Motivating the Need for Java 8 Completable Futures (Part 1)

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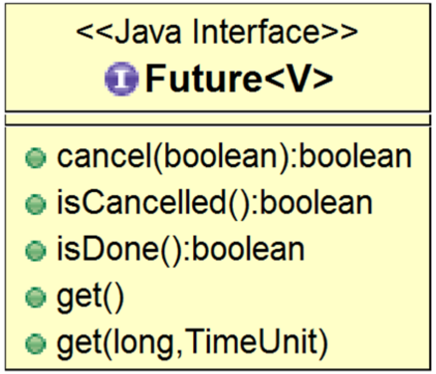
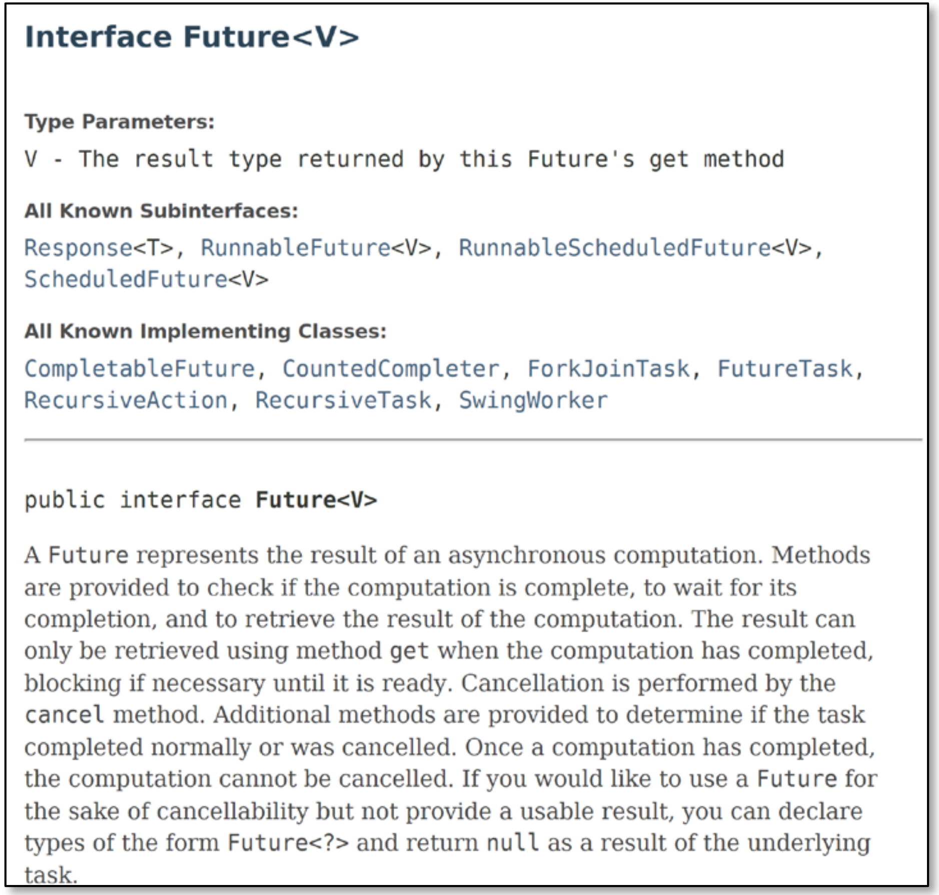
Learning Objectives in this Part of the Lesson

- Motivate the need for Java futures





Interface Future<V>

Type Parameters:

`V - The result type returned by this Future's get method`

All Known Subinterfaces:

`Response<T>, RunnableFuture<V>, RunnableScheduledFuture<V>, ScheduledFuture<V>`

All Known Implementing Classes:

`CompletableFuture, CountedCompleter, ForkJoinTask, FutureTask, RecursiveAction, RecursiveTask, SwingWorker`

`public interface Future<V>`

A `Future` represents the result of an asynchronous computation. Methods are provided to check if the computation is complete, to wait for its completion, and to retrieve the result of the computation. The result can only be retrieved using method `get` when the computation has completed, blocking if necessary until it is ready. Cancellation is performed by the `cancel` method. Additional methods are provided to determine if the task completed normally or was cancelled. Once a computation has completed, the computation cannot be cancelled. If you would like to use a `Future` for the sake of cancellability but not provide a usable result, you can declare types of the form `Future<?>` and return `null` as a result of the underlying task.

Java futures provide the foundation for Java 8 completable futures

Motivating the Need for Futures

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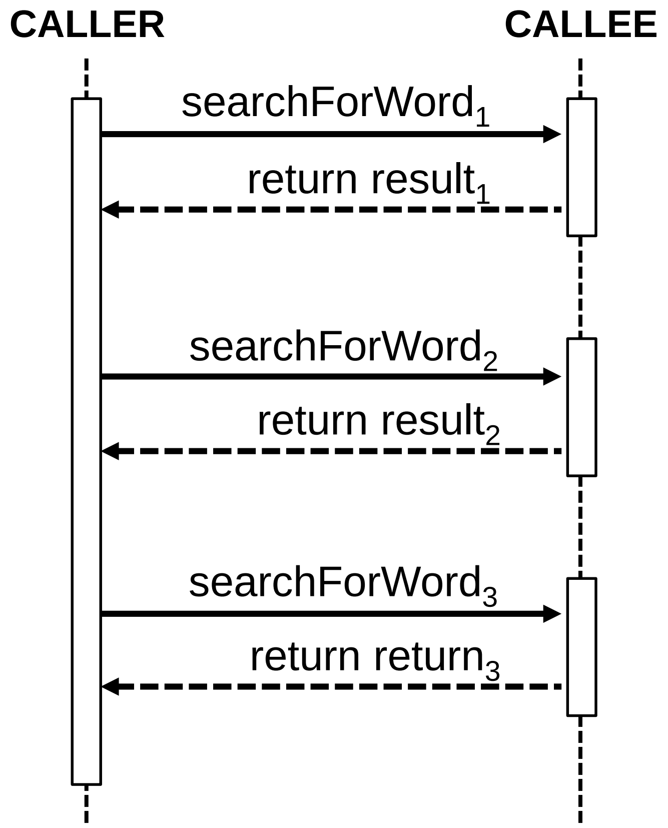
- Thus far, behaviors running in aggregate operations have all been *synchronous*



