

</> htmx & Hypermedia

*Confronting the Complexity of Frameworks and SPA Architectures
Is it Time to Return to Hypermedia ?*

Stefane Fermigier, Abilian // OSXP 2023

- Slides: <https://github.com/sfermigier/slides> /
<https://fermigier.com/presentations/>
- Demo: <https://github.com/sfermigier/demos>

Self introduction

- Web and Python developer since ~1996
- Know also (bits of) JavaScript, Java, C, C++, Clojure, PHP, Ruby...
- Founder and CEO (+ acting CTO) of Abilian since 2012
- Free/Open source user since 1988 (Nethack)
- Linux user since 1991



What is htmx?

<https://htmx.org> (no wikipedia page!)

A single library:

- 15kB (compressed) JavaScript library, no dependencies
- Created by Carson Gross in 2020
- (Rewrite of Intercooler, started in 2014)

Helps implement hypermedia-driven applications (HDA),

Featured on the Thoughtworks Technology Radar

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Assess 

htmx ↗ is a small, neat HTML UI library that recently became popular seemingly out of nowhere. During our Radar discussion, we found its predecessor intercooler.js ↗ existed ten years ago. Unlike other increasingly complex pre-compiled JavaScript/TypeScript frameworks, htmx encourages the direct use of HTML attributes to access operations such as AJAX, CSS transitions, WebSockets and Server-Sent Events. There's nothing technically sophisticated about htmx, but its popularity recalls the simplicity of hypertext in the early days of the web. The project's website also features some insightful (and amusing) essays ↗ on hypermedia and web development, which suggests the team behind htmx have thought carefully about its purpose and philosophy.



Source: [Fireship](#)

Agenda

1. A short history of the Web

1. From Hypermedia to back again.

2. Hypermedia and htmx

1. Hypermedia fundamentals.
2. htmx: the missing pieces to the current web.

3. Using htmx

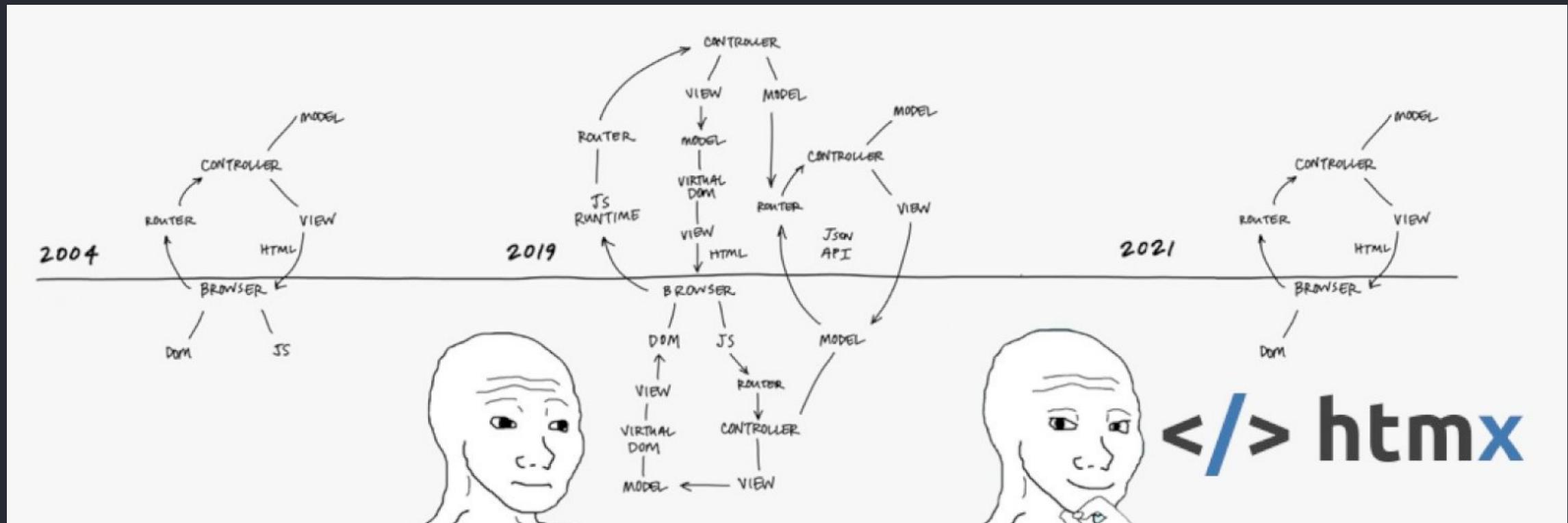
1. Front-end (HTML) patterns
2. Server patterns

