Structure & Functionality of Java Phaser

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Learning Objectives in this Part of the Lesson

- Understand the structure & functionality of the Java Phaser barrier synchronizer

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**Class Phaser**

java.lang.Object  
java.util.concurrent.Phase

```java
public class Phaser  
extends Object

A reusable synchronization barrier, similar in functionality to CyclicBarrier and CountDownLatch but supporting more flexible usage.

**Registration.** Unlike the case for other barriers, the number of parties registered to synchronize on a phaser may vary over time. Tasks may be registered at any time (using methods register(), bulkRegister(int), or forms of constructors establishing initial numbers of parties), and optionally deregistered upon any arrival (using arriveAndDeregister()). As is the case with most basic synchronization constructs, registration and deregistration affect only internal counts; they do not establish any further internal bookkeeping, so tasks cannot query whether they are registered. (However, you can introduce such bookkeeping by subclassing this class.)
```
Overview of Java Phaser
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• Implements yet another Java barrier synchronizer

public class Phaser {
    ...

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

- Implements yet another Java barrier synchronizer
- Allows a variable (or fixed) # of threads to wait for all operations performed in other threads to complete before proceeding

Class Phaser

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One human known use is different work-crews with different #'s of workers coordinating to build a house
Overview of Java Phaser

• Implements yet another Java barrier synchronizer

• Allows a variable (or fixed) # of threads to wait for all operations performed in other threads to complete before proceeding

• Well-suited for variable-size “cyclic”, “entry”, and/or “exit” barriers

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- # of parties can vary dynamically

Class Phaser

```java
import java.lang.Object;
import java.util.concurrent.Phaser;

public class Phaser extends Object {

    // A reusable synchronization barrier, similar in functionality to CyclicBarrier and CountDownLatch but supporting more flexible usage.

    // Registration. Unlike the case for other barriers, the number of parties registered to synchronize on a phaser may vary over time. Tasks may be registered at any time (using methods register(), bulkRegister(int), or forms of constructors establishing initial numbers of parties), and optionally deregistered upon any arrival (using arriveAndDeregister()). As is the case with most basic synchronization constructs, registration and deregistration affect only internal counts; they do not establish any further internal bookkeeping, so tasks cannot query whether they are registered. (However, you can introduce such bookkeeping by subclassing this class.)
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A Phaser may be overkill for fixed-sized barriers..
Overview of Java Phaser

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```java
public class Phaser {
    ...
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```

Does not implement an interface

---

Class Phaser

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java.lang.Object
    java.util.concurrent.Phase
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• Does not apply the *Bridge* pattern

```
public class Phaser {
    ...
```

See `share/classes/java/util/concurrent/Phaser.java`
Overview of Java Phaser

- Does not apply the *Bridge* pattern
- Nor does it use the Abstract QueuedSynchronizer framework

```java
class Phaser {
    // ...
}
```

Unlike the Java ReentrantLock, ReentrantReadWriteLock, Semaphore, ConditionObject, & CountDownLatch classes
Overview of Java Phaser

- Instead, it defines a # of fields that implement a phaser

```java
public class Phaser {
    private volatile long state;
    ...
}
```

See `src/share/classes/java/util/concurrent/Phaser.java`
Overview of Java Phaser

- Instead, it defines a # of fields that implement a phaser
- Primary state representation, holding four bit-fields

See en.wikipedia.org/wiki/Bit_field
Overview of Java Phaser

• Instead, it defines a # of fields that implement a phaser

• Primary state representation, holding four bit-fields:
  • Unarrived
    • the # of parties yet to hit barrier (bits 0-15)
Overview of Java Phaser

- Instead, it defines a # of fields that implement a phaser
- Primary state representation, holding four bit-fields:
  - Unarrived
  - Parties
  - the # of parties to wait for before advancing to the next phase (bits 16-31)

```java
public class Phaser {
    private volatile long state;
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Overview of Java Phaser

• Instead, it defines a # of fields that implement a phaser
• Primary state representation, holding four bit-fields:
  • *Unarrived*
  • *Parties*
  • *Phase*
  • the generation of the barrier (bits 32-62)

class Phaser {
  private volatile long state;
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Overview of Java Phaser

• Instead, it defines a # of fields that implement a phaser

• Primary state representation, holding four bit-fields:
  • *Unarrived*
  • *Parties*
  • *Phase*
  • *Terminated*
    • set if barrier is terminated (bit 63 / sign)

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Instead, it defines a # of fields that implement a phaser:

- **Primary state representation**, holding four bit-fields:
  - **Unarrived**
    - the # of parties yet to hit barrier (bits 0-15)
  - **Parties**
    - the # of parties to wait (bits 16-31)
  - **Phase**
    - the generation of the barrier (bits 32-62)
  - **Terminated**
    - set if barrier is terminated (bit 63 / sign)

To efficiently maintain atomicity, these values are packed into a single (atomic) long that is updated via CAS operations.

End of Structure & Functionality of Java Phaser
1. What of the following are benefit of the Java Phaser over the CyclicBarrier?

a. *It supports fixed-size “cyclic” & “entry” and/or “exit” barriers who # of parties match the # of threads*

b. *It supports variable-size “cyclic” & “entry” and/or “exit” barriers whose # of parties can vary dynamically*

c. *It uses the AbstractQueuedSynchronizer framework to enhance reuse*

d. *They provide better support for fixed-sized # of parties*