# CAPTCHAs as MTD

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Who's Talking

- Antoniu Cîrjan (Toni)

- Studies:
  - Bachelor in Computer Science ('16 - '20)
  - Master in Artificial Intelligence ('20 - '22)

- Current Work:
  - Software Engineer & Researcher in the Security Team at Orange Services

What is a CAPTCHA?

- Completely Automated Public Turing tests to tell Computers and Humans Apart
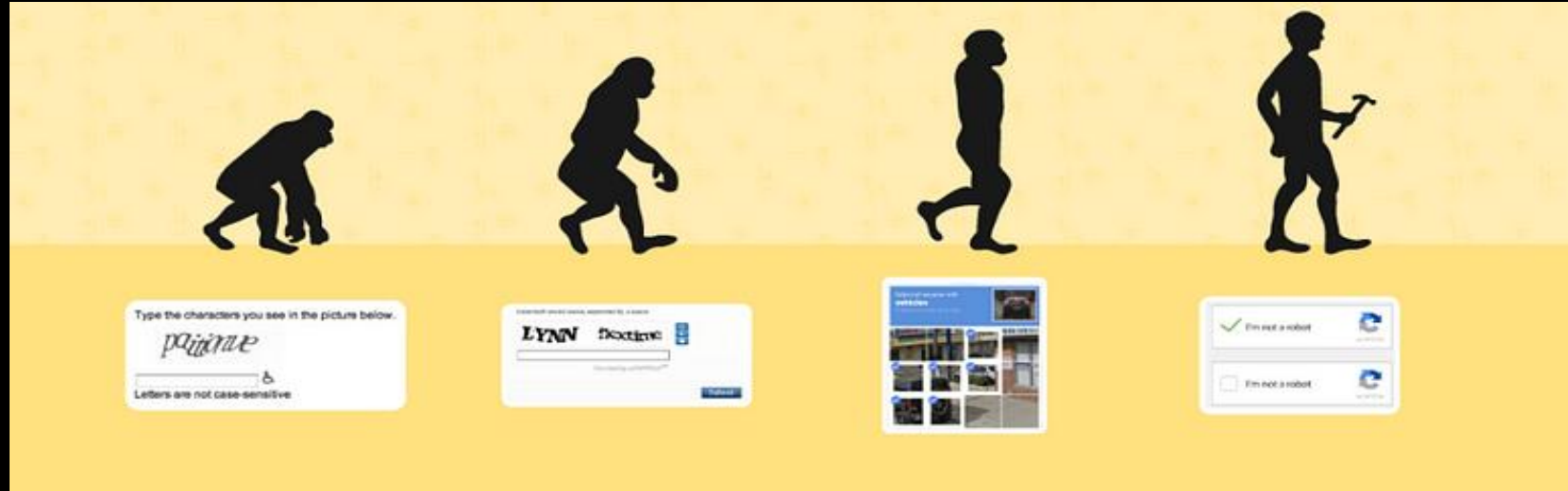
- Human vs Bot

- Challenge → Solve → Pass
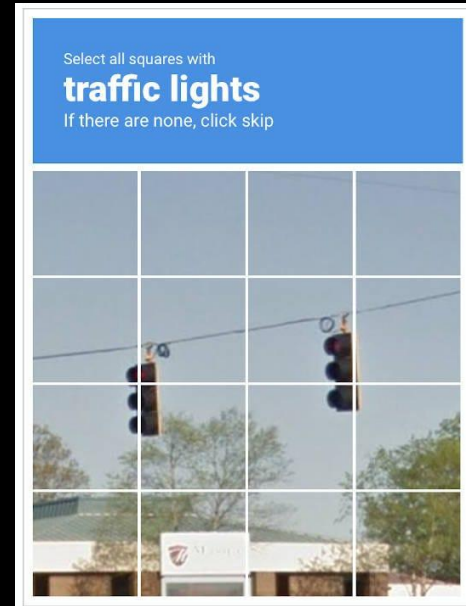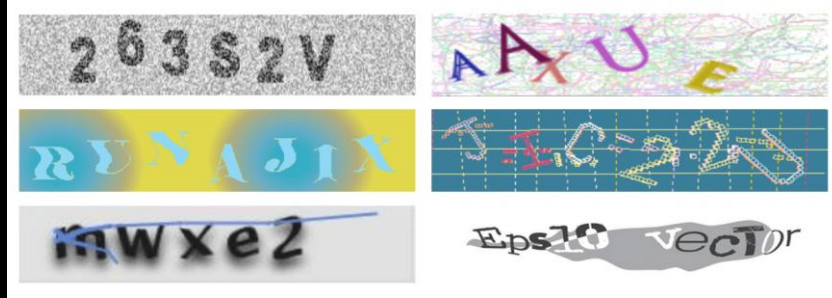
What is Moving Target Defense?

