



GuardXP: From Data Privacy to Improved Cybersecurity

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Universitat Politècnica de Catalunya (UPC)

In collaboration with: Consorci de Serveis Universitaris de Catalunya (CSUC)

RIPE NCC Open House – 6 Feb. 2025

This project is sponsored by Ripe NCC (2024 Community Projects Fund)

Third-party trackers

13 oct 2024 Actualizado 19:23 CEST Selecciones ESPAÑA

EL PAÍS

EL PERIÓDICO DE LA MAÑANA

INTERNACIONAL OPINIÓN ESPAÑA ECONOMÍA SOCIEDAD MEDIO AMBIENTE CIENCIA SALUD TECNOLOGÍA CULTURA DEPORTES GENTE BELLEZA EL PAÍS SEMANAL EL PAÍS COPRO

LA GRAN CRISIS DE LA VIVIENDA

Los jóvenes abanderan la protesta masiva en Madrid por la vivienda

Decenas de miles de personas han participado en una manifestación que demanda a los políticos de todas las administraciones una solución urgente

FOTOGALERÍA La manifestación, en imágenes

Los rostros de la marcha: "No podemos hacer un proyecto de vida propio"

VIDEO: "Estamos al límite", las razones para protestar

La nueva trampa de la vivienda

Encontrar una casa asequible es uno de los grandes problemas: jóvenes y migrantes son los más afectados

Viena, la utopía hecha realidad

Con una tradición socialdemócrata que se remonta a hace un siglo, la capital austriaca ofrece más de 400.000 casas en alquiler barato

Diez datos esenciales para entender el problema

Los gráficos para analizar una crisis que pesa sobre toda una generación

Medidas para una emergencia nacional

Los partidos ante la crisis: tres modelos diferentes para un desafío de época

El PSOE se aferra a los primeros resultados de la ley estatal

Barcelona regulará este año los alquileres de temporada

El show' del ADN de Colón: pudo ser un judío de Valencia, o no

La genética del navegante es "compatible" con un origen judío sefardí, según investigadores de la

FRANÇAIS ENGLISH

Le Monde

Actualités - Élections US - Économie - Vidéos - Débats - Culture - Le Goût du Monde - Services - Q

LIVE Guerre en Ukraine | opération des derniers informations

Alerte Marathon: le record du monde pour la Mayane Ruth Chepngetich à Chicago

Alerte Football: pour Tchouaméni, « ce est fait un peu trop » sur le cas Mouquet

Alerte TGV, places de concert, e-commerce: la danse infernale des « prix dynamiques »

LIVE La Finul, la mission de maintien de la paix de l'ONU au Liban, annonce que deux chars israéliens sont « entrés de force » dans une de ses positions

TGV, places de concert, e-commerce: la danse infernale des « prix dynamiques »

INQUIÊTE Ariane & Gisèle Le conte intime d'Ariane Grimm et de sa mère Gisèle, gardienne de son tombeau littéraire

Aux Etats-Unis, le Nevada miné par la crise du logement, thème central de la campagne présidentielle

STARTSEITE NEWS POLITIK REGION UNTERHALTUNG SPORT FUSSBALL LIFESTYLE RATGEBER GESUNDHEIT SEX & LIEBE AUTO SPIELE DEALS

Bild

Der große Gottschalk-Zoff

Ein alter weis(s)er Mann?

Ich kann über Thommys freche Art lachen

Sorry, aber Thomas ist wirklich herbstblond!

Doppeltes Debüt! Nagelsmann verkündet Startelf-überwechslung

Consent managers

The screenshot shows the EL PAÍS consent manager interface. It features a dark background with white text. At the top, it says "EL PAÍS" and "It offers the following browsing modes:". Below this, there are two columns of text. The left column lists several data processing activities, and the right column describes the "Subscribe and decline" option. At the bottom, there are two buttons: "ACCEPT AND CONTINUE" and "SUBSCRIBE AND DECLINE". A link "Already a subscriber? Log in here." is also present.

