Using Java Lambda Expressions Correctly & Efficiently

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Learning Objectives in this Part of the Lesson

- Understand how lambda expressions provide a foundational functional programming feature in Modern Java
  - & know how to use them correctly & effectively

Using Java Lambda Expressions Correctly & Effectively

Using Java Lambda Expressions Correctly & Effectively

- Lambda expressions cannot modify variables defined outside their scope


```
int answer = 0;

new Thread(() -> {
            answer = 42;
            System.out.println("The answer is " + answer);
            });
```

See github.com/douglascraigschmidt/ModernJava/tree/main/FP/ex4

Using Java Lambda Expressions Correctly & Effectively

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If the body of the lambda is a block of statements or the lambda has no value & is not a single void method invocation, you must use curly brackets

```
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new Thread(() -> {
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                });
```

See stackoverflow.com/a/11145970

Using Java Lambda Expressions Correctly & Effectively

- Lambda expressions cannot modify variables defined outside their scope
  - They can only access final or effectively final variables

```
int answer = 42;

new Thread(() ->
            System.out.println("The answer is " + answer));
```

An "effectively final" variable in Java is a variable that is not declared as final, but its value never changes after it's initialized

See www.linkedin.com/pulse/java-8-effective-final-gaurhari-dass

Using Java Lambda Expressions Correctly & Effectively

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This lambda expression can access the value of "answer," which is an effectively final variable whose value never changes after it's initialized

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new Thread(() ->
            System.out.println("The answer is " + answer));
```

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Using Java Lambda Expressions Correctly & Effectively

- Lambda expressions cannot modify variables defined outside their scope
  - They can only access final or effectively final variables
    - Here's one workaround for this restriction


```
int[] answer = new int[1];

new Thread(() -> {
            answer[0] = 42;
            System.out.println("The answer is " + answer[0]);
            });
...
return answer[0];
```

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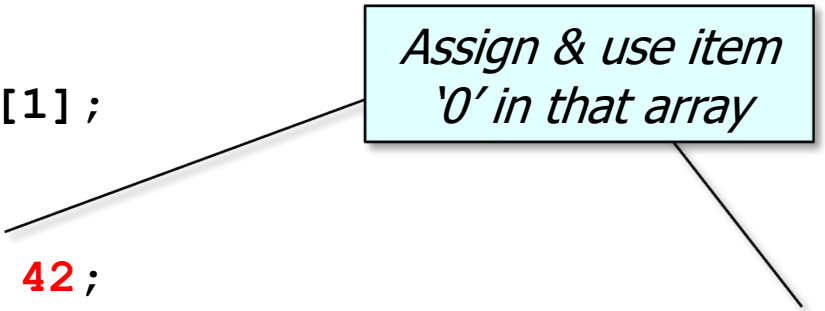

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return answer[0];
```

Do something with the updated array element after the lambda

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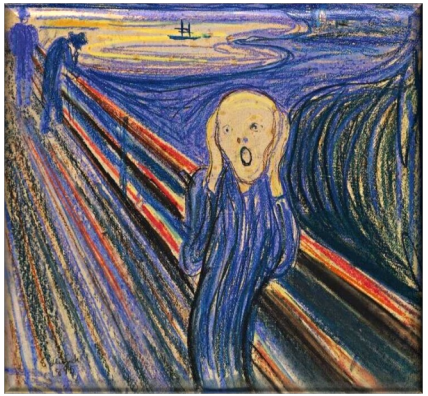

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int[] answer = new int[1];

new Thread(() -> {
            answer[0] = 42;
            System.out.println("The answer is " + answer[0]);
            });
...
return answer[0];
```

However, this solution incurs all the drawbacks of shared mutable state..

See henrikeichenhardt.blogspot.com/2013/06/why-shared-mutable-state-is-root-of-all.html

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- Lambda expressions cannot modify variables defined outside their scope
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    - Here's another workaround

Create an atomic object

```
AtomicInteger answer = new AtomicInteger(0);

new Thread(() -> {
            answer.set(42);
            System.out.println("The answer is " + answer.get());
            });
...
return answer.get();
```

See www.digitalocean.com/community/tutorials/atomicinteger-java

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```

Assign & use that atomic object

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```

Do something with the updated atomic object after the lambda

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new Thread(() -> {
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...
return answer.get();
```

