

# Let's make the web more responsive

How to optimize user interactions, by example



Andrea Verlicchi  
Web Performance GDE  
@verlok



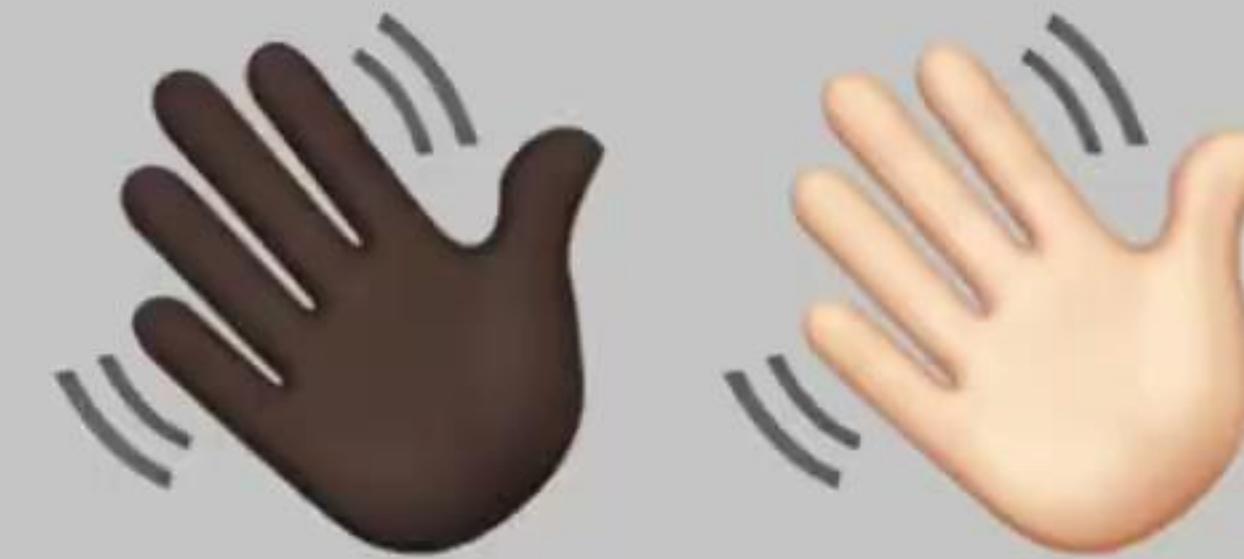


# Hello



[Toggle visibility](#)

# Hello



[Toggle visibility](#)

# What you'll learn

by the end of this talk

- How slow interactions are measured
- How to find and debug slow interactions
- How to avoid common mistakes

# Andrea Verlicchi

Web Performance Engineer

- Web developer
- Frontend
- Ecommerce
- Google Developer Expert
- Speed Kit



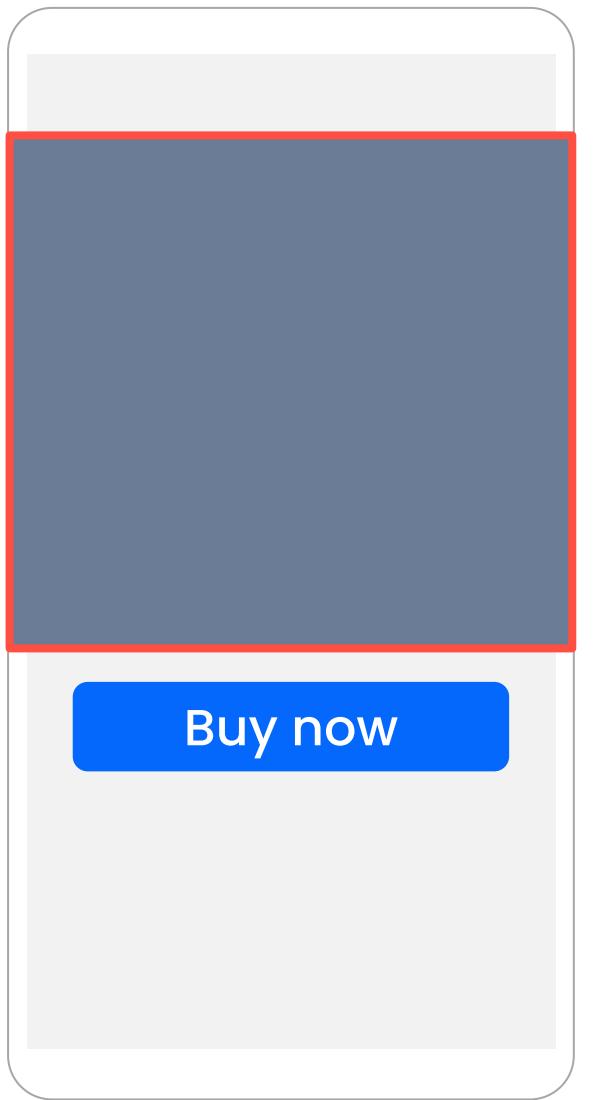
# Coming up next

## Roadmap

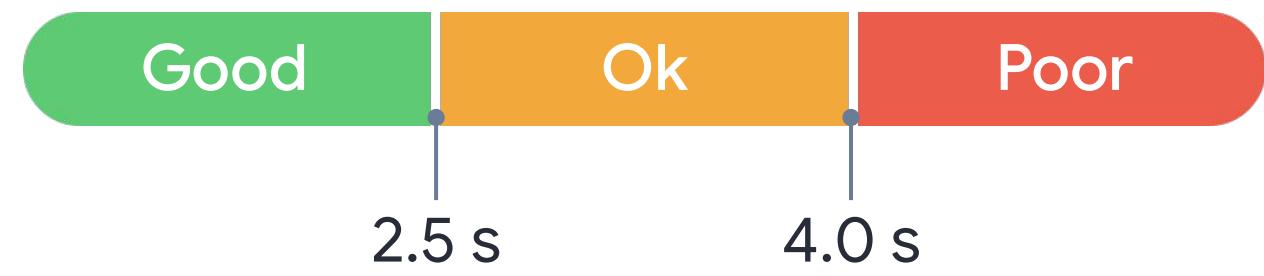
- What are Core Web Vitals?
- What is Interaction to Next Paint (INP)?
- Debugging slow interactions
- 3 common mistakes to avoid

# What are Core Web Vitals?

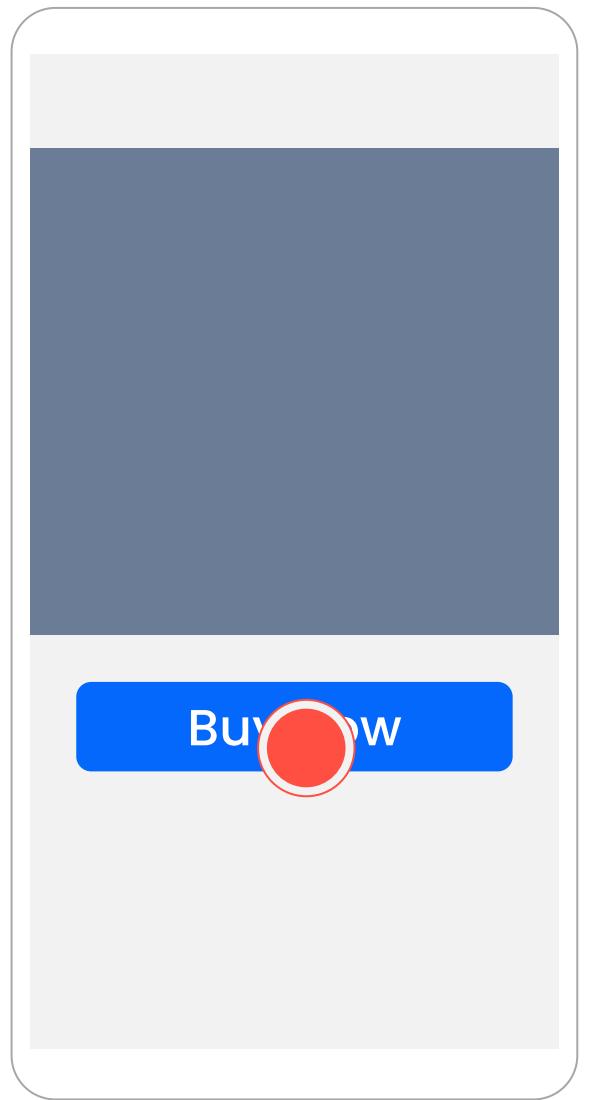
## Loading



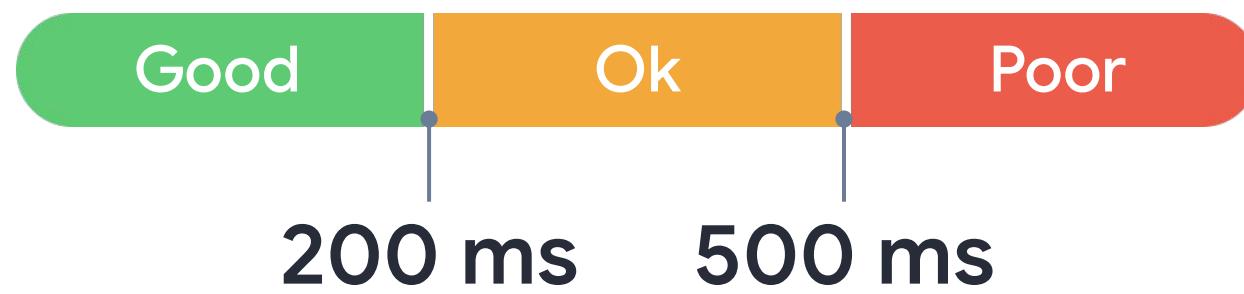
Largest Contentful Paint (LCP)



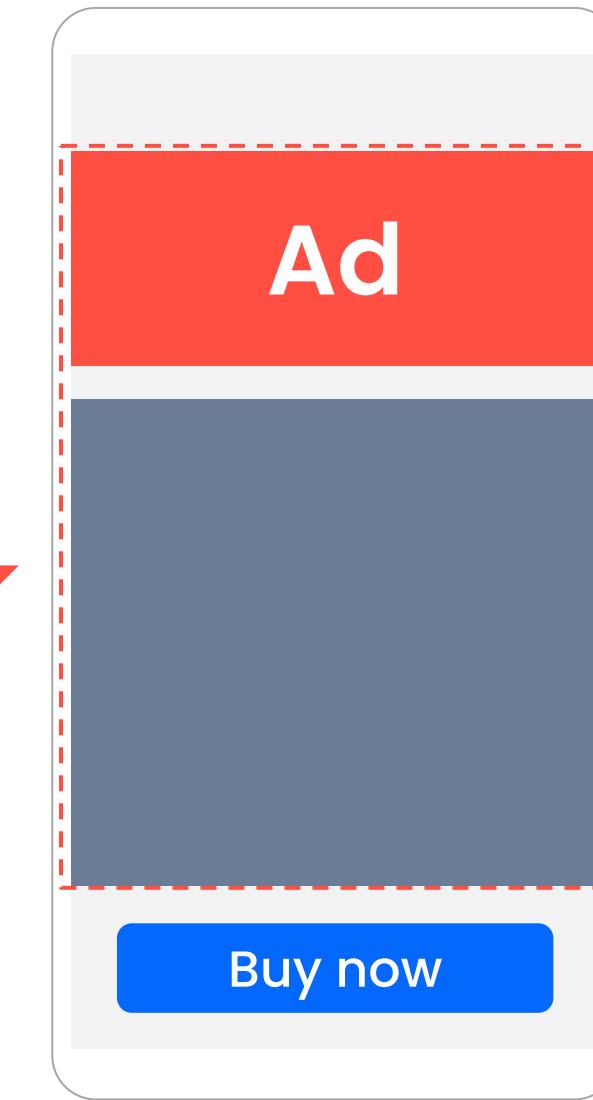
## Interactivity



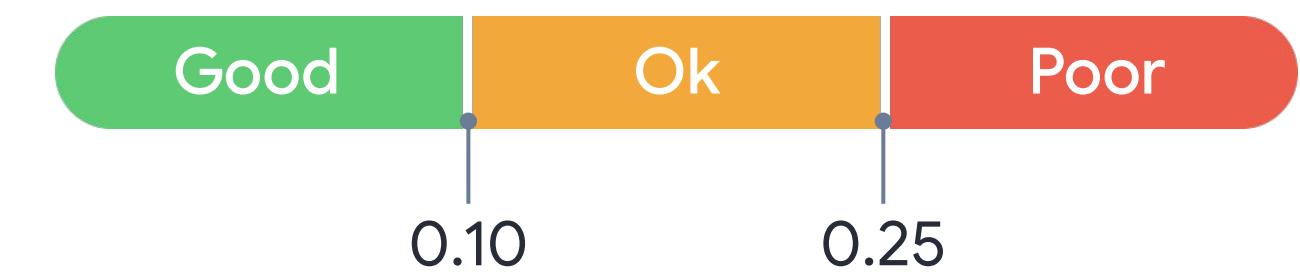
Interaction to Next Paint (INP)



## Visual Stability

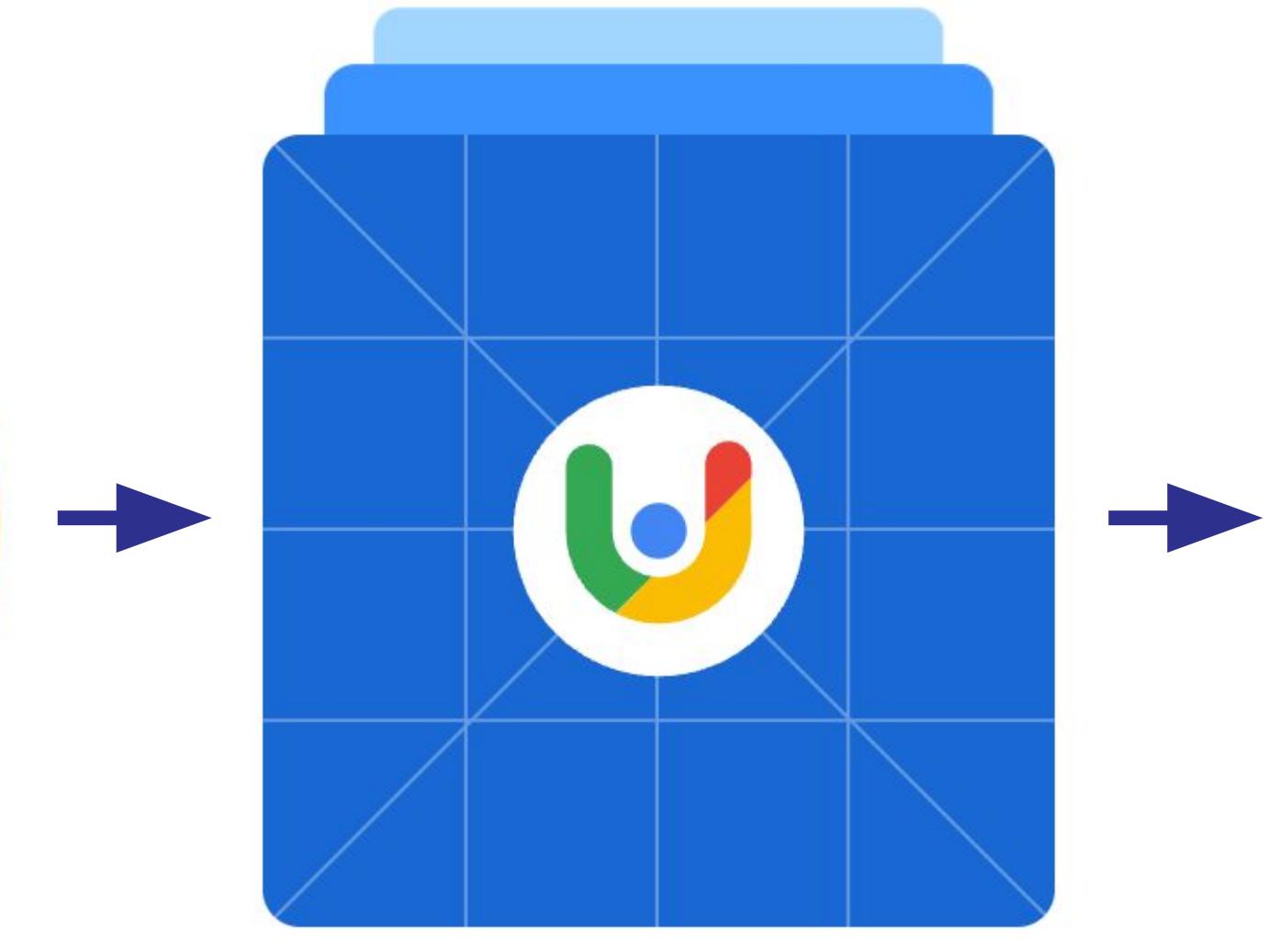


Cumulative Layout Shift (CLS)

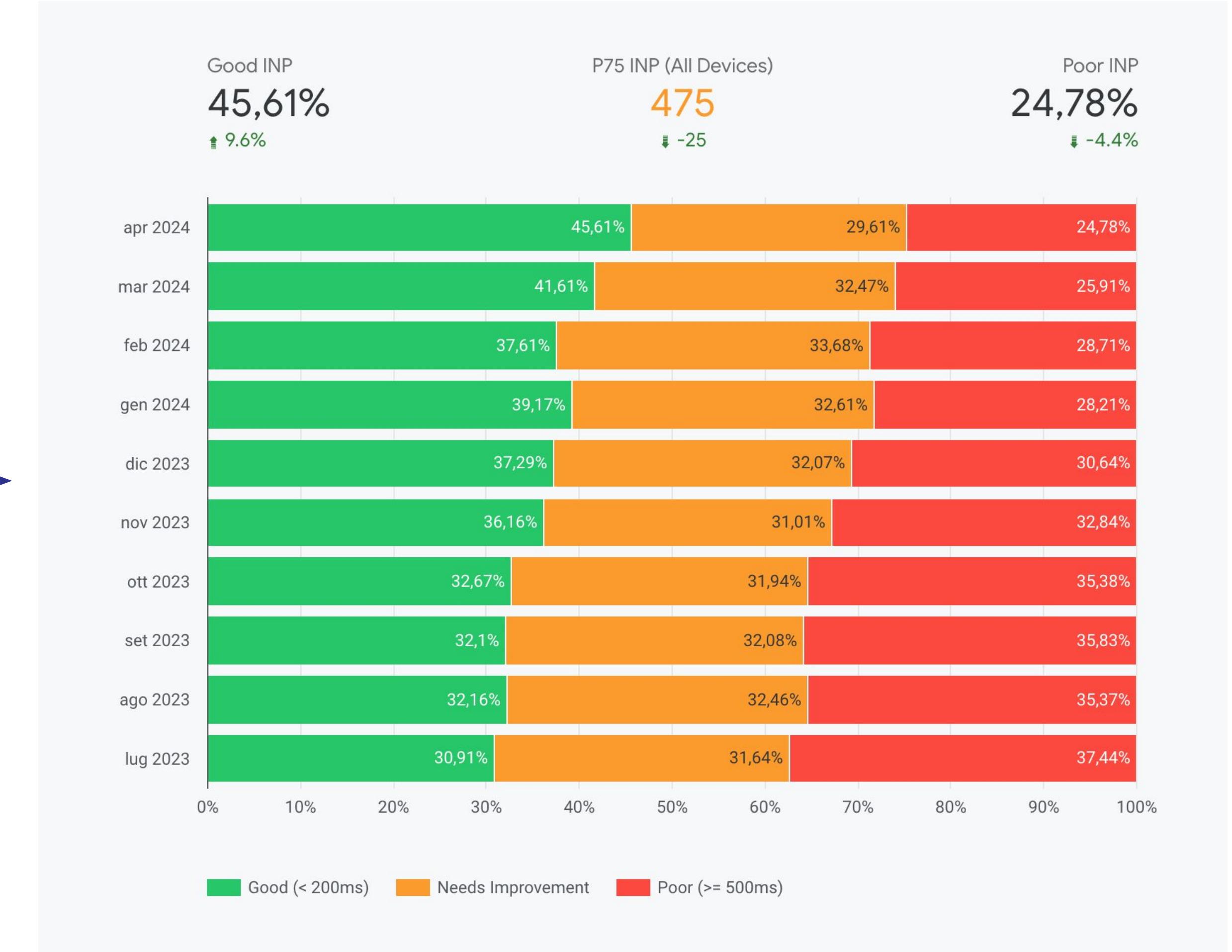




Chrome



Chrome User Experience  
(CrUX)



