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Abstract

The success of generative AI relies heavily on training on data scraped through extensive crawling of the Internet, a practice that has raised significant copyright, privacy, and ethical concerns. While few measures are designed to resist a resource-rich adversary determined to scrape a site, crawlers can be impacted by a range of existing tools such as robots.txt, NoAI meta tags, and active crawler blocking by reverse proxies.

In this work, we seek to understand the ability and efficacy of today's networking tools to protect content creators against AI-related crawling. For targeted populations like human artists, do they have the technical knowledge and agency to utilize crawler-blocking tools such as robots.txt, and can such tools be effective? Using large scale measurements and a targeted user study of 182 professional artists, we find strong demand for tools like robots.txt, but significantly constrained by significant hurdles in technical awareness, agency in deploying them, and limited efficacy against unresponsive crawlers. We further test and evaluate network level crawler blockers by reverse-proxies, and find that despite very limited deployment today, their reliable and comprehensive blocking of AI-crawlers make them the strongest protection for artists moving forward.

#### 1 Introduction

The success of generative AI relies heavily on training on data scraped through extensive crawling of the Internet, a practice that has raised significant copyright, privacy, and ethical concerns. Today, AI model trainers have unleashed large numbers of data scrapers on the Internet. By many reports, these scrapers now dwarf the volume of human traffic on the Internet, partly because human users consume content at a much lower rate than scrapers. For example, analysis by Akamai suggests that on average, roughly 70% of website traffic is due to automated crawlers, compared to only 30% from human users [56]. Other anecdotal evidence suggests that AI scrapers are effectively producing DDoS attacks on smaller websites [44, 45]. While internet scraping is well-studied, the widespread

adoption of generative AI and its intensive data scraping has significantly changed the landscape. Data creators and hosting platforms, who were generally ambivalent toward data scraping in the past, are now raising serious concerns about AI-related scraping, particularly regarding copyright, privacy, and ethical practices. Indeed, these concerns have resulted in over thirty ongoing copyright lawsuits [6, 29, 59], multiple data strikes [17, 62], and a surge in the adoption of anti-scraping tools [38].

Given this new tension between AI training companies seeking training data and content creators who consider unauthorized AI training an existential threat to their livelihoods [57], a natural question arises: *What tools, if any, can content creators use to prevent their content from being scraped for AI training*? Answering this question requires a more thorough understanding of the needs of content creators; their awareness of, accessibility to, and agency over anti-crawling mechanisms; and ultimately, the availability and efficacy of current tools.

This paper presents our efforts to address these issues from several complementary fronts. In terms of representative content creators, we focus on visual artists as the most vulnerable population being targeted by AI crawlers. In terms of anti-crawling mechanisms, we focus on two tools at different ends of the spectrum. The most prominent and popular tool is robots.txt, a voluntary (and non-enforceable) protocol that enables site owners to specify crawling restrictions. We also consider crawler blocking by reverse proxies (e.g. Cloudflare), an active approach that enforces blocking but has seen limited deployment.

We begin with a large-scale measurement of robots.txt across the Web, and inclusion of directives that specifically

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target AI-crawlers over time. This effort serves as broader context on how the arrival of AI-crawlers has changed views across the Web towards web crawlers. We then turn our attention to visual artists, and perform a user study to understand their attitudes towards AI-crawlers, and their awareness of and accessibility to defensive tools like robots.txt. We complement these results with measurements of 1100+ professional artist websites to understand how distribution of hosting services impact artists' control over robots.txt. Next, we conduct our own experiments to determine which AI crawlers respect robots.txt. Finally, we consider active crawler blocking techniques, and perform experiments to measure their deployment as well as their effective coverage across different AI crawlers.

Results from our study highlight critical hurdles that limit or prevent the effective utilization of protective tools by individual creators, leaving these key stakeholders in the data ecosystem vulnerable and often unable to safeguard their work from unauthorized AI-driven use. More specifically, our analysis produces a number of interesting findings:

- We measured the inclusion of AI-crawlers in robots.txt of large content hosts, and found an initial surge followed by a slow increase. We also found a small but growing number of websites that explicitly invite AI crawlers to crawl their content.
- We conducted a survey with 182 professional artists, and found that individual artists often do not have the knowledge (> 60% have never heard about robots.txt) and technology means to include AI-crawlers in their robots.txt. Once presented with more information, most artists indicated that they would like to use robots.txt to disallow AI crawling. At the same time, the majority of the artists do not trust that AI companies will respect it.
- Testing on our own servers, we found most AI companies do respect robots.txt. However, a number of AI-powered apps and crawlers do not respect it (including crawlers from Meta).
- We measure the adoption and operation of active blocking mechanisms. While they can offer stronger protection, they still suffer from several limitations such as an incomplete list of AI-crawlers blocked, and inability to stop AI training for Meta, Google, and Webzio.

Altogether, our work highlights the need for better mechanisms that account for the diverse range of use cases, that make mechanisms more accessible to a broader range of content creators, and that more clearly convey the implications and limitations of using them.

#### 2 Background and Related Work

In this section, we start by providing a brief overview of AI-related crawling in Section 2.1. We then discuss existing mechanisms to stop crawling in Section 2.2.

# 2.1 Data Scraping of Commercial AI

Crawlers are automated programs that visit websites and download their content. In the era of AI, companies use crawlers for a variety of purposes. Thus far, there exist three main types of AI-related crawlers: (1) crawlers for collecting training data (e.g., AppleBot-Extended), (2) crawlers for augmenting AI-backed assistants (e.g., ChatGPT-User), and (3) crawlers for facilitating AI-backed search engines (e.g., OpenAI-SearchBot).

**Crawling practices.** We identify three categories of AIrelated crawling. Top AI companies start to use crawlers with different user agents to declare different crawling intent.

*Crawlers for collecting training data (AI data crawlers).* A major use of crawlers is to collect data for training AI models (hence referred to as . Some companies have developed their own crawlers for such purposes, and other rely upon third-party crawlers (e.g., Common Crawl).

*Crawlers for augmenting AI-backed assistants (AI assistant crawlers).* The second type of crawler is ones that enhance AI-backed assistants with additional information by real-time fetching webpages . For instance, ChatGPT-User is a crawler that can visit websites to fetch additional information when a user poses a question beyond ChatGPT training data. In such cases, the crawler retrieves relevant content from the site and delivers it to the user. While some companies, like OpenAI, state that website content accessed by AI assistants is not directly used for training, it could inadvertently contribute if the company trains models on user interaction logs, as seen with ChatGPT [42].

*Crawlers for facilitating AI-backed search engines (AI search crawlers).* A third major use of crawlers is to facilitate AI-backed search engines. For example, OpenAI-SearchBot is a crawler that indexes websites, which in turn is used by AI-backed search engines. While companies claim that the content of a website retrieved by AI search crawlers is not directly used for training, the user of a website cannot enforce nor verify this claim.

# 2.2 Mechanisms against Crawling

Next, we discuss current mechanisms that are used to control crawling.

**Robots.txt.** The Robots Exclusion Protocol (RFC9309) defines robots.txt, allowing website owners to specify which URLs crawlers can access. Originally designed to reduce server load, it is now widely used to manage content access.

# An example robots.txt file
User-agent: Googlebot
Allow: /

User-agent: ChatGPT-User User-agent: GPTBot Disallow: /

User-agent: \* Disallow: /secret/

Figure 1: An example of a robots.txt file. In this example, Googlebot is allowed to crawl all URLs on the website, ChatGPT-User and GPTBot are disallowed from crawling any URLs, and all other crawlers are disallowed from crawling URLs under the /secret/ directory.

As an honor-based system, compliant crawlers follow its directives, but adherence is not mandatory.

