Diagnose Forced Synchronous Layouts

By Kayce Basques

Technical Writer for Chrome DevTools

By Meggin Kearney

Meggin is a Tech Writer

Warning: This page is deprecated. See Get Started With Analyzing Runtime Performance for an up-to-date tutorial on forced synchronous layouts.

Learn how to use DevTools to diagnose forced synchronous layouts.

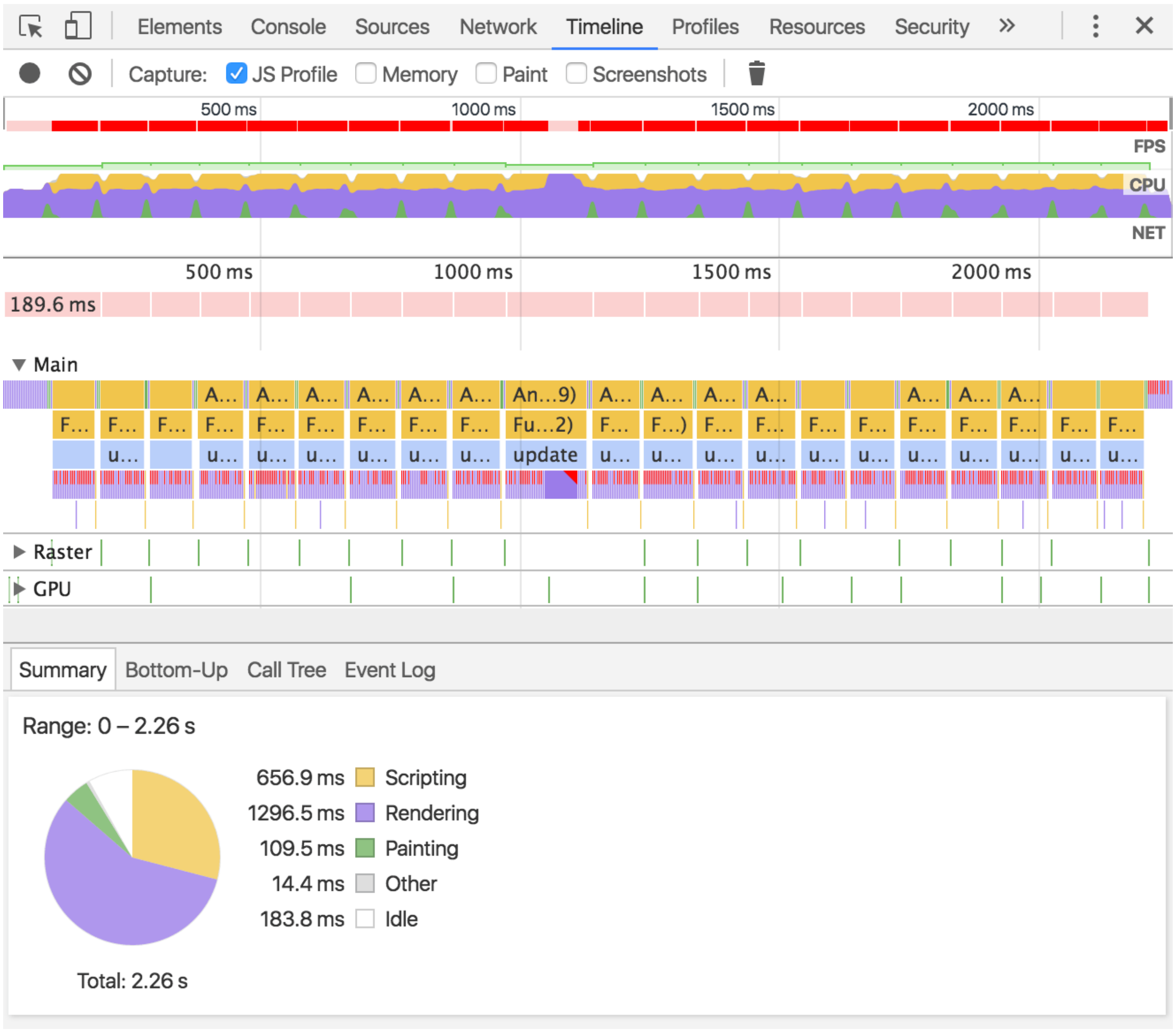
In this guide you learn how to debug forced synchronous layouts by identifying and fixing issues in a live demo. The demo animates images using `requestAnimationFrame()`, which is the recommended approach for frame-based animation. However, there's a considerable amount of jank in the animation. Your goal is to identify the cause of the jank and fix the issue so that the demo runs at a silky-smooth 60 FPS.

