The Pros & Cons of Synchrony

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Learning Objectives in this Part of the Lesson

- Motivate the need for Java futures by understanding the pros & cons of synchrony

Overview of Synchrony & Synchronous Operations

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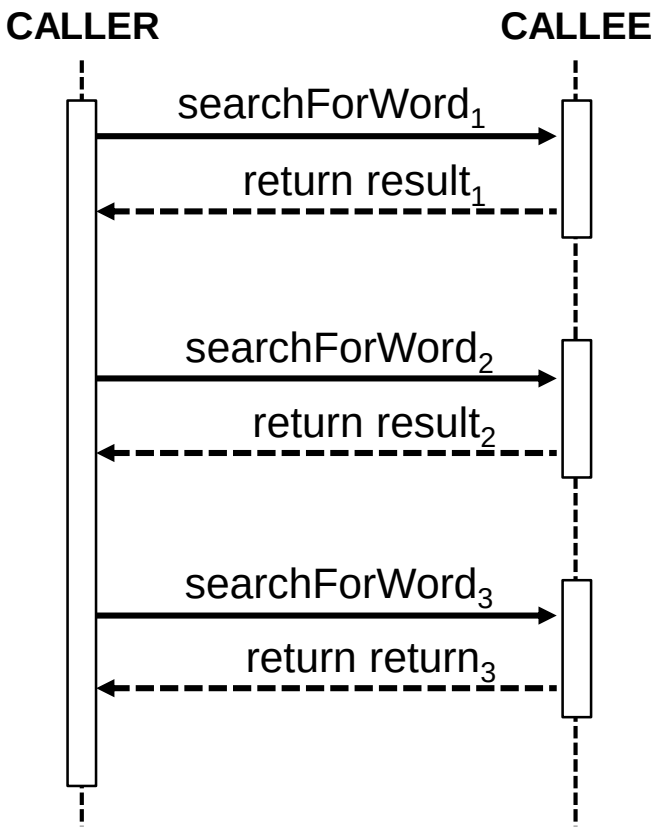
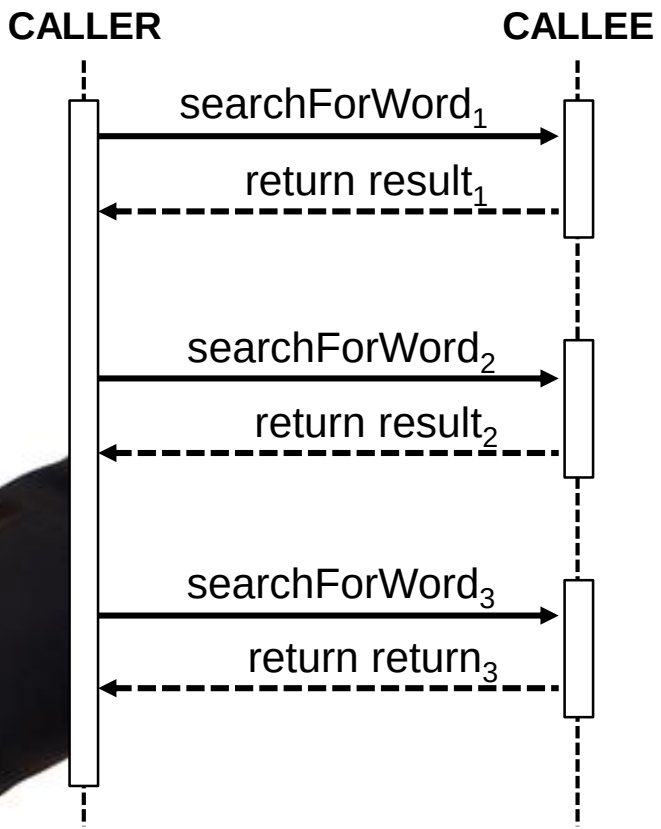
- Method calls in typical Java programs are largely *synchronous*



e.g., calls on Java collections & behaviors in Java stream aggregate operations

Overview of Synchrony & Synchronous Operations

- Method calls in typical Java programs are largely *synchronous*
  - i.e., a callee borrows the thread of its caller until its computation(s) finish