Figure 1 shows an example robots.txt file. The first two lines allow Googlebot to crawl all URLs, while the next three disallow ChatGPT-User and GPTBot from crawling any. The final lines block all other crawlers from accessing the /secret/ directory. Robots.txt can also include sitemaps (URL lists for indexing) and crawl-delay (minimum time between crawler requests).

In this paper, we categorize the levels of restriction imposed by robots.txt on a given crawler into four distinct groups. The first category, **no robots.txt**, applies to sites that do not have a robots.txt file. The second, **no restrictions**, refers to cases where the user-agent is fully allowed to access the website as specified by robots.txt. The third category, **partially disallowed**, indicates that the user-agent is permitted to access some paths but not all. Finally, **completely disallowed** describes instances where the user-agent is prohibited from accessing any paths on the website.

More recently, companies built managers for Robots.txt. These manager services simplify maintenance by offering automated updates and interfaces. Dark Visitors syncs with an AI crawler database, while tools like YoastSEO and AIOSEO provide intuitive features for configuring rules without technical expertise.

Active blocking. Active blocking actively prevents crawlers from accessing a website by first detecting their presence. Detection methods range from simple IP- or user-agent-based rules to advanced techniques like browser fingerprinting. Once detected, the website owner can block the crawler by returning a different HTTP status code (e.g., 403 Forbidden) or displaying an alternative page (e.g., a CAPTCHA). This can be implemented directly on a web server (e.g., via Apache or Nginx rules) or through third-party services like Cloudflare's reverse proxy.

**NoAI Meta Tag.** First proposed by DevianArt, noAI and noImageAI are meta tags a site owner can insert into their HTML (under the "robots" name). Users can indicate to crawlers that they would like their content *not* to be used for AI training by adding such a snippet:

<meta name=''robots'' content=''noai, noimageai''> to their HTML. Previous work [13] suggests that the adoption of this tag is low. We confirm this by checking the top 10k domains in the Trenco dataset, finding that only 17 sites have the noai and 16 have the noimageai tags.

**ai.txt.** Introduced by Spawning AI, ai.txt allows content owners to specify whether AI crawlers can use their data for training. Unlike robots.txt, ai.txt is read when an AI model attempts to download media, enabling real-time updates to preferences, even for previously collected data. Its creators argue it offers a legally enforceable standard, targeting the EU TDM Article 4 exception [1], though its enforcement differences from robots.txt remain unclear.

#### 2.3 Related Work

Given the broad scope of our work, we draw from a variety of related work in the areas of web content control mechanisms, crawler detection and blocking, and the impact of generative AI on content creators.

**Web Content Control Mechanisms.** Robots.txt, arguably the most widely used web content control mechanism, has been extensively studied. Sun et al.[55] analyzed large-scale deployment, identifying errors and the increased use of the now-deprecated "Crawl-Delay" field. Studies by Sun et al.[54] and Kolay et al.[33] revealed biases favoring major search engines. Non-technical aspects, such as legal implications of violating robots.txt[49] and its use for expressing copyright authorization [63], have also been explored. Similar protocols, like security.txt [47] and ads.txt [8], have been examined for purposes beyond web content control.

More recently, studies have revisited robots.txt in the context of generative AI. [14] surveyed web content control mechanisms, while empirical measurements in [13, 38] found a sharp increase in robots.txt adoption post-generative AI, with other mechanisms like the "noai" meta tag remaining rare. [16] conducted a case study on news websites' adoption of robots.txt. These studies focus on broad trends, while our work examines the perspective of individual creators and the unique challenges they face.

**Detection and Blocking of Web Crawlers.** Research on web crawler detection and blocking has explored various techniques, including web traffic analysis [22, 24, 39], server access logs [21, 48, 51], user behavior [11, 21], pattern matching [34], machine learning [25, 53], and browser fingerprinting [3, 28, 58]. Studies have also differentiated crawler behaviors, such as good versus bad bots [37], bogus bots [5], and human versus bot access patterns [2, 35]. Websites use blocking methods like 403 errors, CAPTCHAs, or altered pages [3, 46]. Our work builds on analyses of website and anti-bot service behavior, including studies by Pham et al.[46] on user agents, Azad et al.[3] on anti-bot service effectiveness, and Jones et al. [27] on automated detection of block pages.

**Impact of Generative AI on Content Creators.** A third area of research investigates the impact of generative AI on content creators. The work closes to ours is those that focus on the impact of generative AI on artists. For example, Jiang et al. [26] categorized different types of harms caused by generative AI, such as economic loss and copyright infringement. Kawakami et al. [30] identified similar kinds of harms by summarizing online discussions. Shawn et al. [50] highlighted the specific concern of style mimicry (using AI to generate a specific style of art). Our work contributes to this strand of research by examining the technical needs and challenges artists face in protecting their online presence.

Also related, but orthogonal to our work, is the study of the impact of generative AI on other communities, such as User Experience Design Professionals [36], Early Career Game Developers [10], and Creative Writers [19, 23].

# 3 How Well-resourced Websites Reacted

To provide a broader context on how the arrival of AI-crawlers has changed views across the web towards crawlers, we start by revisiting how well-resourced websites reacted. These websites are more likely to react swiftly, as they have more valuable content to protect and more resources to do so.

In this section, using a corpus of stable top 100k domains, we investigate the extent to which well-resourced websites adopt robots.txt to restrict AI-related crawlers. We find that many popular websites are quick to add restrictions to AI crawlers in robots.txt: over 10% of the domains have explicitly disallowed AI-related crawlers in their robots.txt file, which is in addition to 1.5% of the domains that already have a blanket disallow rule for all crawlers. While there have been many different incentives and efforts (e.g., the recent EU AI Act) to restrict AI crawlers in robots.txt, we also observe a small yet noticeable reverse trend: some sites recently removed restrictions on AI crawlers, likely due to reasons such as having entered into data licensing agreements with AI companies.

#### 3.1 Dataset and Methodology

**Domains in scope.** To estimate intent toward AI-related crawling of well-resourced websites, we use the sites that consistently appear in the Tranco Top 100k domains every month for two years, from September 2023 through October 2024. There are 50k domains that consistently appear.

**List of AI-related user agents.** We compile our list of AI user agents based on Dark Visitors, an industry blog that maintains an up-to-date list of AI user agents [60]. Since Dark Visitors also lists other non-AI user-agents, we only consider the AI-related user agents belonging to the following categories: AI ASSISTANT (AI Assistant Crawler in this paper), AI DATA SCRAPER (AI Data Crawler in this paper), AI SEARCH CRAWLER, and UNDOCUMENTED AI AGENTS. We also cross-validated the list with a prior study that collected popular user-agents in robots.txt [38] and confirmed that our list is a superset of the AI user-agents in this prior study. In total, we identified 24 unique AI-related user agents for the rest of the paper unless otherwise noted.

**Historic Robots.txt Data from Common Crawl.** We used the robots.txt files crawled by the Common Crawl from 2022 to 2024. We find that the coverage of the Common Crawl robots.txt data is approximately 83%. Ultimately, for sites that did not return a 200 or 404 HTTP status code to Common Crawl, we cannot determine whether the site indeed had a robots.txt or not.<sup>1</sup> A summary of our robot.txt historical dataset can be found in Table 4 in the appendix, and more details on how we deduplicate and clean the Common Crawl data can be found in Appendix 10.2.

We validated that the Common Crawl data is accurate by comparing the robots.txt files retrieved by Common Crawl and Internet Archive. We also validated the latest snapshot of the Common Crawl data by conducting our own crawl of robots.txt of the top 10k websites.

