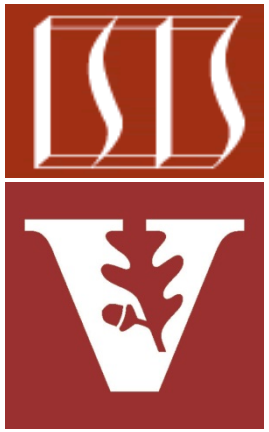
Overview of the Java Executor Framework (Part 1)



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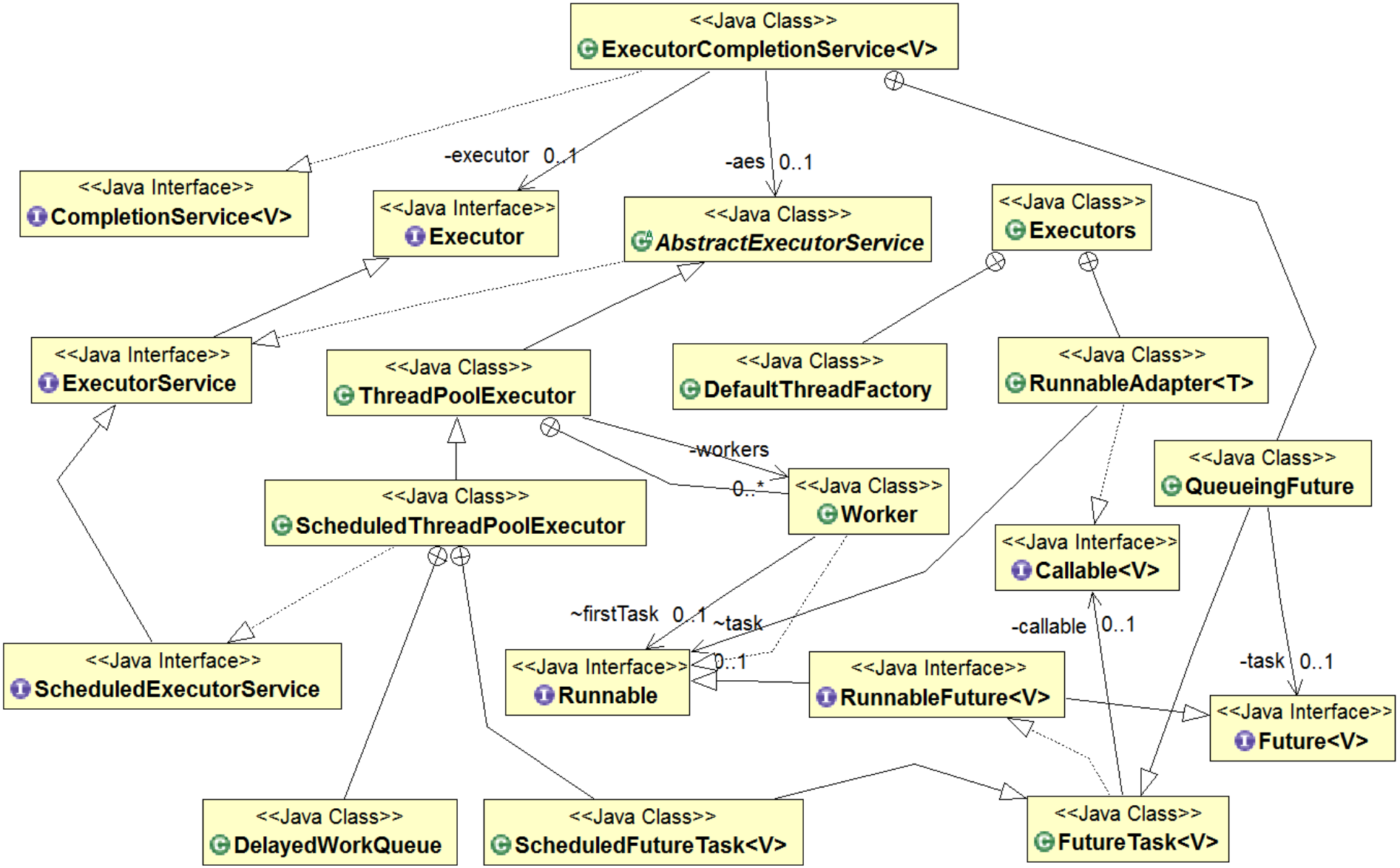
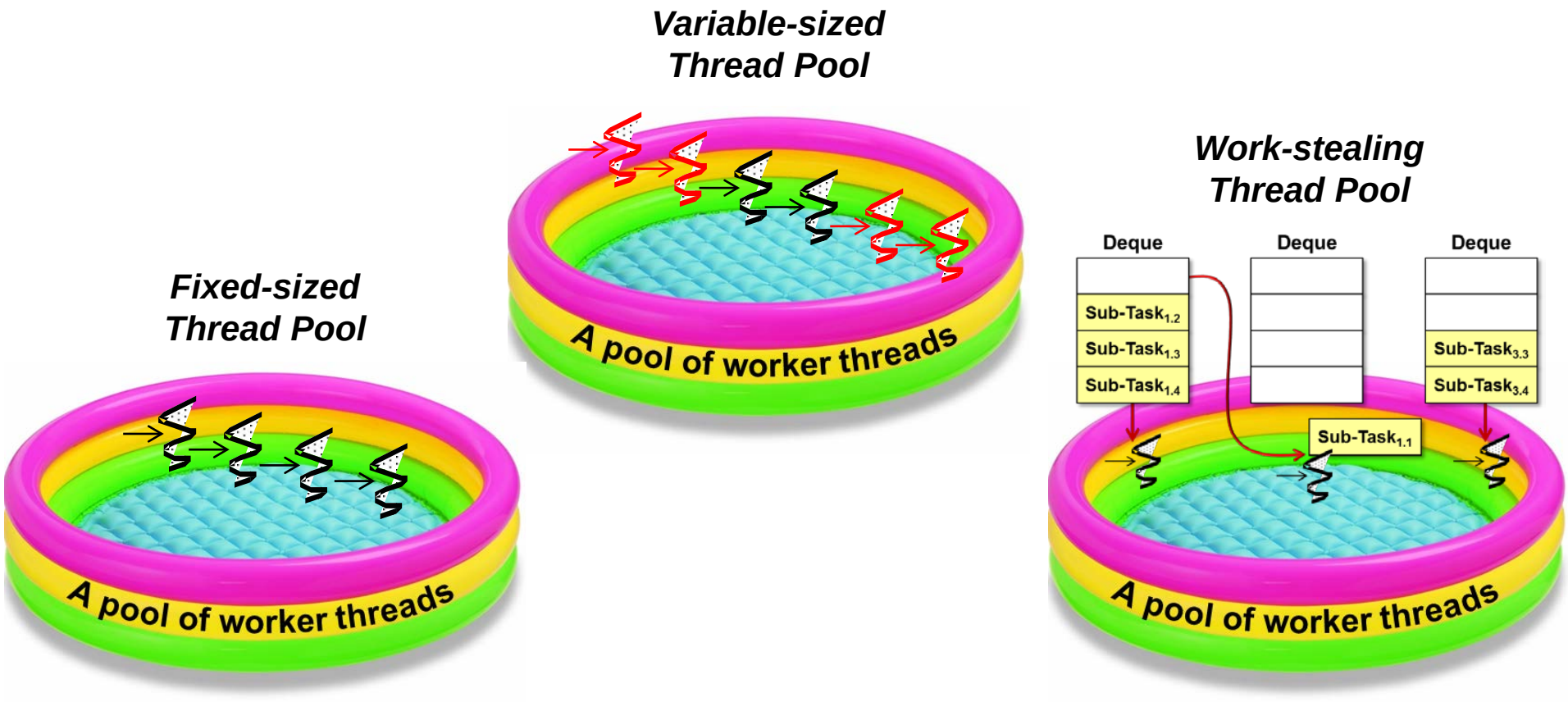
Learning Objectives in this Part of the Lesson

