



## htmx - past is now future

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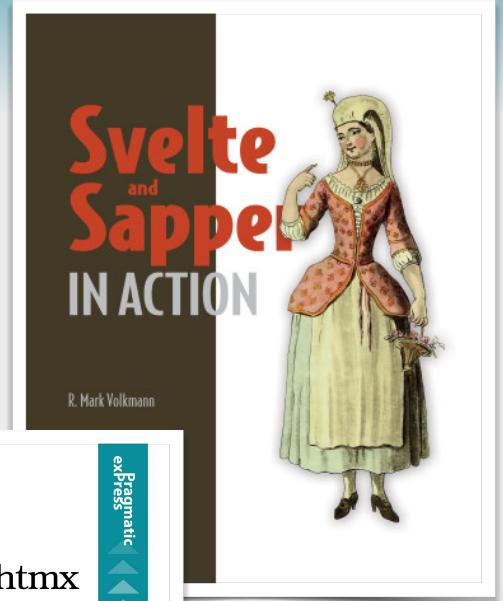
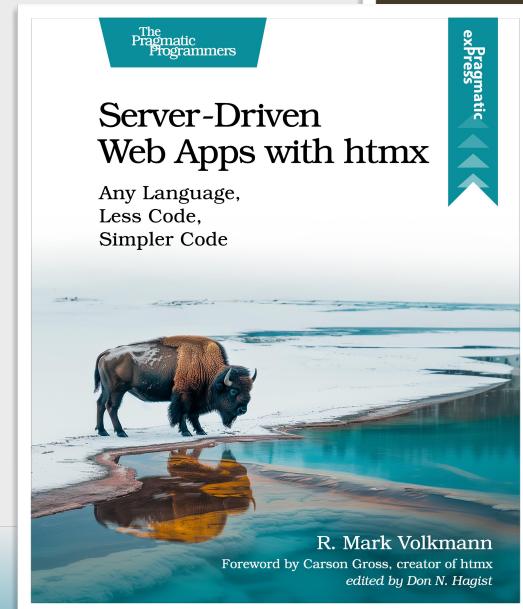
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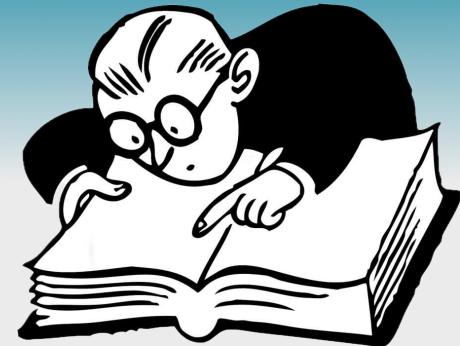
# About Me

- Partner and Distinguished Software Engineer at Object Computing, Inc. in St. Louis, Missouri USA
- 44 years of professional software development experience
- Writer and speaker
- **Blog** at <https://mvolkmann.github.io/blog/>
- Author of Manning book “**Svelte ... in Action**”
- Author of Pragmatic Bookshelf book “**Server-Driven Web Apps with htmx**”

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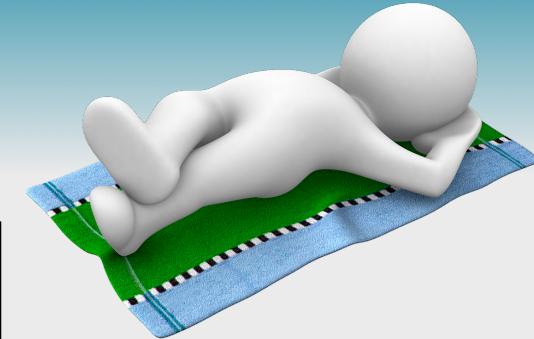


# Terminology



- **Hypermedia:** any data format that can describe branching from one “media” (ex. a document) to another
- **Hypermedia control:** an element that describes a server interaction, such as HTML anchor () and **form** elements
- **HATEOAS:** Hypermedia As The Engine Of Application State pronounced “hay toss”
- all allowed user actions are described by hypermedia controls found in endpoint responses
- **Hypermedia-Driven Application (HDA):** uses HATEOAS
- **Hypermedia client:** software that understands and renders a hypermedia format, such as web browsers with HTML

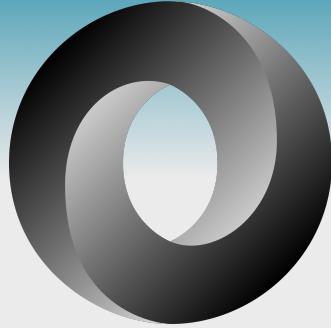
# What is REST?