Gather data

First, you need to capture data so that you can understand exactly what happens as your page runs.

1. Open the demo.
2. Open the **Timeline** panel of DevTools.
3. Enable the **JS Profile** option. When analyzing the flame chart later, this option will let you see exactly which functions were called.
4. Click **Start** on the page to start the animation.
5. Click the **Record** button on the Timeline panel to start the Timeline recording.
6. Wait two seconds.
7. Click the **Record** button again to stop the recording.

When you are finished recording you should see something like the following on the Timeline panel.



Capture: ✓ JS Profile ☐ Memory ☐ Paint ☐ Screenshots

Range: 0 – 2.26 s

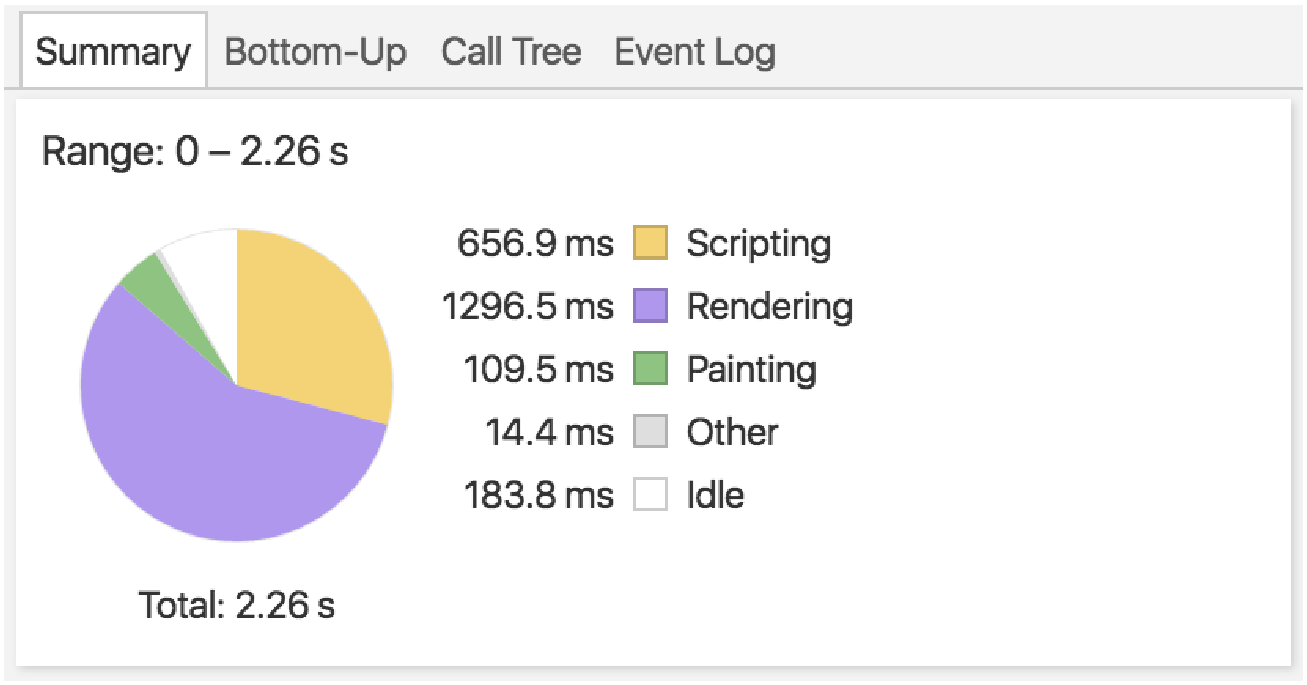
656.9 ms	🟨	Scripting
1296.5 ms	🟪	Rendering
109.5 ms	🟩	Painting
14.4 ms	⬜	Other
183.8 ms	⬜	Idle

Total: 2.26 s

Identify problem

Now that you have your data, it's time to start making sense of it.