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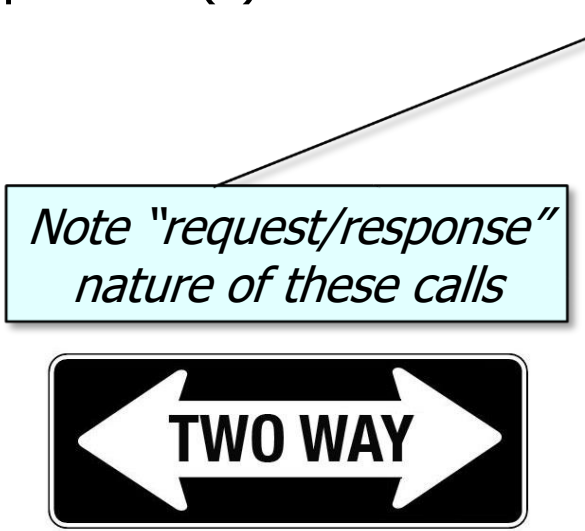

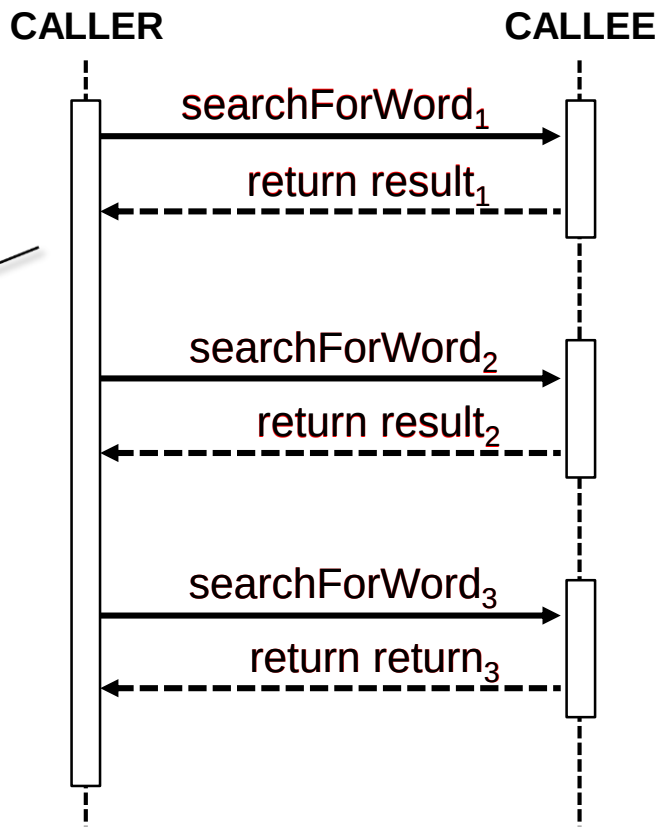

The Pros of Synchrony

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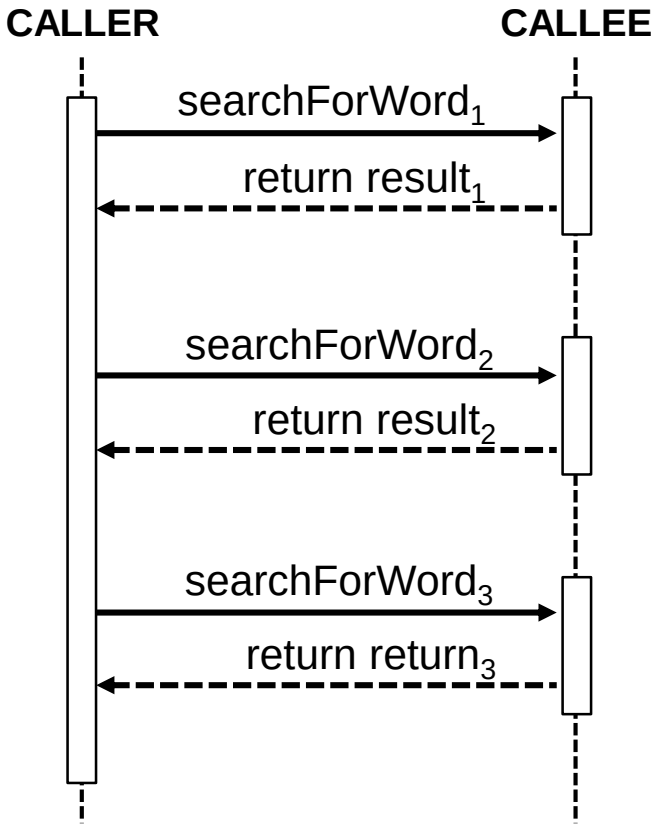