Motivating the Need for Futures

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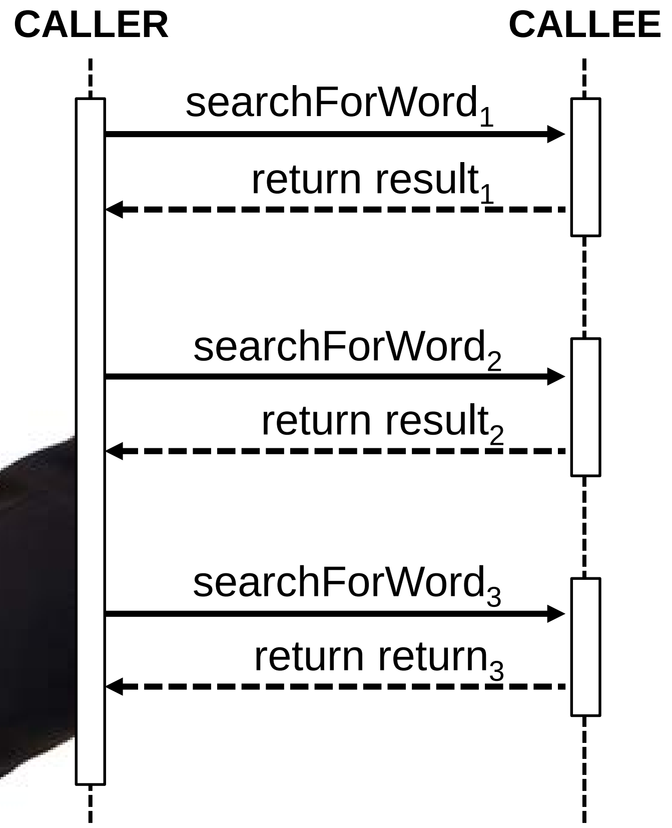
  - i.e., a behavior borrows the thread of its caller until its computation(s) finish



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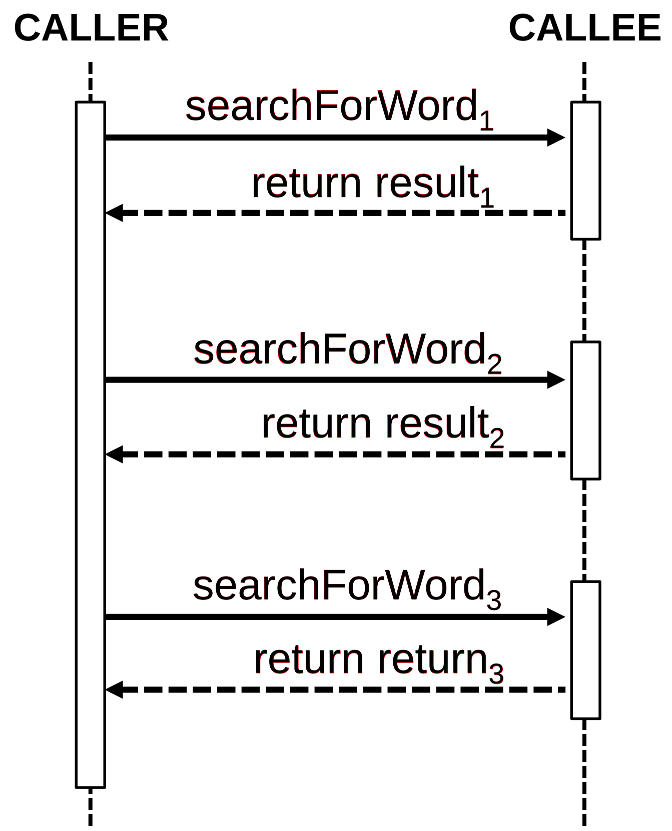
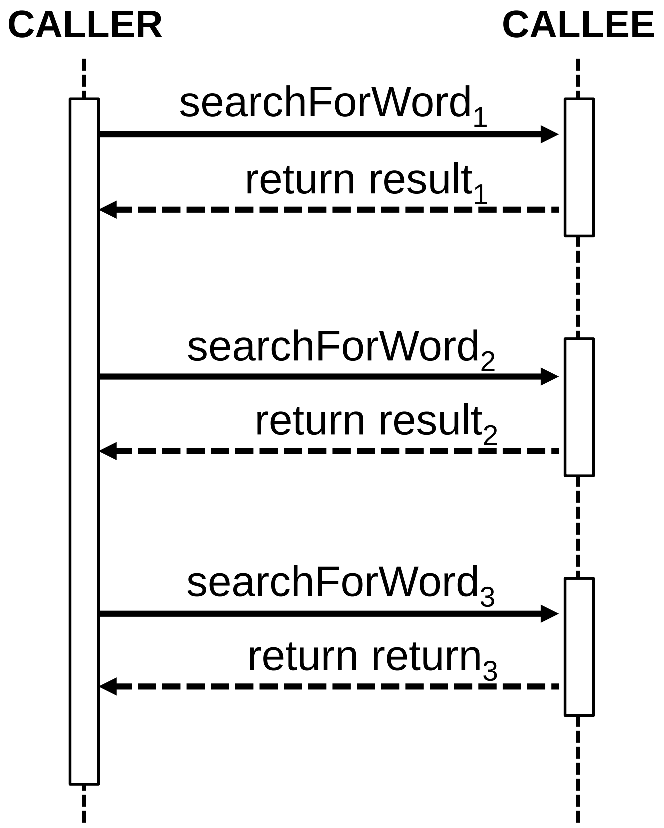