- Understand how the Java executor framework decouples the creation & management of threads from the rest of the app logic



Learning Objectives in this Part of the Lesson

- Understand how the Java executor framework decouples the creation & management of threads from the rest of the app logic
- Know the types of thread pools supported by the Java executor framework



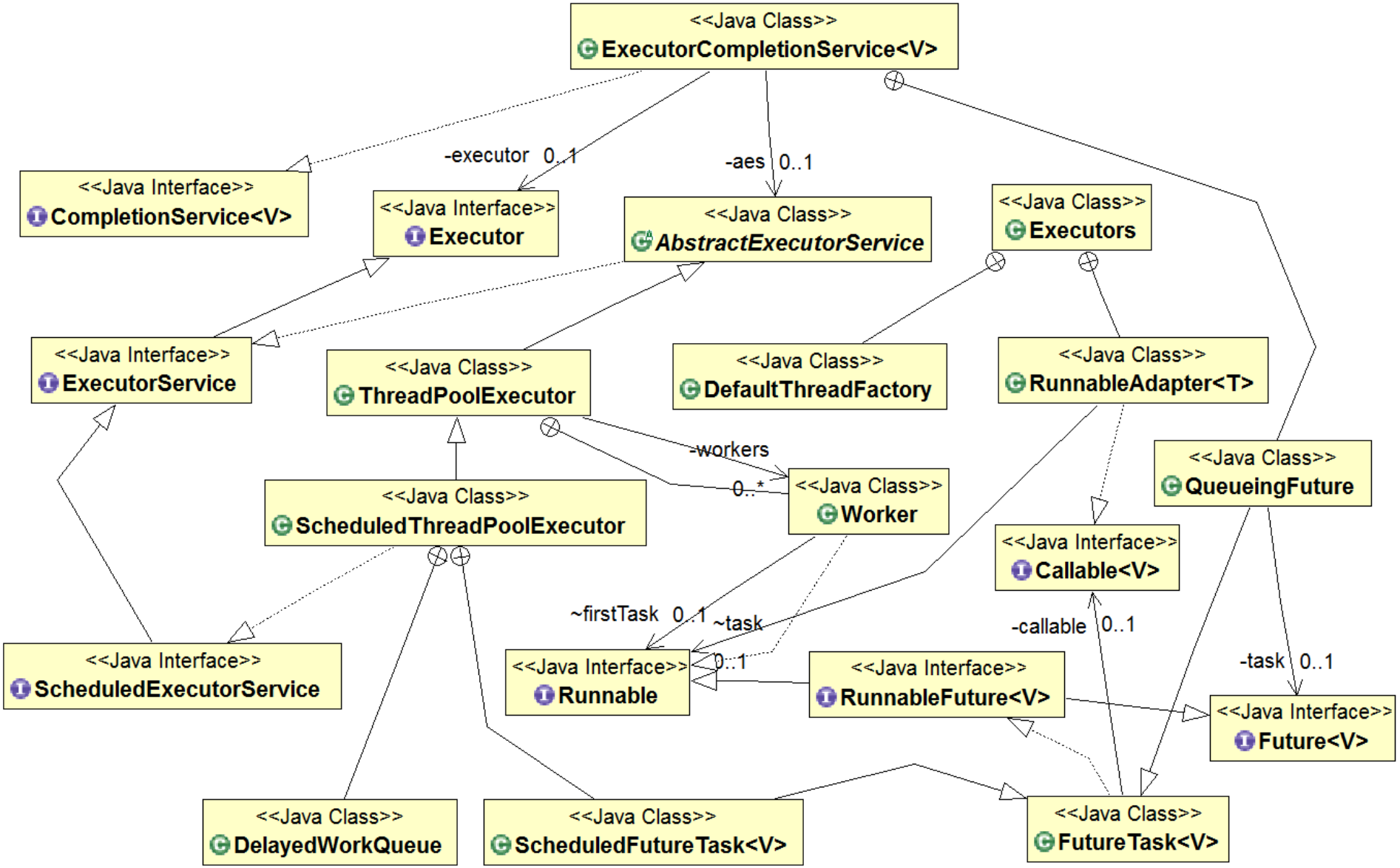
Learning Objectives in this Part of the Lesson

