The Java ForkJoinTask Class

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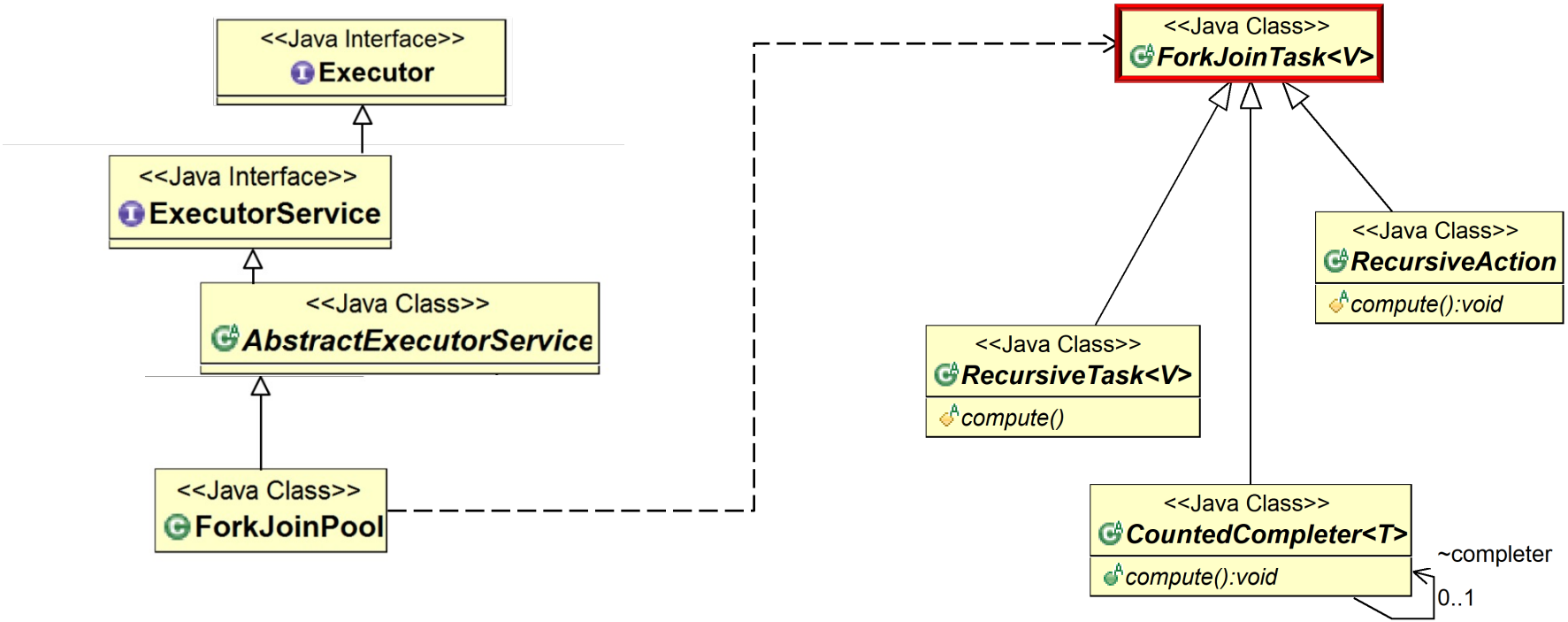
Learning Objectives in this Part of the Lesson

- Understand how the Java fork-join framework processes tasks in parallel
- Recognize the structure & functionality of the fork-join framework



Overview of the ForkJoinTask Class

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- A ForkJoinTask associates a chunk of data along with a computation on that data

Class ForkJoinTask<V>

java.lang.Object
    java.util.concurrent.ForkJoinTask<V>

All Implemented Interfaces:

`Serializable, Future<V>`

Direct Known Subclasses:

`CountedCompleter, RecursiveAction, RecursiveTask`

```
public abstract class ForkJoinTask<V>
extends Object
implements Future<V>, Serializable
```

Abstract base class for tasks that run within a `ForkJoinPool`. A `ForkJoinTask` is a thread-like entity that is much lighter weight than a normal thread. Huge numbers of tasks and subtasks may be hosted by a small number of actual threads in a ForkJoinPool, at the price of some usage limitations.