Motivating the Need for Futures

- Synchronous calls have pros & cons

Motivating the Need for Futures

- Pros of synchronous calls:
  - "Intuitive" since they map cleanly onto conventional two-way method patterns



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

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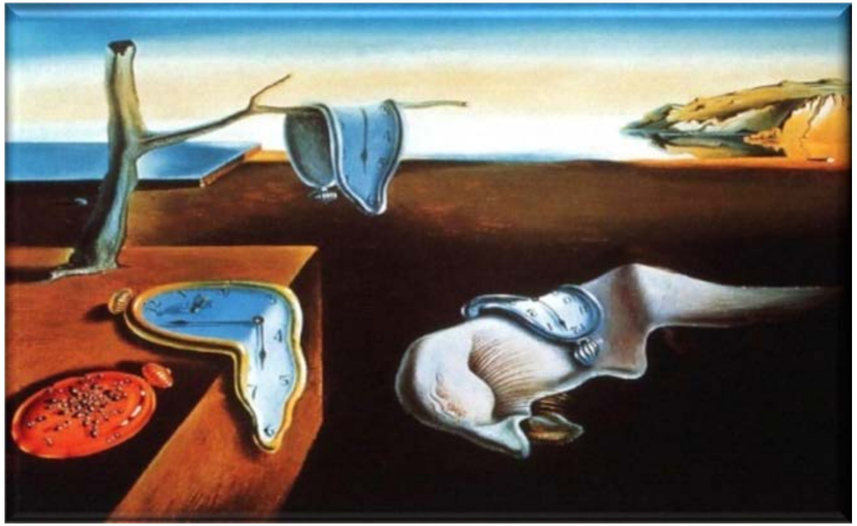
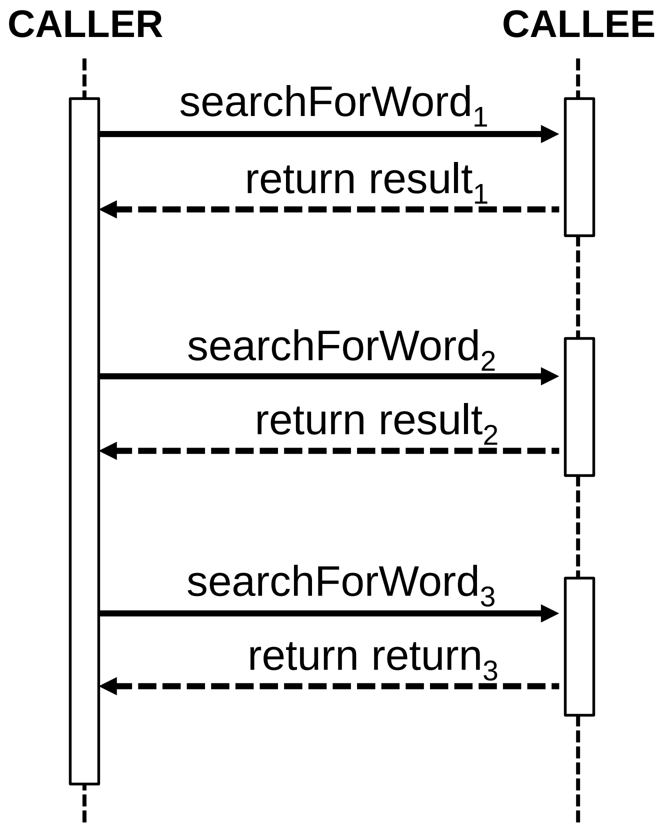
- Cons of synchronous calls:
  - May not leverage all the parallelism available in multi-core systems





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

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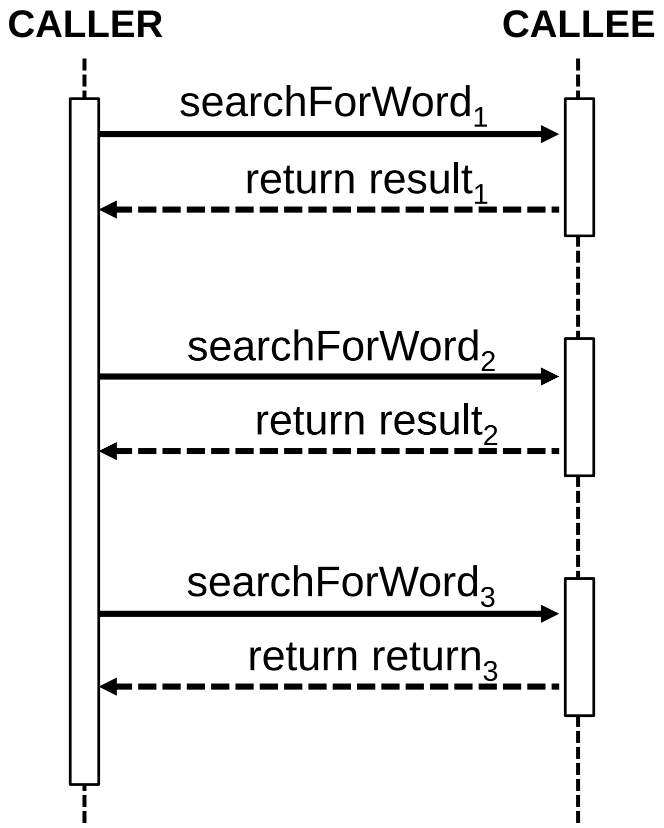
- Cons of synchronous calls:
  - May not leverage all the parallelism available in multi-core systems
    - Blocking threads incur overhead
      - e.g., due to context switching, synchronization, data movement, & memory management



