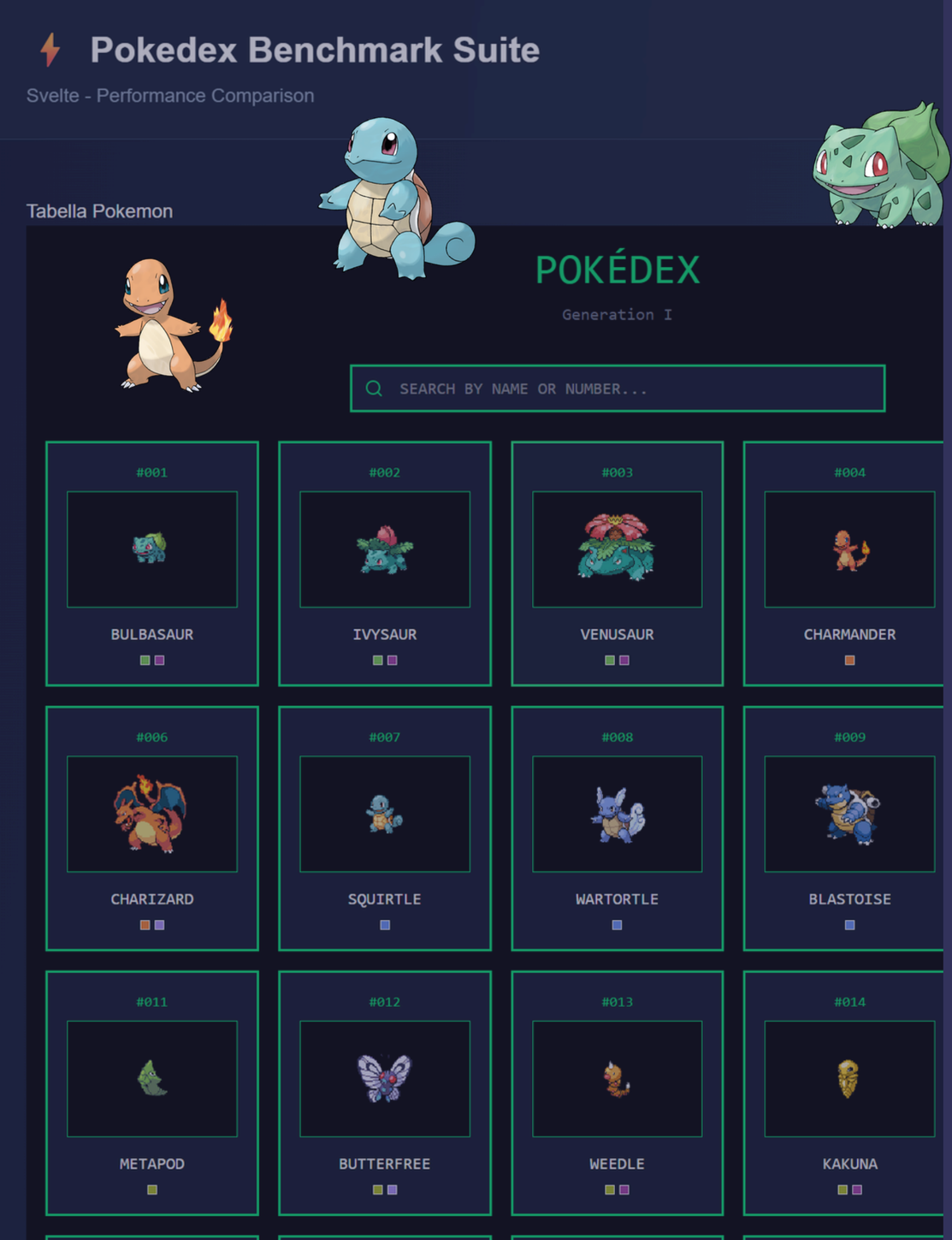


FRONTEND ON STAGE

MASTERING PERFORMANCES

SVELTE

ANGULAR

REACT

CIAO
LET ME INTRODUCE...

Michele Scarpa
Software Engineer

JS World

Speaker

Interviewer

Contact:

@michele-scarpa-90-arco

@jollymick90

I’M PROUD TO INTRODUCE
BACAROTECH

Giorgio Basile
FE developer

BacaroTech is an initiative that aims to recreate the joyful group atmosphere, typical of Venetian bacari, in the IT world through social media outreach, events and workshops.

We have been running this initiative since 2023 and during this time we have built a community of enthusiasts totaling almost 3000 developers.

Michele Scarpa
Software Engineer

WE CATCH
MORE AND MORE... LIKE POKEMON

Danilo

Antonio

Vittorio

Moreno

Lorenzo

Davide

WHAT IS BACAROTECH

BacaroTech

BacaroTech

Code and Fun

La tua **community di sviluppatori** dove si parla di programmazione a 360°: strutture dati, algoritmi, carriera tech e molto altro!

- Canale Whatsapp
- GitHub
- Instagram
- Youtube
- TikTok
- LinkedIn
- Discord

Condividi questa pagina!

Link della repo di questo LinkTree

Buon codice devs!

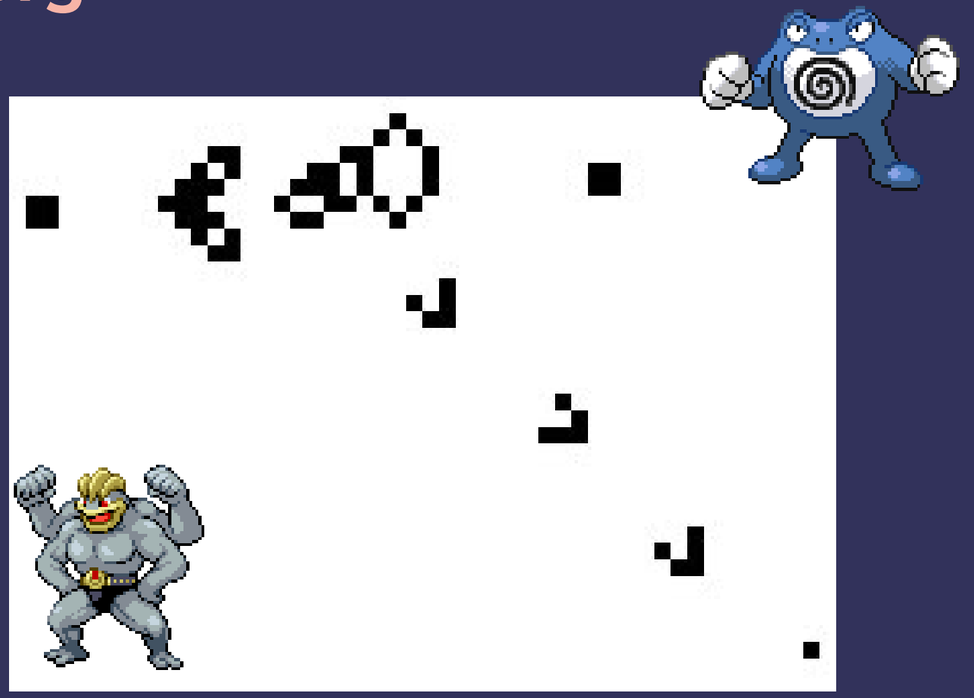
INSPIRATION
CODE RETREAT

What is: A workshop on Extreme Programming practices.
Focus on *Pair Programming* and *Test-Driven-Development*

www.coderetreat.org

Coding session in pairs

- *Each session implements the 'Game of Life' (Conway's Game) in 45 minutes*
- *After each interations:*
  - *Delete the code*
  - *15 minute retrospective*
  - *Break*
  - *If possible: Change pari, change technology*



THE EXPERIMENT

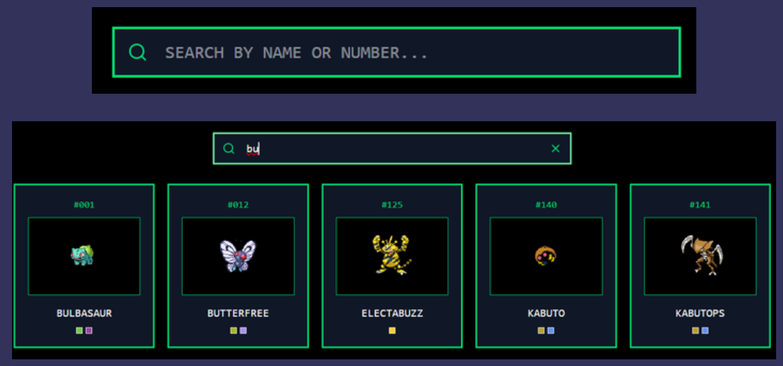
ONE POKEDEX, THREE DIFFERENT FRAMEWORKS

Goal: Compare different tools in practice on the same application. Same UI, same logic, different engine

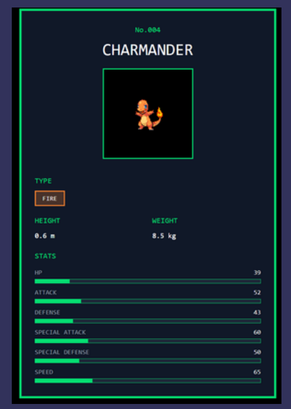
Target: Measure Dev Exp and Performance

List / Grid

Search



Detail



FIRST LESSON LEARN

OUTCOME: FAILURE

How do I measure the performance and dev experience of a complex system?

First Step
Divide and simplify

Second Step:
Learn to measure

Isolate
Components
Dom Manipulation

Understand the
metrics
Know the tools

THE FOUNDATION:
WHAT ARE WE MEASURING??

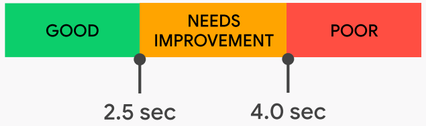
CORE WEB VITALS

Three metrics defined by Google to measure user experience on a web page.