A "main" `ForkJoinTask` begins execution when it is explicitly submitted to a `ForkJoinPool`, or, if not already engaged in a ForkJoin computation, commenced in the `ForkJoinPool.commonPool()` via `fork()`, `invoke()`, or related methods. Once started, it will usually in turn start other subtasks. As indicated by the name of this class, many programs using `ForkJoinTask` employ only methods `fork()` and `join()`, or derivatives such as `invokeAll`. However, this class also provides a number of other methods that can come into play in advanced usages, as well as extension mechanics that allow support of new forms of fork/join processing.

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/ForkJoinTask.html

Overview of the ForkJoinTask Class

- A ForkJoinTask associates a chunk of data along with a computation on that data
  - This enables fine-grained data parallelism

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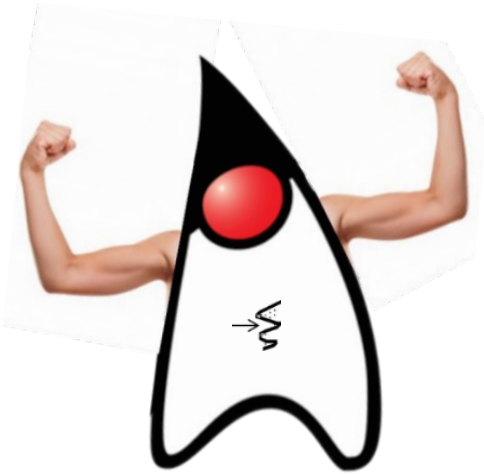
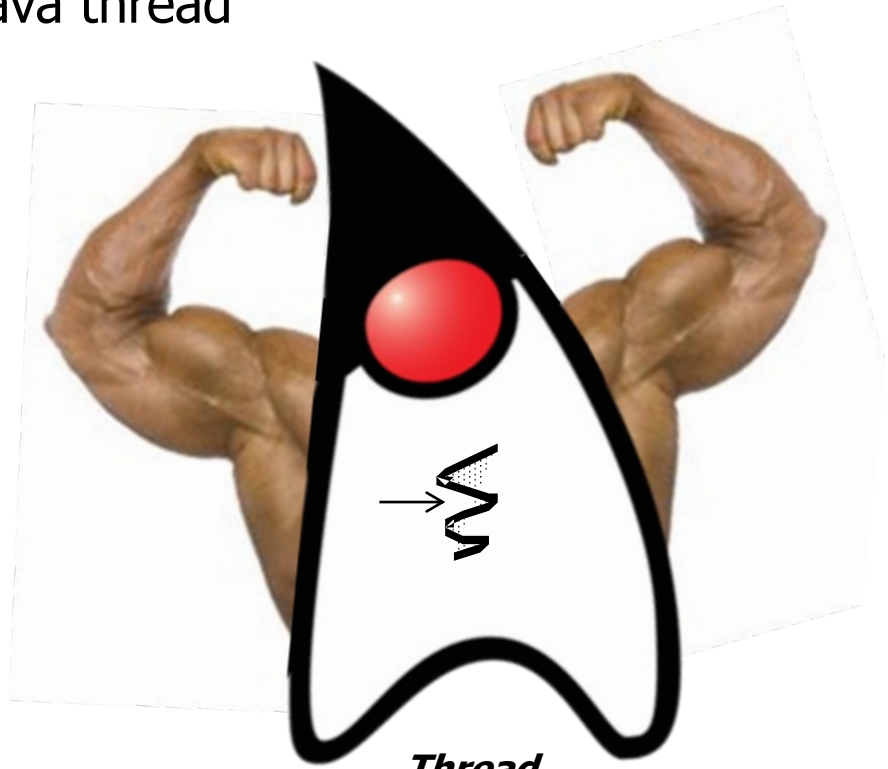
See www.dre.Vanderbilt.edu/~schmidt/PDF/DataParallelismInJava.pdf