Chrome User Experience Report  
(CrUX report)



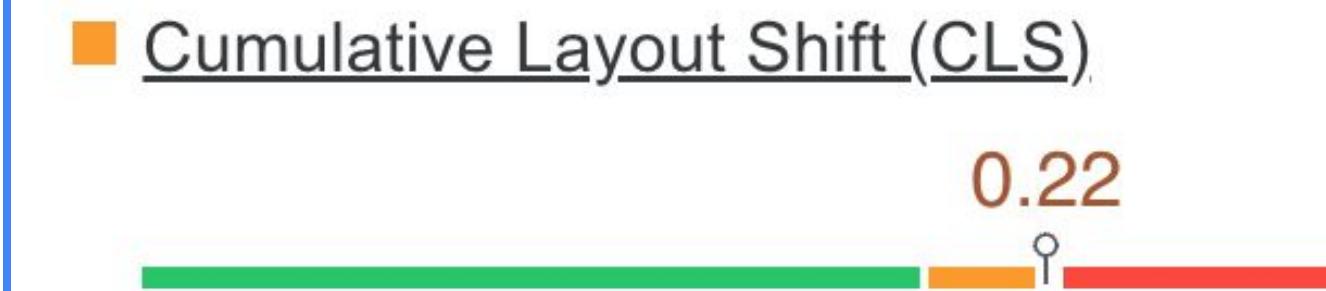
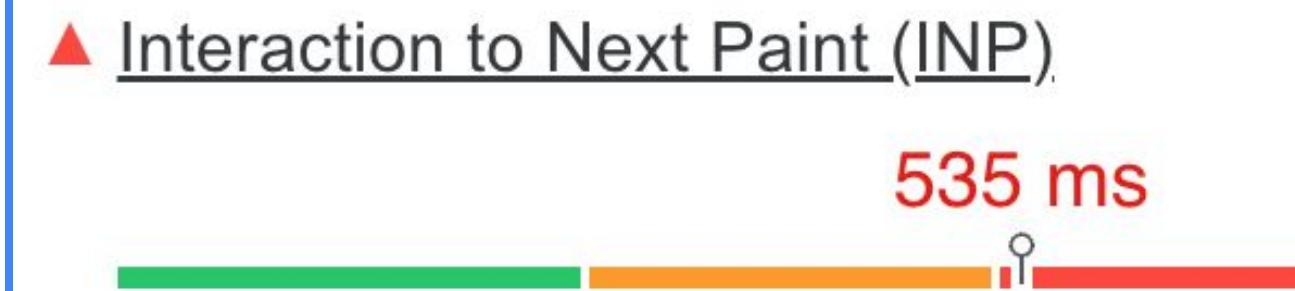
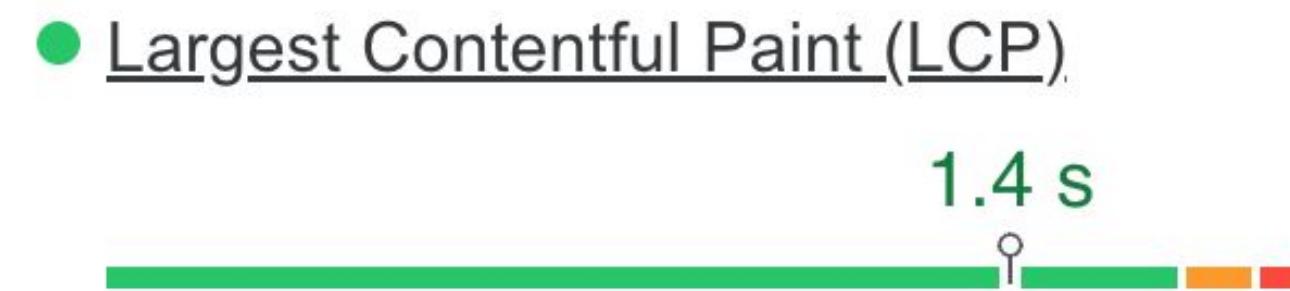
Discover what your real users are experiencing

This URL Origin

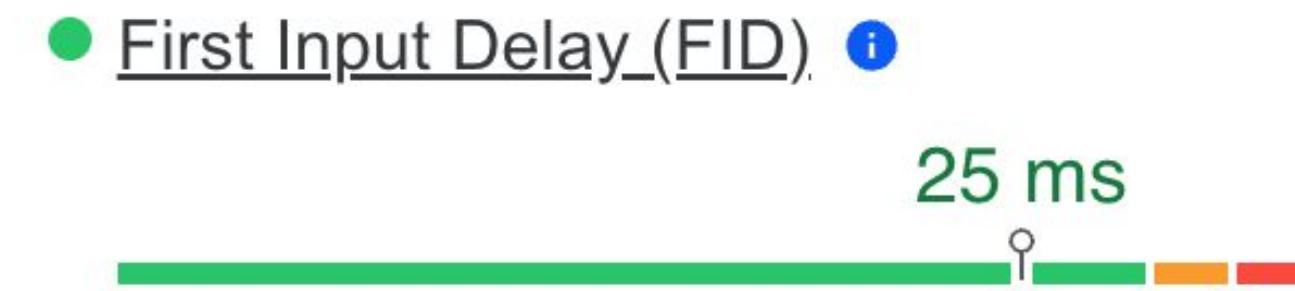


Core Web Vitals Assessment: Failed [?](#)

Expand view



#### OTHER NOTABLE METRICS



📅 Latest 28-day collection period

⌚ Full visit durations

📱 Various mobile devices

📶 Various network connections

➊ Many samples ([Chrome UX Report](#))

⌚ All Chrome versions

# What is Interaction to Next Paint?

INP for short



Q Che cosa stai cercando?



Consegna seleziona una  
data

Per festa della m

Vedi la selezione

Sorprendi con un regalo speciale!



Che cosa stai cercando?

Festa della Mamma

Domenica 12 maggio, esprimi il tuo amore con i nostri fiori!

Scopri di più

Selezione la tua data

Mag 2024

LUN MAR MER GIO VEN SAB DOM

1	2	3	4	5		
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

300 ms

The screenshot shows the Interflora mobile website. At the top, there is a black header bar with the Interflora logo (a stylized flower and the word "Interflora") and a search icon. Below the header is a search bar with the placeholder text "Che cosa stai cercando?". The main content area features a large image of a woman and a child smiling, with a floral wreath on the child's head. Overlaid on this image is the text "Festa della Mamma" and "Domenica 12 maggio, esprimi il tuo amore con i nostri fiori!". A green button labeled "Scopri di più" is visible. Below this, a white overlay box contains two dropdown menus: "Consegna mercoledì 22 maggio 2024" and "Per festa della mamma". A large orange hand cursor icon is pointing at the second dropdown menu. At the bottom of the overlay is a button labeled "Vedi la selezione".

Sorprendi con un regalo speciale!

300 ms

150 ms

Interflora

Che cosa stai cercando?

Festa della Mamma  
Domenica 12 maggio, esprimi

Qual è l'occasione del tuo regalo?

Festa della Mamma

Consegna Express

Auguri

Amore

Condoglianze

Nascita

Congratulazioni

300 ms

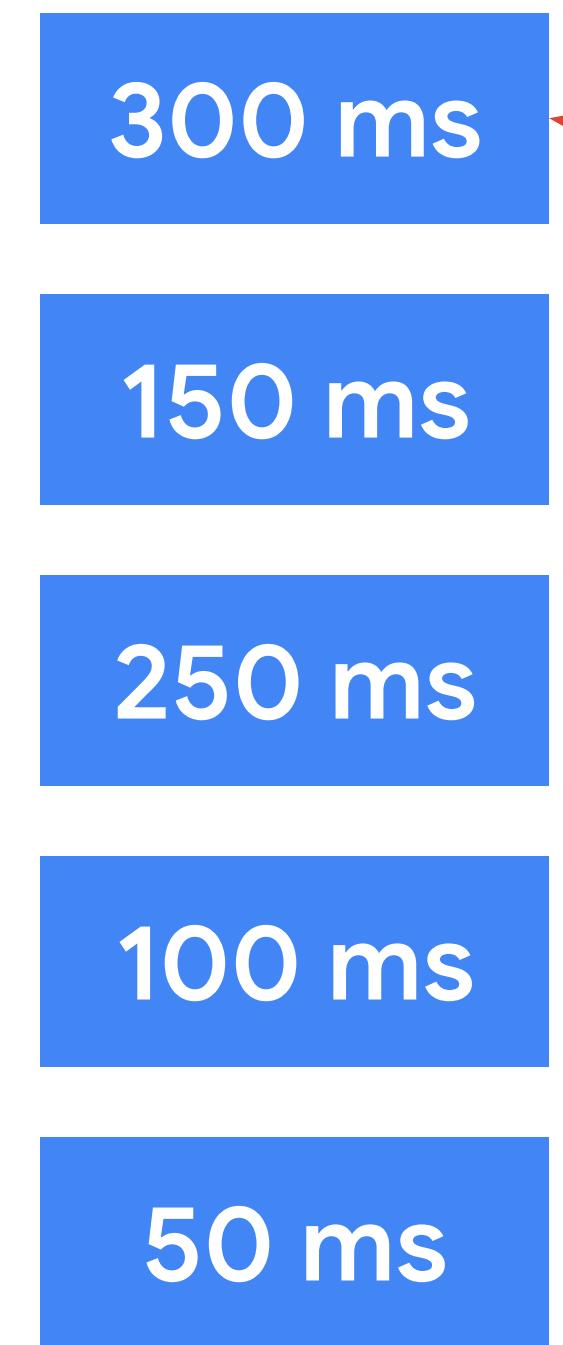
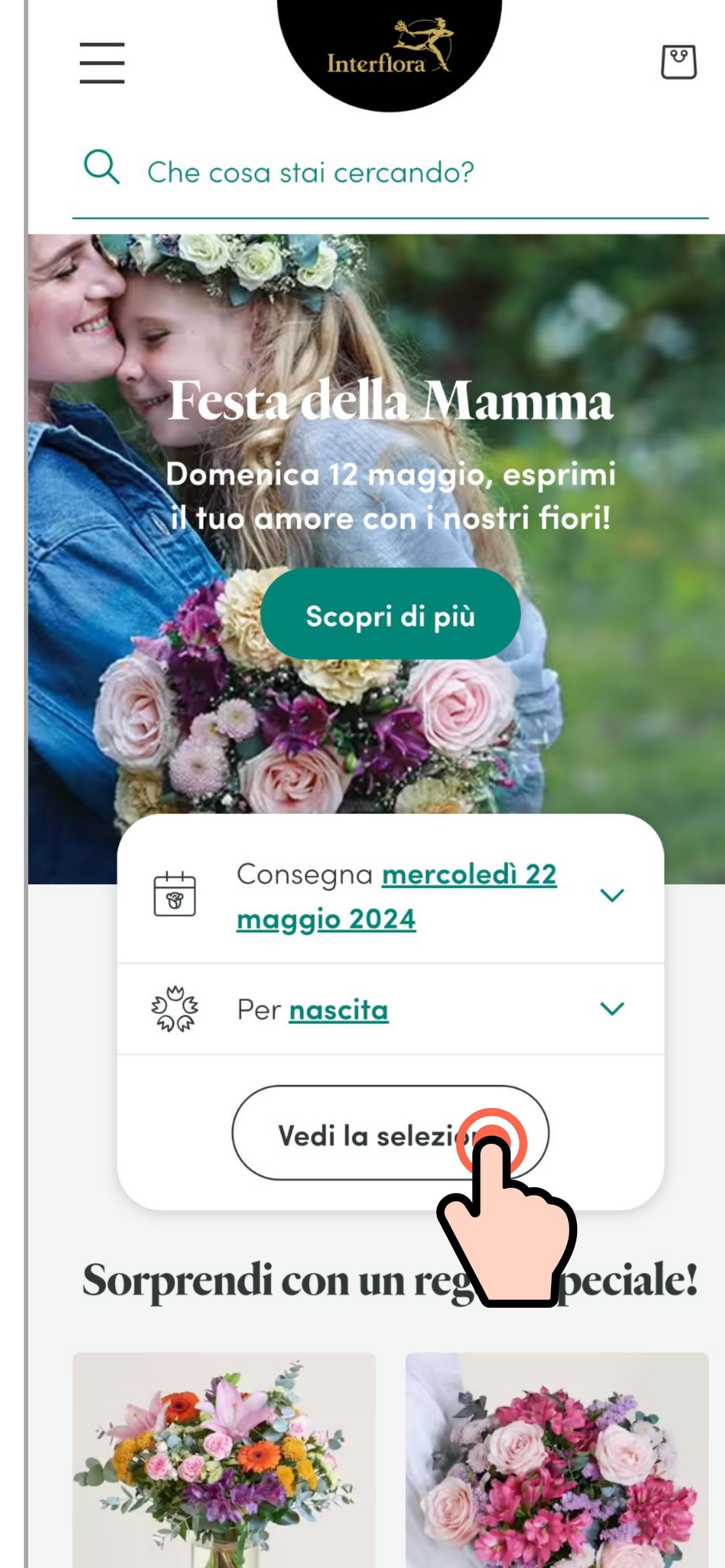
150 ms

250 ms

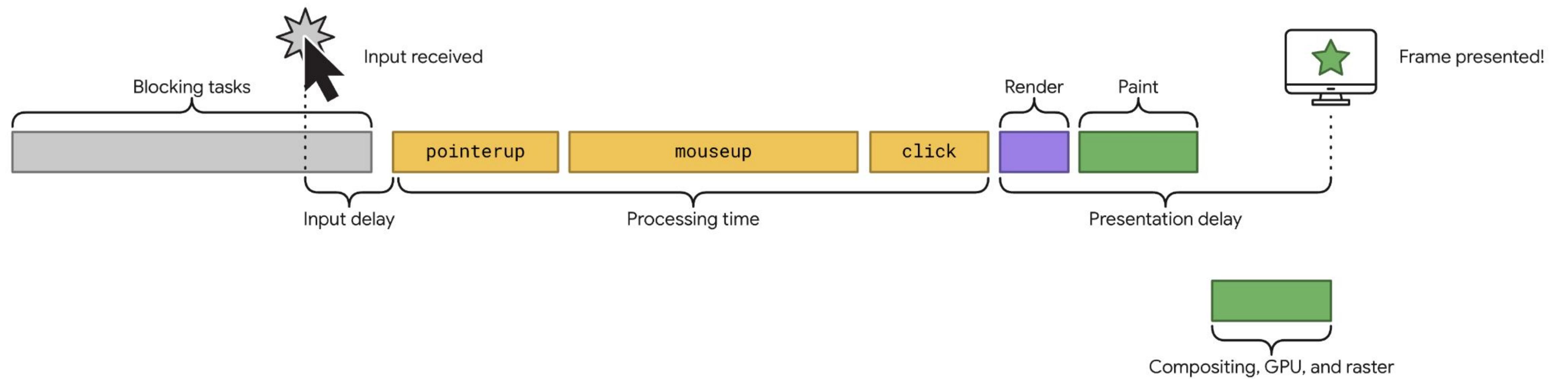
**INP** measures the time taken to update the screen after a user interaction.

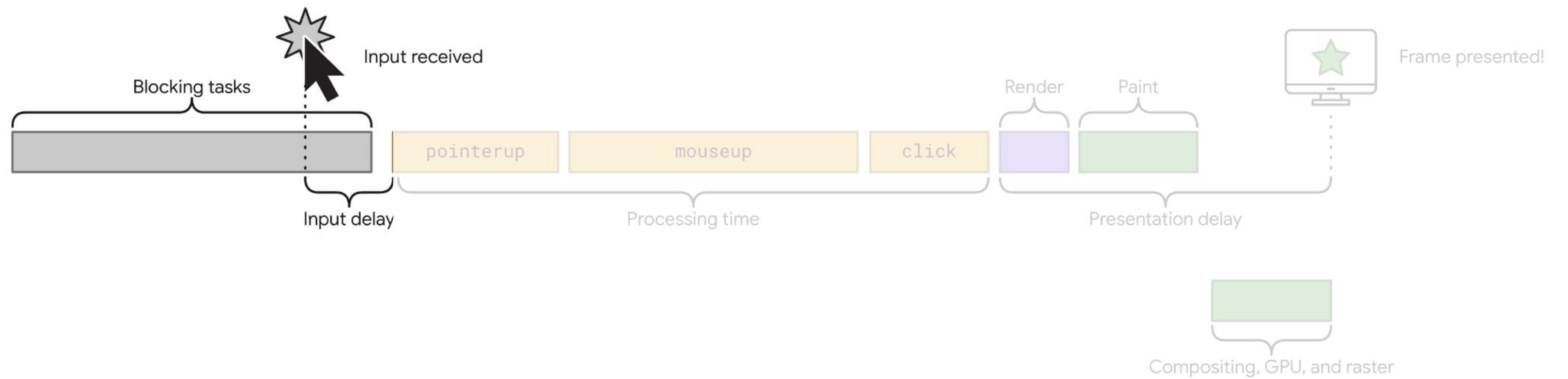
All user interactions within a page are considered: **pointer events** (click / tap), and **keyboard** interactions.

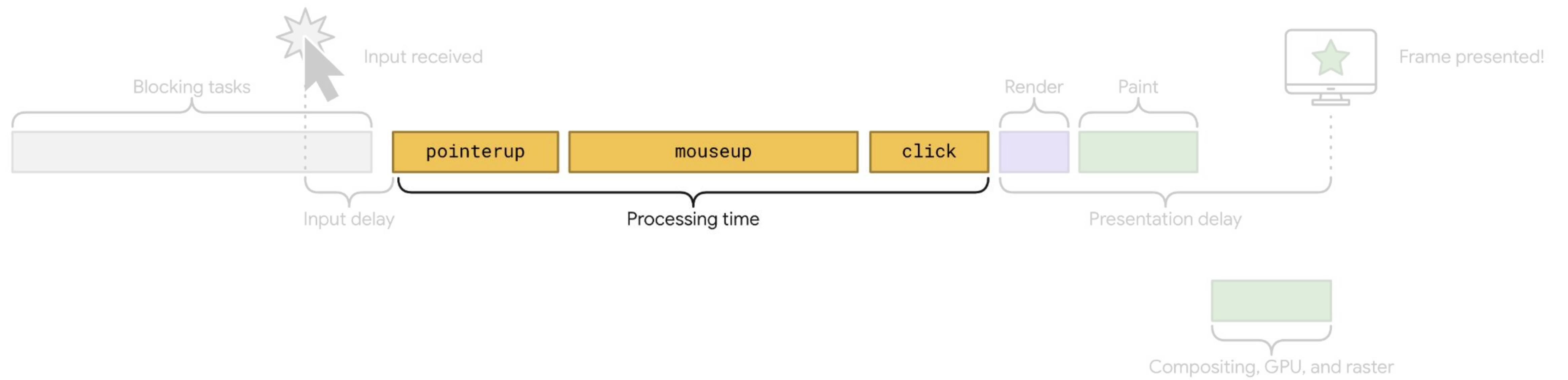
The **slowest interaction** is reported as the Interaction to Next Paint (INP) for the current page view.