- Pros of synchronous calls:
  - "Intuitive" to program & debug



The Pros of Synchrony

- Pros of synchronous calls:
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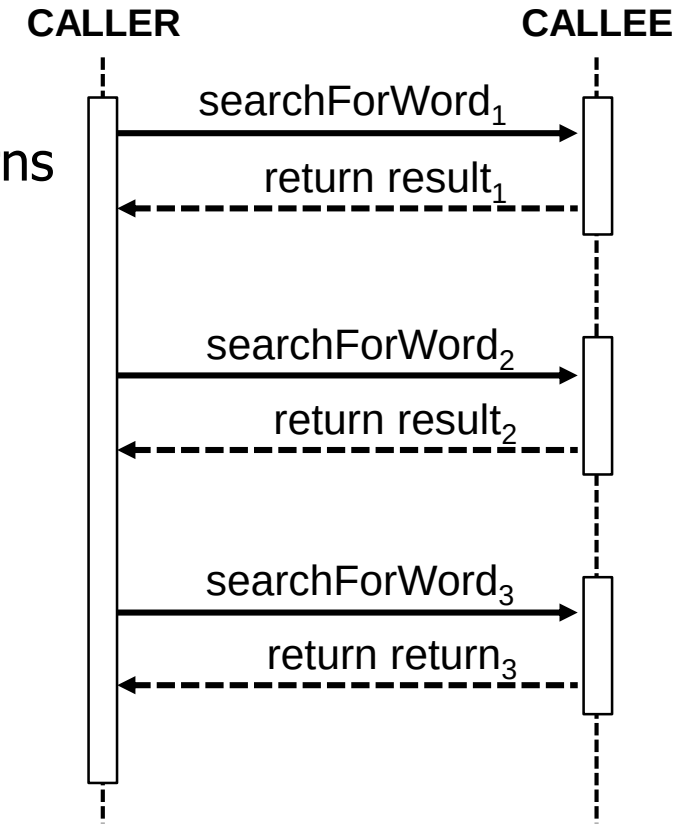
    - Maps onto common two-way method patterns