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Motivating the Need for Futures

- Cons of synchronous calls:
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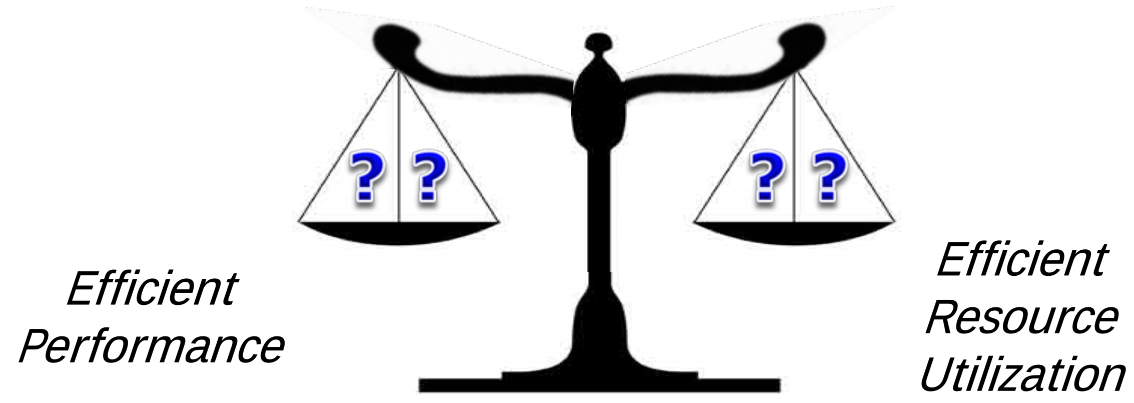
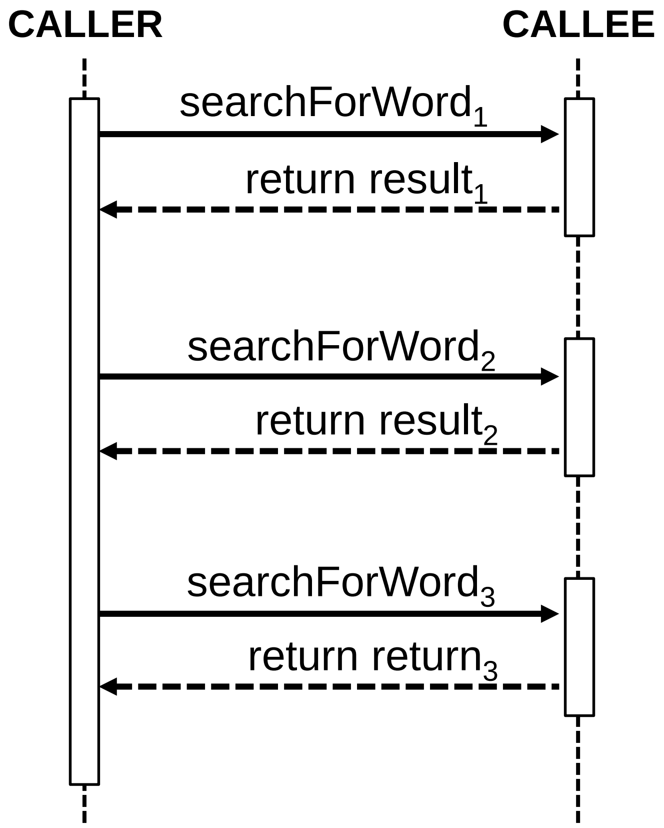
    - Blocking threads incur overhead
    - Selecting right number of threads is hard





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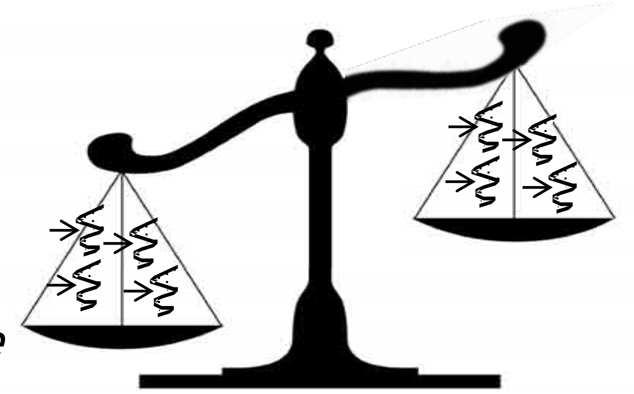