- Understand how the Java executor framework decouples the creation & management of threads from the rest of the app logic
- Know the types of thread pools supported by the Java executor framework
- Recognize a human known use of thread pools

Overview of the Java Executor Framework

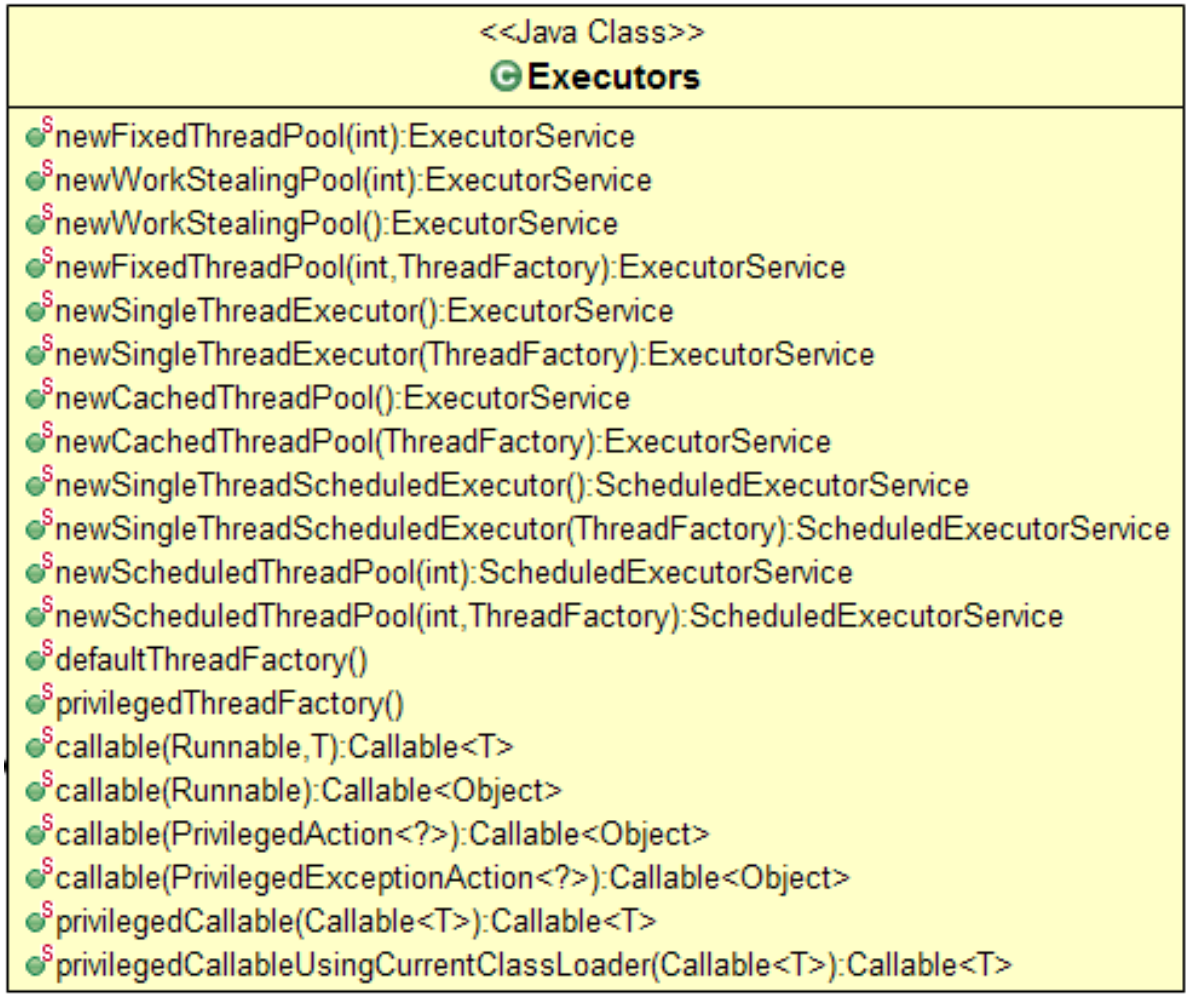
Overview of The Java Executor Framework

- The Java executor framework provides many classes & interfaces that decouple the creation & management of threads from application task logic



