Java Platform Threads vs. Virtual Threads

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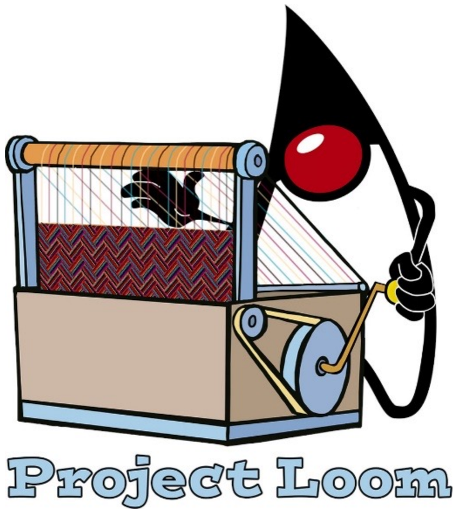
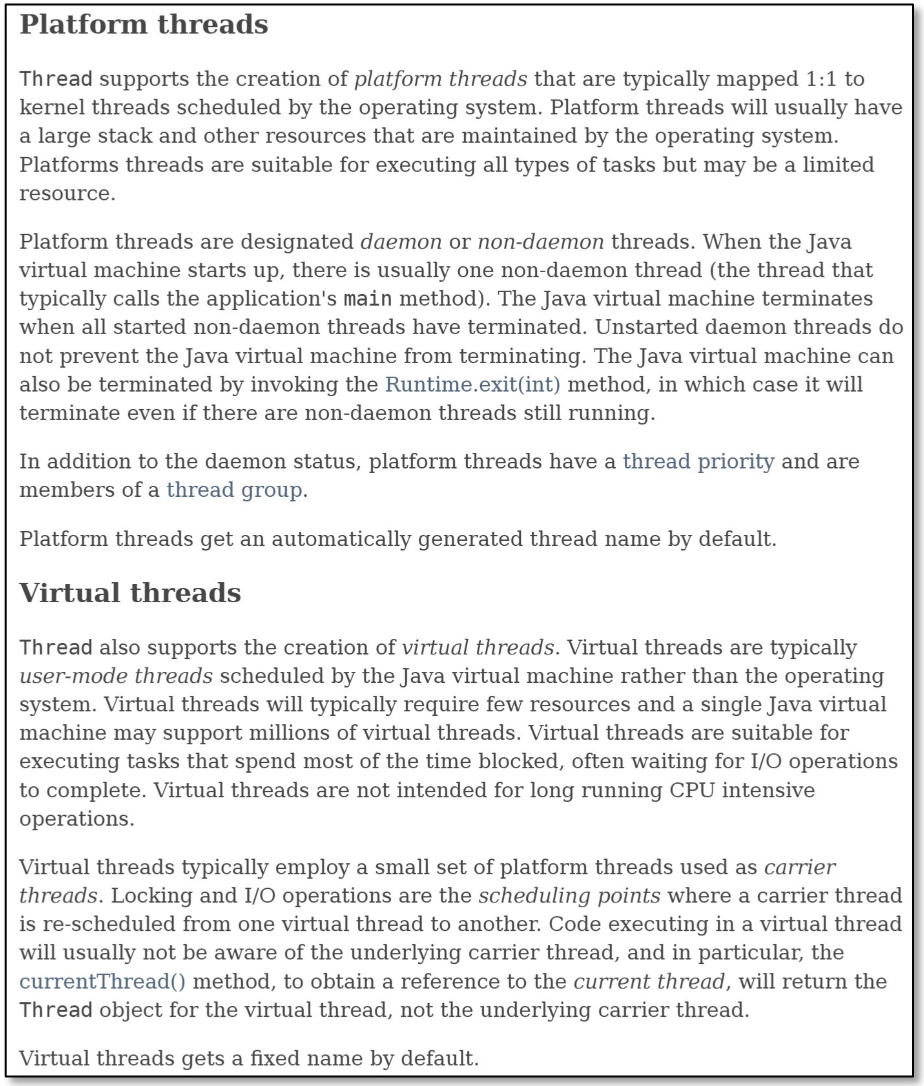
Learning Objectives in this Part of the Lesson

- Understand how Java threads support concurrency
- Learn how our case study app works
- Know alternative ways of giving code to a thread
- Learn how to pass parameters to a Java thread
- Know the differences between Java platform & virtual threads





Platform threads

`Thread` supports the creation of *platform threads* that are typically mapped 1:1 to kernel threads scheduled by the operating system. Platform threads will usually have a large stack and other resources that are maintained by the operating system. Platforms threads are suitable for executing all types of tasks but may be a limited resource.