At a glance, you can see in the **Summary** pane of your Timeline recording that the browser spent most of its time rendering. Generally speaking, if you can optimize your page's layout operations, you may be able to reduce time spent rendering.

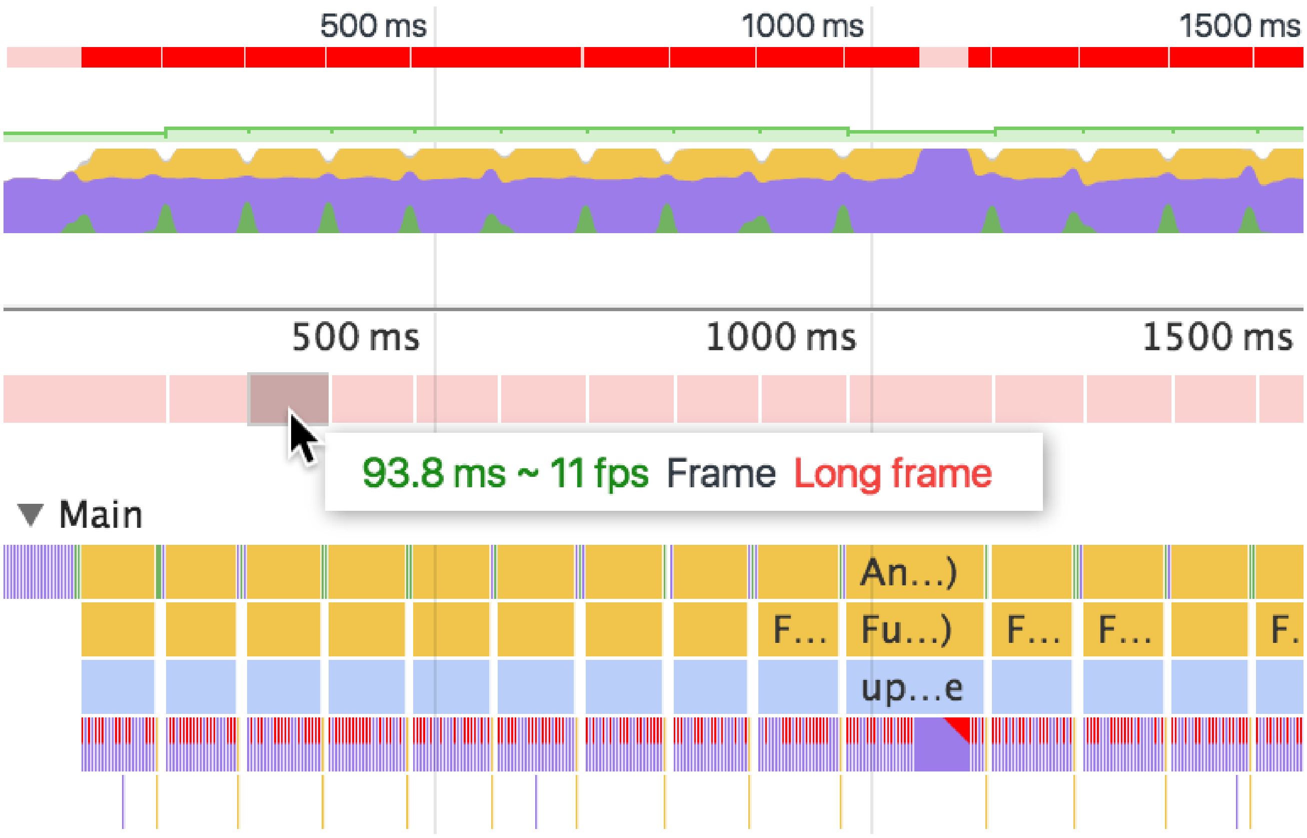


Range: 0 – 2.26 s

656.9 ms	🟨	Scripting
1296.5 ms	🟪	Rendering
109.5 ms	🟩	Painting
14.4 ms	⬜	Other
183.8 ms	⬜	Idle