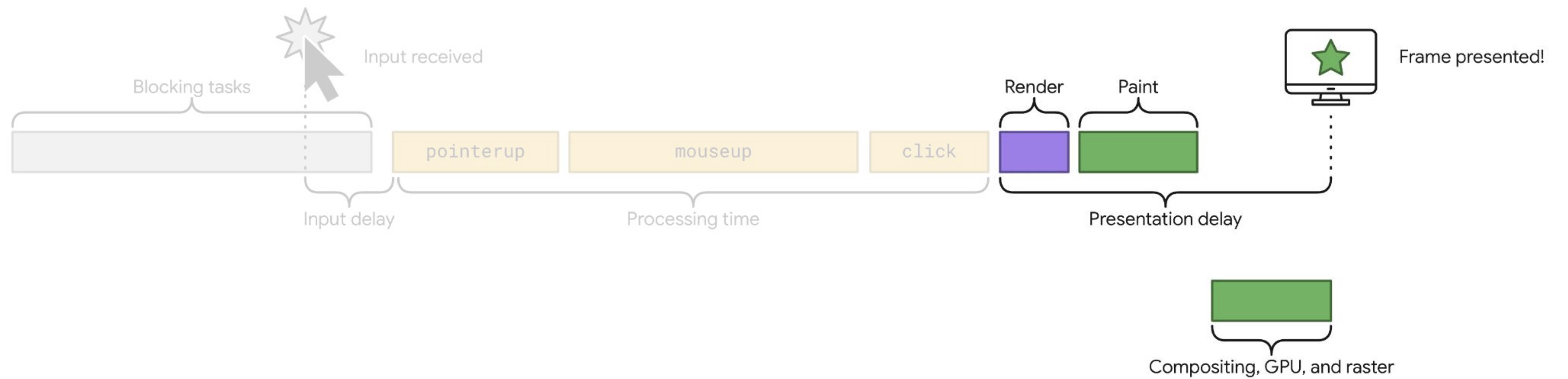


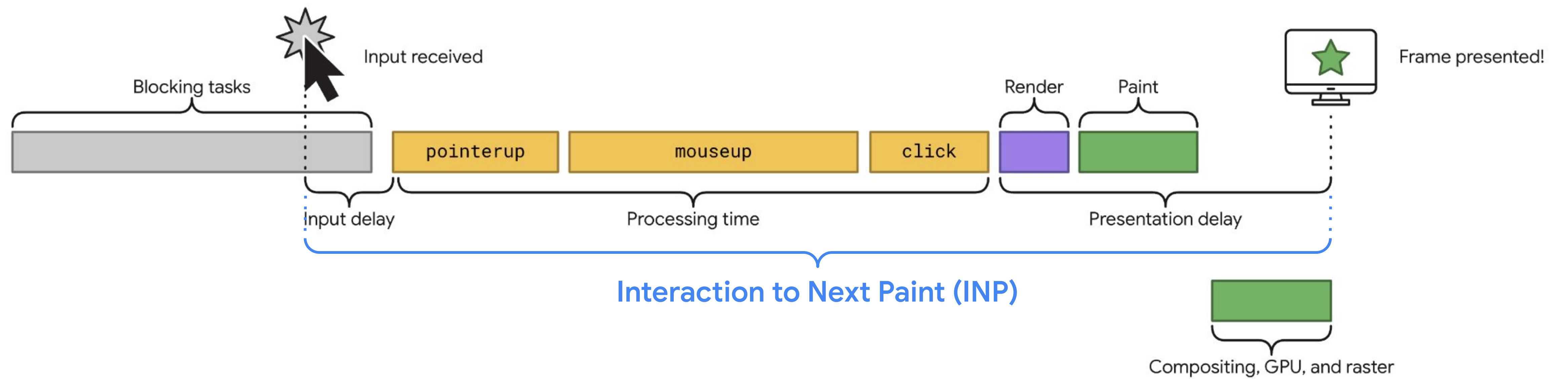
Reported  
INP value









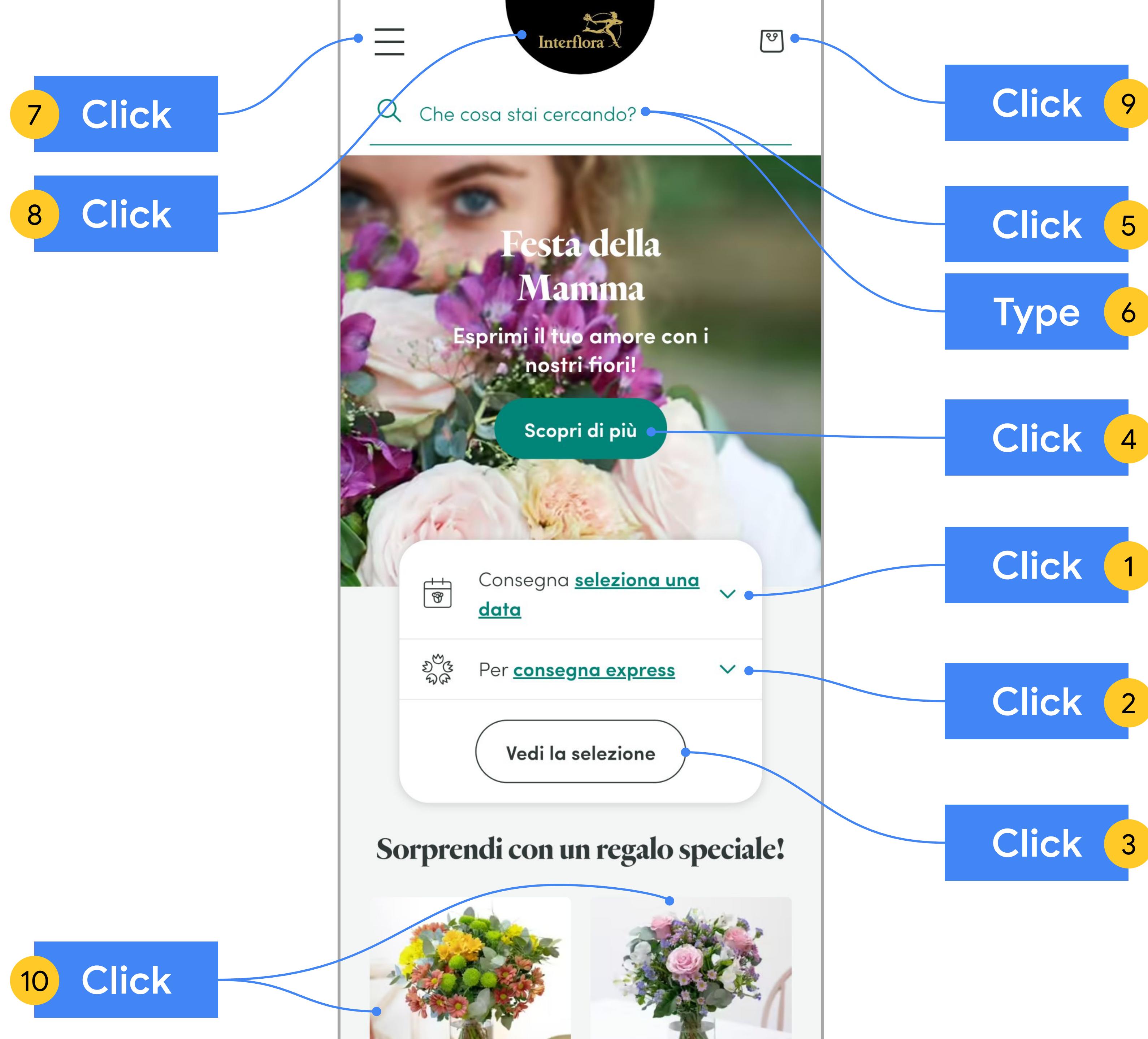


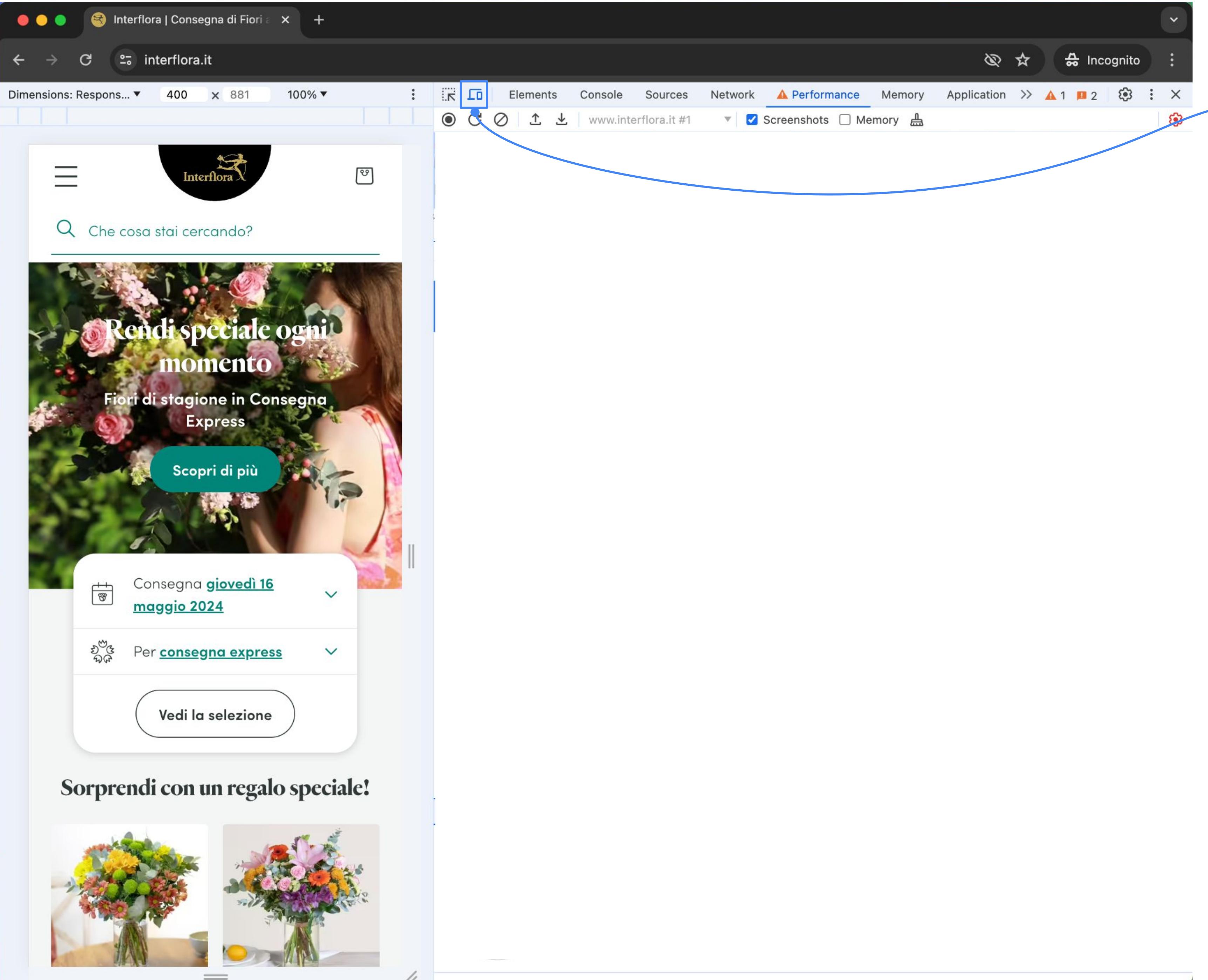
# How to debug slow interactions

“We have an INP of 350 ms,  
can you fix it?”

Your boss

```
function filterStudies({ studies, filterByOrg = false, filterByCategory = false }) {
  return studies.filter(study => {
    if (filterByCategory) {
      return study.categories.some(category => category.id === filterByCategory);
    }
    if (filterByOrg) {
      return study.organizations.some(organization => organization.id === filterByOrg);
    }
    return true;
  });
}
```





1

# Emulate mobile

Interflora | Consegna di Fiori X +

interflora.it

Dimensions: Respons... 400 x 881 100% ▾

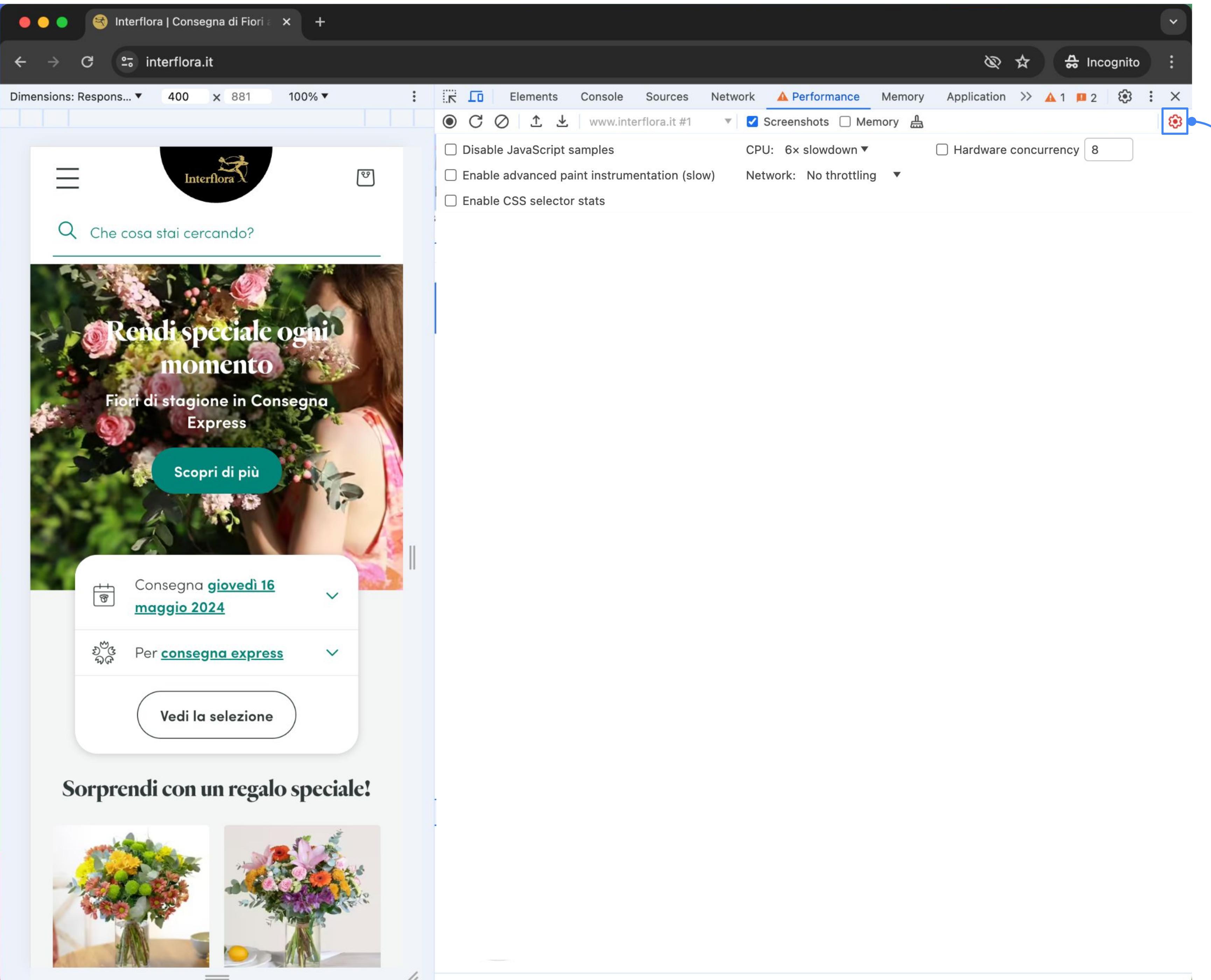
Elements Console Sources Network **Performance** Memory Application >> **1** **2** ⚙️ X

○ C ⌂ ⌂ | www.interflora.it #1  Screenshots  Memory ⚙️

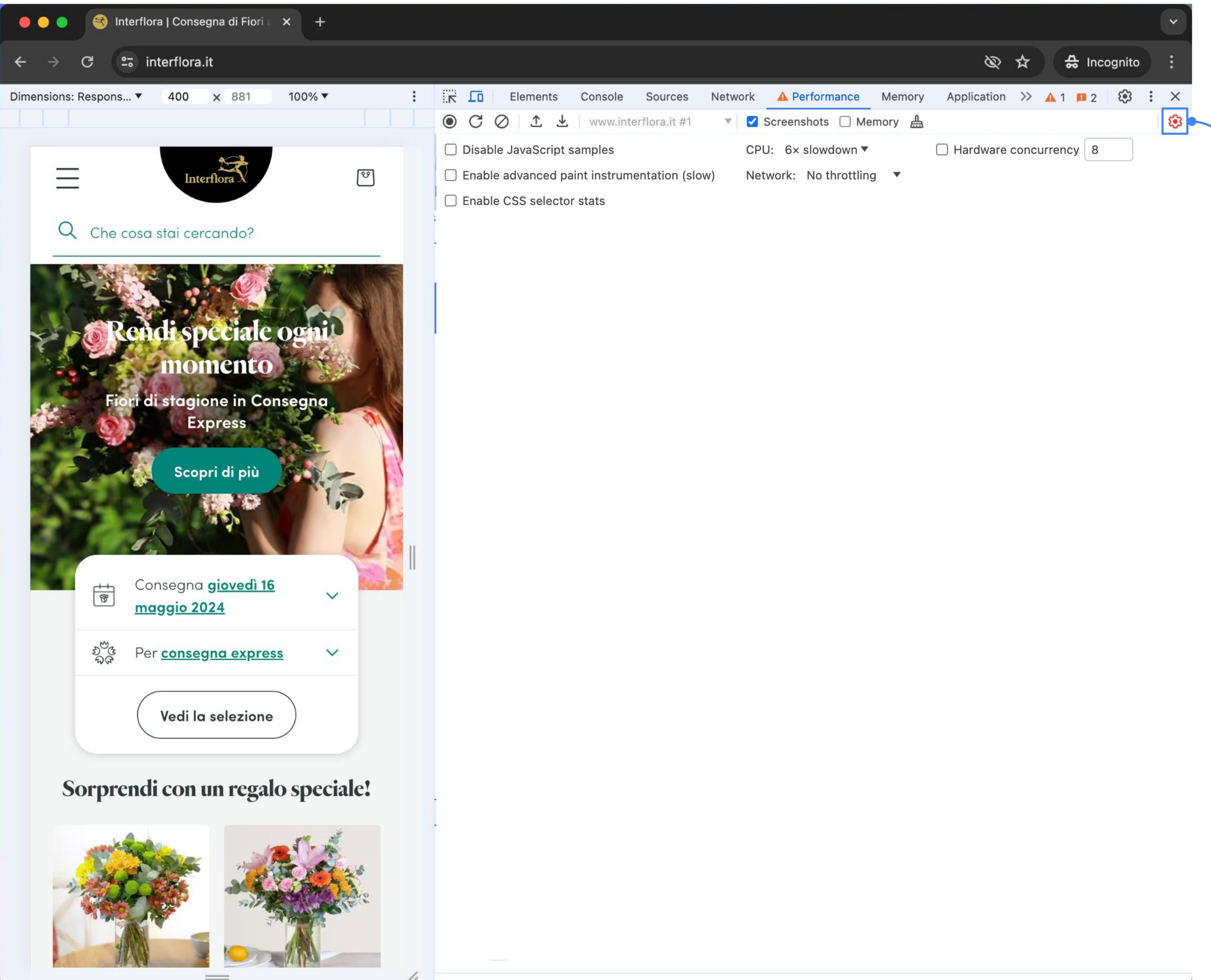
Disable JavaScript samples CPU: 6x slowdown ▾  Hardware concurrency 8

Enable advanced paint instrumentation (slow) Network: No throttling ▾

Enable CSS selector stats



**1** Emulate mobile



**2** Perf options

Interflora

Che cosa stai cercando?