EL PAÍS
It offers the following browsing modes:

- Storage and access to information,
- Sharing data and profiles for analytics and personalized advertising from advertisers for our advertising campaigns,
- Sharing data and profiles for analytics and personalized advertising from advertisers and advertising agencies on the Internet,
- Precise geolocation data and identification through device analytics.

Subscribe and decline
This option will allow you, among other services, unlimited reading of El País on the website and App, access newsletters with exclusive content, unique cultural experiences and comment on news.

If you decide to subscribe, and in accordance with the preferences you grant, you will be able, for example, browse our website without us, or third parties, being able to track you or show you personalized advertising and content.

ACCEPT AND CONTINUE **SUBSCRIBE AND DECLINE**

Legal warning | Cookies policy | Know more

The screenshot shows the Le Monde consent manager interface. It features a dark background with white text. At the top, it says "Le Monde" and "Soutenez un journalisme fiable". Below this, there is a section titled "Accéder gratuitement en acceptant l'utilisation de cookies." and another section titled "...ou s'abonner au Monde pour profiter de tous les contenus." At the bottom, there are two buttons: "Accepter et continuer" and "S'abonner".

Soutenez un journalisme fiable

Accéder gratuitement en acceptant l'utilisation de cookies.
L'accès gratuit au site (hors contenus exclusifs abonnés) est subordonné à votre consentement sur l'utilisation des cookies. Vous pouvez retirer votre consentement à tout moment.

...ou s'abonner au Monde pour profiter de tous les contenus.

L'accès au site avec abonnement vous permet de consulter tous les contenus et archives du Monde depuis notre site et nos applications mobiles. En cliquant sur le bouton « S'abonner », vous pouvez refuser les cookies ou paramétrer vos choix (hors cookies de fonctionnement et de mesure d'audience).

Accepter et continuer **S'abonner**

The screenshot shows the Bild consent manager interface. It features a dark background with white text. At the top, it says "Bild" and "Datenschutz und Nutzungserlebnis auf BILD.de". Below this, there are two columns of text: "Ohne Tracking und Cookies* nutzen" and "Mit Tracking und Cookies nutzen". At the bottom, there are two buttons: "Jetzt BILD Pur abonnieren" and "Alle akzeptieren".

Datenschutz und Nutzungserlebnis auf BILD.de

Ohne Tracking und Cookies* nutzen
Nutzen Sie BILD.de ohne Tracking, Cookies und personalisierte Werbung für 3,99 EUR/Monat (rabattiert für BILDplus-Abonnenten 2,99 EUR/Monat). Informationen zur Datenverarbeitung im BILD Pur-Abo finden Sie in unserer [Datenschutz-Zeichnung](#) und in den FAQ.

Mit Tracking und Cookies nutzen
Sie können unser Angebot auch nutzen, ohne einen Vertrag abzuschließen. Wir übermitteln in diesem Fall personenbezogene Daten an bis zu 280 [Datenanbieter](#), die uns helfen, unser Webangebot zu verbessern und zu finanzieren. In diesem Zusammenhang werden auch Nutzungsprofile (u.a. auf Basis von Cookie-IDs) gebildet, mit Daten von anderen Webseiten angereichert und auch außerhalb des EWR verarbeitet. Hierzu übermitteln wir an diese Drittanbieter auch Ihre Privatsphäreinstellungen bzw. Präferenz in Form einer codierten Zeichenfolge (sog. TC-String). Hierfür und um bestimmte Dienste zu nachfolgend aufgeführten Zwecken verwenden zu dürfen, benötigen wir Ihre Einwilligung, indem Sie "Alle akzeptieren" klicken. Sollen Sie diesen (jederzeit widerruflich) zu Dies umfasst auch Ihre [Einwilligung in die Übermittlung bestimmter personenbezogener Daten in Drittländer](#), u.a. die USA, nach Art. 49 (1) (a) DSGVO. Sie können Ihre Auswahl jederzeit unter "Widerruf Tracking" am Seitenende mit Wirkung für die Zukunft widerrufen.