4. htmx in practice.

1. Case studies
2. Scaling htmx.

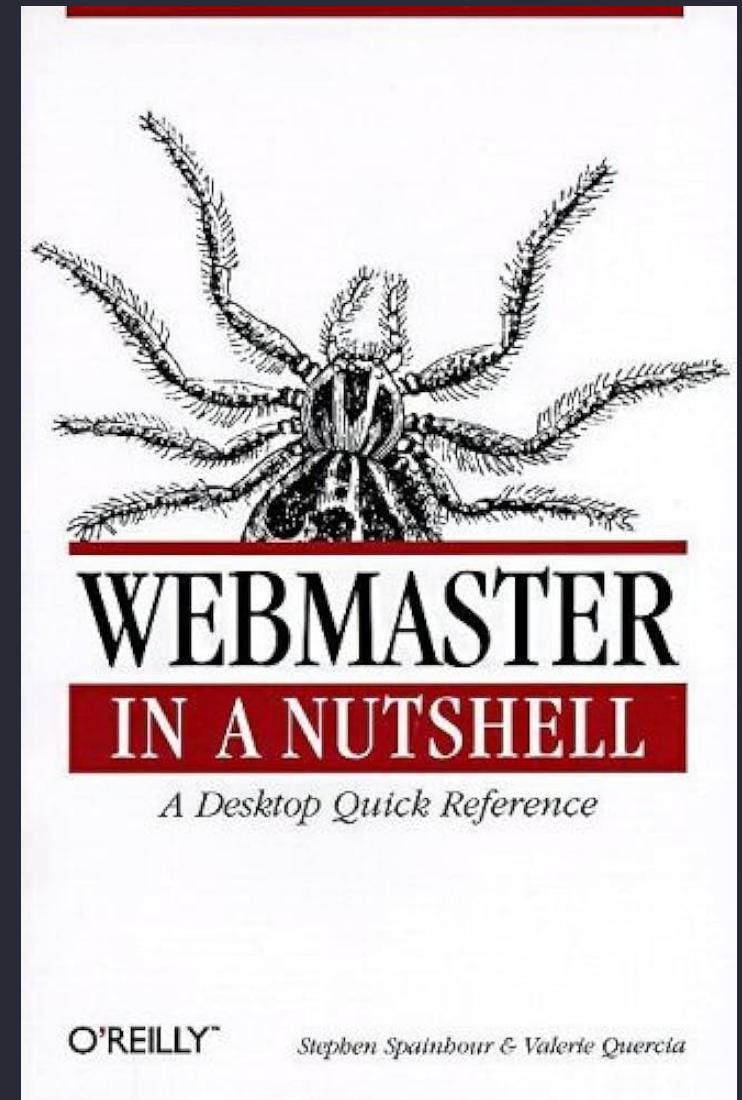
5. Conclusion

A short history of web technologies



1990-2000: The Dawn of Web Apps

- Early beginnings before CSS and JS dominance
- "Web developers" didn't exist - Web specialists were called "webmasters"



1996-2005: Emergence of New (Proprietary) Technologies in 2000s

- Arrival of ActiveX, Java applets, Flash, Silverlight
- App vs. website divide
- CSS and JS in their primitive stages
- XMLHttpRequest for HTML or XML exchange