Overview of The Java Executor Framework

- Access to the mechanisms defined by Java's executor framework is mediated via the Executors class



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

Overview of The Java Executor Framework

- Access to the mechanisms defined by Java's executor framework is mediated via the Executors class
  - This class defines a "façade" consisting of factory methods

<<Java Class>>

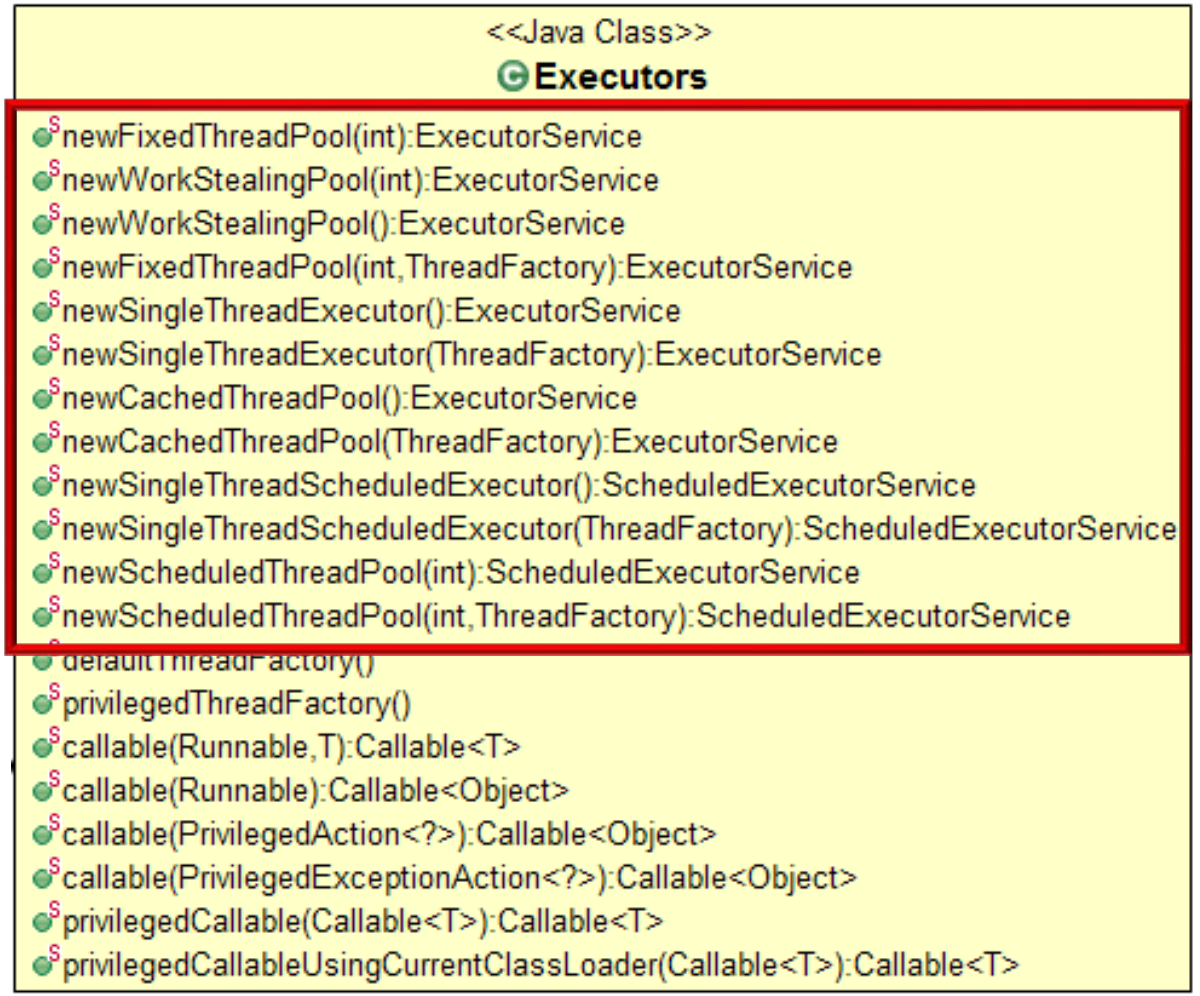
Executors

- newFixedThreadPool(int):ExecutorService
- newWorkStealingPool(int):ExecutorService
- newWorkStealingPool():ExecutorService
- newFixedThreadPool(int,ThreadFactory):ExecutorService
- newSingleThreadExecutor():ExecutorService
- newSingleThreadExecutor(ThreadFactory):ExecutorService
- newCachedThreadPool():ExecutorService
- newCachedThreadPool(ThreadFactory):ExecutorService
- newSingleThreadScheduledExecutor():ScheduledExecutorService
- newSingleThreadScheduledExecutor(ThreadFactory):ScheduledExecutorService
- newScheduledThreadPool(int):ScheduledExecutorService
- newScheduledThreadPool(int,ThreadFactory):ScheduledExecutorService
- defaultThreadFactory()
- privilegedThreadFactory()
- callable(Runnable,T):Callable<T>
- callable(Runnable):Callable<Object>
- callable(PrivilegedAction<?>):Callable<Object>
- callable(PrivilegedExceptionAction<?>):Callable<Object>
- privilegedCallable(Callable<T>):Callable<T>
- privilegedCallableUsingCurrentClassLoader(Callable<T>):Callable<T>

See en.wikipedia.org/wiki/Facade_pattern & en.wikipedia.org/wiki/Factory_method_pattern