Rendi speciale ogni momento

Fiori di stagione in Consegna Express

Scopri di più

Consegna giovedì 16 maggio 2024

Per consegna express

Vedi la selezione

Sorprendi con un regalo speciale!



Interflora | Consegna di Fiori X +

interflora.it

Dimensions: Respons... 400 x 881 100% ▾

Elements Console Sources Network **Performance** Memory Application >> **A 1** **! 2** **⚙️** **X**

Screenshots  Memory

CPU: 6x slowdown ▾

Network: No throttling ▾

Disable JavaScript samples

Enable advanced paint instrumentation (slow)

Enable CSS selector stats

Interflora

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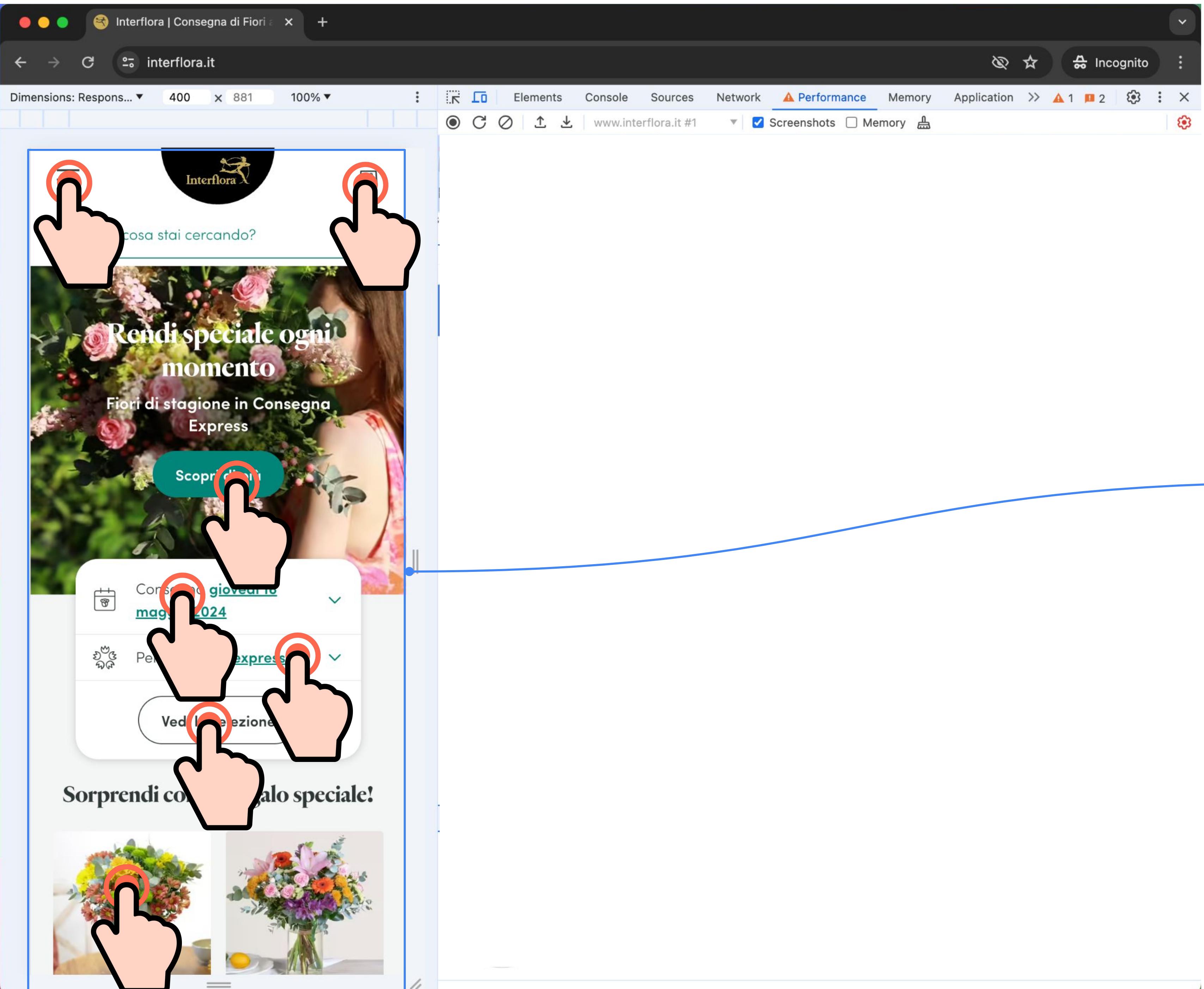
1 Emulate mobile

2 Perf options

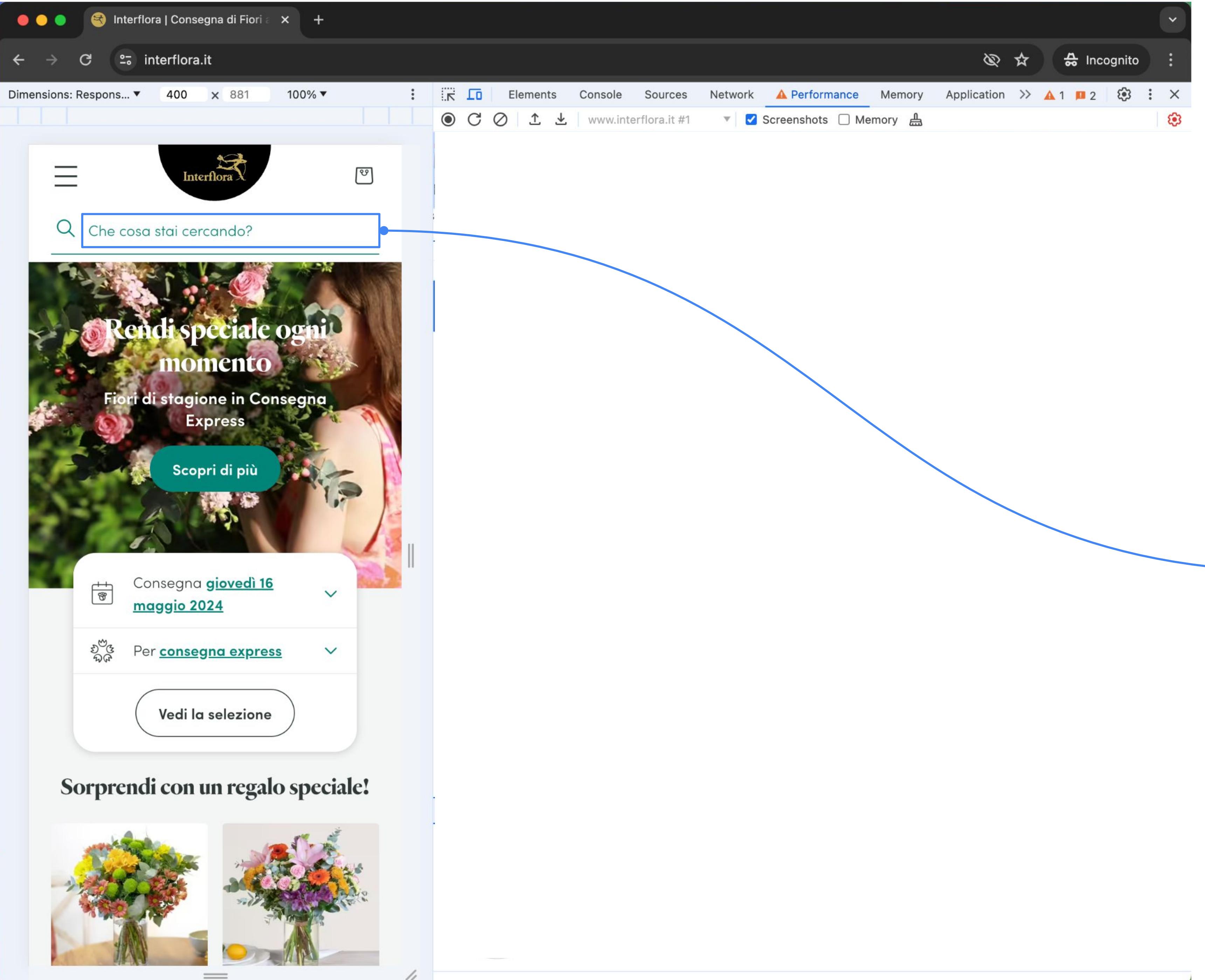
3 Slowdown CPU

A screenshot of a web browser window displaying the Interflora website ([www.interflora.it](http://www.interflora.it)). The browser's address bar shows the URL. The developer tools are open, specifically the Performance tab, which is highlighted in blue. A blue line graph is visible in the background of the browser window, representing performance data. The website itself features a large banner with a woman holding a bouquet and the text "Rendi speciale ogni momento" and "Fiori di stagione in Consegna Express". Below the banner is a dropdown menu for delivery date and express delivery options. At the bottom, there are two small images of flower arrangements.

- 1 Emulate mobile
- 2 Perf options
- 3 Slowdown CPU
- 4 Start recording



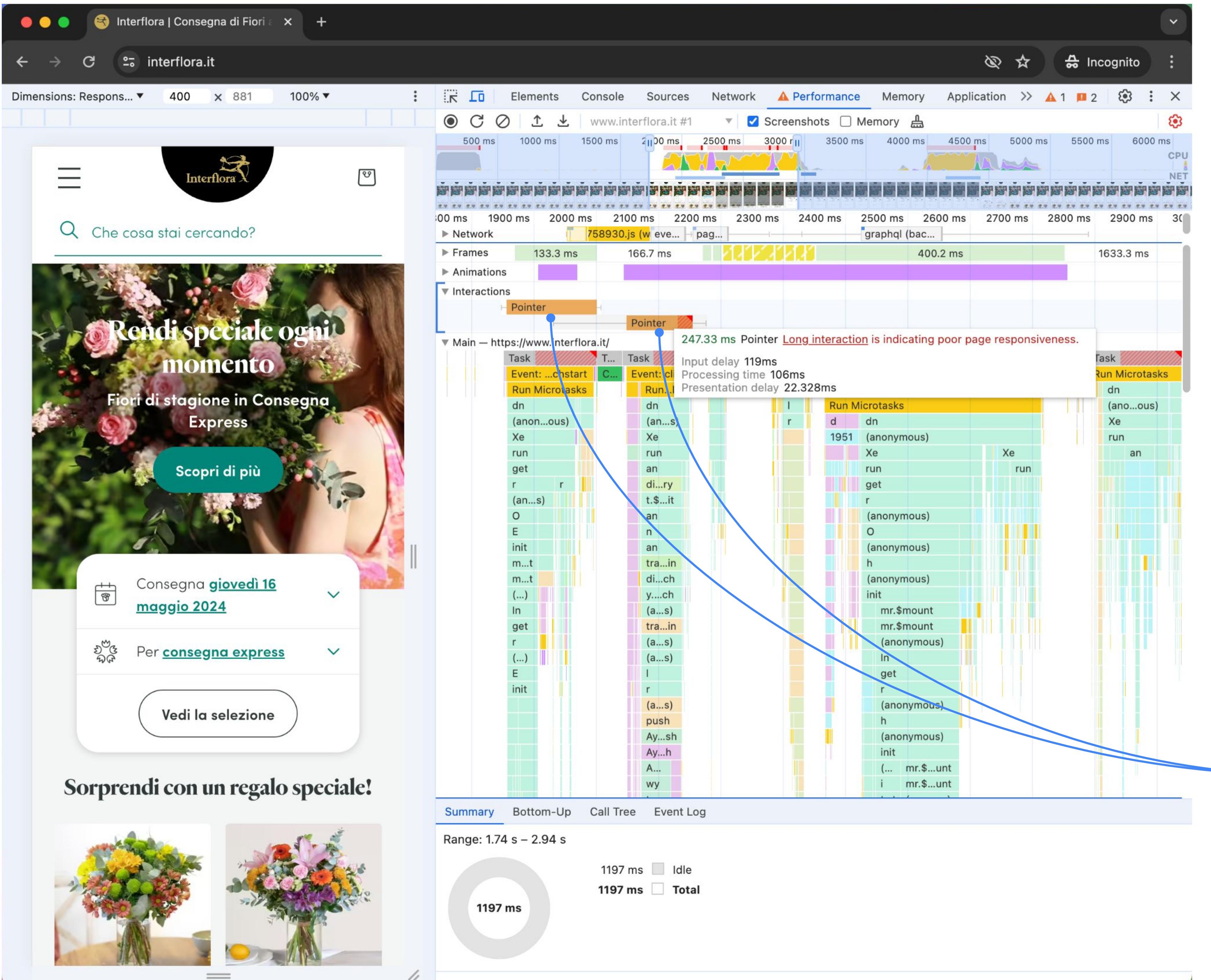
- 1 Emulate mobile
- 2 Perf options
- 3 Slowdown CPU
- 4 Start recording
- 5 Click around



- 1 Emulate mobile
  - 2 Perf options
  - 3 Slowdown CPU
  - 4 Start recording
  - 5 Click around
  - 6 Type around

The screenshot shows a web browser window for [interflora.it](http://interflora.it). The developer tools' Performance tab is active, displaying a timeline of events. A blue line represents the execution flow, starting at the top left and moving downwards and to the right across the page content. The page itself features a large banner with a woman holding flowers and text about special moments and express delivery. Below the banner is a sidebar with delivery date and express delivery selection fields, and a button to view the selection. At the bottom, there's a section for special gifts with two flower arrangements.

- 1 Emulate mobile
- 2 Perf options
- 3 Slowdown CPU
- 4 Start recording
- 5 Click around
- 6 Type around
- 7 Stop recording



1 Emulate device

2 Perf options

3 Slowdown CPU

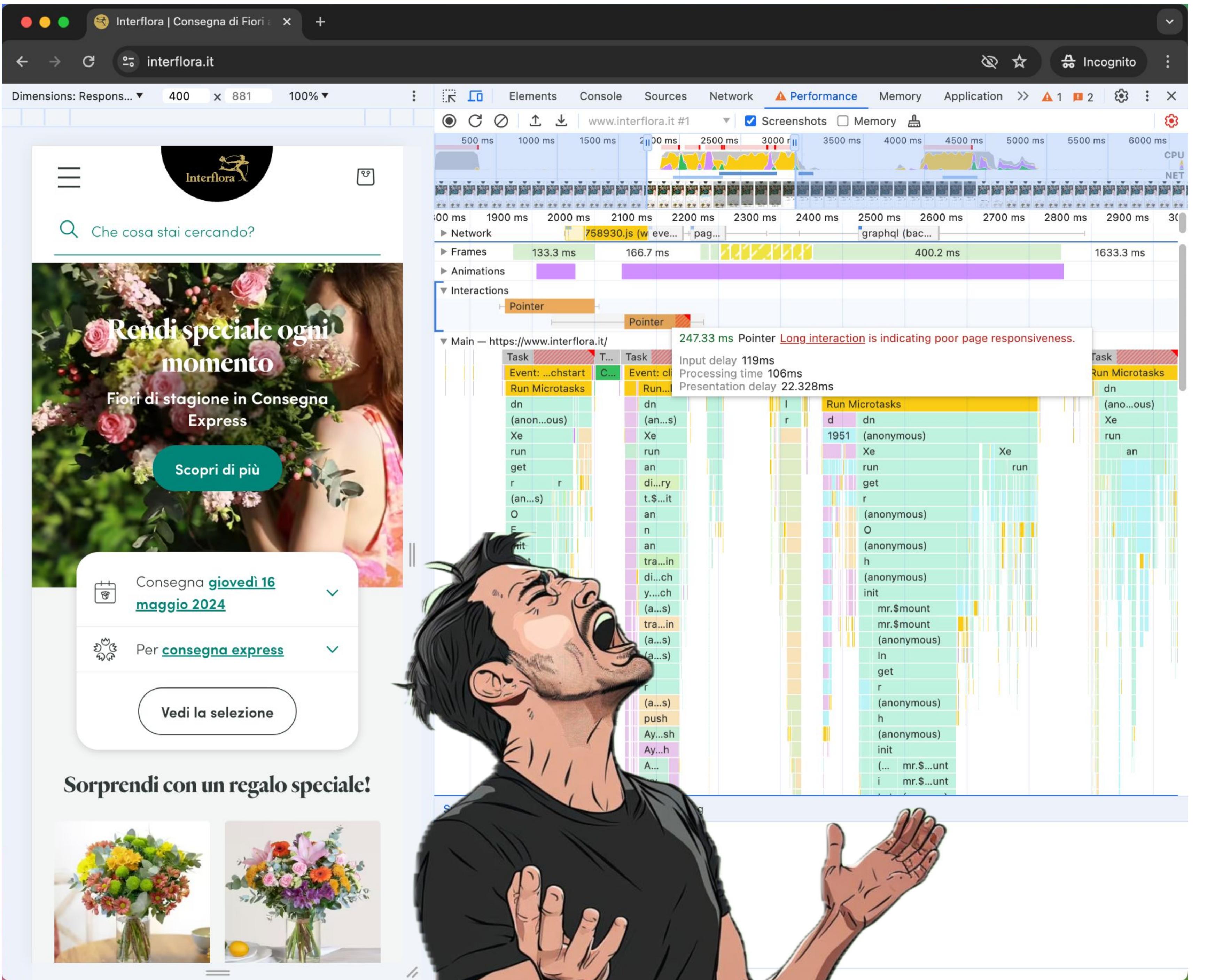
4 Start recording

5 Click around

6 Type around

7 Stop recording

8 Find slow interactions



1 Emulate device

2 Perf options

3 Slowdown CPU

4 Start recording

5 Click around

6 Type around

7 Stop recording

8 Find slow interactions

9 Repeat

# RUM data

## RUM = Real User Monitoring

Information about how people interact with websites.

A constant, real-time survey of what users experience.

It helps to pinpoint performance problems with attribution data.

You can verify your fixes in minutes right after deployment.

# With RUM data

	A Event	A Element	123 InpDel	123 Process	123 PresDel	123 INP	123 Occurred	123 Im...	JΞ	A Device	A Exam
0	keydown	#search	323	2	468	712	2.452	1.745.824	Desktop	https://w	
1	pointerup	picture>img.self-center.max-h-full.max-w-full.object-contain	1.048	0	59	1103	1.421	1.567.363	Mobile	https://w	
2	pointerd...	div>picture>img.m-auto.max-h-full.max-w-full.w-auto.h-auto	436	0	74	491	1.871	918.661	Mobile	https://w	
3	keyup	#search	224	3	465	640	719	460.160	Desktop	https://w	
4	click	picture>img.self-center.max-h-full.max-w-full.object-contain	21	136	46	202	1.847	373.094	Mobile	https://w	
5	click	span.swatch>span.h-full.w-full.block.border.border-white	25	161	49	248	1.417	351.416	Mobile	https://w	
6	pointerup	div.grid.grid-cols-2.md\:grid-cols-4.gap-x-6.gap-y-10.lg\:gap-y-20	1.025	0	64	1097	320	351.040	Mobile	https://w	

Which interactions are problematic?

