

#WWDC19

# Getting Started with Instruments

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Responsiveness





Great user experience





Measure







Orientation

Profiling your app

Using Signposts

Orientation

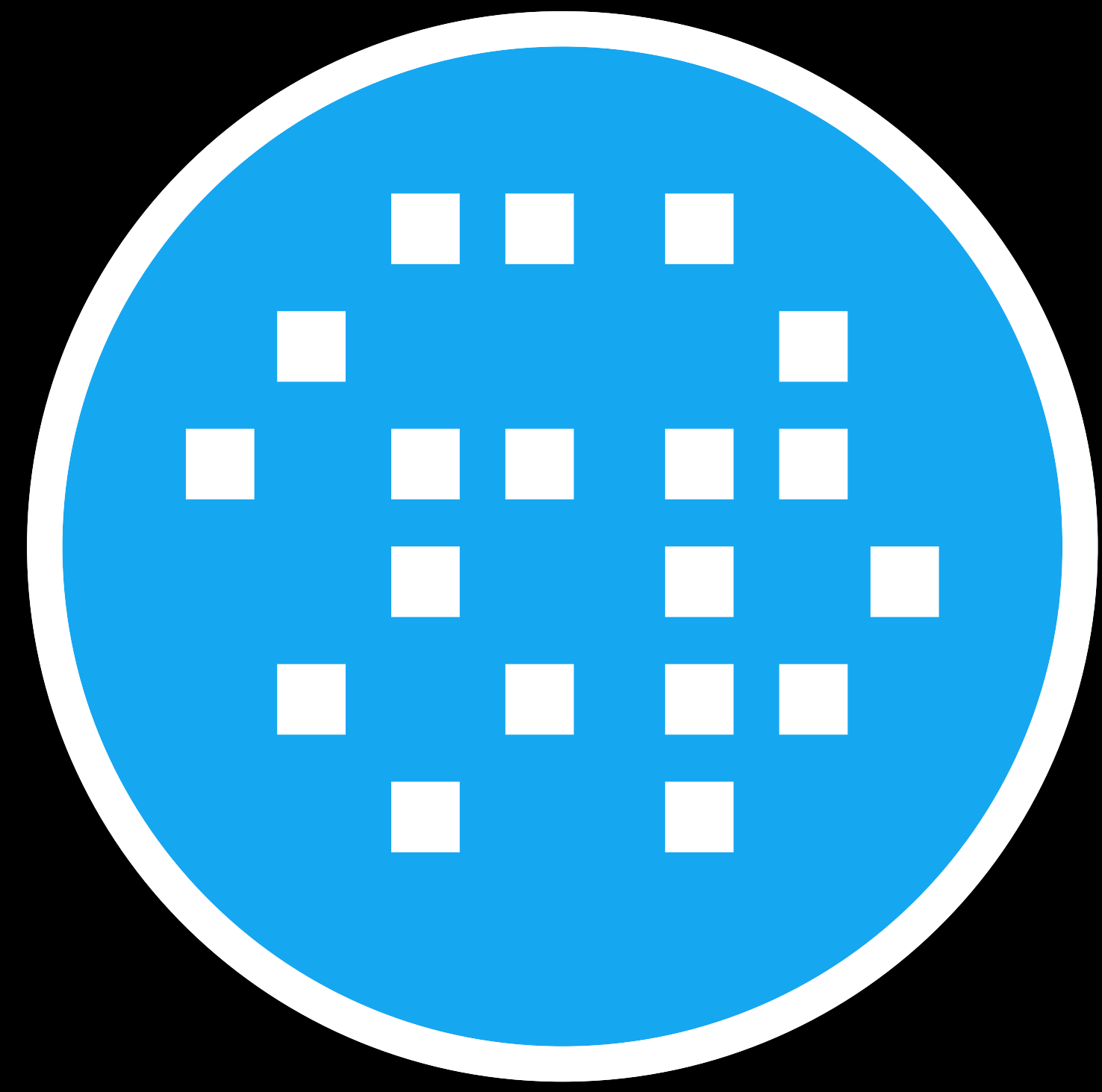
Profiling your app

Using Signposts



Product	
Run	⌘R
Test	⌘U
Profile	⌘I
Analyze	⇧⌘B
Archive	
Build For	▶
Perform Action	▶
Build	⌘B
Clean Build Folder	⇧⌘K
Stop	⌘.
Scheme	▶
Destination	▶
Test Plan	▶
Create Bot...	







Time Profiler



Points of Interest



Choose a profiling template for: Demo's iMac > Solar System Mac.app

Standard

Custom

Recent

Filter



Blank



Activity Monitor



Allocations



App Launch



Core Animation



Core Data



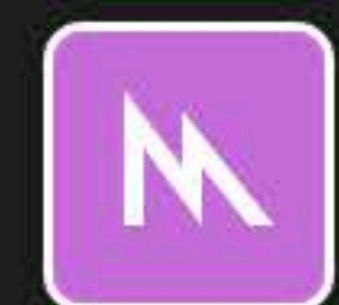
Counters



Energy Log



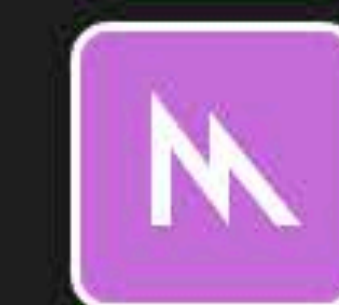
File Activity



Game Performance



Leaks



Metal System Trace



Network



SceneKit



System Trace



Time Profiler



Zombies



Time Profiler

Performs low-overhead time-based sampling of processes running on the system's CPUs.

Open an Existing File...

Cancel

Choose



- Time Profiler** Instrument
- Points of Interest** Instrument
- Thermal State** Instrument

Weight	Self Weight	Symbol Name
No Detail		



00:00.000 00:10.000 00:20.000 00:30.000 00:40.000 00:50.000 01:00.000 01:10.000 01:20.000 01:30.000 01:40.000 01:50.000 02:00.000

- Time Profiler**  
Instrument
- Points of Interest**  
Instrument
- Thermal State**  
Instrument

Weight	Self Weight	Symbol Name
No Detail		

Time Profiler interface showing various instruments and a list of system activity monitors.

Time Profiler Instruments list:

- Time Profiler (Instrument)
- Points of Interest (Instrument)
- Thermal State (Instrument)

Time Profiler > Profile > Root

Weight Self Weight Symbol Name

Activity Monitor List:

- Activity Monitor** - Measures system and process activity.
- Advanced Graphics Statistics** - Views graphics, driver-specific counters. These metrics are low level and OS/hardware dependent.
- Allocations** - Analyzes the memory life-cycle of process' allocated blocks; can record reference counting events.
- Bluetooth On/Off Log** - Tracks when the Bluetooth is enabled.
- Brightness Log** - Tracks the brightness level of the display.
- Core Animation Commits** - Tracks CoreAnimation commit intervals
- Core Animation FPS** - Graphs the estimated Core Animation frames per second.
- Core Data Faults** - Displays information about fault firing in Core Data.
- Core Data Fetches** - Displays information about Core Data fetch activity.
- Core Data Saves** - Displays information about Core Data save activity.
- Counters** - Collects performance counter (PMC) data from running threads on all cores based on regular time intervals.
- CPU Activity Log** - Helps determine if the energy consumption is related to CPU activity.

Filter

Time Profiler interface showing a timeline and instrument list.

**Timeline:** 00:00.000 | 00:10.000 | 00:20.000 | 00:30.000 | 00:40.000 | 00:50.000 | 01:00.000 | 01:10.000 | 01:20.000 | 01:30.000 | 01:40.000 | 01:50.000 | 02:00.000

