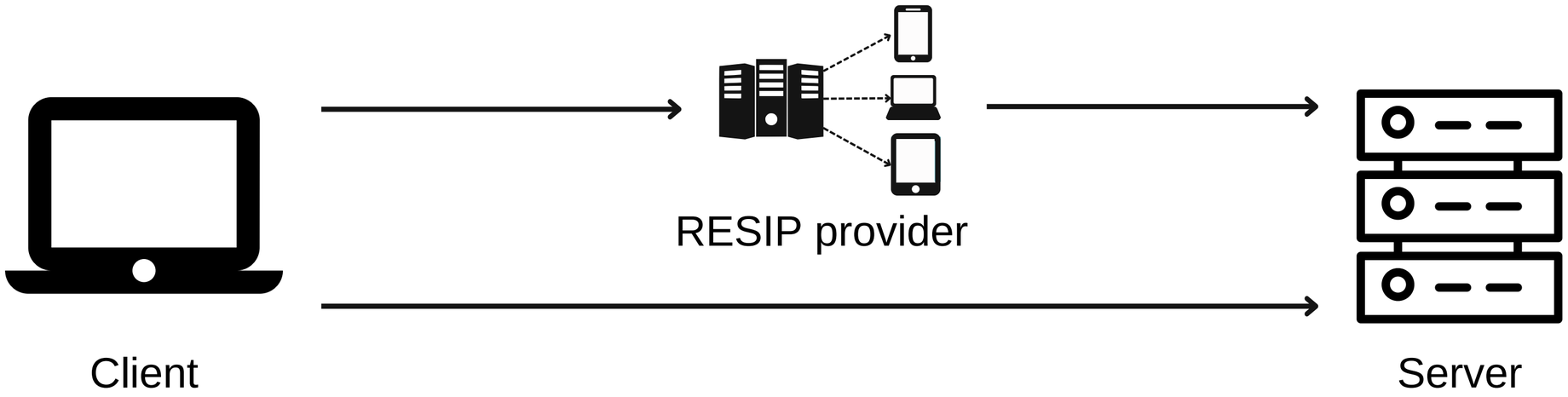
- 4 RESIP services, 22 client/server machines all over the world

Experiment



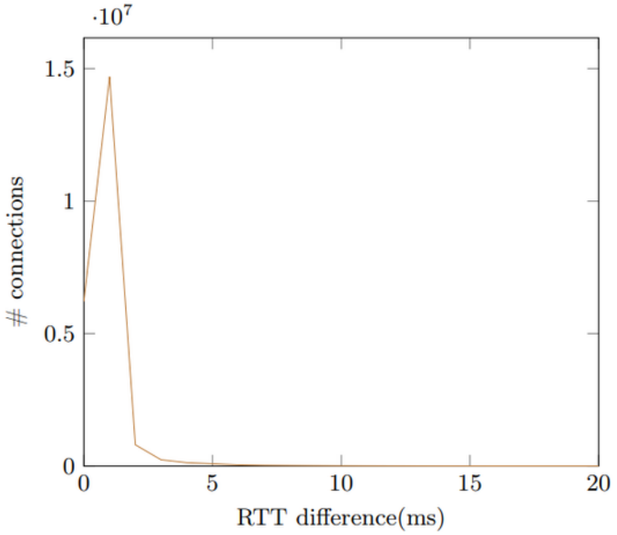
- 4 RESIP services, 22 client/server machines all over the world
- TCP and TLS RTT measurement, difference calculation

Experiment



- 4 RESIP services, 22 client/server machines all over the world
- TCP and TLS RTT measurement, difference calculation
- 4 months experiment, 92M+ connections