(Loading)

LCP

Largest Contentful Paint



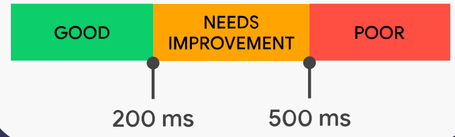
Perceived loading speed

Under 2.5s

(Interactivity)

INP

Interaction to Next Paint



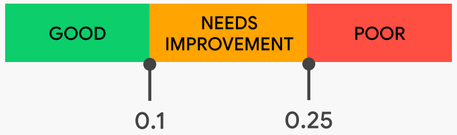
Interface responsiveness

under 200ms

(Visual Stability)

CLS

Cumulative Layout Shift



Visual Stability

Under 0.1s

LIFECYCLE
OF CORE WEB VITALS

Experimental → **Pending** → **Stable**

Initial development and fitness assessment

Ecosystem adaptation and final validation.

Official finalization and active support

the case

FID
First Input Delay

Focus on first impression

INP
Interaction to Next Paint

Entire user session

FRAMEWORKS PRESENTATION

ANGULAR TABLE
ZONEJS

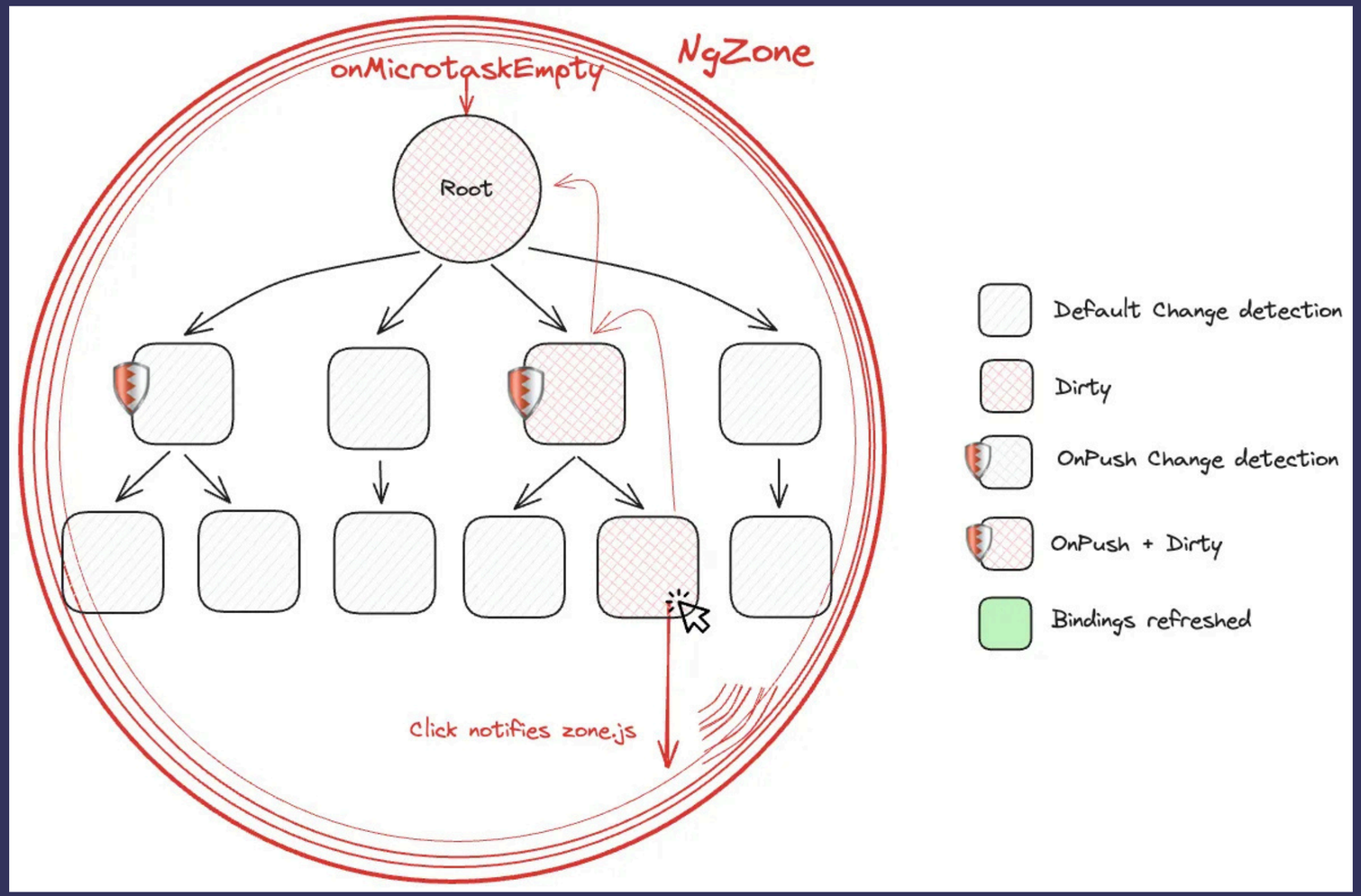
Complete, opinionated, enterprise

```ts
export class TableFullZoneComponent implements
OnInit {
  @Input() cols: number = 100;
  @Input() rows: number = 10;

  public tableData: TableRow[] = [];

  get colHeaders(): string[] {
    return this.tableData.length > 0
      ? Array.from({ length: this.cols }, (_, i)
=> `Campo ${i + 1}`)
      : [];
  }

  ngOnInit(): void {
    this.createRows();
  }

  createRows(): void {
    this.tableData = generateTestData(this.rows,
this.cols);
  }

  clearRows(): void {
    this.tableData = [];
  }
```

```html
<div class="p-8 font-sans">

  <!-- title descriptions and actions/buttons -->

  <div class="overflow-x-auto border border-gray-200 rounded
    <table class="min-w-full divide-y divide-gray-200">
      <thead class="bg-gray-50">
        <tr>
          <th class="px-4 py-2 text-left text-xs font-medium
500 uppercase tracking-wider">ID</th>
          <ng-container *ngIf="tableData.length > 0">
            <th *ngFor="let header of colHeaders" class="px-
left text-xs font-medium text-gray-500 uppercase tracking-wi
              {{ header }}
            </th>
          </ng-container>
        </tr>
      </thead>
      <tbody class="bg-white divide-y divide-gray-200">
        <tr *ngFor="let row of tableData; trackBy: trackById
          <td class="px-4 py-2 whitespace-nowrap text-sm fon
text-gray-900">
            {{ row.id + 1 }}
          </td>
          <td *ngFor="let col of colHeaders; let i = index"
py-2 whitespace-nowrap text-sm text-gray-700">
            {{ row['field' + i] }}
```

- **Component based**
- **Declarative Template**
- **Data binding** *(two-way)*
- **Structural Directives**

CHANGE DETECTION
ANGULAR

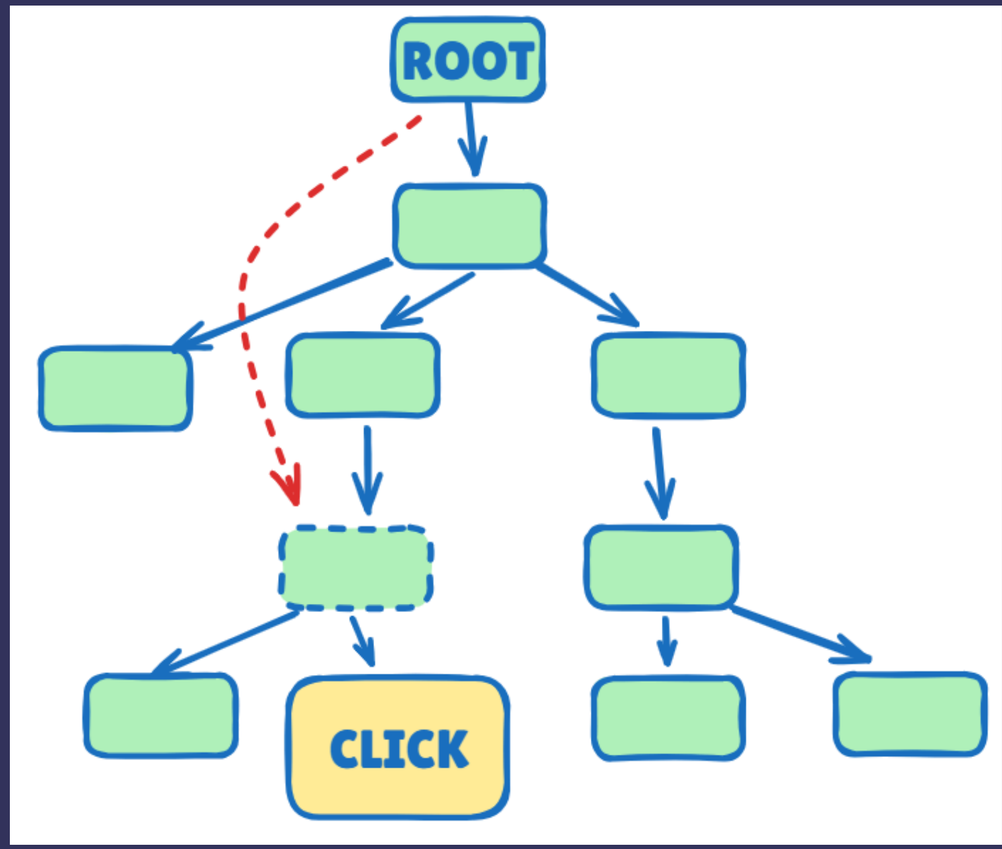


Change Detection
ZoneJS
(heavy runtime)

ANGULAR - 20

- *Zoneless*
- *Signals*
- *Control Flow (@if @each)*

```
  public tableData = signal<TableRow[]>([]);

  public colHeaders = computed(() => {
    return this.tableData().length > 0
      ? Array.from({ length: this.cols }, (_, i
${i + 1}`)
      : [];
  });

  ngOnInit(): void {
    this.createRows();
  }

  createRows(): void {
    const data = generateTesData(this.rows, thi
    this.tableData.set(data);
  }

  clearRows(): void {
    this.tableData.set([]);
  }
```