Overview of the ForkJoinTask Class

- A ForkJoinTask is lighter weight than a Java thread



ForkJoinTask

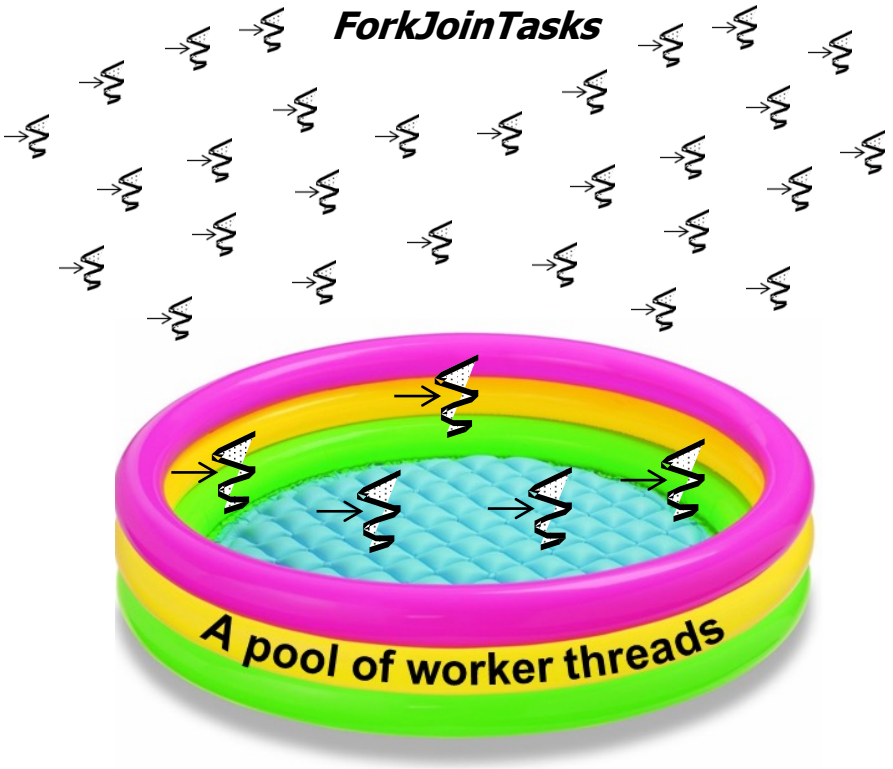


Thread

e.g., it doesn't maintain its own run-time stack, registers, thread-local storage, etc.

Overview of the ForkJoinTask Class

- A ForkJoinTask is lighter weight than a Java thread
  - A large # of ForkJoinTasks can thus run in a small # of worker threads in a fork-join pool