See www.iro.umontreal.ca/~keller/Layla/remote.pdf

The Pros of Synchrony

- Pros of synchronous calls:
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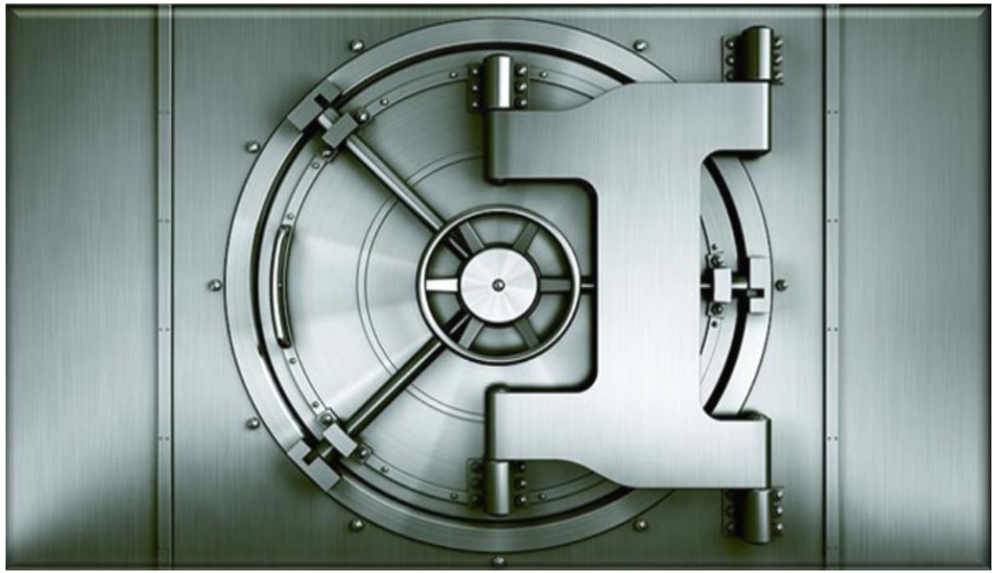
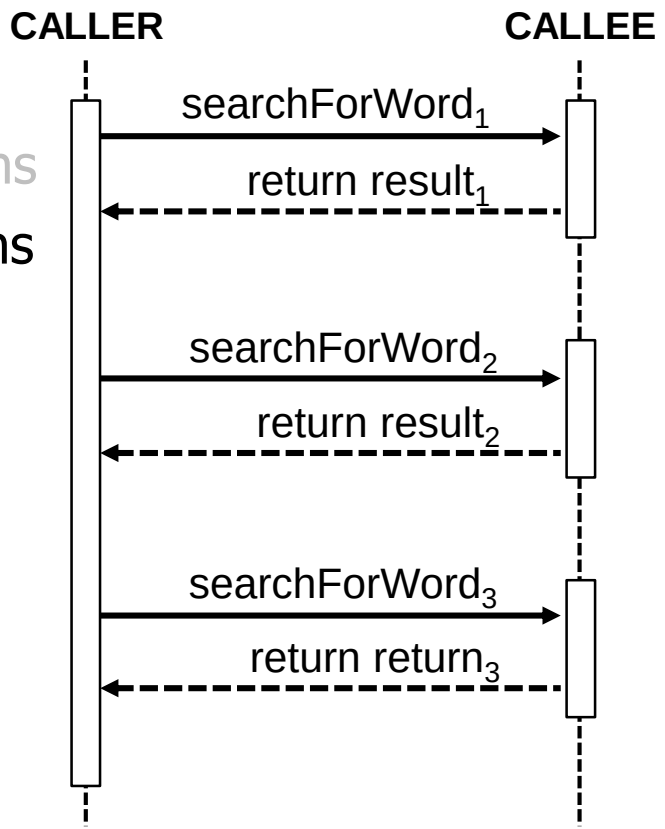
    - Local caller state retained when callee returns