REACT

Library, very large Ecosystem

```
export default function TableSandbox({ cols = 20
TableSandboxProps) {
  const [tableData, setTableData] = useState<Tab
  const ROW_COUNT = rows;
  const COL_COUNT = cols;

  const createRows = () => {
    const data = generateTestData(ROW_COUNT, COL
    setTableData(data);
  };

  const clearRows = () => {
    setTableData([]);
  };

  const colHeaders = useMemo(
    () =>
      tableData.length > 0
        ? Array.from({ length: COL_COUNT }, (_,
        : [],
    [tableData.length, COL_COUNT]
  );

  useEffect(() => {
    createRows();
  }, []);
```

```
return (
  ...
        <tbody className="bg-white ...">
          {tableData.map((row) => (
            <tr key={row.id}>
              <td className="px-4 py-2 ..
                {row.id + 1}
              </td>
              {Array.from({ length: COL_C
                <td
                  key={`${row.id}-${i}`}
                  className="px-4 py-2 ..
                  {row[`field${i}` as key
                </td>
              ))}
            </tr>
          ))}
```

Functional Components

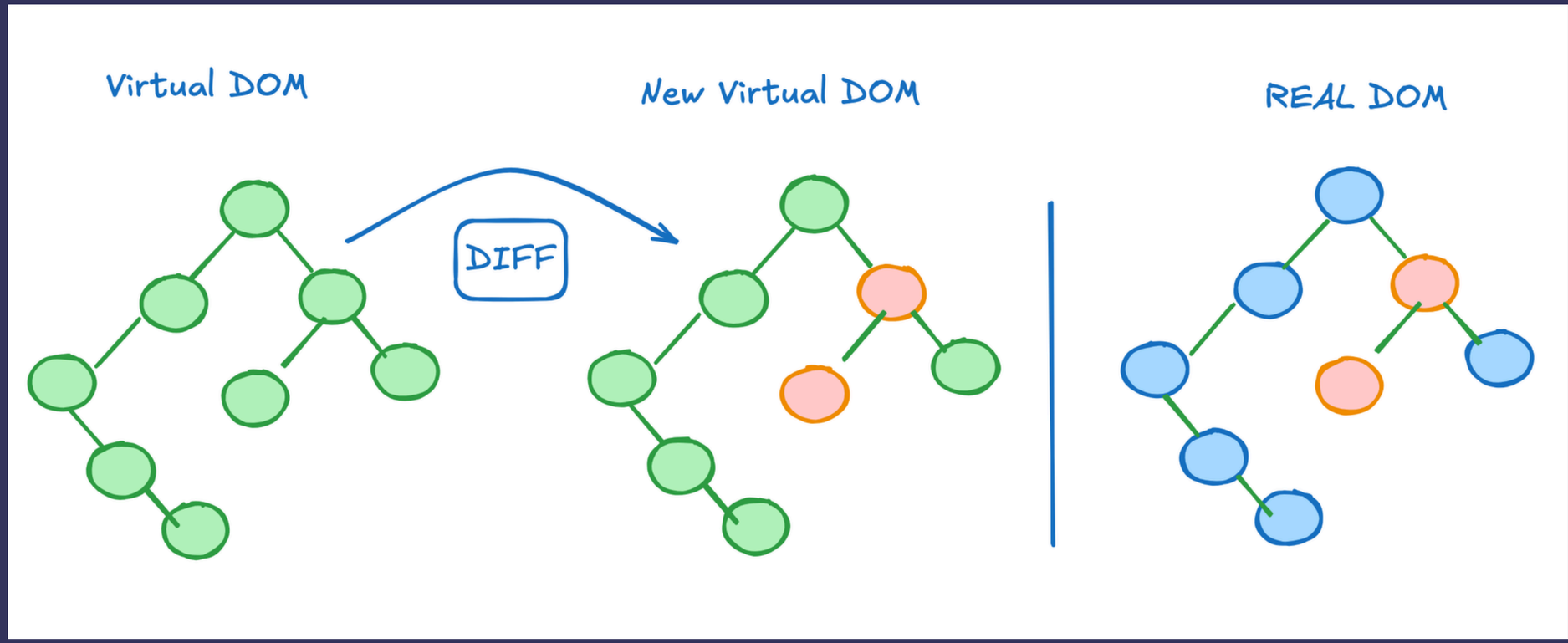
Hooks

Data binding *(one-way)*

JSX

VIRTUAL DOM

VDOM



Lightweight copy of the DOM

SVELTE TABLE

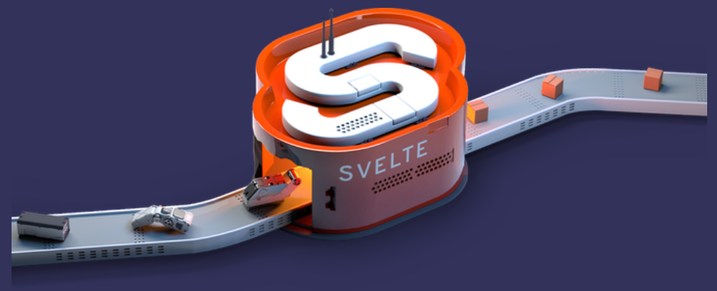
Compiler-first, “write less code”

```
<script lang="ts">

  const {cols = 20, rows = 1000} = $props()


  let tableData: TableRow[] = $state([]);


  let colHeaders: string[] = $derived(
    tableData.length > 0
      ? Array.from({ length: cols }, (_, i) => `
1}`)  : []
  );

  onMount(() => {
    createRows();
  })

  function createRows() {
    tableData = generateTestData(rows, cols);
  }

  function addRow() {
    // tableData = [...tableData, addRow()];
    tableData.push(generateNewRow());
  }

  function clearRows() { tableData = []; }
```

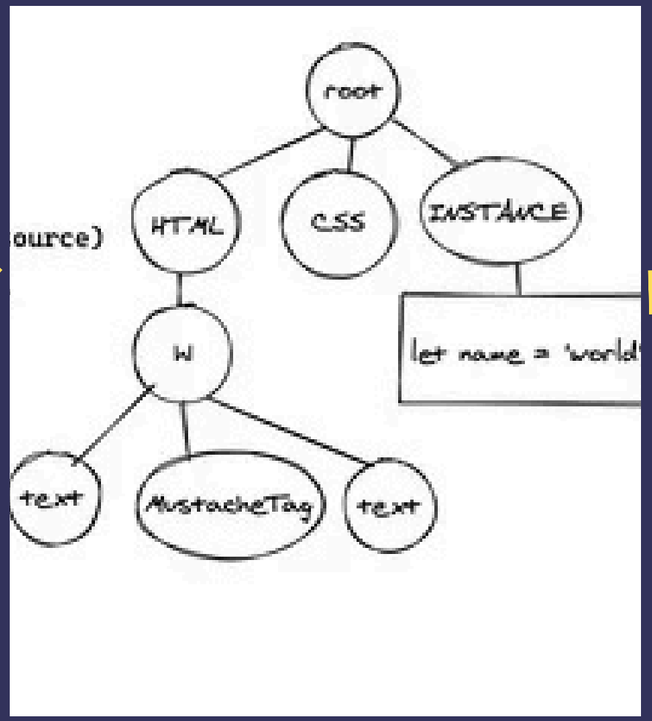
```
<div class="overflow-x-auto border border-gray-200 rounded
  <table class="min-w-full divide-y divide-gray-200">
    <thead class="bg-gray-50">
      <tr>
        <th class="px-4 py-2 text-left text-xs font-mediu
        {#if tableData.length > 0}
          {#each colHeaders as header}
            <th class="px-4 py-2 text-left ...">
              {header}
            </th>
          {/each}
        {/if}
      </tr>
    </thead>
    <tbody class="bg-white divide-y divide-gray-200">
      {#each tableData as row (row.id)}
        <tr>
          <td class="px-4 py-2 whitespace-nowrap ...">
            {row.id + 1}
          </td>
          {#each Array.from({ length: COL_COUNT }) as _, i
            <td class="px-4 py-2 whitespace-nowrap ...">
              {row["field" + i]}
            </td>
          {/each}
```

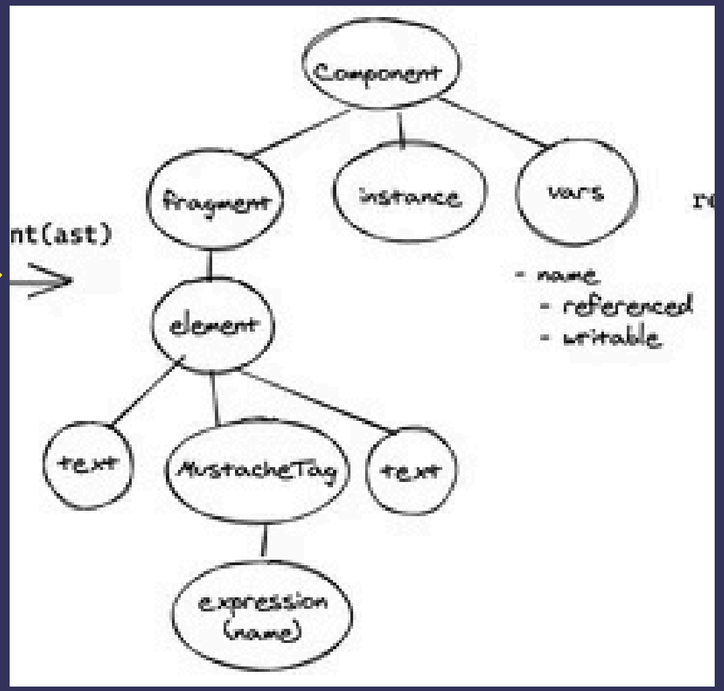
- **Language-Level reactivity** *(runes)*
- **Template with integrated logic**
- **.svelte file** *(html/js/css)*
- **component based**