Jetzt BILD Pur abonnieren **Alle akzeptieren**

Consent managers

What Do You Typically Do When You See a Pop-Up Asking You To Accept Cookies?



Based on a survey of 1,000 U.S. adults.



Second-party trackers

For what purposes my information is used and who uses it? ✕

This Site uses its own and other entities cookies, in order to access and use your information for the below purposes. If you do not agree with any of these purposes, you may customize your choices below.

We and the companies that collaborate with us will use your information obtained through cookies. To know the collaborating companies that incorporate their cookies on our website, such as advertisers, advertising operators and intermediaries, you can access through the button **See our partners**. You can set your consent preferences separately for each of the mentioned partners.


Additional information: You can know the complete information about the use of cookies, their configuration, origin, purposes and rights in our [Cookies Policy](#).

You allow the use of cookies for the following purposes:

+ Storage and access to information	Disagree	Agree
+ Select basic ads	Disagree	Agree
+ Create a personalised ads profile	Disagree	Agree
+ Select personalised ads	Disagree	Agree
+ Create a personalised content profile	Disagree	Agree
+ Select personalised content	Disagree	Agree
+ Measure ad performance	Disagree	Agree
+ Measure content performance	Disagree	Agree
+ Apply market research to generate audience insights	Disagree	Agree
+ Develop and improve products	Disagree	Agree
+ Sharing data and profiles for analysis and personalised advertising from advertisers for our advertising campaigns	Disagree	Agree
+ Actively scan device characteristics for identification	Disagree	Agree
+ Sharing data and profiles for analysis and personalised advertising for advertisers and advertising companies on the Internet.	Disagree	Agree
+ Use precise geolocation data	Disagree	Agree

By giving consent to the purposes above, you also allow this website and its partners to operate the following data processing: Ensure security, prevent fraud, and debug, Link different devices, Match and combine offline data sources, Receive and use automatically-sent device characteristics for identification, and Technically deliver ads or content

[View our partners](#)

PRIVACY MANAGEMENT BY DIDOMI 


Disagree to all **Agree to all**

Select partners for Prisa ✕

You can set your consent preferences for every partner listed below individually. Click on a partner name to get more information on what it does, what data it is collecting and how it is using it.

All partners	Block	Authorize
+ 152 Media LLC IAB TCF	Block	Authorize
+ 1Agency IAB TCF	Block	Authorize
+ 1plusX AG IAB TCF	Block	Authorize
+ 2KDirect, Inc. (dba iPromote) IAB TCF	Block	Authorize
+ 33Across IAB TCF	Block	Authorize
+ 3Q GmbH IAB TCF	Block	Authorize
+ 42 Ads GmbH IAB TCF	Block	Authorize
+ 6Sense Insights, Inc. IAB TCF	Block	Authorize
+ 7Hops.com Inc. (ZergNet) IAB TCF	Block	Authorize

+ View user information

PRIVACY MANAGEMENT BY DIDOMI 

Save

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+ Create a personalised content profile	Disagree	Agree
+ Select personalised content	Disagree	Agree
+ Measure ad performance	Disagree	Agree
+ Measure content performance	Disagree	Agree
+ Apply market research to generate audience insights	Disagree	Agree
+ Develop and improve products	Disagree	Agree
+ Sharing data and profiles for analysis and personalised advertising from advertisers for our advertising campaigns	Disagree	Agree
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+ 3Q GmbH IAB TCF	Block	Authorize
+ 42 Ads GmbH IAB TCF	Block	Authorize
+ 6Sense Insights, Inc. IAB TCF	Block	Authorize
+ 7Hops.com Inc. (ZergNet) IAB TCF	Block	Authorize

+ View user information

PRIVACY MANAGEMENT BY DIDOMI

Save

863 “partners”



“Partners” (starting with A: 150+)