See wiki.c2.com/?ActivationRecord

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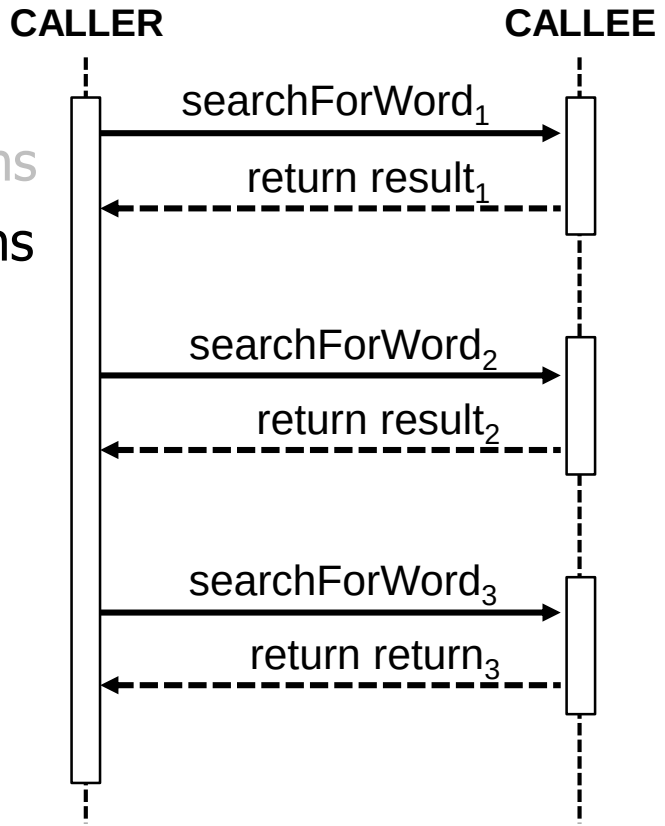
```
byte[] downloadContent(URL url) {
  byte[] buf = new byte[BUFSIZ];
  ByteArrayOutputStream os =
    new ByteArrayOutputStream();
  InputStream is = url.openStream();

  for (int bytes;
       (bytes = is.read(buf)) > 0;)
    os.write(buf, 0, bytes); ...
```



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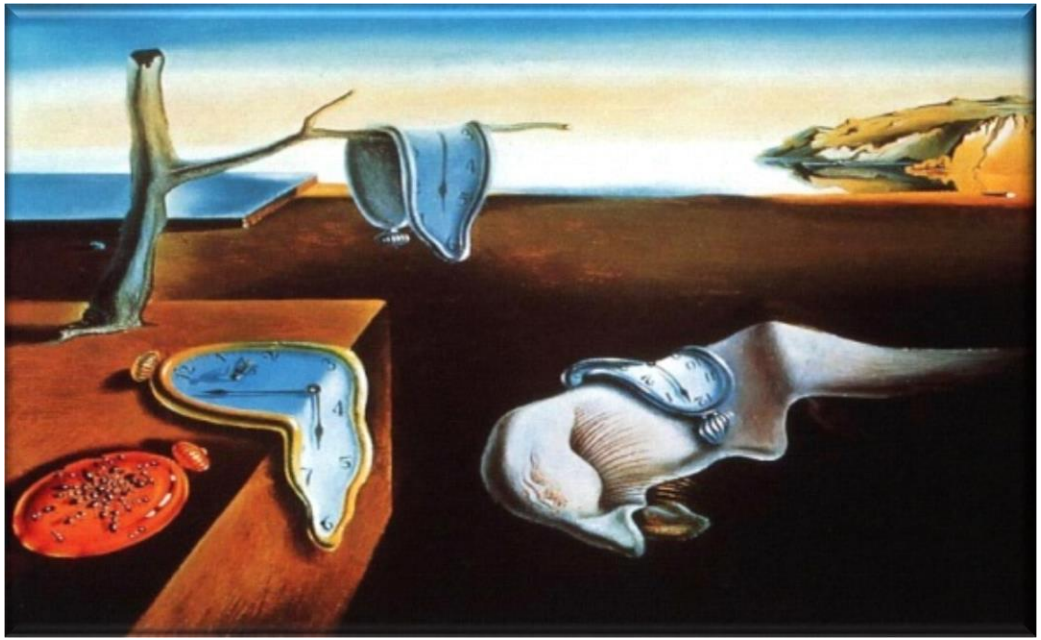
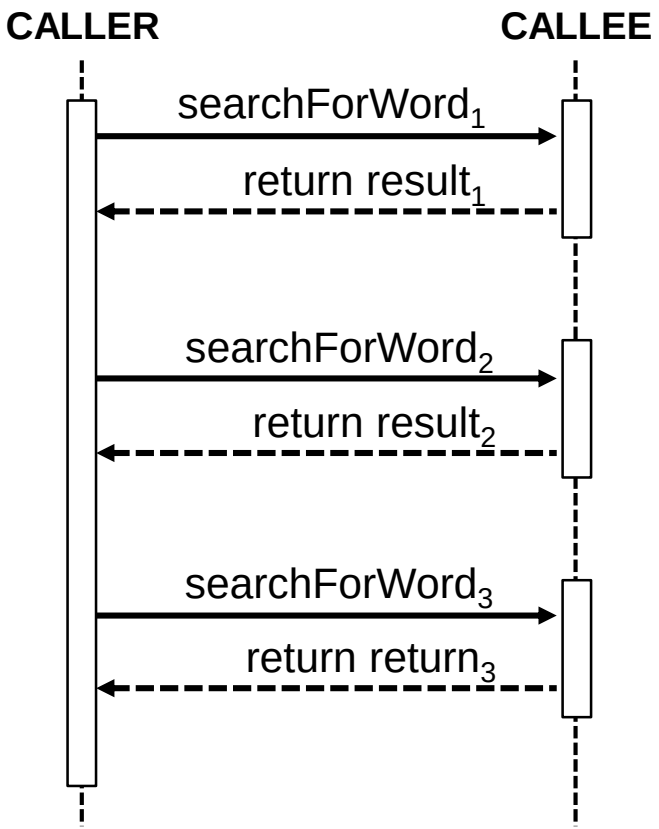
- Cons of synchronous calls:
  - May not leverage all parallelism available in multi-core systems