Platform threads are designated *daemon* or *non-daemon* threads. When the Java virtual machine starts up, there is usually one non-daemon thread (the thread that typically calls the application's `main` method). The Java virtual machine terminates when all started non-daemon threads have terminated. Unstarted daemon threads do not prevent the Java virtual machine from terminating. The Java virtual machine can also be terminated by invoking the Runtime.exit(int) method, in which case it will terminate even if there are non-daemon threads still running.

In addition to the daemon status, platform threads have a thread priority and are members of a thread group.

Platform threads get an automatically generated thread name by default.

Virtual threads

`Thread` also supports the creation of *virtual threads*. Virtual threads are typically *user-mode threads* scheduled by the Java virtual machine rather than the operating system. Virtual threads will typically require few resources and a single Java virtual machine may support millions of virtual threads. Virtual threads are suitable for executing tasks that spend most of the time blocked, often waiting for I/O operations to complete. Virtual threads are not intended for long running CPU intensive operations.

Virtual threads typically employ a small set of platform threads used as *carrier threads*. Locking and I/O operations are the *scheduling points* where a carrier thread is re-scheduled from one virtual thread to another. Code executing in a virtual thread will usually not be aware of the underlying carrier thread, and in particular, the currentThread() method, to obtain a reference to the *current thread*, will return the `Thread` object for the virtual thread, not the underlying carrier thread.

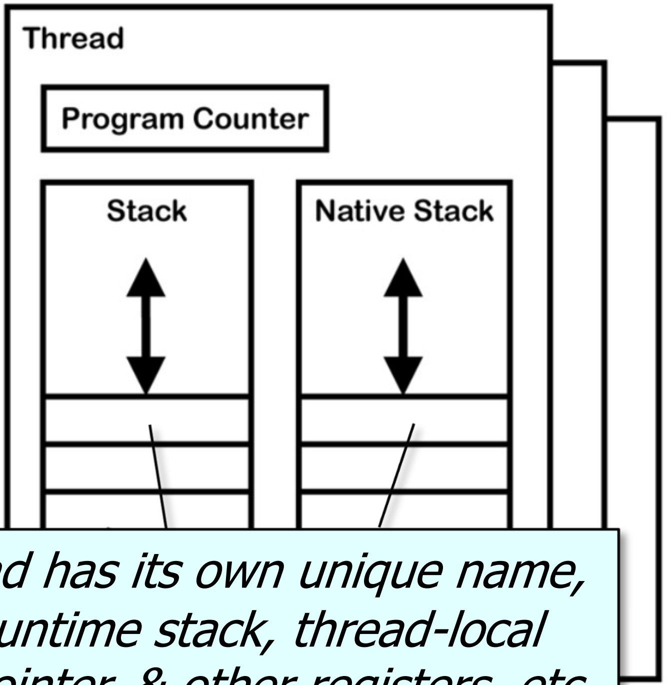
Virtual threads gets a fixed name by default.

See download.java.net/java/early_access/loom/docs/api/java.base/java/lang/Thread.html

Java Platform Threads vs. Virtual Threads

Java Platform Threads vs. Virtual Threads

- A Java Thread has traditionally been an object containing various methods & fields that constitute its "state"



e.g., each Java Thread has its own unique name, identifier, priority, runtime stack, thread-local storage, instruction pointer, & other registers, etc.

See blog.jamesdbloom.com/JVMInternals.html

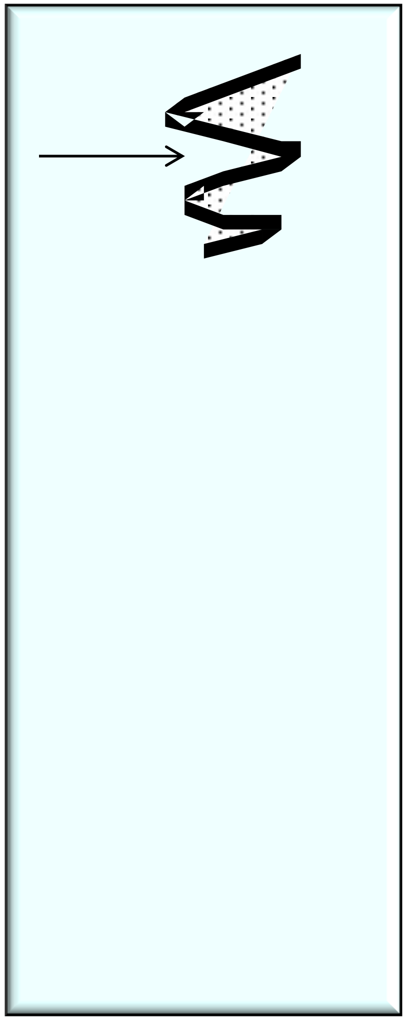
Java Platform Threads vs. Virtual Threads