- Defined by **Roy Fielding's PhD dissertation**
- A software architecture is **RESTful** if it
  - uses a client/server model
  - is stateless
  - can cache responses
  - supports a uniform interface ★
- A **uniform interface** is one where
  - requests identify a resource
  - resources are manipulated through representations
  - messages are self-descriptive ★
  - **HATEOAS is used** ★

“Architectural Styles  
and the Design of  
Network-based  
Software Architectures”

# JSON-based APIs

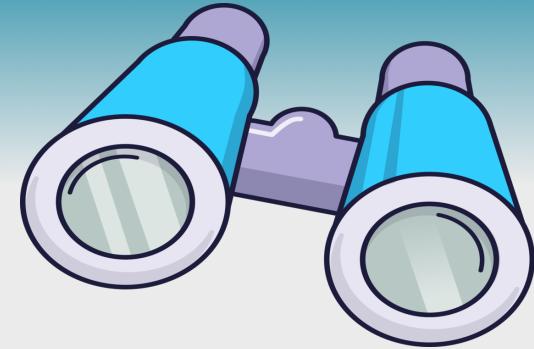


- Typically referred to as REST APIs
- Are **NOT REST** because JSON is not a hypermedia format
  - browsers know how to parse JSON, but don't know how to render it in a way that allows users to interact with it
  - even if JSON data described allowed user interactions, browsers wouldn't understand how to support them
  - requires custom, client-side JavaScript code → such as a framework like React, Svelte, Vue, or Angular
- JSON-based APIs aren't necessarily bad, but they are not REST APIs

Roy Fielding said

“I am getting frustrated by the number of people calling any HTTP-based interface a REST API. ... That is RPC.”

# htmx Overview



- Client-side JavaScript library for implementing hypermedia-driven applications (HDAs)
  - adds support for new HTML attributes that make HTML more expressive
  - uses endpoints that return HTML rather than JSON
  - free and open-source [Zero-Clause BSD license](#)
- Sponsored by 24 companies (as of Jun 2024)
  - including GitHub and JetBrains
- <https://htmx.org/>

# Tech Stacks ...

- Can use any programming language and framework that can implement an **HTTP server** whose endpoints return **HTML responses**
- Referred to as “Hypermedia On Whatever you’d Like” (**HOWL**)
- **Good choices make it easy to**
  - create new endpoints for any HTTP verb
  - specify type checking and validation of request data
  - get request data from headers, path parameters, query parameters, and bodies
  - send HTTP responses that include headers and bodies that contain text or HTML



# ... Tech Stacks



- **Good choices have tooling that supports**
  - **fast server startup** with no build process or a simple one
  - **automatic server restarts** after source code changes are detected
  - **good HTML templating** support (such as JSX) or my npm package js2htmlstr without relying on string concatenation
  - **syntax highlighting** of embedded HTML in code editors

# Creating a Project



- Let's walk through using one tech stack ... TypeScript, Bun, and Hono
  - install Bun from <https://bun.sh>
  - create a directory, cd to it, and enter **bun init**
  - install Hono with **bun add hono**
  - edit **tsconfig.json**  Add this inside **compilerOptions**:  
"jsxImportSource": "hono/jsx",
  - rename **index.ts** to **index.tsx** so JSX can be used
  - create **public/index.html** as shown on next slide
  - modify **index.tsx** as shown on next slide
  - enter **bun run index.tsx**
  - browse localhost:3000

**Other options include:**

- Go with templ
- Python with Flask or Django
- TypeScript with Astro

# Demo Files

```
<html>                                     public/index.html
  <head>
    <title>htmx Demo</title>
    <link rel="stylesheet" href="styles.css" />
    <script
      src="https://unpkg.com/htmx.org@2.0.0"
    ></script>
  </head>
  <body>
    <button hx-get="/version" hx-target="#version">
      Get Bun Version
    </button>
    <div id="version"></div>
  </body>
</html>
```

```
import {type Context, Hono} from 'hono';
import {serveStatic} from 'hono/bun';

const app = new Hono();

// Serve static files from the public directory.
app.use('*', serveStatic({root: './public'}));

app.get('/version', (c: Context) => {
  // Return a Response whose body contains
  // the version of Bun running on the server.
  return c.text('v' + Bun.version);
});

export default app;
```

```
body {           public/styles.css
  font-family: sans-serif;
}

button {
  border-radius: 0.5rem;
  margin-bottom: 1rem;
  padding: 0.5rem;
}
```

Get Bun Version

v1.1.15

When this button is clicked, an HTTP GET request is sent to `/version`. The text it returns replaces the innerHTML of the element with id “`version`”.