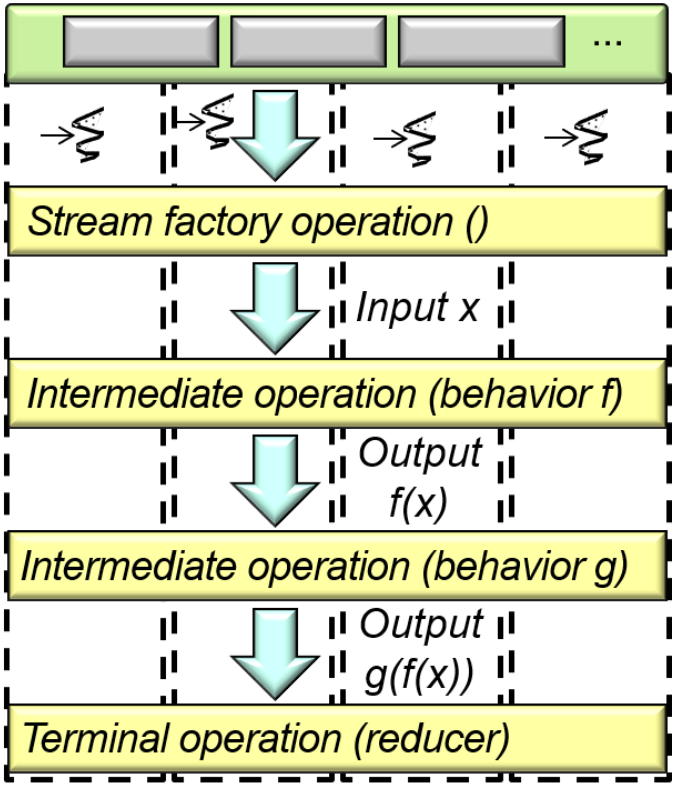
This solution is thread-safe, but incurs some (minor) synchronization overhead

See cephas.net/blog/2006/09/06/atomicinteger

Using Java Lambda Expressions Correctly & Effectively

- Lambda expressions are most effective when they are "stateless" & have no shared mutable state

Stateless lambda expressions are particularly useful when applied to Java parallel streams

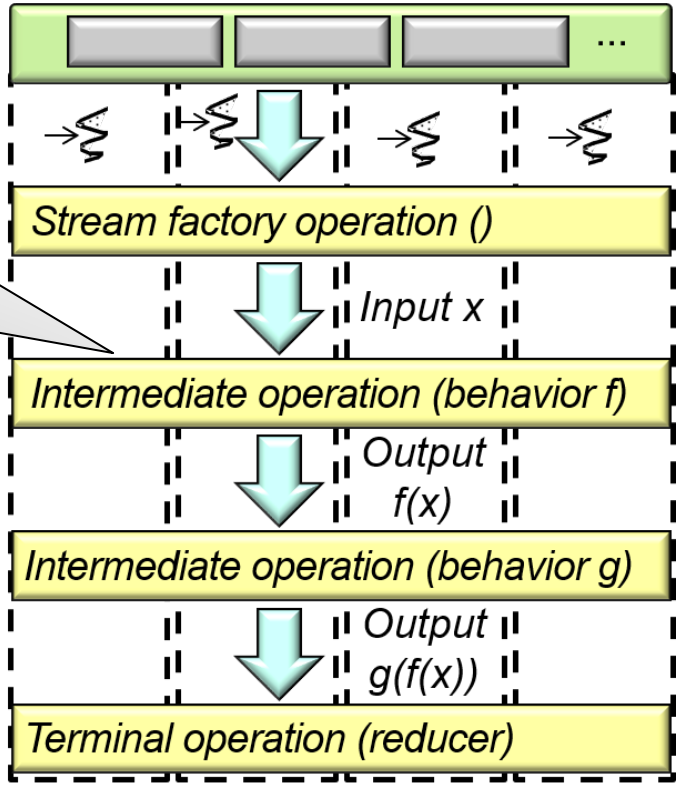


See docs.oracle.com/javase/tutorial/collections/streams/parallelism.html

Using Java Lambda Expressions Correctly & Effectively

- Lambda expressions are most effective when they are "stateless" & have no shared mutable state

```
String capitalize(String s) {
  if (s.length() == 0) return s;
  return s.substring(0, 1)
          .toUpperCase()
       + s.substring(1)
          .toLowerCase();
```



This 'pure function' is stateless

1. *Its return value is the same for the same arguments (no reading of shared mutable state)*
2. *Its evaluation has no side effects (no writing to shared mutable state)*

See en.wikipedia.org/wiki/Functional_programming#Pure_functions

End of Using Java Lambda Expressions Correctly & Efficiently