- Constant Change = More Security

- Raise Uncertainty & Attack Cost

CAPTCHAs = Moving Targets

- Each Challenge is Unique

- Each Session is a New Barrier

CAPTCHA Types & Their MTD Features

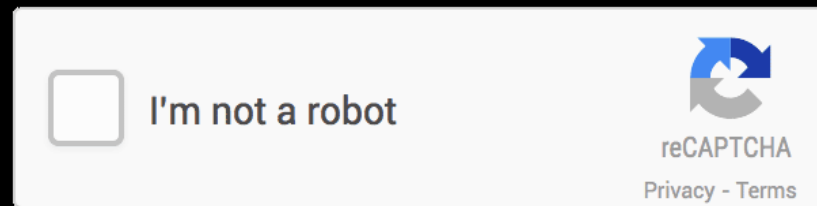| Type	MTD feature	Vulnerability
Text-based	New text + distortion	OCR, Deep Learning solvers
Image-based	Random image grid	CNNs trained on labelled data
Audio	Randomized spoken phrases	Speech-to-text ML models
Behavioral	User-specific risk scoring	Emulated mouse and interaction
Cognitive/Illusion	Stylized puzzles with logic shifts	Still hard for bots, but improving

Analyze what AI struggles with

Evolve CAPTCHA

AI solves CAPTCHA
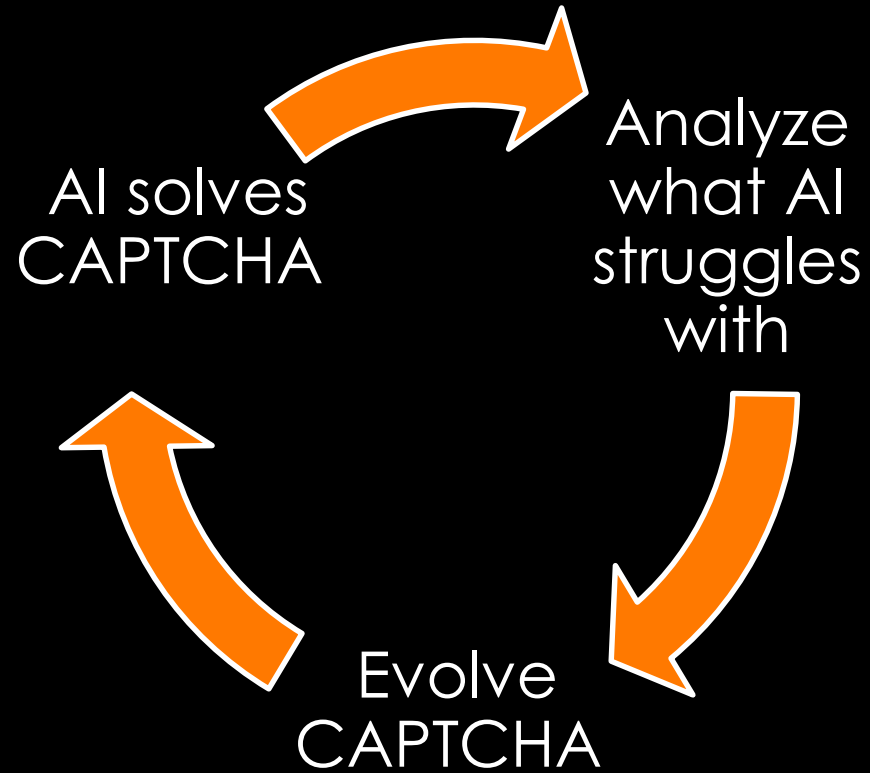
Behavioral & Invisible CAPTCHAs