Direct Connection



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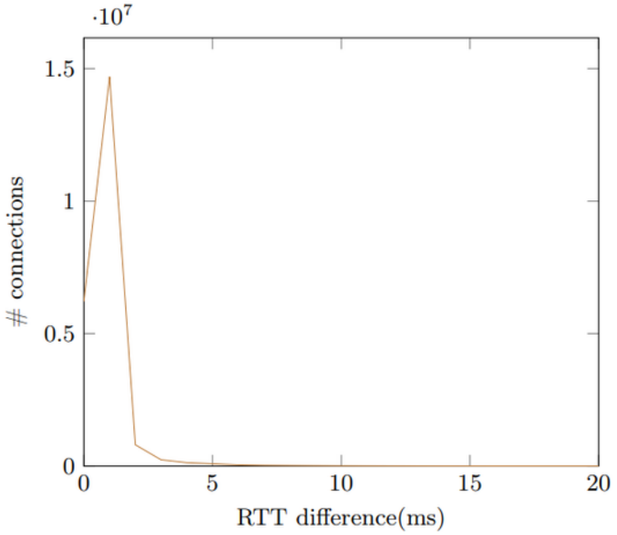

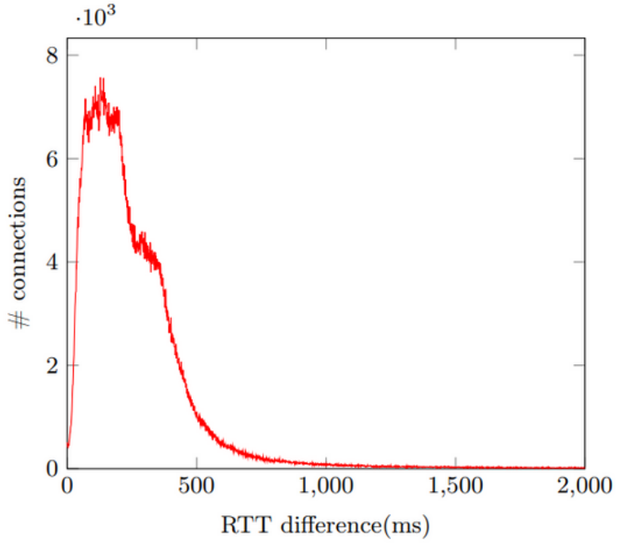

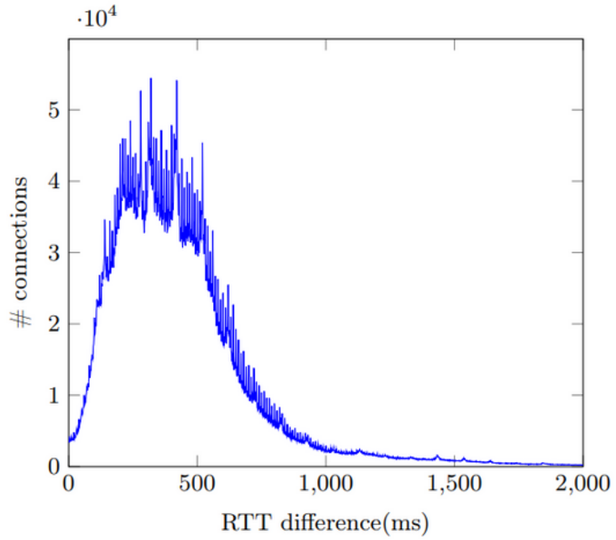

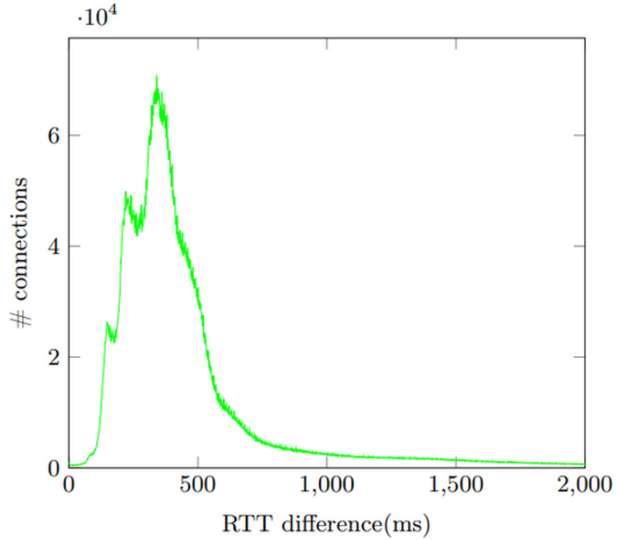

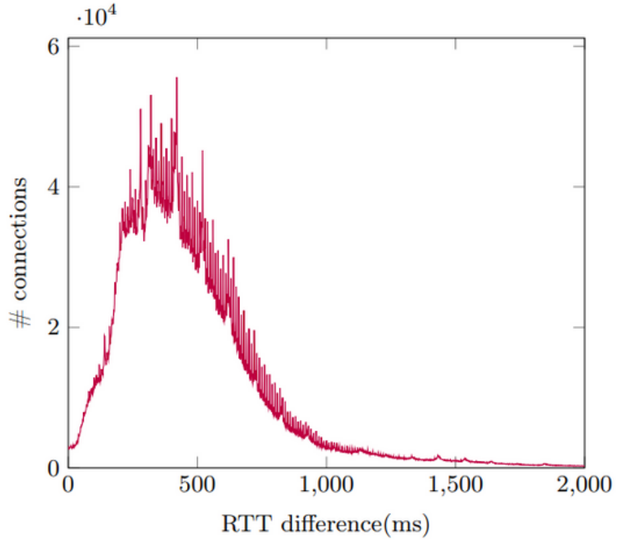

RESIP Connection

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Outcome

Outcome

- Promising technique

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- Filed patent submission

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- Promising technique
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- Next step: test on real-world scraping connections


GAME
OVER

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Scrapers are becoming more and more sophisticated and we need new technologies for detection and mitigation to compete against them

Detection can be improved thanks to a specific RESIP detection method based on the comparison of TLS and TCP RTT