**Instrument List:**

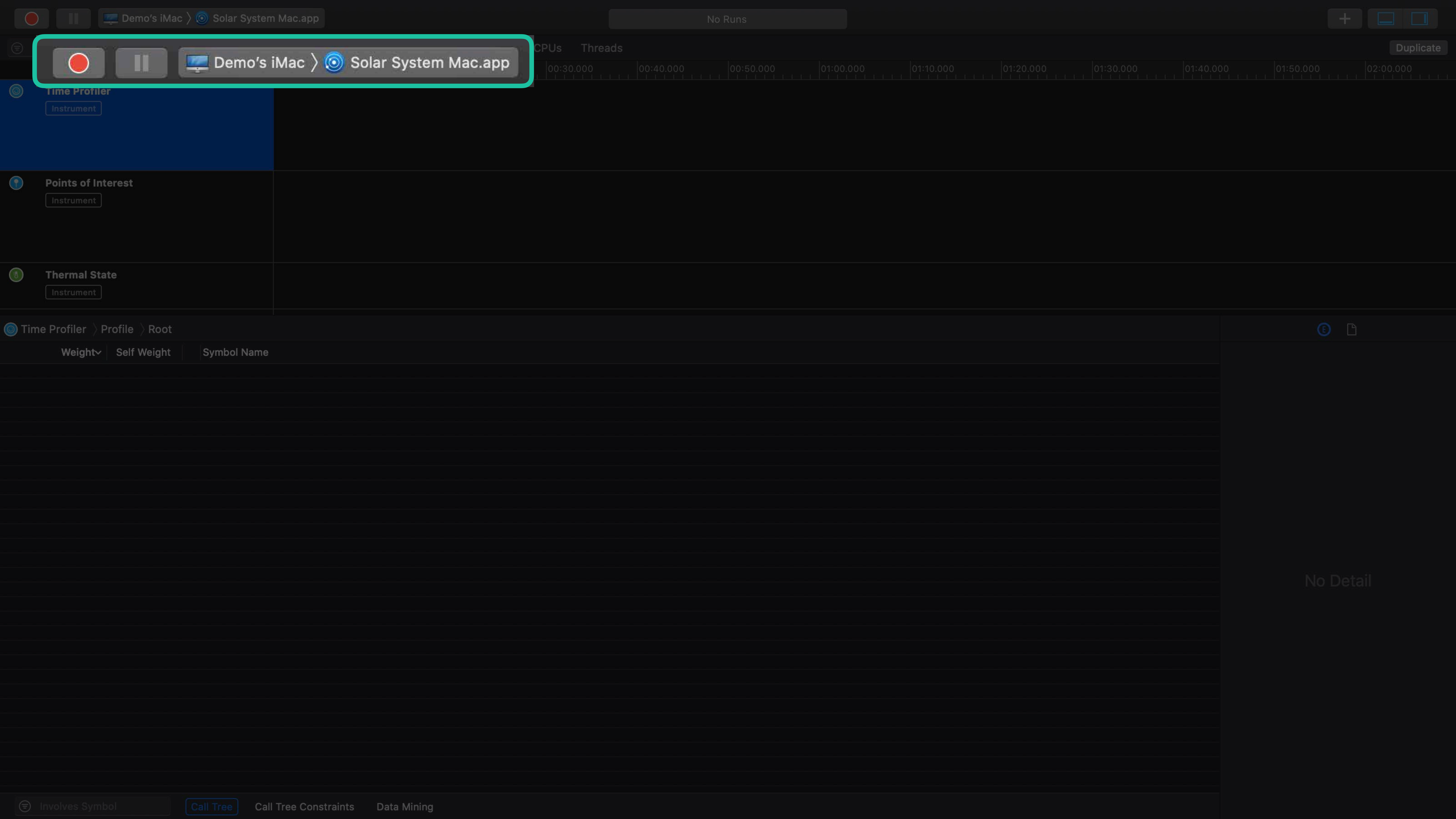
- Time Profiler (Instrument)
- Points of Interest (Instrument)
- Thermal State (Instrument)

**Navigation:** Time Profiler > Profile > Root

**Table Headers:** Weight, Self Weight, Symbol Name

**Bottom Panel:** Involves Symbol | Call Tree | Call Tree Constraints | Data Mining

**Right Panel:** No Detail



⏹️ ⏸️ Demo's iMac > Solar System Mac.app

No Runs

+ 🖥️ 📄

CPUs Threads  
00:30.000 00:40.000 00:50.000 01:00.000 01:10.000 01:20.000 01:30.000 01:40.000 01:50.000 02:00.000 Duplicate

- Time Profiler  
Instrument
- Points of Interest  
Instrument
- Thermal State  
Instrument

Time Profiler > Profile > Root

Weight Self Weight Symbol Name

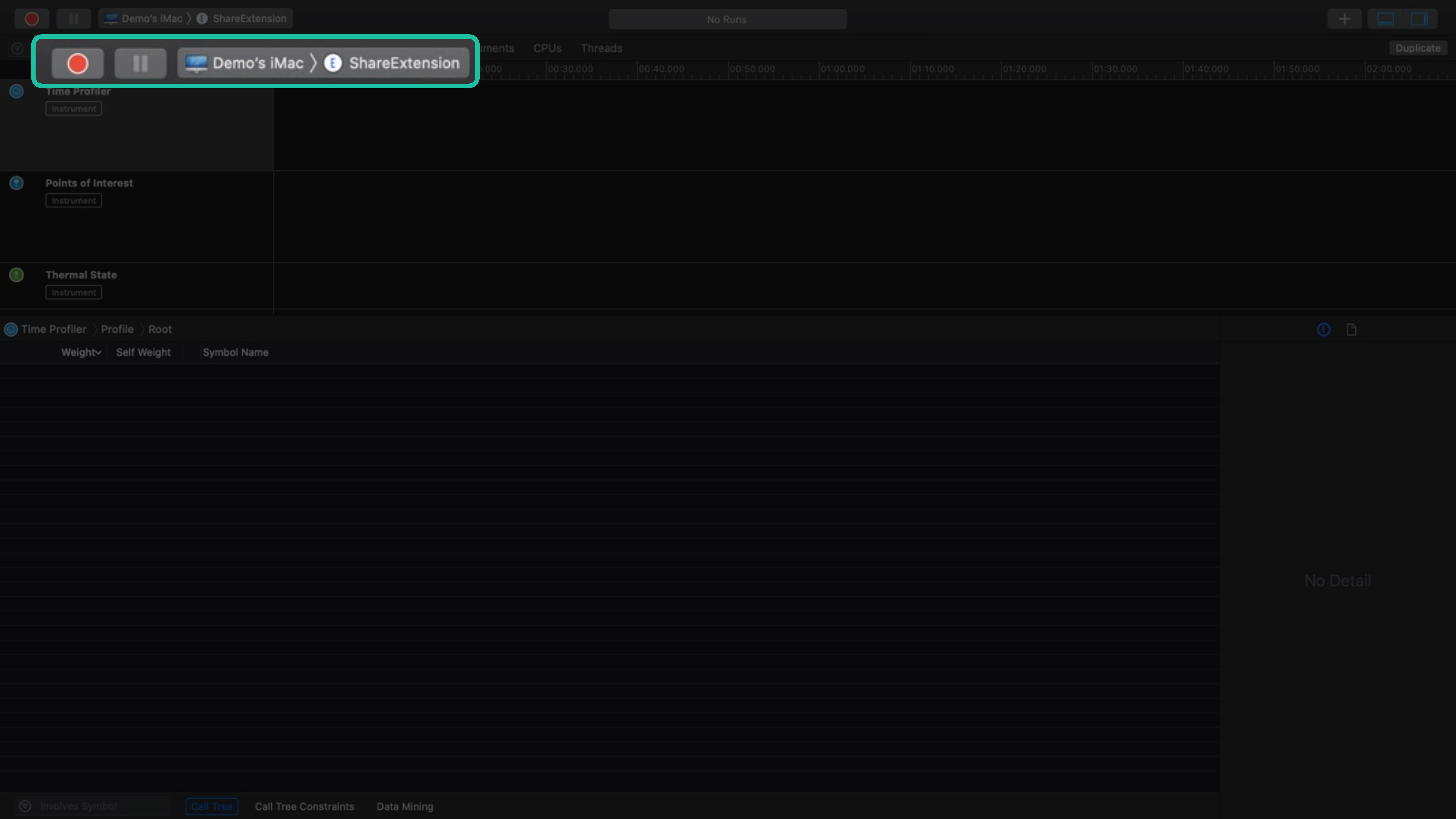
🔍 📄

No Detail

Involves Symbol Call Tree Call Tree Constraints Data Mining







00:00.000 00:10.000 00:20.000 00:30.000 00:40.000 00:50.000 01:00.000 01:10.000 01:20.000 01:30.000 01:40.000 01:50.000 02:00.000

- Time Profiler** Instrument
- Points of Interest** Instrument
- Thermal State** Instrument

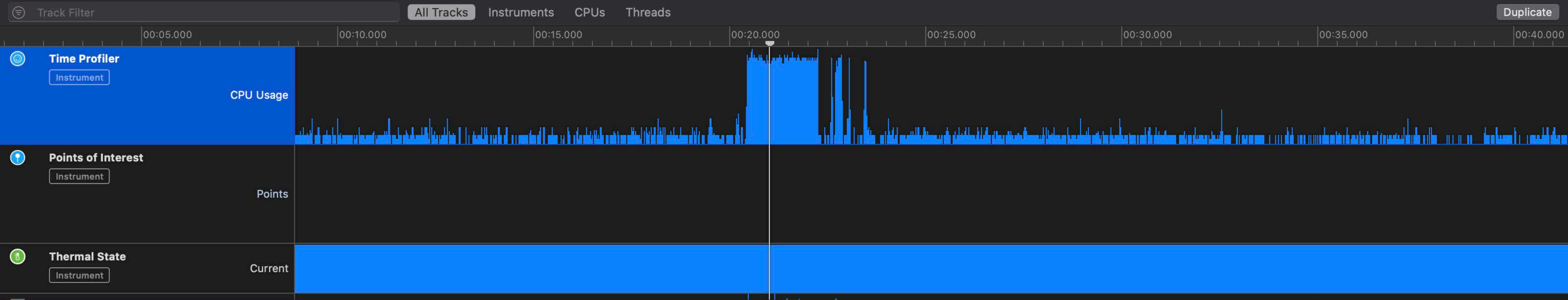
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No Detail		

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- Time Profiler** Instrument
- Points of Interest** Instrument
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No Detail		