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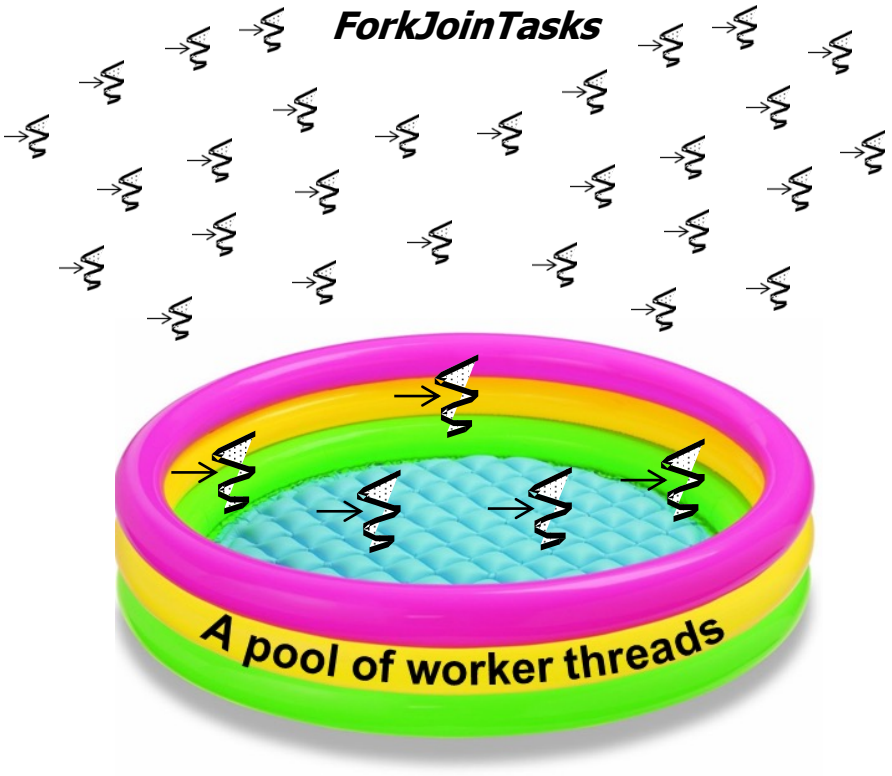
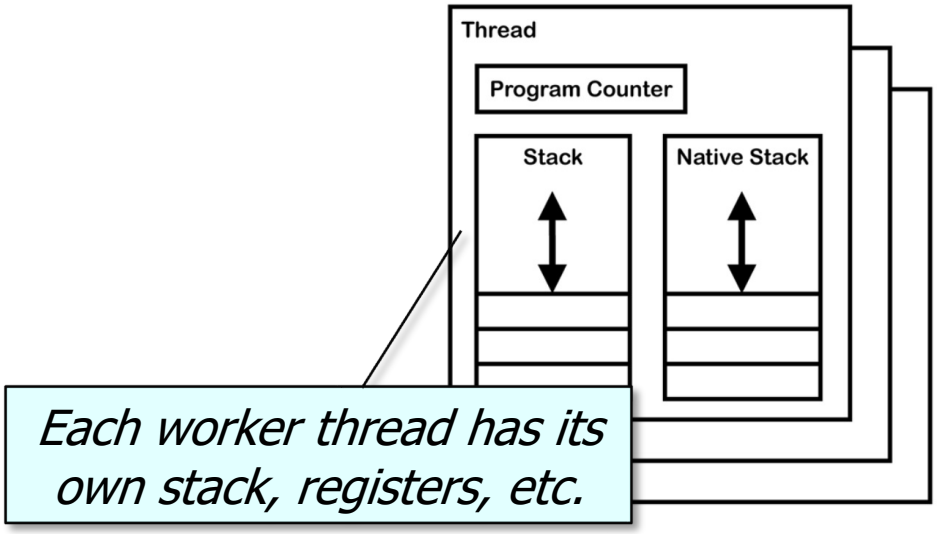
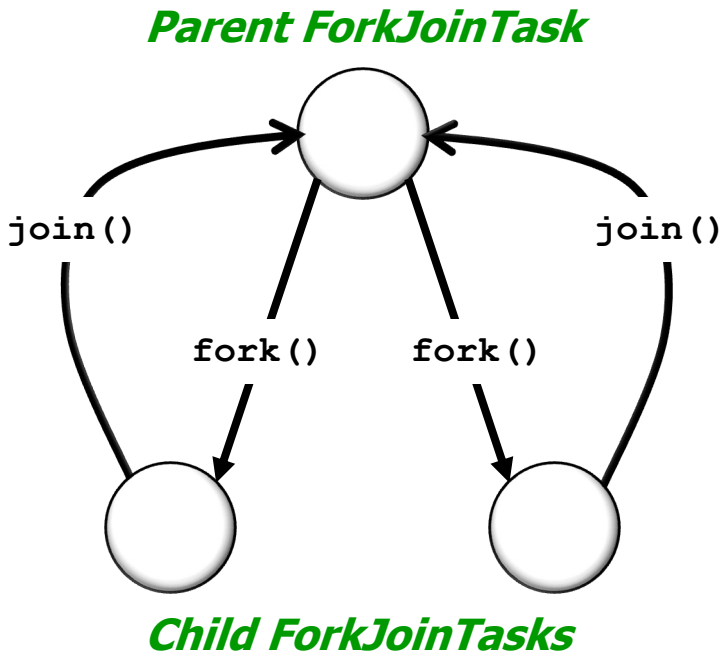




