

Safe Publication in Java: Introduction



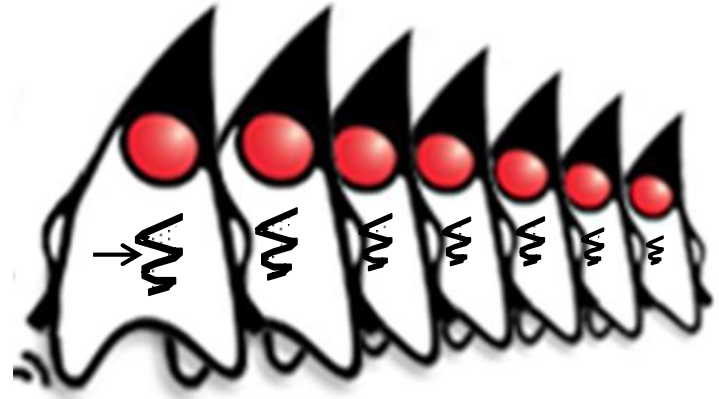
Douglas C. Schmidt
d.schmidt@vanderbilt.edu
www.dre.vanderbilt.edu/~schmidt

**Institute for Software
Integrated Systems
Vanderbilt University
Nashville, Tennessee, USA**



Learning Objectives in this Part of the Lesson

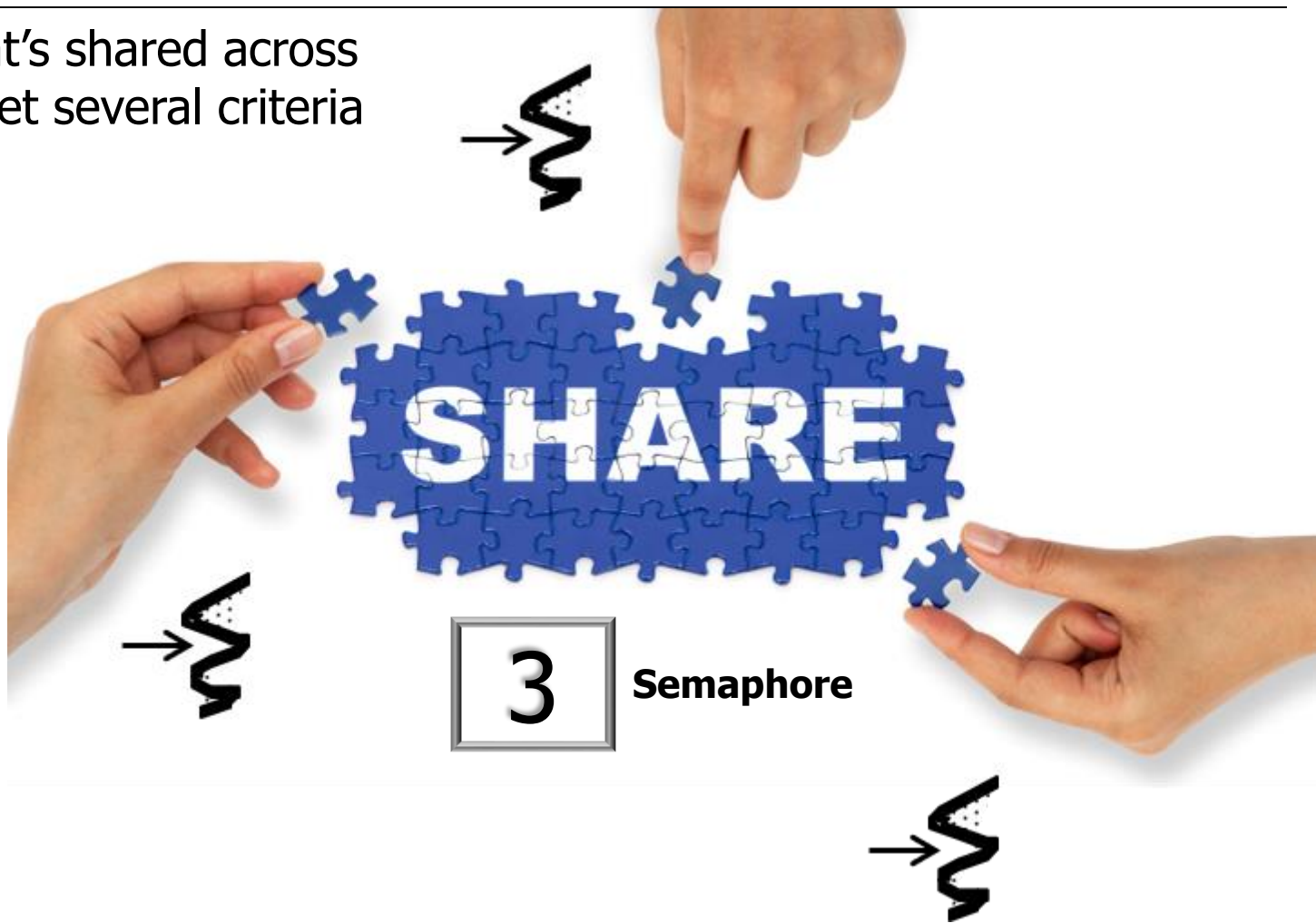
- Understand what “safe publication” means in the context of Java objects



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

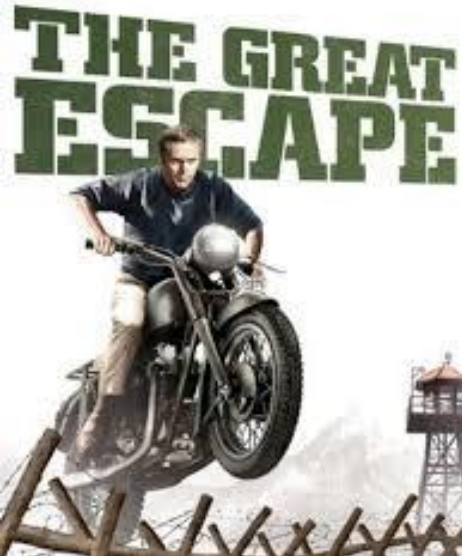
- A Java object that's shared across threads must meet several criteria
 - They must be constructed properly



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



```
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

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

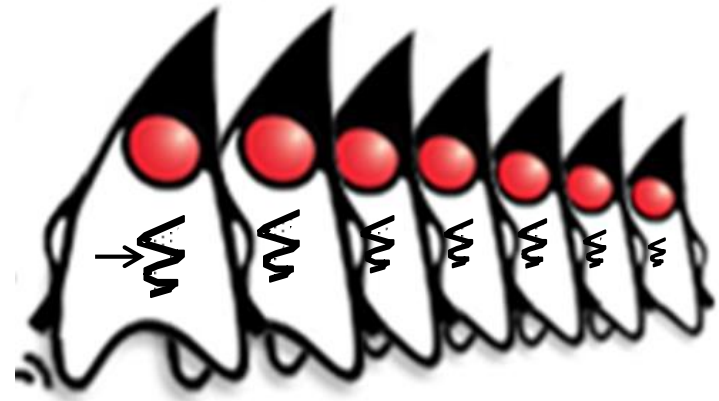
Implicitly publishes the enclosing `ThisEscape` object because inner class instances contain a hidden reference to the enclosing object

```
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

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 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(...);  
        }  
    }  
}
```



Initialize a field in thread T_1

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

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

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);
```

mList is not guaranteed to be initialized when thread T_2 gets a reference to object a

End of Safe Publication in Java: Introduction