12 Thread Sanitizer

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By the time you reach this chapter, you should be a whiz at concurrent programming.

However, just because your app *seems* to run correctly doesn't mean you took care of various concurrency and threading related edge cases. In this chapter you'll learn how to utilize Xcode's built-in **Thread Sanitizer** to discover races and before you deploy to the App Store.

Why the sanitizer?

As discussed in Chapter 5, "Concurrency Problems," you know how important it is to keep all accesses to a variable on the same thread to avoid data races. Depending on how your app is structured, or the architecture of a third-party library that you're using, it can be hard to tell if you're crossing a thread boundary.

The Thread Sanitizer, commonly referred to as TSan, is a tool Apple provides as part of the LLVM compiler. TSan allows you to identify when multiple threads attempt to access the same memory without providing proper access synchronization.

> **Note**: TSan is only supported when running on the simulator.

While there are a few other sanitizers available — such as the **Address Sanitizer** or the **Main Thread Checker** — the only one you'll need to actively use at this point is the **Thread Sanitizer**. The other sanitizers are either meant for other languages, or are on by default.

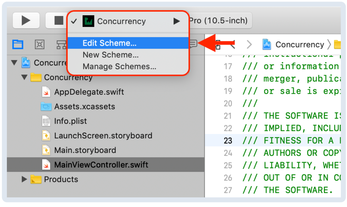
Getting started

Open up the Xcode project provided in this chapter's **starter** folder. It's a pretty simple-looking app that writes to a variable in two separate locations. Build and run the app; you won't see any issues. If you look at the code of **MainViewController.swift**, though, you can see you're clearly utilizing the `counter` property in different dispatch queues.

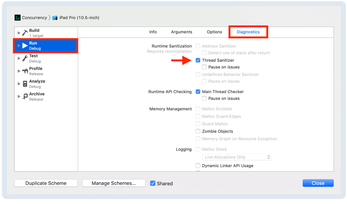
Is there any issue with your code? Probably! But you can easily catch and confirm this and other threading issues with the Thread Sanitizer.

Enabling sanitization

The first step to checking your code with the Thread Sanitizer is enabling it. To do so, first click on the **Concurrency** scheme in the top-left of Xcode, and select the **Edit Scheme...** option.



With the **Run** target selected, choose the **Diagnostics** tab. Then enable the checkbox for **Thread Sanitizer**.



Once you've enabled the thread sanitizer, close the dialog window and then build and run your app.

Almost immediately, you'll notice that Xcode emits a threading issue, and you're shown that you have an access race in your closure.

Switch to the **Issue navigator** (⌘-5) and select the **Runtime** tab. If you expand the stack trace show you'll see exactly where Xcode found the issues. You can click on the lines to be taken to that point in your source code.

It's not code analysis

It's important to keep in mind that the Thread Sanitizer is **runtime** analysis. What that means is that, if an issue doesn't occur during execution, it won't be flagged. If you look at the code in **MainViewController.swift**, you'll see this, around line 40:

```
Thread.sleep(forTimeInterval: 0.1)
```

Comment out that line of code and run the app again. This time, the app runs without any issues. Why is that? Even though you accessed the `counter` variable across multiple threads, those accesses didn't end up happening at the same time. By including the `sleep(forTimeInterval:)` line you forced iOS to switch threads, triggering the issue.

The important takeaway is that you should try to run using the Thread Sanitizer frequently — and not just once. Enabling the sanitizer has a pretty steep performance impact of anywhere between 2x to 20x CPU slowdown, and yet, you should run it often or otherwise integrate it into your workflow, so you don't miss out on all of these sneaky threading issue!

Xcode keeps getting smarter

Apple continues to improve runtime analysis of your apps even without the Thread Sanitizer. You know how important it is, by now, to always execute UI tasks on the main thread. If you forget, your app will abort at runtime in debugging. In years past, you'd have had to use the Thread Sanitizer to identify such a mistake.

Xcode does such a good job of flagging errors at runtime that it was actually quite difficult to come up with an example for this chapter!

Where to go from here?

You've seen how important the Thread Sanitizer is to ensuring stable apps for your customers. I suggest you enable the sanitizer at the start of app development and leave it on until you find that it is impacting the performance of testing. Once it has reached an impactful point, then disable it but continue to run at regular intervals.

Apple's official documentation is always available to you at https://developer.apple.com/documentation/code_diagnostics/thread_sanitizer. You might also look into the various continuous integration techniques available. Many of them will allow the Thread Sanitizer to be utilized during automated testing.

Mark Complete

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