

Overview of Basic Java

CompletableFuture Features

Douglas C. Schmidt

d.schmidt@vanderbilt.edu

www.dre.vanderbilt.edu/~schmidt

Professor of Computer Science

**Institute for Software
Integrated Systems**

**Vanderbilt University
Nashville, Tennessee, USA**



Learning Objectives in this Part of the Lesson

- Understand the basic features in the Java completable futures framework
 - e.g., `get()`, `isDone()`, `isCanceled()`, `cancel()`, `join()`, & `complete()`



Class `CompletableFuture<T>`

```
java.lang.Object  
    java.util.concurrent.CompletableFuture<T>
```

All Implemented Interfaces:

```
CompletionStage<T>, Future<T>
```

```
public class CompletableFuture<T>  
    extends Object  
    implements Future<T>, CompletionStage<T>
```

A `Future` that may be explicitly completed (setting its value and status), and may be used as a `CompletionStage`, supporting dependent functions and actions that trigger upon its completion.

When two or more threads attempt to `complete`, `completeExceptionally`, or `cancel` a `CompletableFuture`, only one of them succeeds.

In addition to these and related methods for directly manipulating status and results, `CompletableFuture` implements interface `CompletionStage` with the following policies:

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

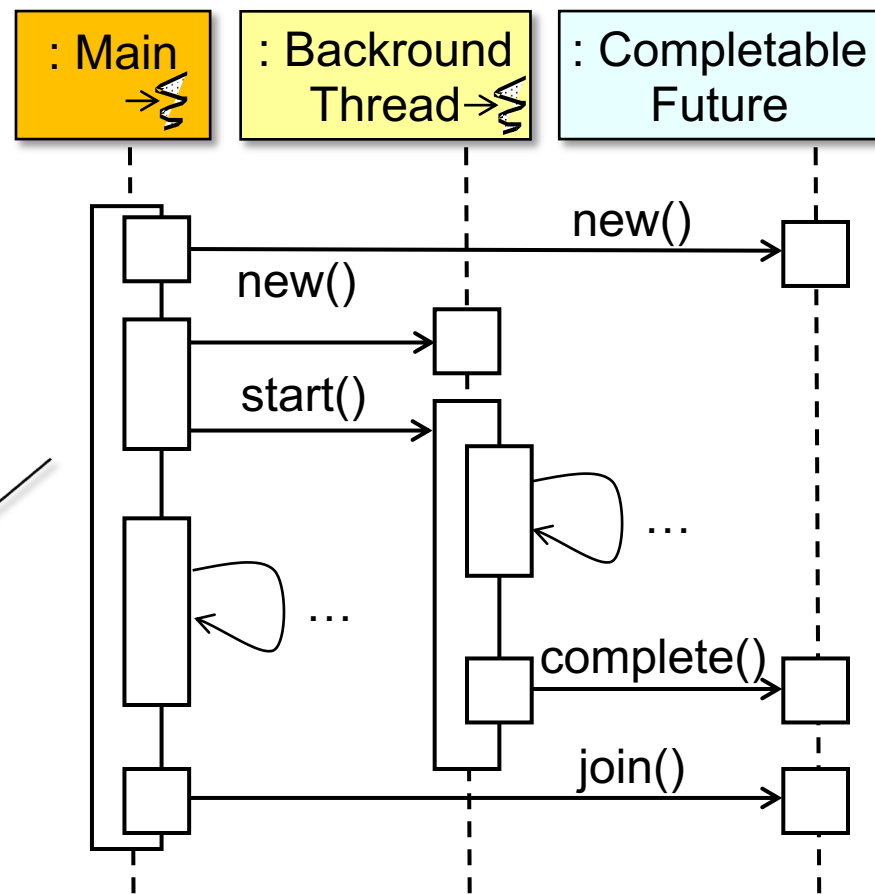
Basic Completable Future Features

Basic CompletableFuture Features

- Basic CompletableFuture features



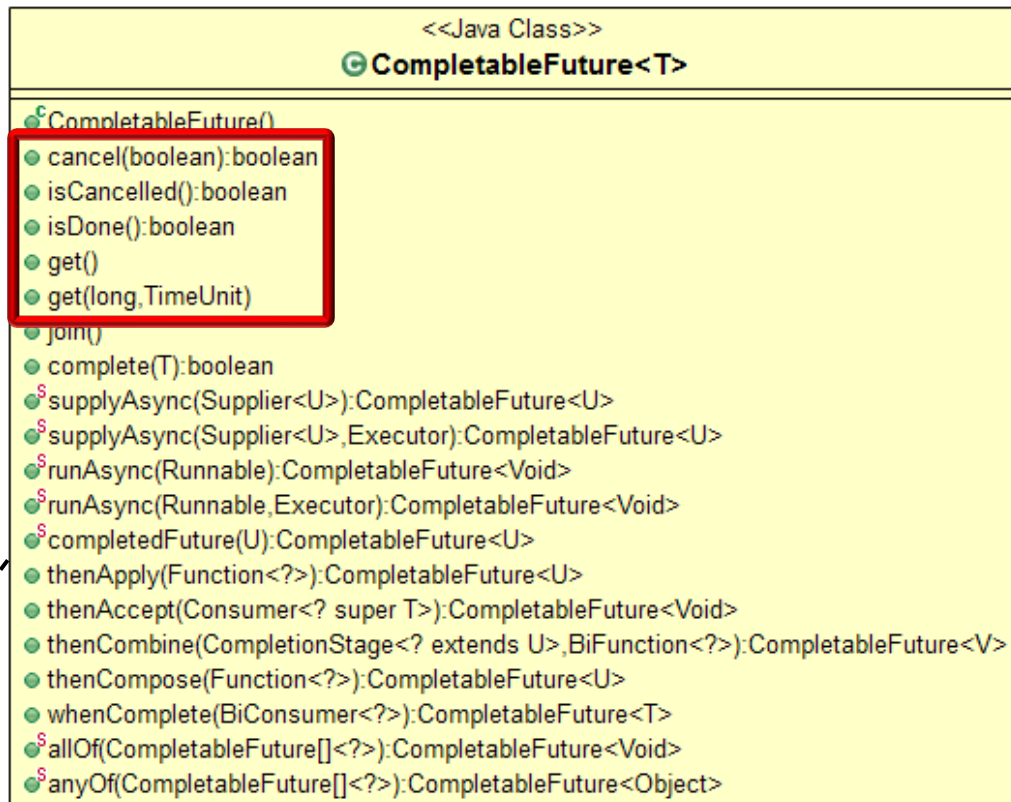
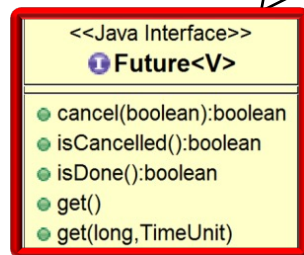
We showcase these basic features in case study ex8



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

Basic CompletableFuture Features

- Basic CompletableFuture features
 - Support the Future API



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

Basic CompletableFuture Features

- Basic CompletableFuture features
 - Support the Future API, e.g.
 - Can block, time-wait, & poll

```
String f1 = "62675744/15668936";  
String f2 = "609136/913704";
```

```
ForkJoinTask<BigFraction> f =  
    commonPool().submit(() -> {  
        BigFraction bf1 =  
            new BigFraction(f1);  
        BigFraction bf2 =  
            new BigFraction(f2);  
        return bf1.multiply(bf2);  
    });  
  
...  
BigFraction result = f.get();  
// f.get(10, MILLISECONDS);  
// f.get(0, 0);
```

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

Basic CompletableFuture Features

- Basic CompletableFuture features
 - Support the Future API, e.g.
 - Can block, time-wait, & poll
 - Can be cancelled & tested if cancelled/done