**Parsing and interpreting robots.txt**. We parse the retrieved robots.txt files using Google's robots.txt parser [18]. We rely on Google's parser as robots.txt is a complex standard and our experience suggested that home-grown parsers are error-prone.<sup>2</sup> We randomly selected a set of 100 robots.txt files, and verified that Google's parser correctly interpreted the robots.txt files for all of them. We also verified that the parser correctly interpreted a variety of edge cases not captured by other parsers, as shown in Appendix 10.3.

<sup>&</sup>lt;sup>1</sup>For instance, if a site implemented active blocking on automated requests (like those of the CC crawler), then Common Crawl may record a 403 Forbidden HTTP status code for those sites.

<sup>&</sup>lt;sup>2</sup>An example is the parser developed by [38], which we estimate to have a 10% error rate in parsing robots.txt. We have notified the authors about this issue.

Name	Category	Company	Publish IP	Respect Robots (Claim)	Respect Robots in Practice
Amazonbot	AI Search	Amazon	Yes	Yes	Yes
AI2Bot	AI Data	Ai2	No	-	-
anthropic-ai	Undocumented Agent	Anthropic	No	-	-
Applebot	AI Search	Apple	Yes	Yes	Yes
Applebot-Extended*	AI Data Scraper	Apple	N/A	Yes	-
Bytespider	AI Data	ByteDance	No	-	No
CCBot	AI Data	Common Crawl	Yes	Yes	Yes
ChatGPT-User	AI Assistant	OpenAI	Yes	Yes	Yes
Claude-Web	Undocumented Agent	Anthropic	No	-	-
ClaudeBot	AI Data	Anthropic	No	Yes	Yes
cohere-ai	Undocumented Agent	Cohere	No	-	-
Diffbot	AI Data	Diffbot	No	-	-
FacebookBot	AI Data	Meta	Yes	Yes	
Google-Extended*	AI Data	Google	N/A	Yes	-
GPTBot	AI Data	OpenAI	Yes	Yes	-
Kangaroo Bot	AI Data	Kangaroo LLM	No	Yes	-
Meta-ExternalAgent	AI Data	Meta	Yes	-	Yes <sup>†</sup>
Meta-ExternalFetcher	AI Assistant	Meta	Yes	No	-
OAI-SearchBot	AI Search	OpenAI	Yes	Yes	-
omgili	AI Data	Webz.io	No	Yes	-
PerplexityBot	AI Search Crawler	Perplexity	No	Yes	-
Timpibot	AI Data	Timpi	No	-	-
Webzio-Extended*	AI Data	Webz.io	N/A	Yes	-
YouBot	AI Search Crawler	You.com	No	-	

Table 1: Summary of AI User Agents studied in this paper. We take the category from Dark Visitors [60]. We also note whether the user agent publishes their IP address, and whether they claim to respect robots.txt in their document, whether they respect robots.txt in practice (Section 5). If we cannot find the documentation associated with a user agent or the documentation does not mention whether they respect robots.txt, we mark it as '-'. If we cannot test whether a user agent respects robots (because they have not visited our website), we mark it as '-'. \*These three user agents are not used by real crawlers, but instead are special for site owners to manage their own data. As a result, we mark their IP address as not applicable (N/A). <sup>†</sup>ExternalAgent has a noticeable delay in updating their robots.txt file.

We build a wrapper around Google's parser that allows us to determine whether a given user-agent is *completely disallowed*, *partially disallowed*, or has *no restrictions*. We also separate the case where the AI-related user-agent is restricted by the wildcard (User-agent: \*) rule (i.e., the AI-related user-agent is not explicitly mentioned in the site's robots.txt). These are websites that technically disallow AI crawlers, but do not show as strong an intent in blocking AI crawlers as other sites that have a specific rule. In further analysis, we only consider the sites that block AI-related crawlers through an explicit rule. The code for this interpreter will be publicly available.

#### 3.2 Increasing Drive to Protect Data

Figure 2 shows the trend of restrictions on AI-related crawlers over time for two sets of sites: those consistently ranked in the top 5k, representing intent of the largest website operators, and all other sites within the top 100k (whose operators are still relatively well-resourced). While both categories of sites have an initial surge in disallowing AI-related crawlers in robots.txt around August 2023 (around the release of OpenAI's GPTBot and ChatGPT-User user agent which identifies their crawlers), the most popular websites are noticeably quicker to add restrictions in robots.txt. Likely since they have more valuable content to protect and more resources, we find that a larger proportion of the most popular sites

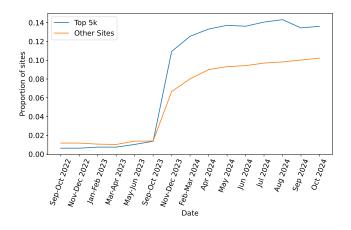
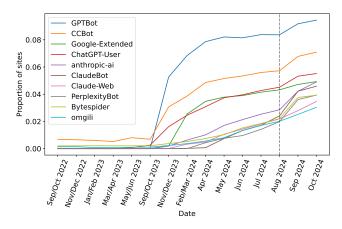


Figure 2: Proportion of sites that fully disallow any AI-related user agent, broken down by site rank



#### Figure 3: Proportion of top 100k sites that explicitly impose restrictions on AI-related crawlers in robots.txt over time. The vertical line indicates when the EU AI Act was released.

have restrictions on any AI-related crawlers when compared to the rest of the top 100k sites (8-10%).

When we break the historical trend down by user agent (Figure 3), we can observe a secondary distinct uptick of restrictions for all user agents around August of 2024. This corresponds to the release of the EU Artificial Intelligence Act, which aims to impose legal regulations on general-purpose AI, and implores signatories to ensure they have lawful access to copyright-protected content. In the draft of the Code of Practice for the AI Act, the regulators explicitly require signatories to read and follow instructions in robots.txt (Sub-Measure 4.1)[15]. The most frequently restricted user-agents are GPTBot (OpenAI) and CCBot (Common Crawl). While Common Crawl merely collects the data (and does not use it for any AI-related purpose itself), Common Crawl is a very frequent data source for AI training.

#### 3.3 Recent Decrease in Restrictions

Within the sites that are consistently in the top 5k, we interestingly not only see the drive to add restrictions to AIrelated crawlers in robots.txt level off, but also some decreases in recent months. This recent behavior is in contrast to predictions in [38] of strictly increasing observable intent to disallow AI-related crawling.

**Public Data Licensing Deals.** One reason why a site will remove an AI-related crawler from robots.txt is that the site owner has entered into a data licensing agreement with an AI company. A blog post from early October 2024 confirmed that such partnerships were indeed the reason for the removal of GPTBot from the robots.txt file of several major publishers' websites, including *The Atlantic* and *Vox Media* [32]. These deals often involve a publisher who controls dozens of domains; e.g. , Newscorp owns more than 10 news and media companies each having its own domains.

In our data, we find that between the release of OpenAI's GPTBot (and ChatGPT-User) user agents in August 2023 and October 2024, 484 sites removed explicit restrictions on GPTBot from their robots.txt (Figure 4). Many of these include sites owned by publishers who have struck publicly known data licensing agreements with OpenAI, such as Dotdash Meredith [40] (e.g., Investopedia.com, People.com, AllRecipes.com), Stack Exchange [43] (e.g., superuser.com, stackoverflow.com), and Conde Nast [31] (e.g., newyorker.com, vanityfair.com, wired.com). Some of these data usage agreements require OpenAI to place direct links to their sites when ChatGPT generates content based on their data, driving more traffic to their website. The full list of such websites is in Table 5 in the appendix.