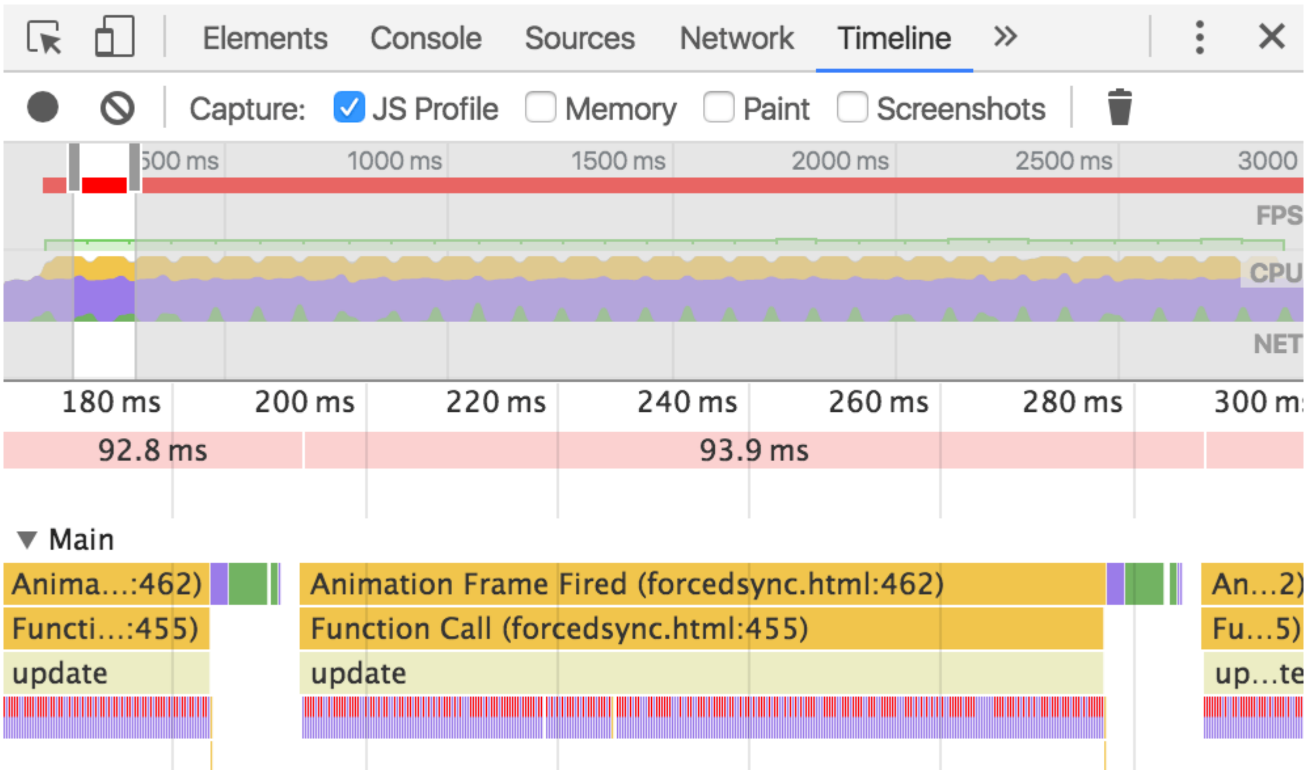
Total: 2.26 s

Now move your attention to the pink bars just below the **Overview** pane. These represent frames. Hover over them to see more information about the frame.



The frames are taking a long time to complete. For smooth animations you want to target 60 FPS.