Overview of The Java Executor Framework

- Access to the mechanisms defined by Java's executor framework is mediated via the Executors class
  - This class defines a "façade" consisting of factory methods
  - These factory methods create thread pools



See en.wikipedia.org/wiki/Thread_pool_pattern

Overview of Thread Pools

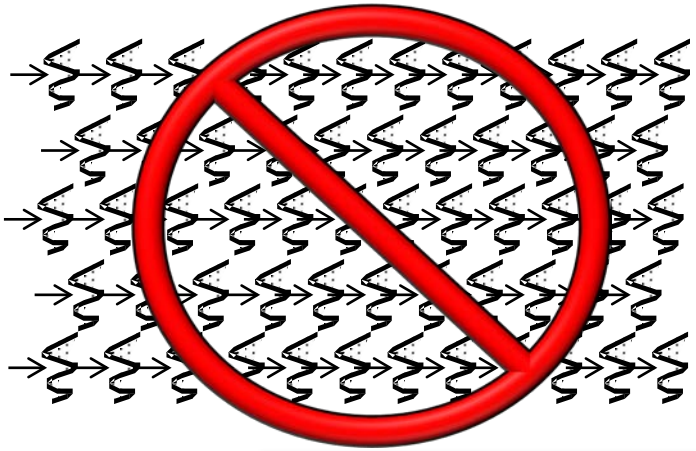
Overview of Thread Pools

- Concurrent programs must often handle a large # of clients

e.g., consider a web server that must handle thousands of client requests simultaneously

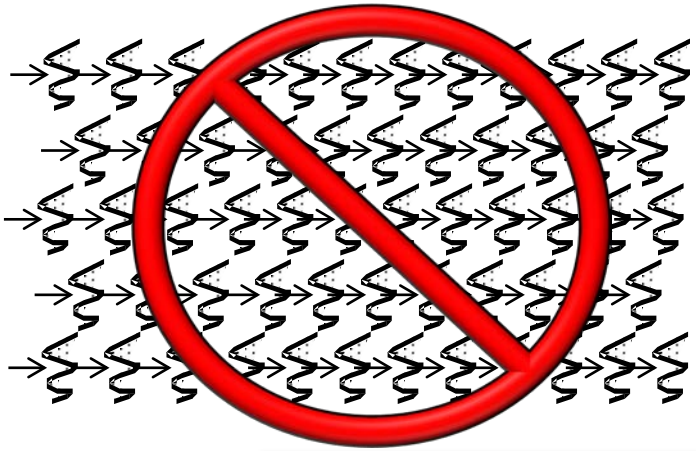
Overview of Thread Pools

- However, spawning a thread per client doesn't scale



Overview of Thread Pools

- However, spawning a thread per client doesn't scale, e.g.
  - Dynamically spawning a thread per client incurs excessive processing overhead



```
void handleClientRequest(Request request) {
  new Thread(makeRequestRunnable(request));
  ...
```

Overview of Thread Pools

- However, spawning a thread per client doesn't scale, e.g.
  - Dynamically spawning a thread per client incurs excessive processing overhead
  - It consumes an excessive amount of memory resources for all the threads


```
void handleClientRequest(Request request) {
  new Thread(makeRequestRunnable(request));
  ...
```

Overview of Thread Pools

- A pool of threads is often a better way to scale concurrent app performance

See en.wikipedia.org/wiki/Thread_pool_pattern

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  - Amortizes memory/processing overhead associated with spawning threads

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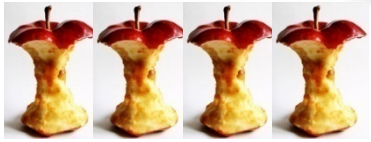
  - Amortizes memory/processing overhead associated with spawning threads
  - Pool size determined by factors like # of cores, I/O-intensive vs. compute-intensive tasks



See www.ibm.com/developerworks/library/j-jtp0730

Overview of Thread Pools

- Java's executor service framework has several types of thread pools

Overview of Thread Pools

- Java's executor service framework has several types of thread pools
  - *Fixed-size pool*
    - Reuses a fixed # of threads to amortize creation overhead


```
mExecutor = Executors.newFixedThreadPool(sMAX_THREADS);
...

void handleClientRequest(Request request) {
  mExecutor.execute(makeRequestRunnable(request));
  ...
```

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/Executors.html#newFixedThreadPool