Recording in Windowed Mode



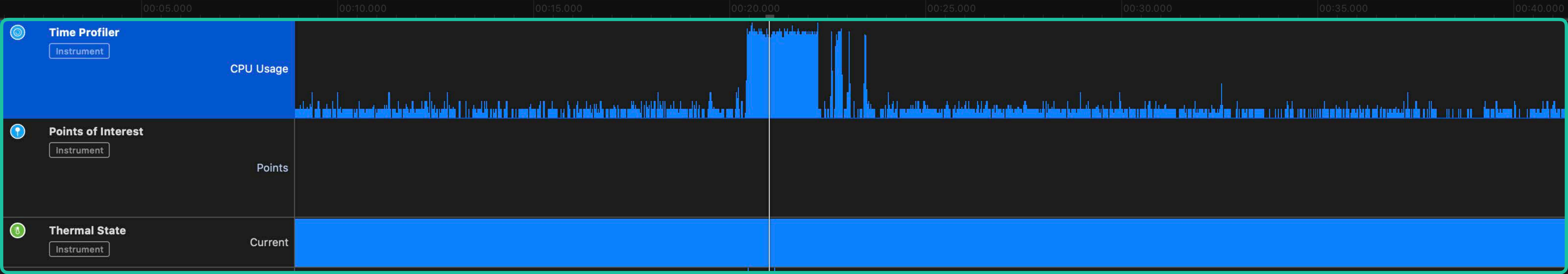
Time Profiler > Profile > Root

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7.55 s 100.0%	0 s	▼ Solar System Mac (11840) Ⓡ
5.91 s 78.2%	0 s	▶ Main Thread 0x724be
629.00 ms 8.3%	0 s	▶ _NSEventThread 0x72608
254.00 ms 3.3%	0 s	▶ _dispatch_workloop_worker_thread 0x725fc
223.00 ms 2.9%	0 s	▶ _dispatch_worker_thread2 0x72600
215.00 ms 2.8%	0 s	▶ _dispatch_worker_thread2 0x725fd
192.00 ms 2.5%	0 s	▶ _dispatch_workloop_worker_thread 0x72607
119.00 ms 1.5%	0 s	▶ CVDisplayLink::runIOThread 0x72605
12.00 ms 0.1%	0 s	▶ _dispatch_workloop_worker_thread 0x725ff

ⓘ 📄

Heaviest Stack Trace 🔍

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- 3170 SceneController.prepareScene()
- 3154 SceneController.setupScene()
- 1730 NSArray.\_\_allocating\_init(content
- 1730 @nonobjc NSArray.init(contents

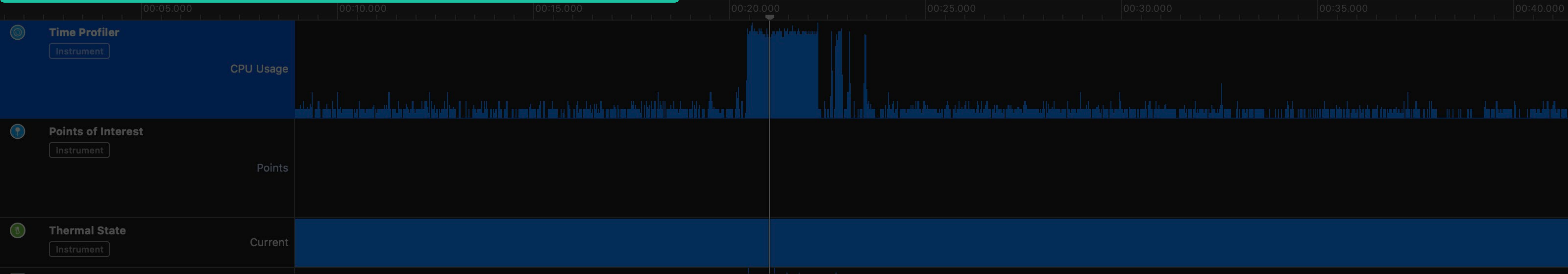


Time Profiler > Profile > Root

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Heaviest Stack Trace

7554	Solar System Mac (11840)
5910	Main Thread 0x724be
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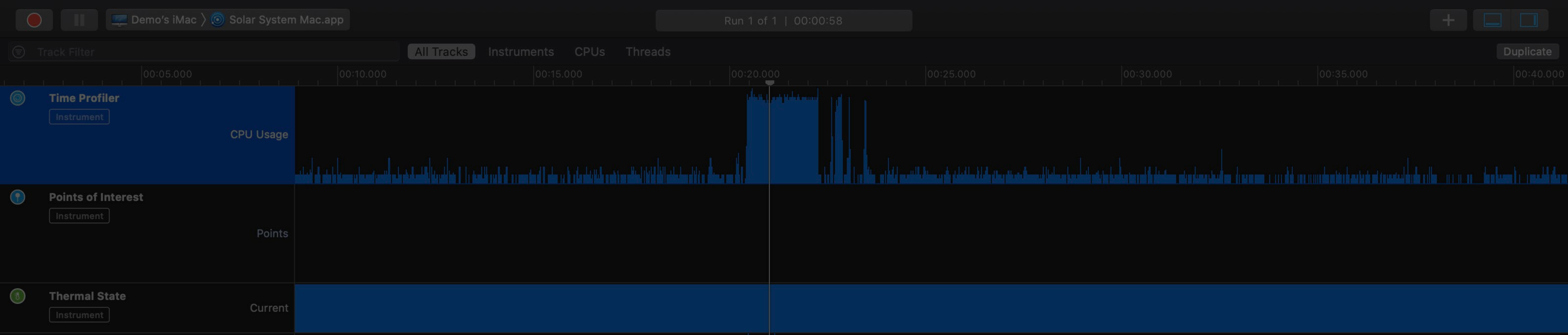


Time Profiler > Profile > Root

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Time Profiler > Profile > Root

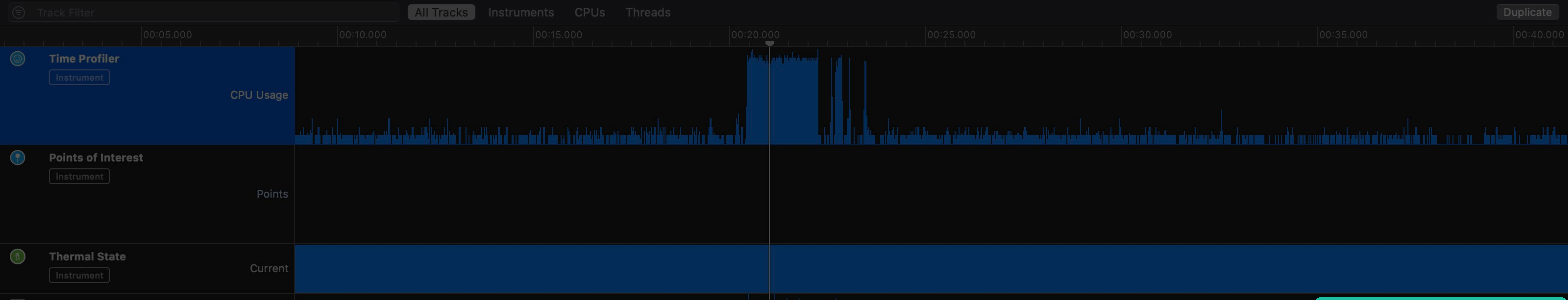
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Input Filter: Involves Symbol | **Call Tree** | Call Tree Constraints | Data Mining

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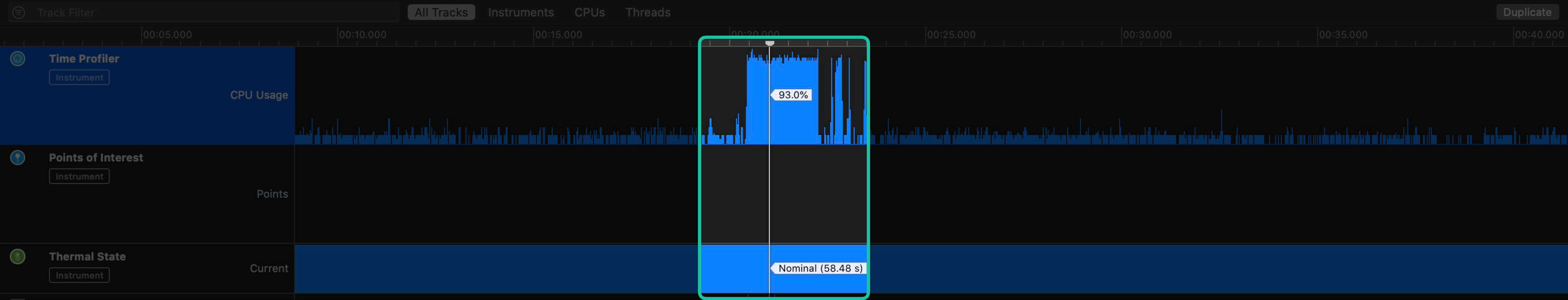


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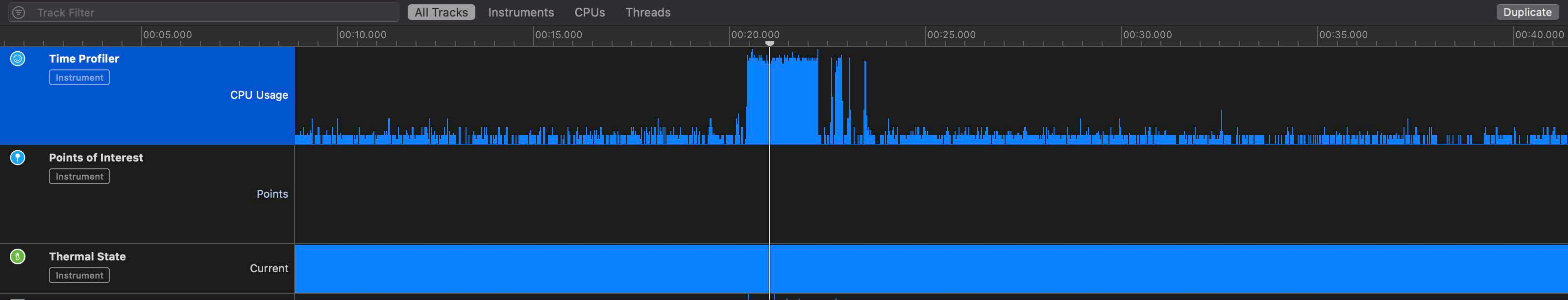