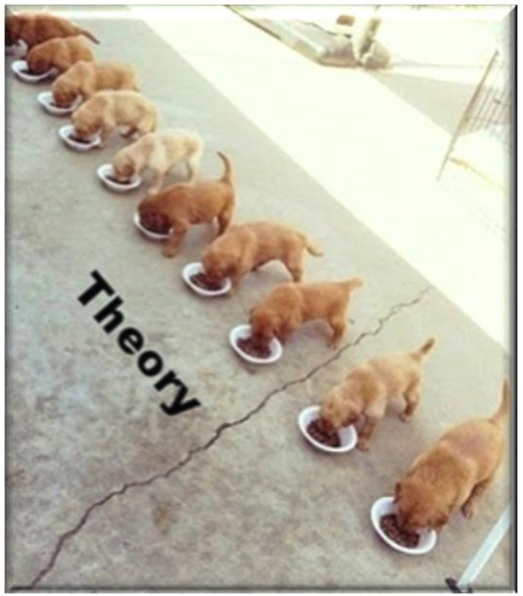




See www.ibm.com/developerworks/library/j-jvmc3

The Cons of Synchrony

- Cons of synchronous calls:
  - May not leverage all parallelism available in multi-core systems
    - Blocking threads incur overhead
      - e.g., synchronization, context switching, data movement, & memory management costs



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The Cons of Synchrony

- Cons of synchronous calls:
  - May not leverage all parallelism available in multi-core systems
    - Blocking threads incur overhead
    - Selecting right # of threads is hard

Efficient Performance

Efficient Resource Utilization

```
List<Image> filteredImages = urls
   .parallelStream()
   .filter(not(this::urlCached))
   .map(this::downloadImage)
   .flatMap(this::applyFilters)
   .collect(toList());
```


```
Image downloadImage(URL url){
  return new Image(url,
                   downloadContent(url));
}
```

See github.com/douglascraigschmidt/LiveLessons/tree/master/ImageStreamGang

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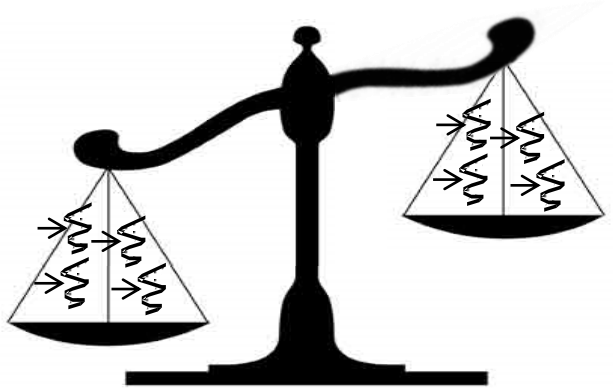

