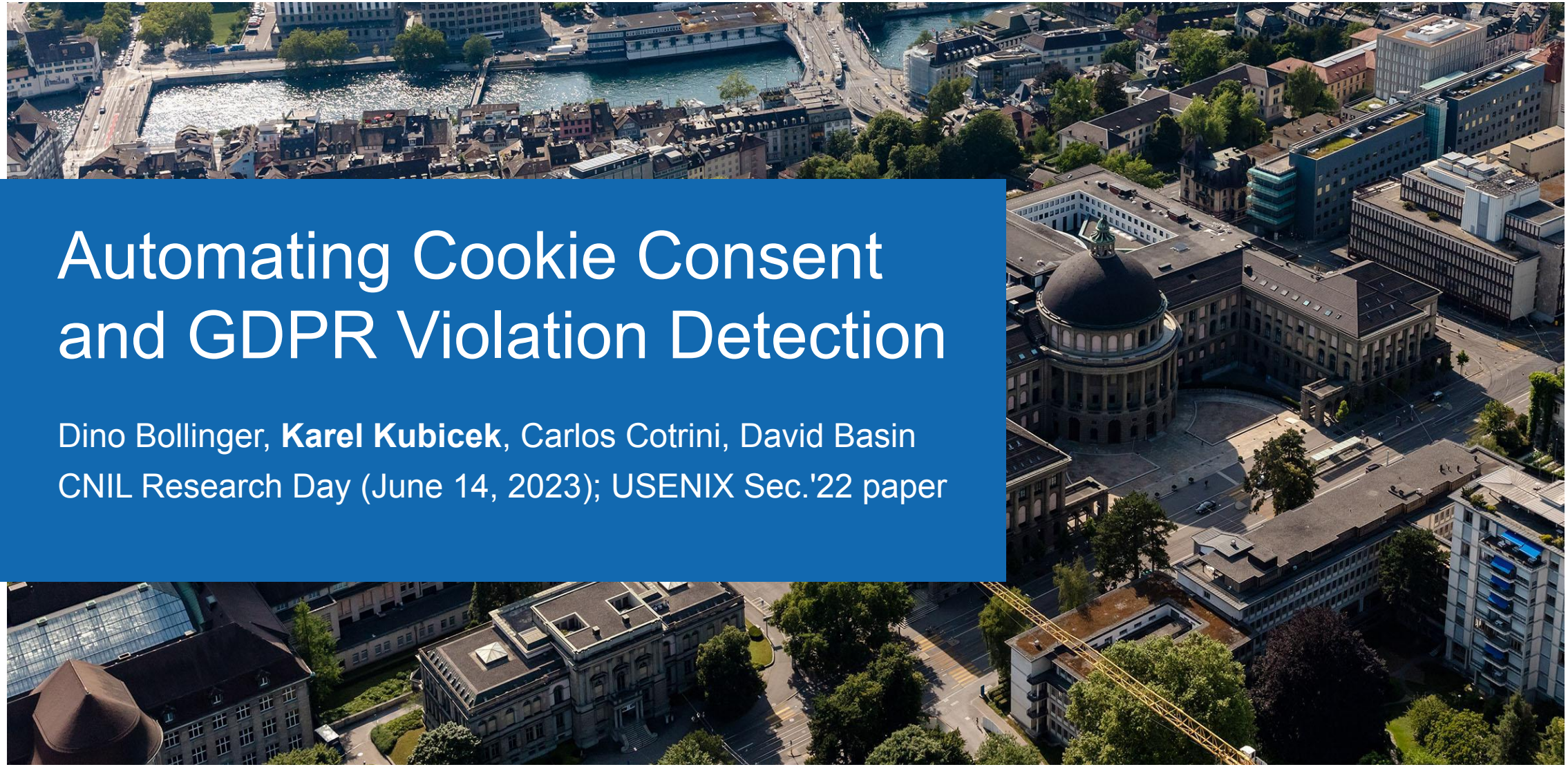
ETH zürich



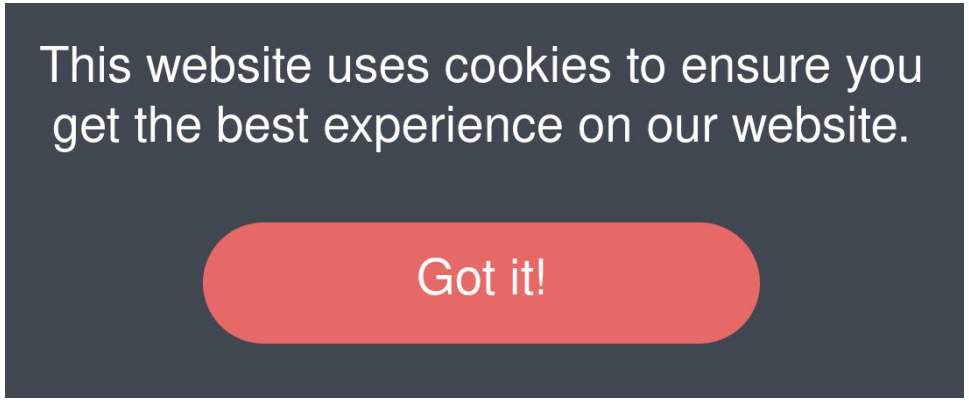
Automating Cookie Consent and GDPR Violation Detection

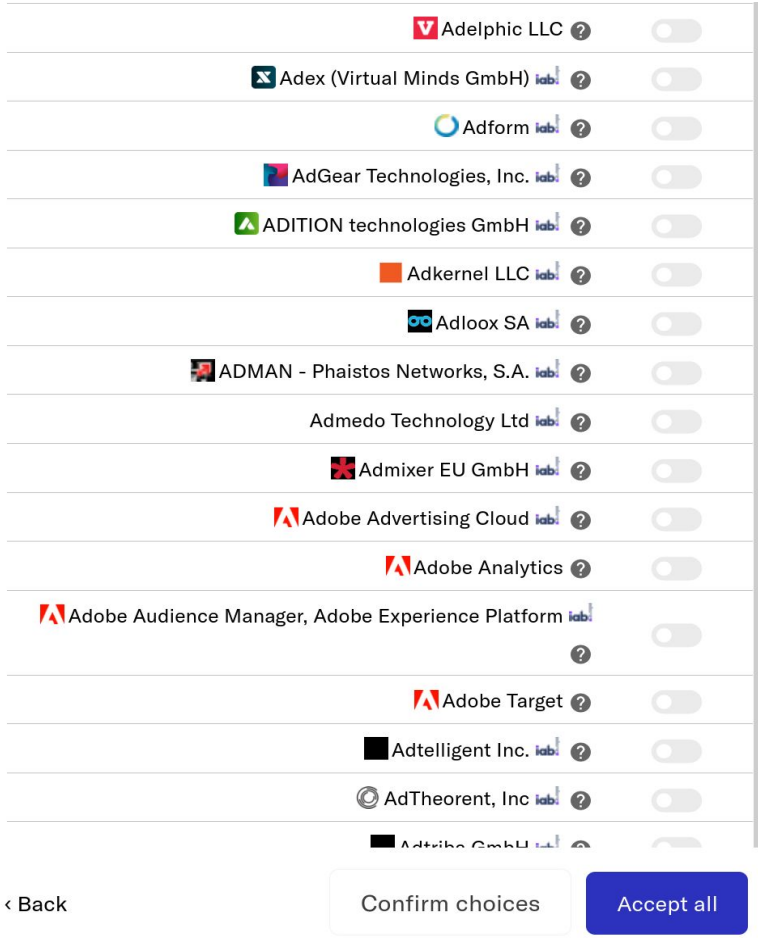
Dino Bollinger, **Karel Kubicek**, Carlos Cotrini, David Basin