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***Demo***

Profiling your app

Ben Mitchell, Xcode Engineer

# Profiling Tips

# Profiling Tips

Time Profiler shows how your app is spending time

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Check main thread when responsiveness issues occur

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Time Profiler shows how your app is spending time

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Profile release builds



# Profiling Tips

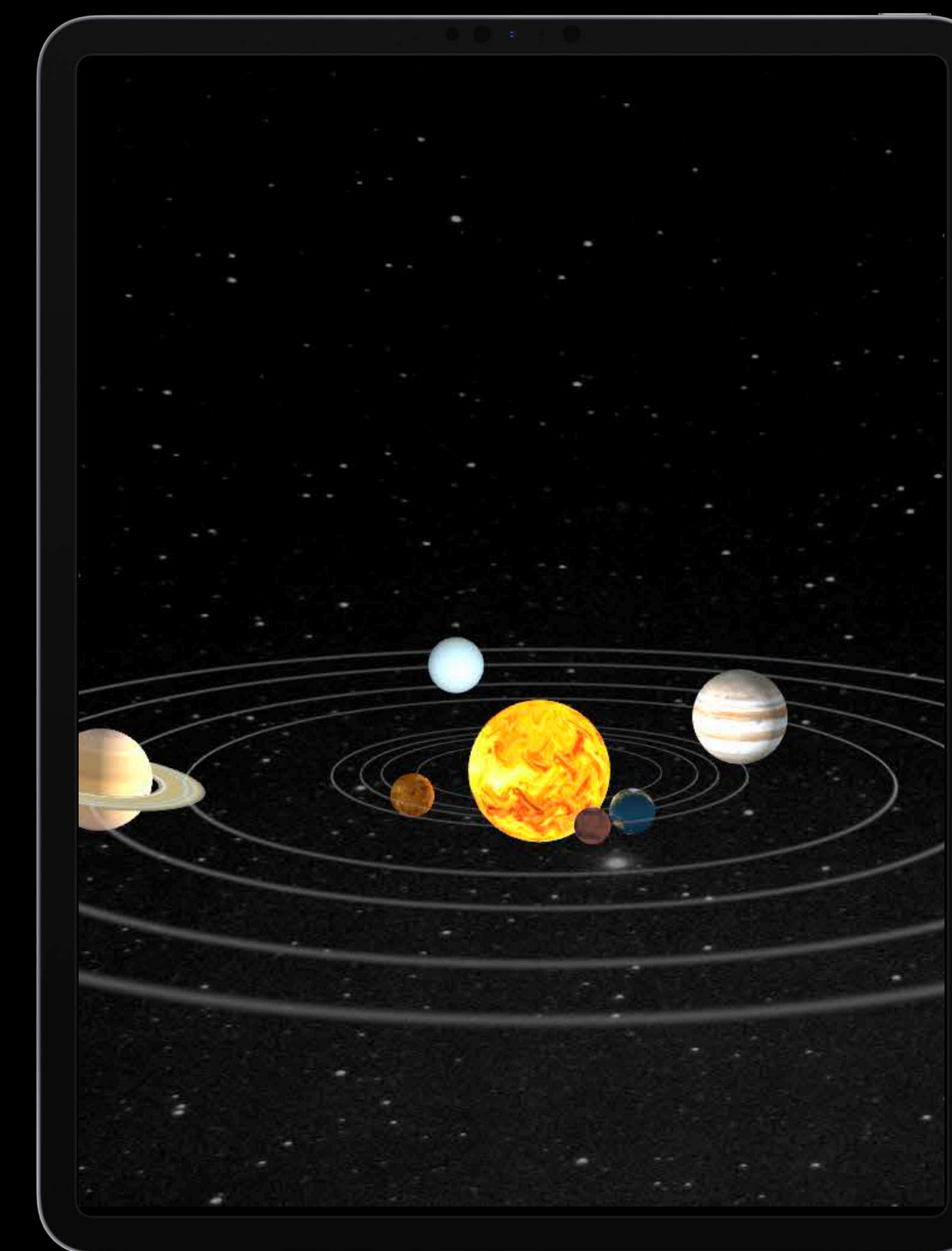
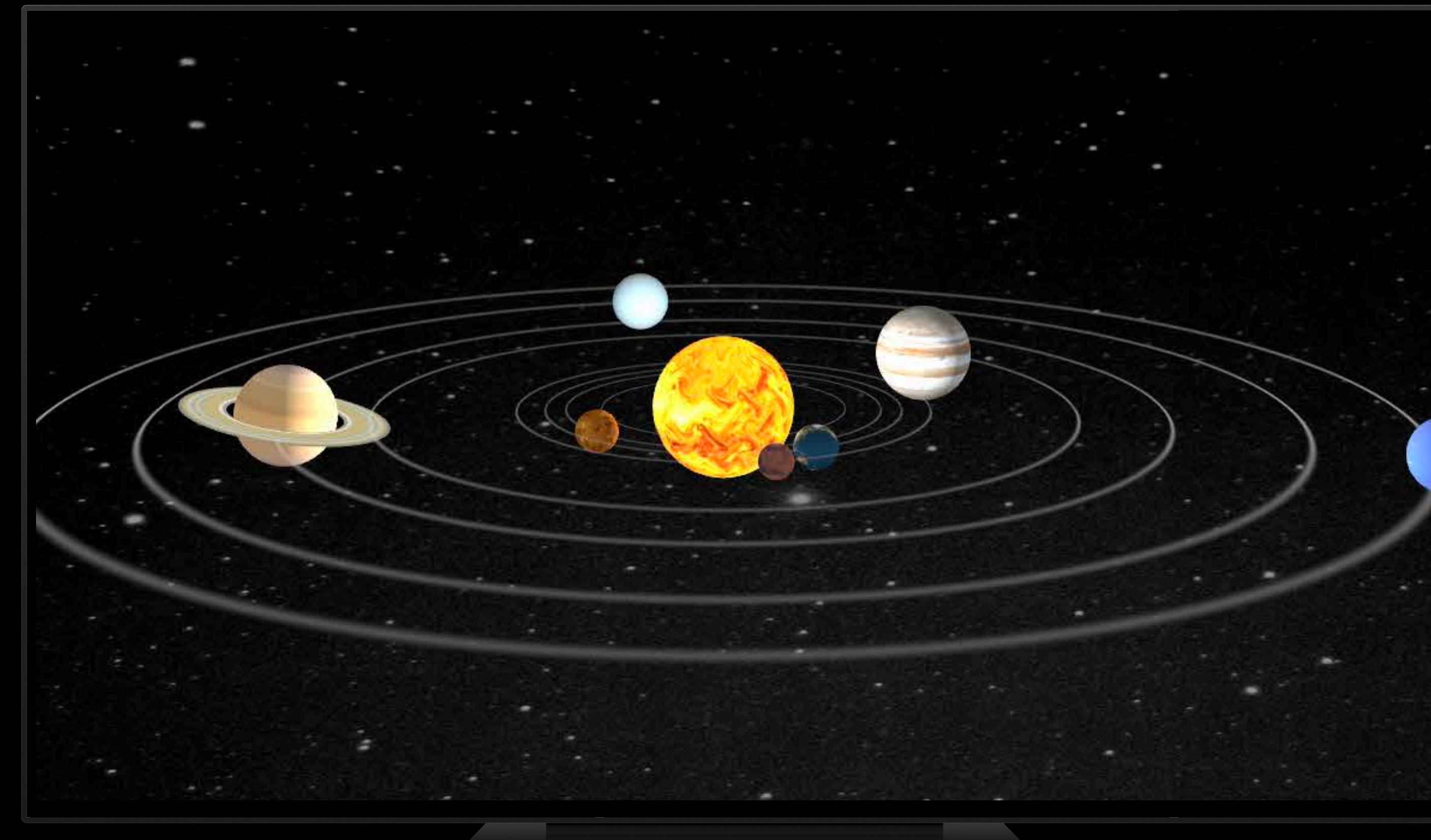
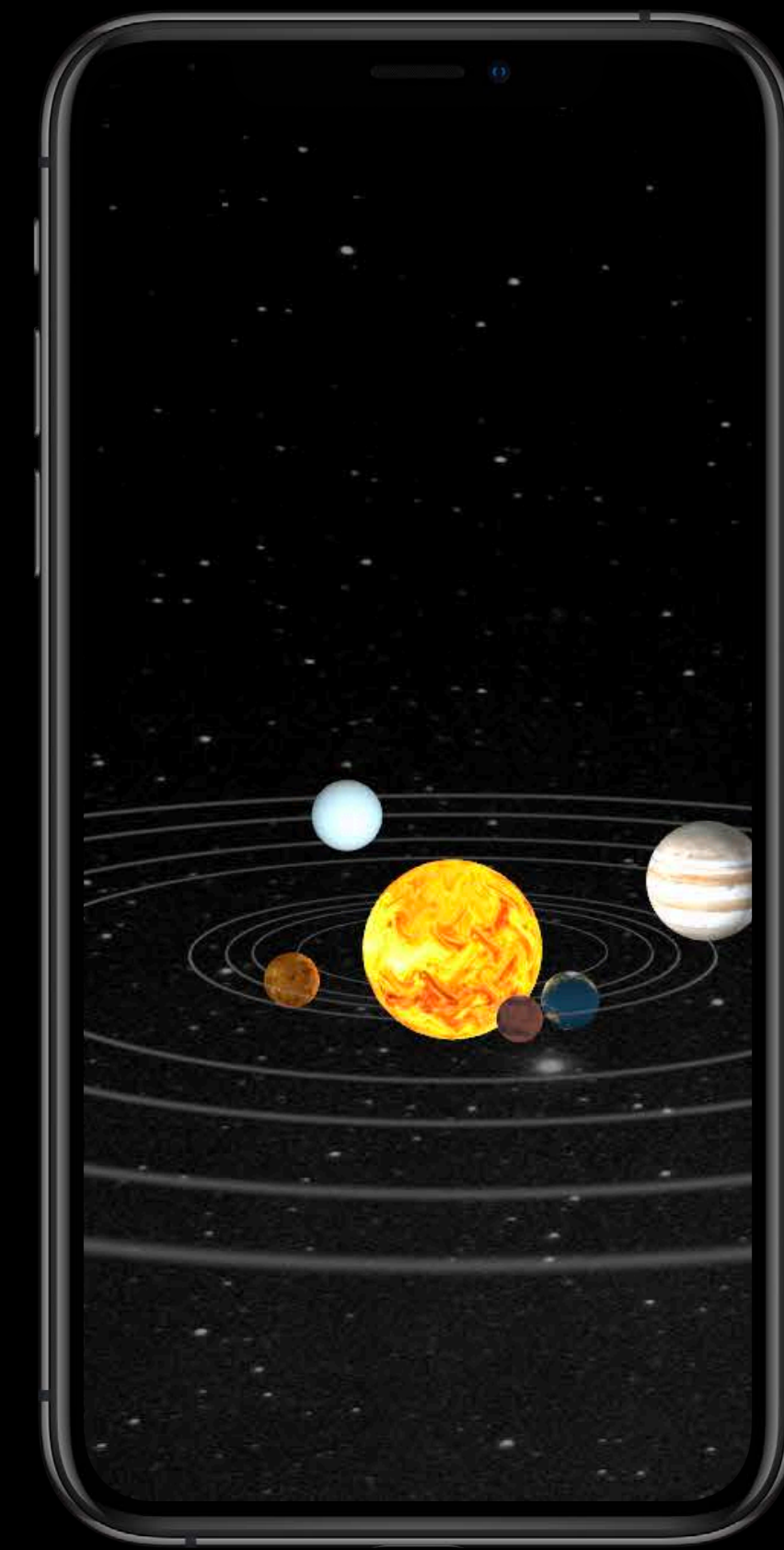
Time Profiler shows how your app is spending time