# With RUM data

	A Event	A Element	123 InpDel	123 Process	123 PresDel	123 INP	123 Occurred	123 Im...	JΞ	A Device	A Exam
0	keydown	#search	323	2	468	712	2.452	1.745.824	Desktop	https://w	
1	pointerup	picture>img.self-center.max-h-full.max-w-full.object-contain	1.048	0	59	1103	1.421	1.567.363	Mobile	https://w	
2	pointerd...	div>picture>img.m-auto.max-h-full.max-w-full.w-auto.h-auto	436	0	74	491	1.871	918.661	Mobile	https://w	
3	keyup	#search	224	3	465	640	719	460.160	Desktop	https://w	
4	click	picture>img.self-center.max-h-full.max-w-full.object-contain	21	136	46	202	1.847	373.094	Mobile	https://w	
5	click	span.swatch>span.h-full.w-full.block.border.border-white	25	161	49	248	1.417	351.416	Mobile	https://w	
6	pointerup	div.grid.grid-cols-2.md\:grid-cols-4.gap-x-6.gap-y-10.lg\:gap-y-20	1.025	0	64	1097	320	351.040	Mobile	https://w	

What's the problem?

# With RUM data

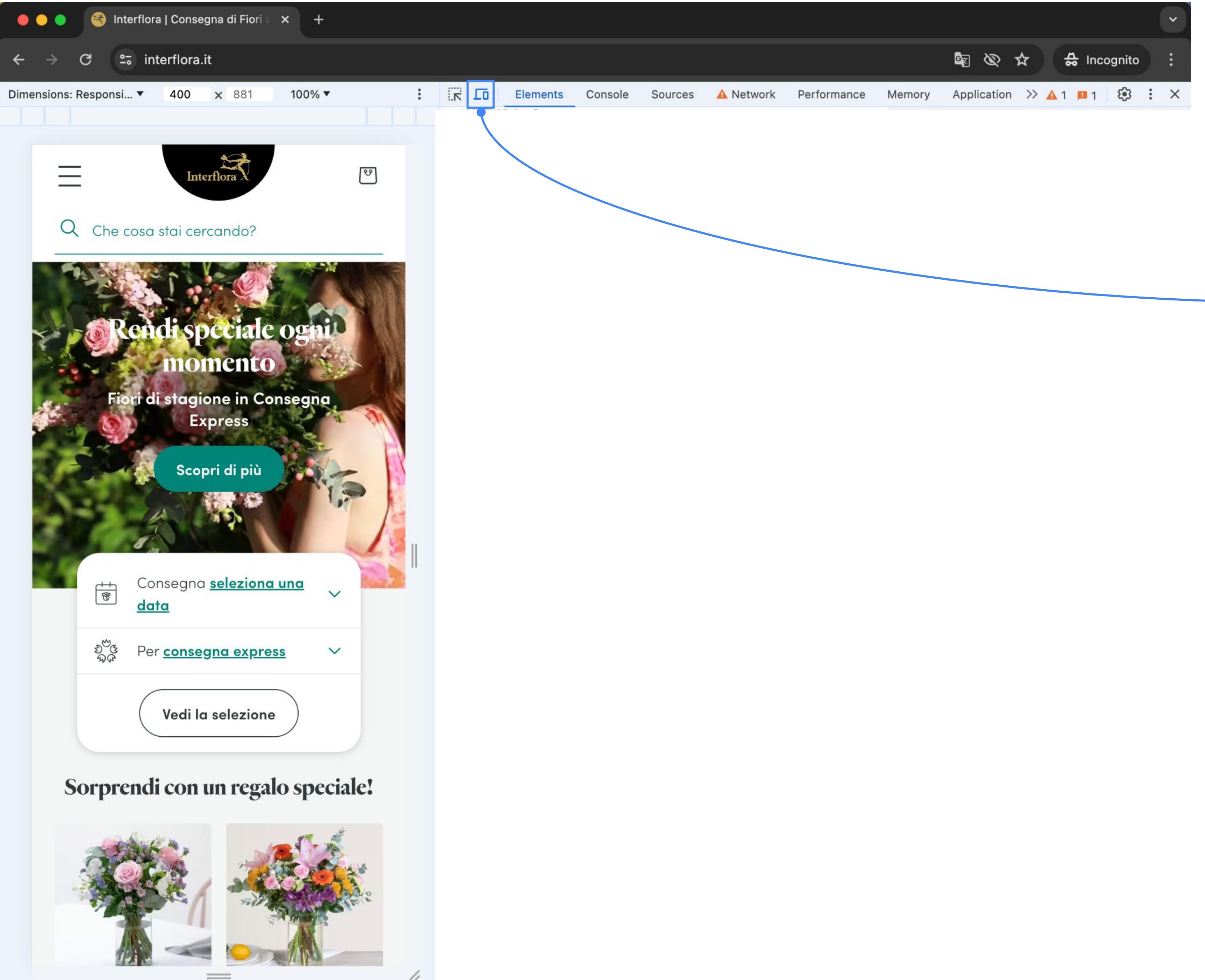
	A Event	A Element	123 InpDel	123 Process	123 PresDel	123 INP	123 Occurred	123 Im...	JΞ	A Device	A Exam
0	keydown	#search	323	2	468	712	2.452	1.745.824		Desktop	https://w...
1	pointerup	picture>img.self-center.max-h-full.max-w-full.object-contain	1.048	0	59	1103	1.421	1.567.363		Mobile	https://w...
2	pointerd...	div>picture>img.m-auto.max-h-full.max-w-full.w-auto.h-auto	436	0	74	491	1.871	918.661		Mobile	https://w...
3	keyup	#search	224	3	465	640	719	460.160		Desktop	https://w...
4	click	picture>img.self-center.max-h-full.max-w-full.object-contain	21	136	46	202	1.847	373.094		Mobile	https://w...
5	click	span.swatch>span.h-full.w-full.block.border.border-white	25	161	49	248	1.417	351.416		Mobile	https://w...
6	pointerup	div.grid.grid-cols-2.md\:grid-cols-4.gap-x-6.gap-y-10.lg\:gap-y-20	1.025	0	64	1097	320	351.040		Mobile	https://w...

What's the impact?

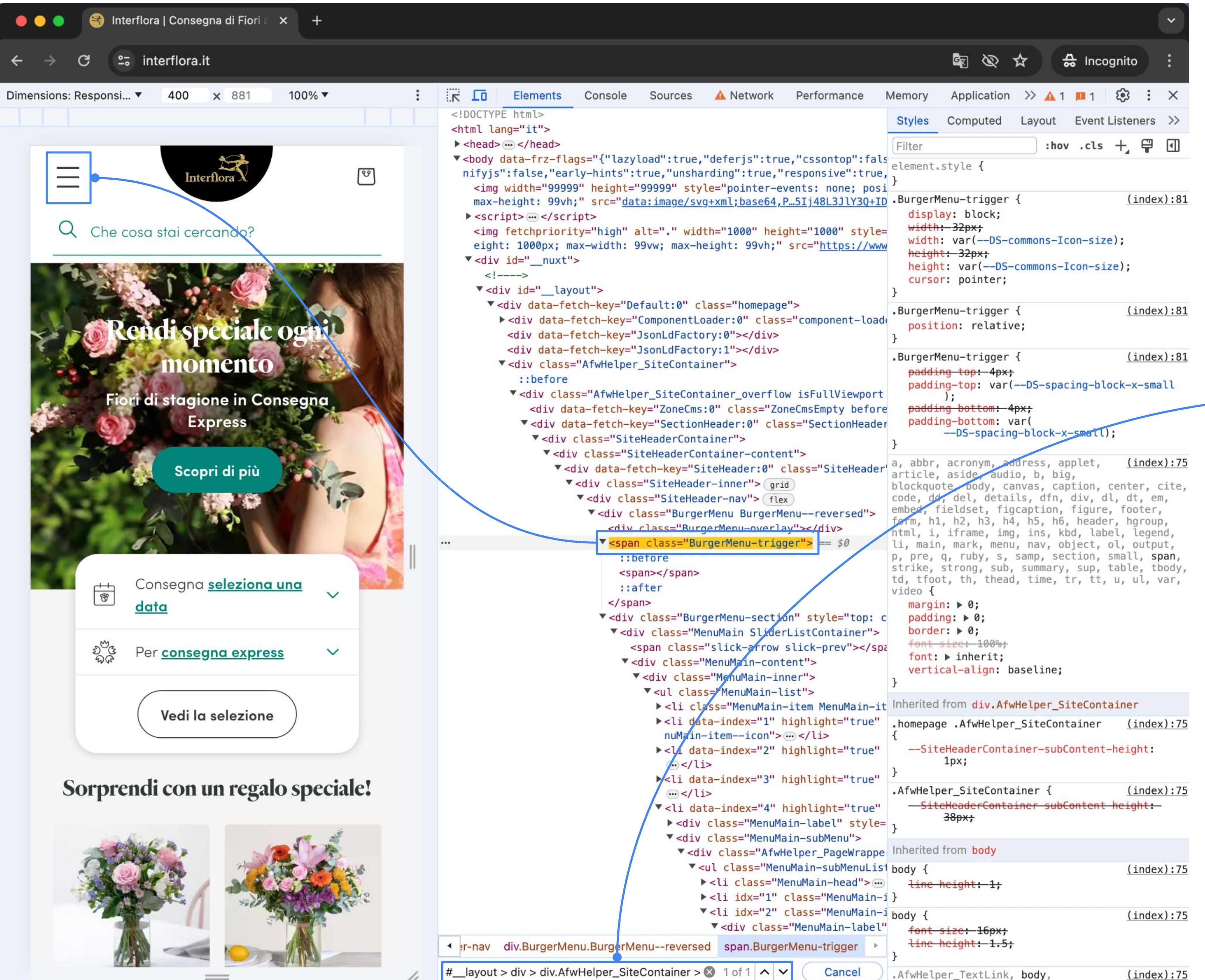
# With RUM data

	A Event	A Element	123 InpDel	123 Process	123 PresDel	123 INP	123 Occurred	123 Im...	JΞ	A Device	A Exam
0	keydown	#search	323	2	468	712	2.452	1.745.824	Desktop	https://w...	
1	pointerup	picture>img.self-center.max-h-full.max-w-full.object-contain	1.048	0	59	1103	1.421	1.567.363	Mobile	https://w...	
2	pointerd...	div>picture>img.m-auto.max-h-full.max-w-full.w-auto.h-auto	436	0	74	491	1.871	918.661	Mobile	https://w...	
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4	click	picture>img.self-center.max-h-full.max-w-full.object-contain	21	136	46	202	1.847	373.094	Mobile	https://w...	
5	click	span.swatch>span.h-full.w-full.block.border.border-white	25	161	49	248	1.417	351.416	Mobile	https://w...	
6	pointerup	div.grid.grid-cols-2.md\:grid-cols-4.gap-x-6.gap-y-10.lg\:gap-y-20	1.025	0	64	1097	320	351.340	Mobile	https://w...	

Where can I reproduce it?



# 1 Emulate device



# 1 Emulate device

# Find element

Interflora | Consegna di Fiori X +

interflora.it

Dimensions: Respons... 400 x 881 100% ▾

Elements Console Sources Network **Performance** Memory Application >> **A 1** **! 2** **⚙️** **X**

Screenshots  Memory **...** **⚙️**

Che cosa stai cercando?

Rendi speciale ogni momento  
Fiori di stagione in Consegna Express

Scopri di più

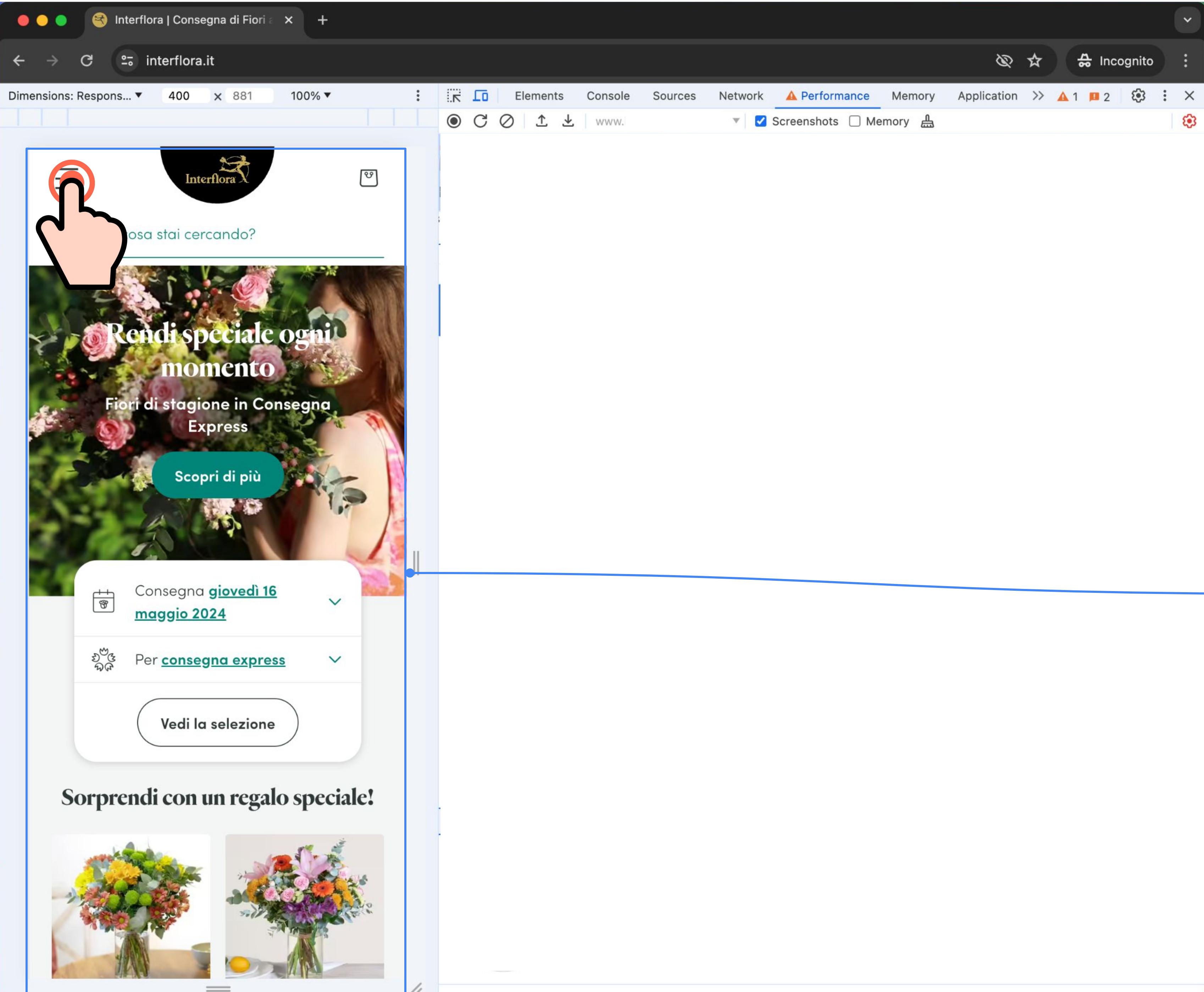
Consegna giovedì 16 maggio 2024

Per consegna express

Vedi la selezione

Sorprendi con un regalo speciale!

- 1 Emulate device
- 2 Find element
- 3 Start recording



- 1 Emulate device
  - 2 Find element
  - 3 Start recording
  - 4 Perform action

Interflora | Consegna di Fiori X +

interflora.it

Dimensions: Respons... 400 x 881 100% ▾

Elements Console Sources Network **Performance** Memory Application >> **A 1** **! 2** **⚙️** **X**

Screenshots  Memory **⋮** **⚙️**

Interflora

Che cosa stai cercando?

Rendi speciale ogni momento  
Fiori di stagione in Consegna Express

Scopri di più

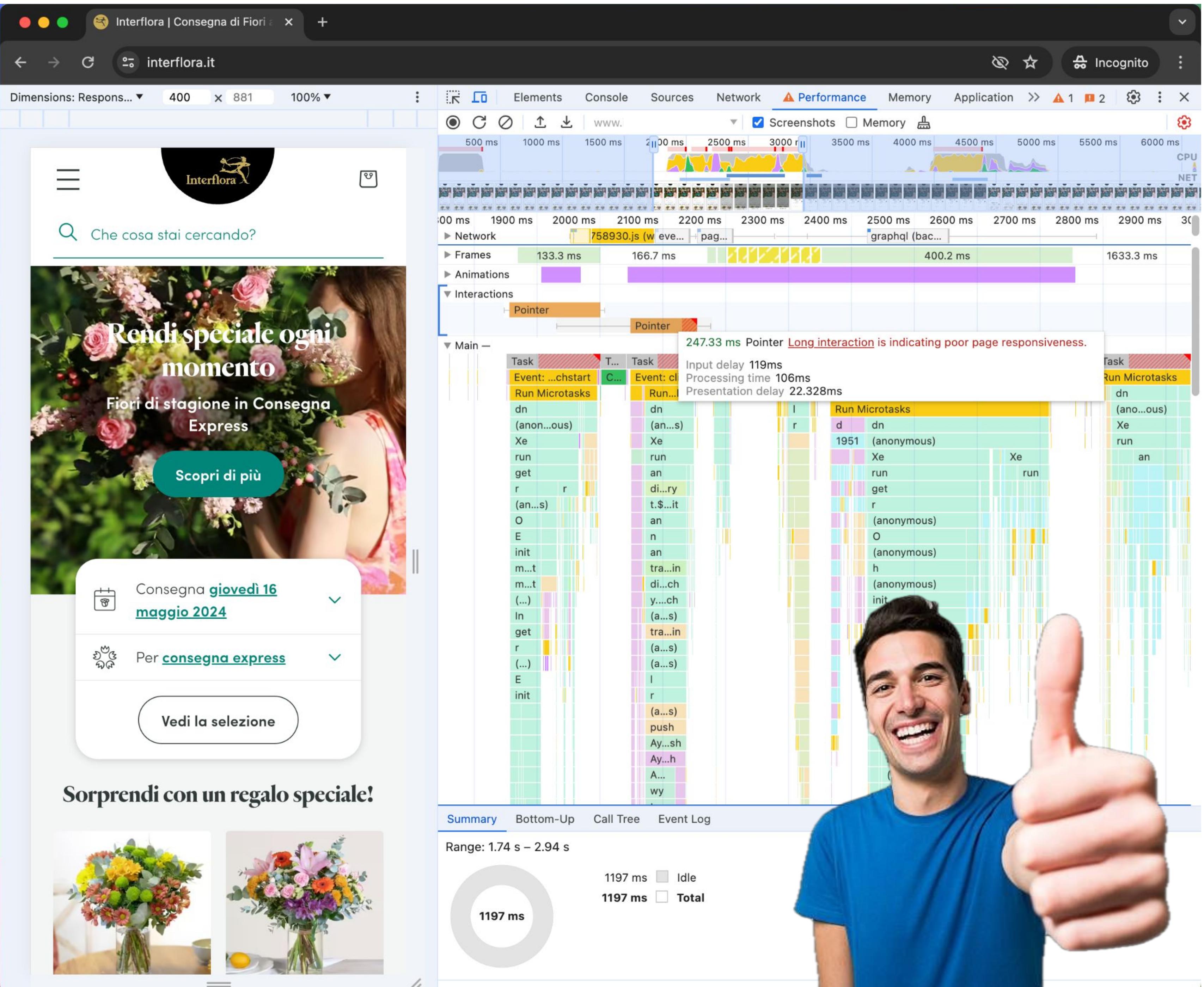
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- 1 Emulate device
- 2 Find element
- 3 Start recording
- 4 Perform action
- 5 Stop recording