- A Java Thread has traditionally been an obje containing various methods & fields that constitute its "state"
  - Project Loom now refers to these types of Java threads as "platform threads"

See wiki.openjdk.java.net/display/loom/Main

Java Platform Threads vs. Virtual Threads

- Each Java platform thread is associated 1-to-1 with an OS kernel thread



See en.wikipedia.org/wiki/Thread_(computing)#Kernel_threads

Java Platform Threads vs. Virtual Threads

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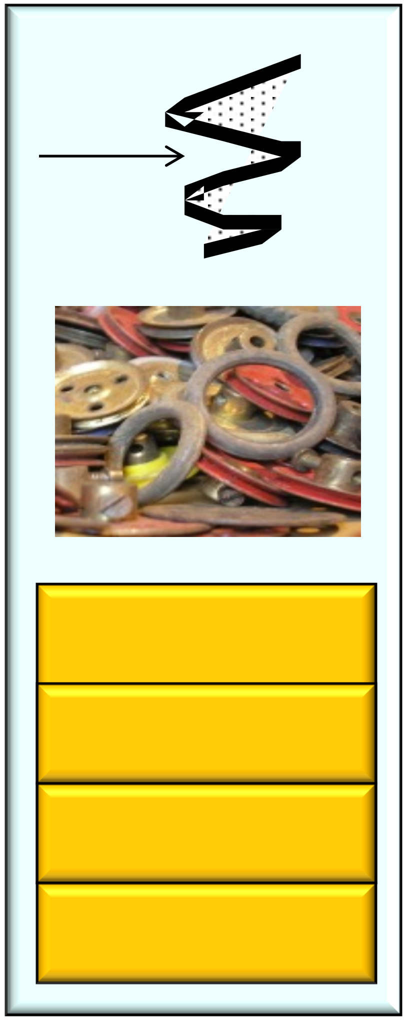
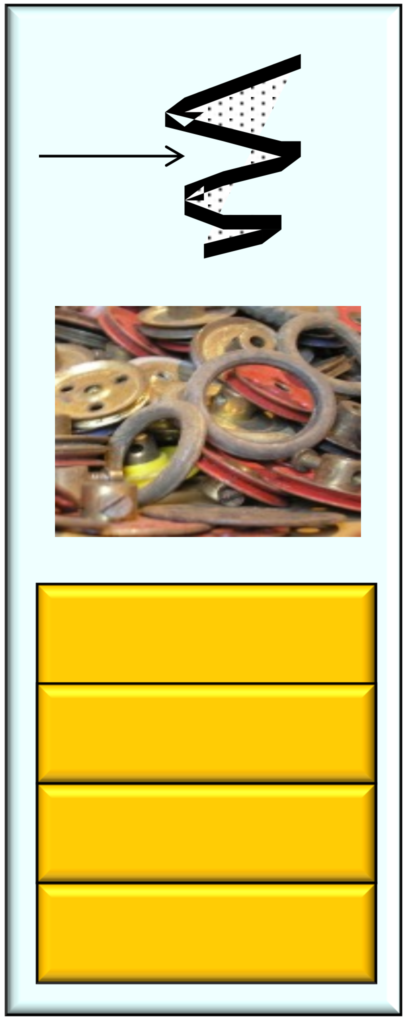
  - It contains the same unique "state" as a traditional Java Thread object