Check main thread when responsiveness issues occur

Profile release builds

Profile with difficult workloads and older devices

# Instruments on All Platforms



# Simulator Caveat



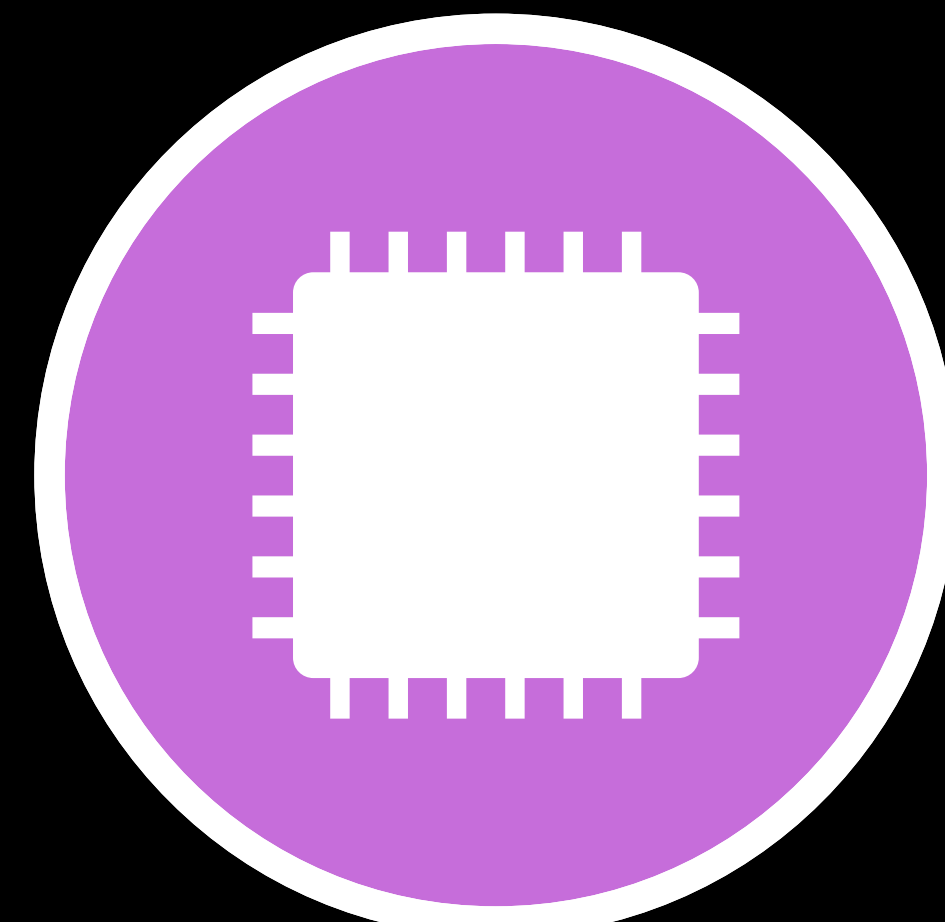
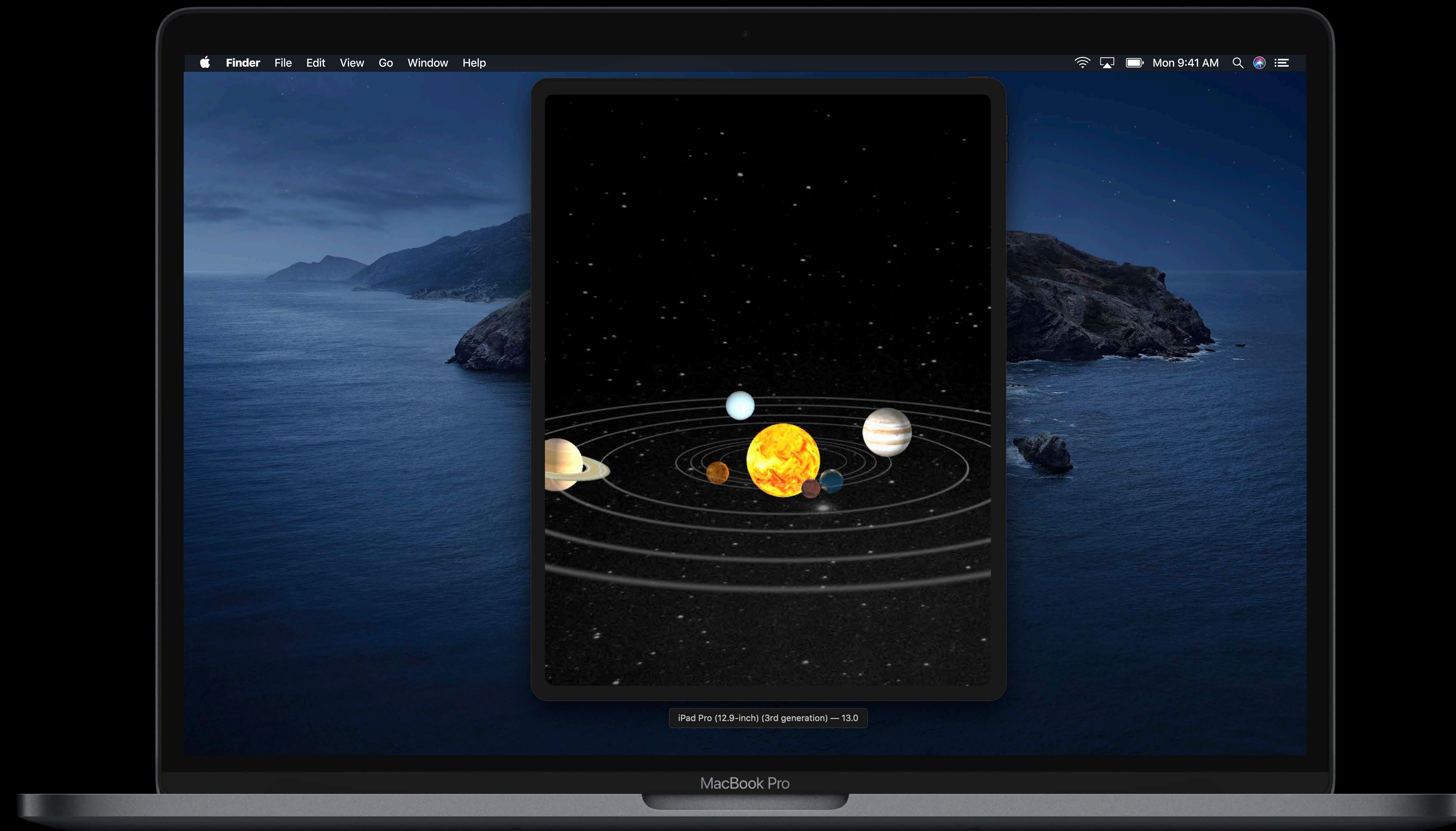
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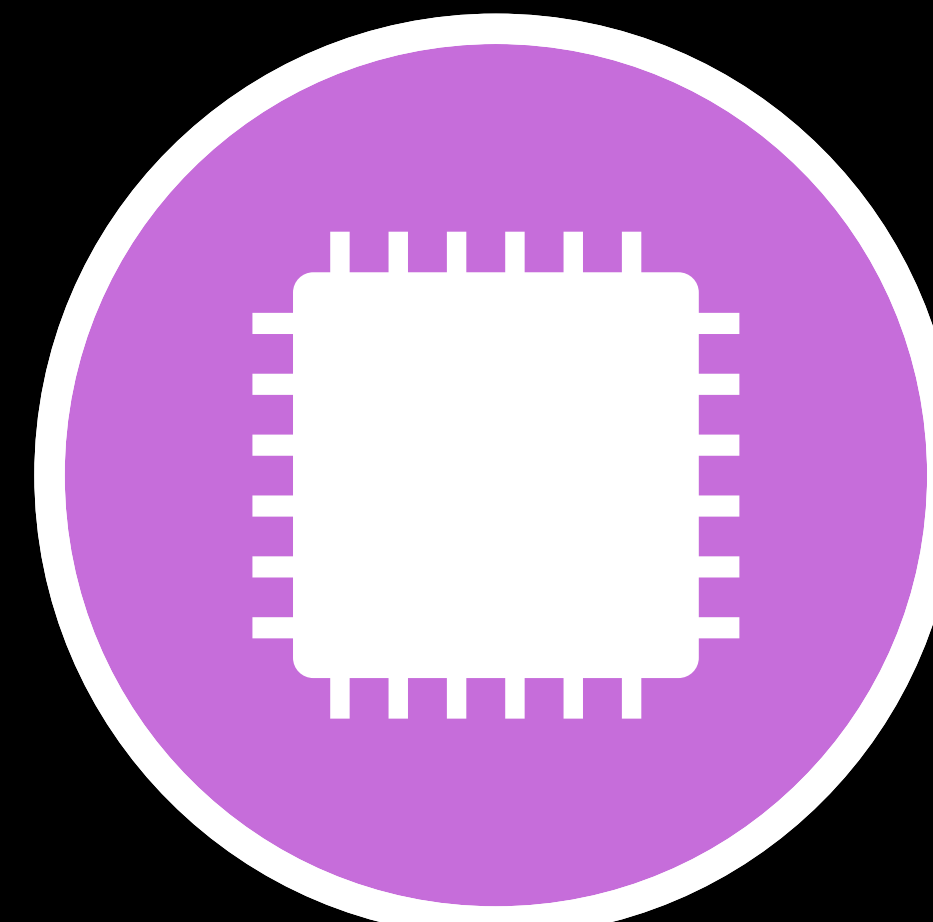
# Simulator Caveat