- 1 Emulate device**
- 2 Find element**
- 3 Start recording**
- 4 Perform action**
- 5 Stop recording**

**“RUM data has saved me countless hours when auditing Core Web Vitals”**

Andrea Verlicchi

```
function filterStudies({ studies, filterByOrg = false, filterByCategory = false }) {
  const filteredStudies = studies.filter(study => {
    if (filterByCategory) {
      return study.categories.some(category => category === filterByCategory);
    }
    if (filterByOrg) {
      return study.organizations.some(organization => organization === filterByOrg);
    }
    return true;
  });
  return filteredStudies;
}
```

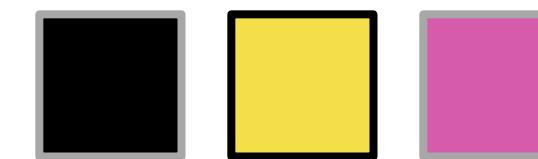
# 3 common mistakes to avoid

and how to fix them

**Send analytics data  
synchronously**

## Bologna JS T-shirt

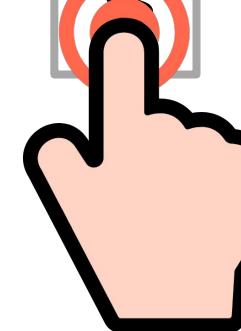
Available colors



Choose your size



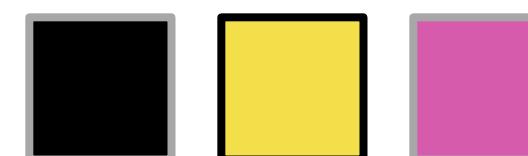
Delivery date: 23 May 2024



1100 ms

## Bologna JS T-shirt

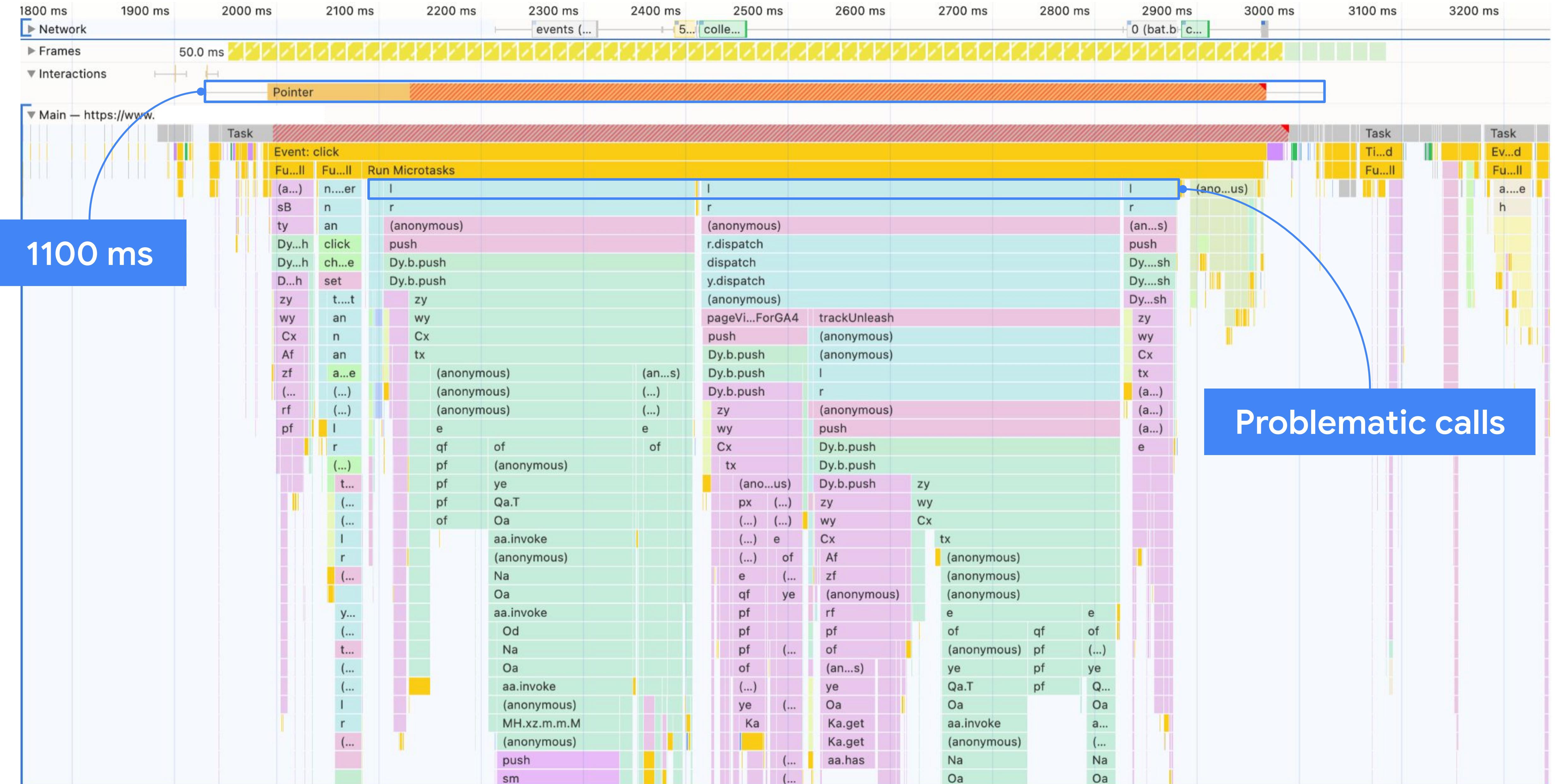
Available colors



Choose your size



Delivery date: 23 September 2024



```
function selectSizeHandler() {  
    selectSize();  
    pushToTagManager();  
}  
 
```

```
function selectSizeHandler() {  
    selectSize();  
  
    pushToTagManager();  
}
```

```
async function selectSizeHandler() {  
    selectSize();  
    await yieldToMain();  
    pushToTagManager();  
}
```

```
async function selectSizeHandler() {  
  selectSize();  
  await yieldToMain();  
  pushToTagManager();  
}
```

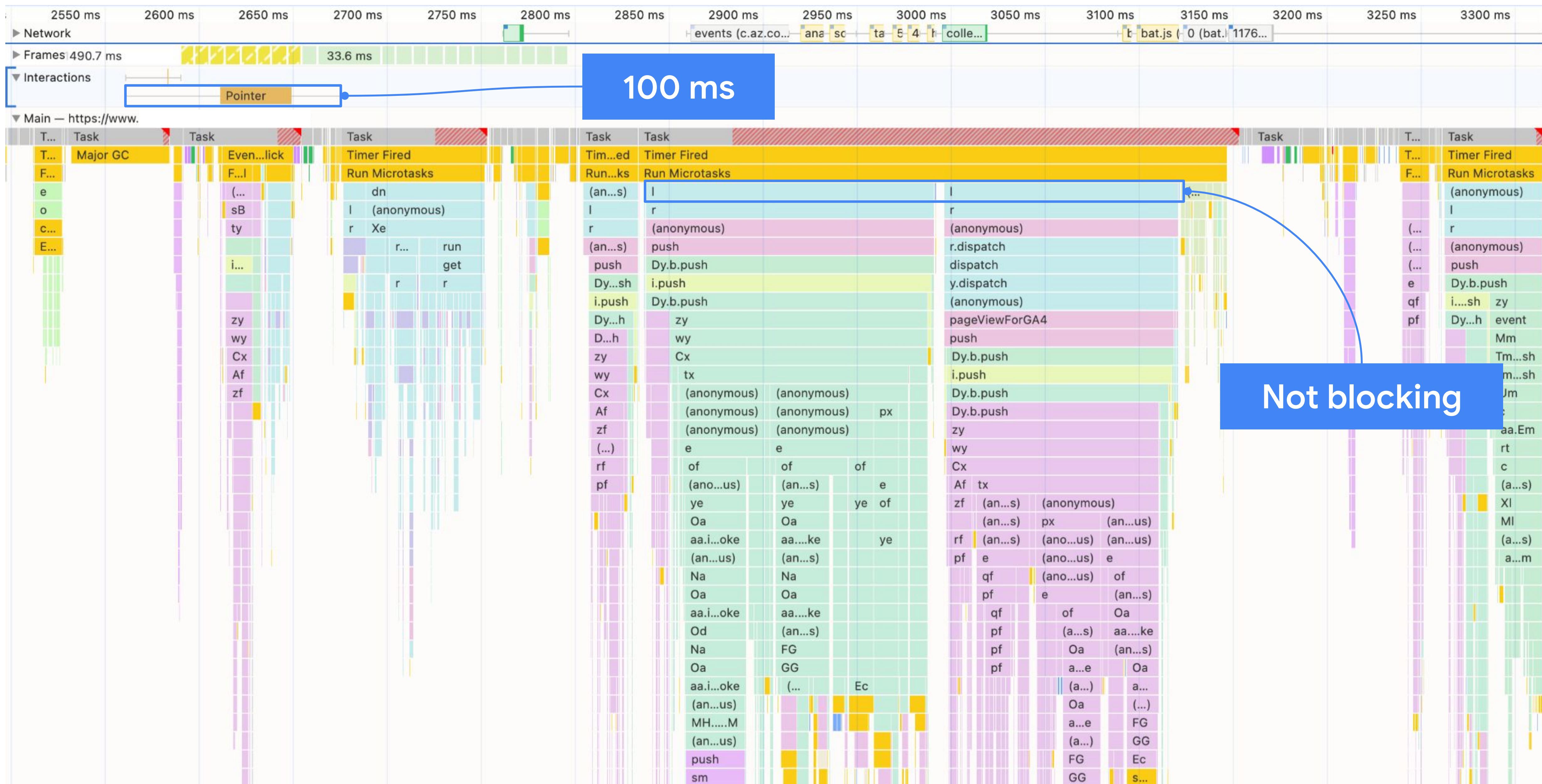
```
function yieldToMain() {  
}  
}
```

```
async function selectSizeHandler() {  
  selectSize();  
  await yieldToMain();  
  pushToTagManager();  
}
```

```
function yieldToMain() {  
  return new Promise((resolve) => {  
    setTimeout(resolve, 0);  
  });  
}
```

```
async function selectSizeHandler() {  
    selectSize();  
    await yieldToMain();  
    pushToTagManager();  
}
```

```
function yieldToMain() {  
    if ("scheduler" in window && "yield" in scheduler) {  
        return scheduler.yield();  
    }  
    return new Promise((resolve) => {  
        setTimeout(resolve, 0);  
    });  
}
```

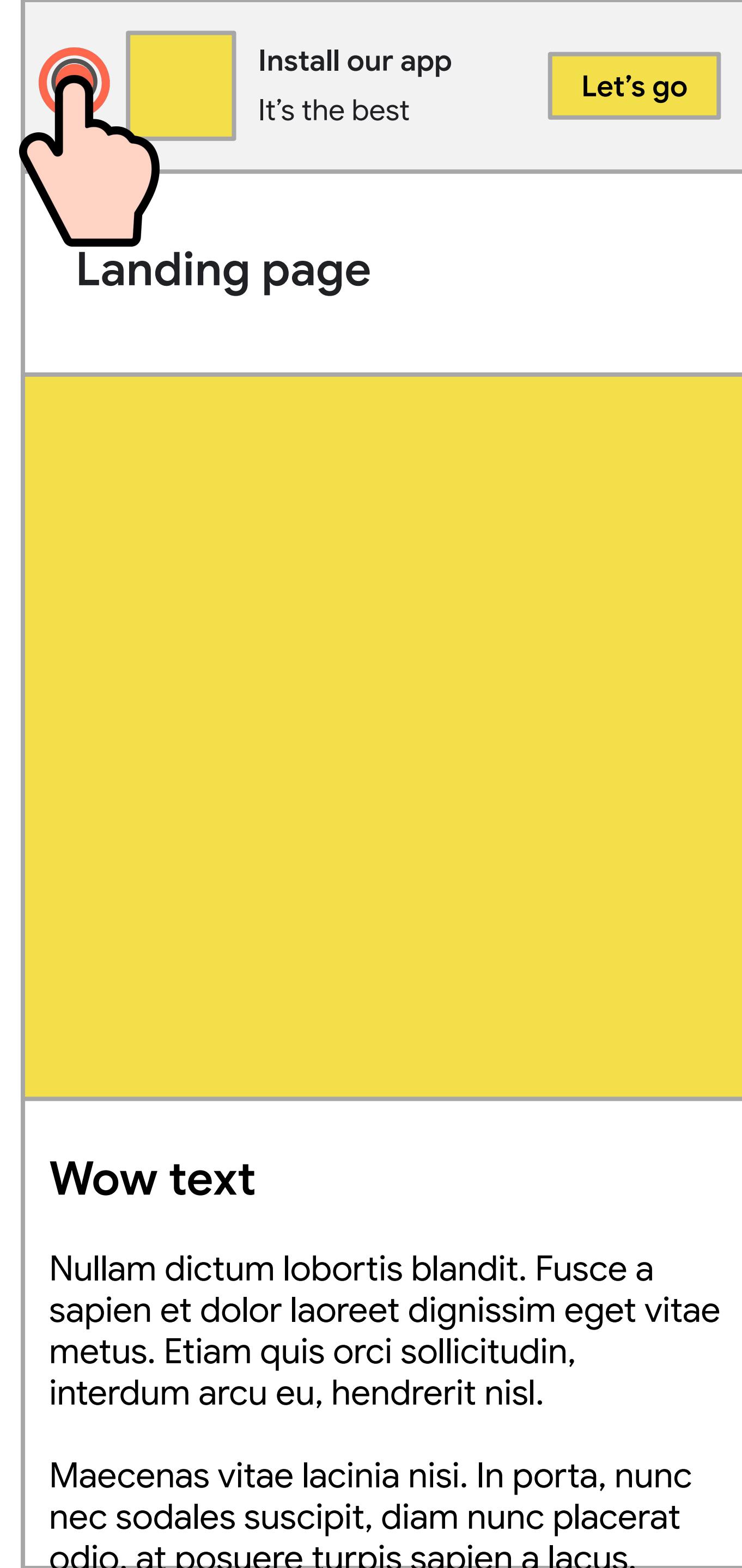




**Always yield to the main thread  
before calling tracking functions**

(or any other long-running function)

# Forcing style / layout recalculation



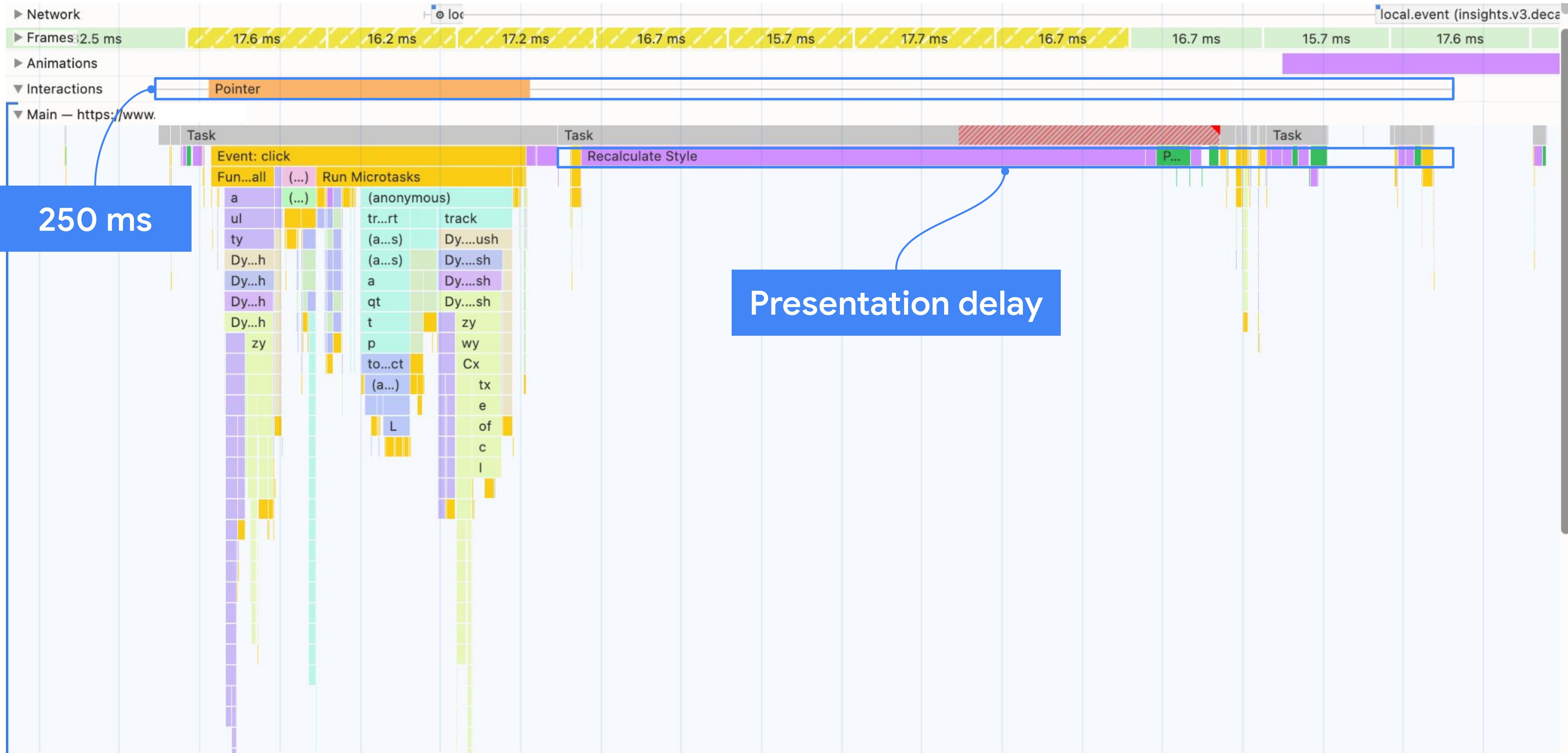
## Landing page

250 ms

## Wow text

Nullam dictum lobortis blandit. Fusce a sapien et dolor laoreet dignissim eget vitae metus. Etiam quis orci sollicitudin, interdum arcu eu, hendrerit nisl.

Maecenas vitae lacinia nisi. In porta, nunc nec sodales suscipit, diam nunc placerat odio, at posuere turpis sapien a lacus. Integer varius ornare lectus egestas commodo.

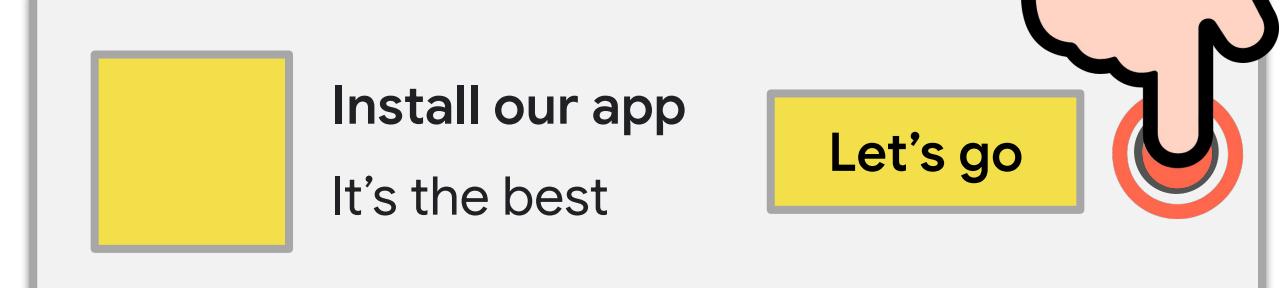


# Landing page

## Wow text

Nullam dictum lobortis blandit. Fusce a sapien et dolor laoreet dignissim eget vitae metus. Etiam quis orci sollicitudin, interdum arcu eu, hendrerit nisl.