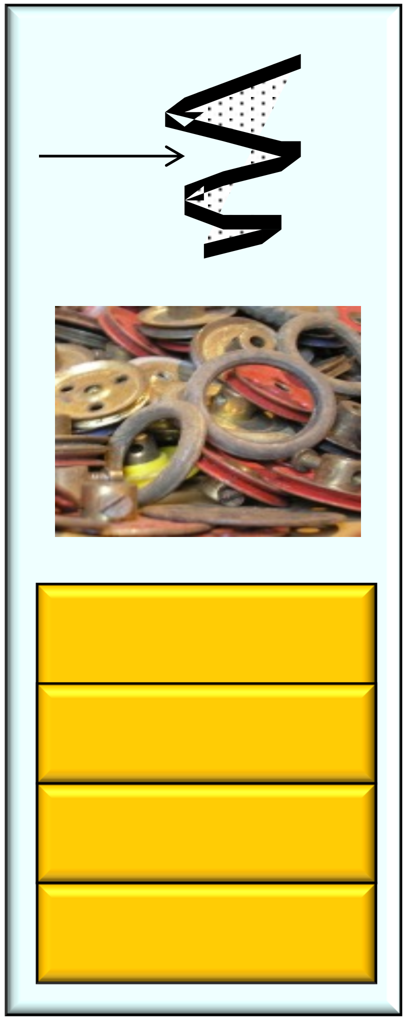
Java Platform Threads vs. Virtual Threads

- Each Java platform thread is associated 1-to-1 with an OS kernel thread
  - It contains the same unique "state" as a traditional Java Thread object
  - Platforms threads are suitable for executing all types of tasks



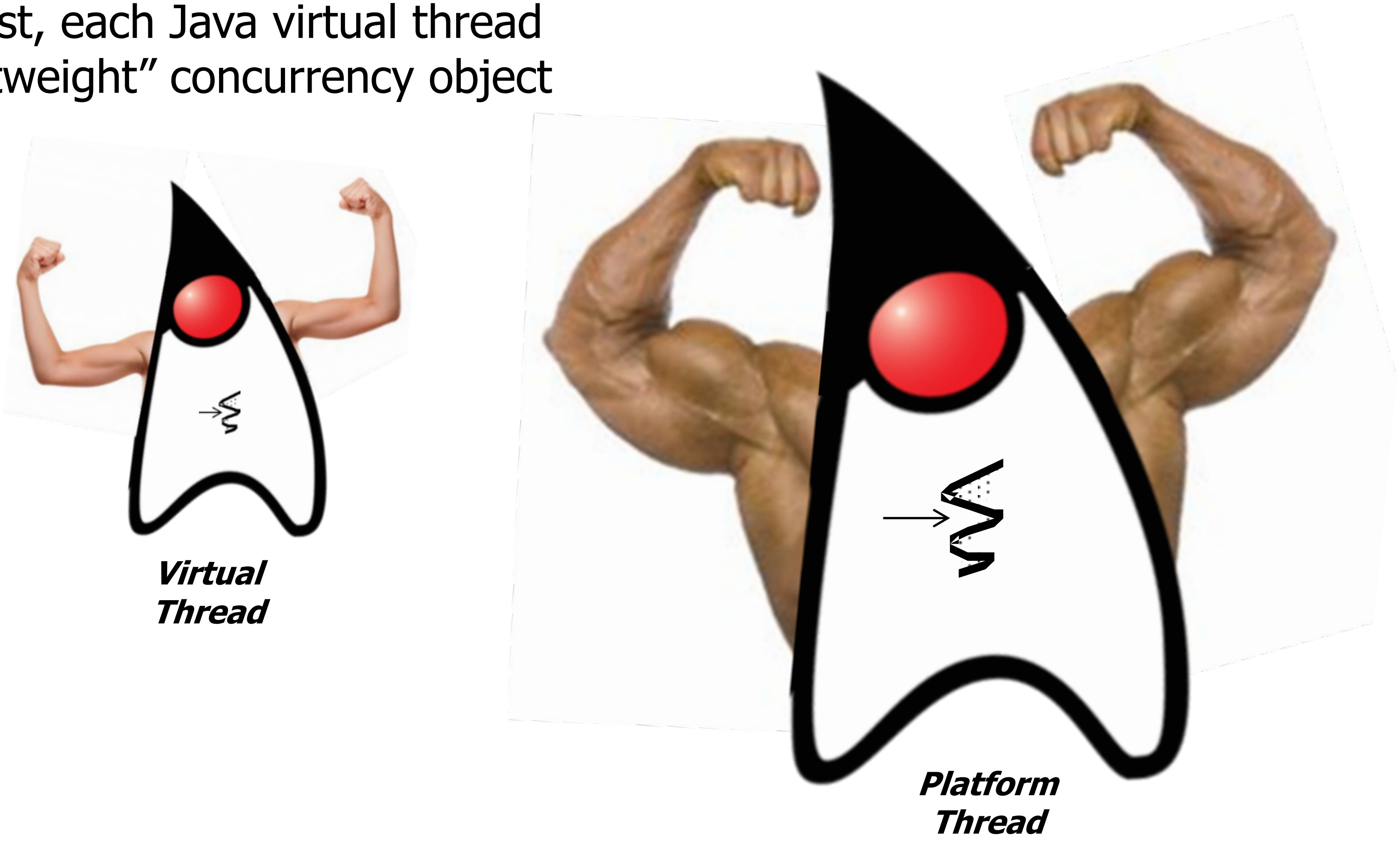
Java Platform Threads vs. Virtual Threads