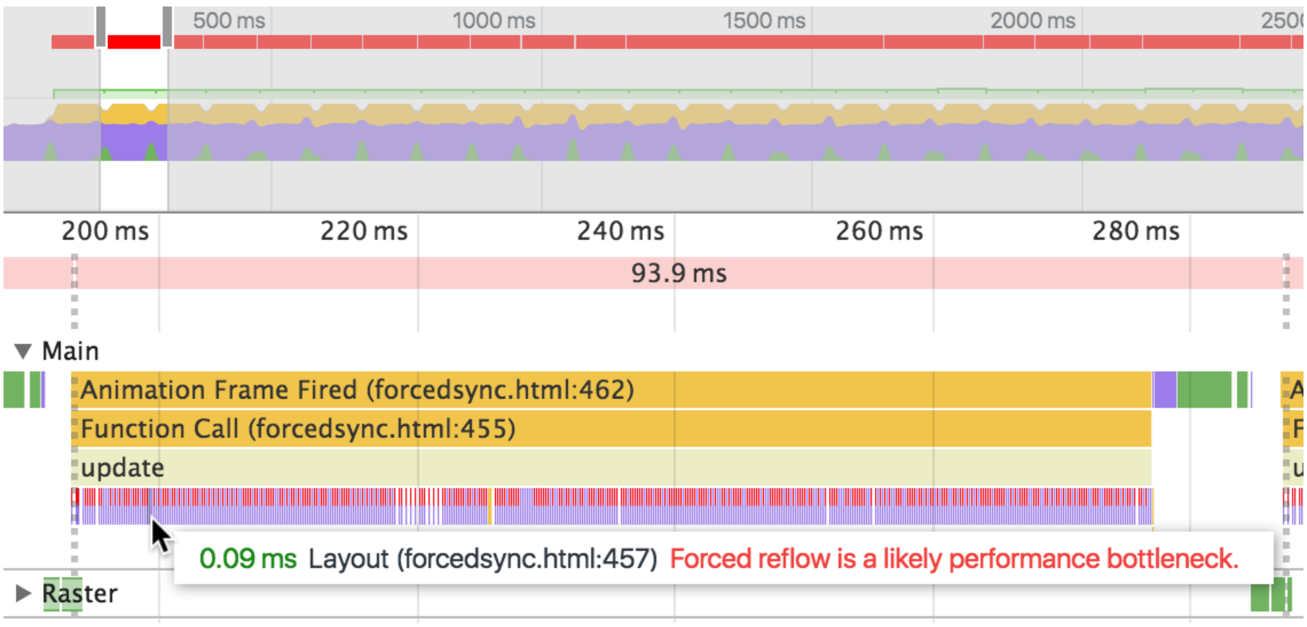
Now it's time to diagnose exactly what is wrong. Using your mouse, zoom in on a call stack.



The top of the stack is an **`Animation Frame Fired`** event. The function that you passed to **`requestAnimationFrame()`** is called whenever this event is fired. Below **`Animation Frame Fired`** you see **`Function Call`**, and below that you see **`update`**. You can infer that a method called **`update()`** is the callback for **`requestAnimationFrame()`**.

