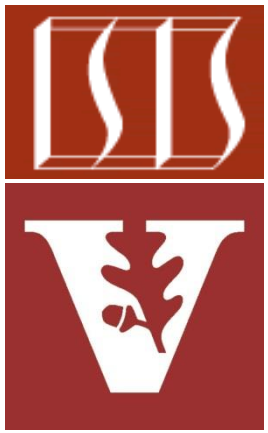
Java Thread: Evaluation



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Learning Objectives in this Part of the Lesson

- Understand how Java threads support concurrency
- Learn how our case study app works
- Know alternative ways of giving code to a thread
- Learn how to pass parameters to a Java thread
- Know how to run a Java thread
- Recognize common thread mechanisms
- Appreciate Java thread "happens-before" orderings
- Understand the implementation of the GCD concurrent app
- Know the pros & cons of Java thread programming models

Pros & Cons of Java Thread Programming Models

Pros & Cons of Java Thread Programming Models

- Now that we've examined the source code for the GCD concurrent app we'll summarize the pros & cons of the various Java thread programming models

Pros & Cons of Java Thread Programming Models

- Pros with extending Thread

```
public class GCDThread
       extends Thread  {
  ...
  private MainActivity mActivity;

  public GCDThread setActivity
    (MainActivity activity) {
    mActivity = activity;
    return this;
  }

  private int computeGCD
     (int number1, number2) {
    ...
  }

  public void run()
  { ... }
  ...
}
```

Pros & Cons of Java Thread Programming Models

- Pros with extending Thread
  - It's straightforward to extend the Thread super class

```
public class GCDThread
       extends Thread  {
  ...
  private MainActivity mActivity;

  public GCDThread setActivity
    (MainActivity activity) {
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  private int computeGCD
     (int number1, number2) {
    ...
  }

  public void run()
  { ... }
  ...
}
```

Pros & Cons of Java Thread Programming Models

- Pros with extending Thread
  - It's straightforward to extend the Thread super class
    - Just override the run() hook method!

```
public class GCDThread
       extends Thread  {
  ...
  private MainActivity mActivity;

  public GCDThread setActivity
    (MainActivity activity) {
    mActivity = activity;
    return this;
  }

  private int computeGCD
     (int number1, number2) {
    ...
  }

  public void run()
  { ... }
  ...
}
```

Pros & Cons of Java Thread Programming Models

- Pros with extending Thread
  - It's straightforward to extend the Thread super class
  - All state & methods are consolidated in one place

```
public class GCDThread
       extends Thread  {
  ...
  private MainActivity mActivity;

  public GCDThread setActivity
    (MainActivity activity) {
    mActivity = activity;
    return this;
  }
  ...

// Main app
Thread thread = new GCDThread()
  .setActivity(this)...;

thread.start();

...
```

Pros & Cons of Java Thread Programming Models

- Pros with extending Thread
  - It's straightforward to extend the Thread super class
  - All state & methods are consolidated in one place
    - Enables central allocation & management of the thread

```
public class GCDThread
       extends Thread  {
  ...
  private MainActivity mActivity;

  public GCDThread setActivity
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    mActivity = activity;
    return this;
  }
  ...

// Main app
Thread thread = new GCDThread()
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thread.start();

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```

Pros & Cons of Java Thread Programming Models

- Pros with extending Thread
  - It's straightforward to extend the Thread super class
  - All state & methods are consolidated in one place
    - Enables central allocation & management of the thread
    - This design is useful when the thread must be updated during runtime configuration changes

```
public class GCDThread
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  private MainActivity mActivity;

  public GCDThread setActivity
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    mActivity = activity;
    return this;
  }
  ...

