Safe Publication in Java: Introduction

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Learning Objectives in this Part of the Lesson

• Understand what “safe publication” means in the context of Java objects
Overview of Safe Publication in Java
Overview of Safe Publication in Java

• A Java object that’s shared across threads must meet several criteria

See flylib.com/books/en/2.558.1/safe_publication.html
Overview of Safe Publication in Java

- A Java object that’s shared across threads must meet several criteria
- They must be constructed properly

See shipilev.net/blog/2014/safe-public-construction
Overview of Safe Publication in Java

- A Java object that's shared across threads must meet several criteria
  - They must be constructed properly
  - If the `this` reference “escapes” during construction the object is *not* properly constructed

```java
public class ThisEscape {
    public ThisEscape (EventSource source) {
        source.registerListener(new EventListener() {
            public void onEvent(Event event) {
                doSomething(event);
            }
        });
    }
}
```

See vlkan.com/blog/post/2014/02/14/java-safe-publication
A Java object that’s shared across threads must meet several criteria:

- They must be constructed properly.
- If the this reference “escapes” during construction the object is not properly constructed.

```java
public class ThisEscape {
    public ThisEscape (EventSource source) {
        source
            .registerListener
                (new EventListener() {
                public void onEvent (Event event) {
                    doSomething(event);
                }
            });
    }
}
```

*Implicitly publish the enclosing ThisEscape object because inner class instances contain a hidden reference to the enclosing object.*

See [vlkan.com/blog/post/2014/02/14/java-safe-publication](http://vlkan.com/blog/post/2014/02/14/java-safe-publication)
Overview of Safe Publication in Java

- A Java object that’s shared across threads must meet several criteria
  - They must be constructed properly
  - They must be “published safely”

See shipilev.net/blog/2014/safe-public-construction
Overview of Safe Publication in Java

- A Java object that’s shared across threads must meet several criteria
  - They must be constructed properly
  - They must be “published safely”
    - Safe publication ensures all values written within a thread before the publication are visible to all reader threads that observe the published object

This “object-level” property can be viewed as a generalization of “operation-level” atomic operations discussed in earlier lessons.
Overview of Safe Publication in Java

• A Java object that’s shared across threads must meet several criteria
  • They must be constructed properly
  • They must be “published safely”
    • Safe publication ensures all values written within a thread before the publication are visible to all reader threads that observe the published object
  • Storing a object reference into a public field is insufficient to publish that object safely

```
class A {
    public ArrayList<String> mList;
    public void initialize() {
        mList = new ArrayList<>(Array.asList(...));
    }
}

// Thread T1
A a = new A();
a.initialize();

// Thread T2
doSomething(a.mList);
```

This problem only arises in multi-threaded programs on multi-core CPUs
Overview of Safe Publication in Java

A Java object that’s shared across threads must meet several criteria:

- They must be constructed properly
- They must be “published safely”
  - Safe publication ensures all values written within a thread before the publication are visible to all reader threads that observe the published object
- Storing an object reference into a public field is insufficient to publish that object safely

```java
class A {
    public ArrayList<String> mList;

    public void initialize() {
        mList = new ArrayList<>(Array.asList(...));
    }
}

// Thread T1
A a = new A();
a.initialize();

// Thread T2
doSomething(a.mList);
```

Initialize a field in thread $T_1$
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- A Java object that’s shared across threads must meet several criteria
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  - Storing a object reference into a public field is insufficient to publish that object safely

```java
class A {
    public ArrayList<String> mList;

    public void initialize() {
        mList = new ArrayList<>()
            Array.asList(...);
    }
}

// Thread T1
A a = new A();
a.initialize();

// Thread T2
doSOMETHING(a.mList);
```

*mList is not guaranteed to be initialized when thread T2 gets a reference to object a*
End of Safe Publication in Java: Introduction