See blog.jamesdbloom.com/JVMInternals.html

Overview of the ForkJoinTask Class

- A ForkJoinTask has two methods that control parallel processing/merging



ForkJoinTask <T>	**fork**() – Arranges to asynchronously execute this task in the appropriate pool
V	**join**() – Returns result of computation when it is done

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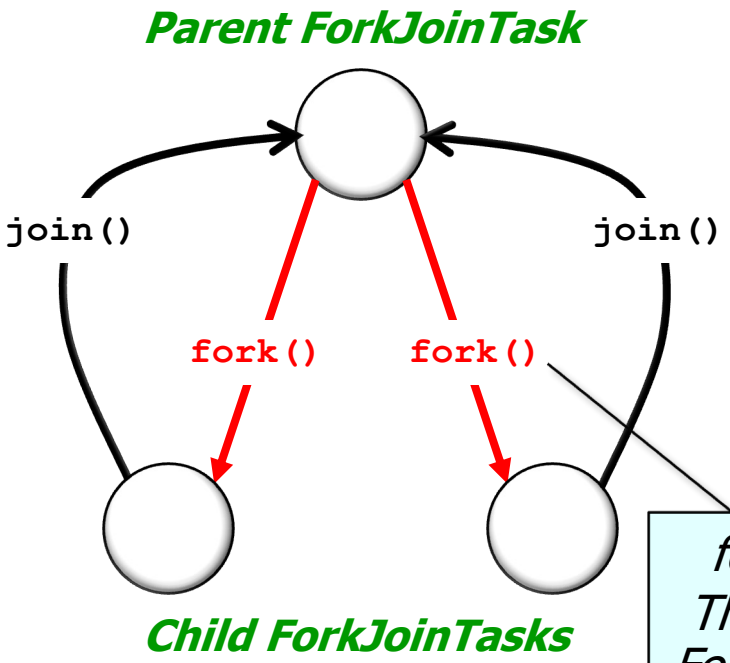

fork() is a lightweight variant of Thread.start() that creates a child ForkJoinTask for parallel processing

In this scenario a parent task may only fork a single child task to minimize overhead

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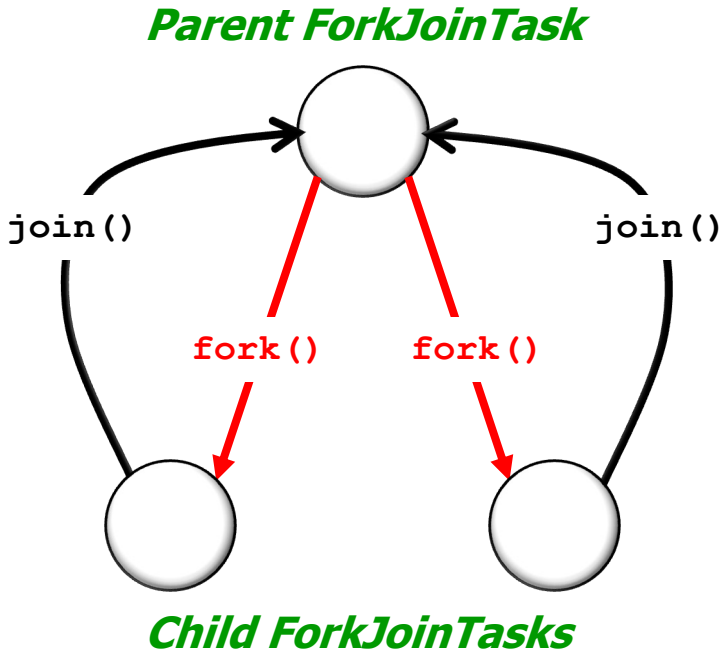

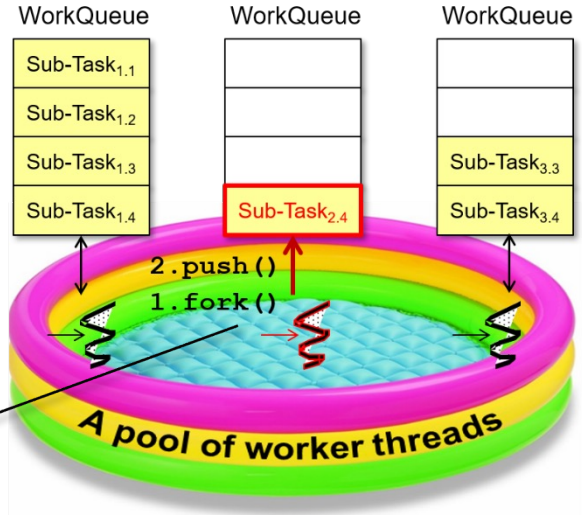

fork() doesn't run the task, but places it on a work queue in the calling worker thread