2005-2015: The Web 2.0 Era

- Introduction of jQuery, AJAX ("Asynchronous JavaScript and XML") / AJAJ
- Decline of ActiveX, Flash unsupported on iPhone
- => Developers' challenge: Replicating Flash apps with HTML, CSS, JS
- Browser limitations: Lack of HTML5, CSS3, ES5, and JSON.parse
- IE8 and Chrome 1's limitations

2010-2020: The Rise of SPAs

- General adoption of HTML5, CSS3, ES5
- Shift in web traffic to mobile devices
- Rise of Single Page Applications (SPA)
 - Frameworks: Angular, Ember, Backbone, Knockout, React, Vue, Svelte, Solid, Alpine, Nue...
- Hypermedia apps renamed (by contrast) "MPA" (Multiple Pages Applications)

Since 2020: The Domination of SPAs and JSON APIs

- Traditional web frameworks now push JSON to the browsers (e.g. DRF, Flask-Rest*, etc.)
 - + New frameworks focused on JSON APIs: FastAPI, Sanic, Litestar...
- Server frameworks adapting to "HTML for apps" approach
 - Rise of Blazor, Phoenix LiveView, Livewire, htmx...
- Innovations and complexities introduced by SPAs.

=> Seeking the balance of flexibility and simplicity.

Hypermedia Systems & htmx

Hypermedia Systems

A hypermedia system is a system that adheres to the **RESTful network architecture** in Fielding's original sense of this term, and in particular to the HATEOAS (Hypermedia as the engine of application state) principles.

NB: “REST” shouldn't be confused with "JSON APIs". JSON is not a natural hypermedia due to the absence of hypermedia controls. The exchange of hypermedia is (according to Gross) an explicit requirement for a system to be considered “RESTful.”

Limitations of Traditional ("Web 1.0") Hypermedia

- Why should only `<a>` and `<form>` be able to make HTTP requests?
- Why should only `click` & `submit` events trigger them?
- Why should only `GET` & `POST` methods be available?
- Why should you only be able to replace the entire screen?

How htmx Solves these Four Problems?

Any element should be able to make HTTP requests

- `hx-get`, `hx-post`, `hx-put`,
`hx-patch`, `hx-delete`

Any event should be able to trigger an HTTP request

- `hx-trigger`

Any HTTP Action should be available

- `hx-put`, `hx-patch`, `hx-delete`

Any place on the page should be replaceable

- `hx-target`, `hx-swap`

Benefits of Introducing htmx

htmx solves all these four problems elegantly and without demanding developers write JavaScript code.

“ htmx gives access to "AJAX", CSS Transitions, browser history, WebSockets and Server Sent Events directly in HTML, using only attributes, so you can build modern user interfaces ("SPA-like") with the simplicity and power of hypertext ”

Front-End Patterns / Examples

Getting started

```
<script src="https://unpkg.com/htmx.org@latest"></script>
```

(45 kB minified, 15 kB gzipped)

hx-boost

hx-boost allows you to “boost” normal anchors and form tags to use AJAX instead. It works even with JavaScript disabled.

```
<div hx-boost="true">
  <a href="/page1">Go To Page 1</a>
  <a href="/page2">Go To Page 2</a>
</div>
<!-- or -->
<form hx-boost="true" action="/example" method="post">
  <input name="email" type="email" placeholder="Enter email..."/>
  <buttonbutton>
</form>
```

AJAX and HTTP methods

```
<div id="contacts">
  <button hx-get="/contacts" hx-target="#contacts">
    Get The Contacts
  </button>
</div>
```

- `hx-get` – send GET request to the provided URL
- `hx-post` – send POST request to the provided URL
- `hx-put` – send PUT request to the provided URL
- `hx-patch` – send PATCH request to the provided URL
- `hx-delete` – send DELETE request to the provided URL

Triggers

Browser events can trigger htmx actions:

```
<div id="contacts"></div>

<button
  hx-get="/contacts" hx-target="#main"
  hx-swap="outerHTML" hx-trigger="mouseenter">
  Get The Contacts
</button>
```

Trigger modifiers

The `hx-trigger` attribute accepts an additional modifier to change the behavior of the trigger, including:

- `once` – ensures a request will only happen once
- `changed` – issues a request if the value of the HTML element has changed
- `delay:<time interval>` – waits for the given amount of time before issuing the request
- `from:<CSS Selector>` – listens for the event on a different element
- ...