CNIL Research Day (June 14, 2023); USENIX Sec.'22 paper

Cookie consent

- Solomos et al. (2019): 90% of websites use tracking cookies
- EU law: Websites must notify users, gather consent
- Consent notices to comply with regulations

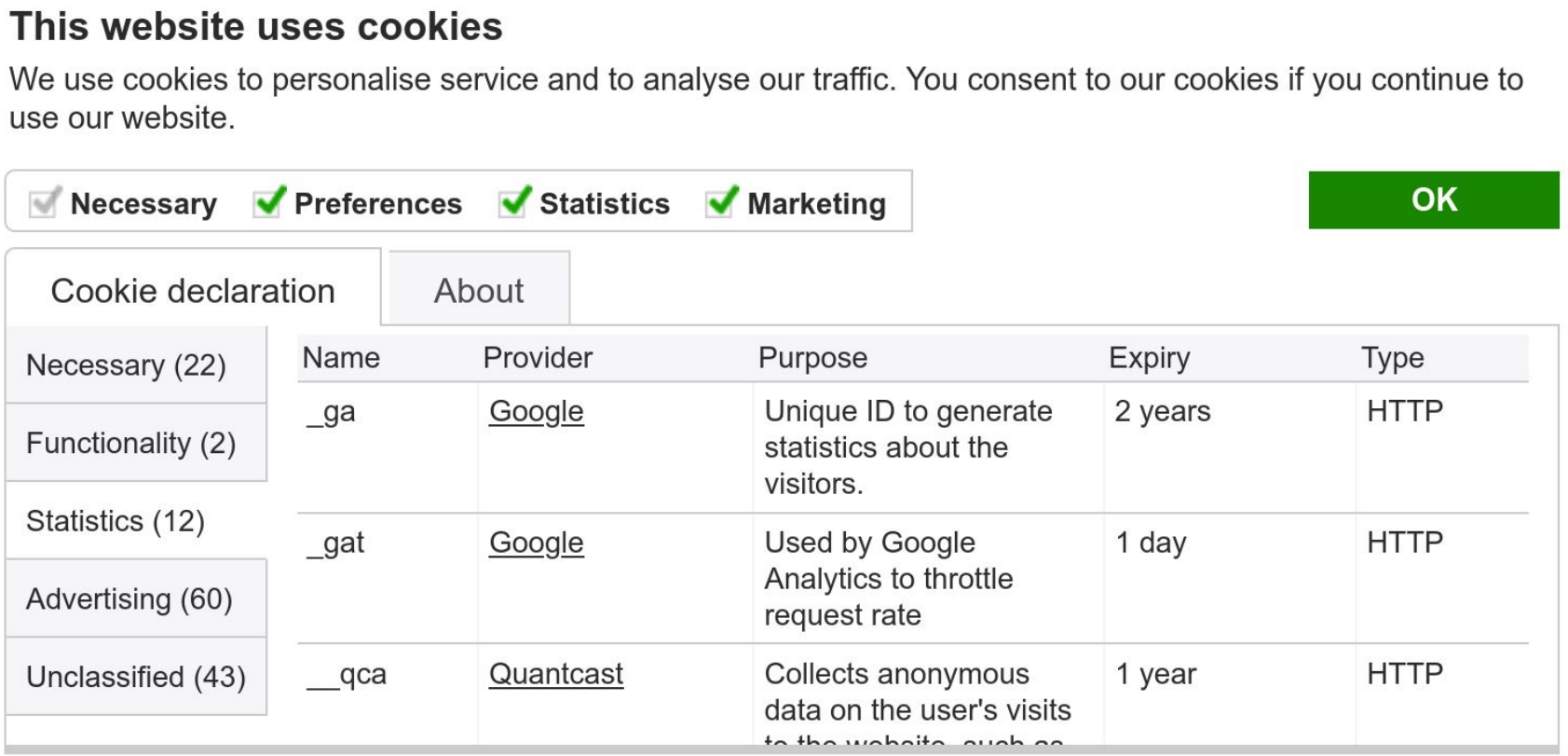




ePrivacy Directive and General Data Protection Regulation (*GDPR*)

ePrivacy Directive:

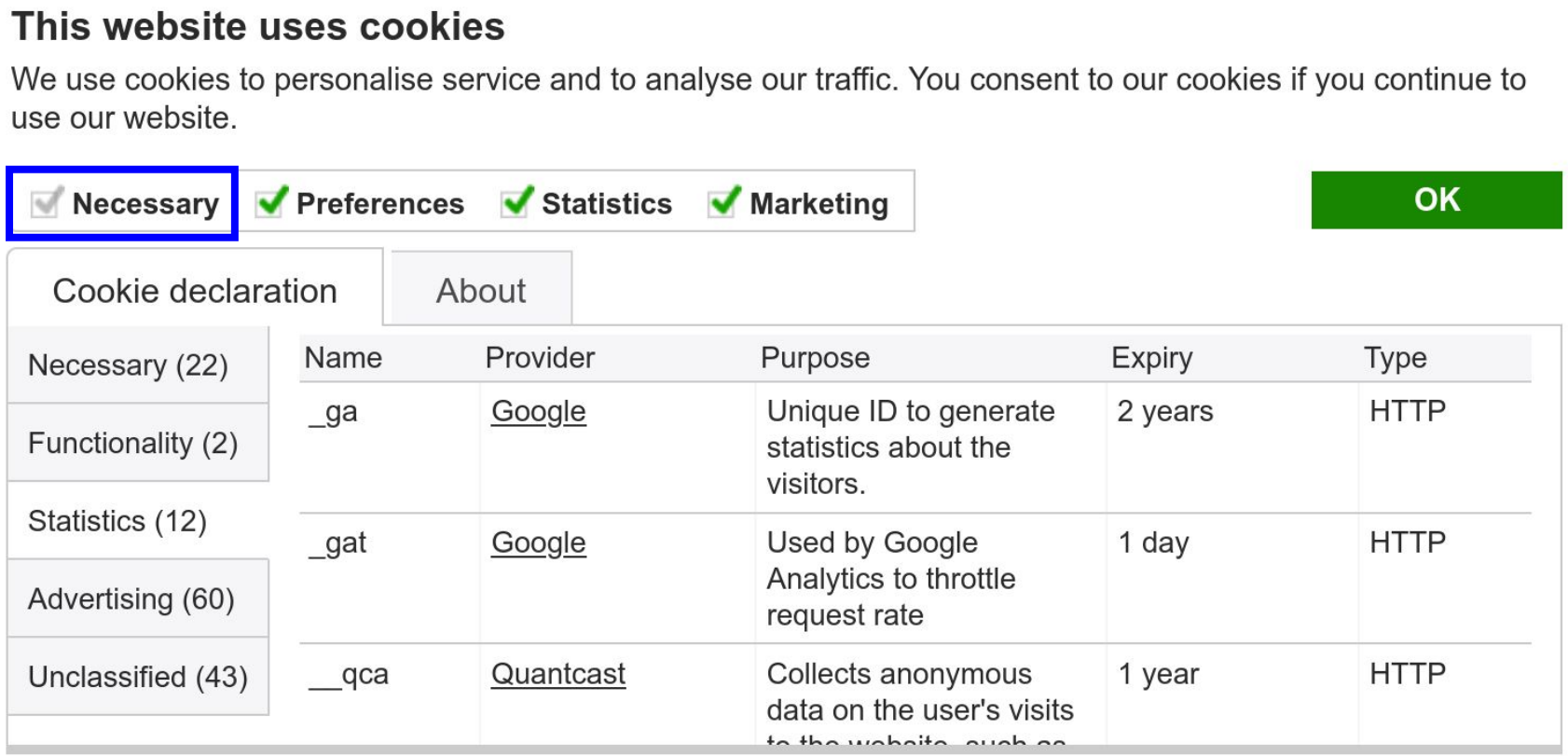
- All but strictly necessary data processing requires consent