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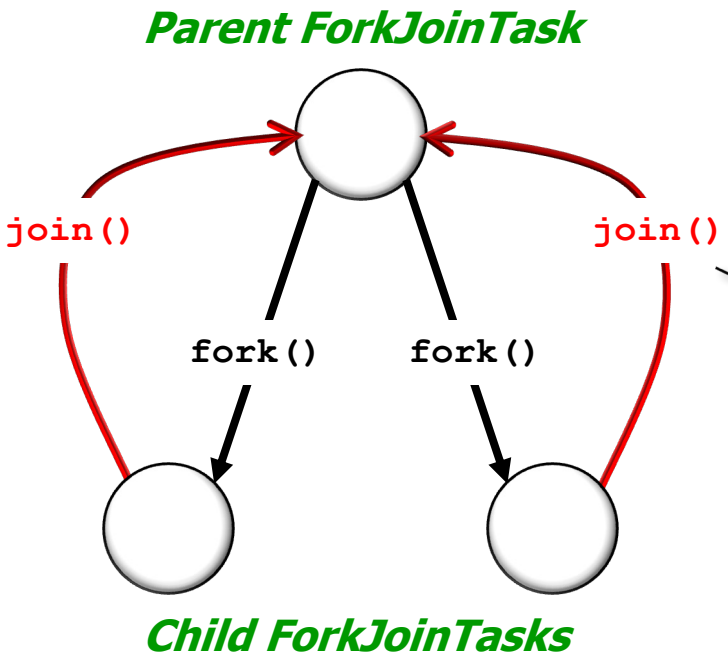

join() returns the result of a child task to the parent task that forked it

Overview of the ForkJoinTask Class

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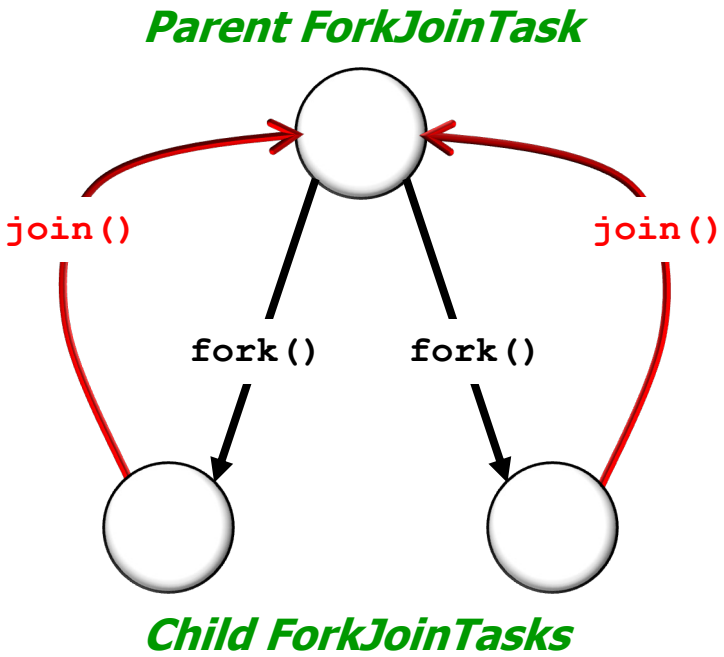

ForkJoinTask <T>	**fork**() – Arranges to asynchronously execute this task in the appropriate pool
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- Unlike Thread.join(), ForkJoinTask.join() doesn't simply block the calling thread