- Each Java platform thread is associated 1-to-1 with an OS kernel thread
  - It contains the same unique "state" as a traditional Java Thread object
  - Platforms threads are suitable for executing all types of tasks
    - However, they are a limited resource due to large runtime stack size



Java Platform Threads vs. Virtual Threads

- In contrast, each Java virtual thread is a "lightweight" concurrency object



Java Platform Threads vs. Virtual Threads

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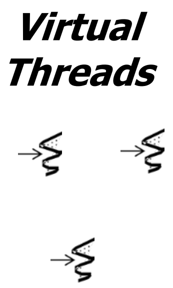
  - It is a user thread rather than a kernel thread



User threads

See en.wikipedia.org/wiki/Thread_(computing)#User_threads

Java Platform Threads vs. Virtual Threads

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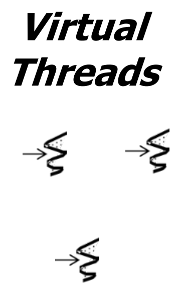
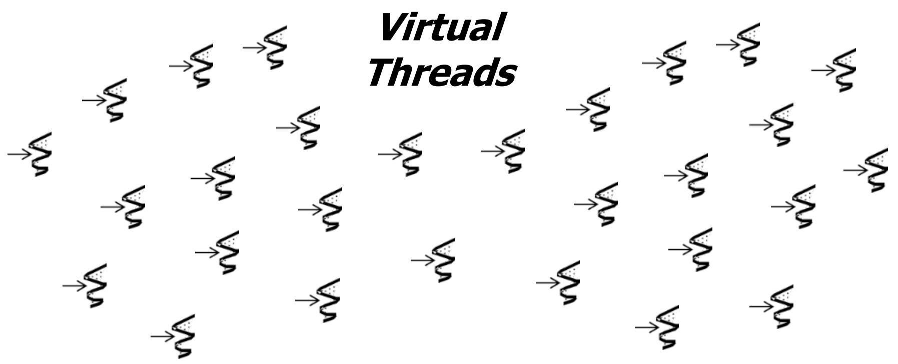
  - It is a user thread rather than a kernel thread
    - It is scheduled by the Java execution environment rather than the underlying OS



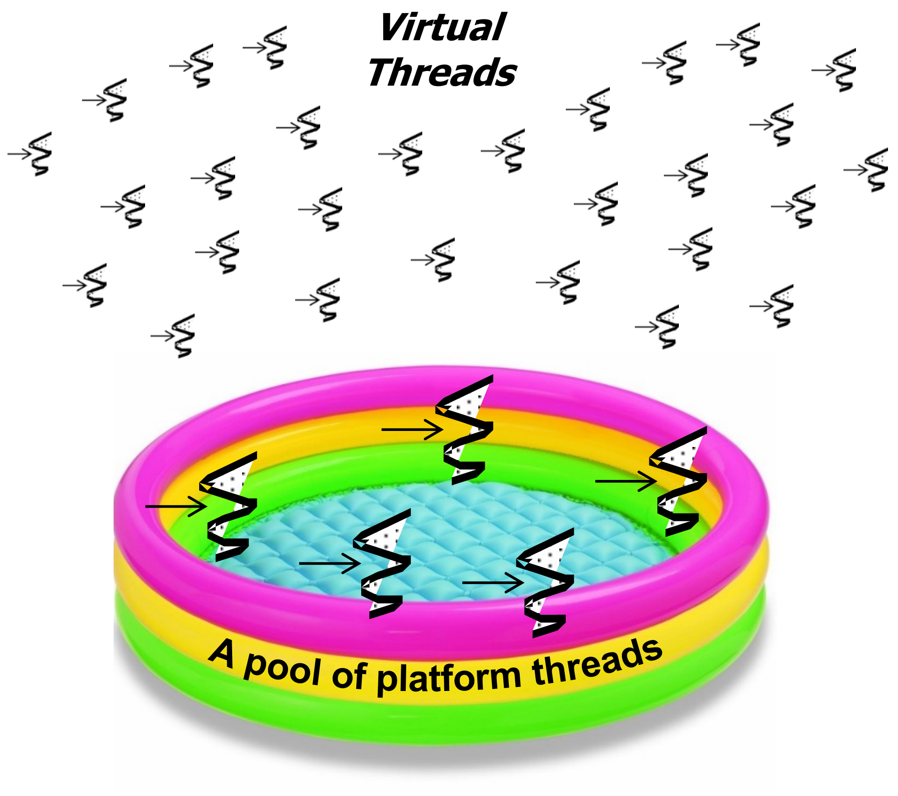
Java Platform Threads vs. Virtual Threads