Mitigation can be improved implementing the WebApp Honeypot which enables to lure attackers into believing they passed by undetected while receiving incorrect data

Thank you!
Q&A

More questions? **elisa.chiapponi@amadeus.com**

Our works:

- Chiapponi et al. (2022). "**An industrial perspective on web scraping characteristics and open issues**" in 52nd Annual IEEE/IFIP DSN 2022 - Industry Track.
- Chiapponi et al. (2021). "**Scraping Airlines Bots: Insights Obtained Studying Honeypot Data**" in International Journal of Cyber Forensics and Advanced Threat Investigations (CFATI).
- Chiapponi et al. (2022) "**BADPASS: Bots taking ADvantage of Proxy AS a Service**" in The 17th International Conference on Information Security Practice and Experience (ISPEC 2022).

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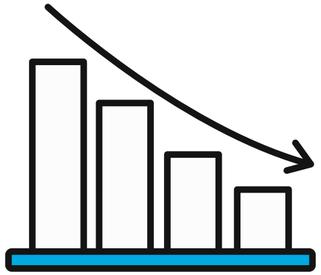
Competitors monitoring



Statistics modification

Content reselling

Why do they scrape?

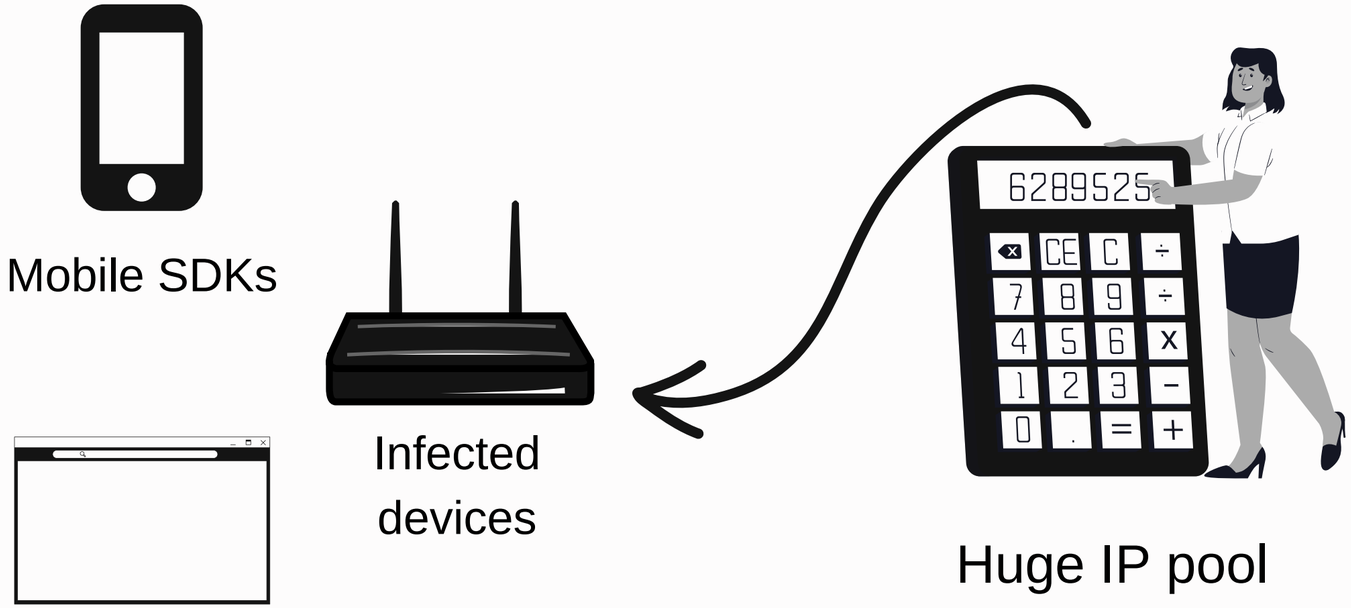
Scrapers vs amadeus: why?