Server-Side Patterns

Search example (server)

```
@blueprint.get("/search")
def search():
    q = request.args.get("q", "").strip()
    talks = get_talks(q)

    if request.headers.get("HX-Trigger") == "search":
        return render_template("search/_rows.html", talks=talks)

    return render_template("search/index.html", talks=talks)
```

Search example (`search/index.html`)

```
<input  
    id="search" type="search" name="q"  
    placeholder="Enter title or speaker"  
    value="{{ request.args.get('q') or '' }}"  
    {# htmx specific attrs #}  
    hx-get="{{ url_for('.search') }}"  
    hx-trigger="search, keyup delay:400ms changed"  
    hx-target="tbody" hx-push-url="true" />  
<table>  
    <thead>...</thead>  
    <tbody>  
        {% include "search/_rows.html" %}  
    </tbody>  
</table>
```

Search example (`search/_rows.html`)

```
{% for talk in talks %}  
  <tr>  
    <td>{{ talk.title }}</td>  
    <td>{{ talk.presenter }}</td>  
  </tr>  
{% else %}  
  <tr>  
    <td colspan="2">  
      No relevant announcements  
    </td>  
  </tr>  
{% endfor %}
```

Discussion

Template generation should respect the "Locality of Behaviour" (LoB) principle.

“ The behaviour of a unit of code should be as obvious as possible by looking only at that unit of code ”

Splitting the templates should be done a way that respects this principle. Some patterns have emerged (see, e.g., [Django htmx patterns](#)) but rely on specific features of template languages or extensions. (No time to discuss today),

Quick-and-dirty alternative

```
@blueprint.get("/search")
def search():
    q = request.args.get("q", "").strip()
    talks = get_talks(q)
    return render_template("search/index.html", talks=talks)
# with
def after_app_request(response):
    if "HX-Request" in request.headers:
        data = response.get_data()
        tree = html.fromstring(data, parser=parser)
        target = request.headers["HX-Target"]
        target_elem = tree.xpath(f"//*[@id='{target}']")[0]
        oob_elems = tree.xpath("//*[@hx-swap-oob]")
        elems = [target_elem] + oob_elems
        response.data = "".join([html.tostring(elem, encoding=str) for elem in elems])
    return response
```

Experience Reports

Contexte (2022)

- The effort took about 2 months (from a 21K LOC code base)
- No reduction in the application's UX
- Reduced the overall code base size by 67%**
- Increased python code by 140% (500 LOC to 1200 LOC) - a good think if you like Python
- First load time-to-interactive reduced by 50-60%
- Handles much larger data sets (react simply couldn't handle the data)
- Web application memory usage was reduced by 46% (75MB to 45MB)



What happened to the codebase?

	Django + React	Django + htmx
Python (LoC)	500	1,200
HTML + CSS + JS (LoC)	21,000	6,000 (1,500 + 3,500 + 1,000)
JS deps (sub-deps)	49 (255)	5 (9)
JS + CSS build time	41s	5s



What happened to the team?