// Main app
Thread thread = new GCDThread()
  .setActivity(this)...;

thread.start();

...
```

Pros & Cons of Java Thread Programming Models

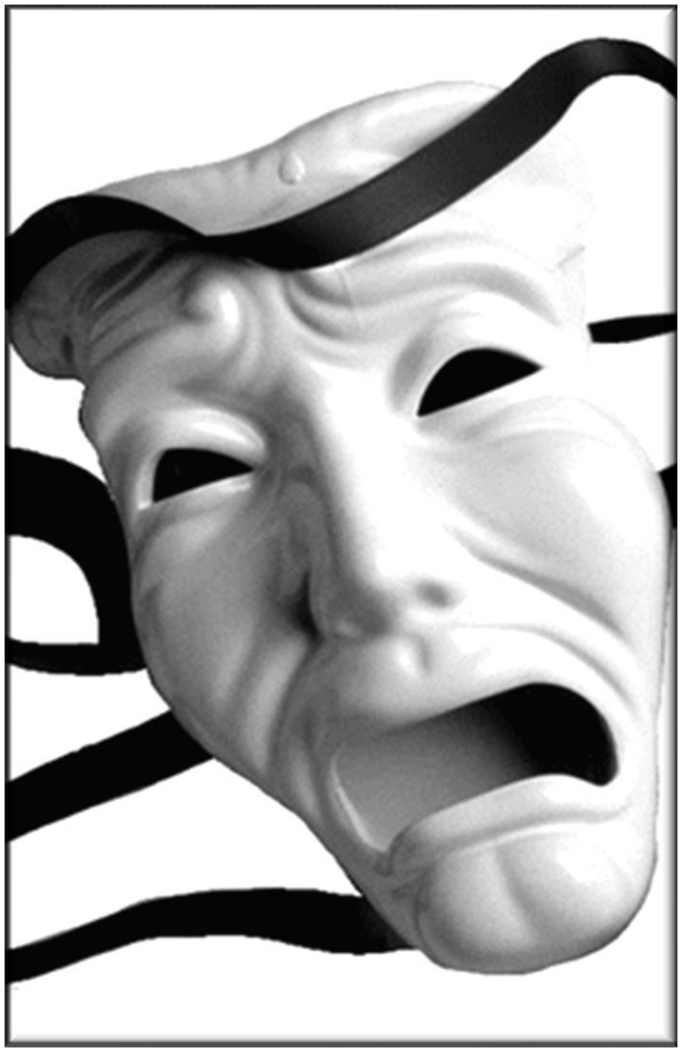
- Pros with extending Thread
  - It's straightforward to extend the Thread super class
  - All state & methods are consolidated in one place
    - Enables central allocation & management of the thread
    - This design is useful when the thread must be updated during runtime configuration changes
      - e.g., interrupting/restarting a running thread & reading/ writing its state

```
public class GCDThread
       extends Thread  {
  ...
  private MainActivity mActivity;

  public GCDThread setActivity
    (MainActivity activity) {
    mActivity = activity;
    return this;
  }
  ...

// Main app
Thread thread = new GCDThread()
  .setActivity(this)...;

thread.start();

...
```

See the upcoming lessons on "*Managing the Java Thread Lifecycle*"

Pros & Cons of Java Thread Programming Models

- Cons with extending Thread



```
public class GCDThread
        extends Thread {
   ...
   private int computeGCD
       (int number1, number2) {
      ...
   }

   public void run() {
      ...
   }
   ...
}
```

Pros & Cons of Java Thread Programming Models

- Cons with extending Thread
  - A subclass must extend the Thread superclass

```
public class GCDThread
        extends Thread {
   ...
   private int computeGCD
       (int number1, number2) {
      ...
   }

   public void run() {
      ...
   }
   ...
}
```

Pros & Cons of Java Thread Programming Models

- Cons with extending Thread
  - A subclass must extend the Thread superclass
    - This is restrictive since Java only allows one superclass per subclass!