COMPILER
SVELTE



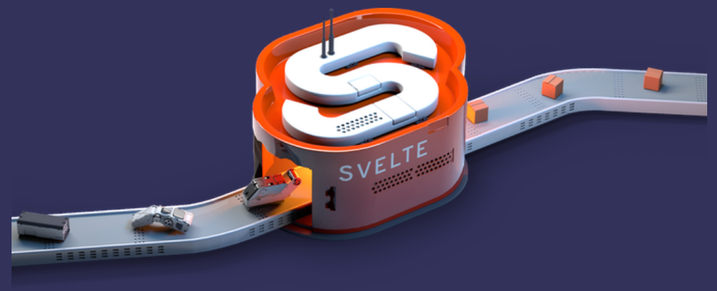
```
<script>
  let name = $state('world
  let count = $state(0);
</script>

<h1>Hello {name}!</h1>

<input bind:value={name} /
<button onclick={() => cou
  clicks: {count}
</button>
```

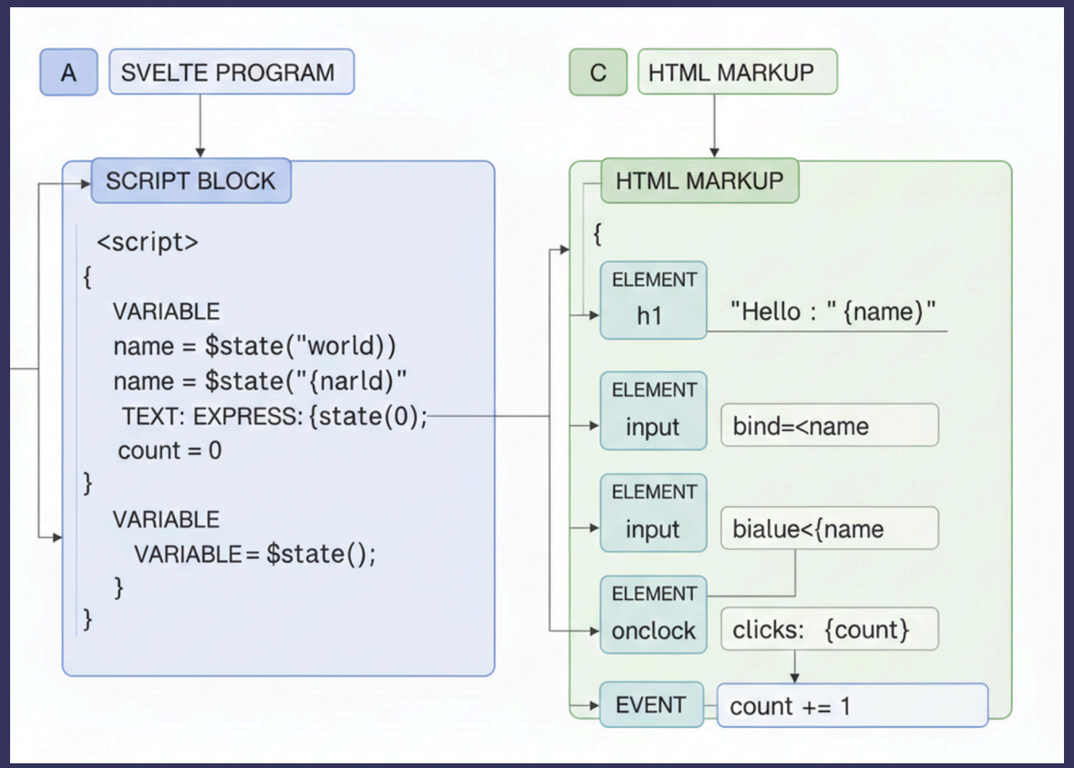




AST

COMPILER
SVELTE






```
1  import 'svelte/internal/disclose-version';
2  import 'svelte/internal/flags/async';
3  import * as $ from 'svelte/internal/client';
4
5  var root = $.from_html(`<h1> </h1> <input/> <button> <
6
7  export default function App($$anchor) {
8    let name = $.state('world');
9    let count = $.state(0);
10   var fragment = root();
11   var h1 = $.first_child(fragment);
12   var text = $.child(h1);
13
14   $.reset(h1);
15
16   var input = $.sibling(h1, 2);
17
18   $.remove_input_defaults(input);
19
20   var button = $.sibling(input, 2);
21
22   button.__click = () => $.set(count, $.get(count) + 1
23
24   var text_1 = $.child(button);
```

COMPILER OPTIONS

```
result = svelte.compile(source, {
  generate:    "client"  "server" ,
  fragments:   "html"  "tree" ,
  dev:         false
});
```

DEVELOPER EXPERIENCE

OUT OF COMFORT ZONE

critical
personal/biased

Typescript
Promises
Async/await

Convergence
Influense

Signals e SolidJS

Components
pattern redux

pre-comilation
@if - @each

"But our solution is fine as it is..."

"If it works, don't touch it..."

LET'S START MEASURING

DON'T TRUST IT!
MEASURE IT!

"Users have never complained about the performance."

"Yes, it's a bit slow sometimes, but it's nothing that's a showstopper."

BUNDLE SIZE

```
npm run build
```

Result

Initial chunk files	Names	Raw size	Estimated transfer size
main-DWE75XJD.js	main	204.23 kB	55.47 kB
polyfills-5CFQRCPP.js	polyfills	34.59 kB	11.33 kB
styles-32VHVH7W.css	styles	9.18 kB	2.25 kB
	Initial total	**247.99 kB**	**69.06 kB**

Dimensione

JS 66.81 kB

What have

- *Framework engine,*
- *core modules,*
- *integrated tools*

```
vite v7.1.10 building for production...
✓ 32 modules transformed.
dist/index.html                  0.46 kB │ gzip:  0.30 kB
dist/assets/index-DxC6xAfP.css   9.60 kB │ gzip:  2.71 kB
dist/assets/index-C2cOlMle.js  196.51 kB │ gzip: 61.62 kB
✓ built in 1.46s
```

JS 61.62 kB

- *react library engine,*
- *jsx runtime,*
- *external library, a lot of library*

```
vite v7.1.10 building for production...
✓ 106 modules transformed.
dist/index.html                  0.46 kB │ gzip:  0.30 kB
dist/assets/index-CLSam6NI.css   9.81 kB │ gzip:  2.74 kB
dist/assets/index-CwnnBK2b.js   28.78 kB │ gzip: 11.67 kB
✓ built in 1.61s
```

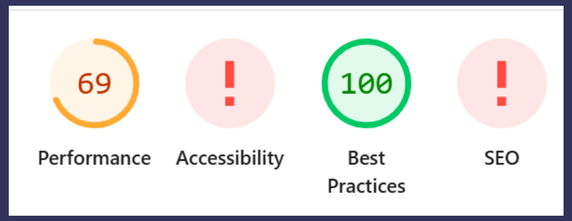
JS 11.67 kB

solo output compilato

CHROME DEV TOOLS
READY TO START

Inspect it! You always find something.

Run only production code!
NO npm run dev



There were issues affecting this run of Lighthouse:

- **Chrome extensions negatively affected this page's load performance. Try auditing the page in incognito mode or from a Chrome profile without extensions.**

Nuova finestra di navigazione in incognito Ctrl+Maiu

```
npm start
```

```
http-server -p 4201
```

```
npm run preview
```

AUDIT TOOLKIT

WHAT TOOLS DO WE HAVE AVAILABLE?