**Possible private deals.** In the case of major American publishers Future PLC, over 10 of their sites (including techradar.com, tomguide.com, and cyclingnews.com) removed restrictions on GPTBot in May 2024, while the rest of the robots.txt file remained identical. However, in an August 2024 podcast, the CEO of Future stated that they did not have any partnership with OpenAI [7]. A few other smaller publishers and news sites also removed restrictions on GPTBot, indicating possible deals.

# 3.4 Increases in Explicitly Allowing AI Crawlers

To our surprise, we found a growing number of sites explicitly allowing AI-related crawlers in their robots.txt, welcoming AI crawlers to scrape their websites. While a small number of sites fall into this unique category, interestingly, the overall number of sites that *explicitly allow* AI-related crawlers is increasing over time (Figure 4).

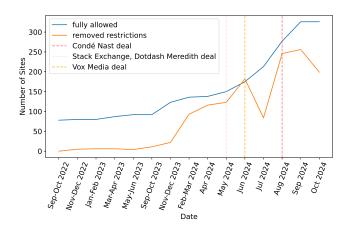


Figure 4: Number of sites that explicitly allow AIrelated crawlers in robots.txt, and number of sites that removed restrictions on AI-related crawlers in each time period. The horizontal lines indicate public data deals between major publishers (who control 40+ domains) and OpenAI.

In total, we found 79 sites that not only had no restrictions on GPTBot in robots.txt, but also explicitly mentioned them to be allowed. Part of this increase (especially in mid-2024) is accounted for by the aforementioned data licensing agreements between OpenAI and publishers, but there are also other reasons.

Amongst these sites, we found popular right-wing misinformation sites, which may be motivated by spreading misinformation to LLMs. In other cases, we find shopping sites that potentially seek to use LLMs to increase traffic to their site. See Appendix 10.4 for the full list of sites where we observe this *reverse* intent toward GPTBot. This case study highlights that there are also cases where sites have different motives for allowing AI companies to train on their data.

# 4 Individual Artists' Sentiments and Actions

Previously in Section 3, we show that many well-resourced websites have swiftly adopted robots.txt to protect their content. In this section, we explore the question of what individual artists think about AI-related crawling and what actions they have taken, if any. Compared to large organizations, individual artists are much more impacted yet under-resourced.

We first present a user study, comprised of 182 professional artists, to understand their sentiments, actions, and challenges they face when dealing with AI-related web crawling. While many artists are extremely concerned about AI, they lack the awareness (over 60% of artists have never heard about the term "robots.txt"), technical ability (not knowing how to use robots.txt), and agency (unable to edit robots.txt because their websites are hosted with by a third-party) to utilize existing technical approaches like robots.txt.

Informed by our user study, we follow up with a measurement study of over 1100 artist websites to further examine the hosting services artists use and levels of control these services provide. We find that the majority of artists use third-party hosting services that do not allow for modification of robots.txt. Among the few that do, we find that artists do not exercise their control, with less than 17% of artists disallowing AI-related crawlers in their robots.txt.

### 4.1 User Study Setup

We conducted a user study (approved by our university's institutional review board) with professional artists. We draw participants from professional artists informed via their social circles and professional networks. In total, we obtained 182 responses from artists who share their artwork online.

We start by gathering the basic information of each participant. Then, we ask them about their perceptions of AIgenerated art, concerns regarding its impact on their job security, and actions taken in response to AI-generated art. We then examine their knowledge and use of robots.txt, as well as their willingness to adopt robots.txt in the future. We compensate participants at a rate of \$15/hour.

#### 4.2 Sentiment Towards AI-related Crawling

We find a strong sentiment against AI-related crawling and desire for effective tools to stop it.

Artists are worried and have taken actions against AI. Over 79% (144, n=182) of artists express concerns about the impact of AI-generated art on their job security, with more than 54% anticipating that AI art will have a significant or severe effect on their careers. A notable majority (79%) have reported taking proactive measures to address these concerns. Among these artists, 67% use Glaze [50], a tool that employs adversarial machine learning to protect artwork, while 60% have reduced the volume of work shared online, and 51% now share only lower-resolution images to mitigate potential misuse.

**Artists would like to stop AI crawling.** When introduced to the concept of a potential tool for preventing crawlers from crawling their sites, over 96% (175, n = 182) of the artists expressed a desire to use such a tool. A significant majority (91%) indicated that they were "very likely" to adopt it. The most commonly cited reasons included protecting their intellectual property from "theft" or "stealing," objecting to the unauthorized use of their work, and not being compensated for their creations. Interestingly, three artists noted that such tools could provide legal grounds to challenge unauthorized crawling of their content. We observe similar results when we asked artists who had not heard of robots.txt about their willingness to adopt robots.txt in the future. Almost all of the artists have a reasonable understanding after reading a brief explanation of robots.txt.<sup>3</sup> Among these artists, 73% (84, n = 115) indicated that they would likely or very likely adopt robots.txt in the future. For those who indicated neutral or unlikely, the most common reasons cited were concerns regarding its efficacy (that robots.txt does not fully stop crawling) and ease of use.

Artists do not trust AI-related crawlers will respect robots.txt. When asked about their trust in AI companies, only 25% of participants believed AI companies were likely or very likely to respect robots.txt. Artists cited several reasons for this distrust, including the potential for loopholes, the lack of legal enforcement, and the poor track record of AI companies. One participant remarked, "[AI companies] feel they have a right to everything for free, and if things like copyright don't stop them, why would a polite notice on a website?". In fact, these worries are not unfounded: as we show later in Section 5, at least one AI crawler (Bytespider) does not respect robots.txt.

Despite a strong level of distrust, the majority of artists remain interested in adopting, or have already adopted, robots.txt (89%). This result demonstrates a willingness among artists to explore measures they perceive as imperfect, perhaps viewing them as necessary steps toward protecting their work even if not completely effective.

# 4.3 Challenges in Adopting Technical Measures

We identify three main challenges for artists to utilize technical measures such as robots.txt: lack of awareness, ability, and agency.

The most significant challenge is the lack of awareness among artists: over 60% of the artists (115, n = 182) have **never heard about** robots.txt prior to our study. Among the 40% who had heard of robots.txt, the majority (60 out of 64) demonstrated a reasonable understanding of its purpose, describing it as a way of "blocking" or "stopping" crawlers.

Another major challenge is the lack of technical ability to utilize robots.txt. Among the 33 artists who maintain personal websites and were aware of robots.txt before the study, most of them (27 out of 33) have not utilized robots.txt on their personal websites. When prompted why, the single most cited reason was not knowing how to do it.

Lastly, among the 27 artists who had not utilized robots.txt, seven of them mentioned that they do not have the agency: they do not have control over the content of the robots.txt

CMS	% Sites	Edit?	% Disallow AI
Squarespace	20.7	No <sup>AI,SE</sup>	17
Artstation	20.4	No	0
Wix (Paid)	9.3	Yes	0
Adobe Portf.	4.8	No <sup>SE</sup>	0
Wix (Free)	3.5	No	0
Weebly	3.1	No <sup>SE</sup>	0
Shopify	1.7	No	0
Carbonmade	1.5	No	100

Table 2: The top 8 web hosting providers artists use and their options for modifying robots.txt. *AI*: option available to disallow AI crawlers; *SE*: option available to disallow search engine crawlers.

file, as they use web hosting platforms or post on websites that do not allow for modification of robots.txt.

# 4.4 Measurement of Artists' Websites

Guided by the findings from our user study, we performed a measurement study on over 1,100 artist websites to better understand the services used by artists and the level of control these services provide. We find that the majority of artists use third-party hosting services that do not allow for modification of robots.txt. Among the few that do, we find that artists do not exercise their control, with less than 17% of artists utilizing the option to disallow AI-related crawlers in their robots.txt.

Below, we start by describing our method for collecting artists' websites and identifying the services they use. We then present the results.

