The Java CompletableFuture ImageStreamGang Case Study: Applying Arbitrary-Arity Methods

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Learning Objectives in this Part of the Lesson

• Understand the design of the Java completable future version of ImageStreamGang

• Know how to apply completable futures to ImageStreamGang, e.g.
  • Factory methods
  • Completion stage methods
  • Arbitrary-arity methods
Applying Arbitrary-Arity Methods in ImageStreamGang
Applying Arbitrary-Arity Methods in ImageStreamGang

- collect() returns a future to a stream of futures to images being processed asynchronously

```java
void processStream() {
    List<URL> urls = getInput();

    CompletableFuture<Stream<Image>> resultsFuture = urls.stream()
        .map(this::checkUrlCachedAsync)
        .map(this::downloadImageAsync)
        .flatMap(this::applyFiltersAsync)
        .collect(toFuture())
        .thenApply(stream ->
            log(stream.flatMap(Optional::stream), urls.size())
        ).join();
}
```

flatMap() outputs a stream of futures associated with processing that’s running asynchronously
Applying Arbitrary-Arity Methods in ImageStreamGang

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        .collect(toFuture())
        .thenApply(stream ->
            log(stream.flatMap(Optional::stream), urls.size()))
        .join();
}

collect() also triggers processing of all the intermediate operations
Applying Arbitrary-Arity Methods in ImageStreamGang

- `collect()` returns a future to a stream of futures to images being processed asynchronously.
- `StreamOfFuturesCollector` wraps “arbitrary-arity” allOf() method.

```java
void processStream() {
    List<URL> urls = getInput();

    CompletableFuture<Stream<Image>> resultsFuture = urls
        .stream()
        .map(this::checkUrlCachedAsync)
        .map(this::downloadImageAsync)
        .flatMap(this::applyFiltersAsync)
        .collect(toFuture())
        .thenApply(stream ->
            log(stream.flatMap(Optional::stream), urls.size())
        )
        .join();
```

Return a future that completes when all futures in the stream complete.

See [AndroidGUI/app/src/main/java/livelessons/utils/StreamOfFuturesCollector.java](AndroidGUI/app/src/main/java/livelessons/utils/StreamOfFuturesCollector.java)
Applying Arbitrary-Arity Methods in ImageStreamGang

- `collect()` returns a future to a stream of futures to images being processed asynchronously.
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    List<URL> urls = getInput();

    CompletableFuture<Stream<Image>>
        resultsFuture = urls.stream()
            .map(this::checkUrlCachedAsync)
            .map(this::downloadImageAsync)
            .flatMap(this::applyFiltersAsync)
            .collect(toFuture())
            .thenApply(stream ->
                log(stream.flatMap(Optional::stream), urls.size())
            )
            .join();

    Log the results after the final future completes
}
```
Applying Arbitrary-Arity Methods in ImageStreamGang

void processStream() {
    List<URL> urls = getInput();

    CompletableFuture<Stream<Image>> resultsFuture = urls
        .stream()
        .map(this::checkUrlCachedAsync)
        .map(this::downloadImageAsync)
        .flatMap(this::applyFiltersAsync)
        .collect(toFuture())
        .thenApply(stream ->
            log(stream.flatMap(Optional::stream), urls.size()))
        .join();
}

Remove empty optional values from the stream in Java 9+

See docs.oracle.com/javase/9/docs/api/java/util/Optional.html#flatMap
Applying Arbitrary-Arity Methods in ImageStreamGang

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    CompletableFuture<Stream<Image>> resultsFuture = urls
        .stream()
        .map(this::checkUrlCachedAsync)
        .map(this::downloadImageAsync)
        .flatMap(this::applyFiltersAsync)
        .collect(toFuture())
        .thenApply(stream -> log(stream
            .filter(Optional::isPresent)
            .map(Optional::get),
            urls.size()))
        .join();

    // Remove empty optional values from the stream in Java 8
}```
Applying Arbitrary-Arity Methods in ImageStreamGang

- `collect()` returns a future to a stream of futures to images being processed asynchronously
- `StreamOfFuturesCollector` wraps "arbitrary-arity" `allOf()` method

```java
void processStream() {
    List<URL> urls = getInput();

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        .stream()
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        .flatMap(this::applyFiltersAsync)
        .collect(toFuture())
        .thenApply(stream -> log(stream
            .filter(Optional::isPresent)
            .map(Optional::get), urls.size()))
        .join();
}
```

Java 8 is more verbose...

See blog.codefx.org/java/java-9-optional
Applying Arbitrary-Arity Methods in ImageStreamGang

- `collect()` returns a future to a stream of futures to images being processed asynchronously.
- Images are displayed after async processing completes.
- `StreamOfFuturesCollector` wraps “arbitrary-arity” `allOf()` method.

```java
void processStream() {
    List<URL> urls = getInput();

    CompletableFuture<Stream<Image>> resultsFuture = urls
        .stream()
        .map(this::checkUrlCachedAsync)
        .map(this::downloadImageAsync)
        .flatMap(this::applyFiltersAsync)
        .collect(toFuture())
        .thenApply(stream ->
            log(stream.flatMap(Optional::stream), urls.size()))
        .join();
}
```

Wait until all the async processing is completed.

See [docs.oracle.com/javase/8/docs/api/java/util/concurrent/CompletableFuture.html#join](http://docs.oracle.com/javase/8/docs/api/java/util/concurrent/CompletableFuture.html#join)
Applying Arbitrary-Arity Methods in ImageStreamGang

- collect() returns a future to a stream of futures to images being processed asynchronously

```java
void processStream() {
    List<URL> urls = getInput();

    CompletableFuture<Stream<Image>> resultsFuture = urls
        .stream() // THERE CAN BE
        .map(this::checkUrlCachedAsync)
        .map(this::downloadImageAsync)
        .flatMap(this::applyFiltersAsync)
        .collect(toFuture())
        .thenApply(stream ->
            log(stream.flatMap(Optional::stream),
                 urls.size())
        )
        .join(); // ONLY ONE
}
```

This is the one & only call to join() in this async stream pipeline!
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- `collect()` returns a future to a stream of futures to images being processed asynchronously.

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    List<URL> urls = getInput();

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        .stream()
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        .flatMap(this::applyFiltersAsync)
        .collect(toFuture())
        .thenApply(stream ->
            log(stream.flatMap(Optional::stream), urls.size())
        ).join();
}
```

Images are displayed after all the async processing completes.
End of the Java Completable Future ImageStreamGang Case Study: Applying Arbitrary-Arity Methods