Chrome Dev Tools

- 📊 Performance
- 💡 LightHouse

Production

- ⚡ PageSpeed
- CrUX
- Search Console

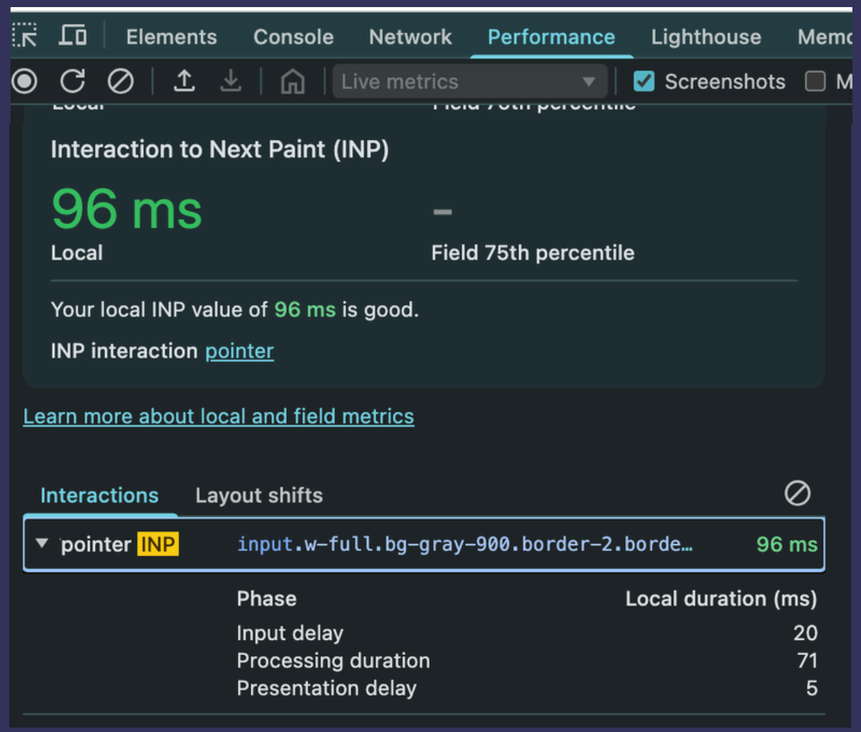
Code

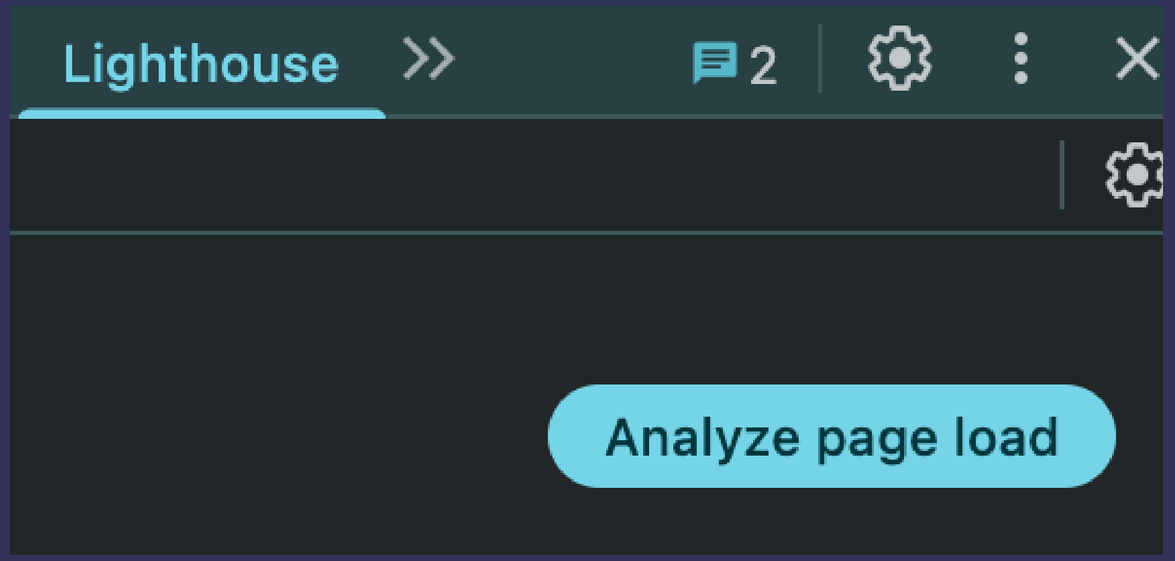
- 🎭 Puppeteer
  - 💡 LightHouse
  - 📊 Performance
  - ....
- 🤖 Playwright
  - 💡 LightHouse
  - 📊 Performance
  - ....

STARTED TOOLS
CHROME DEV TOOLS

Performance

LightHouse

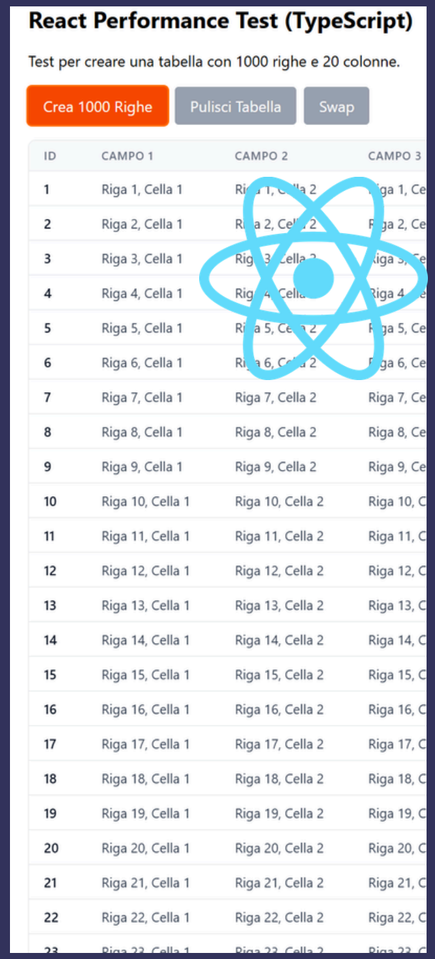


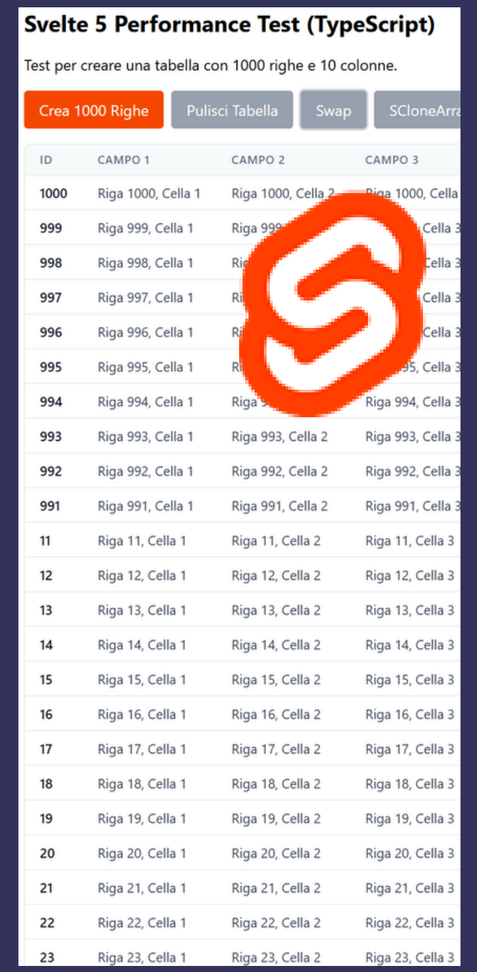


SIMPLIFICATION
THE TABLE COMPONENT

We can thus evaluate:

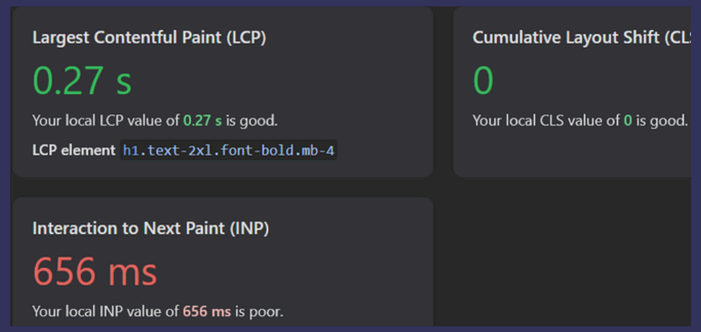
- Rendering efficiency
- Developer Experience (DevEx)
- Reactivity
- Syntax and Boilerplate

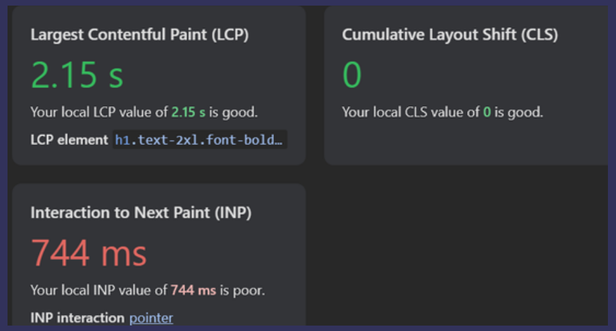




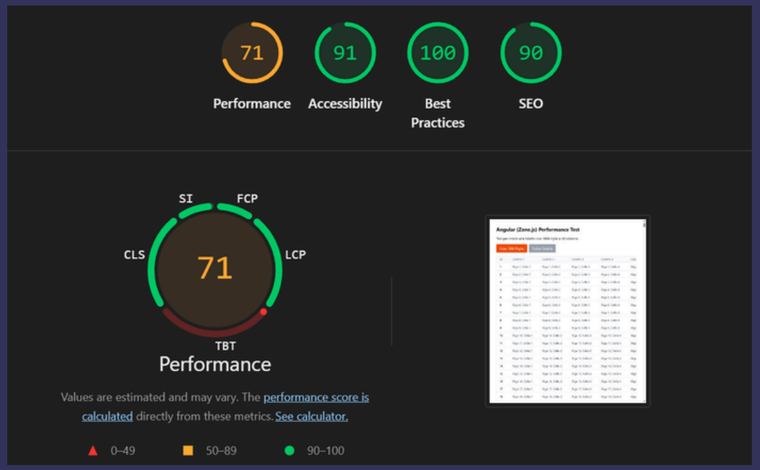
RESULTS

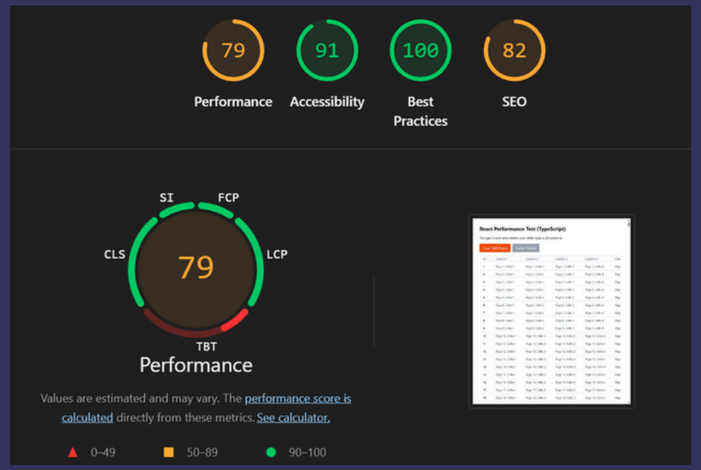
Performance

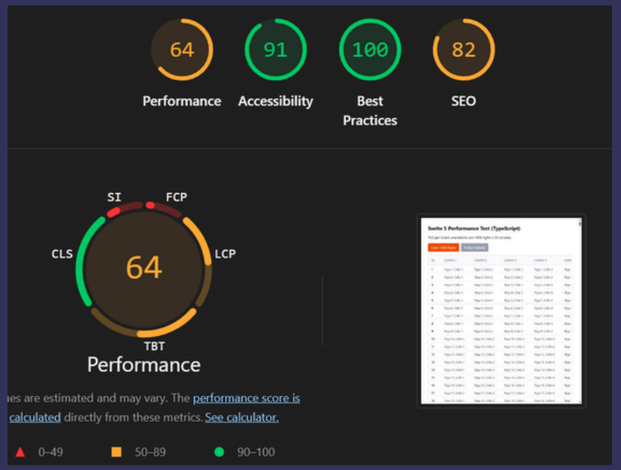




Lighthouse







FIRST COMPARISON

SVELTE - I EXPECTED BETTER

Interactions	Layout shifts	⊘
▸ pointer	button.px-4.py-2.bg-gray-400.text-white…	88 ms
▸ pointer	button.px-4.py-2.bg-gray-400.text-whit…	152 ms
▸ pointer	button#create.px-4.py-2.bg-orange-600.t…	40 ms
▸ pointer INP	button#create.px-4.py-2.bg-orange-600…	1,096 ms
▸ pointer	button#swap.px-4.py-2.bg-gray-400.text-…	80 ms
▸ pointer	button#swap.px-4.py-2.bg-gray-400.text…	272 ms

Pulisci Tabella

Crea 1000 Righe

Swap

Local metrics

Largest Contentful Paint (LCP)

1.22 s

Your local LCP value of 1.22 s is good.