Artist Websites and Their Service Provider. We collected artist's personal websites using directories of two top artist associations in the U.S. (Concept Art Association and Animation Union). Both organizations published their member lists along with each artist's personal website. In total, we collected 1182 artists' personal websites. We find that the majority of artists (over 78%) use one of eight content management systems (CMS), such as Squarespace and Art-Station, to host their websites, followed by a long tail of small providers, self-hosted websites, and social media platforms. As such, we focus on the top 8 CMSes in our analysis. These platforms provide drag-and-drop tools, allowing artists to easily upload their portfolios and personal information. As well, many artists get custom domain names through these services for an additional fee.

To determine which CMS an artist's website uses, we rely on DNS. In some cases (e.g., Carbonmade), the artist sites are subdomains of their CMS (e.g., example.carbonmade.com). For other services (e.g., Squarespace), the domain's DNS record points to the service's infrastructure.

<sup>&</sup>lt;sup>3</sup>That said, we caution that many artists use languages such as "block" or "stop", while robots.txt is a voluntary mechanism.

**Limited Control and Information Available.** We find that CMS providers give limited control and information to artists. Table 2 shows the services uses by artists, usage percentage, and percentage of websites that disallow any AI-related crawlers (Table 1) in their robots.txt. We found that the contents of robots.txt files are identical for all artists who host with a CMS except artists who uses Squarespace.

To better understand these CMSes, we registered accounts with each of them. We found that four do not provide any method for users to modify the robots.txt file, which is set by default. Out of these four, only Carbonmade disallows AI-related crawlers (GPTBot and CCBot) in their default robots.txt file. Two providers (Adobe Portfolio and Weebly) offer users the option to disallow search engine crawlers through their robots.txt file; however, none of the sites in our data set have this option enabled. Only one provider, the paid version of Wix, allows users to directly modify the content of the robots.txt file.

Squarespace is the only provider that gives the user the option to disallow AI-related crawlers in robots.txt. This option adds full restrictions on 10 AI-related user-agents, including GPTBot and anthropic-ai (full list in Appendix 10.5).

We also investigate if any of these CMSes opt to actively block AI-related crawlers in addition to disallowing them in robots.txt. (For a detailed methodology, see Section 6.1.) We find that Weebly does in fact specifically block requests that have the user-agent set to Claudebot and Bytespider, whereas Artstation and Carbonmade implement captcha-like challenges for all automated requests.

Artists Do Not Exercise Their Control. We now examine to what extent artists actively utilize these options. For Wix's paid version, which provides the highest level of control over the robots.txt file, we found that **none of the 110 websites** in our dataset had edited their robots.txt file. When attempting to modify the file through our paid Wix account, we discovered that the interface is very confusing and unclear, making it difficult to determine how to make changes. In the case of Squarespace, the platform offers a straightforward option: a single button that allows users to disallow AI access. However, we found that fewer than 17% of artists had enabled this option — a figure significantly lower compared to the 79% of artists who, in our user study, expressed a desire to disallow AI-related crawlers when given the choice.

We hypothesize that the significant gap between the high number of artists willing to take action and the small number who actually do so is due to two main reasons. First, many artists lack awareness of these tools or an understanding of their functionality. This issue is evident from the low number of respondents who had ever heard of robots.txt. Second, the

Artificial Intelligence Crawlers	
Al companies use the content of websites they scan to improve the ac of their models. If turned off, your site won't be scanned to train Al mod	

Figure 5: Screenshot of the Squarespace option that lets users include AI-related crawlers in their site's robots.txt.

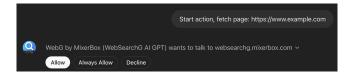


Figure 6: Example of a GPT app (WebG) that can retrieve information from the web through a third-party infrastructure (mixerbox.com). Upon clicking "Allow", this GPT app can retrieve information from the web using service provided by mixerbox.com.

current tools are poorly designed and inadequately communicated. For example, Squarespace provides no transparency about how its AI-blocking feature works when enabled. Figure 5 shows a screenshot of the information provided to users, which lacks any mention of robots.txt or details on which AI-related crawlers are included. It states, "your sites won't be scanned to train AI models"—a misleading claim, as the feature only modifies the robots.txt file and does not prevent all scanning or data usage by AI.

# 5 Do AI Crawlers Respect Robots.txt?

Since robots.txt is a voluntary mechanism, web crawlers do not have to respect it. The recent emergency of AI assistant crawlers that fetch webpages for generative models further complicates the situation — these are crawlers triggered by users, a use case not clearly covered by the robots.txt standard. In this section, we explore the question of whether AI-related crawlers, including both AI data crawlers and AI assistant crawlers, respect robots.txt files. We find that the majority of the AI data crawlers respect robots.txt, while the majority of AI assistant crawlers do not.

For the rest of the section, we start by describing our setup, as well as the methodology we use to identify additional AI assistant crawlers. We then present our results on whether AI data crawlers and AI assistant crawlers respect robots.txt.

#### 5.1 Methodology

**Identifying additional AI assistant crawlers.** LLMs such as ChatGPT and Meta's LLAMA have the built-in capacity to retrieve information from the web. In addition, apps in ChatGPT's store (also known as GPT Apps), can also retrieve information from the web through a third-party's infrastructure (e.g., the party that runs the GPT app). Figure 6 shows an example of a third-party GPT app (WebG) that can retrieve information from the web through a third-party infrastructure (mixerbox.com). To identify a list of third-party GPT apps that can retrieve information from the web, we start by examining a list of top 5k GPTs listed on GPTStore (a popular website cited in various prior work that studies GPT apps [20, 52, 64]). We then interact with each GPT app automatically to determine whether it can retrieve information from the web by asking it to visit websites we control. We use two different prompts: a) "Start action, fetch page: [url]"; and b) "Get web page content: [url]." We then check if the prompt triggers the GPT app to retrieve the content of the website. This process yields a total of 85 third-party GPT apps. Using a combination of domain name and IP address, we identify 24 distinct third-party services that operate these GPT apps.

**Testing if crawlers respect robots.txt.** We setup two kinds of robots.txt, one with a '\*' that disallows all crawlers and another that lists every user-agent individually. For AI data crawlers, we passively wait for the crawlers to visit our website, as we cannot trigger visits from these crawlers. For AI assistant crawlers, we actively trigger visits from the crawlers by submitting a URL to the crawlers. We then check if the crawlers respect the robots.txt file.

#### 5.2 Results

5.2.1 Al data crawlers. Most of the data crawlers we tested respected the robots.txt (Table 1). Concretely, during our twomonth of testing, we were able to attract seven data crawlers to our website: Amazonbot, Applebot, Bytespider, CCBot, ClaudeBot, GPTBot, and Meta-ExternalAgent. We found that five crawlers (Amazonbot, Applebot, CCBot, ClaudeBot, and GPTBot) respected the robots.txt file given our setup. One crawler (Meta-ExternalAgent) has some delay in updating their robots.txt file — it initially fetched the content of our website despite being disallowed, but eventually respected our robots.txt file. One crawler (Bytespider) fetches the robots.txt file but does not respect it.

5.2.2 Al assistant crawlers. We found that both ChatGPT's and Facebook's built-in crawler respects the robots.txt file. ChatGPT's crawler can be identified with the user-agent "ChatGPT-User" while Meta would probe the robots.txt of a website using User-Agent "facebookexternalhit". If the robots.txt file disallows the crawler, the crawler will not fetch the content of the website. Otherwise, the crawler can be identified as "meta-externalagent". We also note that the robots.txt is cached and does not seem to be requested for every visit.

