

# Measuring accessibility of popular websites while using Tor

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## Background

- Tor: anonymity network
- Used by privacy aware users
- But also used for abuse such as DoS, Botnet etc.
- Websites block Tor users
- Common blocks:
  - Entire domain blocked
  - Functionality blocked
  - CAPTCHA provided
  - 2FA required

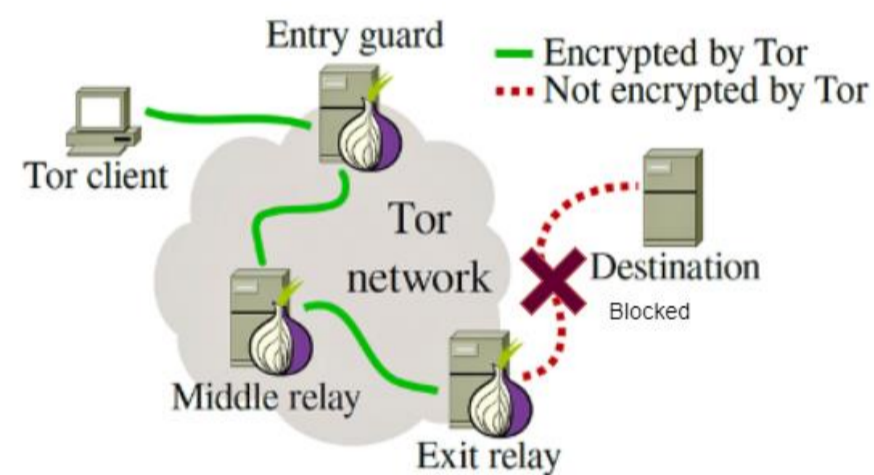


Figure 1: A Tor request being blocked by the destination.

### Research question (s)

- To what extent do websites block users accessing them using Tor?
- How frequent is the blocking?
- What content does it affect?

## Methodology

- Requesting Alexa Top 1000 websites with (control) and without Tor in 4 phases.
- 4 Tor exit nodes.
- Website blocked if it is discriminating on any page for all Tor exit nodes.
- Comparison using HTTP status codes, perceptual hashing, structural similarity.

