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

Class Phaser

java.lang.Object
    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.)

Overview of Java Phaser

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- Implements yet another Java barrier synchronizer

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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

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public class Phaser {
  ...
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One human known use is different work-crews with different #'s of workers coordinating to build a house

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  - 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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A Phaser may be overkill for fixed-sized barriers..

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Does not implement an interface

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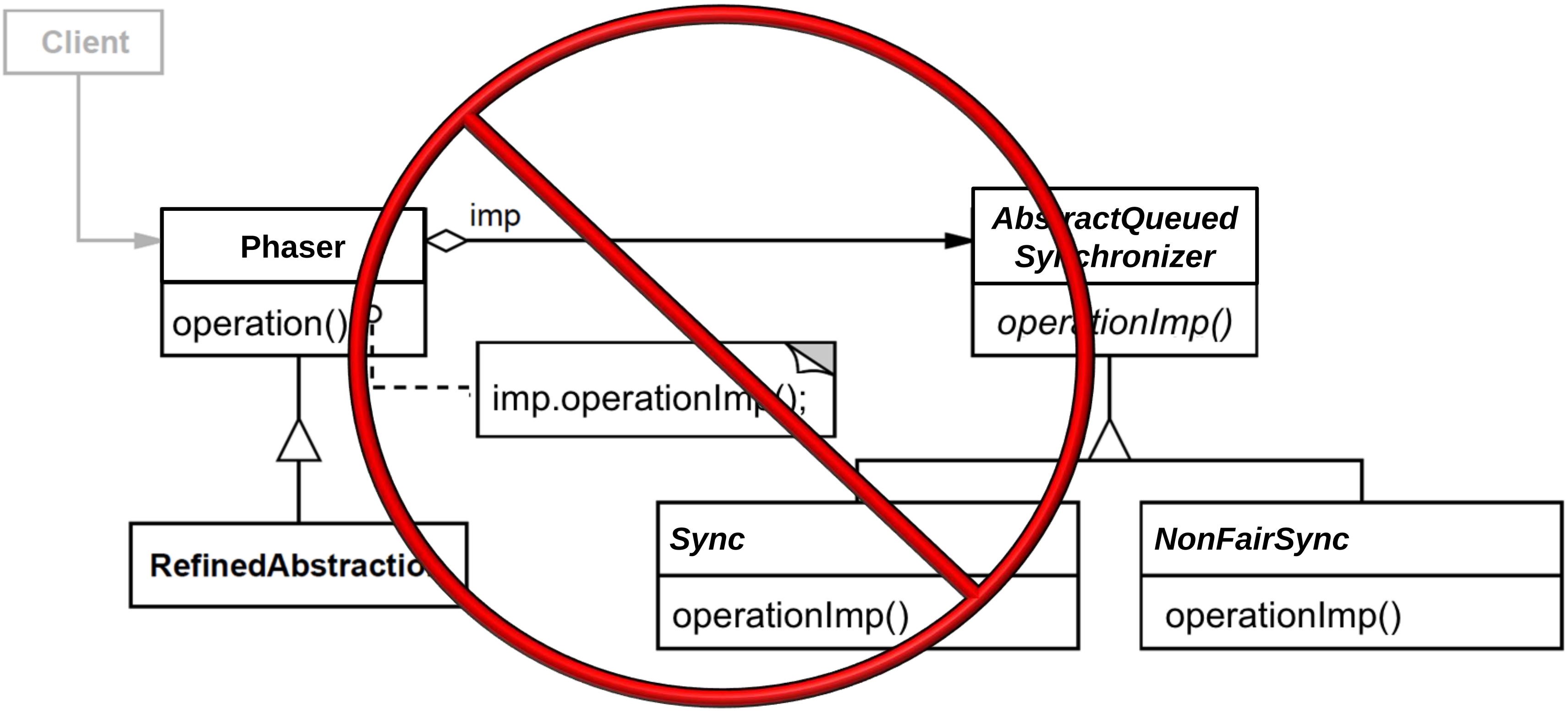
Overview of Java Phaser