# Pros ...

5 Slides Worth!



- **Fixes HTML shortcomings**
  - any user interaction on any HTML element can trigger any kind of HTTP request and insert an HTML response without a full page refresh
- **Improves startup time**
  - metrics such as “First Contentful Paint” and “Time to Interactive”
  - significant for users with old computers/phones or slow internet connections
- **Favors Locality of Behavior (LoB) over Separation of Concerns (SoC)**
  - places related code together which makes code easier to understand and modify

mostly refers to associating logic with HTML elements by adding new attributes

# ... Pros ...



- **Eliminates JSON as intermediate format**
  - in SPA applications
    - endpoints fetch data, serialize it to JSON, and return JSON
    - browser code parses JSON and generates HTML from it
  - in htmx applications
    - endpoints fetch data, generate HTML from it, and return HTML
    - browser only has to insert and render returned HTML
    - no custom client-side code is required
  - results in simpler, faster code

# ... Pros ...



- **Eliminates need for API versioning**
  - JSON APIs
    - client-side code parses JSON and extracts data from it
    - if used by multiple clients, APIs must be versioned and each version must remain stable to avoid breaking clients
  - HTML APIs
    - client-side code does not parse HTML and extract data from it
    - intended for use by a single client application and can be specific to it
    - can be freely modified as long as the desire is for all users to get latest version on next site visit

The initial application URL renders the starting page.

All other interactions are derived through URLs in that page and pages reached from it.

This is crux of HATEOAS.



# ... Pros ...

- **Enables HOWL** Hypermedia On Whatever you'd Like
  - use any programming language that can implement an HTTP server whose endpoints return HTML responses
- **Encourages full-stack development**
  - often in SPA development one team implements JSON endpoints and another team implements UIs that use them
  - with htmx, developers implement complete features by defining endpoints that return HTML that can include htmx attributes
  - requires developers to know a programming language, HTML, and CSS, but not necessarily JavaScript

# ... Pros



- **Simplifies state management**
  - typical SPA applications manage state on both server and client
    - keeping state in sync in two places is tedious and error-prone
  - with htmx, all non-UI state is only on server
    - no state synchronization is needed and browser memory usage is reduced
- **Simplifies client-side code**
  - client-side code is mostly unnecessary because logic is embedded in HTML elements returned by server
  - fewer client-side dependencies are needed

# Cons



- htmx is a **new way of thinking** about web development
  - will take time to learn common patterns
- htmx is **not appropriate for apps that**
  - need UI updates on every mouse move or drag
    - too slow if each movement triggers a new HTTP request
    - examples include Google Maps and many games
  - require changes in one part of UI to trigger changes in many others

htmx can be used in conjunction with other approaches

such as  
spreadsheets

# htmx History

- Created by **Carson Gross**
  - principal software engineer at Big Sky Software
  - Computer Science instructor at Montana State University
- Work on predecessor **intercooler.js** began in 2013
- **First version** of htmx was released in May 2020
- **Latest version** 2.0.0 released June 2024 is **less than 16K** minified and compressed
- Has extensive set of integration tests implemented in Mocha
- Interest in htmx exploded in 2023 after **YouTube videos** from **ThePrimeagen** and **Fireship** were released
- Strong showing in 2023 **JavaScript Rising Stars**
  - 2nd place in “Front-end Frameworks” behind React



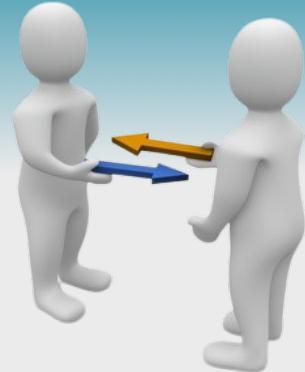
# htmx Basics



- Add htmx attributes to elements that will trigger HTTP requests
- Specify events that trigger the request
  - **hx-trigger** comma-separated list of event names with optional modifiers
- Specify HTTP verb to use and endpoint URL
  - **hx-get**, **hx-post**, **hx-put**, **hx-patch**, and **hx-delete**
- Specify element where response HTML will go
  - **hx-target** can be CSS selector and/or use several keywords; defaults to **this**
- Specify where to place HTML relative to target
  - **hx-swap** see next slide

All elements have a **default trigger**.  
**form** elements trigger on **submit**.  
**input**, **textarea**, and **select** elements trigger on **change**.  
All other elements trigger on **click**.