## Experiment design

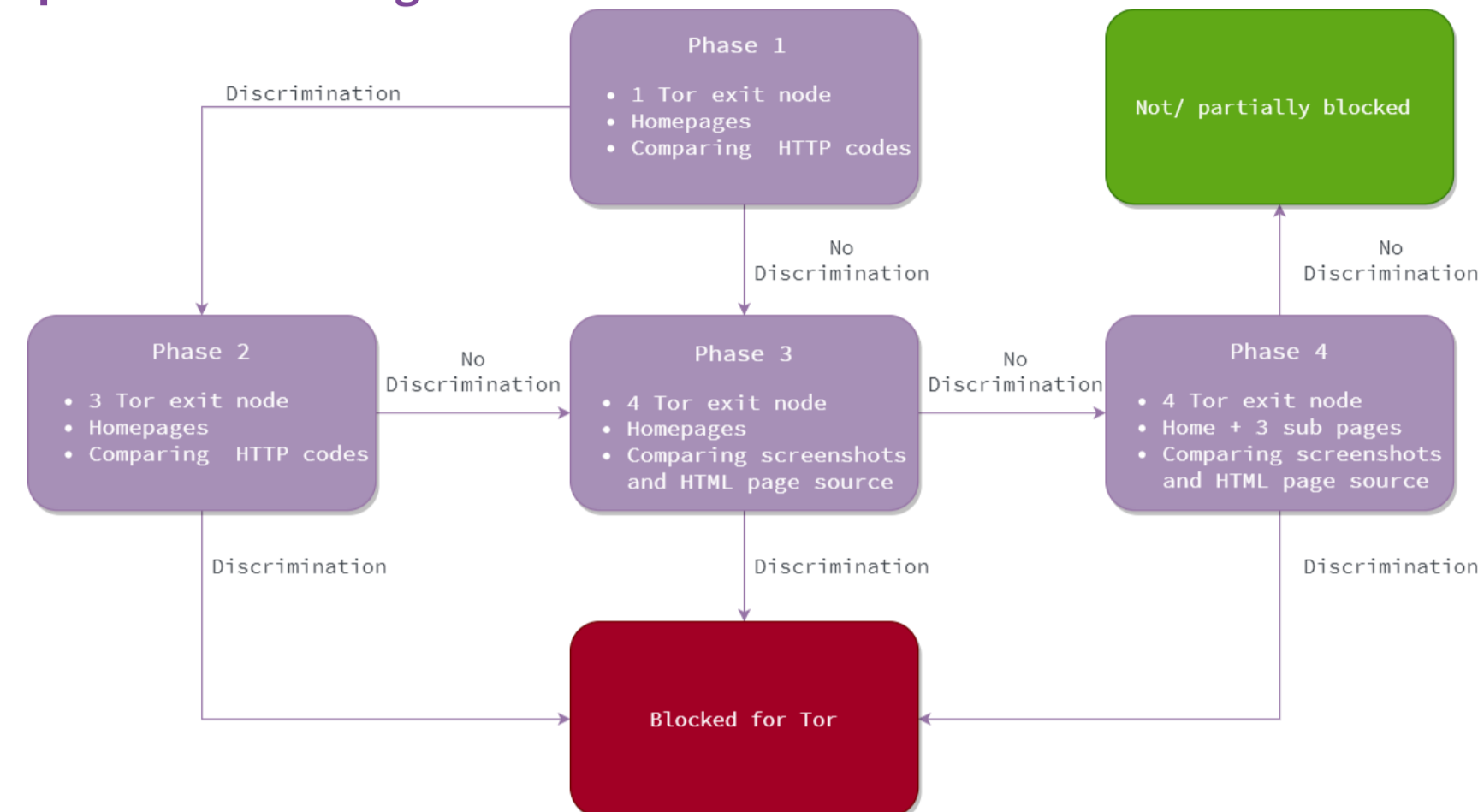


Figure 2: Phases of experiment

## Results

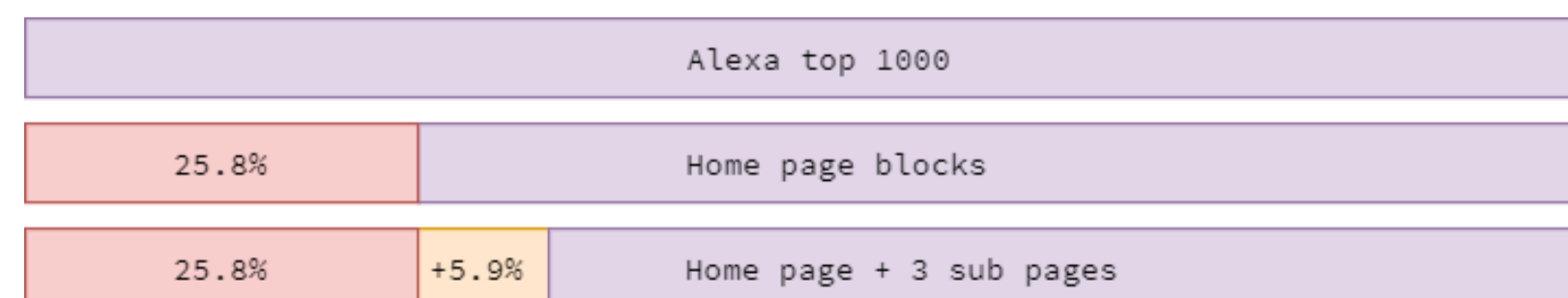
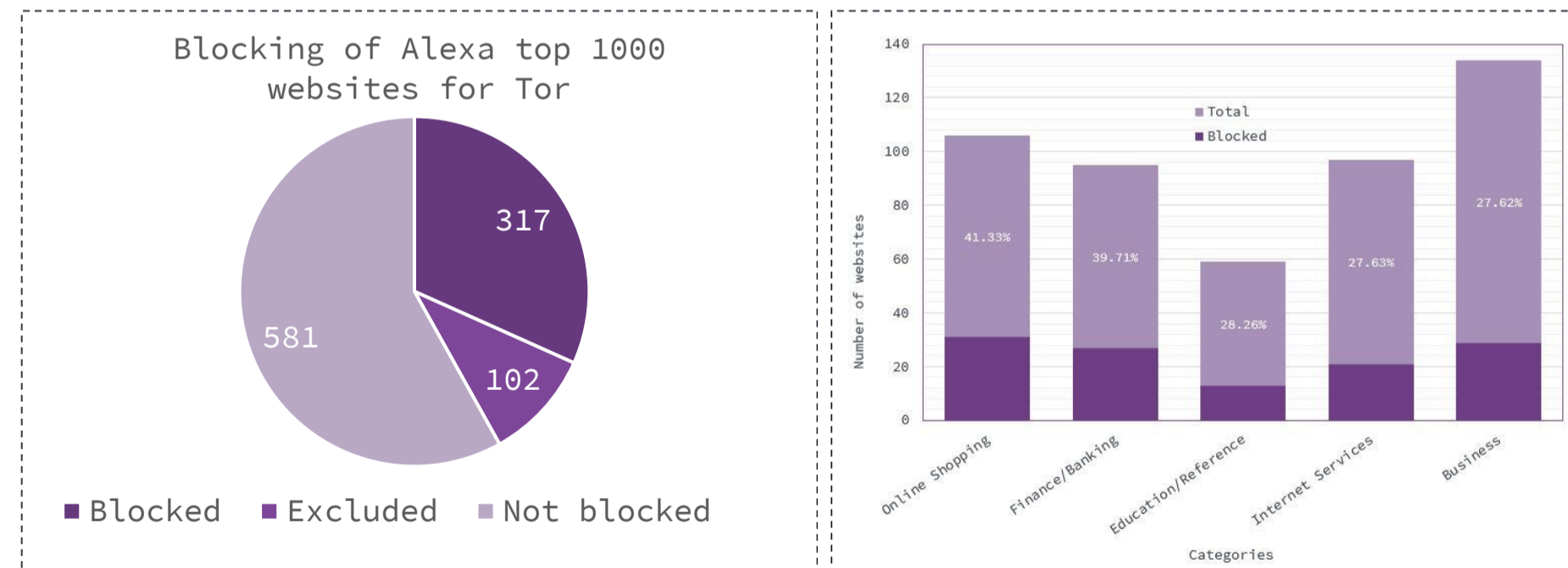


Figure 3: Percentage of websites discriminating against Tor users among the Alexa top 1000.

## Discrimination criteria

- Phase 1:
  - Discrimination if control and Tor both return HTTP 2xx or both non 2xx.
- Phase 2:
  - Discrimination if control returns HTTP 2xx and all 3 Tor return non 2xx.
- Phase 3 and 4: Use two metrics
  - Structural similarity:
    - Comparing order of HTML tags
    - Similar images have a similar structure of HTML.
    - Discrimination if value less than threshold.
  - Perceptual hashing:
    - Similar hash for similar images
    - Comparing hamming distance of two hashes.
    - Discrimination if distance above a threshold.

## Conclusions

- 25.8% blocking observed on front pages compared to 20.03% in 2017.
- 31.7% blocking including 3 sub-pages.
- Blocks commonly observed:
  - CAPTCHA
  - Blocked login
  - Served different/outdated versions of websites.
- Most affected content:
  - Online Shopping
  - Banking/Finance
- Possible causes of blocking:
  - Fear of DoS or Botnet attacks.
- Studies show Tor users are as likely to make purchases as non-Tor users.
- Overall degradation in Tor reputation since 2017.
- New ways to tackle abuse must be discovered.

