

http-garden: Differential fuzzing REPL for HTTP implementations.

http-garden: Differential fuzzing REPL for HTTP implementations. - narfindustries, GitHub.

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README.md

Blob 280cce31b6e5, 11497 bytes, at commit b417e806c1b1.

The HTTP Garden

The HTTP Garden is a collection of HTTP servers and proxies configured to be composable, along with scripts to interact with them in a way that makes finding vulnerabilities much much easier. For some cool demos of the vulnerabilities that you can find with the HTTP Garden, check out [our ShmooCon 2024 talk](#).

Acknowledgements

We'd like to thank our friends at [Galois](#), [Trail of Bits](#), [Narf Industries](#), and [Dartmouth College](#) for making this project possible.

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Getting Started

Dependencies

1. The HTTP Garden runs on x86_64 and AArch64 Linux, and is untested on other platforms.
2. The target servers are built and run in Docker containers, so you'll need Docker.
3. You'll also need Python 3.12+ and the following Python packages, which you can get from PyPI (i.e. with `pip`) or from your system package manager:
4. `docker`
 - For interacting with Docker
5. `pyyaml`
 - For parsing yaml
6. `tqdm`
 - For progress bars

If you're installing Python packages with your system package manager, be aware that the package names may need to be prefixed with `py3-`, `python3-`, or `python-`, depending on the system.

Running

- Build and start up some servers and proxies:

```
./garden.sh start --build gunicorn hyper nginx haproxy
```

- From another shell, start the repl:

```
./garden.sh repl
```

- Send a basic GET request through [HAProxy](#), then send the result to [Gunicorn](#), [Hyper](#), and [Nginx](#) origin servers, and display whether their interpretations match:

```

garden> payload 'GET / HTTP/1.1\r\nHOST: a\r\n\r\n' | transduce haproxy | fanout | grid
'GET / HTTP/1.1\r\nHOST: a\r\n\r\n'
haproxy
'GET / HTTP/1.1\r\nhost: a\r\n\r\n'
unicorn: [
  HTTPRequest(
    method=b'GET', uri=b'/', version=b'1.1',
    headers=[
      (b'host', b'a'),
    ],
    body=b'',
  ),
]
hyper: [
  HTTPRequest(
    method=b'GET', uri=b'/', version=b'1.1',
    headers=[
      (b'host', b'a'),
    ],
    body=b'',
  ),
]
nginx: [
  HTTPRequest(
    method=b'GET', uri=b'/', version=b'1.1',
    headers=[
      (b'host', b'a'),
      (b'content-length', b''),
      (b'content-type', b''),
    ],
    body=b'',
  ),
]
g
u
n
i h n
c y g
o p i
r e n
n r x
+-----
unicorn|

```

```
hyper |
nginx |
```

Seems like they all agree. (Note that even though Nginx added `content-length` and `content-type` headers, the Garden is aware of this and does not let this insignificant discrepancy show up in `grid` output.)

Let's try a payload that uses a bare LF line ending in a chunked message body. This is [disallowed in the spec](#).

```
garden> payload 'POST / HTTP/1.1\r\nHost: a\r\nTransfer-Encoding: chunked\r\n\r\n0\r\n\r\n' | fanout | grid
gunicorn: [
  HTTPResponse(version=b'1.1', method=b'400', reason=b'Bad Request'),
]
hyper: [
]
nginx: [
  HTTPRequest(
    method=b'POST', uri=b'/', version=b'1.1',
    headers=[
      (b'transfer-encoding', b'chunked'),
      (b'host', b'a'),
      (b'content-length', b'0'),
      (b'content-type', b''),
    ],
    body=b'',
  ),
]
g
u
n
i h n
c y g
o p i
r e n
n r x
+-----
gunicorn|    X
hyper   |    X
nginx   |
```

Okay, so Gunicorn responded 400, Hyper didn't respond, and Nginx accepted. This is a violation of the spec by the Nginx authors that [they don't care to fix](#).

You may also have noticed that even though Gunicorn and Hyper didn't have exactly the same response, they showed as agreeing in the `grid` output earlier. This is because their responsees are essentially equivalent (a rejection of the message), and the Garden takes this into account.