- In contrast, each Java virtual thread is a "lightweight" concurrency object
  - It is a user thread rather than a kernel thread
    - It is scheduled by the Java execution environment rather than the underlying OS
    - A very large # of virtual threads can therefore be created



Java Platform Threads vs. Virtual Threads

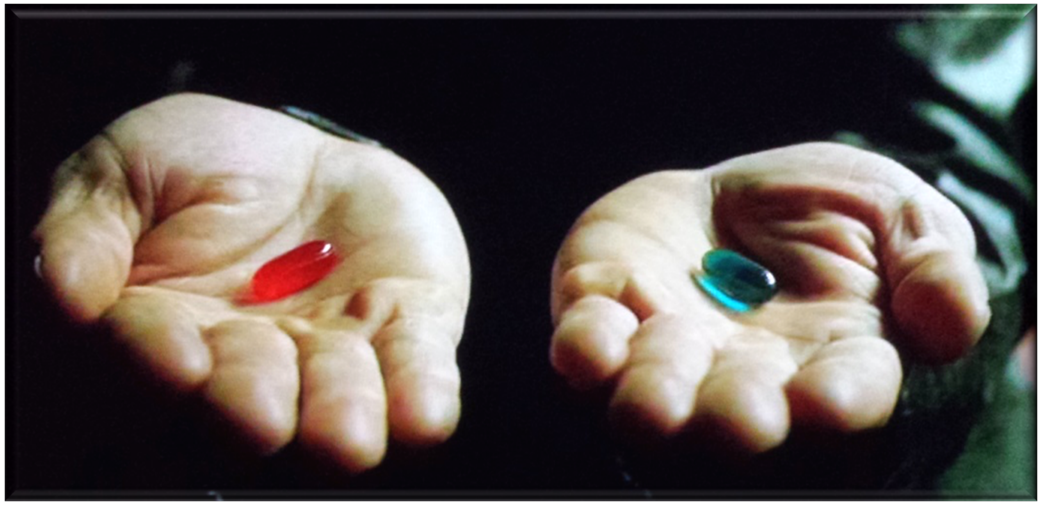
- In contrast, each Java virtual thread is a "lightweight" concurrency object
  - It is a user thread rather than a kernel thread
  - Virtual threads are multiplexed atop a pool of platform threads



Creating Java Platform Threads vs. Virtual Threads

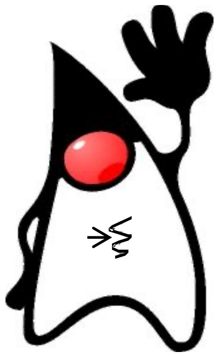
Creating Java Platform Threads vs. Virtual Threads

- Java platform threads can be created in two different ways



Creating Java Platform Threads vs. Virtual Threads

- Java platform threads can be created in two different ways
  - The traditional way



```
public class GCDThread
                 extends Thread {
   public void run() {
      // code to run goes here
   }
}

Thread gcdThread = new GCDThread();
gcdThread.start();
```

Create & start a thread using GCDThread, which is a named subclass of Thread

Creating Java Platform Threads vs. Virtual Threads

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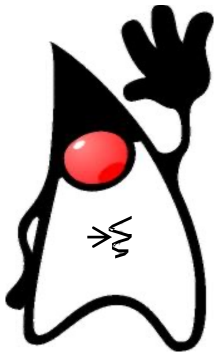
  - The traditional way



```
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   public void run() {
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   }
}

Thread gcdThread = new GCDThread();
gcdThread.start();
```

```
public class GCDRunnable
       implements Runnable {
  public void run() {
    // code to run goes here
  }
}

Runnable gcdRunnable =
  new GCDRunnable();
new Thread(gcdRunnable).start();
```