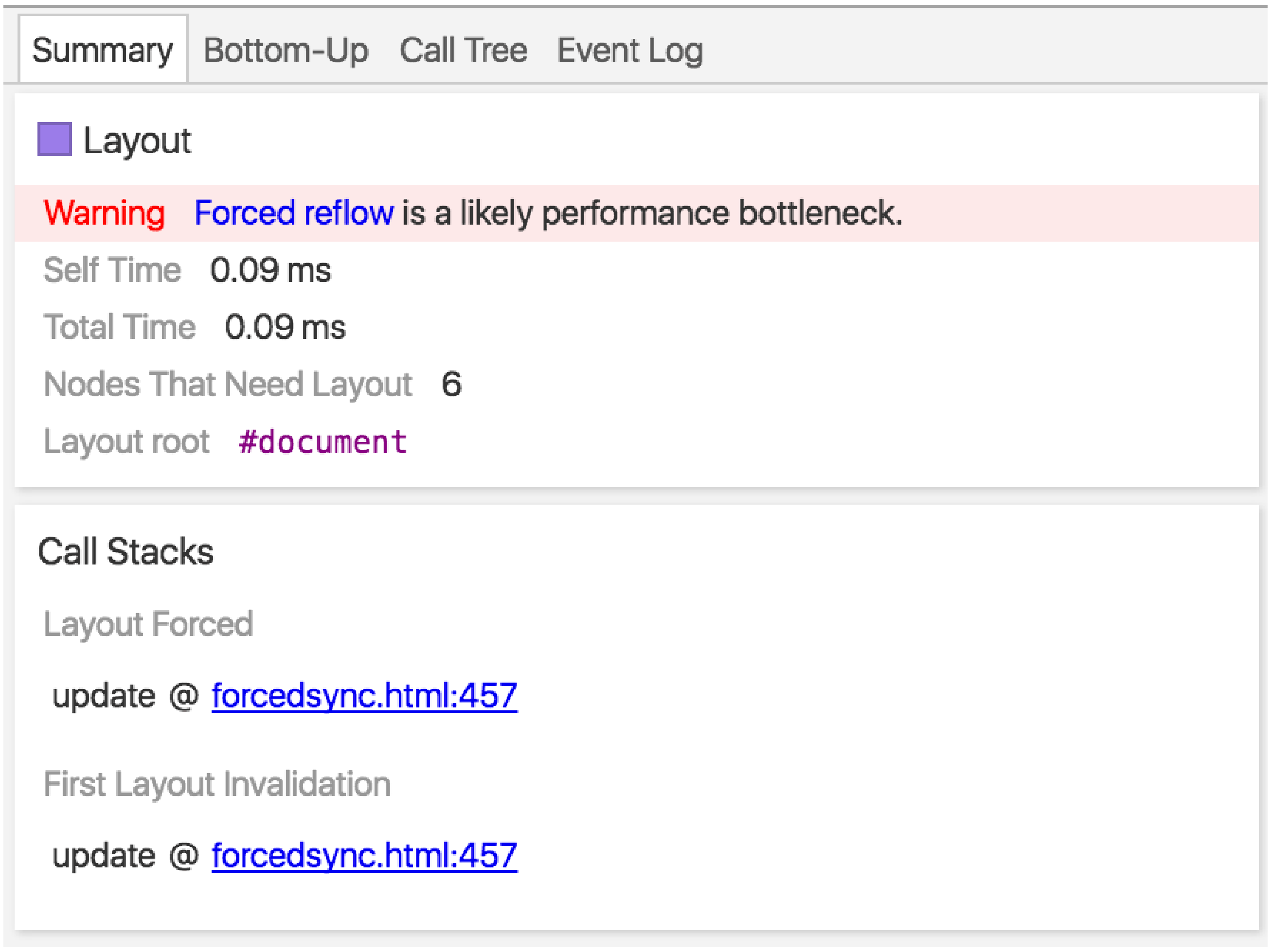
Note: This is where the **JS Profile** option that you enabled earlier is useful. If it was disabled, you would just see `Function Call`, followed by all the small purple events (discussed next), without details on exactly which functions were called.

Now, focus your attention on all of the small purple events below the **`update`** event. The top part of many of these events are red. That's a warning sign. Hover over these events and you see that DevTools is warning you that your page may be a victim of forced reflow. Forced reflow is just another name for forced synchronous layouts.



Animation Frame Fired (forcedsync.html:462)
Function Call (forcedsync.html:455)
update
0.09 ms Layout (forcedsync.html:457) Forced reflow is a likely performance bottleneck.

Now it's time to take a look at the function which is causing all of the forced synchronous layouts. Click on one of the layout events to select it. In the Summary pane you should now see details about this event. Click on the link under **Layout Forced** (`update @ forcedsync.html:457`) to jump to the function definition.



Layout

Warning Forced reflow is a likely performance bottleneck.

Self Time	0.09 ms
Total Time	0.09 ms
Nodes That Need Layout	6
Layout root	#document