Overview of Thread Pools

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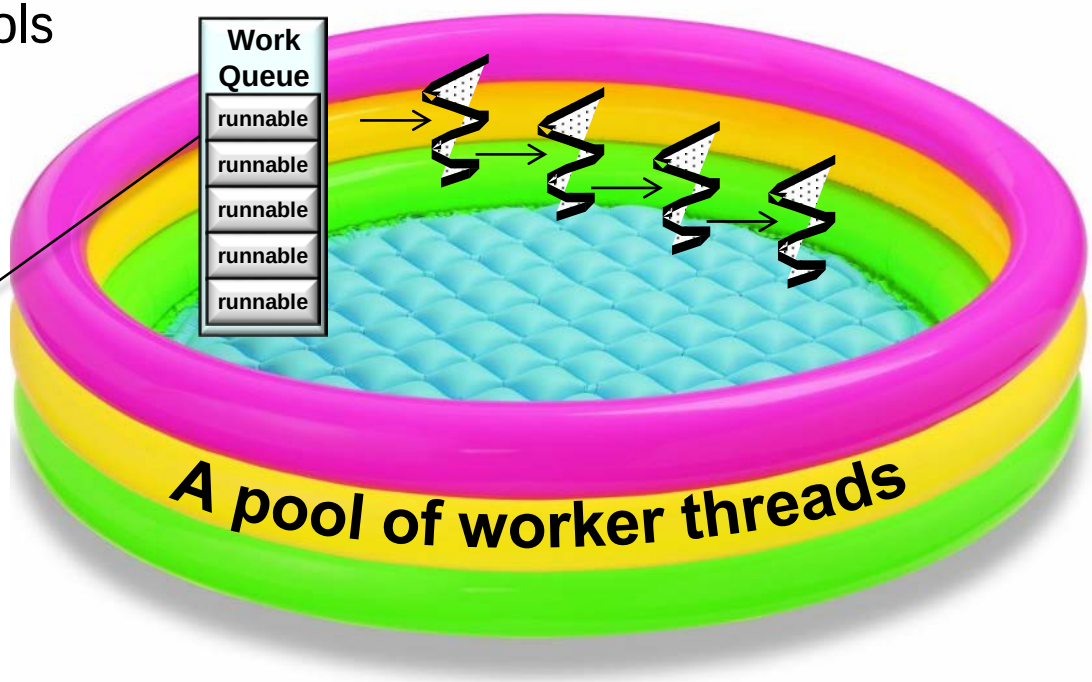
  - *Fixed-size pool*
    - Reuses a fixed # of threads to amortize creation overhead



Addition tasks will be queued until a thread is available

```
mExecutor = Executors.newFixedThreadPool(sMAX_THREADS);
...

void handleClientRequest(Request request) {
  mExecutor.execute(makeRequestRunnable(request));
  ...
```

Overview of Thread Pools

- Java's executor service framework has several types of thread pools
  - *Fixed-size pool*
  - *Cached*
    - Create new threads on-demand in response to client workload


```
mExecutor = Executors.newCachedThreadPool();
...

void handleClientRequest(Request request) {
  mExecutor.execute(makeRequestRunnable(request));
  ...
```

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/Executors.html#newCachedThreadPool

Overview of Thread Pools

- Java's executor service framework has several types of thread pools
  - *Fixed-size pool*
  - *Cached*
    - Create new threads on-demand in response to client workload

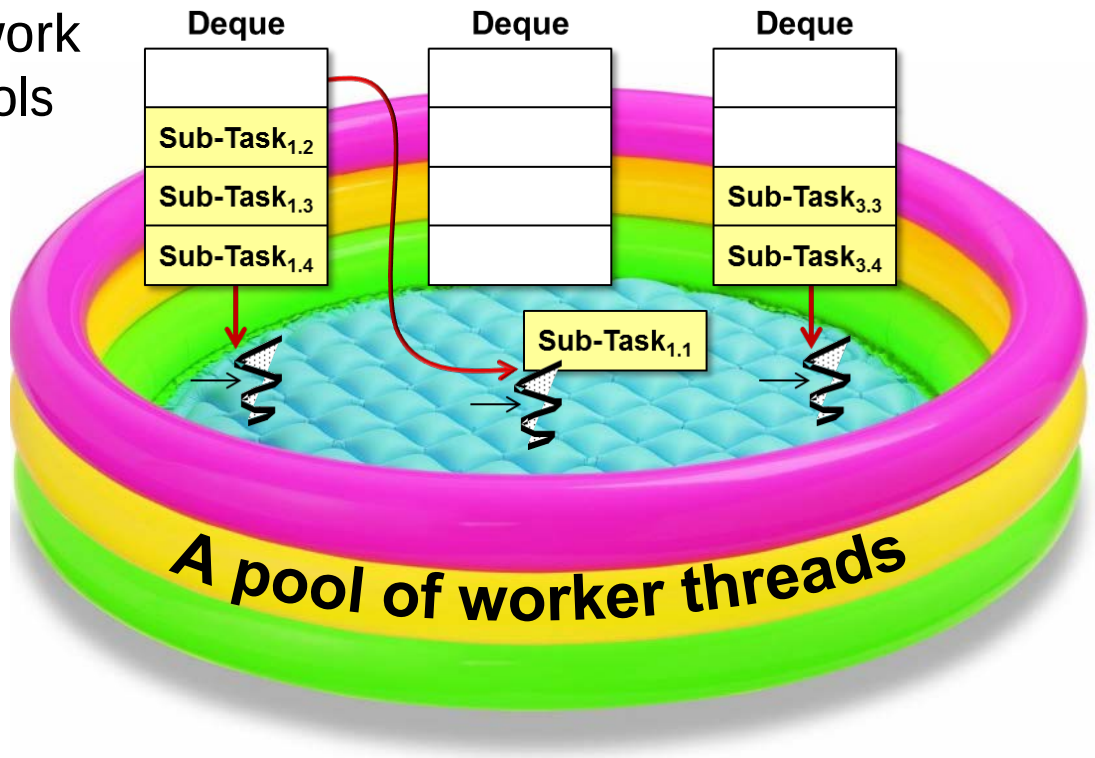
Threads are terminated if not used for a certain time

```
mExecutor = Executors.newCachedThreadPool();
...

void handleClientRequest(Request request) {
  mExecutor.execute(makeRequestRunnable(request));
  ...
```

Overview of Thread Pools

- Java's executor service framework has several types of thread pools
  - *Fixed-size pool*
  - *Cached*
  - *Fork/join pool*
    - Supports "work stealing" queues that maximize core utilization




```
mExecutor = Executors.newWorkStealingPool();
...

void handleClientRequest(Request request) {
  mExecutor.execute(makeRequestRunnable(request));
  ...
```