Pass runnable to a new Thread object & start it

See en.wikipedia.org/wiki/Thread_(computing)#User_threads

Creating Java Platform Threads vs. Virtual Threads

- Java platform threads can be created in two different ways
  - The traditional way

```
public class GCDThread
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public class GCDRunnable
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}

Runnable gcdRunnable =
  new GCDRunnable();
new Thread(gcdRunnable).start();
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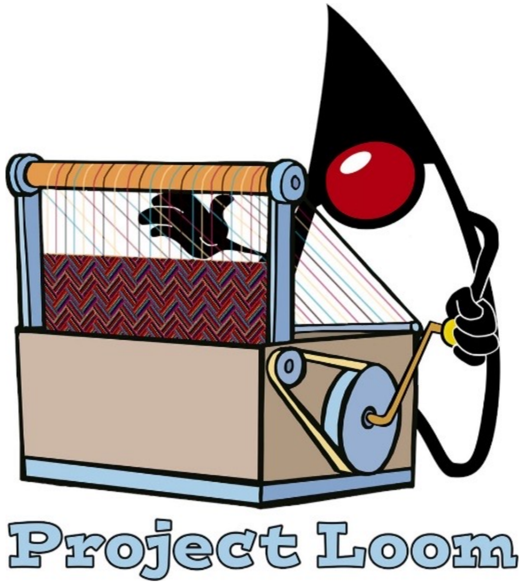
Java threads are relatively "heavyweight"

Creating Java Platform Threads vs. Virtual Threads

- Java platform threads can be created in two different ways
  - The traditional way
  - The Project Loom way



```
public class GCDRunnable
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  public void run() {
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  }
}

Runnable gcdRunnable =
  new GCDRunnable();

Thread.ofPlatform()
      .start(gcdRunnable);
```

Create & start a platform thread so it executes gcdRunnable

See download.java.net/java/early_access/loom/docs/api/java.base/java/lang/Thread.html#ofPlatform

Creating Java Platform Threads vs. Virtual Threads

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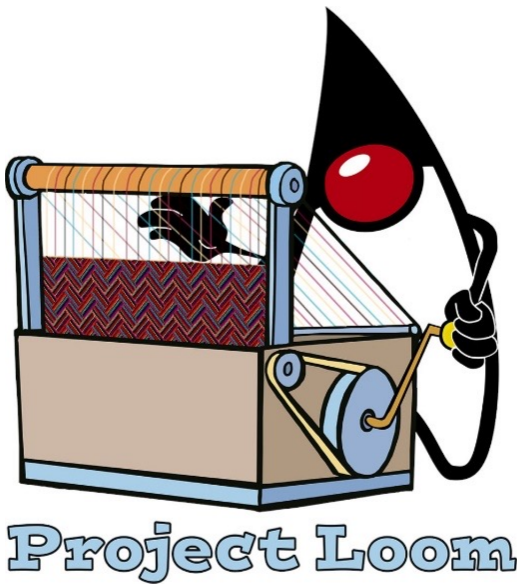

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}

Runnable gcdRunnable =
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Thread thread = Thread
      .ofPlatform()
      .unstarted(gcdRunnable);
...
thread.start();
```

Create an "unstarted" platform thread & then start it so it executes gcdRunnable

Creating Java Platform Threads vs. Virtual Threads

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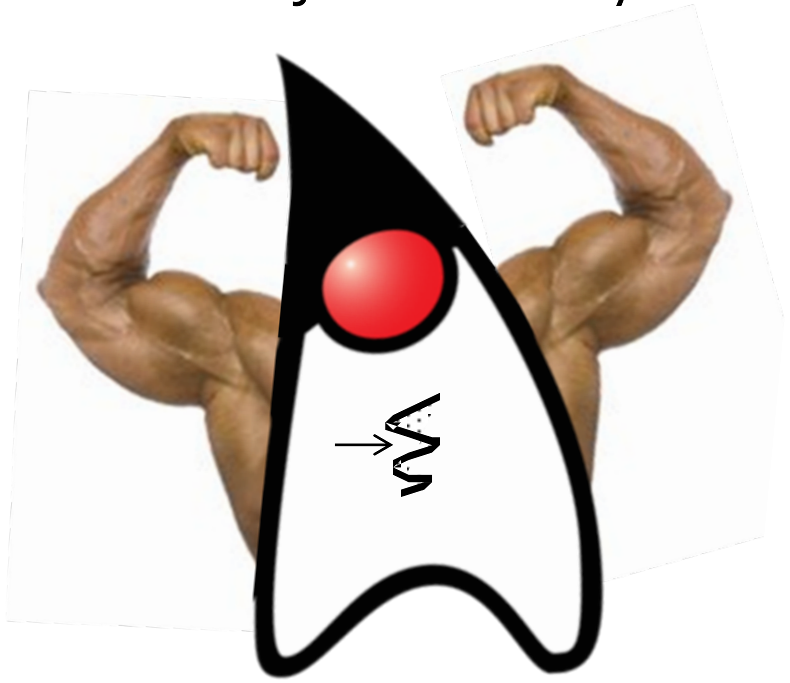
  - The traditional way
  - The Project Loom way