	Django + React	Django + htmx
Browser-only devs	1	0
Server-only devs	2	0
Full-stack devs	1	3

OpenUnited (2023)

- Code base size **reduced by 61%**
(31237 LOC to 12044 LOC)
- Subjectively, **development velocity felt at least 5X faster**
- Rather than prototyping in Figma and then porting to HTML, UX development was done directly in HTML

Source: [Linkedin post](#)

Code base (before/after):

<https://github.com/OpenUnited/>

Old Codebase (React, AntD, Typescript, GraphQL, Django)

Language	files	blank	comment	code
TypeScript	141	1589	194	15404
Python	352	3051	582	12133
LESS	17	230	130	1506
CSS	5	177	2	784
CSV	15	0	0	246
YAML	5	41	36	208
JavaScript	5	12	8	177
SCSS	2	18	0	144
HTML	8	0	0	141
SVG	18	1	0	131
JSON	5	0	0	106
SQL	1	36	0	83
Markdown	2	24	0	57
Text	4	7	0	56
Dockerfile	3	19	3	41
Bourne Shell	3	3	1	12
diff	1	2	6	5
INI	1	0	0	3
SUM:	588	5210	962	31237

New Codebase (Django, TailwindUI, Javascript, HTMX)

Language	files	blank	comment	code
Python	70	849	196	5640
JSON	16	0	0	2718
HTML	37	188	8	2039
JavaScript	14	127	31	731
CSS	1	107	10	495
SVG	17	0	0	175
Text	1	0	0	112
Bourne Shell	4	19	8	43
YAML	1	3	0	41
Markdown	1	21	0	39
Dockerfile	1	4	1	11
SUM:	163	1318	254	12844

Abilian

- htmx introduced in ongoing projects (sometimes alongside AlpineJS)
- Ongoing rewrite of older jQuery- and Vue-based projects
- Demos on <https://github.com/sfermigier/demos>
- webbits: an open source component framework and library for Python & htmx (ongoing project)

When and Why to Use htmx / HDA?

- **Ideal for Low-Interactivity Sites:** Best for text and image-based sites (e.g., Amazon, eBay, news sites).
- **Server-Side Value Addition:** Great for applications relying on server-side processing and data analysis.
- **Large-Grain Data Transfers:** All applications which use anchor tags and forms, with responses that return entire HTML documents from requests.
- **Wide Application Range:** Suitable for a variety of applications, extending beyond basic content display sites.
- **Simplifies Client-Side Complexity:** Reduces the need for client-side routing, state management, and JavaScript logic.

When and Why Not to Use Hypermedia?

- **Highly Dynamic Interfaces:** online spreadsheets (where updates trigger cascading changes), games...
- **Performance Concerns:** Hypermedia can reduce performance in situations requiring rapid, dynamic updates on user interactions.
- **Complex User Interface Dynamics:** Ineffective for interfaces without clear update boundaries, needing continuous data refresh.
- **Avoid for Large-Grain Data Inefficiency:** Not ideal for applications where the "large-grain hypermedia data transfer" model is too coarse.
- **Use Case for Sophisticated Client-Side JavaScript:** Better to use advanced client-side JavaScript for complex, interactive elements.

Mixing and Mashing

You can still use JavaScript (or Hyperscript) to provide (presumably lightweight) interactivity on the client (ex: hamburger menus, rich-text editors, complex data-grid, image editor...) in a context of an HDA / MPA, htmx-based (or not), application.

A DX issue can be the confusion that can appear from mixing 2 different template languages (*e.g.* Jinja and Vue or Alpine).

AlpineJS or Web Components are approaches that can be seen in the wild (and that I have personally experimented).

Short example using Hyperscript

```
{% extends "_layout.html" %}  
{% block content %}  
<script src="https://unpkg.com/hyperscript.org@0.9.12"></script>  
<script src="https://cdn.jsdelivr.net/npm/sweetalert2@11"></script>  
<button  
    hx-delete="/post{{post.id}}"  
    _="on htmx:confirm(issueRequest)  
        halt the event  
        call Swal.fire({  
            title: 'Confirm', text:'Do you want to delete this post?'  
        })  
        if result.isConfirmed issueRequest()  
    ">Delete</button>  
{% endblock %}
```

Carson Gross recommends

- “ The prime directive of an HDA is to use Hypermedia As The Engine of Application State. A hypermedia-friendly scripting approach will follow this directive. ”
- “ Practically, this means that scripting should avoid making non-hypermedia exchanges over the network with a server. ”
- “ hypermedia-friendly scripting should avoid the use of `fetch()` and `XMLHttpRequest` unless the responses from the server use a hypermedia of some sort (e.g. HTML), rather than a data API format (e.g. plain JSON). ”

In any Case

- **Use Hypermedia for Simpler App Parts:** Can be beneficial for simpler parts of an app, like settings pages with straightforward forms.
- **Manage Your Complexity Budget:** Reserve hypermedia for simpler application aspects, allocating more complexity to critical, intricate functionalities.