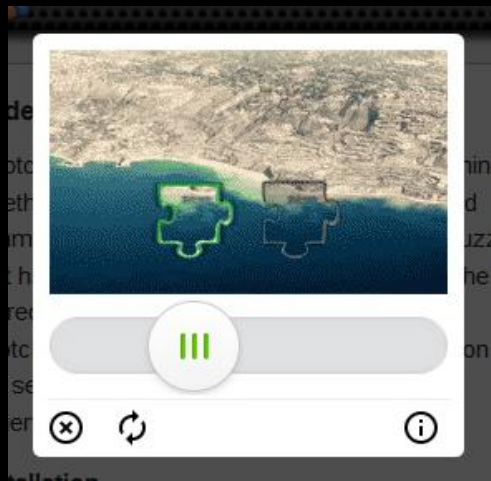**No challenge? The test is YOU.**
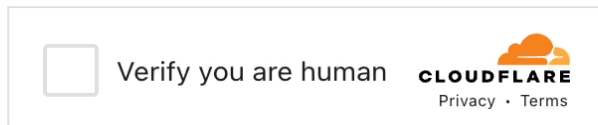
reCAPTCHA v2

CloudFlare

reCAPTCHA v3

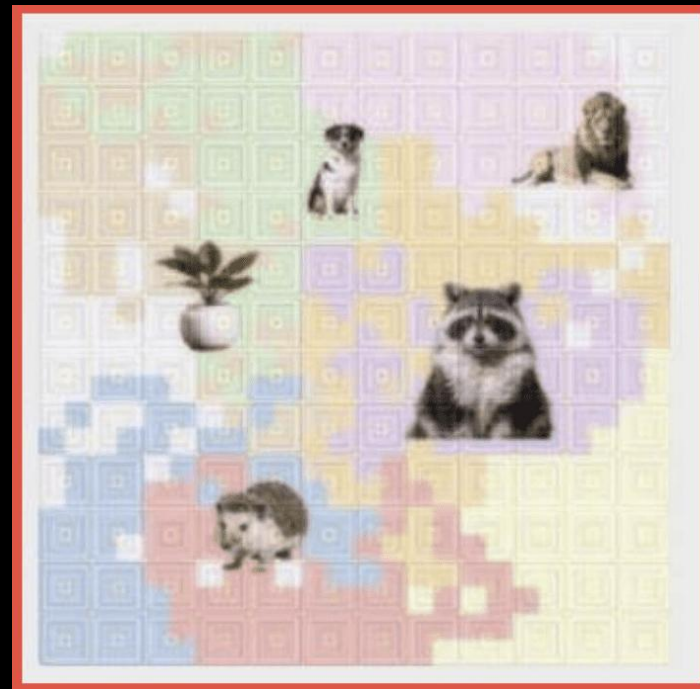# Adversarial & Cognitive CAPTCHAs

Fool AI, Not Humans

Use Illusions, Logic, Stylization

Dark web examples

https://www.darkowl.com/blog-content/cracking-the-code-exploring-the-sophistication-of-captchas/

Dark web examples

Dark web examples

Sign Up

Click to Enable PGP 2FA (Required for vendors)

7 L A R Z A N N 3

| A | 3 | A | V | L | Z |

You are not using a referral link. Ask your favourite vendor.