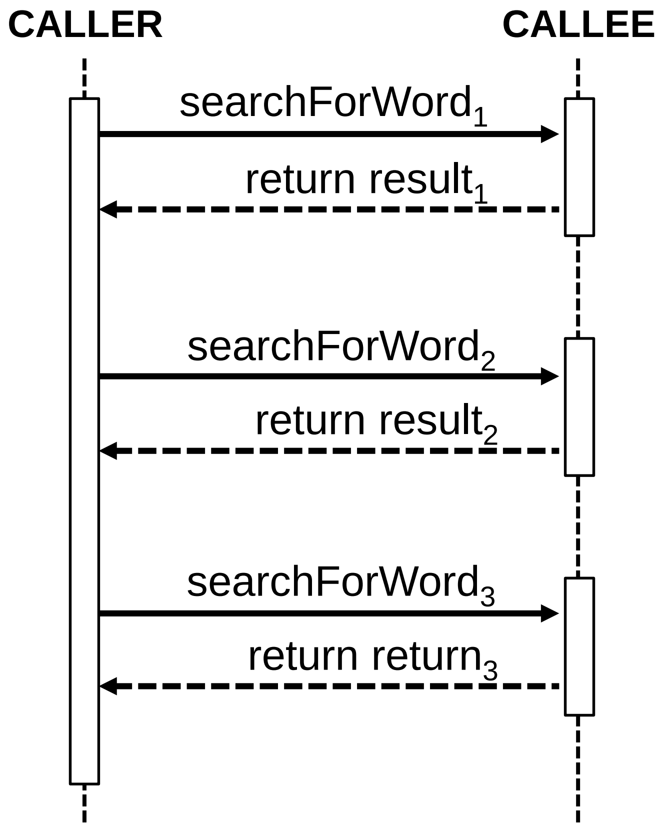

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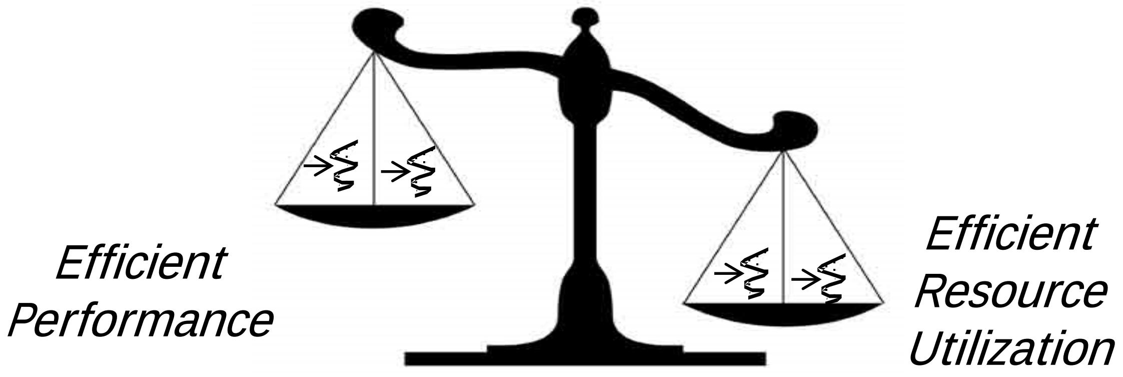

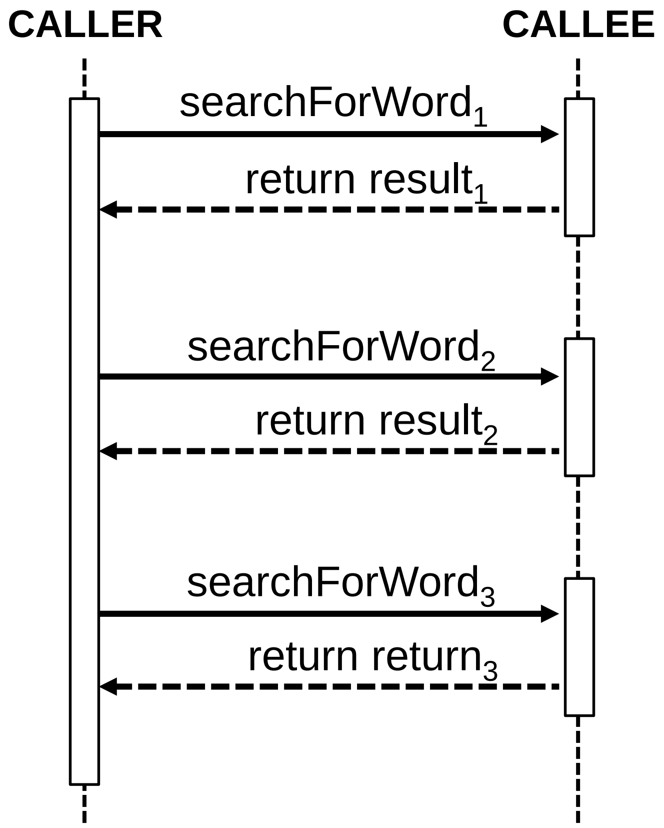

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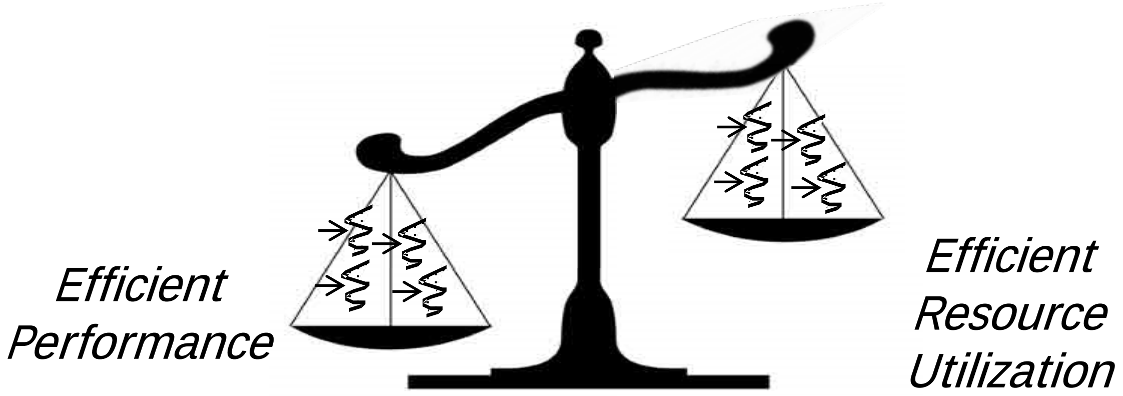