+A Million AdsiAB TCF	+AdElement Media Solutions Pvt LtdIAB TCF	+Admixer EU GmbHIAB TCF	+adsquare GmbHIAB TCF	+ADYOUlike SAIAB TCF	+Anzu Virtual Reality LTDIAB TCF	+Audience Solutions S.A.IAB TCF
+A.MobiAB TCF		+Admo.tv (Clickon)IAB TCF	+ADSTOURS SASIAB TCF	+Adzymic Pte LtdIAB TCF	+Apester LtdIAB TCF	+Audience Trading Platform Ltd.IAB TCF
+AA INTERNET-MEDIA LtdIAB TCF	+Aderize, Inc.IAB TCF	+Adnami ApsIAB TCF	+AdsWizz Inc.IAB TCF	+Agate Systems LimitedIAB TCF	+Appier PTE LtdIAB TCF	+AudienceProject ApsIAB TCF
+Aarki, Inc.IAB TCF	+Adevinta Spain S.L.U.IAB TCF	+adnanny.com SLUIAB TCF	+Adsyield InclIAB TCF	+agof - daily campaign factsIAB TCF	+Appstock LTD.IAB TCF	+AudienceProject Measurement AmziAB TCF
+AAX LLCIAB TCF	+Adex (Virtual Minds GmbH)IAB TCF	+ADNOW I RENODO MEDIA LTDIAB TCF	+Adtarget Teknoloji A.S.IAB TCF	+agof studiesIAB TCF	+appTV Ltd.IAB TCF	+Audiencerate LTDIAB TCF
+Accorp Sp. z o.o.IAB TCF	+ADFI MEDIA SLIAB TCF	+Adnuntius ASIAB TCF	+ADTARGET.ME UABIAB TCF	+AiCreo S.r.l.IAB TCF	+Appush TechnologiesIAB TCF	+AudienceRun corpiAB TCF
+AccountInsight LtdIAB TCF	+Adform A/SIAB TCF	+Adobe Advertising CloudIAB TCF	+Adtelligent Inc.IAB TCF	+AIDEM Technologies LTDIAB TCF	+Aptivio InclIAB TCF	+Audiens S.r.l.IAB TCF
+Active Agent (Virtual Minds GmbH)IAB TCF	+AdGear Technologies, Inc.IAB TCF	+Adobe Audience Manager, Adobe Experience PlatformIAB TCF	+AdTheorent, InclIAB TCF	+Airnow Media LtdIAB TCF	+AragoIAB TCF	+Audiennz AGIAB TCF
+ACTV8, Inc.IAB TCF	+AdheseIAB TCF	+Adobe Audience Manager, Adobe Experience Platform	+AdTiming Technology Company LimitedIAB TCF	+Akamai	+Arbeitsgemeinschaft Media-AnalyseIAB TCF	+AuDigentIAB TCF
+AcuityAds Inc.IAB TCF	+adhood.comIAB TCF	+AdomikiIAB TCF	+Adtriba GmbHIAB TCF	+AlgoriX Technology Pte. Ltd.,IAB TCF	+Arcanor Bilgi Teknolojileri ve Hizmetleri A.Ş.IAB TCF	+audio content & control GmbHIAB TCF
+AcxiomIAB TCF	+AdikteevIAB TCF	+Adpone SLIAB TCF	+ADTTTRIBUTION InclIAB TCF	+AlkimilIAB TCF	+ArcSpan Technologies, Inc.IAB TCF	+Audiohook CorporationIAB TCF
+Ad Alliance GmbHIAB TCF	+AdInMo LTDIAB TCF	+adQueryIAB TCF	+ADUXIAB TCF	+Allegro sp. z o.o.IAB TCF	+Arcspire LimitedIAB TCF	+AUDIOMOB LTDIAB TCF