```
public class GCDThread
        extends Thread {
   ...
   private int computeGCD
      (int number1, number2) {
     ...
   }

   public void run() {
     ...
   }
   ...
}
```

See docs.oracle.com/javase/tutorial/java/IandI/subclasses.html

Pros & Cons of Java Thread Programming Models

- Pros of implementing Runnable

```
public class GCDRunnable
       implements Runnable,
       implements Serializable,
       extends Random {
   ...
   private int computeGCD
       (int number1, number2) {
      ...
   }

   public void run() {
      ...
   }
   ...
```

Pros & Cons of Java Thread Programming Models

- Pros of implementing Runnable
  - A subclass can implement multiple interfaces

```
public class GCDRunnable
       implements Runnable,
       implements Serializable,
       extends Random {
   ...
   private int computeGCD
       (int number1, number2) {
      ...
   }

   public void run() {
      ...
   }
   ...
```

See docs.oracle.com/javase/tutorial/java/concepts/interface.html

Pros & Cons of Java Thread Programming Models

- Pros of implementing Runnable
  - A subclass can implement multiple interfaces
    - Which enables it to extend a different superclass

```
public class GCDRunnable
       implements Runnable,
       implements Serializable,
       extends Random {
   ...
   private int computeGCD
       (int number1, number2) {
      ...
   }

   public void run() {
      ...
   }
   ...
```

See docs.oracle.com/javase/tutorial/java/concepts/interface.html

Pros & Cons of Java Thread Programming Models

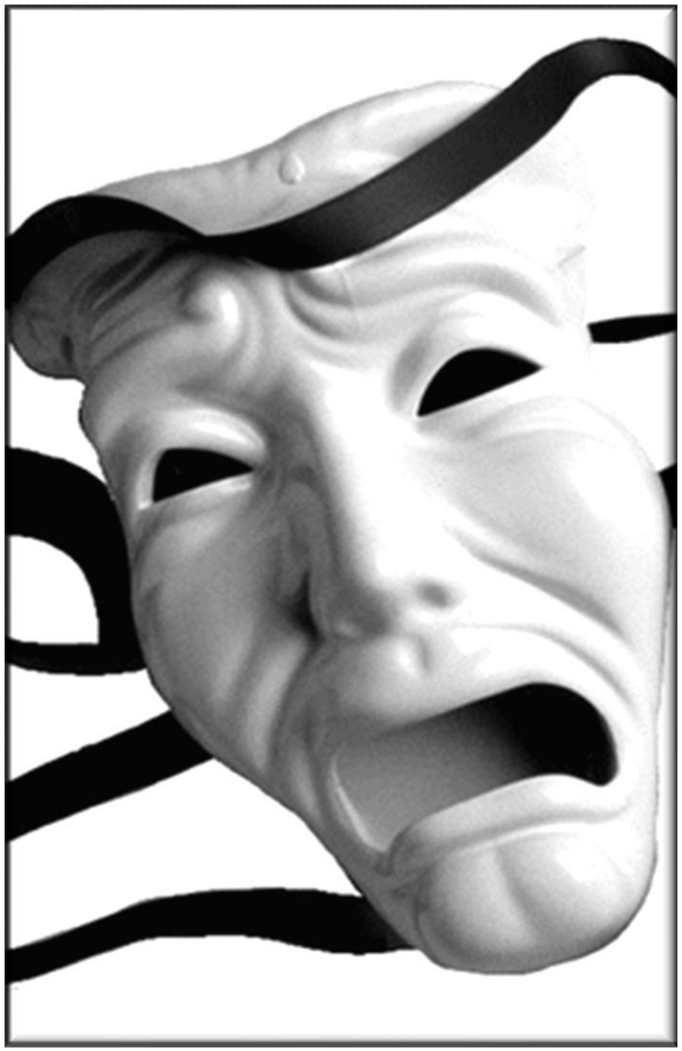
- Pros of implementing Runnable
  - A subclass can implement multiple interfaces
  - Runnables are flexible since they can be reused in other contexts

```
public class GCDRunnable
       implements Runnable,
       ... {
  ...
}
...