LCP element `h1.text-2xl.font-bold.mb-4`

Cumulative Layout Shift (CLS)

0

Your local CLS value of 0 is good.

Interaction to Next Paint (INP)

1,096 ms

Your local INP value of 1,096 ms is poor.

INP interaction pointer

create 1096ms 

swap 272 ms 

LCP

1.22

FIRST COMPARISON

REACT - WHAT A SURPRISE!

Interactions	Layout shifts	
pointer	button.px-4.py-2.bg-gray-400.text-white…	80 ms
pointer	button.px-4.py-2.bg-gray-400.text-whit…	144 ms
pointer	button#create.px-4.py-2.bg-orange-600.t…	40 ms
pointer	button#create.px-4.py-2.bg-orange-600.…	928 ms
pointer	button#swap.px-4.py-2.bg-gray-400.text-…	80 ms
pointer INP	button#swap.px-4.py-2.bg-gray-400.tex…	1,008 ms

Pulisci Tabella

Crea 1000 Righe

Swap

create 928ms

swap 1008 ms

LCP

0.34

Local metrics

Largest Contentful Paint (LCP)

0.34 s

Your local LCP value of 0.34 s is good.

LCP element `h1.text-2xl.font-bold.mb-4`

Cumulative Layout Shift (CLS)

0

Your local CLS value of 0 is good.

Interaction to Next Paint (INP)

1,008 ms

Your local INP value of 1,008 ms is poor.

INP interaction pointer

FIRST COMPARISON

SVELTE - I EXPECTED BETTER

create 1096ms 

create 928ms

swap 272 ms

swap 1008 ms 

LCP

1.22

LCP

0.34

REACT WINS FOR LCP WHY?

🔴 ***Svelte's Drawback: The Monolithic Task***

entire heavy rendering job as one single, blocking task

✅ ***React's Advantage: Distributed Workload (React Fiber)***

React uses React Fiber to break the massive rendering job into smaller, scheduled units. This allows the browser to show some content quickly (Progressive Rendering).

Name Duration for...	svelte-v5.13.0	react-classes-v19.0.0	react-hooks-v19.0.0	react-com-piler-hooks-v19.0.0	react-rxjs-v19.0.0 + 0.10.7
Implementation notes					
Implementation link	code	code	code	code	code
create rows creating 1,000 rows. (5 warmup runs).	24.2 ± 0.1 (1.05)	27.6 ± 0.4 (1.20)	28.6 ± 0.5 (1.24)	28.9 ± 0.5 (1.26)	27.3 ± 0.5 (1.19)
replace all rows					

react-kr-observ-able-v19.0.0 + 3.0.8	react-mobX-v19.0.0 + 6.13.5	react-zus-tand-v19.0.0 + 5.0.2	react-re-dux-hooks-v19.0.0 + 9.2.0
code	code	code	code
30.8 ± 0.4 (1.34)	29.4 ± 0.3 (1.28)	29.6 ± 0.5 (1.29)	28.9 ± 0.4 (1.26)

Simple Lesson:
Svelte is great for small bundles,
React is superior for smoothly handling large, complex page updates.

JS-FRAMEWORK-BENCHMARH

https://krausest.github.io/
js-framework-benchmark

🔑 Key Takeaways

- Benchmark Already Done
- Find Your Favorite
- The Engine Framework measure
- Automated & Explained

lliseconds ± 95% confidence interval (Slowdown = Duration / Fastest)

svelte-v5.13.0	solid-v1.9.3	vue-v3.6.0-alpha.2	angular-cf-nozone-v20.0.1	angular-cf-v20.0.1	angular-cf-signals-v20.0.1	react-classes-v19.0.0	angular-cf-new-no-zone-v20.0.1	react-hooks-v19.0.0	angular-cf-signals-nozone-v20.0.1	angular-ngfor-v20.0.1
code	code	code	code	code	code	code	code	code	code	code
24.2 ± 0.1 (1.05)	24.0 ± 0.1 (1.04)	27.8 ± 0.2 (1.21)	31.3 ± 0.2 (1.36)	32.7 ± 0.1 (1.42)	33.1 ± 0.2 (1.44)	27.6 ± 0.4 (1.20)	38.5 ± 0.5 (1.67)	28.6 ± 0.5 (1.24)	38.2 ± 0.5 (1.66)	32.6 ± 0.2 (1.42)
28.3 ± 0.1 (1.10)	27.8 ± 0.2 (1.08)	31.1 ± 0.2 (1.21)	36.6 ± 0.2 (1.42)	39.0 ± 0.3 (1.51)	38.9 ± 0.3 (1.51)	34.3 ± 0.2 (1.33)	39.5 ± 0.9 (1.53)	33.3 ± 0.2 (1.29)	38.9 ± 1.1 (1.51)	38.4 ± 0.2 (1.49)
11.0 ± 0.2 (1.11)	10.9 ± 0.2 (1.10)	13.3 ± 0.3 (1.34)	12.5 ± 0.3 (1.26)	13.0 ± 0.5 (1.31)	13.3 ± 0.2 (1.34)	14.3 ± 0.2 (1.44)	12.3 ± 3.3 (1.24)	15.1 ± 0.3 (1.53)	13.3 ± 3.3 (1.34)	12.6 ± 0.2 (1.27)
3.3 ± 0.1 (1.57)	2.5 ± 0.1 (1.19)	3.3 ± 0.1 (1.57)	4.1 ± 0.1 (1.95)	4.0 ± 0.2 (1.90)	4.4 ± 0.2 (2.10)	4.5 ± 0.2 (2.14)	4.5 ± 0.2 (2.14)	4.5 ± 0.2 (2.14)	4.6 ± 0.2 (2.19)	4.4 ± 0.2 (2.10)
13.7 ± 0.2 (1.10)	14.0 ± 0.2 (1.13)	14.7 ± 0.4 (1.19)	15.9 ± 0.3 (1.28)	15.6 ± 0.3 (1.26)	15.8 ± 0.4 (1.27)	105.9 ± 1.0 (8.54)	30.6 ± 4.2 (2.47)	105.3 ± 0.6 (8.49)	15.0 ± 3.8 (1.21)	123.5 ± 1.3 (9.96)

DEEP DIVE
INP DETAILS

CREATION

`button#create.px-4...` **688 ms**

Phase	Local duration (ms)
Input delay	0
Processing duration	525
Presentation delay	163

`button#create.px-4...` **656 ms**

Phase	Local duration (ms)
Input delay	0
Processing duration	58
Presentation delay	598

SWAP

`button#swap.px-4.p...` **904 ms**

Phase	Local duration (ms)
Input delay	42
Processing duration	678
Presentation delay	184

`button#swap.px-4.py...` **176 ms**

Phase	Local duration (ms)
Input delay	0
Processing duration	8
Presentation delay	167

CHANGE OF STRATEGY
STEP BY STEP

List Virtualization

```
function renderNextChunk() {
  const startIndex = currentChunkIndex * CHUNK_SIZE;
  const endIndex = Math.min(startIndex + CHUNK_SIZE,
fullTableData.length);
  if (startIndex < fullTableData.length) {
    // Extract the data chunk
    const nextChunk = fullTableData.slice(startIndex

    tableData = [...tableData, ...nextChunk];

    // Move to the next chunk
    currentChunkIndex += 1;

    setTimeout(renderNextChunk, DELAY_MS);
  } else {
    console.log(`Rendering completed for ${tableData
  }
}
```

```
button#create.px-4.py-2.bg-orange-600.t…   40 ms
button#create.px-4.py-2.bg-orange-600.t…   80 ms
```

Idle Callback Batching

```
function createRowsIdle() {
  console.time("Svelte Idle Rendering");
  const allData = generateTestData(ROW_COUNT, CO
  const BATCH_SIZE = 100;
  let currentIndex = 0;

  TABLE_DATA_RENDERING = [];    Not committed ye

  function processBatch(deadline: IdleDeadline)
    while (deadline.timeRemaining() > 0 && curre
      const batch = allData.slice(currentIndex,
      TABLE_DATA_RENDERING = [...TABLE_DATA_RENDI
      currentIndex += BATCH_SIZE;
    }

    if (currentIndex < allData.length) {
      requestIdleCallback(processBatch);
    } else {
      console.timeEnd("Svelte Idle Rendering");
    }
  }

  requestIdleCallback(processBatch);
}
```

Largest Contentful Paint (LCP)

0.24 s

Your local LCP value of 0.24 s is good.

LCP element `h1.text-2xl.font-bold.mb-4`

Cumulative Layout Shift (CLS)

0.03

Your local CLS value of 0.03 is good.