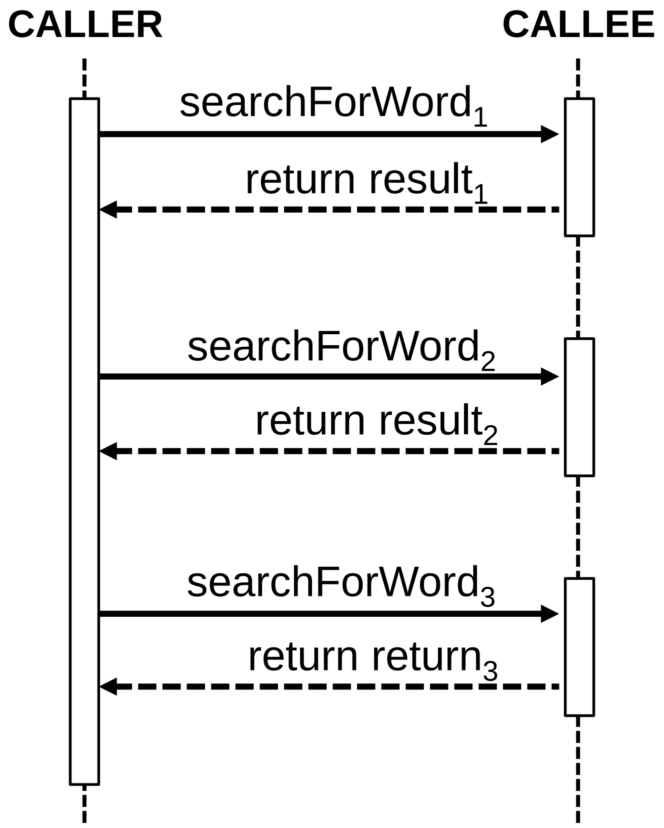

Particularly tricky for I/O-bound programs that need more threads to run efficiently

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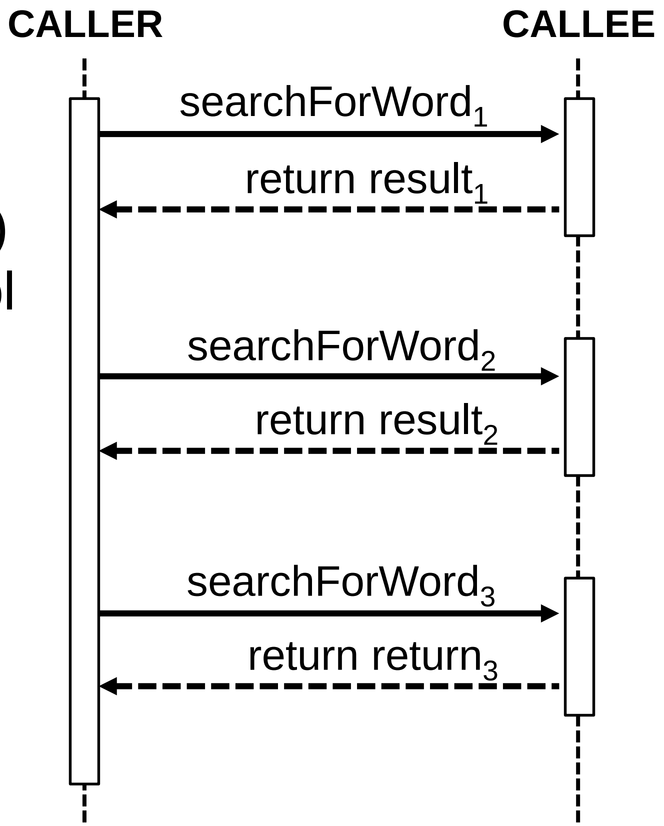
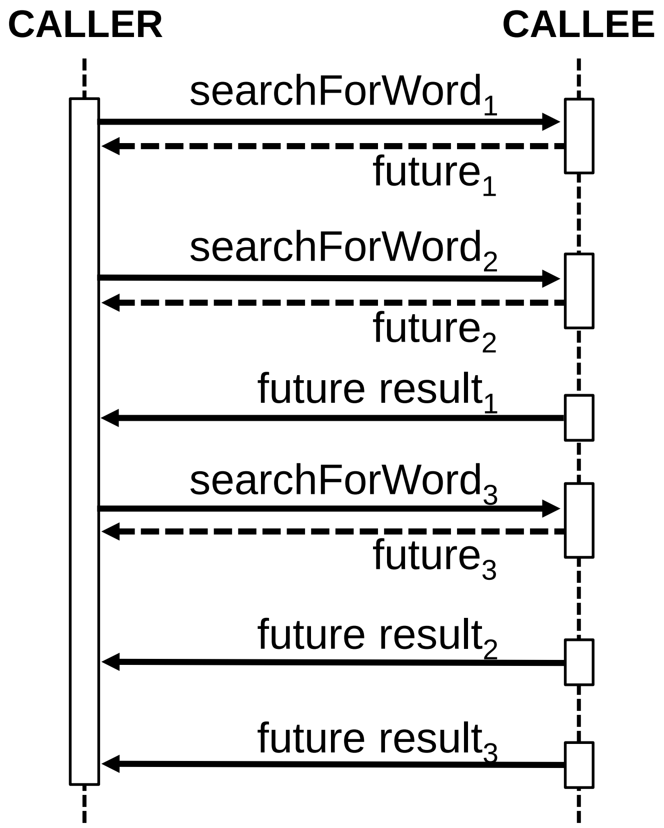
- Cons of synchronous calls:
  - May not leverage all the parallelism available in multi-core systems
  - Synchronous calls may need to (dynamically) change the size of the common fork-join pool