GCDRunnable runnableCommand =
  new GCDRunnable(...);

ExecutorService executor =
   Executors.newFixedThreadPool
                          (POOL_SIZE);
 ...
 executor.execute
   (runnableCommand);
```

See upcoming lessons on "*the Java Executor framework*"

Pros & Cons of Java Thread Programming Models

- Cons of implementing Runnable



```
public class GCDRunnable
        implements Runnable,
        ... {
   ...
}
...

GCDRunnable runnableCommand =
  new GCDRunnable(...);

Thread thr =
  new Thread(runnableCommand);
...
thr.start();
```

Pros & Cons of Java Thread Programming Models

- Cons of implementing Runnable
  - Yields more "moving parts"


```
public class GCDRunnable
        implements Runnable,
        ... {
   ...
}
...

GCDRunnable runnableCommand =
  new GCDRunnable(...);

Thread thr =
  new Thread(runnableCommand);
...
thr.start();
```

Pros & Cons of Java Thread Programming Models

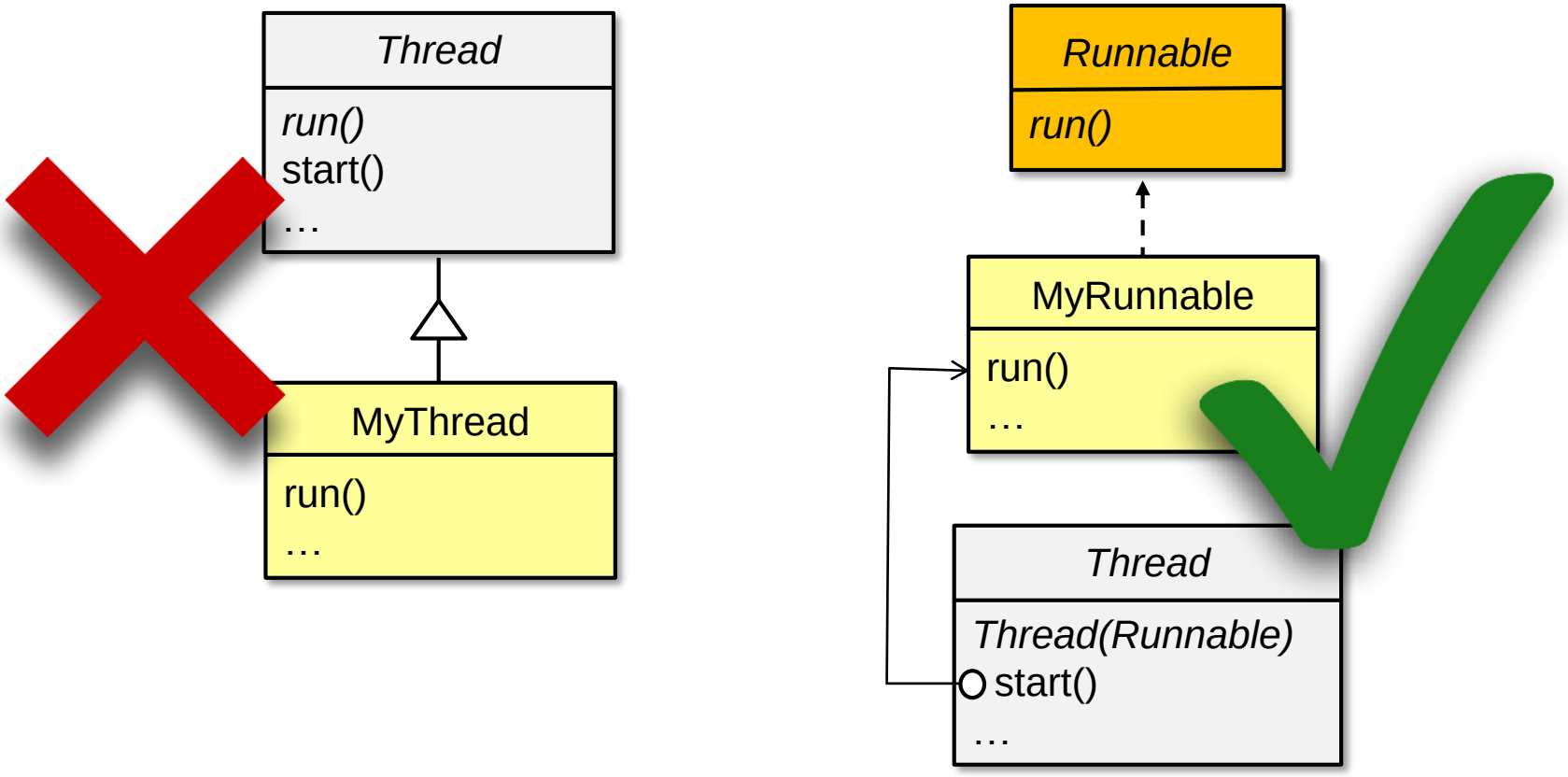
- Cons of implementing Runnable
  - Yields more "moving parts"
    - e.g., Runnable & Thread are separate entities & must be managed/accessed separately