ePrivacy Directive and General Data Protection Regulation (*GDPR*)

ePrivacy Directive:

- All but strictly necessary data processing requires consent



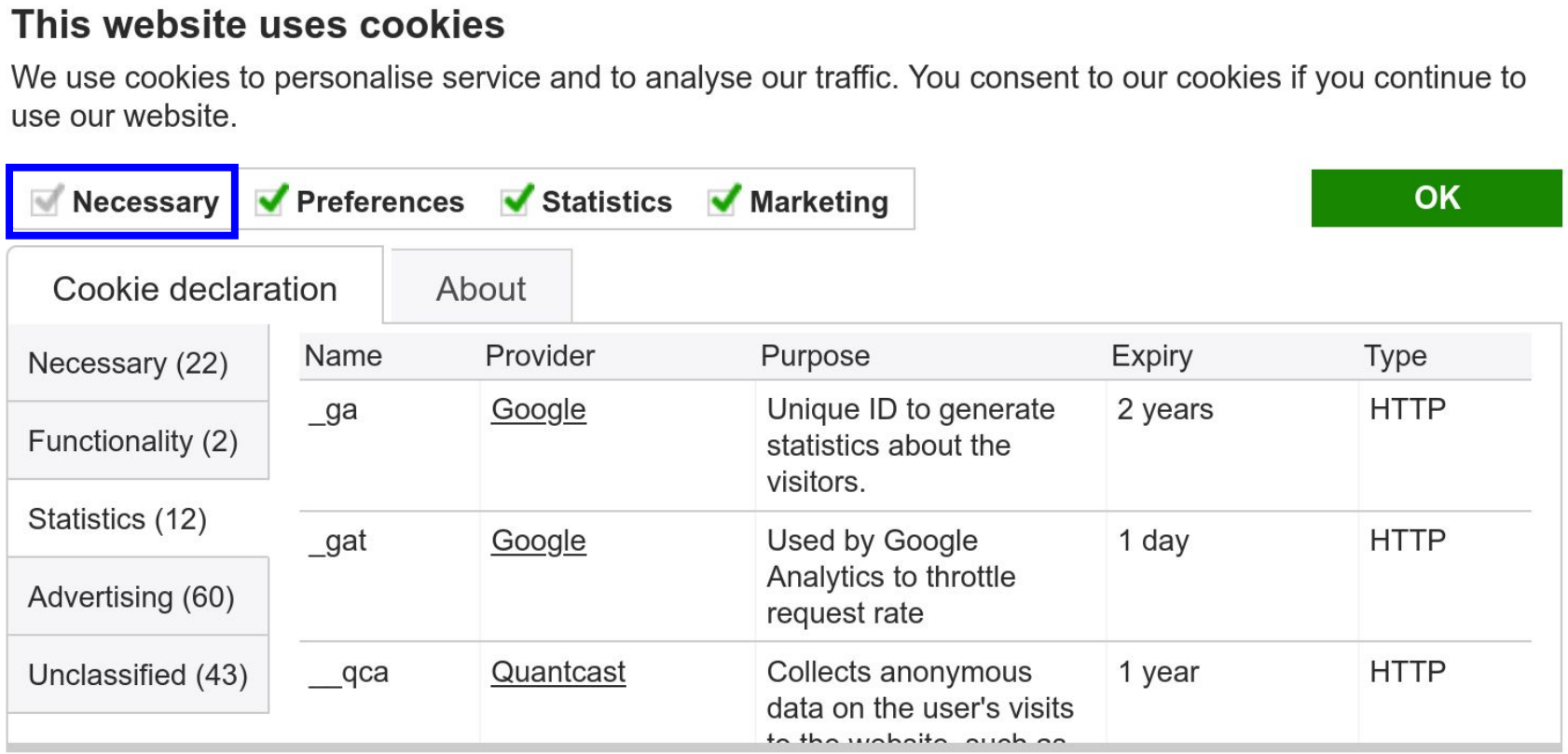
ePrivacy Directive and General Data Protection Regulation (*GDPR*)

ePrivacy Directive:

- All but strictly necessary data processing requires consent

GDPR Consent:

- Freely-given
- Unambiguous
- Specific
- Informed
- Purpose-limited



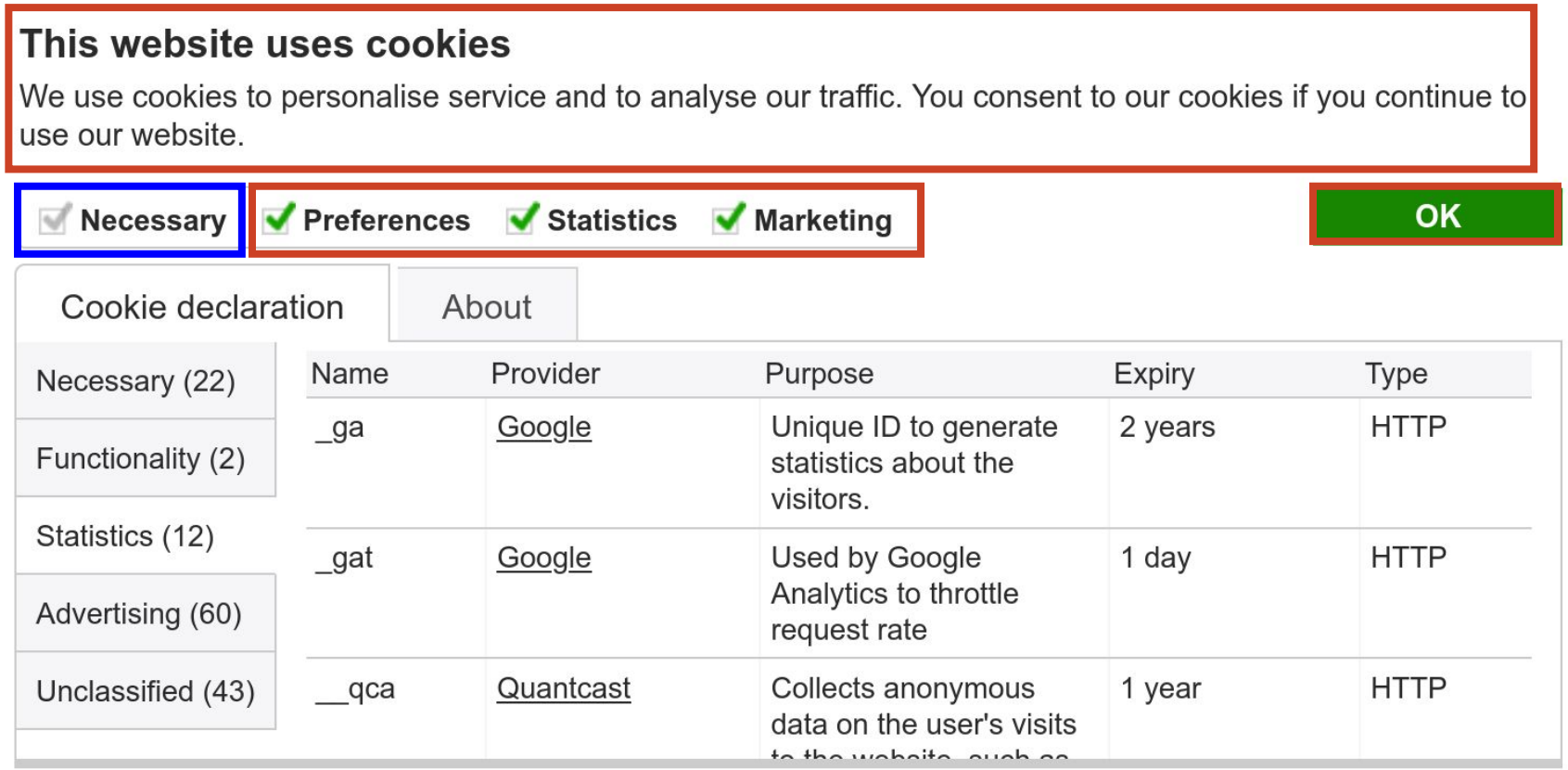
ePrivacy Directive and General Data Protection Regulation (*GDPR*)

ePrivacy Directive:

- All but strictly necessary data processing requires consent

GDPR Consent:

- Freely-given
- Unambiguous
- Specific
- Informed
- Purpose-limited



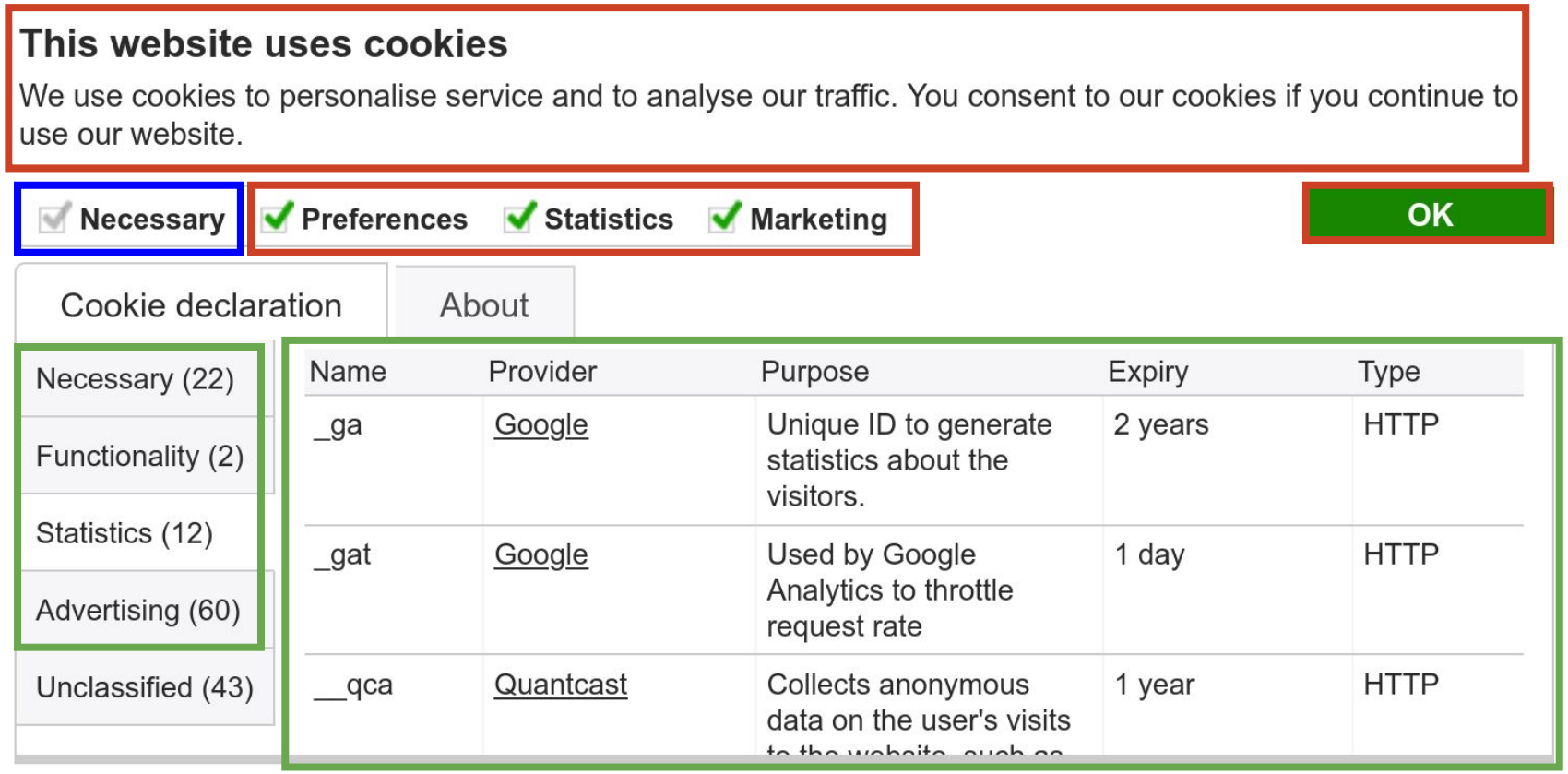
ePrivacy Directive and General Data Protection Regulation (*GDPR*)

ePrivacy Directive:

- All but strictly necessary data processing requires consent

GDPR Consent:

- Freely-given
- Unambiguous
- Specific
- Informed
- Purpose-limited



Non-compliance is widespread

- Empirical studies:
  - Non-compliance in up to 80% of websites (e.g., cookies set before consent)

    (Utz 2019, Trevisan 2019, Matte 2020, Nouwens 2020, Kampanos 2021, Santos 2021, etc.)
  - Websites do not respect user choices

    (Libert 2018, Trevisan 2019, Matte 2020, Nouwens 2020, etc.)