For the 24 services that operate GPT apps and can retrieve information from the web, we found that two services fetch and respect robots.txt files. One service has a bug in its implementation that causes it to incorrectly fetch the robots.txt file. Others do not fetch the robots.txt file at all (and hence do not respect it).

### 6 Active Blocking of AI Crawlers

The effectiveness of a mechanism like robots.txt depends both on the ability of content owners to express their intent to prevent crawling, as well as the willingness of AI companies to respect the prohibitions that content creators have indicated. Instead, content owners can take matters into their own hands and actively block crawlers by refusing to return content when HTTP requests include AI crawler user agents.

In this section, we first measure the use of active blocking on popular sites. While the extent of active blocking is similar to the use of robots.txt, our results indicate that there are still several limitations to active blocking: it does not offer a perfect replacement for robots.txt, and it can require technical proficiency to configure properly. Finally, as a case study we comprehensively study the AI-specific active blocking option provided by Cloudflare. While its deployment does not require technical sophistication, it does have coverage limitations.

#### 6.1 Methodology

Interestingly, active blocking is largely overlooked as a content access control mechanism in prior work [13, 14, 16, 38], so its adoption for this purpose is relatively unknown. Hence, we first aim to estimate the proportion of top websites that have blocking mechanisms that specifically target AI-related crawlers.

For simplicity, we opted for a user-agent based approach (inspired by [46]). We acknowledge that many advanced bot detection methods exist (e.g., through fingerprinting or behavioral analysis), and consider our results a conservative estimate of the overall number of domains that specifically block AI crawlers. Following [46], for each website, we perform the following steps:

**Control Case:** To gauge a site's AI-crawler-specific blocking behavior, we exclude sites that inherently block our automation tool (i.e., regardless of the user-agent). In these cases, we cannot determine whether a site is blocking our tool, or is blocking based on a change in the user-agent. We do this by visiting the site with our headless browser (Chromium automated by Selenium) and setting its useragent to be that of a typical Chrome user, and the OS matching the machine the browser is running on. We exclude the sites that return a non-200 HTTP status code. By not including these sites, we consider the active blocking adoption rate to be a lower bound.

AI Case: Holding all else constant, we set our user-agent to be that of an AI bot. To account for IP-based bot detection mechanisms, we only test the Claudebot and anthropic-ai user-agents: according to Dark Visitors [60], these are the top two most-frequently restricted AI-related user agents that do not have published IP address origins. Since the companies do not publish IP address ranges, site operators would likely block them based on user-agent.

**Detecting Blocking Behavior Based on User-agent:** Following the methology described in [46], we check the HTTP status code, any exceptions that occur, and whether there are significant differences in the HTTP content length returned (inspired by [27]). Any differences in these features between the "Control" and "AI" crawls indicate active blocking based on the AI user-agent.

#### 6.2 Sites Using Active Blocking

We infer that at least 14% of the top 10k sites actively block AIrelated crawlers, indicating that active blocking, like robots.txt, is a relatively established content access-control mechanism.

Many sites use active blocking in place of restrictions in robots.txt. Empirically, we find that only 2% of sites that actively block anthropic-ai and Claudebot have explicit restrictions on these user-agents in robots.txt, indicating that many sites indeed use active blocking as their sole form of restriction on AI-related crawling.

However, active blocking cannot replace robots.txt for all AI-related crawlers. While active blocking may seem like a suitable or even stronger alternative, it inherently cannot replace some directives in robots.txt. Specifically, in the case where companies use the same crawler to collect AI training data as for other purposes, active blocking can only provide an all-or-nothing approach which can have unwanted side-effects. Such examples of these mixed-use crawlers include Google's Googlebot and Apple's Applebot: blocking them completely can have severe consequences on a site's visibility on the Internet. The only way for users to optout of AI training for these companies is through robots.txt by adding a disallow directive for a special "dummy" useragent (Google-Extended and Applebot-Extented), highlighting that robots.txt is indeed still necessary even with active blocking measures in place.

Active blocking can be a black box for the user. While some active blocking configurations require the user to manually input the blocking rules (e.g., through Apache's .htaccess), other active blocking tools (such as 3rd-party botdetection platforms) act as black boxes for users, leaving them unaware of its exact behavior (e.g., which user-agents



Table 3: User agents blocked by Cloudflare's *Block AI Scrapers and Crawlers* option. Note that magpie-cralwer, MeltwaterNews, AwarioSmartBot, and AwarioRssBot are not in Dark Visitors' list of AI-related agents.

are blocked). On one hand, if the list of AI-related user-agents is incomplete, for example, it can lead to a false sense of security for its user. On the other hand, a website owner may unintentionally block AI-related crawlers through the use of such an opaque blocking option.

**Key Takeaway:** For a comprehensive approach to prevent AI-related crawling, it is important for site owners to still use robots.txt in conjunction with active blocking and verify that their active blocking configuration's operation is in line with their expectations.

# 6.3 3rd-party Active Blocking

As a case study of 3rd-party active blocking, we examine Cloudflare's recently-launched "Block AI Bots" feature [9]. It is a compelling feature to evaluate because Cloudflare is currently the only 3rd-party service that offers any AIspecific active blocking mechanism, is highly popular [61], and this feature is clearly targeted toward a less technicallyproficient user-base. While the feature is designed to be user-friendly (a "single click"), its operation is unfortunately a black box to the user. We therefore use our experiments to also infer details of its behavior.

**Grey-box Evaluation.** To evaluate its operation, we created an account with Cloudflare and set up their reverseproxy service on a website we host and control. While Cloudflare states that the AI-bot-blocking feature will be available for all payment tiers, for validation we tested both the free and "Pro" accounts. We use our web server logs and Cloudflare's internal dashboard as a source of ground truth.

**Inferring the list of AI-related user agents covered.** Cloudflare does not document the list of AI-related crawlers they block under this new switch. Thus, to infer its coverage, we send requests to our own website with the AI-related user agents from Dark Visitors. For comprehensiveness, we also tested an additional 590 user agents<sup>4</sup> from a public list of scrapers and crawlers [41]. For each request, we determine whether or not a given user-agent was blocked using the

<sup>&</sup>lt;sup>4</sup>The GitHub repository we used includes the full user-agent string, which is important to note in case a service uses specific pattern matching.

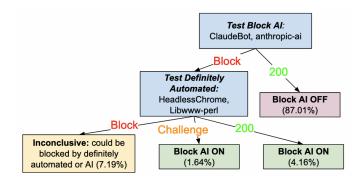


Figure 7: Flowchart for inferring the AI blocking setting on websites using Cloudflare.

HTTP response code and the dashboard for our Cloudflare account. We make a request first with the AI-bot-blocking option turned off, and again with it on. In all, we find that Cloudflare's feature encompasses 17 AI-related user agents, as shown in Table 3.

**Inferring the adoption of Cloudflare's Block AI Bots Option.** Figure 7 shows the logic we used to infer whether or not a website using Cloudflare has turned on the AI blocking setting. Cloudflare also has another managed ruleset, called *Definitely Automated*, that covers all the unverified<sup>5</sup> AI crawlers shown in Table 3.

We used the ClaudeBot and anthropic-ai user-agents as they are not Cloudflare-verified bots, and do not publish or document their IP address origins, so it is unlikely that Cloudflare uses IP addresses to check for requests from these two crawlers. As for inferring the *Definitely Automated* option, we chose the user-agents of two lesser-used web automation libraries that are blocked by the managed rule, reducing the chance that a website has configured some custom blocking rule against one of them.

For the set of websites that use Cloudflare, we visit them with a headless browser and modify the user-agent strings as shown in Figure 7. We inspect the HTTP response code and the returned HTML content to detect whether a Cloudflare Block or Challenge page was returned, or if the site content was returned (indicating the user-agent was not blocked).