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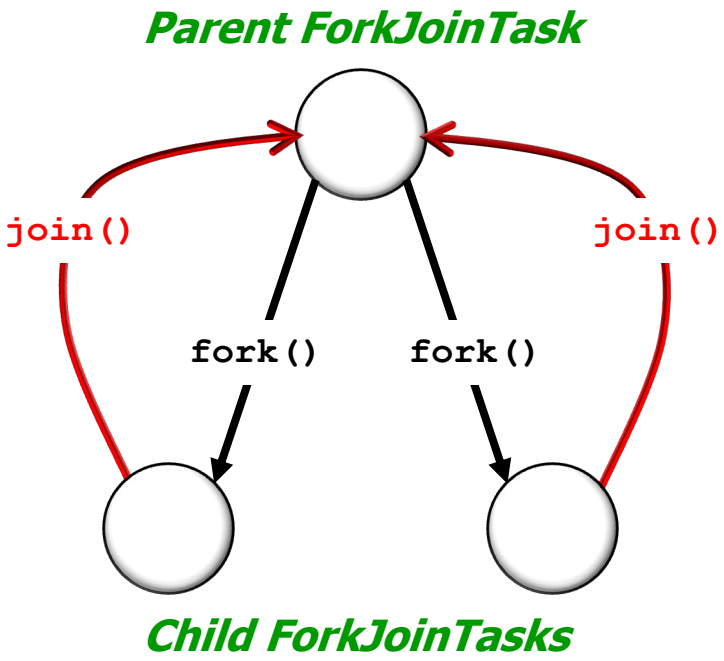

ForkJoinTask <T>	**fork**() – Arranges to asynchronously execute this task in the appropriate pool
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- Unlike Thread.join(), ForkJoinTask.join() doesn't simply block the calling thread
  - It uses a worker thread to run tasks

It "pitches in" via the "Collaborative Jiffy Lube" model of processing!

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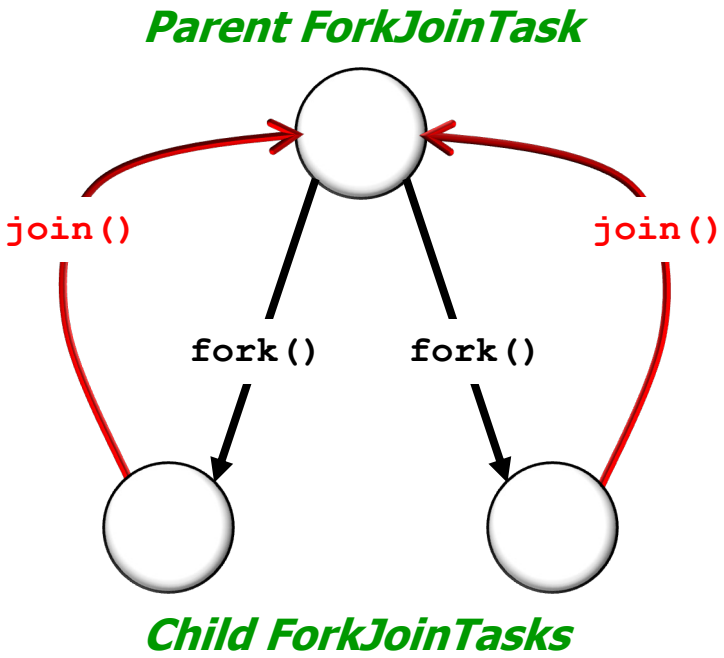
- A ForkJoinTask has two methods that control parallel processing/merging



ForkJoinTask <T>	**fork**() – Arranges to asynchronously execute this task in the appropriate pool
V	**join**() – Returns result of computation when it is done

- Unlike Thread.join(), ForkJoinTask.join() doesn't simply block the calling thread
  - It uses a worker thread to run tasks
  - When a worker thread encounters a join() it processes other tasks until it notices the target sub-task is done