Worst cluster 2 shifts

ANGULAR COMPARISON

ZONEJS VS ZONELESS

🤔 **LCP Degradation: Why is the initial load score worse with Zoneless/Signals?**

❌ ***Overhead: The Signals mechanism adds a small computational overhead for dependency tracking.***

✅ **Same Core Logic: For initial rendering, both systems use the same underlying build process.**

➡️ ***Result: The small Signals overhead leads to a slightly higher LCP score.***

zonejs

88 ms
144 ms
56 ms
1,032 ms
88 ms
1,136 ms

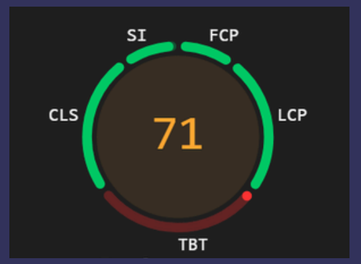
Pulisci Tabella

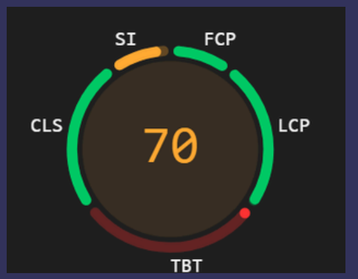
Crea 1000 Righe

Swap

zoneless

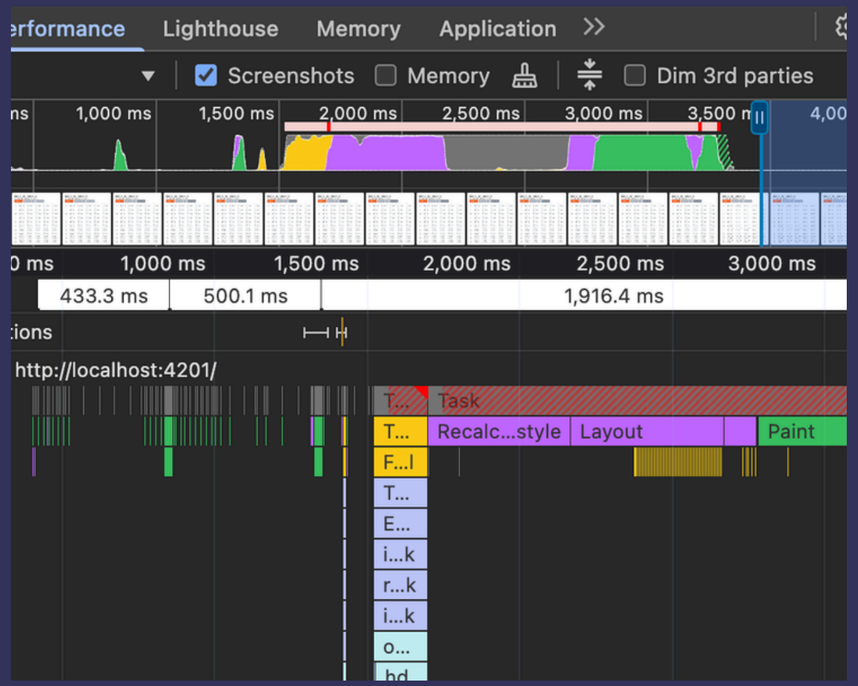
72 ms
144 ms
48 ms
1,032 ms
80 ms
224 ms



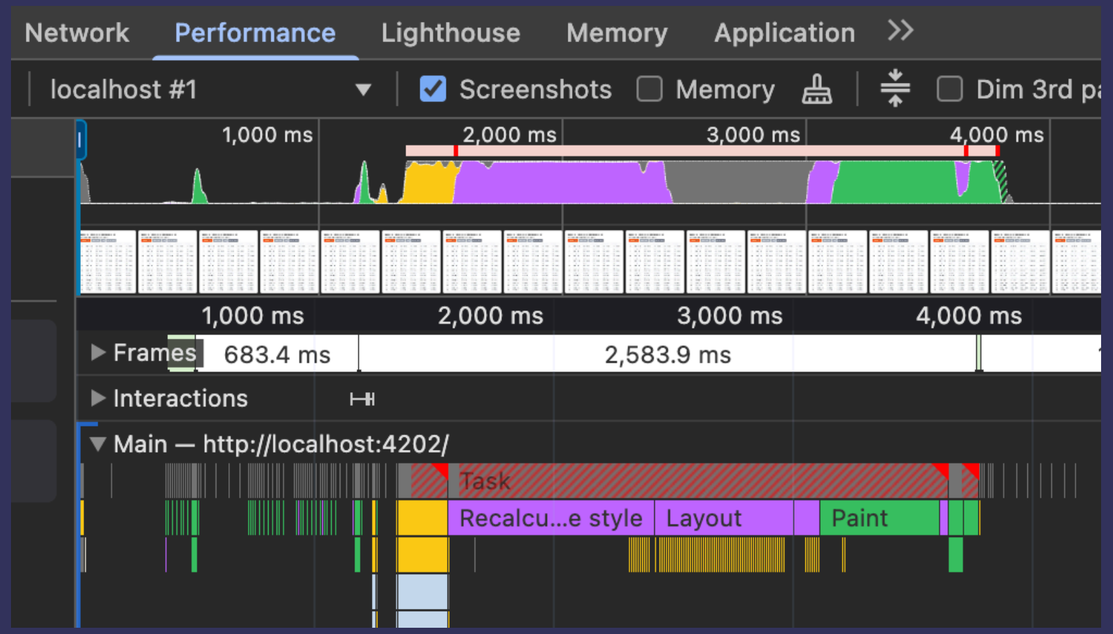


INTERACTION IS NOT RENDERING

zonejs



zoneless



PUPPETEER + LIGHTHOUSE

Puppeteer Docs Puppeteer API @puppeteer/browsers API 24.26.1

Version: 24.26.1

Puppeteer

Lighthouse

CI failing npm v24.26.1

> Puppeteer is a JavaScript library which provides a high-level API to control Chrome or Firefox over the DevTools Protocol or WebDriver BiDi. Puppeteer runs in the headless (no visible UI) by default

Get started | API | FAQ | Contributing | Troubleshooting

```
npm i puppeteer # Downloads compatible Chrome during installation.
npm i puppeteer-core # Alternatively, install as a library, without downloading Chrome.
```

Puppeteer

LightHouse Performance ....

Playwright

LightHouse Performance ....

PUPPETEER + LIGHTHOUSE

```
const puppeteer = require('puppeteer');

/**
 * Esegue i test di performance (creazione, swap, Lighthouse)
 */
async function runSingleTest(browser, lighthouse, framework)
  const page = await browser.newPage();

  // Abilita metriche di performance
  await page.evaluateOnNewDocument(() => {
    window.performanceMetrics = [];
  });

  await page.goto(framework.url, { waitUntil: 'networkidle0'

  // Test 1: Caricamento iniziale
  const createButton = await page.$('#create');

  await page.evaluate(() => {
    performance.mark('create-start');
  });

  await createButton.click();
```

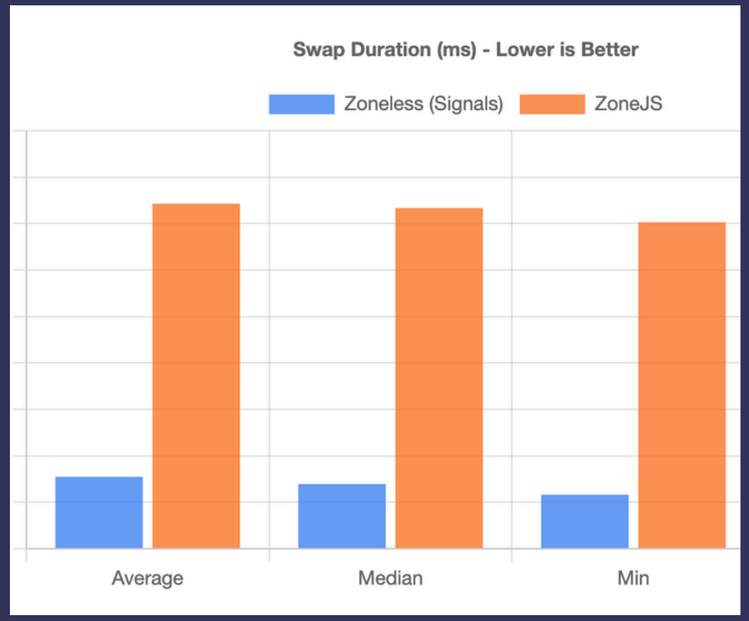
```
(node:8776) ExperimentalWarning: CommonJS module /Users/michelescarpa/pokedex-fr
s loading ES Module /Users/michelescarpa/pokedex-frontend/benchmark/puppeteer/nc
Support for loading ES Module in require() is an experimental feature and might
(Use `node --trace-warnings ...` to show where the warning was created)

🧪 Testing Angular Zoneless (Signals)...
  Iteration 1/5
❌ Error in Angular Zoneless (Signals): TypeError: page.waitForTimeout is not a
    at measureSwapPerformance (/Users/michelescarpa/pokedex-frontend/benchmark/p
    at async main (/Users/michelescarpa/pokedex-frontend/benchmark/puppeteer/anc

🔦 Running Lighthouse for Angular Zoneless (Signals)...
❌ Test failed: TypeError: lighthouse is not a function
    at runLighthouseAudit (/Users/michelescarpa/pokedex-frontend/benchmark/puppe
    at async main (/Users/michelescarpa/pokedex-frontend/benchmark/puppeteer/anc
(base) michelescarpa@MacBook-Pro-2 puppeteer % node angular-zone-zoneless.js
🚀 Starting Performance Comparison Test...
   Configuration: 1000 rows x 20 cols
   Iterations: 5
```

```
🧪 Testing Angular Zoneless (Signals)...
  Iteration 1/5
  Iteration 2/5
  Iteration 3/5
  Iteration 4/5
  Iteration 5/5

🔦 Running Lighthouse for Angular Zoneless (
```

PUPPETEER + LIGHTHOUSE
ANGULAR RESULTS

🔦 Lighthouse Metrics

Metric	Zoneless (Signals)	ZoneJS	Difference
Performance Score	92/100	88/100	4.00 pts
First Contentful Paint	416ms	454ms	38ms
Largest Contentful Paint	661ms	494ms	-167ms
Total Blocking Time	361ms	482ms	121ms



SSG E SSR
MODERN RENDERING

```
<tr>
    <td class="px-4 py-2 whitespace-nowrap text-sm font-medium text-gray-900">64 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 1 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 2 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 3 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 4 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 5 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 6 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 7 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 8 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 9 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 10 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 11 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 12 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 13 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 14 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 15 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 16 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 17 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 18 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 19 </td>
    <td class="px-4 py-2 whitespace-nowrap text-sm text-gray-700">Riga 64, Cella 20 </td>
    <!---->
</tr>
```

Largest Contentful Paint (LCP)

0.29 s

Your local LCP value of 0.29 s is good.