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

Motivating the Need for Futures

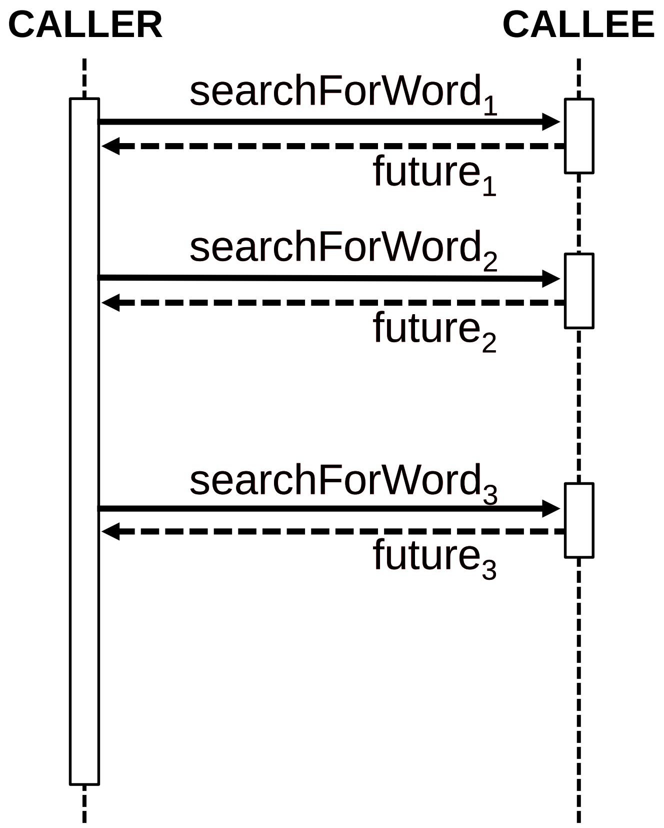
- An alternative approach uses asynchronous (async) calls & Java futures



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

Motivating the Need for Futures

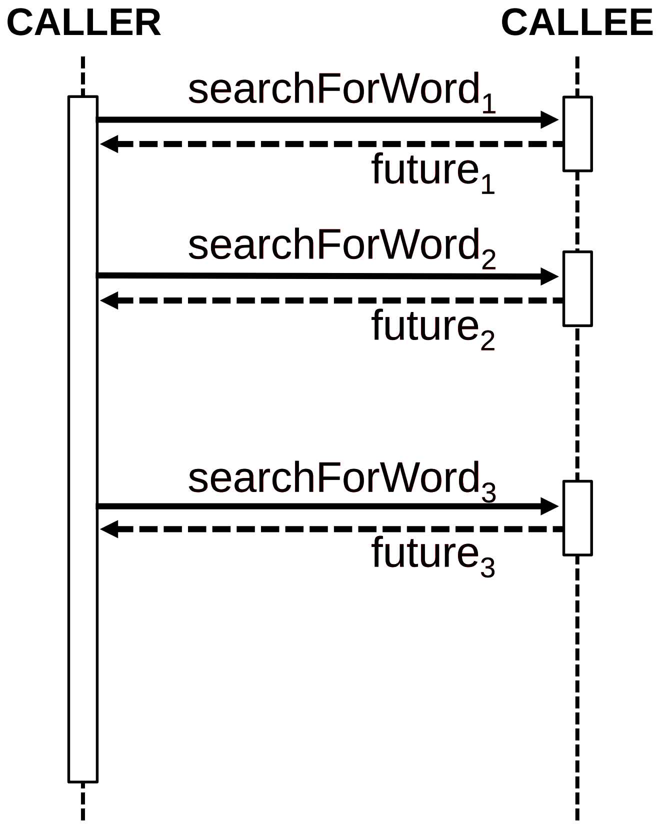
- An alternative approach uses asynchronous (async) calls & Java futures
  - Async calls return a future & continue running the computation in the background



See en.wikipedia.org/wiki/Asynchrony_(computer_programming)

Motivating the Need for Futures

- An alternative approach uses asynchronous (async) calls & Java futures
  - Async calls return a future & continue running the computation in the background
  - A future is a proxy that represents the result of an async computation



See en.wikipedia.org/wiki/Futures_and_promises

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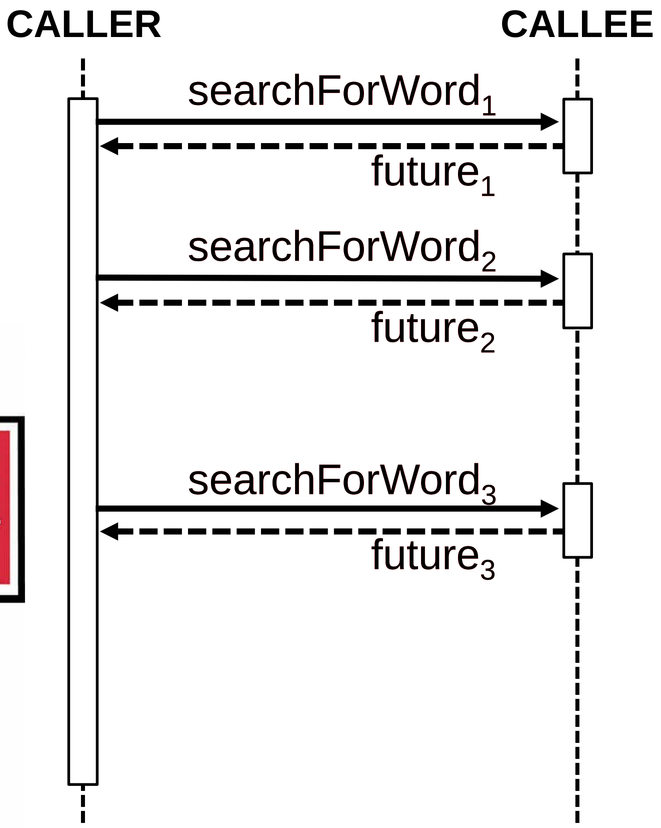
    - e.g., McDonald's vs Wendy's