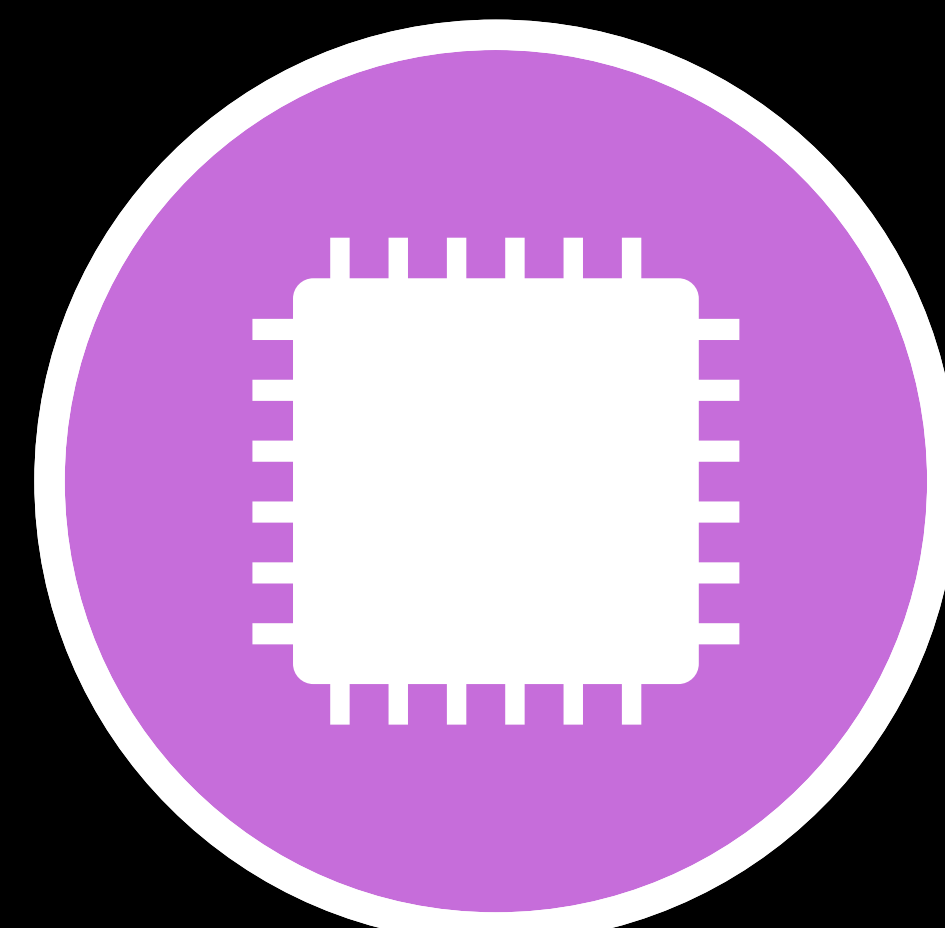
# Simulator Caveat



# Simulator Caveat



# Simulator Caveat





# What About Efficiency?

Main thread responsiveness isn't the whole story

High CPU use can

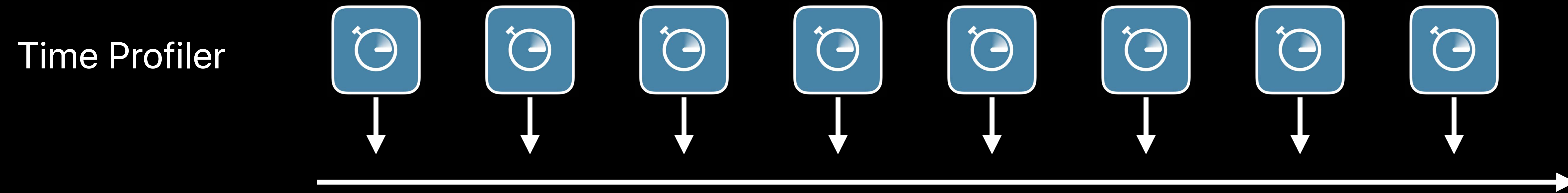
- Drain the battery
- Heat up the device
- Spin up fans

# Using Signposts

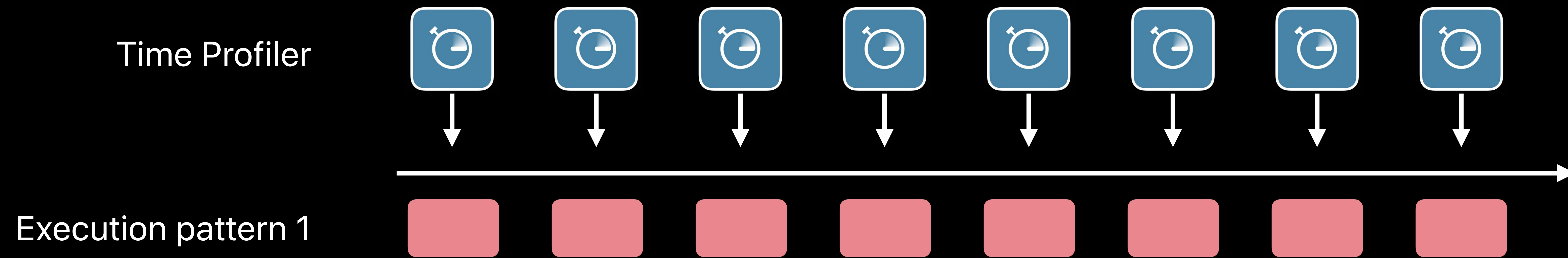
Anand Subramanian, Xcode Engineer

# Statistical Profile Versus Measurement

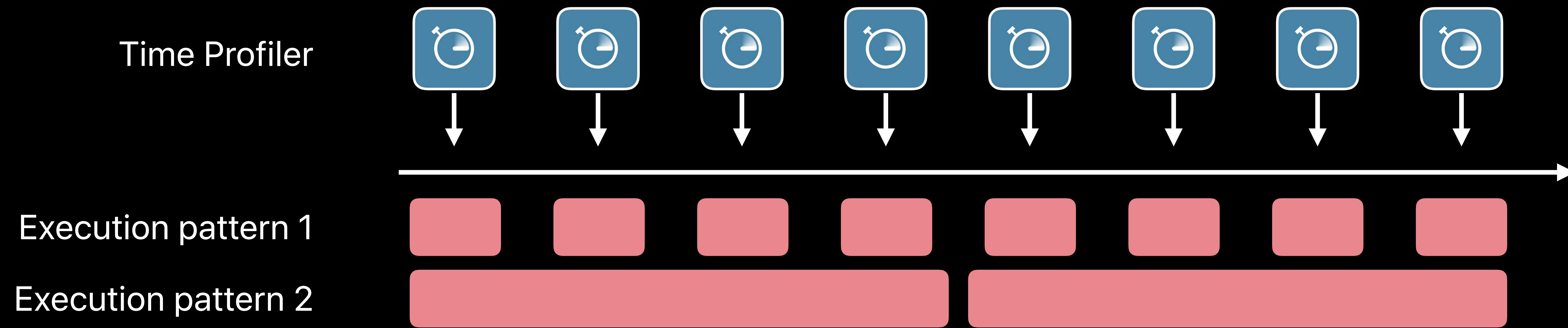
# Statistical Profile Versus Measurement