+ad6medialAB TCF	+ADITION (Virtual Minds GmbH)IAB TCF	+AdQuiver Media SLIAB TCF	+advanced store GmbHIAB TCF	+Alliance Gravity Data MediaIAB TCF	+AREIA (ADLOOP)IAB TCF	+AudionIAB TCF
+Adacado Technologies Inc. (DBA Adacado)IAB TCF	+Adjust Digital A/SIAB TCF	+ADRENALADIAB TCF	+ADventori SASIAB TCF	+Alphonso Inc. IAB TCF	+ArkeeroIAB TCF	+Automatic AdsIAB TCF
+adality GmbHIAB TCF	+Adjust GmbHIAB TCF	+Adrino Mobile Sp. z o.o.IAB TCF	+Adventure MediaIAB TCF	+Always-Computing SASIAB TCF	+ARKHEUSIAB TCF	+Avantis Video LtdIAB TCF
+Adasta Media S.r.l.IAB TCF	+Adkernel LLCIAB TCF	+adrule mobile GmbHIAB TCF	+AdverlineIAB TCF	+Amazon Ad ServerIAB TCF	+ARMIS SASIAB TCF	+Avocet Systems LimitedIAB TCF
+adbouncer Werbeagentur GmbHIAB TCF	+Adlane LTDIAB TCF	+Ads Interactive Ltd.IAB TCF	+Adverticum cPlc.IAB TCF	+Amazon AdvertisingIAB TCF	+Arpeely Ltd.IAB TCF	+AWIN AGIAB TCF
+adbility media GmbHIAB TCF	+Adloox SAIAB TCF	+Adserve.zone / Artworx ASIAB TCF	+Advertising.Tech FZ-LLCIAB TCF	+Amnet GmbHIAB TCF	+Arrivalist Co.IAB TCF	+Axel Springer Teaser Ad GmbHIAB TCF
+AdClear GmbHIAB TCF	+Adludio Ltd.IAB TCF	+AdServing Factory srlIAB TCF	+Advertly AB (publ)IAB TCF	+Amobee Inc.IAB TCF	+ArtChaos s.r.o.IAB TCF	+Axiom Media ConnectIAB TCF
+AdColony, Inc.IAB TCF	+ADMAN - Phaistos Networks, S.A.IAB TCF	+AdViewIAB TCF	+Advertly AB (publ)IAB TCF	+Amplified IntelligenceTechnologiesIAB TCF	+Artefact Deutschland GmbHIAB TCF	+AXIS CORP LTDIAB TCF
+AddAppttr GmbHIAB TCF	+ADman Interactive SLUIAB TCF	+Advisible ABIAB TCF	+Advertly AB (publ)IAB TCF	+ANINPRO-CREATIVE, S.L.IAB TCF	+Aryel s.r.l.IAB TCF	+Axonix LTDIAB TCF
+AdDefend GmbHIAB TCF	+adMarketplace, Inc.IAB TCF	+Adwatch	+AdViewIAB TCF	+Aniview LTDIAB TCF	+Ask LocalIAB TCF	+Azerion Holding B.V.IAB TC
+AdDefend GmbHIAB TCF	+ADMAXIAB TCF	+Adsolutions BVIAB TCF	+ADWAYS SASIAB TCF	+AnonymisedIAB TCF	+AttributyIAB TCF	+ >700 more partners!!
+AddrelevanceIAB TCF	+AdMaxim LimitedIAB TCF	+AdsonicalIAB TCF	+adWWMGIAB TCF	+Anteriad, LLCIAB TCF	+Audience NetworkIAB TCF	
+Adelaide Metrics InclIAB TCF	+admetrics GmbHIAB TCF	+Adspirit GmbHIAB TCF	+Adxperience SASIAB TCF	+AntVoiceIAB TCF		