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/Executors.html#newWorkStealingPool

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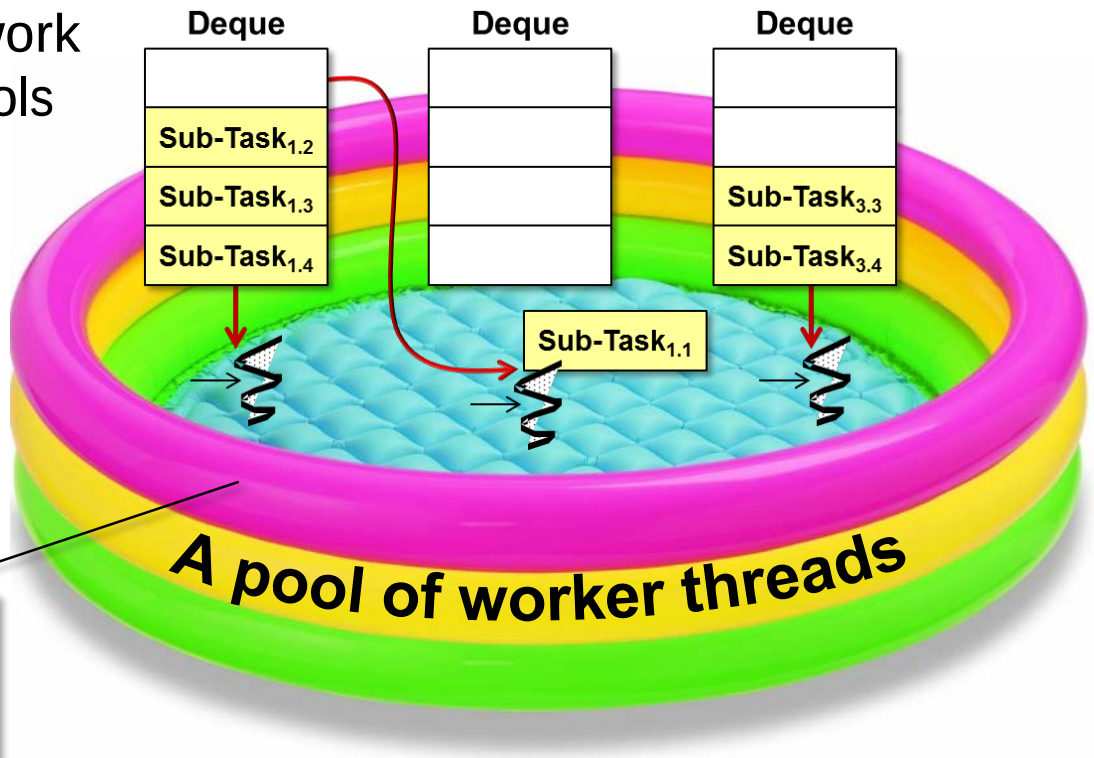


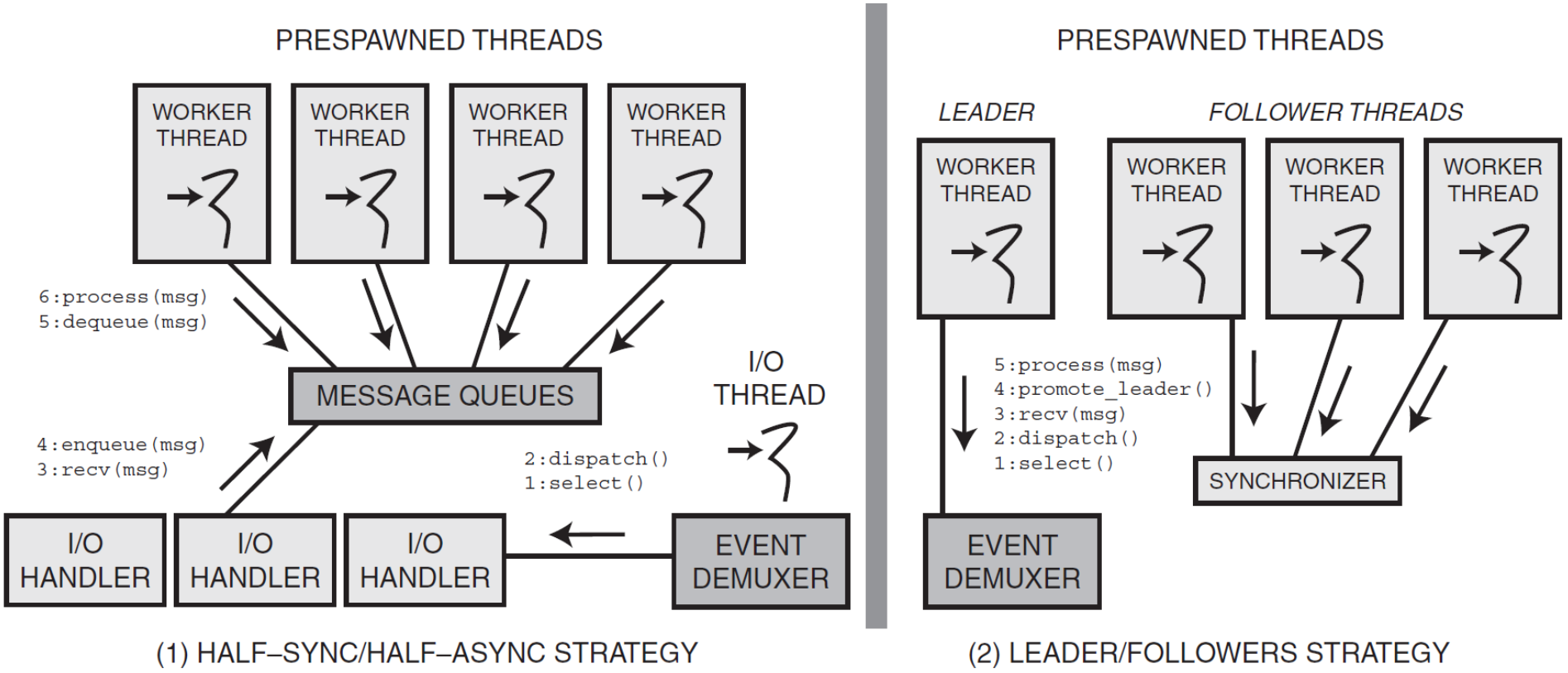
The pool size defaults to all available processor cores as its target parallelism level

```
mExecutor = Executors.newWorkStealingPool();
...

void handleClientRequest(Request request) {
  mExecutor.execute(makeRequestRunnable(request));
  ...
```