# hx-swap



Assume **hx-target** refers to the **ul** element.

Options to  
insert content

**beforebegin**

**afterbegin**

**beforeend**

**afterend**

```
<p>before list</p>
<ul>
  <li>Red</li>
  <li>Green</li>
  <li>Blue</li>
</ul>
<p>after list</p>
```

Options to  
replace content

**outerHTML**

**innerHTML** (default)

Options that do not  
use response HTML

**delete**

removes target element

**none**

leaves target element as-is

# HTTP Verb Review



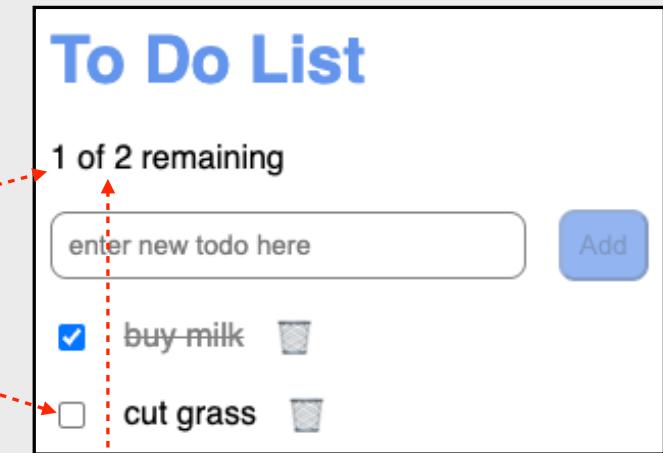
HTTP

- **POST** - create and non-CRUD operations
- **GET** - read
- **PUT** - update all
- **PATCH** - update some
- **DELETE** - delete

# Endpoints

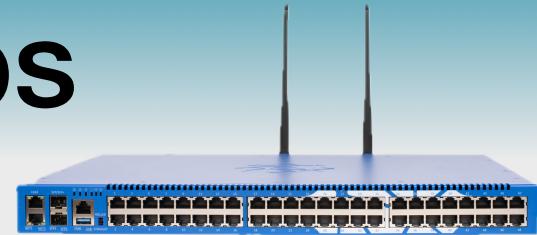
- Endpoints can return any combination of
  - one element to be placed **relative to target**
    - example: a new todo item
  - any number of elements to be placed **out-of-band**
    - example: updated status text
  - an **HX-Trigger** header to trigger an **event** in browser
    - example

```
<p hx-get="/todos/status" hx-trigger="load, status-change from:body" />
```



The event bubbles up to **body** element.

# Out-of-band Swaps



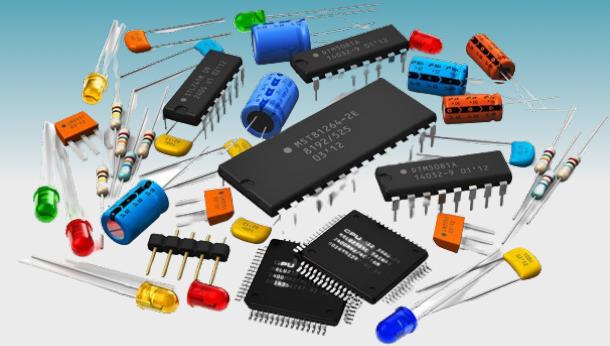
- Returned HTML can target multiple elements
  - one primary element and any number of additional elements that replace existing elements with a matching id
- Example

```
<>
<TodoItem todo={todo} />
<p id="error" hx-swap-oob="true">
  {message}
</p>
</>
```

- To place element relative to target rather than replace it, use an **hx-swap** value for **hx-swap-oob** (ex. **beforeend**)

# Components

- Can write functions that return HTML
  - see `TableRow` in “Infinite Scroll” example later
- JavaScript endpoints can generate HTML with JSX
  - JSX is perhaps the best part of React
  - other parts of React like virtual DOM and hooks are not used
- Returned elements can include `htmx` and `Alpine` attributes
  - see Alpine example later



# Input Validation



```
<div>
  <label for="email">Email</label>
  <input
    id="email"
    hx-get="/email-validate"
    hx-target="#email-error"
    hx-trigger="keyup changed delay:200ms"
    name="email"
    placeholder="email"
    required
    size="30"
    type="email"
  />
  <span class="error" id="email-error" />
</div>
```