“Partners” visibility

← **Select partners for Prisa** ✕

You can set your consent preferences for every partner listed below individually. Click on a partner name to get more information on what it does, what data it is collecting and how it is using it.

All partners	Block	Authorize
+ 152 Media LLC IAB TCF	Block	Authorize
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+ 7Hops.com Inc. (ZergNet) IAB TCF	Block	Authorize

+ View user information


PRIVACY MANAGEMENT BY DIDOMI  Save

← **Select partners for EIMundo** ✕

You can set your consent preferences for every partner listed below individually. Click on a partner name to get more information on what it does, what data it is collecting and how it is using it.

All partners	Block	Authorize
#		
+ 152 Media LLC IAB TCF	Block	Authorize
+ 1Agency IAB TCF	Block	Authorize
+ 1plusX AG IAB TCF	Block	Authorize
+ 2KDirect, Inc. (dba iPromote) IAB TCF	Block	Authorize
+ 33Across IAB TCF	Block	Authorize
+ 3Q GmbH IAB TCF	Block	Authorize
+ 42 Ads GmbH IAB TCF	Block	Authorize

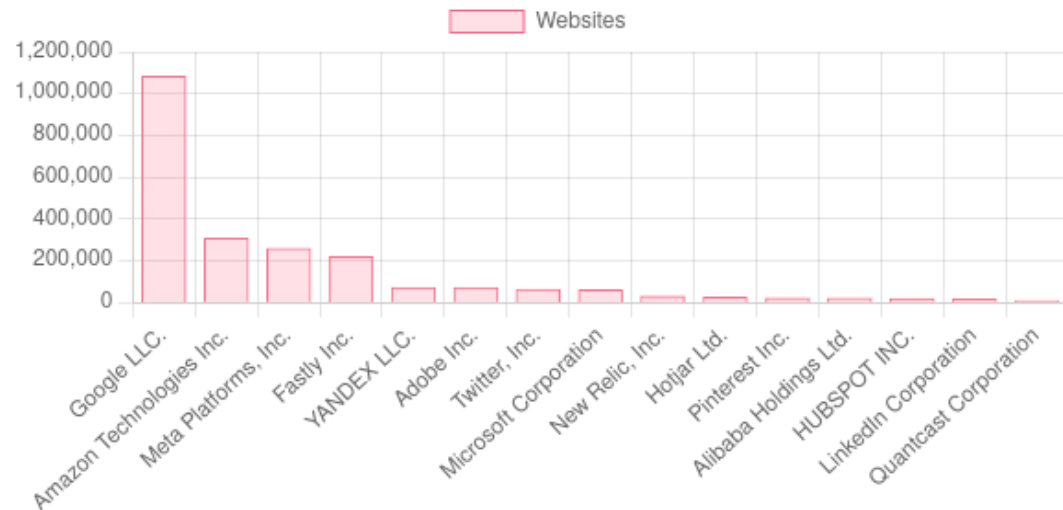
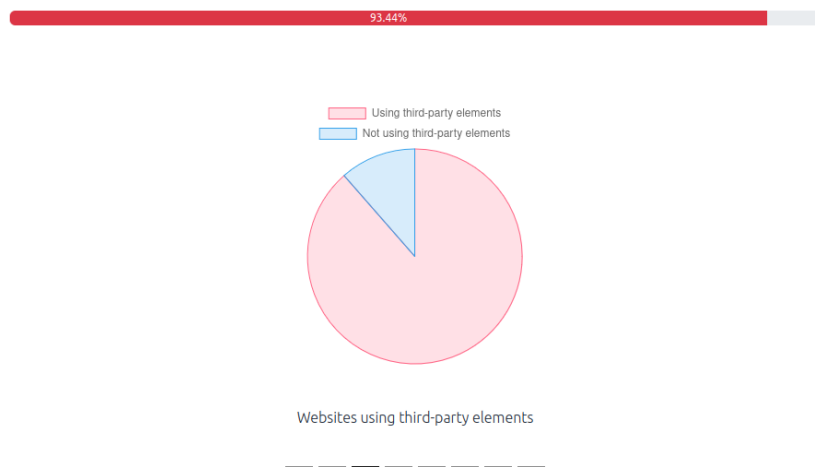
+ View user information

PRIVACY MANAGEMENT BY DIDOMI  Save

Third-party trackers

- Third-party trackers are present in >90% of the websites
- They can easily recover our *browsing history* (at least)
- They can track us even if we delete cookies, use private mode, DNT, VPN, etc.