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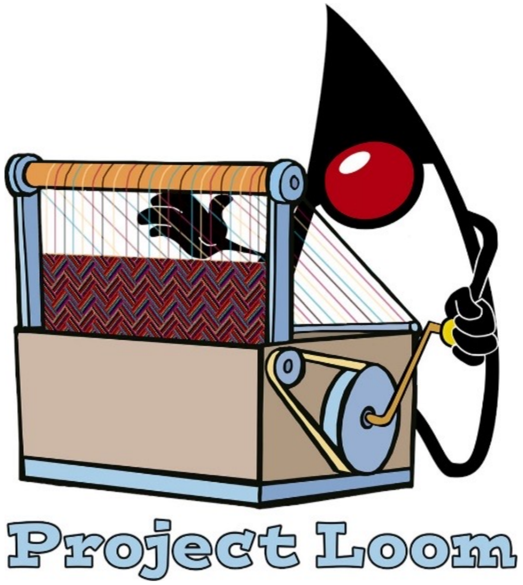
Java platform threads are also relatively “heavyweight”

Creating Java Platform Threads vs. Virtual Threads

- Java virtual threads can also be created in Project Loom



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Runnable gcdRunnable =
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Thread.ofVirtual()
      .start(gcdRunnable);
```

Create & start a virtual thread so it executes gcdRunnable

See download.java.net/java/early_access/loom/docs/api/java.base/java/lang/Thread.html#ofVirtual

Creating Java Platform Threads vs. Virtual Threads

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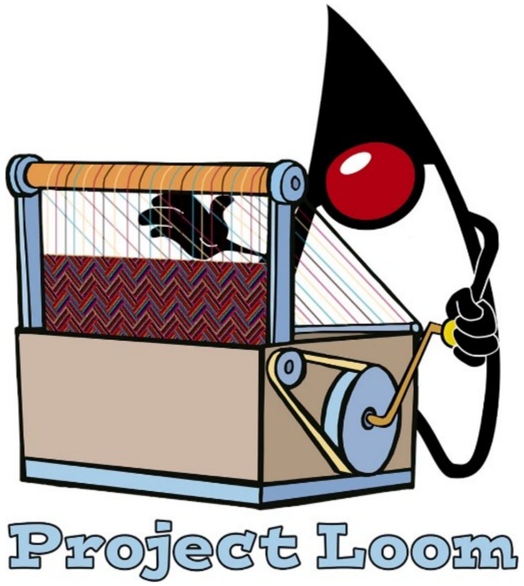

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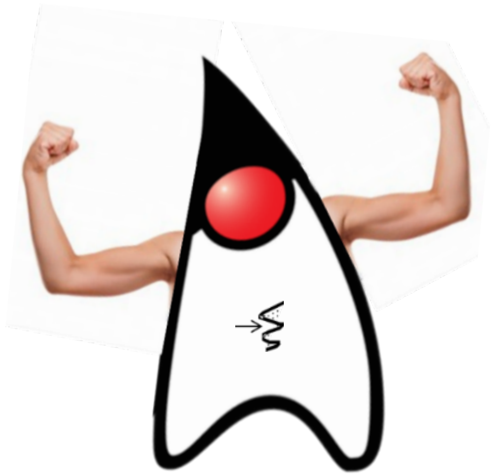
Create an "unstarted" virtual thread & then start it so it executes gcdRunnable

Creating Java Platform Threads vs. Virtual Threads

- Java virtual threads can also be created in Project Loom



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Java virtual threads are relatively "lightweight"

End of Java Platform Threads vs. Virtual Threads