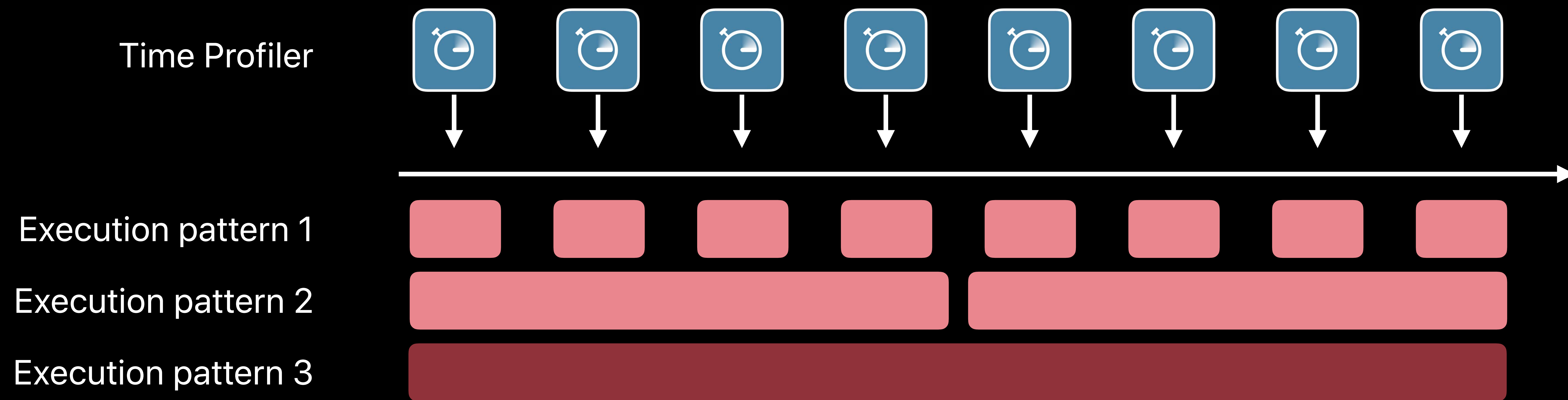
# Statistical Profile Versus Measurement



# Statistical Profile Versus Measurement



# Statistical Profile Versus Measurement



How to log operations?



Use Signposts!