Maeconas vitae laciniis nisi. In port...



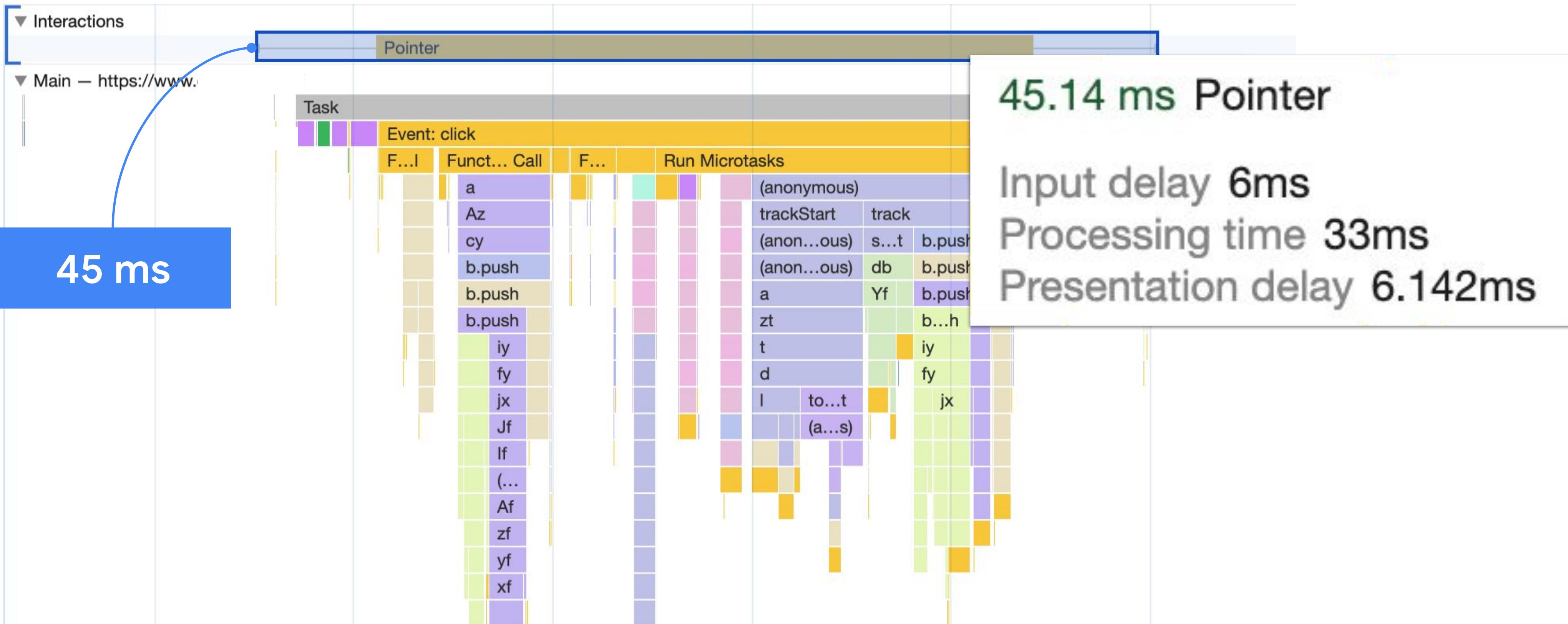
## Landing page

45 ms

## Wow text

Nullam dictum lobortis blandit. Fusce a sapien et dolor laoreet dignissim eget vitae metus. Etiam quis orci sollicitudin, interdum arcu eu, hendrerit nisl.

Maecenas vitae lacinia nisi. In porta, nunc nec sodales suscipit, diam nunc placerat odio, at posuere turpis sapien a lacus. Integer varius ornare lectus egestas commodo.



# What forces layout / reflow

These properties and methods will force browsers to synchronously recalculate layout.

```
// Getting box metrics
elem.offsetTop|Top|Width|Height|Parent;
elem.clientLeft|Top|Width|Height;
elem.getClientRects();
elem.getBoundingClientRect();

// Scroll stuff
elem.scrollBy();
elem.scrollTo();
elem.scrollIntoView();
elem.scrollIntoViewIfNeeded();
elem.scrollWidth|Height|Left|Top; //also, setting them

// Getting window dimensions
window.scrollX|Y;
window.innerHeight|Width;
window.visualViewport.height|width|offsetTop|offsetLeft;

// Calling getComputedStyle()
window.getComputedStyle();
```

# Batch your style reads and do them first

(where the browser can use the previous frame's layout values)

and then do any writes.

```
// BAD
function logBoxHeight () {
  box.classList.add('super-big');
  console.log(box.offsetHeight);
}
```

```
// GOOD
function logBoxHeight () {
  console.log(box.offsetHeight);
  box.classList.add('super-big');
}
```

# Batch your style reads and do them first

(where the browser can use the previous frame's layout values)

and then do any writes.

```
// REALLY BAD
function resizeAllToMatchBlockWidth () {
    // Puts the browser into a read-write-read-write cycle.
    for (let i = 0; i < paragraphs.length; i++) {
        paragraphs[i].style.width = `${box.offsetWidth}px`;
    }
}

// GOOD
const width = box.offsetWidth; // Read.

function resizeAllToMatchBlockWidth () {
    for (let i = 0; i < paragraphs.length; i++) {
        // And now write.
        paragraphs[i].style.width = `${width}px`;
    }
}
```



# Be careful with layout thrashing

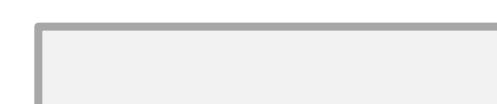
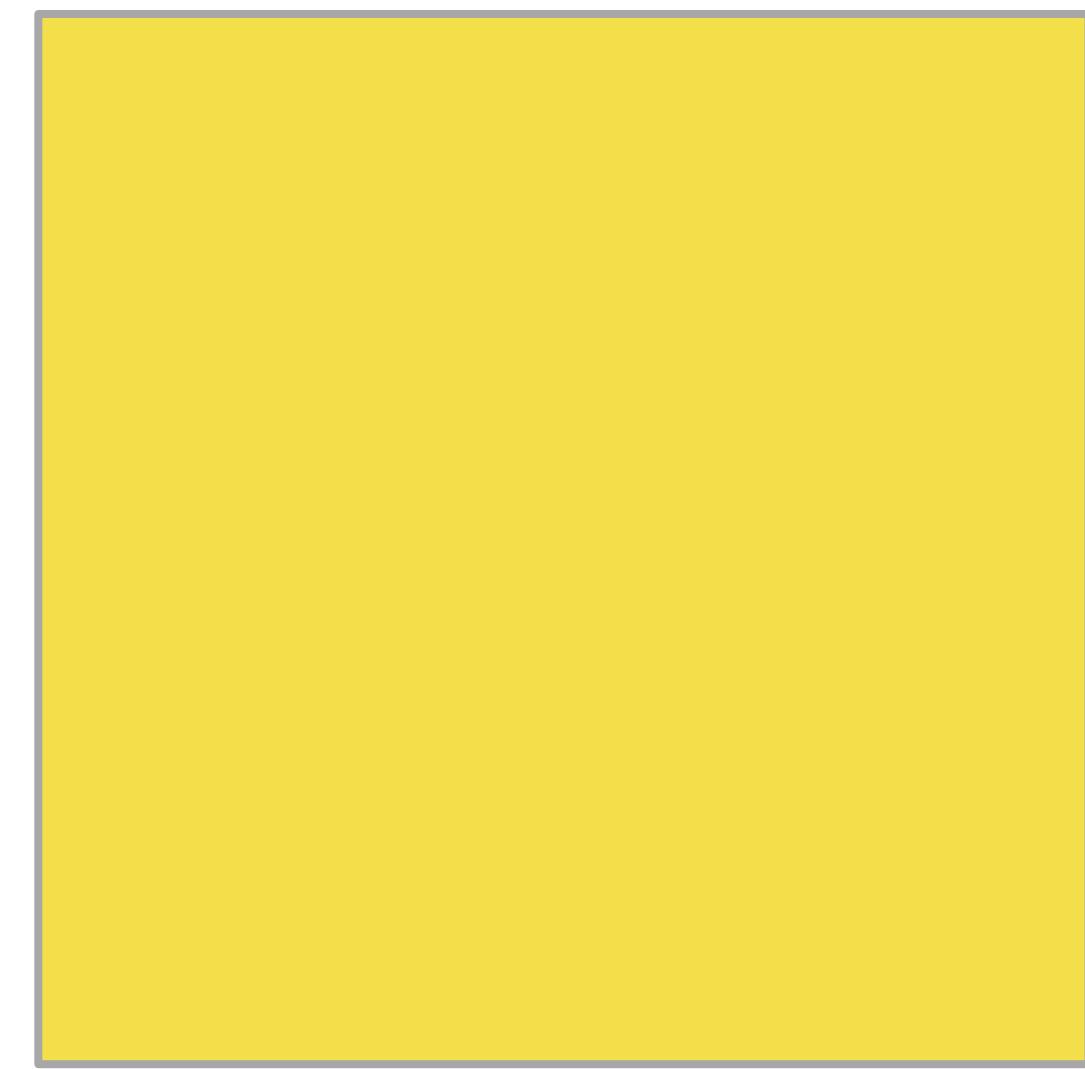
(and use CSS instead of JS whenever you can)

# Scheduling long tasks using requestAnimationFrame()

# Landing page

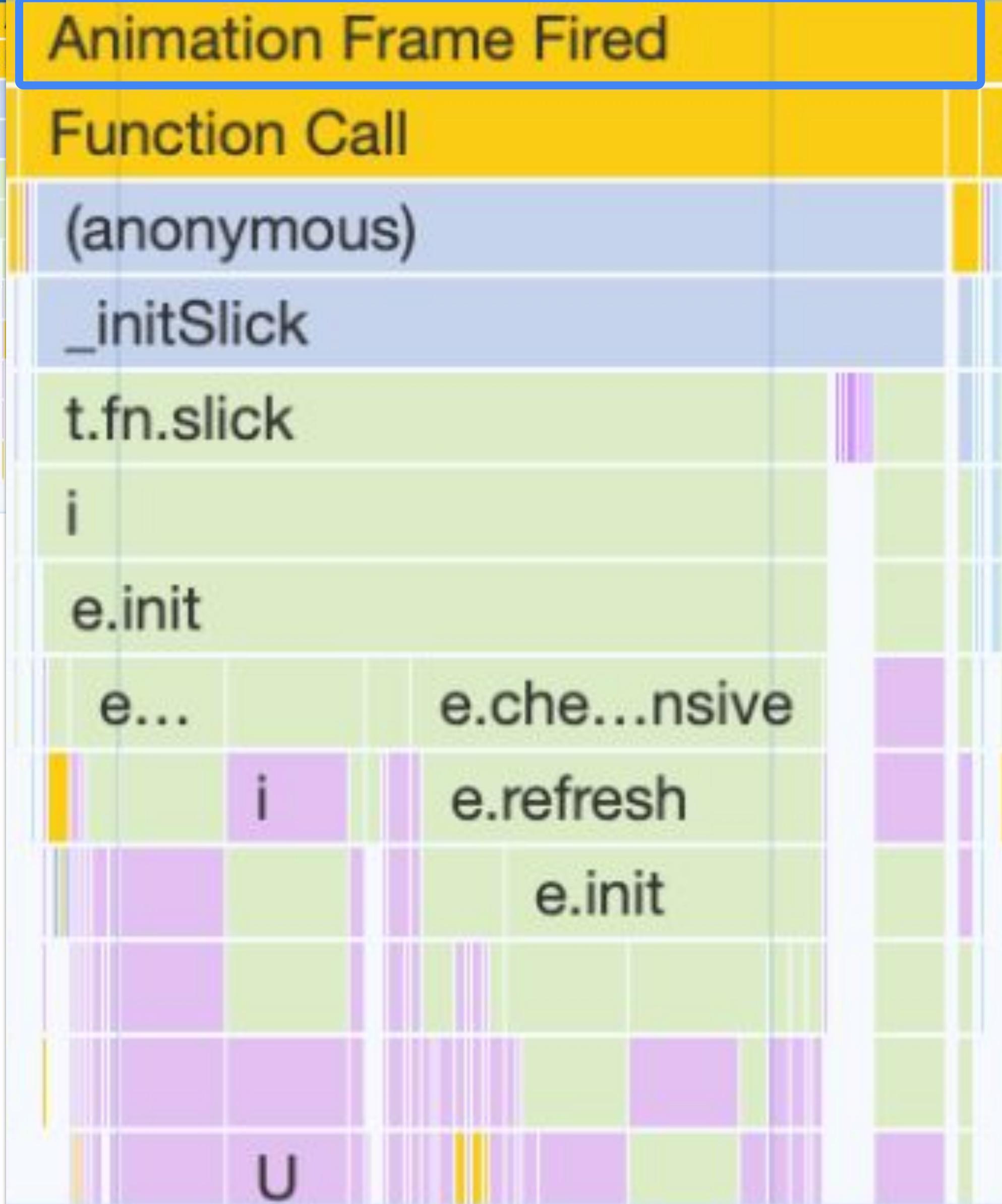


# Landing page

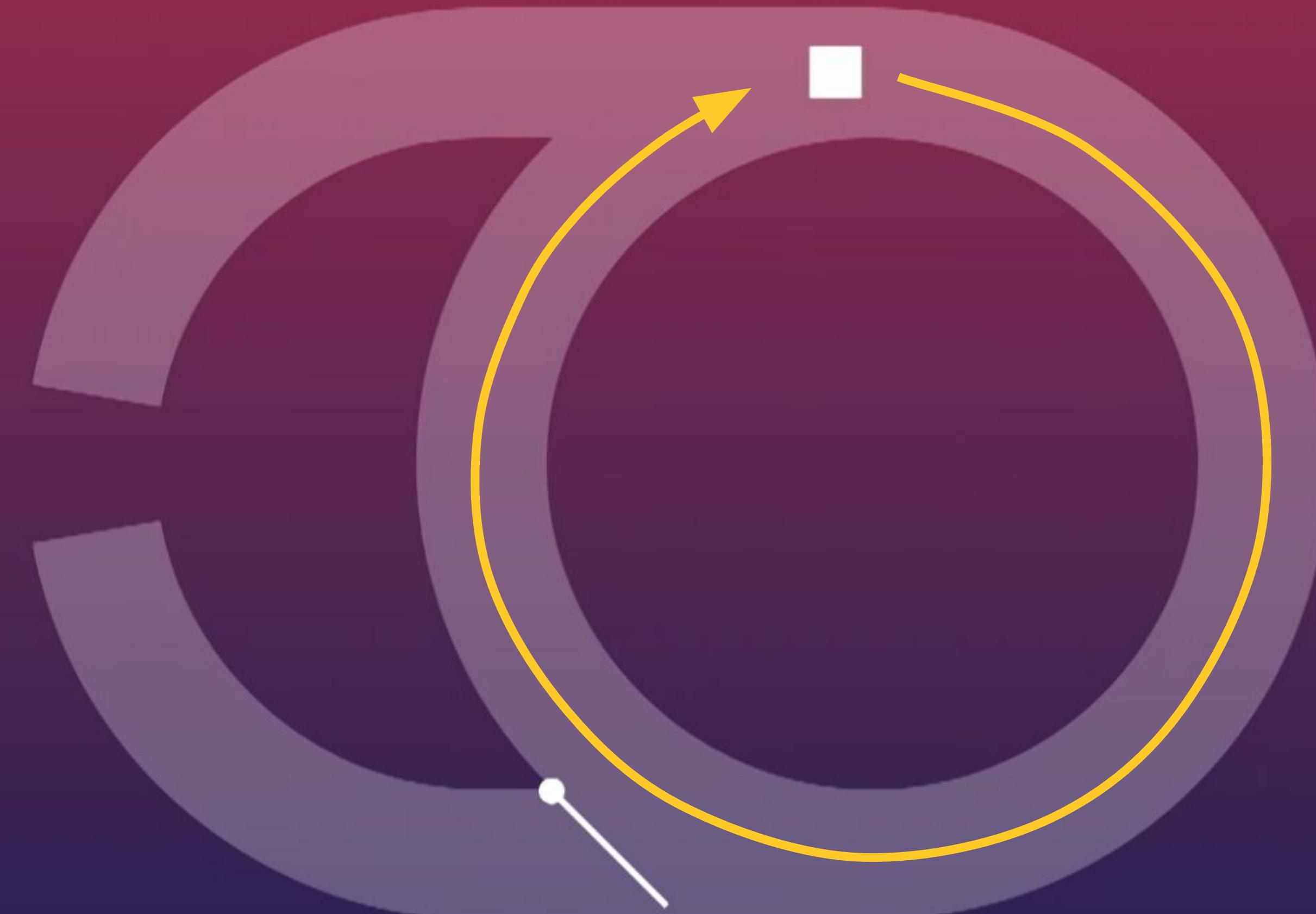


Task

Ani...red	Animation...me Fired	Anim...ired
Func...all	Function Call	Func...Call
(an...us)	(anonymous)	(ano...ous)
_initSlick	_initSlick	_initSlick
t.fn.slick	t.fn.slick	t.fn.slick
i	i	i
e.init	e.init	e.init
	e.ch...sive	e....ve
	e.refresh	e....h
	e.init	e.init
	e...	
	i	

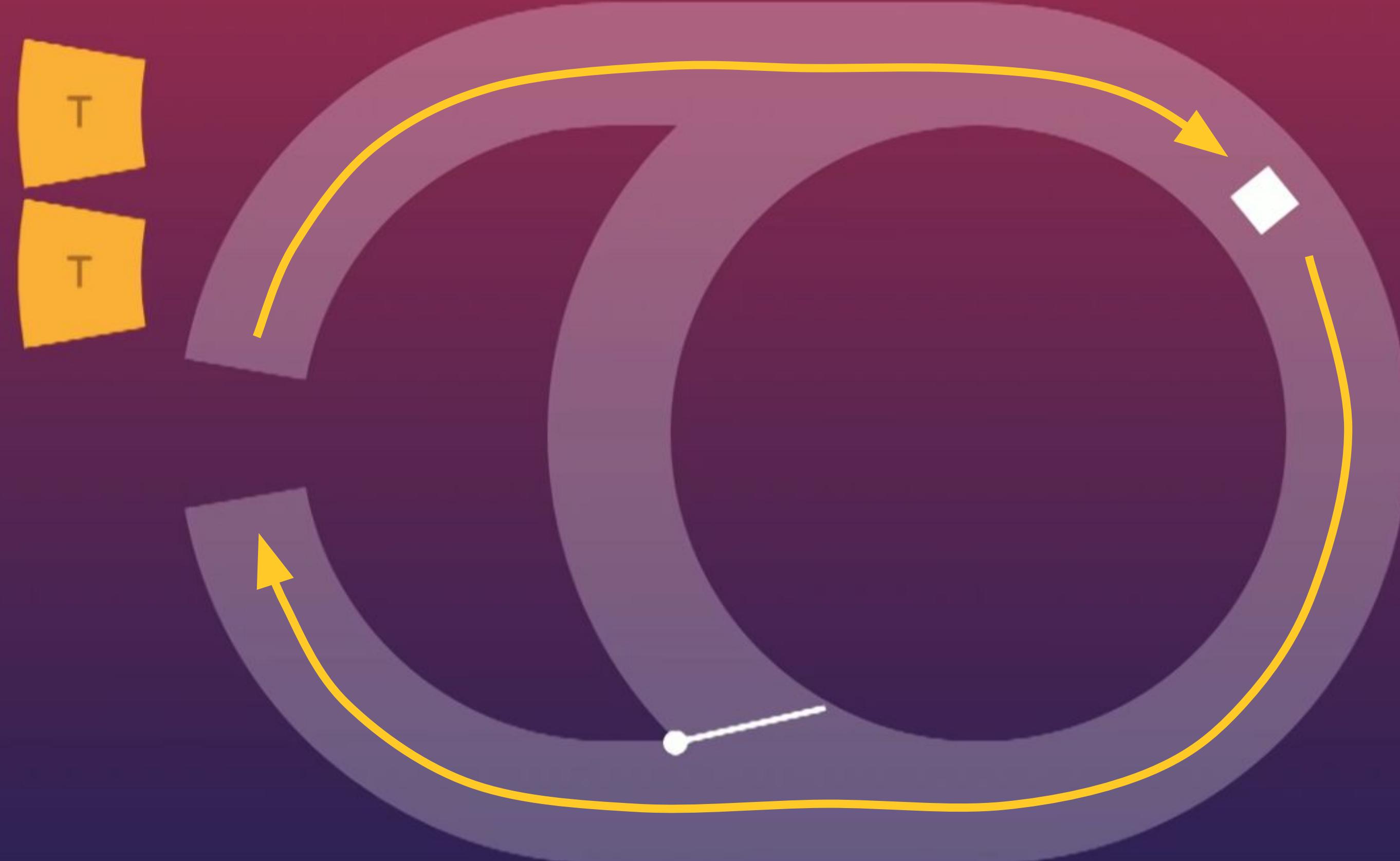


Animation Frame Fired		C...
Function Call		
(anonymous)		
_initSlick		
t.fn.slick		relinit
i		string
e.init		o.a.fn...ation
	e.che...nsive	each
	e.refresh	each
	e.init	(anonymous)
	e...	value
	i	s
		each