Percentage of domains using web tracking



Adblockers

- Most popular protection methods
 - Block URLs using pattern lists
 - Difficult to maintain updated and block new methods
 - Easy to evade by periodically changing the hosting domains
 - Adblockers are *too* conservative
- Why are they conservative?
 - “Users want protection that does not break websites” [15]
 - “When extensions break websites, users disable them based on how important the content they are accessing is to them” [16]
- Usually do not block URLs that can impact the website functionality



[15] C. E. Wills and D. C. Uzunoglu, “What Ad Blockers Are (and Are Not) Doing,” HotWeb, 2016

[16] G. Merzdovnik, M. Huber, D. Buhov, N. Nikiforakis, S. Neuner, M. Schmiedecker, and E. Weippl, “Block Me If You Can: A Large-Scale Study of Tracker-Blocking Tools,” EuroS&P, 2017

GuardXP

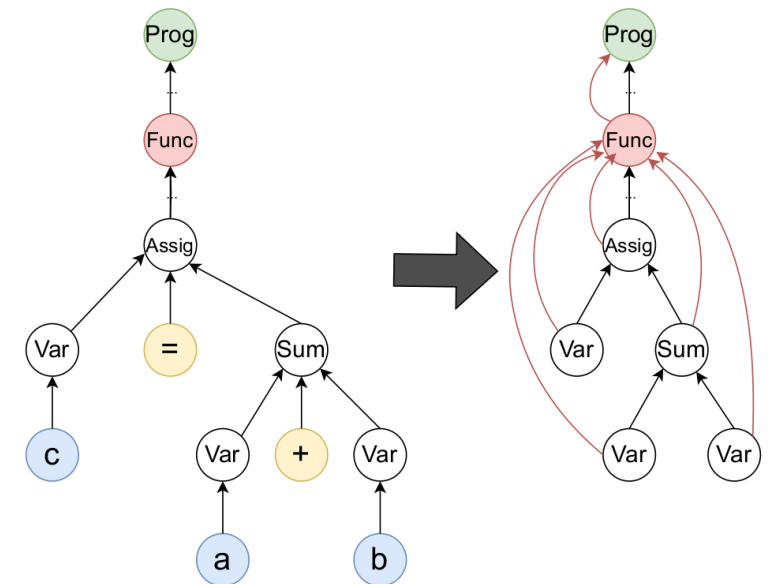
- GuardXP addresses the two main problems of AdBlockers
 - Limitations of blacklists (hard to maintain and easy to evade)
 - Functionality loss (block less than they should)
- GuardXP is based on two previous works:
 - TrackSign: For discovering new tracking methods (INFOCOM 2021) [1]
 - ATrack: For selectively blocking tracking code (INFOCOM 2023) [2]

[1] TrackSign: Guided Web Tracking Discovery: <https://personals.ac.upc.edu/pbarlet/papers/TrackSign.Infocom2021.pdf>

[2] ATrack: Automatic Detection and Removal of Web Tracking Code with Minimal Functionality Loss: <https://arxiv.org/pdf/2301.10895.pdf>

TrackSign + ATrack

- Automatically detect *unknown* web trackers
 - Known trackers under unknown URLs
 - Completely new tracking methods
- Analyze website code instead of URLs
 - Popularity: #resources that use this piece of code
 - Dirtiness: %resources known to perform tracking
- Focus on code structure rather than code content
 - More robust against obfuscation and minification
 - Selectively block tracking AST to better preserve functionality



Project objectives

- Integrate TrackSign + ATrack into actual tools that can be used by individual users and companies to protect their privacy and security (GuardXP)
- Individual user: Browser plugin
 - Cleans tracking code from user browser activity
 - Main challenges: Online operation + Browser limitations
 - Firefox-based browsers
- Companies: Web proxy
 - Clean tracking code from company's web traffic by intercepting all web connections
 - Main challenges: Online operation + SSL / HTTPS
 - Offered as cloud-based SaaS or on-premise

Project benefits

Enhanced privacy and security

- Reduce the risk of targeted attacks and data breaches (e.g., phishing)

Improved performance

- Removing tracking improves browsing speed and performance

Increased productivity

- Users receive less customized content which reduces distractions

Cost savings

- Reduced bandwidth can result in less cost for companies

Better understanding

- Data can help to understand data market ecosystem in the Internet



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