LCP element `h1.text-2xl.font-bold.mb-4`

Cumulative Layout Shift (CLS)

0.02

Your local CLS value of 0.02 is good.

Worst cluster 1 shift

Interaction to Next Paint (INP)

224 ms

Your local INP value of 224 ms needs improveme

INP interaction pointer

CLASSNAME HELPER

UTILITY FOR CONSTRUCTING CLASSNAME STRINGS CONDITIONALLY

```tsx
import {
  type ClassValue,
  clsx,
} from 'clsx';
import { twMerge } from 'tailwind-merge';

export function cn(...inputs: ClassValue[]) {
  return twMerge(clsx(inputs));
}
```

```tsx
const btnClass = classNames({
        btn: true,
        'btn-pressed': isPressed,
        'btn-over': !isPressed && isHovered,
});
```

CLASSNAME HELPER
CHANGE STYLE EXAMPLE

Trigger Re-render (10000 items)

- Item #1 (ON)
- Item #2 (ON)
- Item #3 (ON)
- Item #4 (ON)
- Item #5 (ON)
- Item #6 (ON)
- Item #7 (ON)
- Item #8 (ON)
- Item #9 (ON)
- Item #10 (ON)
- Item #11 (ON)
- Item #12 (ON)

Trigger Re-render (10000 items)

- Item #1 (OFF)
- Item #2 (OFF)
- Item #3 (OFF)
- Item #4 (OFF)
- Item #5 (OFF)
- Item #6 (OFF)
- Item #7 (OFF)
- Item #8 (OFF)
- Item #9 (OFF)
- Item #10 (OFF)
- Item #11 (OFF)
- Item #12 (OFF)

CLASSNAME HELPER

SVELTE VS REACT

```svelte
<div
  class:bg-gray-100={index % 2 === 0}
  class:bg-white={index % 2 !== 0}

  class:border-r-4={isShiny}
  class:border-yellow-400={isShiny}
  class:border-transparent={!isShiny}

  class="flex items-center py-2 px-4
  cursor-pointer {getItemClass(index >
  500, isShiny)}"
>
```

```react
const itemClasses = cn(
  'flex items-center py-2 px-4 cursor-pointer',
  // Simple conditional
  isEven ? 'bg-gray-100' : 'bg-white',
  // Conflict
  isHeavy ? 'text-base' : 'text-sm',
  // Toggle
  isShiny ? 'border-r-4 border-yellow-400' :
  'border-r-4 border-transparent',
  // Conflict
  isShiny ? 'text-yellow-600' : 'text-gray-900',
);
```

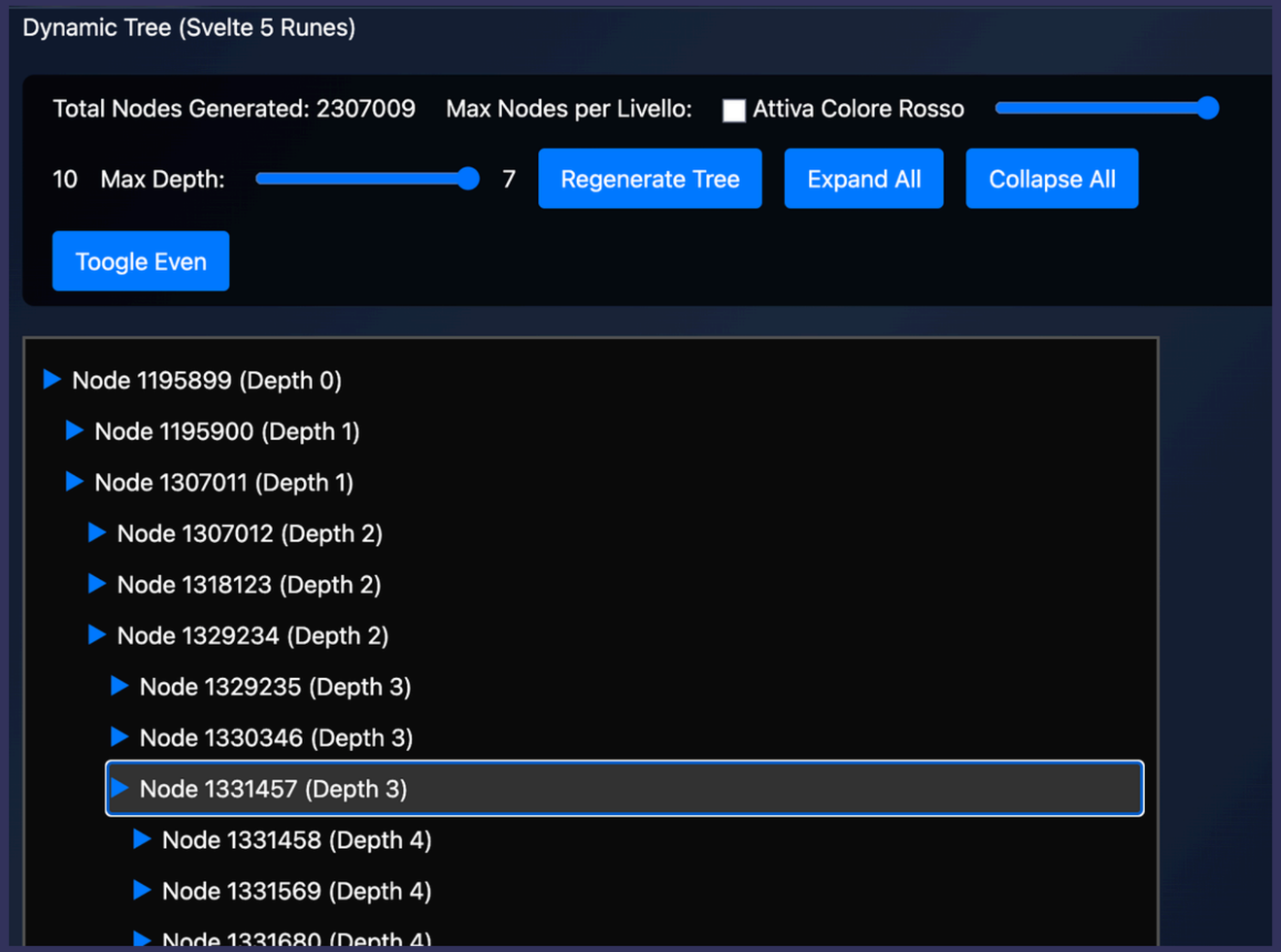
CLASSNAME HELPER

SVELTE VS REACT

Interactions	Layout shifts	⊘	
▸ pointer	button.px-4.py-2.bg-blue-50…		24 ms
▸ pointer	button.px-4.py-2.bg-blue-5…		272 ms
▸ pointer	button.px-4.py-2.bg-blue-5…		256 ms
▸ pointer	button.px-4.py-2.bg-blue-50…		16 ms
▸ pointer	button.px-4.py-2.bg-blue-5…		280 ms
▸ pointer	button.px-4.py-2.bg-blue-50…		16 ms
▸ pointer INP	button.px-4.py-2.bg-blue-5…		312 ms
▸ keyboard	button.px-4.py-2.bg-blue-50…		40 ms

Interactions	Layout shifts	⊘	
▸ pointer	button.px-4.py-2.bg-blue-…		16 ms
▸ pointer INP	button.px-4.py-2.bg-blu…		520 ms
▸ pointer	button.px-4.py-2.bg-blue-…		16 ms
▸ pointer	button.px-4.py-2.bg-blu…		480 ms
▸ pointer	button.px-4.py-2.bg-blue-…		16 ms
▸ pointer	button.px-4.py-2.bg-blu…		440 ms
▸ keyboard	button.px-4.py-2.bg-blue…		48 ms

FOLDER TREE
NESTED NODE



PATTERN
CODE RETREAT'S STYLE

Find a Sample
Edge Case
Stress Test

Measure

Undestand WHY

Try Solution

Valuate
Yourself

CONCLUSIONS

CORE WEB VITALS

WHY THIS MATTERS

Search Ranking

User Experience

Real-World Data

QUICK ACTIONS FOR YOUR POKEDEX

Layout & Image Optimization (CLS)

✅ Add explicit width and height to all <img> tags

✅ Convert images to WebP

Loading Optimization (LCP/FCP)

✅ Use `fetchpriority="high"` onn key/main sprites

Long Task Management (INP/TBT)

✅ Implement lazy loading on the grid

✅ Implement yielding in filtering operations

✅ Virtualize the Pokémon list

KNOW YOUR FRAMEWORK

AI/HIPE WARNING!

Know the Framework Well

- Understand the Best Practices / Philosophy
- Track its Evolution
- Be Careful with Code Generated by AI *(Generate X from Y' without review)*

Risk of poor performance, especially when migrating from one framework to another.

KNOW YOUR MEASUREMENT TOOLS

LEARN HOW TO TAKE MEASUREMENTS

Environment - Setup

- Take multiple measurements
- One test at time! Chrome is resource-intensive on RAM during measurement

Deeply Understand the Measurement Tool

Know What You Are Measuring (2 vs 20 vs 100 columns)

Integrate Additional Measurement Tools

KEY TAKEAWAYS
DIVE DEEP INTO TESTING

Leverage AI for 'Vibe Test Coding

Don't Rely on AI for Initial Assessments

Explore different Tools / Frameworks

Extreme/Edge Case Testing

VI RINGRAZIA TUTTI PER AVER PARTECIPATO!

ASPETTIAMO VOSTRE DOMANDE

BACARO TECH

SEGUITECI!

BacaroTech

BacaroTech

Code and Fun

La tua **community di sviluppatori** dove si parla di programmazione a 360°: strutture dati, algoritmi, carriera tech e molto altro!

- Canale Whatsapp
- GitHub
- Instagram
- Youtube
- TikTok
- LinkedIn
- Discord

Condividi questa pagina!

Link della repo di questo LinkTree

Buon codice devs!

QUANTO CODICE SCRIVIAMO
BACAROTECH POKEDEX

BacaroTech/pokedex-frontend