Call Stacks

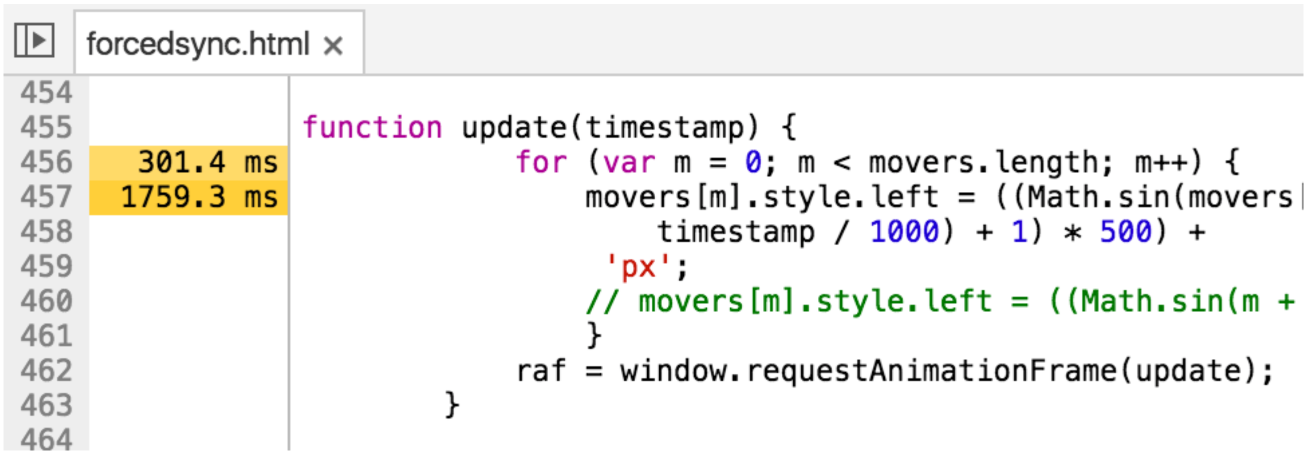
Layout Forced

update @ forcedsync.html:457

First Layout Invalidation

update @ forcedsync.html:457

You should now see the function definition in the **Sources** panel.



```
function update(timestamp) {
        for (var m = 0; m < movers.length; m++) {
            movers[m].style.left = ((Math.sin(movers
                timestamp / 1000) + 1) * 500) +
            'px';
            // movers[m].style.left = ((Math.sin(m +
        }
        raf = window.requestAnimationFrame(update);
    }
```

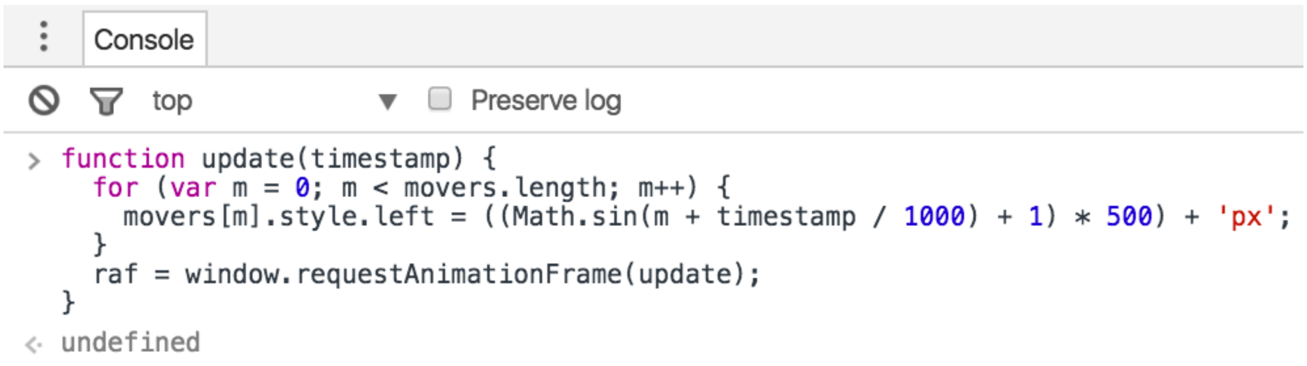
The `update()` function is the callback handler for `requestAnimationCallback()`. The handler computes each image's `left` property based off of the image's `offsetTop` value. This forces the browser to perform a new layout immediately to make sure that it provides the correct value. Forcing a layout during every animation frame is the cause of the janky animations on the page.

So now that you've identified the problem, you can try to fix it directly in DevTools.

Apply fix within DevTools

This script is embedded in HTML, so you can't edit it via the **Sources** panel (scripts in `*.js` can be edited in the Sources panel, however).

However, to test your changes, you can redefine the function in the Console. Copy and paste the function definition from the HTML file into the DevTools Console. Delete the statement that uses `offsetTop` and uncomment the one below it. Press `Enter` when you're done.