Overview of Thread Pools

- There are also other ways of implementing thread pools



See www.dre.vanderbilt.edu/~schmidt/PDF/lf.pdf & www.dre.vanderbilt.edu/~schmidt/PDF/HS-HA.pdf

Human Known Uses of Thread Pools

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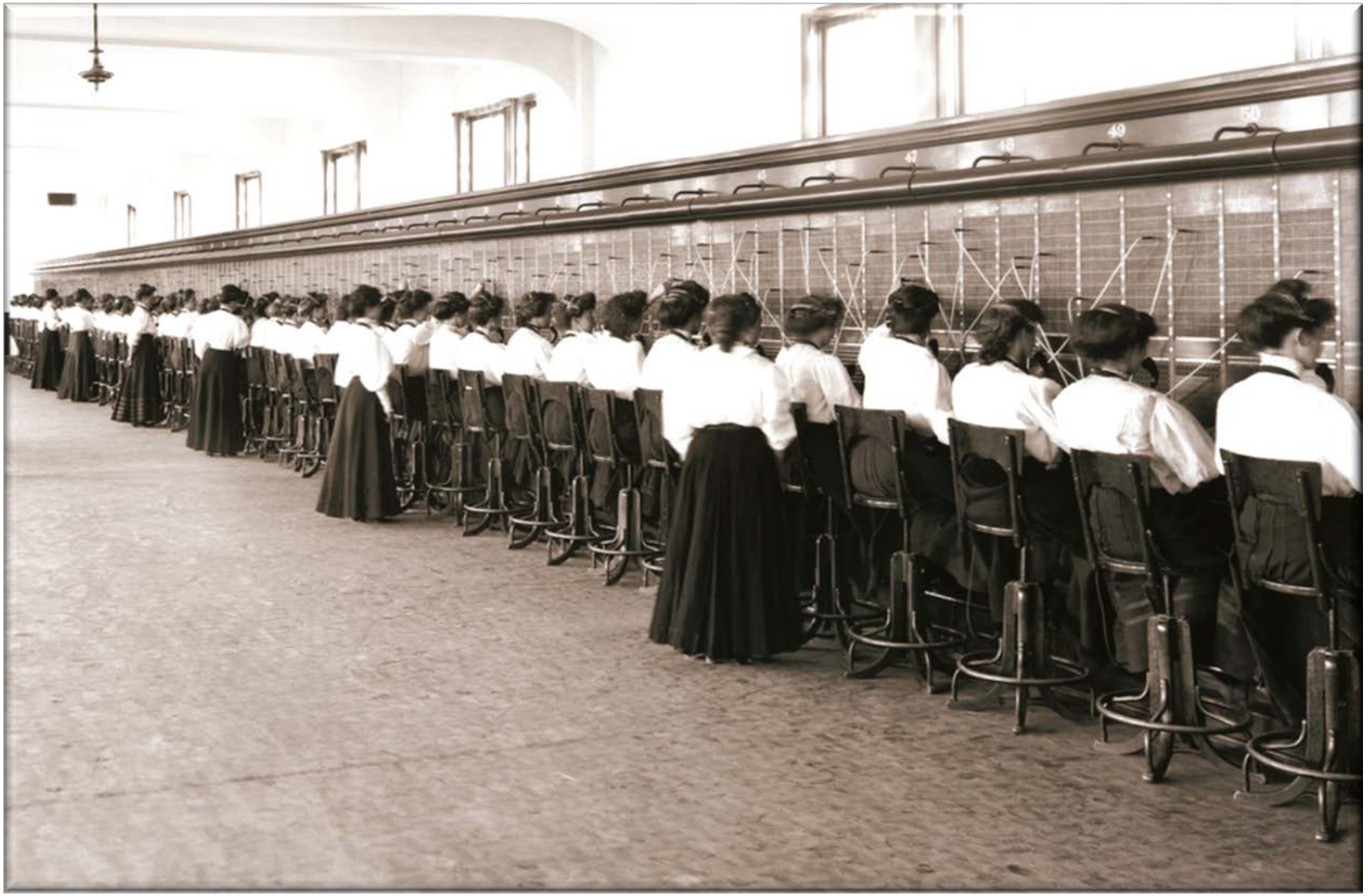
- A human known use of a thread pool is a call center



See en.wikipedia.org/wiki/Call_centre

End of Overview of the Java Executor Framework (Part 1)