Sign Up

DDOS Mitigation   SuperMarket

Solve the captcha before time runs out.
You have 51 seconds left...

| ? | ? | ? | ? | ? | ? |

Validate Session

Captcha:

result = 7 MINUS 4 plus 2

MIRROR ALPHA URL starts with: kerberosazmn
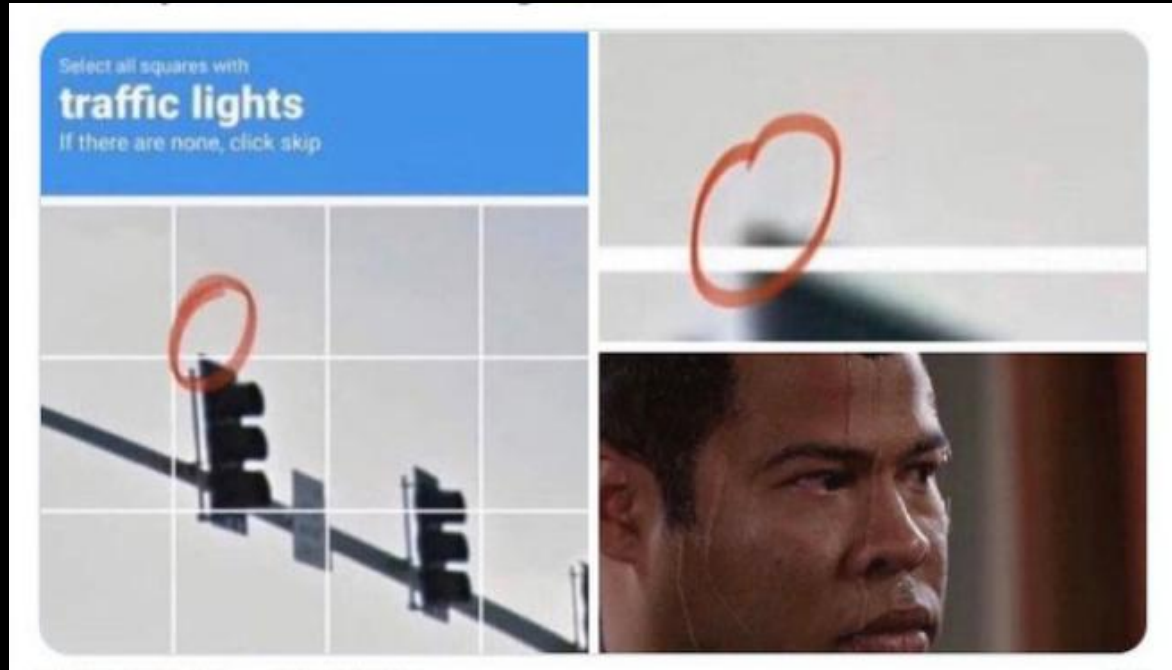
12
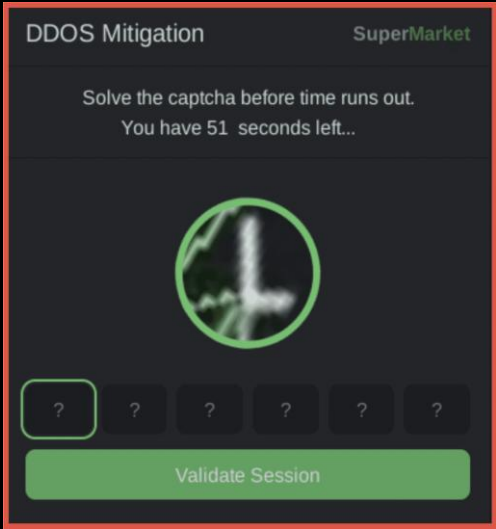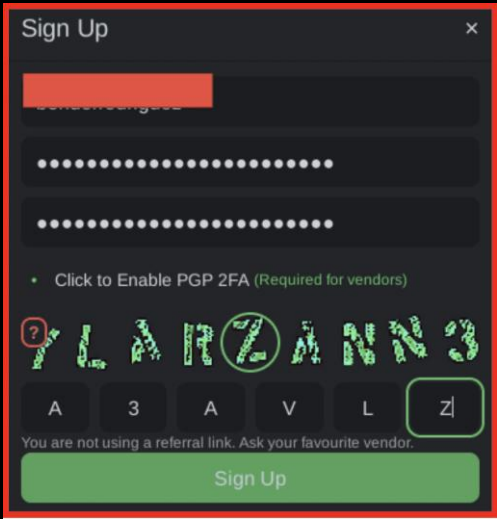
Dark web examples