<https://github.com/mvolkmann/htmx-examples/tree/main/input-validation>

```
app.get('/email-validate', (c: Context) => {
  const email = c.req.query('email') || '';
  const valid = validEmail(email);
  return c.text(valid ? '' : 'email in use');
});
```

## Sign Up

Email	<input type="text" value="old@aol.com"/> old@aol.com	email in use
Password	<input type="password" value="*****"/> .....	invalid password
<input type="button" value="Submit"/>		

# Lazy Loading

<https://github.com/mvolkmann/htmx-examples/tree/main/lazy-load>



```
<div  
    hx-get="/users"  
    hx-indicator=".htmx-indicator"  
    hx-trigger="revealed"  
/>  

```

Assume this `div` is part of a larger page and is not rendered until the user scrolls down on the page.

Users

ID	Name	Email	Company
1	Leanne Graham	Sincere@april.biz	Romaguera-Crona
2	Ervin Howell	Shanna@melissa.tv	Deckow-Crist
3	Clementine Bauch	Nathan@yesenia.net	Romaguera-Jacobson
4	Patricia Lebsack	Julianne.OConner@kory.org	Robel-Corkery
5	Chelsey Dietrich	Lucio_Hettinger@annie.ca	Keebler LLC
6	Mrs. Dennis Schulist	Karley_Dach@jasper.info	Considine-Lockman
7	Kurtis Weissnat	Telly.Hoeger@billy.biz	Johns Group
8	Nicholas Runolfsdottir V	Sherwood@rosamond.me	Abernathy Group
9	Glenna Reichert	Chaim_McDermott@dana.io	Yost and Sons
10	Clementina DuBuque	Rey.Padberg@karina.biz	Hoeger LLC

# Active Search

<https://github.com/mvolkmann/htmx-examples/tree/main/active-search>



```
<label for="name">Name</label>  
<input
```

```
  hx-trigger="keyup changed delay:200ms"  
  hx-post="/search"  
  hx-target="#matches"  
  name="name"  
  size="10"  
>  
<ul id="matches" />
```

Name ar

Mark

Richard

```
app.post('/search', async (c: Context) => {  
  const data = await c.req.formData();  
  const name = (data.get('name') as string) || '';  
  if (name == '') return c.html('');  
  
  const lowerName = name.toLowerCase();  
  const matches = names.filter(n => n.toLowerCase().includes(lowerName));  
  return c.html(  
    <>  
      {matches.map(name => (  
        <li>{name}</li>  
      ))}  
    </>  
  );  
});
```

# Infinite Scroll ...

```
<table
  hx-trigger="load"
  hx-get="/pokemon-rows?page=1"
  hx-indicator=".htmx-indicator"
  hx-swap="beforeend"
>
  <tr>
    <td>ID</td>
    <td>Name</td>
    <td>Description</td>
  </tr>
</table>

```

<https://github.com/mvolkmann/htmx-examples/tree/main/infinite-scroll>

```
app.get('/pokemon-rows', async (c: Context) => {
  const page = c.req.query('page');
  if (!page) throw new Error(
    'page query parameter is required');

  const pageNumber = Number(page);
  const offset = (pageNumber - 1) * ROWS_PER_PAGE;
  const url = POKEMON_URL_PREFIX +
    `?offset=${offset}&limit=${ROWS_PER_PAGE}`;
  const response = await fetch(url);
  const json = await response.json();
  const pokemonList = json.results as Pokemon[];

  return c.html(
    <>
      {pokemonList.map((pokemon, index) => {
        const isLast = index === ROWS_PER_PAGE - 1;
        return TableRow(pageNumber, pokemon, isLast);
      })}
    </>
  );
});
```

on next slide

## Infinite Scroll

ID	Name	Description
1	bulbasaur	
2	ivysaur	
3	venusaur	
4	charmander	
5	charmeleon	
6	charizard	

# ... Infinite Scroll



```
function TableRow(page: number, pokemon: Pokemon, isLast: boolean) {
  const attributes = isLast
    ? {
        'hx-trigger': 'revealed',
        'hx-get': '/pokemon-rows?page=' + (page + 1),
        'hx-indicator': '.htmx-indicator',
        'hx-swap': 'afterend'
      }
    : {};
  const {name, url} = pokemon;
  const id = url.split('/')[6]; // 7th part of URL
  const imageUrl =
    `https://raw.githubusercontent.com/PokeAPI/sprites/master/sprites/pokemon/${id}.png`;

  return (
    <tr {...attributes}>
      <td>{id}</td>
      <td>{name}</td>
      <td>
        <img alt={name} src={imageUrl} />
      </td>
    </tr>
  );
}
```