- Usability: dark patterns successfully trick users

  (Bösch 2016, Grassl 2020, Hasner 2021, Sanchez-Rola 2019, Htut Soe 2020, etc.)

Goal: Enforce cookie consent on client-side.

Our solution: CookieBlock

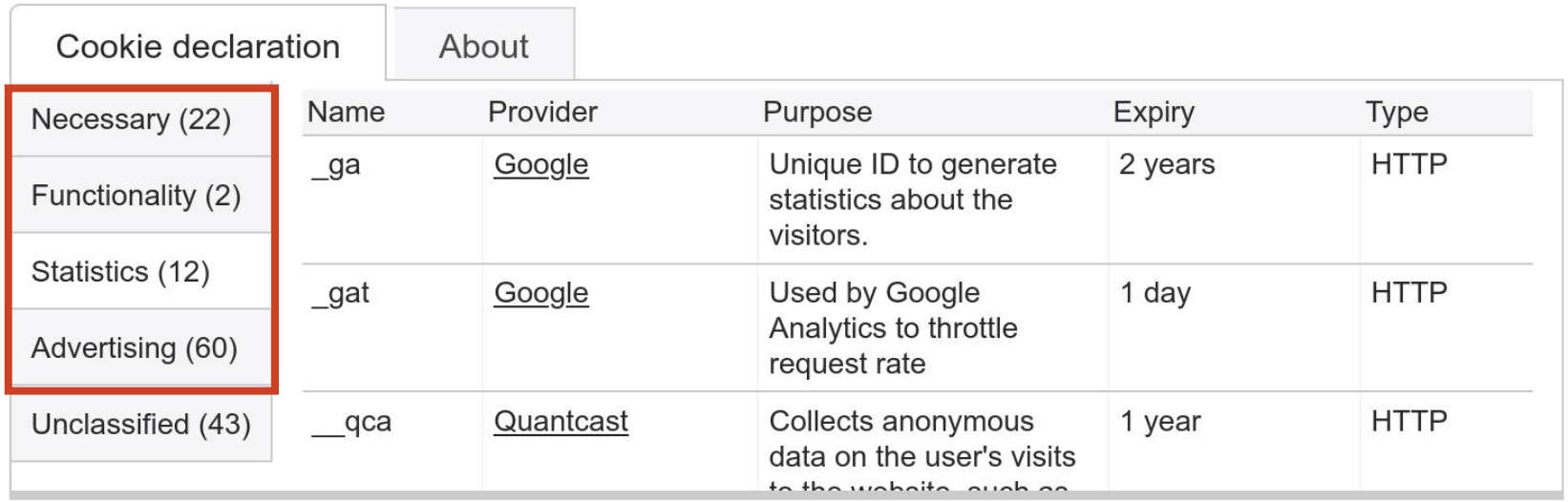
- Browser extension to predict purposes for cookies using machine learning
- Remove cookies of unconsented purposes on client-side

Implementation:

1. Crawl web to gather training data (ground truth)
2. Extract features and train an ML model
3. Apply the model in the browser extension

Data collection: selecting data sources

- Source for training data:



- Consent Management Platform (*CMP*):

Cookiebot OneTrust Termly

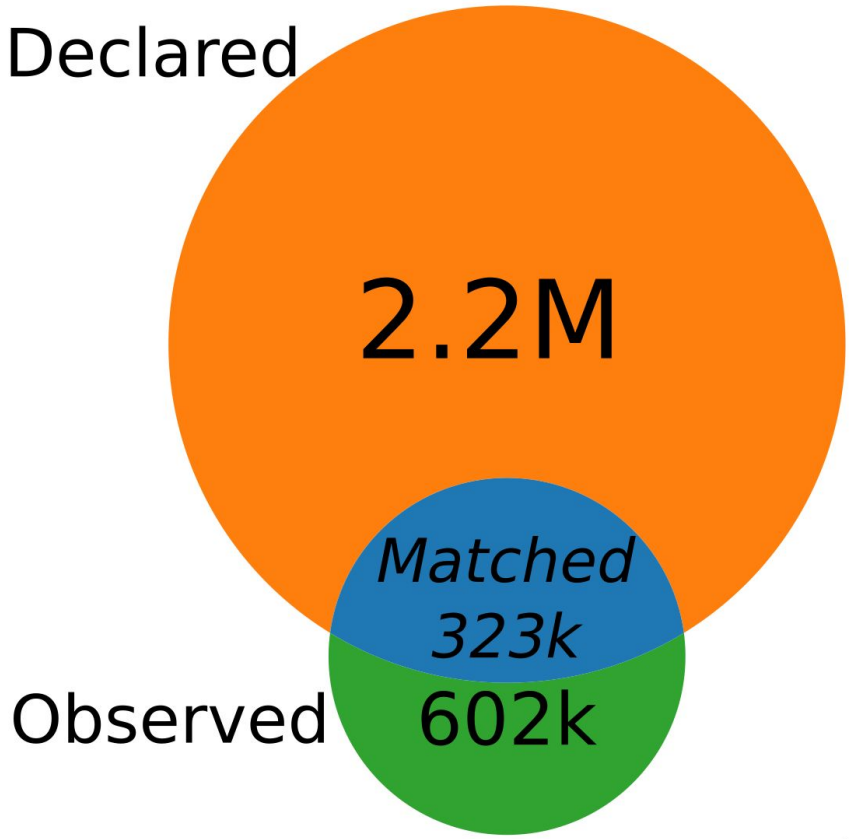
Data collection: web crawlers

- CMP presence crawler:
  - Input: 6 million domains, sourced from Tranco list
  - Output: ~37.5k domains with confirmed CMP