Directory Layout

images

The `images` directory contains a subdirectory for each HTTP server and transducer in the Garden. Each target gets its own Docker image. All programs are built from source when possible. So that we can easily build multiple versions of each target, all targets are paremetrized with a repository URL (`APP_REPO`), branch name (`APP_BRANCH`), and commit hash (`APP_VERSION`).

tools

The `tools` directory contains the scripts that are used to interact with the servers. Inside it, you'll find

- `probe_quirks.py` : A script for enumerating benign HTTP parsing quirks in the systems under test to be ignored during fuzzing,
- `repl.py` : The primary user interface to the HTTP Garden,
- `update.py` : A script for updating the commit hashes in `docker-compose.yml` ,
- ...and a few more scripts that aren't user-facing.

Targets

HTTP Servers

| - | | [aiohttp](#) | | [apache_httpd](#) | | [apache_tomcat](#) | | [appweb](#) | | [aws_c_http](#) | | [cpp_httplib](#) | | [eclipse_grizzly](#) | | [eclipse_jetty](#) | | [fasthttp](#) | | [go_stdlib](#) | | [gunicorn](#) | | [h2o](#) | | [haproxy_fcgi](#) | | [hyper](#) | | [hypercorn](#) | | [ktor](#) | | [libevent](#) | | [libmicrohttpd](#) | | [libsoup](#) | | [lighttpd](#) | | [mongoose](#) | | [netty](#) | | [nginx](#) | | [node_stdlib](#) | | [openbsd_httpd](#) | | [openlitespeed](#) | | [openwrt_uhttpd](#) | | [protocol_http1](#) | | [puma](#) | | [tornado](#) | | [twisted](#) | | [undertow](#) | | [uvicorn](#) | | [waitress](#) | | [webrick](#) | | [yahns](#) |

HTTP Transducers

| - | | [apache_httpd_proxy](#) | | [apache_traffic_server](#) | | [envoy](#) | | [go_stdlib_proxy](#) | | [h2o_proxy](#) | | [haproxy](#) | | [lighttpd_proxy](#) | | [nghttpx](#) | | [nginx_proxy](#) | | [openlitespeed_proxy](#) | | [pound](#) | | [squid](#) | | [varnish](#) | | [yahns_proxy](#) |

Omissions

The following are explanations for a few notable omissions from the Garden:

Name	Rationale
Anything from Microsoft	MSRC told us "HTTP smuggling is not consider a vulnerability," and I feel no particular need to help Microsoft.
unicorn	Uses the same HTTP parser as <code>yahns</code> .
SwiftNIO	Uses <code>llhttp</code> for HTTP parsing, which is already covered by <code>node_stdlib</code> .
Bun	Uses <code>picohttpparser</code> for HTTP parsing, which is already covered by <code>h2o</code> .
Deno	Uses <code>hyper</code> for HTTP parsing, which is already in the Garden.
Daphne	Uses <code>twisted</code> for HTTP parsing, which is already in the Garden.
pitchfork	Uses the same parser as <code>yahns</code> .
nghttpx	Uses <code>llhttp</code> for HTTP parsing, which is already covered by <code>node_stdlib</code> .
Cheroot	Ignores our reports.
CherryPy	Uses <code>cheroot</code> for HTTP parsing.
libhttpserver	Uses <code>libmicrohttpd</code> for HTTP parsing, which is already in the Garden.
Werkzeug	Uses the CPython stdlib for HTTP parsing, which is already in the Garden.
Caddy	Uses the Go stdlib for HTTP parsing, which is already in the Garden.
Tengine	Uses Nginx's HTTP parser.
OpenResty	Uses Nginx's HTTP parser.
Google Cloud Global External Application Load Balancer	Based on Envoy.
Google Cloud Regional External Application Load Balancer	Based on Envoy.
Phusion Passenger	Uses <code>llhttpd</code> for HTTP parsing, which is already covered by <code>node_stdlib</code> .
passim	Uses <code>libsoup</code> for HTTP parsing, which is already in the Garden.
boa	Unmaintained.
Ulfius	Uses <code>libmicrohttpd</code> , which is already in the Garden.
Vultr Load Balancer	It's just HAProxy, which is already in the Garden.
VMWare Avi Load Balancer	It's just Nginx, which is already in the Garden.
Sanic	Uses <code>httptools</code> , which is already covered by Uvicorn.

Name	Rationale
CPython http.server	Not intended for production use.
openjdk_stdlib	Provides no coherent vulnerability disclosure channel.
dart_stdlib	Ignored prior reports.
eventlet	HTTP library is just a fork of the one in the CPython stdlib.
uwsgi	Doesn't support chunked message bodies.

Results

See TROPHIES.md for a complete list of bugs that the Garden has found.

Archived from <https://github.com/narfindustries/http-garden>. Rendered offline from the local Markdown copy.