```
public class GCDRunnable
        implements Runnable,
        ... {
   ...
}
...

GCDRunnable runnableCommand =
  new GCDRunnable(...);

Thread thr =
  new Thread(runnableCommand);
...
thr.start();
```

This decoupling get complicated if a program needs to access the state of a runnable, but only holds a reference to the thread object..

Pros & Cons of Java Thread Programming Models

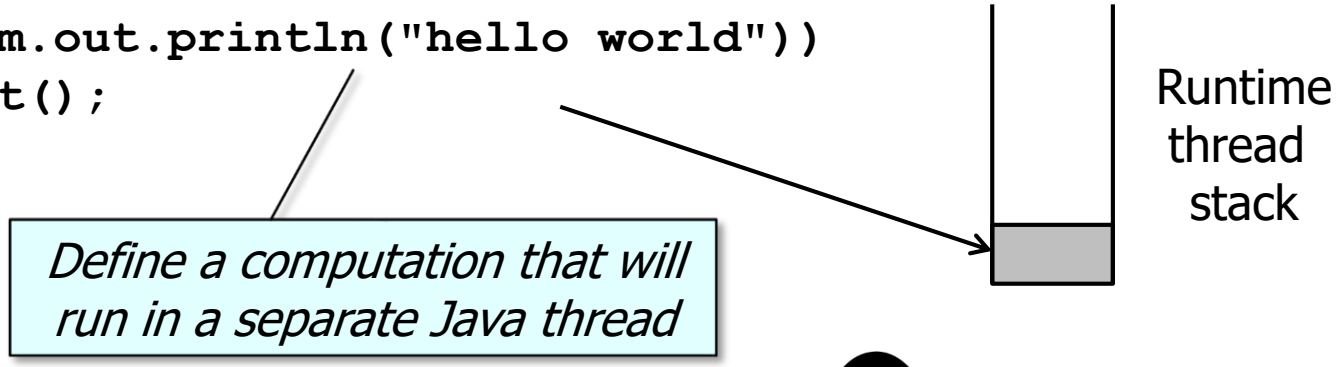
- In practice, Java & Android software often implements Runnable rather than extending Thread

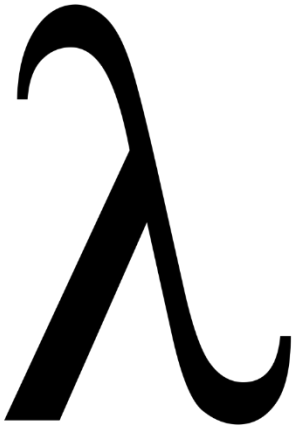


Pros & Cons of Java Thread Programming Models

- In practice, Java & Android software often implements Runnable rather than extending Thread
  - Lambda expressions have become a popular to provide computations to threads on Java 8-based platforms

```
new Thread(() ->
        System.out.println("hello world"))
        .start();
```





See www.drdobbs.com/jvm/lambda-expressions-in-java-8/240166764

End of Java Thread: Evaluation