We were able to conclusively determine the setting for 93%<sup>6</sup> of sites using Cloudflare. We find that only 5.7% of sites using Cloudflare have the "Block AI Bots" option enabled. Yet, these sites also disallow AI-related crawlers in their

robots.txt files at a much higher rate than average: 24% as opposed to 12% within the other sites. These sites show a strong intent to block AI crawlers.

**Key Takeaway:** The active blocking feature provided by Cloudflare may not be widely used yet, but it is an encouraging new option. It is user-friendly and actively blocks content from being returned to crawlers. However, given the need to coordinate active blocking together with robots.txt, we strongly encourage platforms providing such features to transparently document which user-agent strings they block so that sites can continue to be indexed by search crawlers while achieving their goals of blocking AI crawlers.

#### 7 Ethics

We believe our work has very low ethical risk. Our user study is approved by the IRB at our institution. Our longitudinal analysis leverages common crawl data, which is publicly available and does not contain any personal information. Our active blocking experiments are conducted at a responsible rate, and we report our findings in aggregate manners and do not involve individual websites. Last, we will make our data and code available to the community upon publication.

#### 8 Limitations

In this section, we discuss some limitations of our work.

**Scope of Participants.** The user study focused on 182 professional artists, which does not fully represent the entire population of content creators. In particular, most participants were based in the US, which limits the coverage of creators from other countries. For example, European-based artists might be more familiar with robots.txt due to the implications of the AI Act.

**Blocked Data Collection Requests.** In our dataset, robots.txt files were collected by Common Crawl or our own custom crawlers. A small number of sites returned non-200 responses and were excluded from our analysis. These sites likely employed active blocking measures against CCBot or our crawler in addition to robots.txt blocks to prevent our requests. Excluding this data might lead to us underreporting the adoption of robots.txt.

**Automation tools can be inherently blocked.** Our estimation of the adoption rate of active blocking presented in section 6.2 is a conservative lower bound, as for 15% of sites we could not determine their active blocking behavior due to our crawling setup being inherently blocked.

**Custom active blocking configurations are possible.** In 6.3, we assume that the site does not configure any custom active blocking rules against the user-agents we use. For example, for a small proportion of sites we determined

<sup>&</sup>lt;sup>5</sup>The verified AI-related bots include Amazonbot, Applebot (which is not blocked), GPTBot, OAI-SearchBot (not blocked), ChatGPT-User, ICC Crawler (not blocked), and DuckAssistbot (not blocked). For more details on the operation of this setting, see Appendix 10.6

<sup>&</sup>lt;sup>6</sup>For the remaining sites, we were unable to determine the setting as they may have been using 3rd party blocking mechanisms, or have some custom, non-standard Cloudflare WAF configurations.

they were using an additional active blocking service (e.g., Perimeter X). We excluded those sites from our analysis.

#### 9 Discussion and Conclusion

At the core of the conflict in this paper is the notion that content creators now wish to control *how* their content is used, not simply if it is accessible. While such rights are typically explicit in copyright law, they are not readily expressible, let alone enforceable in today's Internet. Instead, a series of ad hoc controls have emerged based on repurposing existing web norms and firewall capabilities, none of which match the specificity, usability, or level of enforcement that is, in fact, desired by content creators. We believe there exist three categories of issues that need to be addressed: ambiguity, respect for signal, and user control.

# 9.1 Issues of Ambiguity

Perhaps unsurprisingly, robots.txt is an imperfect mechanism for this purpose and introduces a range of ambiguities – even for the purpose of measurement. One of the key issues is in ambiguity around what robots.txt means and how it is honored.

**Syntactic Ambiguity** For example, the syntactic and lexical structure of robots.txt is unintuitively complex. One result is that different parsers can interpret the same set of directives differently. For example, the parser used in [38], misinterprets grouping rules and the ignores User-agent line being case-insensitive, leading to large numbers of disallow directives being ignored. Similarly, robots.txt authors can misinterpret correct syntax and we have found that approximately 1% of sites have mistakes in their robots.txt, such as not starting a path with a /, or using deprecated or non-existent directives.

**Naming ambiguity** However, a more significant problem is that robots.txt's ability to specify that LLM-training crawlers are unwelcome is predicated on the notion that the purpose of a crawler is clearly and uniquely identified via the User-Agent string. Thus, an LLM crawler that does not selfidentify as such will not provoke the creation of a robots.txt rule. Moreover, keeping track of the current User-Agent's of all such crawlers is a burden placed on each web administrator. Lastly, a number of crawlers serve dual purposes gathering data that is used both for updating search indexes *and* for training AI models, adding additional complexity.

**Mode of access ambiguity** The Robots Exclusion Protocol, as currently specified, does not make clear what a "robot" is. This is left to the interpretation of each organization's automotive access. For example, Google documents that robots.txt is not applicable to crawlers that are controlled by users (for example, feed subscriptions). Thus far, it is unclear whether user-triggered fetches are exempt from the protocol, even when such fetches may themselves be driven by a generative AI. For example, Meta's Meta-ExternalFetcher is dispatched by Meta AI products in response to user prompts and cam bypass robots.txt rules. However, the OpenAI's usertriggered AI-related fetcher ChatGPT-User follows robots.txt rules.

#### 9.2 Respect for Signal

Even if all of these other ambiguities are successfully managed, the underlying signaling protocol is voluntary — crawlers must abide by the directives of robots.txt. As we have shown in Section 5 not all crawlers respect robots.txt (e.g., ByteDance's Bytespider ignores robots.txt directives) and others, while they abide, may cache robots.txt and may continue to fetch content even after it has changed (e.g., FacebookExternalAgent). At the extreme some crawlers may pretend to be regular user browsers, thus necessitating the use of advanced active blocking techniques such as fingerprinting [9].

In comparison, active blocking, e.g., IP-level blocking practiced by Cloudflare, allows better enforcement of an access policy, but still suffers from issues such as dual-purpose crawlers and fetches laundered via a third-party infrastructure. In addition, some LLM crawlers do not use identifiable ranges of IPs and thus IP-level blocking is not technically feasible (e.g., Anthropic [4]).

#### 9.3 User control

Both robots.txt and active blocking (i.e., via firewall rules) presuppose that the content creator has the capability to change this state on the Web server hosting their content *and* that they have the technical capability and domain knowledge to do so correctly.

However, most content creators are not also system administrators, nor do they run their own Web servers. Thus, these mechanisms are of most utility to larger organizations whose policy interests can be aligned with their use of technical controls. Indeed, in our data, we observed that multiple large publishers have *removed* restrictions in robots.txt for the sites they own after striking data usage deals with AI companies. This shows that large content owners are willing to let their data be used for AI training, but only if they receive *monetary compensation* and/or *site traffic*<sup>7</sup> in exchange for the usage of their data.

Since few individual creators maintain their own Web server, they must rely on their website hoster to provide a user-interface to such capabilities that that creators can understand and is technically effective. However, few hosters appear to export robots.txt directly to their customers (Wix

<sup>&</sup>lt;sup>7</sup>For example, in the deal between OpenAI and Dotdash Meredith, one contract term requires that OpenAI must link to their site when displaying information relevant to one of their subsidiaries[40].

is one of the few we identified offering this capability) and most do not provide any separate mechanism to express a desire to block AI bots.

In summary, our work highlights the trifecta of challenges for today's content creators. First, there are no existing mechanisms for explicitly controlling whether publicly-accessible Web content is used training AI models or not. Second, the existing mechanisms that we have brought to bear for this purpose are poor fits for the task, lack appropriate specificity, comprehensiveness or verifiability. Third, these mechanisms are generally not readily available to individual content creators and more serve the interests of large organizations seeking to protect large troves of content.