Competitive intelligence companies

Aggregators

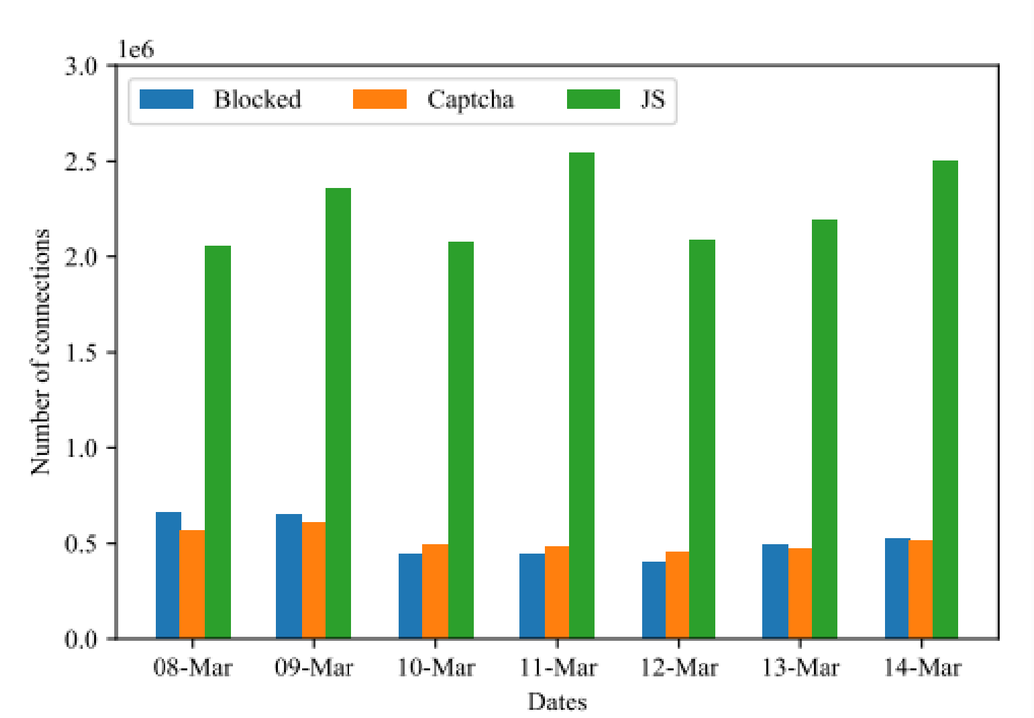
Online travel agencies

RESIP devices



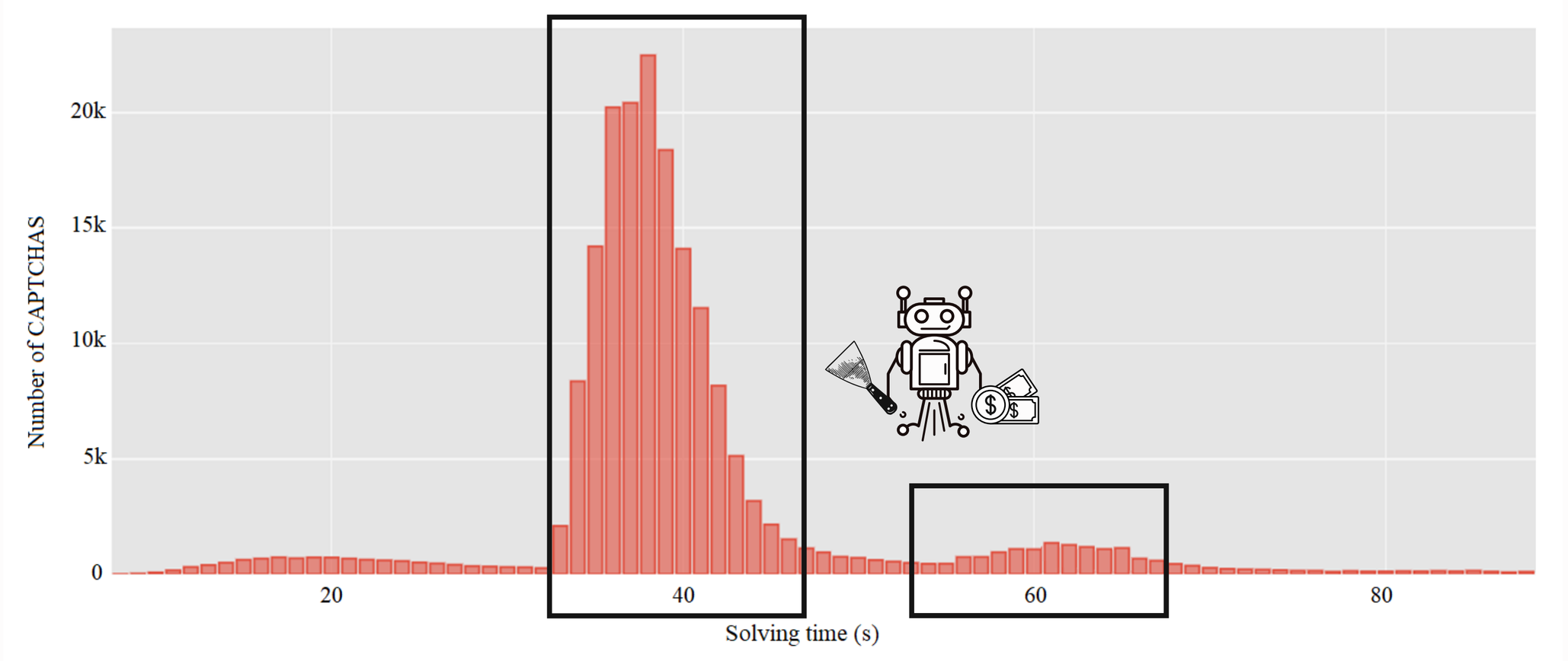
Scrapers vs amadeus: how much?

- Every month, anti-bot rules triggered by **140 million** requests
- **41%** of the attempted connections detected as bots (February 2022)
- **Constant** bot traffic
- Bot reaction to countermeasures: from days (past years) to **hours** (now)



Daily amount of reactions
between 08/03/22 and 14/03/22.

CAPTCHA solving time (2018)



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RESIP activities in amadeus

Residential IPs detected as bots in 30 days: **12%**

Goal: reducing false positives

Total RESIP traffic is a much **larger** portion

Wide usage of RESIP

Some questions...

- Is it possible to recognise a bot campaign from the information included in the payloads?
- Are bots crafting payloads to detect the honeypot?
- Can we derive meaningful information studying the patterns of bot IPs?

Behavioral analysis

- 51,5% of requests for return flights
- Return flights: 7 days period
- Only 25 combination of departure and arrival airports, small fraction of the airline's offer
- Homogeneous distribution of the time interval between departure and request date among different segments and request dates