- Does not apply the *Bridge* pattern

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

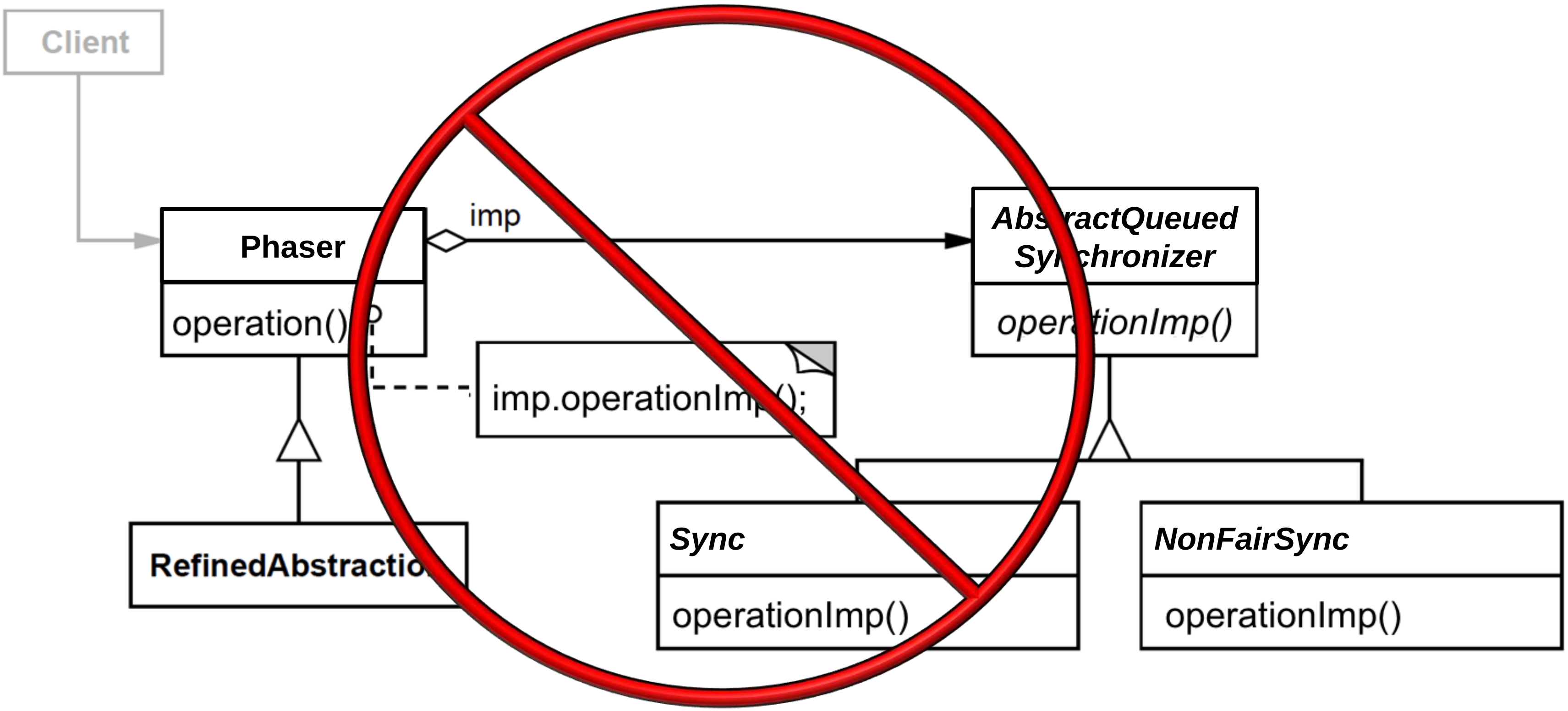


See share/classes/java/util/concurrent/Phaser.java

Overview of Java Phaser

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

```
public 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

```
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

```
public class Phaser {
  private volatile long state;
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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)

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- 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)

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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)

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

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

See en.wikipedia.org/wiki/Compare-and-swap

End of Structure & Functionality of Java Phaser

Discussion Questions

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*