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# 10 Appendix

#### **10.1 CC Dataset Summary**

Snapshot	Month	# sites	# sites with robots.txt
2022-05	Sep/Oct 2022	40177	31494
2022-21	Nov/Dec 2022	40614	31536
2022-40	Jan/Feb 2023	39080	30063
2023-06	Mar/Apr 2023	39216	29963
2023-14	May/Jun 2023	39212	30107
2023-23	Sep/Oct 2023	39033	29721
2023-40	Nov/Dec 2023	39722	30060
2023-50	Feb/Mar 2024	41446	31282
2024-10	Apr 2024	41640	31010
2024-18	May 2024	41004	30763
2024-22	Jun 2024	41047	30661
2024-26	Jul 2024	40927	30526
2024-33	Aug 2024	40455	29922
2024-38	Sep 2024	40444	29806
2024-42	Oct 2024	40420	29867

Table 4: Number of sites in the Trenco top 100k inter-section in the Common Crawl dataset.

# 10.2 Cleaning Historic Robots.txt Data from Common Crawl

**Historic Data From Common Crawl.** For our historic robots.txt dataset, we used the robots.txt files crawled by the Common Crawl from 2022 to 2024. We use 15 consecutive snapshots from Common Crawl, beginning with 2022-05, through to 2024-38. For each snapshot, Common Crawl may

crawl a site several times over the period in which the data for the snapshot was collected. In these cases, we deduplicate the robots.txt files by taking the most recent non-errored crawl in the snapshot. The Common Crawl crawler also does not follow redirects. To improve our coverage, for domains that returned a non-200 HTTP status code to Common Crawl (such as 301 Redirect), we also checked Common Crawl for the robots.txt file for the domain prepended with www. (if not already) and without (if already prepended).

#### 10.3 Robots.txt edge cases

Below, we list several edge cases in robots.txt that are still syntatically correct, but are often not captured by more simplistic, home-brewed robots.txt parsers.

User-agent: \* # Blog restrictions Disallow: /blog/latest/\* Disallow: /blogs/\*

Figure 8: Edge case 1: comments or new lines between the user-agent line and the Disallow/Allow directives should be effectively ignored, but we find that some parsers fail miss the directives under the comment or new line.

```
User-agent: GPTBot
User-agent: anthropic-ai
User-agent: Claudebot
Disallow: /
```

Figure 9: Edge case 2: Grouping rules. The RFC allows for User-agent directives to be grouped as shown above. However, we found the parser in [38] to ignore all useragents except for the last when parsing robots.txt.

# 10.4 Domains that explicitly allow GPTBot in robots.txt

Table 5 shows the list of domains that explicitly fully allow GPTBot (e.g., User-agent: GPTBot\nAllow: /) in their robots.txt, and which Common Crawl snapshot we first observed this behavior. We note that 5 sites, nfhs.org, 10best.com, ground.news, network54.com, and tarleton.edu, have persistently allowed GPTBot since around the time of its release to our latest snapshot.

```
User-agent: *
Disallow: /
User-agent: *
Crawl-Delay: 5
User-agent: GoogleBot
Allow: /
Disallow: /z/
```

Figure 10: Edge case 3: using deprecated or unsupported directives can have unintended consequences: for this robots.txt, since Crawl-Delay is ignored, all user-agents will (unintentionally) follow the directives for Googlebot due to the grouping rule.

url	snapshot	url	snapshot
nfhs.org	2023-40	bleedcubbieblue.com	2024-42
10best.com	2023-40	popsugar.com	2024-42
ground.news	2023-40	voxmedia.com	2024-42
opindia.com	2024-42	patspulpit.com	2024-42
tarleton.edu	2023-50	barcablaugranes.com	2024-42
alldatasheet.com	2024-42	eater.com	2024-42
bestproductsreviews.com	2024-42	popsugar.co.uk	2024-42
network54.com	2023-50	prideofdetroit.com	2024-42
care.com	2024-42	royalsreview.com	2024-42
kbs.co.kr	2024-42	truebluela.com	2024-42
brit.co	2024-42	thrillist.com	2024-42
lonza.com	2024-42	sbnation.com	2024-42
millersville.edu	2024-42	arrowheadpride.com	2024-42
icelandair.com	2024-42	theringer.com	2024-42
customink.com	2024-42	adslzone.net	2024-42
celebmafia.com	2024-18	milehighreport.com	2024-42
credit-agricole.fr	2024-42	polygon.com	2024-42
adelaidenow.com.au	2024-42	racked.com	2024-42
dailytelegraph.com.au	2024-42	behindthesteelcurtain.com	2024-42
walkhighlands.co.uk	2024-42	bavarianfootballworks.com	2024-42
softonic-ar.com	2024-22	bleedinggreennation.com	2024-42
heraldsun.com.au	2024-42	silverscreenandroll.com	2024-42
royalsocietypublishing.org	2024-22	gnc.com	2024-42
softonic.com	2024-42	cagesideseats.com	2024-42
shopstyle.com	2024-42	blazersedge.com	2024-42
couriermail.com.au	2024-42	badlefthook.com	2024-42
theaustralian.com.au	2024-42	cincyjungle.com	2024-42
news.com.au	2024-42	hogshaven.com	2024-42
kaufland.de	2024-42	bigblueview.com	2024-42
sendpulse.com	2024-26	ninersnation.com	2024-42
washingtonexaminer.com	2024-33	pinstripealley.com	2024-42
thedodo.com	2024-42	bloggingtheboys.com	2024-42
g2a.com	2024-42	guickbase.com	2024-42
fieldgulls.com	2024-42	embluemail.com	2024-42
recode.net	2024-42	softonic.com.br	2024-42
novartis.com	2024-38	stimulustech.com	2024-42
mmafighting.com	2024-42	searchenginejournal.com	2024-42
vox.com	2024-42	giant-bicycles.com	2024-42
mmamania.com	2024-42	realself.com	2024-42

Table 5: Domains that explicitly fully allow GPTBot in their robots.txt, and which Common Crawl snapshot we first observed this behavior.

#### 10.5 Squarespace Restricted AI Bots

Figure 11 shows the content added to the robots.txt file for Squarespace when the "Block AI crawling" option is selected.

User-agent:	GPTBot
User-agent:	ChatGPT-User
User-agent:	CCBot
User-agent:	anthropic-ai
User-agent:	Google-Extended
User-agent:	FacebookBot
User-agent:	Claude-Web
User-agent:	cohere-ai
User-agent:	PerplexityBot
User-agent:	Applebot-Extended
Disallow: /	

Figure 11: Content added to the robots.txt file for Squarespace websites when the "Block AI crawling" option is selected

# 10.6 Cloudflare "Definitely Automated" User-agents

Below, we list the user-agents we inferred Cloudflare's "Definitely Automated" setting to block. We note that IP address likely plays a role in the operation of this setting through blocking "fake" verified bots (e.g., a request that claims to be a particular Cloudflare Verified Bot, but does not come from a documented IP address). We exclude these user-agents from the list, but note that the list of Cloudflare verified bots is publicly available [12].

wget, Python-urllib, python-requests, aiohttp, httpx, libwww-perl, Nutch, Go-http-client, Teoma, grub.org, CCBot, 360Spider, binlar, Scrapy, PhantomJS, PiplBot, omgili, AHC, Apache-HttpClient, magpie-crawler, MeltwaterNews, Diffbot, axios, W3C-checklink, HeadlessChrome, serpstatbot, curl, Bytespider, PHP-Curl-Class, centurybot, node-fetch, PerplexityBot, Claudebot, anthropic-ai

Figure 12: List of user-agents inferred to be blocked by Cloudflare's "Definitely Automated" rule.