Advanced Java CompletableFuture Features: Factory Method Internals

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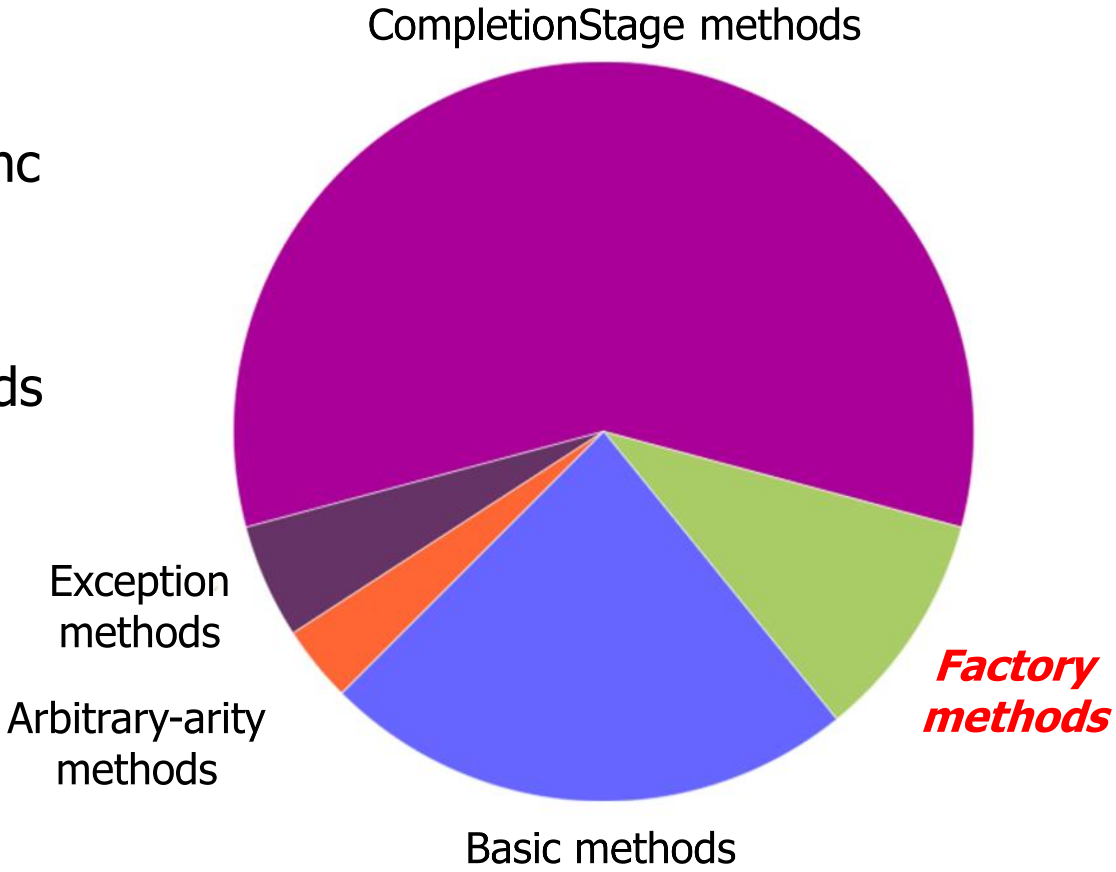
Learning Objectives in this Part of the Lesson

- Understand advanced features of completable futures, e.g.
  - Factory methods initiate async computations
    - Applying factory methods
    - Internals of factory methods



Internals of Completable Future Factory Methods

Internals of CompletableFuture Factory Methods

- The supplyAsync() method runs the supplier lambda in a thread residing in the common fork-join pool.

```
String f1("62675744/15668936"); String f2("609136/913704");

CompletableFuture<BigFraction> future = CompletableFuture
    .supplyAsync(() -> {
       BigFraction bf1 =
         new BigFraction(f1);
       BigFraction bf2 =
         new BigFraction(f2);

       return bf1.multiply(bf2);});

System.out.println(future.join().toMixedString());
```

See github.com/douglascraigschmidt/LiveLessons/tree/master/Java8/ex8

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System.out.println(future.join().toMixedString());
```

supplyAsync() does not create a new thread!

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/CompletableFuture.html#supplyAsync

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Instead, it return a future that's completed by a worker thread running in common fork-join pool

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```

supplyAsync()'s parameter is a supplier lambda that multiplies two BigFractions

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System.out.println(future.join().toMixedString());
```

Although Supplier.get() takes no params, effectively final values can be passed to this supplier lambda.

See javarevisited.blogspot.com/2015/03/what-is-effectively-final-variable-of.html

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System.out.println(future.join().toMixedString());
```

The worker thread calls the Supplier.get() method to obtain this supplier lambda & perform the computation

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/CompletableFuture.html#supplyAsync

Internals of Completable Future Factory Methods

- The supplyAsync() method arranges to execute a supplier lambda in a worker thread residing in the common fork-join pool.

```
<U> CompletableFuture<U> supplyAsync(Supplier<U> supplier) {
  ...
  CompletableFuture<U> f =
    new CompletableFuture<U>();

  execAsync(ForkJoinPool.commonPool(),
            new AsyncSupply<U>(supplier, f));

  return f;
}
...
```

Here's how supplyAsync() code uses the supplier passed to it

See classes/java/util/concurrent/CompletableFuture.java

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  ...
  CompletableFuture<U> f =
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  execAsync(ForkJoinPool.commonPool(),
                 new AsyncSupply<U>(supplier, f));

  return f;
}
...
```

```
() -> { ... return
  bf1.multiply(bf2);
}
```

The supplier parameter is bound to the lambda passed to supplyAsync()

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  ...
  CompletableFuture<U> f =
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  execAsync(ForkJoinPool.commonPool(),
            new AsyncSupply<U>(supplier, f));

  return f;
}
...
```

The supplier is encapsulated in an AsyncSupply message.

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  ...
  CompletableFuture<U> f =
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  execAsync(ForkJoinPool.commonPool(),
            new AsyncSupply<U>(supplier, f));

  return f;
}
...
```

This message is enqueued for async execution in common fork-join pool.

This design is one example of "message passing" a la Reactive programming!

Internals of Completable Future Factory Methods

- The supplyAsync() method arranges to execute a supplier lambda in a worker thread residing in the common fork-join pool.

```
...
static final class AsyncSupply<U> extends Async {
    final Supplier<U> fn;

    AsyncSupply(Supplier<U> fn, ...) { this.fn = fn; ... }

    public final boolean exec() {
        ...
        U u = fn.get();
        ...
    }
}
```

Async extends ForkJoinTask & Runnable so it can be executed in a thread pool

See [classes/java/util/concurrent/CompletableFuture.java]()

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```
() -> { ... return
  bf1.multiply(bf2);
}
```

AsyncSupply stores the original supplier lambda passed into supplyAsync()

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() -> { ... return
  bf1.multiply(bf2);
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A worker thread in the pool then runs the supplier lambda asynchronously

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        ...
    }
}
```

This get() method could use ForkJoinPool ManagedBlocker mechanism to auto-scale the pool size for blocking operations

See earlier lesson on "*The Java Fork-Join Pool: the ManagedBlocker Interface*"

End of Advanced Java CompletableFuture Features: Factory Method Internals