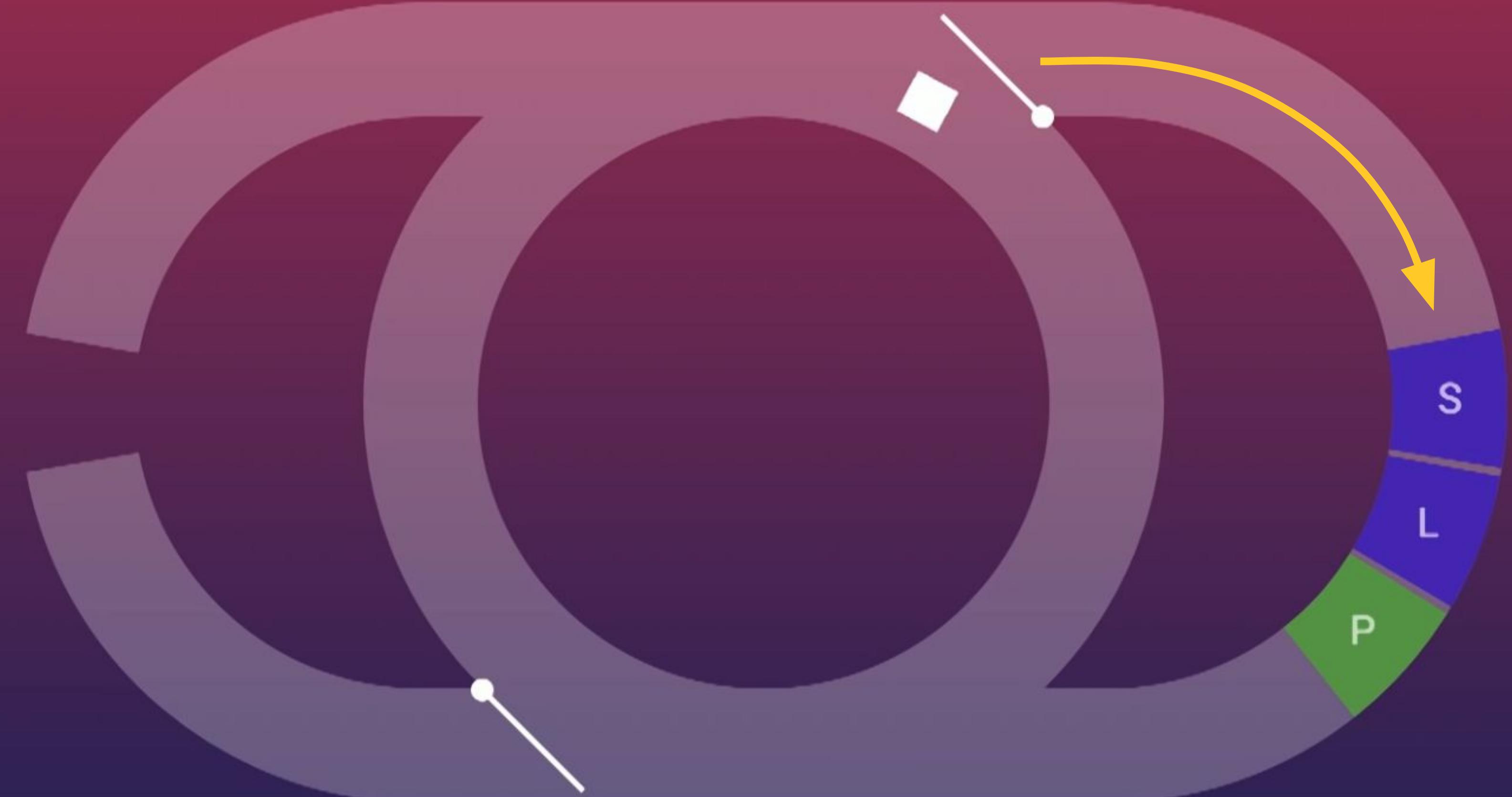
@jaffathecake

Jake Archibald's talk "In the loop" video or Jake's talk, transposed



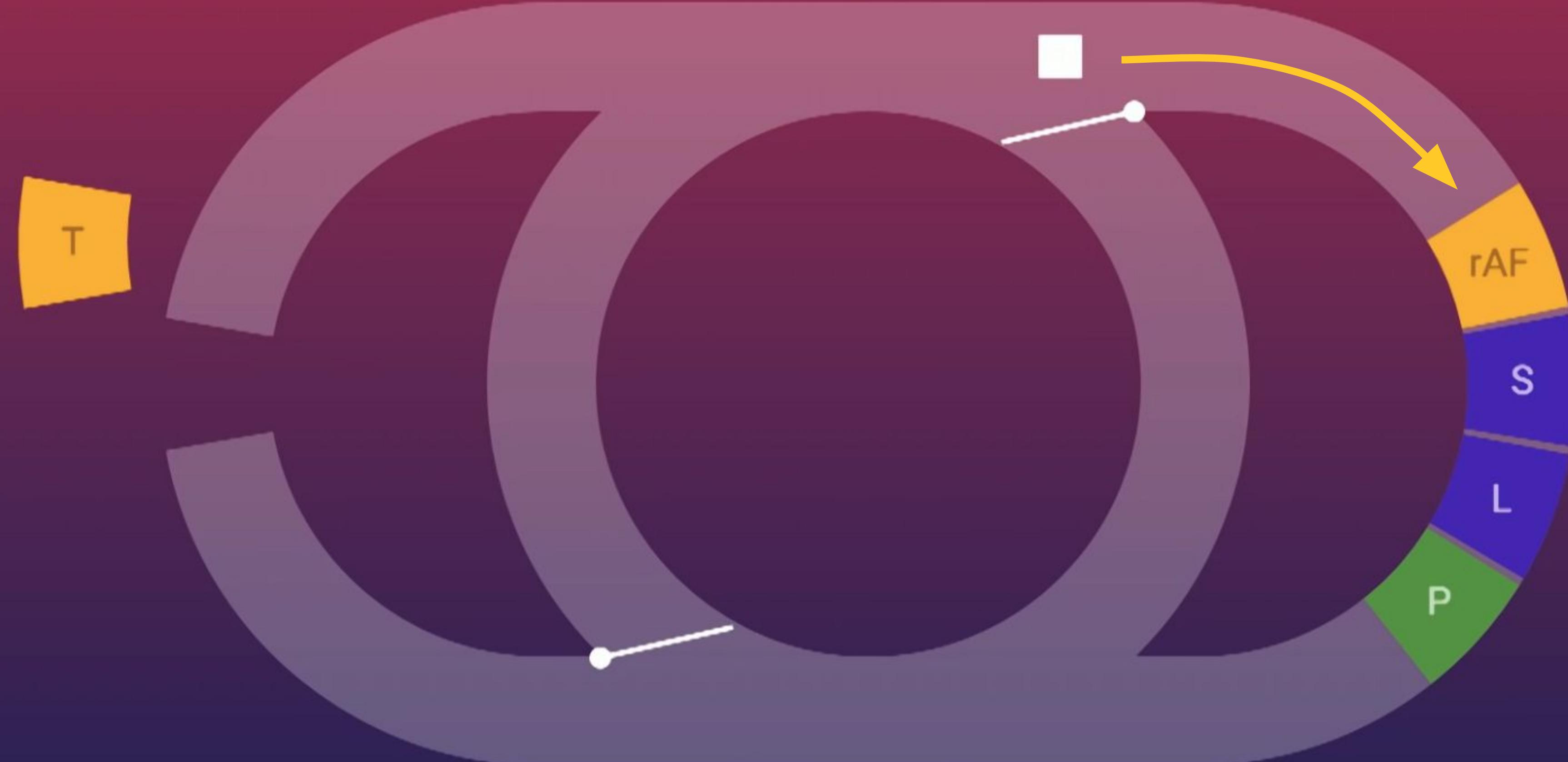
@jaffathecake

Jake Archibald's talk "In the loop" video or Jake's talk, transposed



@jaffathecake

Jake Archibald's talk "In the loop" video or Jake's talk, transposed



@jaffathecake

Jake Archibald's talk "In the loop" video or Jake's talk, transposed



**Don't use `requestAnimationFrame()` for scheduling non-animation work**

**Bonus: Outdated consent  
management platform**

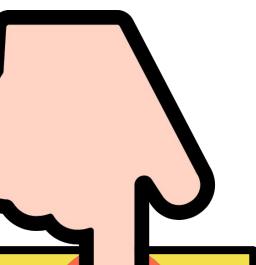
# Landing page

## Cookie preferences

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Cras ornare neque lacus, at blandit magna eleifend ac. Nullam commodo porttitor mi sit amet blandit. Etiam lacinia erat, finibus in luctus ut, varius id nisl.

Aenean interdum erat quis nisi lacinia pharetra. In accumsan dui augue, sed convallis neque fermentum nec. Aliquam erat volutpat. Nunc nunc mi, eleifend sit amet nisl pellentesque, accumsan ultricies nunc. Ut a congue arcu, in aliquam lectus.

Donec accumsan orci leo, vel sollicitudin erat scelerisque in. Nam facilisis ac purus sed ullamcorper. Pellentesque sodales interdum aliquet.



No, thanks

Accept all

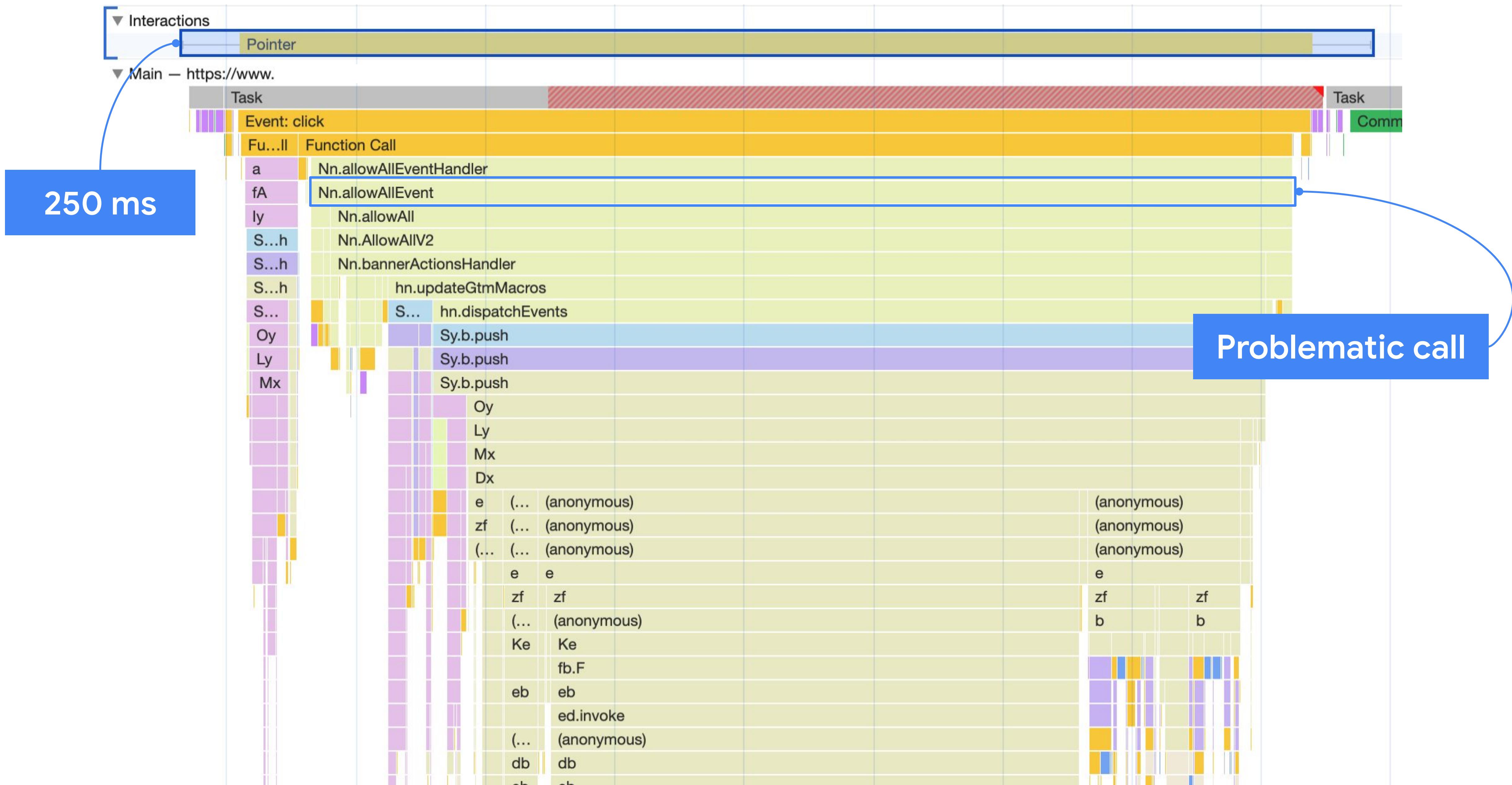
## Landing page

250 ms

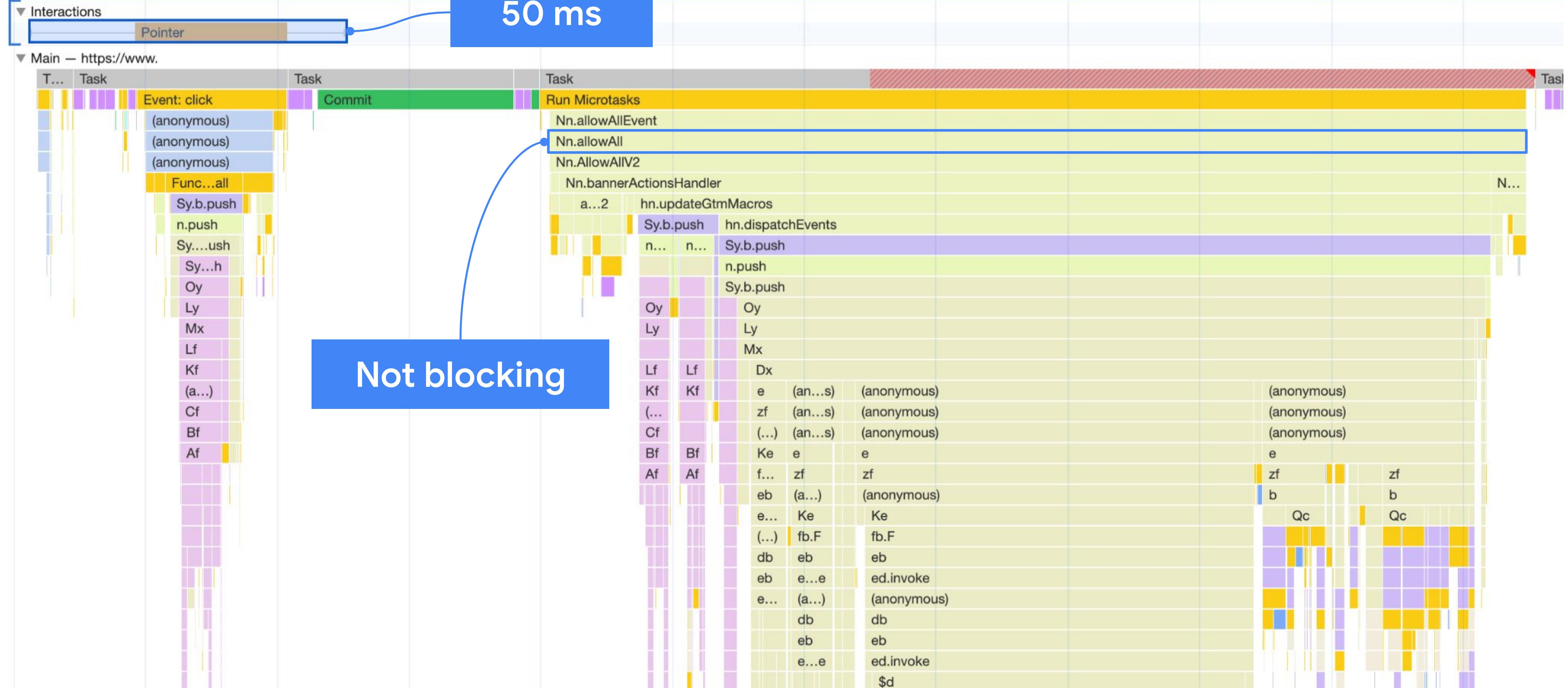
## Wow text

Nullam dictum lobortis blandit. Fusce a sapien et dolor laoreet dignissim eget vitae metus. Etiam quis orci sollicitudin, interdum arcu eu, hendrerit nisl.

Maecenas vitae lacinia nisi. In porta, nunc nec sodales suscipit, diam nunc placerat odio, at posuere turpis sapien a lacus. Integer varius ornare lectus egestas commodo.



50 ms





**Keep your consent management  
platform updated**

(or switch to a more performant one)

# Conclusion

# Wrapping up

## Key things to remember

- Debugging slow interactions:  
dev tools, emulate mobile, slow down  
CPU, record with performance panel
- RUM data is suuuuper helpful  
because of INP attribution
- Yield to the main thread before  
long-running functions (tracking, etc.)
- Be kind with your DOM. Avoid forcing  
style / layout recalculation
- Use requestAnimationFrame() only for  
scheduling animation work
- Keep your cookie management  
platform updated

# Thank you!

Questions?



👉 Feedback is appreciated





How to optimize INP - web.dev  
<https://web.dev/explore/how-to-optimize-inp>



Optimizing INP for a React App & Performance Learnings - TK  
<https://www.iamtk.co/optimizing-inp-for-a-react-app-and-performance-learnings>



Optimize for INP Deep Dive



Web Performance

Optimizing INP: A deep dive  
Chrome for developers



Troubleshoot slow interactions  
Jeremy Wagner



In the loop, JS Conf Asia  
Jake Archibald