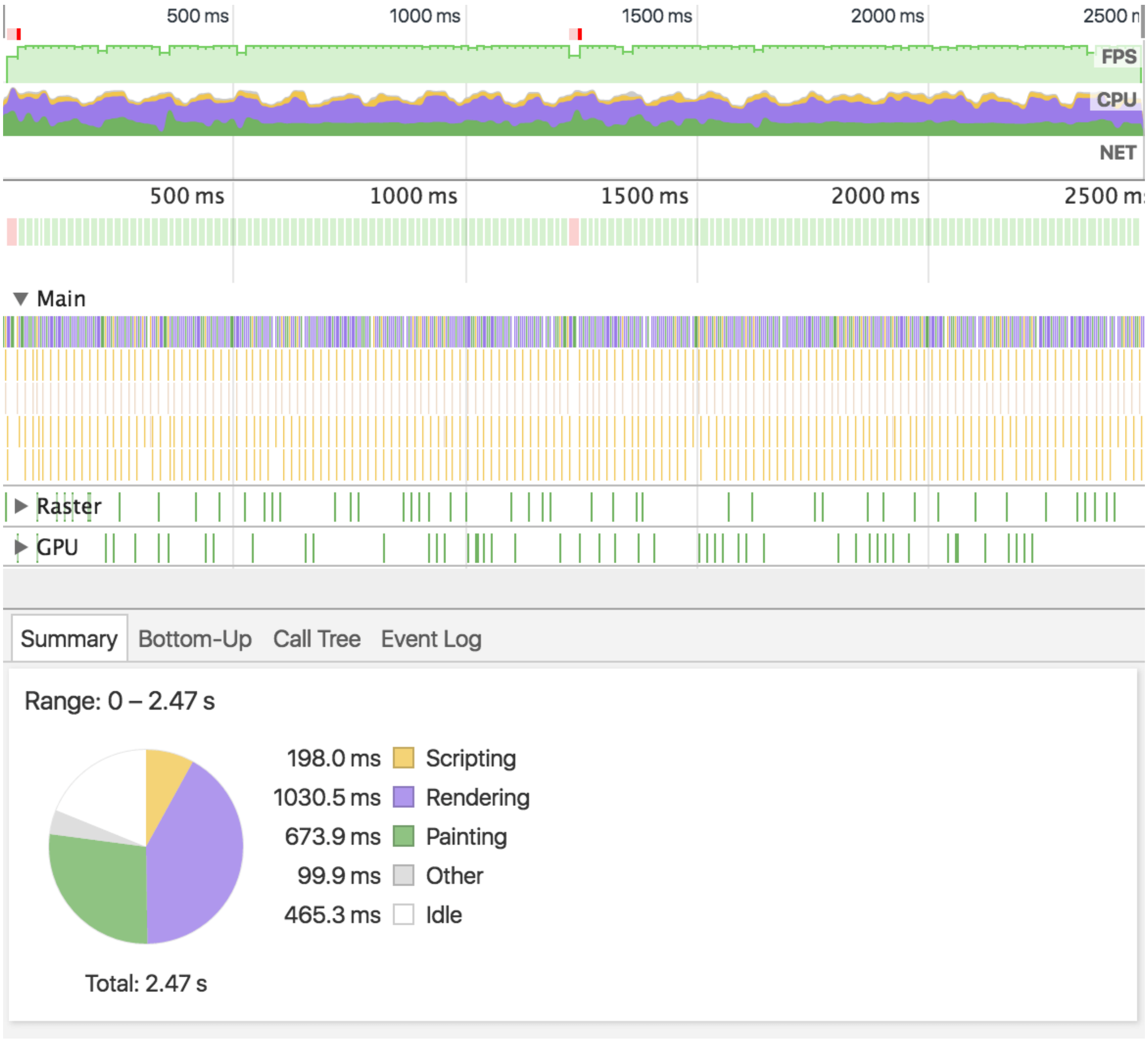


```
> function update(timestamp) {
    for (var m = 0; m < movers.length; m++) {
      movers[m].style.left = ((Math.sin(m + timestamp / 1000) + 1) * 500) + 'px';
    }
    raf = window.requestAnimationFrame(update);
  }
<· undefined
```

Restart the animation. You can verify visually that it's much smoother now.

Verify with another recording

It's always good practice to take another recording and verify that the animation truly is faster and more performant than before.



Range: 0 – 2.47 s

198.0 ms	🟨	Scripting
1030.5 ms	🟪	Rendering
673.9 ms	🟩	Painting
99.9 ms	⬜	Other
465.3 ms	⬜	Idle

Total: 2.47 s

Much better.

Last updated July 2, 2018.