Overview of the ForkJoinTask Class

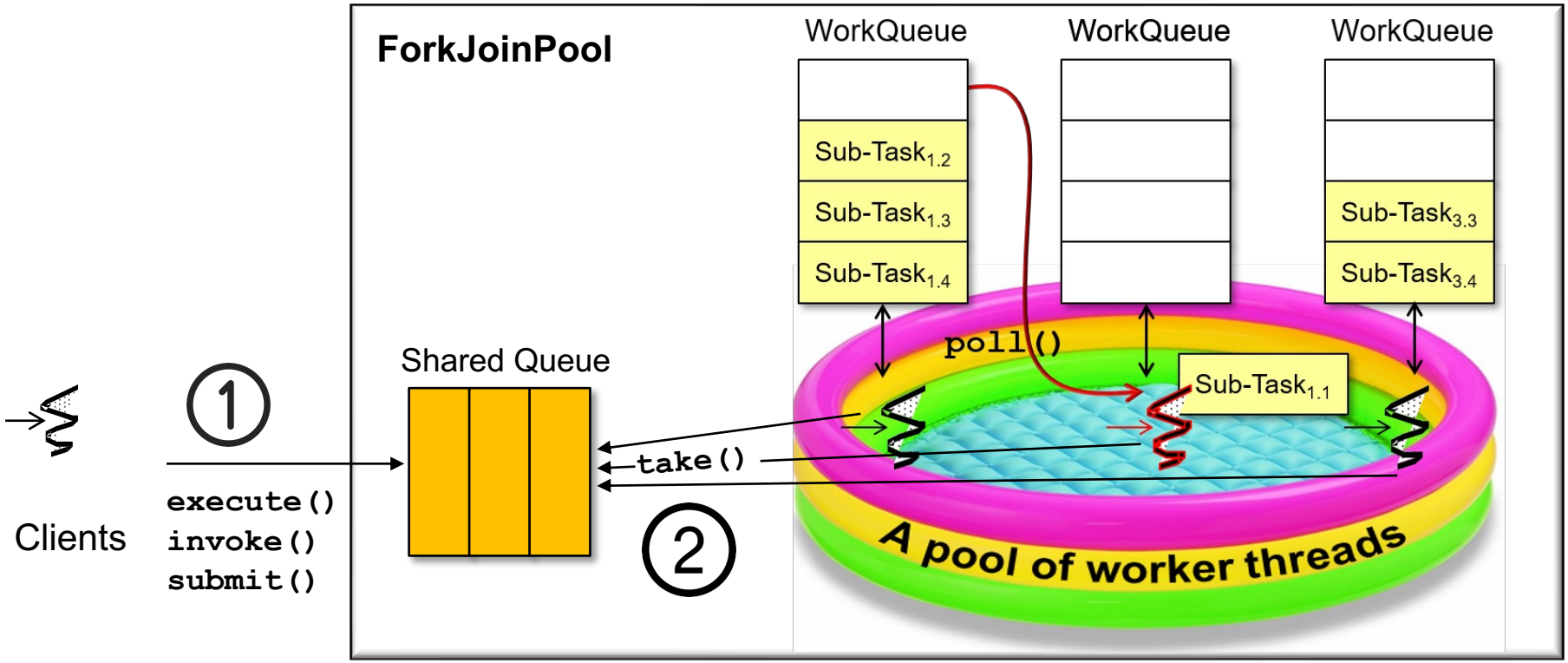
- ForkJoinPool enables non-ForkJoinTask clients to process ForkJoinTasks

void	execute(ForkJoinTask<T>) – Arrange async execution
T	invoke(ForkJoinTask<T>) – Performs the given task, returning its result upon completion
ForkJoinTask <T>	submit(ForkJoinTask) – Submits a ForkJoinTask for execution, returns a future

See upcoming lesson on "*The Java Fork-Join Pool: Key Methods in ForkJoinPool*"

Overview of the ForkJoinTask Class

- Clients insert new fork-join tasks onto a fork-join pool's shared queued, which feeds "work-stealing" queues managed by worker threads



See en.wikipedia.org/wiki/Work_stealing

Overview of the ForkJoinTask Class

- Clients insert new fork-join tasks onto a fork-join pool's shared queued, which feeds "work-stealing" queues managed by worker threads
  - The goal of "work-stealing" is to maximize processor core utilization

See docs.oracle.com/javase/tutorial/essential/concurrency/forkjoin.html

End of the Java ForkJoinTask Class