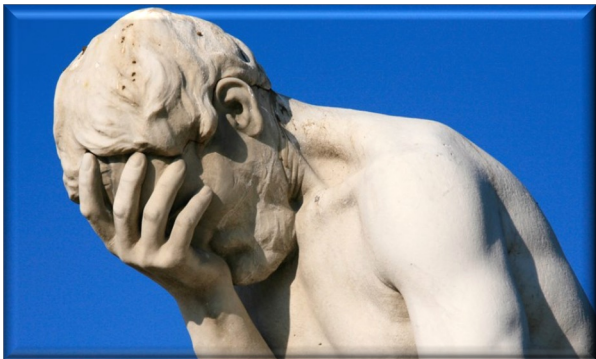
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String f1 = "62675744/15668936";  
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```
ForkJoinTask<BigFraction> f =  
    commonPool().submit(() -> {  
        BigFraction bf1 =  
            new BigFraction(f1);  
        BigFraction bf2 =  
            new BigFraction(f2);  
        return bf1.multiply(bf2);  
    });  
...  
if (!(f.isDone()  
    || !f.isCancelled()))  
    f.cancel();
```

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

Basic CompletableFuture Features

- Basic CompletableFuture features
 - Support the Future API, e.g.
 - Can block, time-wait, & poll
 - Can be cancelled & tested if cancelled/done
 - `cancel()` doesn't interrupt the computation by default..



```
String f1 = "62675744/15668936";  
String f2 = "609136/913704";
```

```
ForkJoinTask<BigFraction> f =  
    commonPool().submit(() -> {  
        BigFraction bf1 =  
            new BigFraction(f1);  
        BigFraction bf2 =  
            new BigFraction(f2);  
        return bf1.multiply(bf2);  
    });  
...  
if (!(f.isDone()  
    || !f.isCancelled()))  
    f.cancel();
```

Basic CompletableFuture Features

- Basic CompletableFuture features
 - Support the Future API
 - Define a join() method

<<Java Class>>	
G CompletableFuture<T>	
•	CompletableFuture()
•	cancel(boolean):boolean
•	isCancelled():boolean
•	isDone():boolean
•	get()
•	get(long,TimeUnit)
•	join()
•	complete(T):boolean
•	supplyAsync(Supplier<U>):CompletableFuture<U>
•	supplyAsync(Supplier<U>,Executor):CompletableFuture<U>
•	runAsync(Runnable):CompletableFuture<Void>
•	runAsync(Runnable,Executor):CompletableFuture<Void>
•	completedFuture(U):CompletableFuture<U>
•	thenApply(Function<?>):CompletableFuture<U>
•	thenAccept(Consumer<? super T>):CompletableFuture<Void>
•	thenCombine(CompletionStage<? extends U>,BiFunction<?>):CompletableFuture<V>
•	thenCompose(Function<?>):CompletableFuture<U>
•	whenComplete(BiConsumer<?>):CompletableFuture<T>
•	allOf(CompletableFuture[]<?>):CompletableFuture<Void>
•	anyOf(CompletableFuture[]<?>):CompletableFuture<Object>

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

Basic CompletableFuture Features

- Basic CompletableFuture features
 - Support the Future API
 - Define a join() method
 - Blocks awaiting results



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See www.educative.io/answers/what-is-completablefuturejoin-in-java

Basic CompletableFuture Features

- Basic CompletableFuture features
 - Support the Future API
- Define a join() method
 - Blocks awaiting results
- Behaves like get() *without* using checked exceptions

futures