Efficient Performance

Efficient Resource Utilization

A large # of threads may help to improve performance, but can also waste resources

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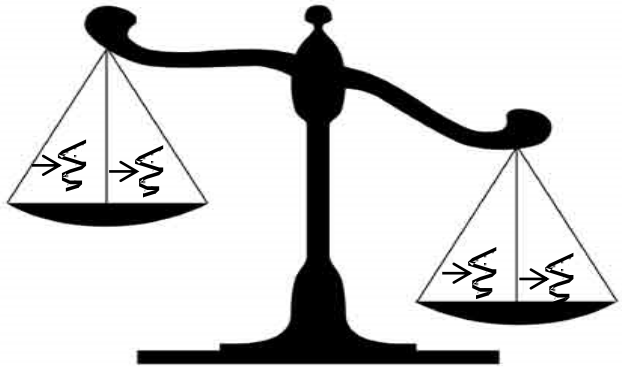

Efficient Performance | *Efficient Resource Utilization*

A small # of threads may conserve resources at the cost of performance

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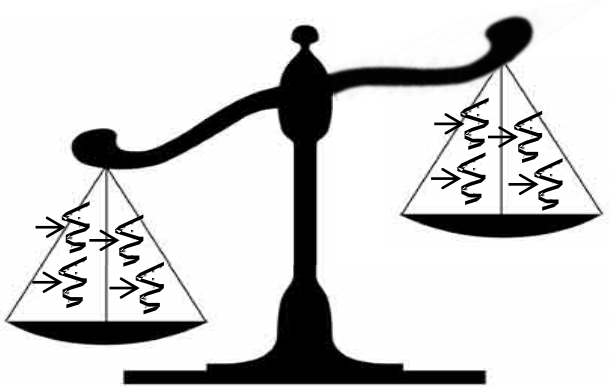
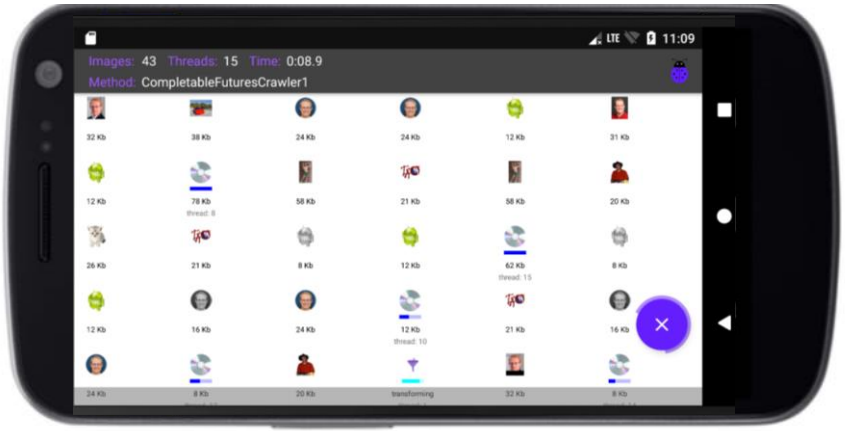


Efficient Performance

Efficient Resource Utilization



Particularly tricky for I/O-bound programs that need more threads to run efficiently

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  - May need to change common fork-join pool size in a Java parallel stream

See dzone.com/articles/think-twice-using-java-8

The Cons of Synchrony

- Cons of synchronous calls:
  - May not leverage all parallelism available in multi-core systems
  - May need to change common fork-join pool size in a Java parallel stream
    - Or use the Java fork-join pool ManagedBlocker feature to increase common pool size automatically/temporarily

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/ForkJoinPool.ManagedBlocker.html

End of the Pros & Cons of Synchrony