# Boosting



- Consider anchor (`a`) and `form` elements that do not have `htmx` attributes like `hx-get` or `hx-post`
- These send HTTP requests to a given URL and perform a full page refresh
- Can add `hx-boost="true"` to any element
  - changes descendant plain anchor and `form` elements to send HTTP requests using AJAX if JavaScript is enabled
- Results in faster navigation and better user experience
  - rather than full page refresh,  
`body` content in response replaces that in current page  
and `title` in `head` replace that in current `head`
  - avoids processing `link` and `script` tags in response `head`
  - assumes current page has already loaded all required CSS and JavaScript

add to `body` to “boost” all plain anchor and `form` elements

# More to Investigate



- htmx has support for all these features that we didn't have time to cover
  - animation with CSS transitions
  - WebSockets
  - Server-Sent Events
  - History API
  - security through a Content Security Policy (CSP) or sanitizing HTML
  - htmx JavaScript API

# Hyperview



- Hypermedia approach to developing mobile apps
  - for Android and iOS
- Builds on React Native
- <https://hyperview.org/>

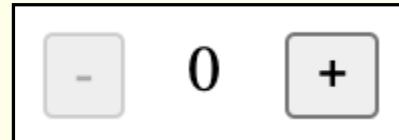
# Alpine



- “A lightweight JavaScript framework that uses custom HTML attributes to add dynamic behavior”
- Consider using this with htmx for client-side state and interactivity
- Example

similar to how htmx adds custom HTML attributes

```
<div style="display: flex; gap: 1rem" x-data="{ count: 0 }">
  <button x-bind:disabled="count <= 0" x-on:click="count--">
    -
  </button>
  <div x-text="count"></div>
  <button x-on:click="count++">
    +
  </button>
</div>
```



See my blog page on Alpine at  
<https://mvolkmann.github.io/blog>.



# Todo App Example

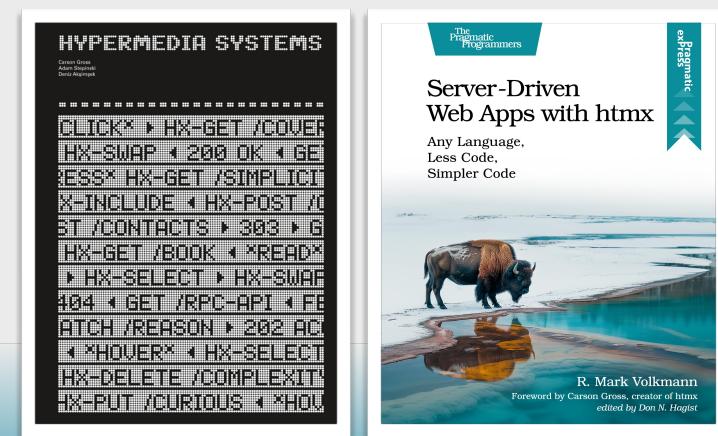
- For a larger htmx example app, see <https://github.com/mvolkmann/htmxa-examples/tree/main/todo-hono>
- A todo app implemented with TypeScript, Bun, Hono, htmx, and Alpine
- Demonstrates many useful htmx patterns
- Persists data to a SQLite database for which Bun has built-in support

The screenshot shows a 'To Do List' application with the following interface elements:

- Title:** To Do List
- Status:** 1 of 2 remaining
- Input Field:** enter new todo here
- Add Button:** A blue button labeled 'Add'.
- Tasks:**
  - buy milk (checkbox checked, trash can icon)
  - cut grass (checkbox unchecked, trash can icon)

# Resources

- **htmx home page** - <https://htmx.org>
  - see docs, reference, examples, talk, and essays
- **My blog** - <https://mvolkmann.github.io/blog/> (select htmx)
- **My htmx example code** -  
<https://github.com/mvolkmann/htmx-examples/>
- **htmx Discord server** - <https://htmx.org/discord>
- **“Hypermedia Systems” book**
  - <https://hypermedia.systems/>
- **“Server-Driven Web Apps with htmx”**
  - my book from Pragmatic Bookshelf



# Wrap Up

- **htmx** provides a new way of implementing web applications that has many benefits
  - HTML becomes more expressive
  - code is easier to understand
  - state management is simplified
  - can implement with any programming language
  - faster app startup
    - due to downloading much less client-side JavaScript
  - faster client/server interactions
    - due to removal of JSON generation and parsing