```
.stream()  
.map(CompletableFuture  
    ::join)  
.collect(toList())
```

<<Java Class>>	
G CompletableFuture<T>	
•	CompletableFuture()
•	cancel(boolean):boolean
•	isCancelled():boolean
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•	allOf(CompletableFuture[]<?>):CompletableFuture<Void>
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CompletableFuture::join can be used as a method reference in a Java stream

See www.javaadvent.com/2020/12/exceptions-and-streams.html

Basic CompletableFuture Features

- Basic CompletableFuture features
 - Support the Future API
 - Define a join() method
 - Blocks awaiting results
 - Behaves like get() *without* using checked exceptions

futures
stream()
.map(future
-> try { future.get();
} catch (Exception e) {
})
.collect(toList())



<<Java Class>>	
G CompletableFuture<T>	
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Mixing checked exceptions & Java streams is ugly..

Basic CompletableFuture Features

- Basic CompletableFuture features
 - Support the Future API
- Define a join() method
 - Blocks awaiting results
- Behaves like get() *without* using checked exceptions

futures

```
.stream()  
.map(f -> rethrowSupplier  
      (f::get).get())  
.collect(toList())
```

<<Java Class>>	
G CompletableFuture<T>	
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Exception laundering is also an option, but may be overkill compared with join()

See stackoverflow.com/a/27644392/3312330

Basic CompletableFuture Features

- Basic CompletableFuture features
 - Support the Future API
- Define a join() method
 - Blocks awaiting results
 - Behaves like get() *without* using checked exceptions
- There is no timed version of join()



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See tedblob.com/completablefuture-join-vs-get

Basic CompletableFuture Features

- Basic CompletableFuture features
 - Support the Future API
 - Define a join() method
 - Can be completed explicitly



you complete me

<<Java Class>>	
CompletableFuture<T>	
CompletableFuture()	
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Basic CompletableFuture Features

- Basic CompletableFuture features

- Support the Future API
- Define a join() method
- Can be completed explicitly
 - i.e., sets future result to a given value, which is then returned by get()/join()

```
CompletableFuture<...> future =  
    new CompletableFuture<>();
```

```
...
```

```
new Thread (() -> {  
    ...  
    future.complete(...);  
}).start();
```

```
...
```

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

Basic CompletableFuture Features

- Basic CompletableFuture features

- Support the Future API
- Define a join() method
- Can be completed explicitly
 - i.e., sets future result to a given value, which is then returned by get()/join()

```
CompletableFuture<...> future =  
    new CompletableFuture<>();
```

...

Create an incomplete future

```
new Thread (() -> {  
    ...  
    future.complete(...);  
}).start();
```

...

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

Basic CompletableFuture Features

- Basic CompletableFuture features

- Support the Future API
- Define a join() method
- Can be completed explicitly
 - i.e., sets future result to a given value, which is then returned by get()/join()

*Create/start a new thread
that runs concurrently
with the calling thread*

```
CompletableFuture<...> future =  
    new CompletableFuture<>();
```

```
...
```

```
new Thread (() -> {  
    ...  
    future.complete(...);  
}) .start();
```

```
...
```

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

Basic CompletableFuture Features

- Basic CompletableFuture features

- Support the Future API
- Define a join() method
- Can be completed explicitly
 - i.e., sets future result to a given value, which is then returned by get()/join()

```
CompletableFuture<...> future =  
    new CompletableFuture<>();
```

```
...
```

*After complete() is done
calls to join() will unblock*

```
new Thread (() -> {  
    ...  
    future.complete(...);  
}) .start();
```

```
...
```

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

Basic CompletableFuture Features

- Basic CompletableFuture features

- Support the Future API
- Define a join() method
- Can be completed explicitly
 - i.e., sets future result to a given value, which is then returned by get()/join()

A completable future can be initialized to a value/constant

```
CompletableFuture<...> future =  
    new CompletableFuture<>();
```

```
CompletableFuture<Long> zero  
    = CompletableFuture  
        .completedFuture(0L);
```

```
new Thread (() -> {  
    ...  
    future.complete(zero.join());  
}).start();
```

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

End of Overview of Basic Java
CompletableFuture Features