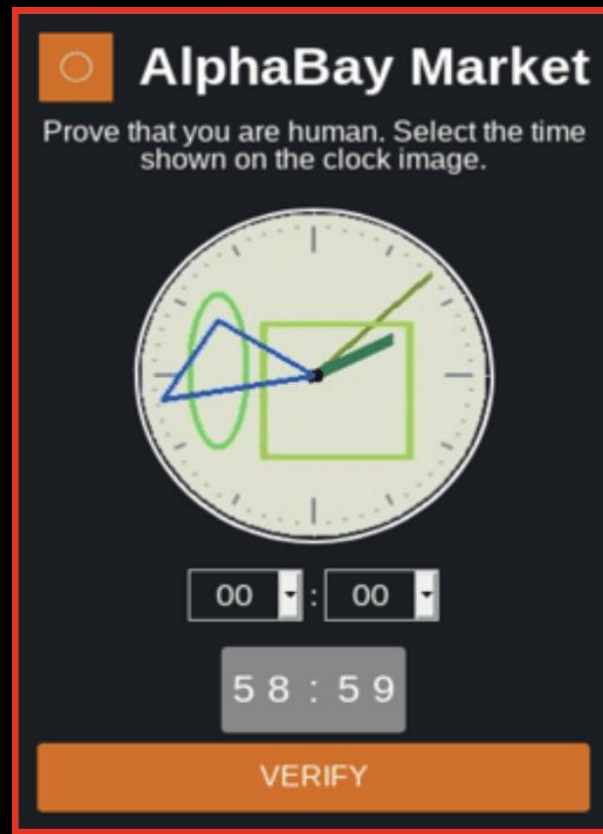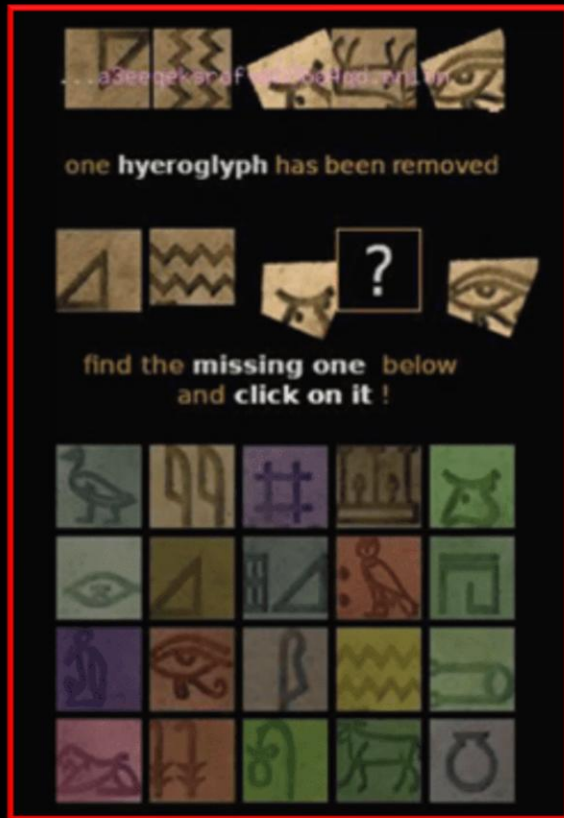
Why CAPTCHAs Are MTD

- Dynamic

- Unpredictable

- Hard to Automate

Limitations & Challenges

- User Annoyance

- Usability vs Security

- AI Keeps Catching Up

Conclusion

- CAPTCHAs = Practical MTD

- Defense Must Keep Moving

- AI is Both Threat & Tool

- *CAPTCHA solving is a business

Thank you!

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