Overview of the Java ThreadPoolExecutor

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Learning Objectives in this Part of the Lesson

- Recognize the powerful features defined in the Java ExecutorService interface
- Understand other interfaces related to ExecutorService
- Know the key methods provided by ExecutorService
- Be aware of how ThreadPoolExecutor implements ExecutorService
- Focusing on how to customize ThreadPoolExecutor behaviors based on params passed to its constructor
Overview of the Java ThreadPoolExecutor
Overview of the Java ThreadPoolExecutor

- ThreadPoolExecutor implements the ExecutorService interface
- Indirectly via the AbstractExecutorService super class
ThreadPoolExecutor runs each submitted task via a worker thread provided by a pool.

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/ThreadPoolExecutor.html
Overview of the Java ThreadPoolExecutor

- ThreadPoolExecutor runs each submitted task via a worker thread provided by a pool.
Overview of the Java ThreadPoolExecutor

- ThreadPoolExecutor’s constructor can be configured via various parameters

```java
ThreadPoolExecutor
    (int corePoolSize,
     int maximumPoolSize,
     long keepAliveTime,
     TimeUnit unit,
     BlockingQueue<Runnable>
          workQueue,
     ThreadFactory
          threadFactory)
```

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

Overview of the Java ThreadPoolExecutor

- The # of threads in the pool can be controlled programmatically
- `corePoolSize` – # of threads to keep in the pool, even if they are idle
- `maximumPoolSize` – maximum # of threads to allow in the pool

```
ThreadPoolExecutor (int corePoolSize,
                   int maximumPoolSize,
                   long keepAliveTime,
                   TimeUnit unit,
                   BlockingQueue<Runnable>
                   workQueue,
                   ThreadFactory
                   threadFactory)
```
Overview of the Java ThreadPoolExecutor

- The lifetime of threads in the pool can be controlled programmatically
- `keepAliveTime` – maximum time that excess idle threads will wait for new tasks before terminating when # of threads is greater than the core
- `unit` – the time unit for the `keepAliveTime` argument

```
ThreadPoolExecutor
(int corePoolSize,
 int maximumPoolSize,
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 TimeUnit unit,
 BlockingQueue<Runnable>
 workQueue,
 ThreadFactory
 threadFactory)
```
Overview of the Java ThreadPoolExecutor

- The queue holding tasks submitted by the execute() & submit() methods can be controlled programmatically.

- `workQueue` – the queue to use for holding tasks before they are run.

```java
ThreadPoolExecutor
    (int corePoolSize,
     int maximumPoolSize,
     long keepAliveTime,
     TimeUnit unit,
     BlockingQueue<Runnable>
        workQueue,
     ThreadFactory
        threadFactory)
```

WorkQueue

- callable
- callable
- callable
Overview of the Java ThreadPoolExecutor

- The queue can be strategized
- Direct handoff (used by cached pool)

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/SynchronousQueue.html
Overview of the Java ThreadPoolExecutor

- The queue can be strategized
- Direct handoff (used by cached pool)

ThreadPoolExecutor

(int corePoolSize, 
int maximumPoolSize, 
long keepAliveTime, 
TimeUnit unit, 
BlockingQueue<Runnable> workQueue, 
ThreadFactory threadFactory)

*SynchronousQueue implements a “rendezvous” model, where the caller blocks until the task is handed off to new or cached thread*
Overview of the Java ThreadPoolExecutor

- The queue can be strategized
- Direct handoff (used by cached pool)
  - Pros – Avoids deadlocking on internal dependencies

See [aszajder.github.io/thread-pool-induced-deadlocks](aszajder.github.io/thread-pool-induced-deadlocks)
Overview of the Java ThreadPoolExecutor

- The queue can be strategized
- Direct handoff (used by cached pool)
  - Pros – Avoids deadlocking on internal dependencies
  - Cons – Can create unlimited threads

ThreadPoolExecutor
   (int corePoolSize,
    int maximumPoolSize,
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    TimeUnit unit,
    BlockingQueue<Runnable>
    workQueue,
    ThreadFactory
    threadFactory)
Overview of the Java ThreadPoolExecutor

- The queue can be strategized
- Direct handoff
- Unbounded queues (used by default fixed pool)

See [docs.oracle.com/javase/8/docs/api/java/util/concurrent/LinkedBlockingQueue.html](docs.oracle.com/javase/8/docs/api/java/util/concurrent/LinkedBlockingQueue.html)
Overview of the Java ThreadPoolExecutor

• The queue can be strategized
  • Direct handoff
  • Unbounded queues (used by default fixed pool)
  • Pros – Smooths bursty requests

ThreadPoolExecutor
(int corePoolSize,
int maximumPoolSize,
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workQueue,
ThreadFactory
threadFactory)
Overview of the Java ThreadPoolExecutor

- The queue can be strategized
  - Direct handoff
- Unbounded queues (used by default fixed pool)
  - Pros – Smooths bursty requests
  - Cons – Can consume unlimited resources

```java
ThreadPoolExecutor
(int corePoolSize,
 int maximumPoolSize,
 long keepAliveTime,
 TimeUnit unit,
 BlockingQueue<Runnable>
 workQueue,
 ThreadFactory
 threadFactory)
```
Overview of the Java ThreadPoolExecutor

- The queue can be strategized
  - Direct handoff
  - Unbounded queues
  - Bounded queues (used by custom fixed pool)

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/ArrayBlockingQueue.html
Overview of the Java ThreadPoolExecutor

- The queue can be strategized
  - Direct handoff
  - Unbounded queues
  - Bounded queues (used by custom fixed pool)
- Pros – Limits resource utilization

```
ThreadPoolExecutor
    (int corePoolSize,
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```
Overview of the Java ThreadPoolExecutor

- The queue can be strategized
  - Direct handoff
  - Unbounded queues
  - Bounded queues (used by custom fixed pool)
- Pros – Limits resource utilization
- Cons – Hard to tune & may deadlock

See [aszajder.github.io/thread-pool-induced-deadlocks](aszajder.github.io/thread-pool-induced-deadlocks)
Overview of the Java ThreadPoolExecutor

- The factory used to create threads can be controlled programmatically
- `threadFactory` – the factory to use when creating a new thread

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(int corePoolSize,
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 threadFactory)
```

ThreadFactory removes hardwiring of calls to new Thread, enabling programs to use special thread subclasses, priorities, etc.
End of Overview of the Java ThreadPoolExecutor