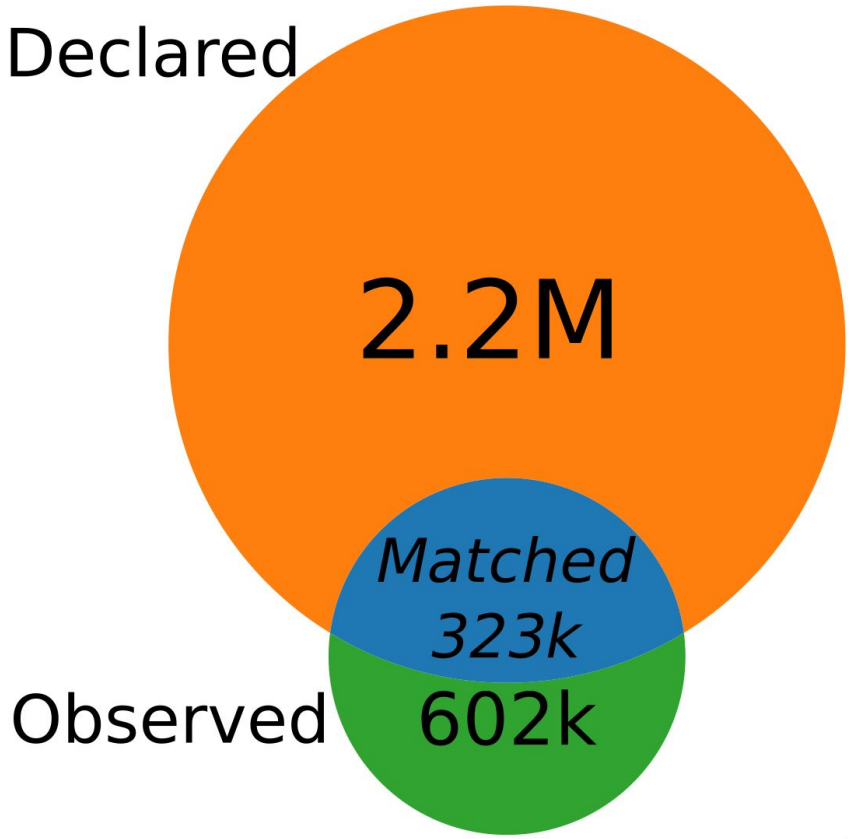
HTTP GET

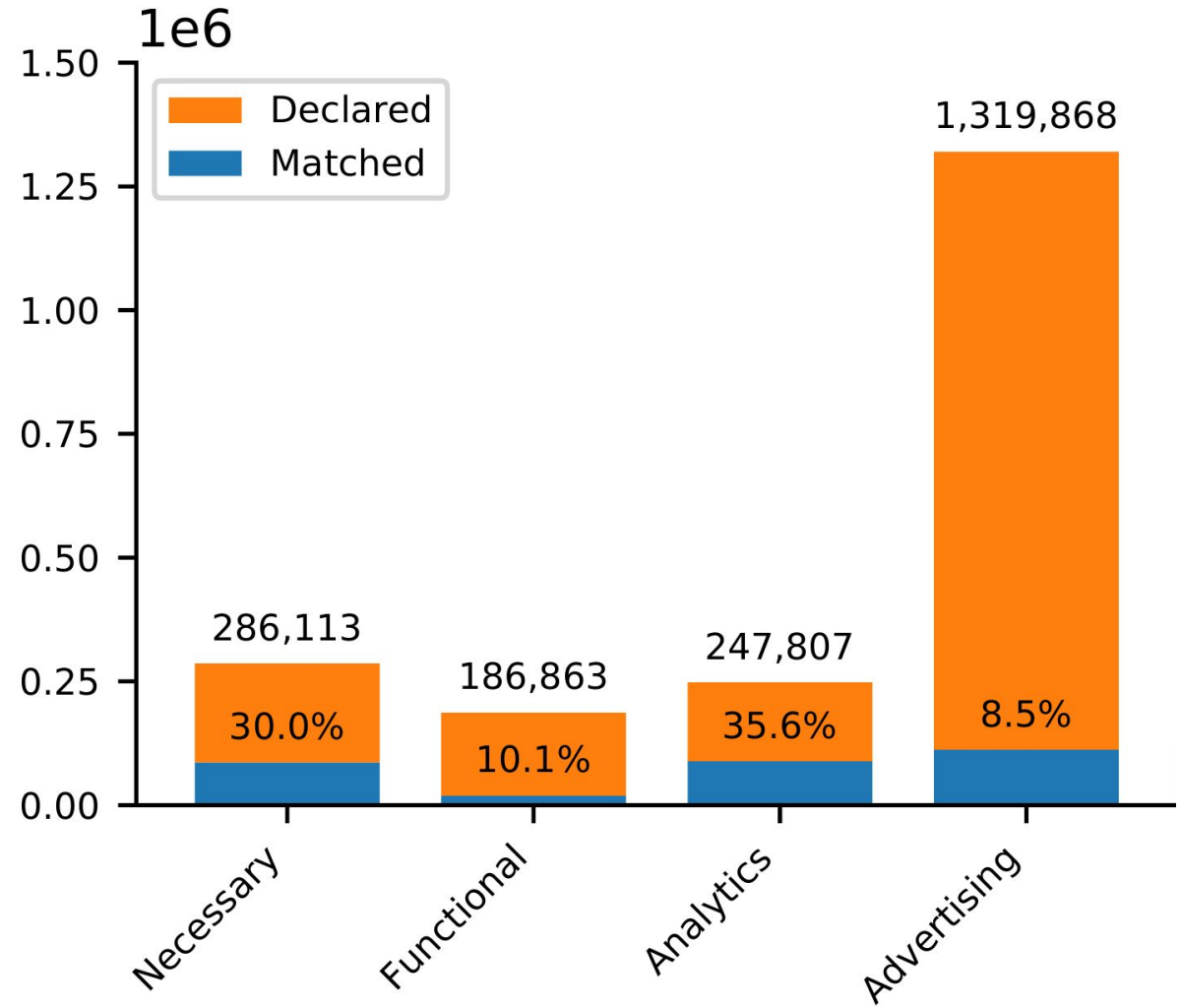
- Cookie consent crawler:
  - Browse websites, gather cookie declarations + observed cookies
  - Based on OpenWPM – visit subpages, move cursor, etc.
  - Successful for ~30k domains

Data collection: results of OpenWPM crawl



Data collection: results of OpenWPM crawl





Feature extraction from textual cookies

Example: Shannon entropy

- Higher entropy, more randomness
- Indicator for unique identifiers

```
{
    "id": "pid=4ecf225b293bded2e68c1d8e4379ea0c",
    "session_count": 1,
    "last_session_ts": 1652872456152
}
```

52 types in total, including:

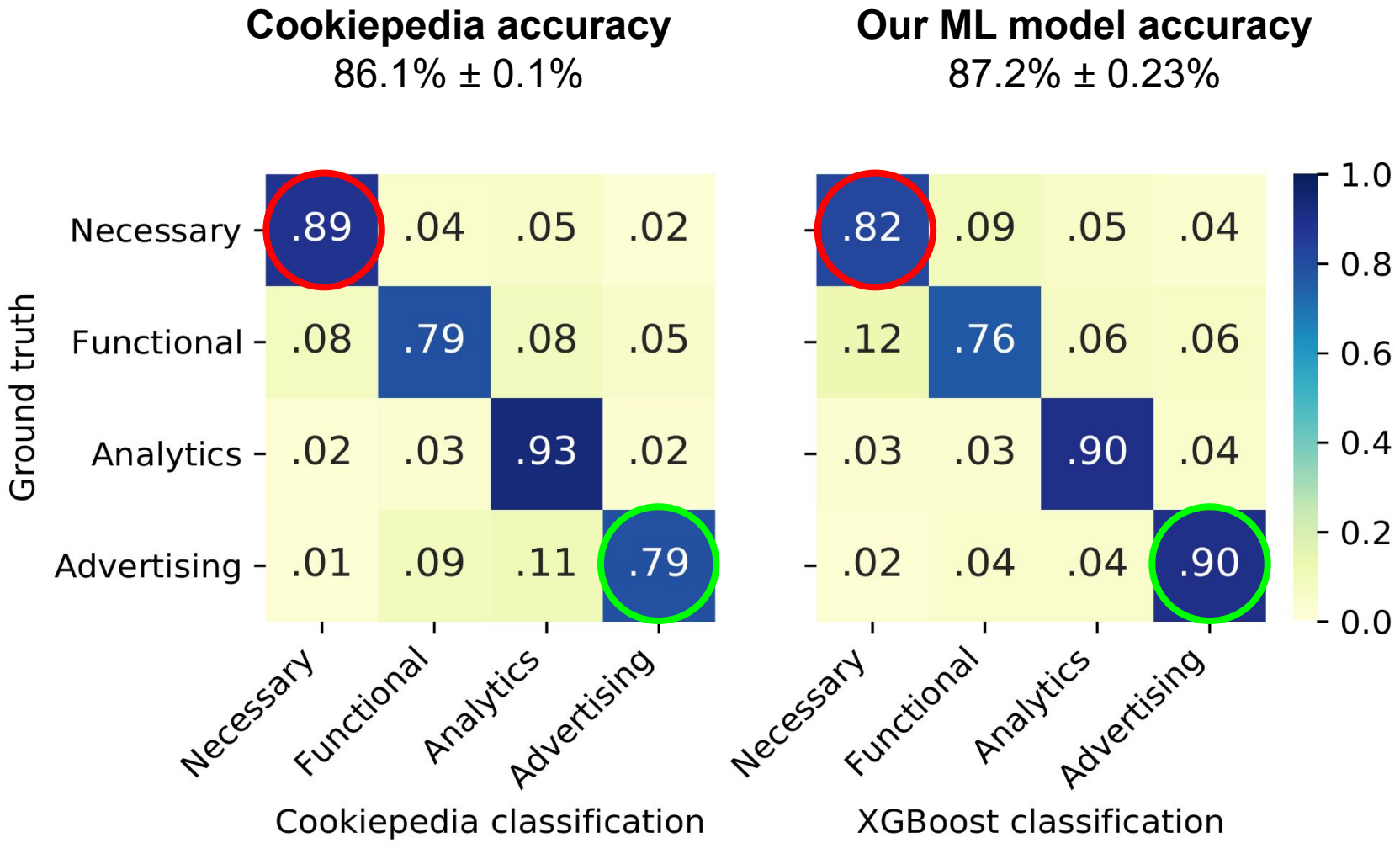
- *Encodings, name patterns, content size, timestamps, language strings, cookie flags, third-party status, expiry, etc.*

Classifier evaluation

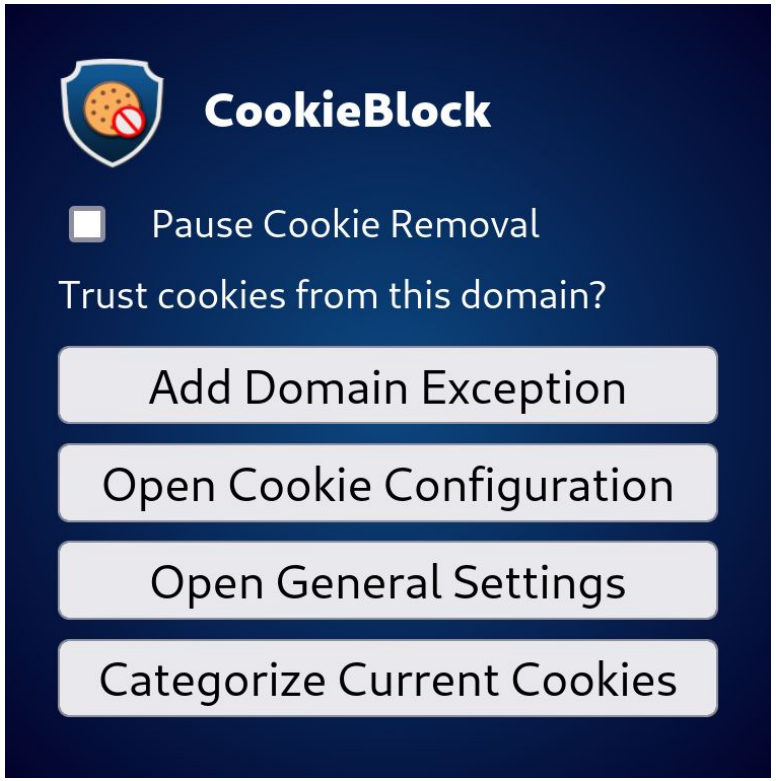
Cookiepedia accuracy
86.1% ± 0.1%

Our ML model accuracy
87.2% ± 0.23%

Classifier evaluation



CookieBlock browser extension

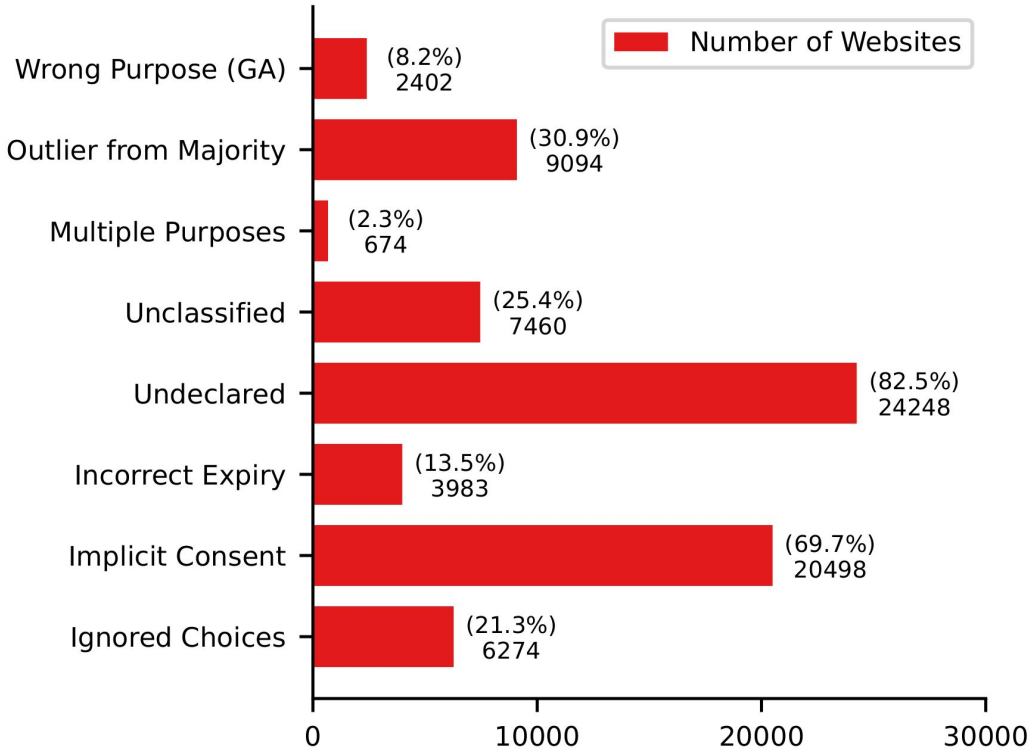


- User defines consent preferences when installed
- Classifies cookies and deletes those with rejected purpose
- Available for Firefox, Chrome, Edge, and Opera, 14k users, 4 ⭐