# Features of Signposts

# Features of Signposts

Simpler and more efficient than printing

# Features of Signposts

Simpler and more efficient than printing

Built-in support for measuring time

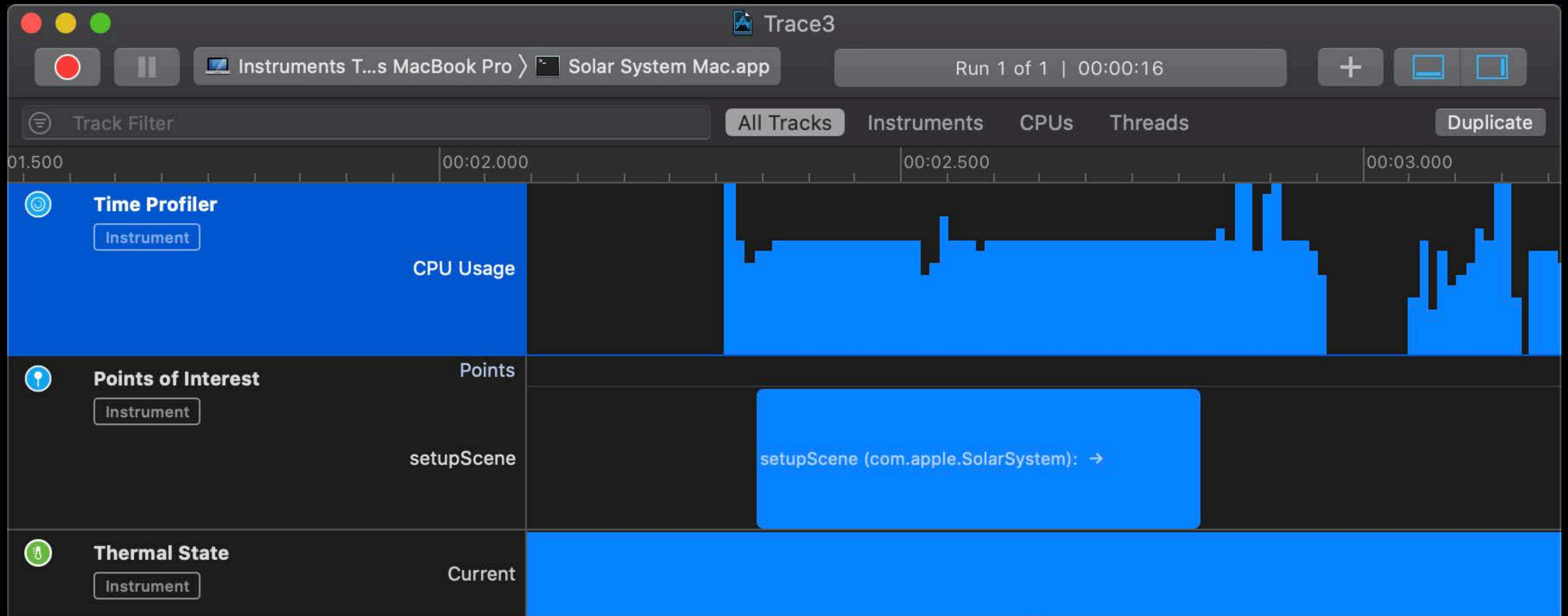
# Features of Signposts

Simpler and more efficient than printing

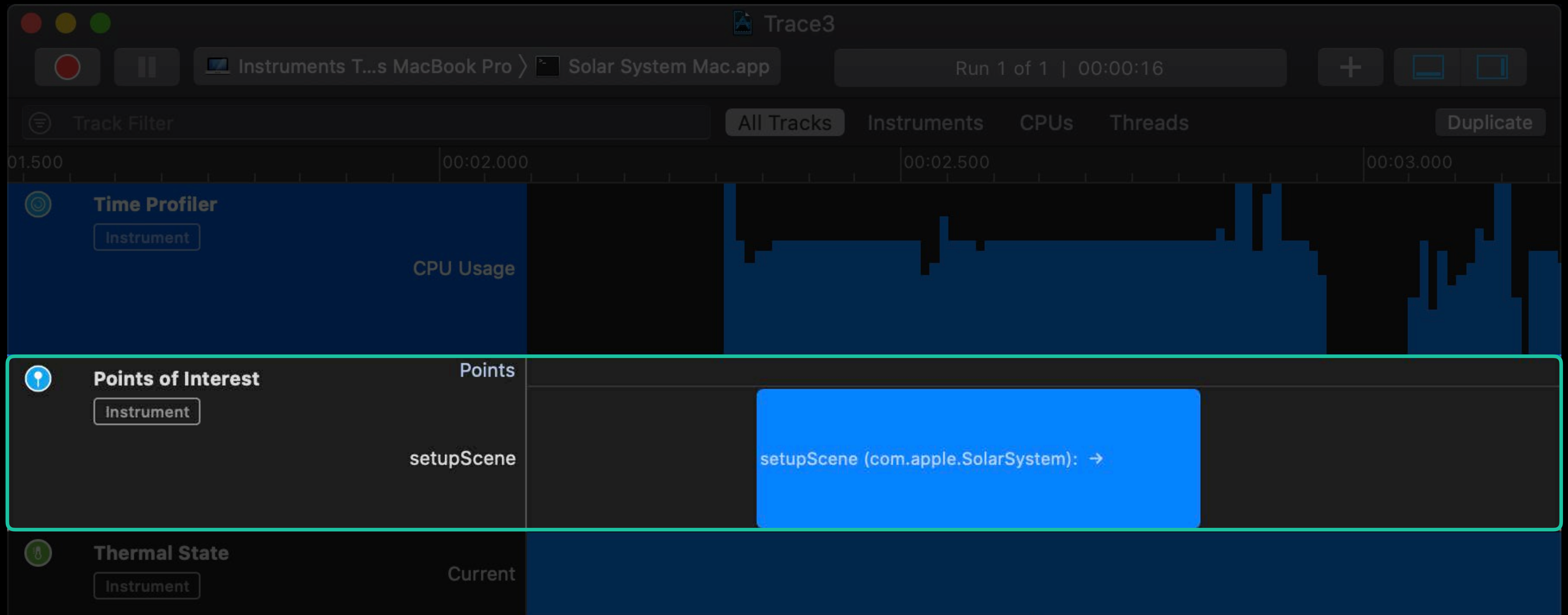
Built-in support for measuring time

Traced by Instruments

# Signpost Intervals in Instruments



# Signpost Intervals in Instruments



***Demo***

Using Signposts with Points of Interest



# Concepts

# Concepts

Statistical profiles show which code is most commonly executed

# Concepts

Statistical profiles show which code is most commonly executed

Exact measurements show how and why code is executed

# Concepts

Statistical profiles show which code is most commonly executed

Exact measurements show how and why code is executed

XCTests reliably reproduce workloads for profiling

# Instruments Templates for Resource Usage

# Instruments Templates for Resource Usage



File Activity

# Instruments Templates for Resource Usage



File Activity



Network

# Instruments Templates for Resource Usage



File Activity



Network

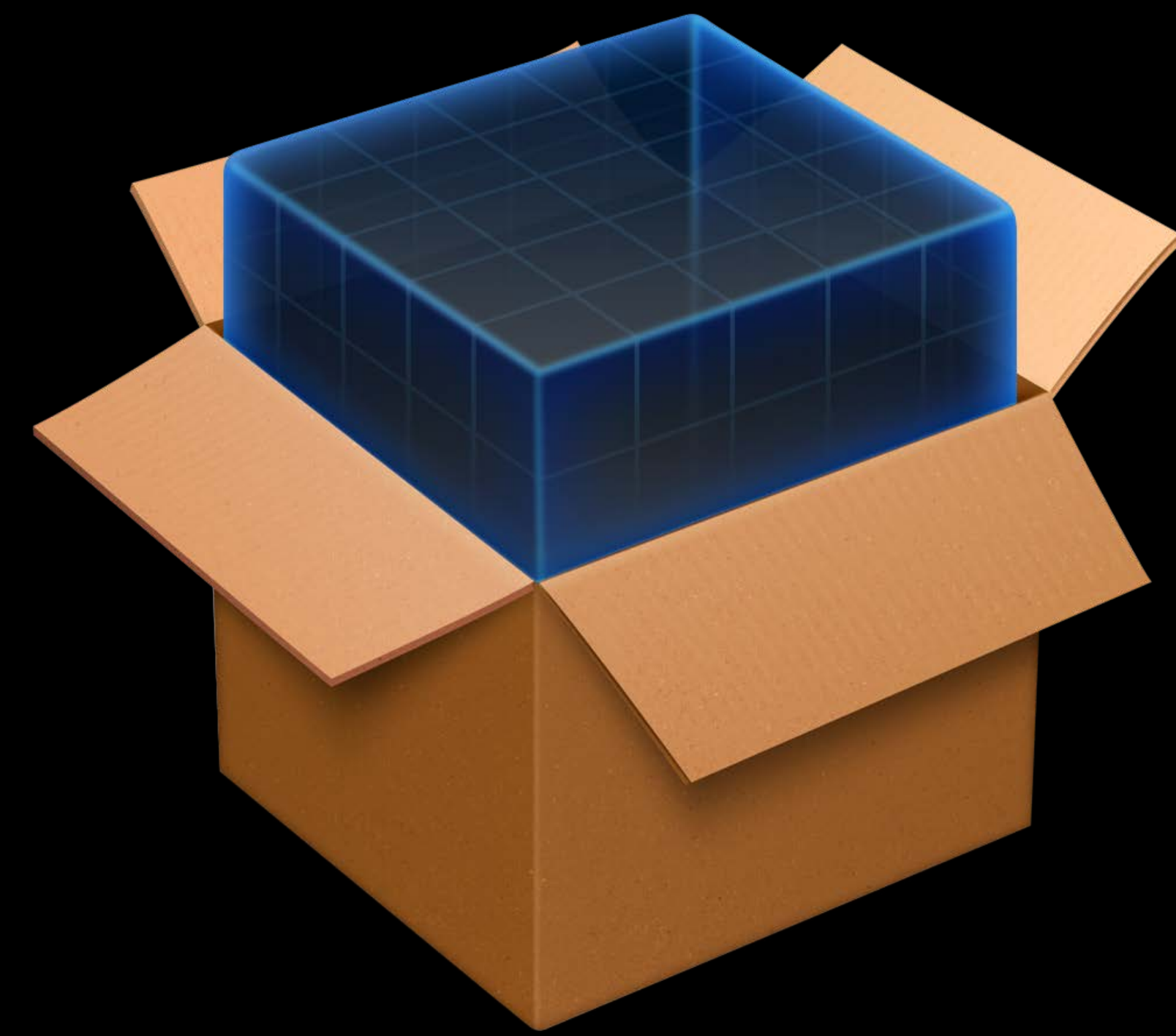


System Trace

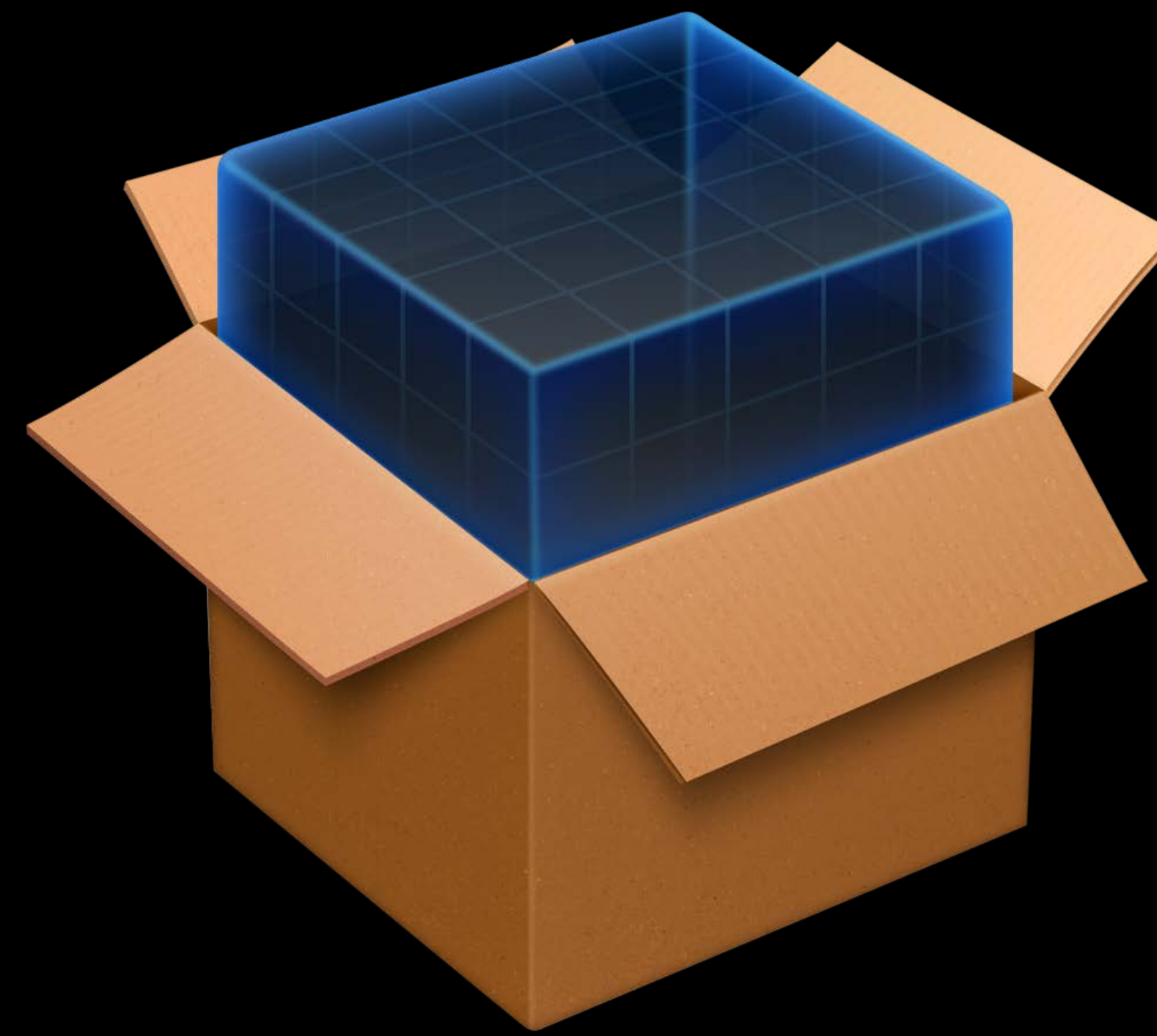


# Custom Instruments and Templates

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-  **Counters** - Collects performance counter (PMC) data from running threads on all cores based on regular time intervals.
  -  **CPU Activity Log** - Helps determine if the energy consumption is related to CPU activity.
  -  **Disk I/O Latency** - Visualize the completion times of Disk I/O operations to help diagnose I/O saturation
  -  **Disk Usage** - Inspect and profile an application's interaction with a device storage medium by gathering statistics and visualizing I/O operations.
  -  **Display** - Records Display events.
  -  **Energy Log** - Tracks the power requirements of the target device
  -  **File Locks** - Observes advisory file locking via the flock API.
  -  **Filesystem Activity** - Inspect and profile an application's filesystem activity, such as its operations on files.
  -  **Filesystem Suggestions** - Spot filesystem and disk I/O antipatterns that arose during a trace.
  -  **GCD Performance** - A tool to help spot sub-optimal use of Grand Central Dispatch APIs
  -  **GPS On/Off Log** - Tracks when the GPS is enabled.
  -  **GPU** - Records GPU events.
-  Filter

# Summary

# Summary

Profile early and often

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Profile early and often

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# More Information

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