The Java CompletableFuture ImageStream Gang Case Study: Applying Factory 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
  - `supplyAsync()`
Applying Factory Methods in ImageStreamGang
• Initiate an async check to see if images are cached locally

```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();
}
```

*map() calls the behavior checkUrlCachedAsync()*
• Initiate an async check to see if images are cached locally

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

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

Asynchronously check if a URL is already downloaded
• Initiate an async check to see if images are cached locally

```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();
}
```

*Returns a stream of completable futures to optional URLs, which have a value if the URL is not cached or are empty if it is cached.*

Later behaviors simply ignore “empty” optional URL values.
Applying Factory Methods in ImageStreamGang

- `checkUrlCachedAsync()` uses the `supplyAsync()` factory method internally

```java
CompletableFuture<Optional<URL>> checkUrlCachedAsync(URL url) {
    return CompletableFuture.
        supplyAsync(() ->
            Optional.ofNullable(urlCached(url)
                ? null
                : url),
        getExecutor());
}
```

See [imagestreamgang/streams/ImageStreamCompletableFutureBase.java](imagestreamgang/streams/ImageStreamCompletableFutureBase.java)
Applying Factory Methods in ImageStreamGang

- checkUrlCachedAsync() uses the supplyAsync() factory method internally

```java
CompletableFuture<Optional<URL>> checkUrlCachedAsync(URL url) {
    return CompletableFuture.supplyAsync(() ->
        Optional.ofNullable(urlCached(url) ? null : url),
        getExecutor());
}
```

This factory method registers an action that runs asynchronously.

See [docs.oracle.com/javase/8/docs/api/java/util/concurrent/CompletableFuture.html#supplyAsync](https://docs.oracle.com/javase/8/docs/api/java/util/concurrent/CompletableFuture.html#supplyAsync)
void initiateStream() {
    // Set the executor to the common fork-join pool.
    setExecutor(ForkJoinPool.commonPool());
    ...
}

CompletableFuture<Optional<URL>> checkUrlCachedAsync(URL url) {
    return CompletableFuture.supplyAsync(() ->
        Optional.ofNullable(urlCached(url)
            ? null
            : url),
        getExecutor());
}

supplyAsync() runs action in a worker thread from the common fork-join pool

see dzone.com/articles/common-fork-join-pool-and-streams
Applying Factory Methods in ImageStreamGang

- checkUrlCachedAsync() uses the supplyAsync() factory method internally

```java
CompletableFuture<Optional<URL>> checkUrlCachedAsync(URL url) {
    return CompletableFuture.
      supplyAsync(() ->
        Optional.ofNullable(urlCached(url)
          ? null
          : url),
        getExecutor());
}
```

`ofNullable()` is a factory method that returns an optional URL, which has a value if the URL is not cached or is empty if it is already cached.

See [docs.oracle.com/javase/8/docs/api/java/util/Optional.html#ofNullable](docs.oracle.com/javase/8/docs/api/java/util/Optional.html#ofNullable)
• checkUrlCachedAsync() uses the supplyAsync() factory method internally

```java
CompletableFuture<Optional<URL>> checkUrlCachedAsync(URL url) {
    return CompletableFuture.supplyAsync(() ->
        Optional.ofNullable(urlCached(url)
            ? null
            : url),
        getExecutor());
}
```

Returns true if the image has already been filtered before

```java
boolean urlCached(URL url) {
    return mFilters.stream()
        .anyMatch(filter -> urlCached(url,
            filter.getName()));
}
```

See imagestreamgang(streams/ImageStreamGang.java)
Applying Factory Methods in ImageStreamGang

- `checkUrlCachedAsync()` uses the `supplyAsync()` factory method internally.

```java
CompletableFuture<Optional<URL>> checkUrlCachedAsync(URL url) {
    return CompletableFuture.
        supplyAsync(() ->
            Optional.ofNullable(urlCached(url)
                ? null
                : url),
        getExecutor());
}
```

Returns true if image file already exists

```java
boolean urlCached(URL url, String filterName) {
    File file = new File(getPath(), filterName);
    File imageFile = new File(file, getNameForUrl(url));
    return !imageFile.createNewFile();
}
```

See `imagestreamgang/streams/ImageStreamGang.java`
checkUrlCachedAsync() uses the supplyAsync() factory method internally.

```java
CompletableFuture<Optional<URL>> checkUrlCachedAsync(URL url) {
    return CompletableFuture.
        supplyAsync(() ->
            Optional.ofNullable(urlCached(url)
                ? null
                : url),
        getExecutor());
}
```

There are clearly better ways of implementing an image cache!

```java
boolean urlCached(URL url, String filterName) {
    File file = new File(getPath(), filterName);
    File imageFile = new File(file, getNameForUrl(url));
    return !imageFile.createNewFile();
}
```
End of the Java Completable Future ImageStreamGang Case Study: Applying Factory Methods