Empirical evaluation:

- No broken functionality on 85 out of 100 pages
- 8x minor issues (cookie notice reappear)
- 7x authentication issues (login, registration)

Potential violations

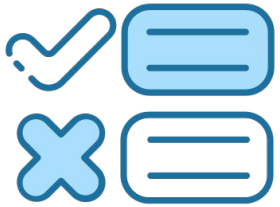


Potential violations

Undeclared cookies

- Not listed in the consent

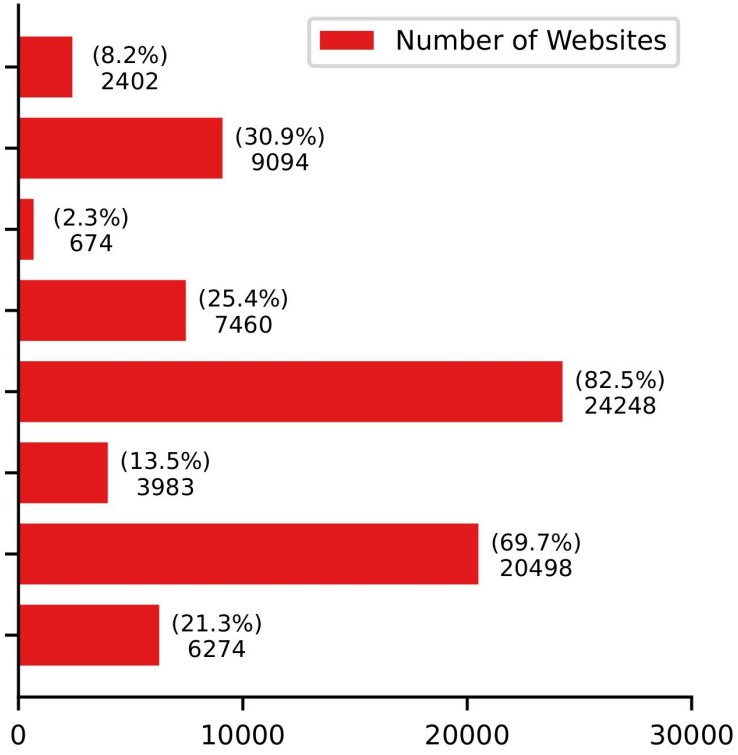
GDPR informed consent requirement



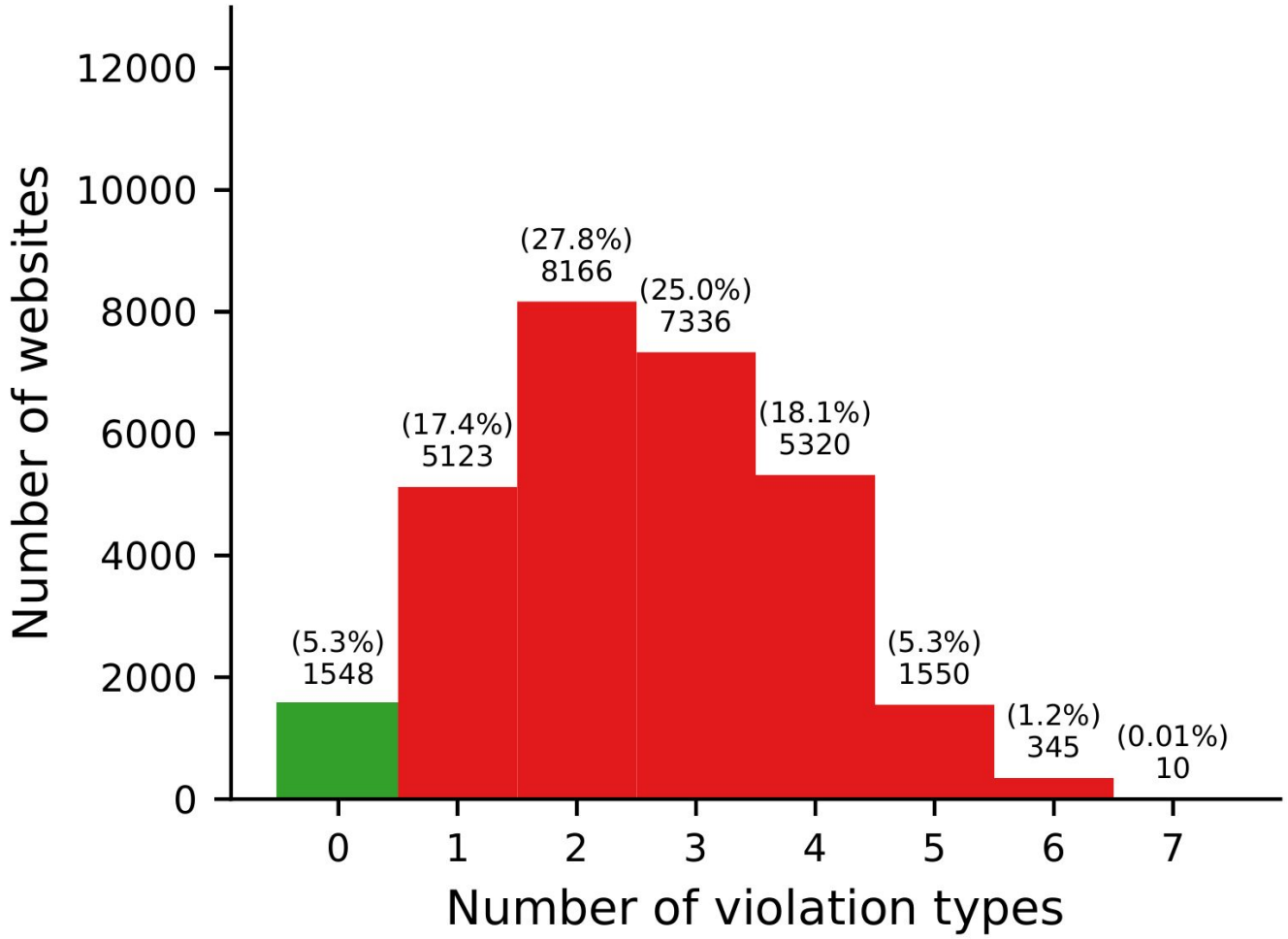
Cookies set prior to user's consent

Cookies set despite negative consent

Article 5(3) of the ePrivacy Directive



Potential violations: histogram



Conclusion

More info, source, extension links:
https://karelkubicek.github.io/post/cookieblock

- Users:
  - Consent notices are broken → CookieBlock brings privacy control
- Researchers, DPAs:
  - Detected 8 potential violation types on ~95% of websites
  - Cookie purpose ML model improves tracking detection
- Developers, DPAs:
  - CookieAudit extension: audit GDPR violations in cookie notices

Authors: Dino Bollinger, Karel Kubicek, Carlos Cotrini, David Basin