Scaling htmx

Scaling Hypermedia-Driven Applications

- Common skepticism: HDAs (and htmx) won't scale for large projects
- Scaling? = handling more nodes, requests, features, complexity, and team size
- The Web as the most successful and large scale distributed system
 - Hypermedia's role in the Web's scalability
 - Importance to individual developers

Scaling Application Performance in HDAs

- Conditions for scaling efficiently:
 - Software should be stateless
 - Software should support horizontal scaling
 - Features in the software should be independent
 - The performance of the system should be observable
 - The software should utilize caching
- HDA ticks all the boxes

Scaling with Number of Features in HDAs

- Independent endpoints driven by UI needs
- MVC architecture fostering scalability
- Server-side includes for view reuse
- Decoupled feature development

Scaling with Complexity of Features in HDAs

- Distinction between server-side and client-side deep features
- HDAs are well suited for server-side complex features
- HDAs are less suited for client-side intense UI interactions
- In which case the architecture should enable integrating complex front-end behavior developed using client-side technologies (JavaScript, WASM...)

Scaling the Development Team in HDAs

- Anecdotal evidence suggests fewer developers needed
- Elimination of front-end/back-end split
- Preference for smaller, more efficient teams
- But larger teams should be OK too

References

Hypermedia systems

Book written by Carson Gross & co-authors.

"Learn how hypermedia, the revolutionary idea that created The Web, can be used today to build modern, sophisticated web applications, often at a fraction of the complexity of popular JavaScript frameworks."

Freely available on
<https://hypermedia.systems/>

HYPERMEDIA SYSTEMS

Carson Gross
Adam Stepinski
Dmitri Alimov

```
CLICK* ➔ HX-GET /COVER
HX-SWAP ↵ 200 OK ↵ GET
PRESS* HX-GET /SIMPLICITY
HX-INCLUDE ↵ HX-POST /CREATE /CONTACTS ➔ 303 ➔ GET
HX-GET /BOOK ➔ *READ*
➔ HX-SELECT ➔ HX-SWAP
404 ➔ GET /RPC-API ➔ FEEDBACK /REASON ➔ 202 ACCEPTED
➔ *HOVER* ➔ HX-SELECT
HX-DELETE /COMPLEXITY
HX-PUT /CURIOUS ➔ *HOT*
```

Projects

Python projects or extensions:

- [Flask-htmx](#) (Flask extension)
- [Django htmx](#) (Django extension)
- [hx-request](#) (Django extension)
- [Litestar htmx](#) (1st party support)
- ...

Alternatives to htmx:

- [Hotwired](#)
- [Inertia](#) (Laravel)
- [Livewire](#) (Laravel)
- Many others

Other useful references

- [Essays on htmx.org](#)
- [Django + htmx patterns](#)
- More:
 - [Server-Side Examples on htmx.org](#)
 - [PyHAT: Awesome Python htmx](#)

Conclusion

Your turn!

Embrace htmx and HDA in Modern Web Development!

- In many cases, htmx is a viable alternative to SPAs.
- It balances performance, simplicity, and scalability.
- Future prospects for htmx and hypermedia in large-scale projects.

Merci!

Credits: a large part of the content of this presentation is derived from the htmx.org and hypermedia.systems websites. Errors are mine.

Contact:

- sf@abilian.com / <https://abilian.com/>
- sf@fermigier.com / <https://fermigier.com/>

Slides created with [MARP](#).