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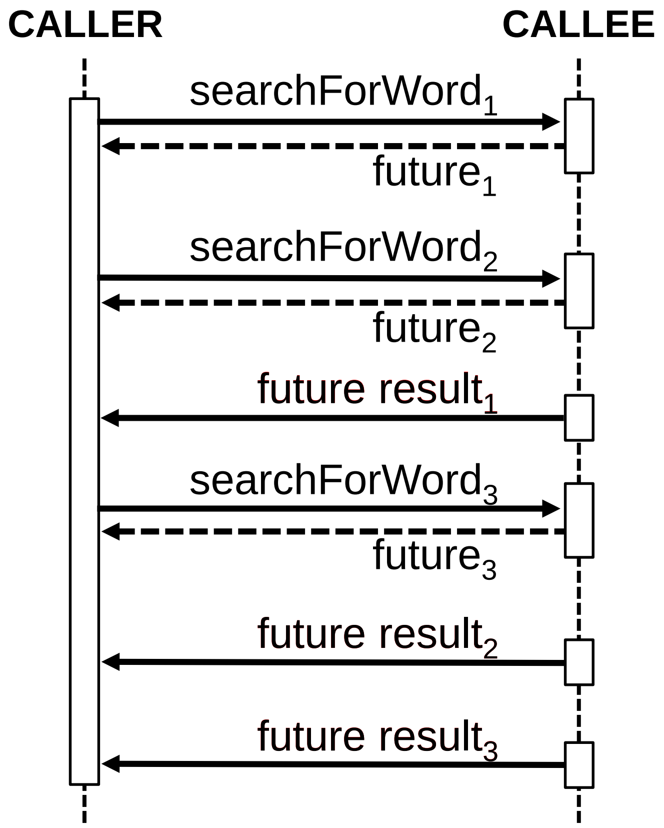

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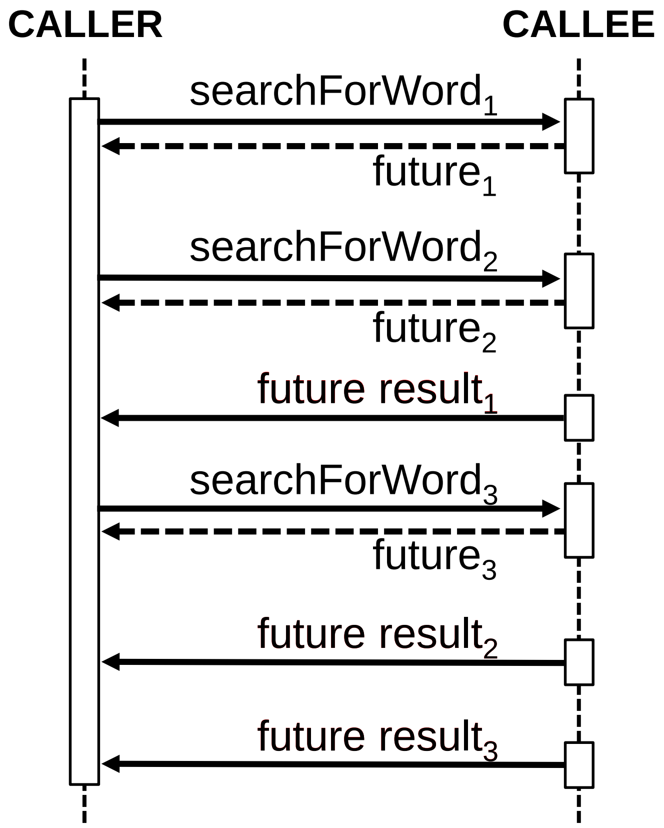

See www.nurkiewicz.com/2013/02/javautilconcurrentfuture-basics.html

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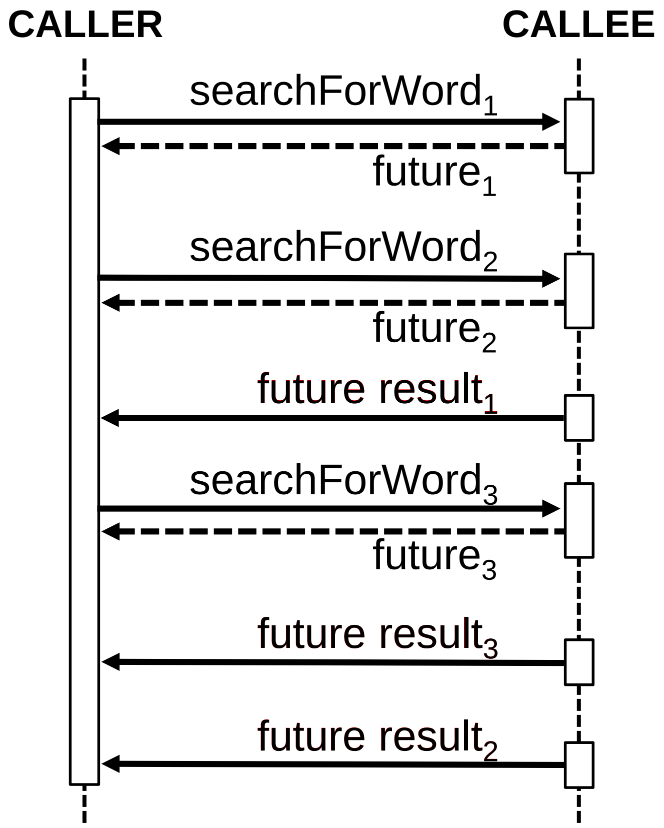
  - A future is a proxy that represents the result of an async computation
  - When the computation completes the future is triggered & the caller can get the result
    - get() returns a result via blocking, polling, or time-bounded blocking
    - Results can occur in a different order than the original calls were made



End of Motivating the Need for Java 8 Completable Futures (Part 1)