Applying Java Functional Programming Features to Start & Join Threads

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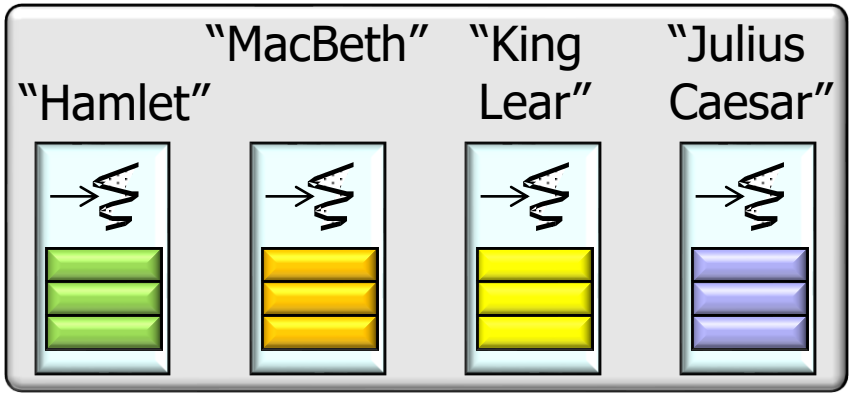
Learning Objectives in this Part of the Lesson

- Understand how Java functional programming features are applied in a simple parallel program
- Know how to start & join Java threads via functional programming features



Example of Starting & Joining Java Threads

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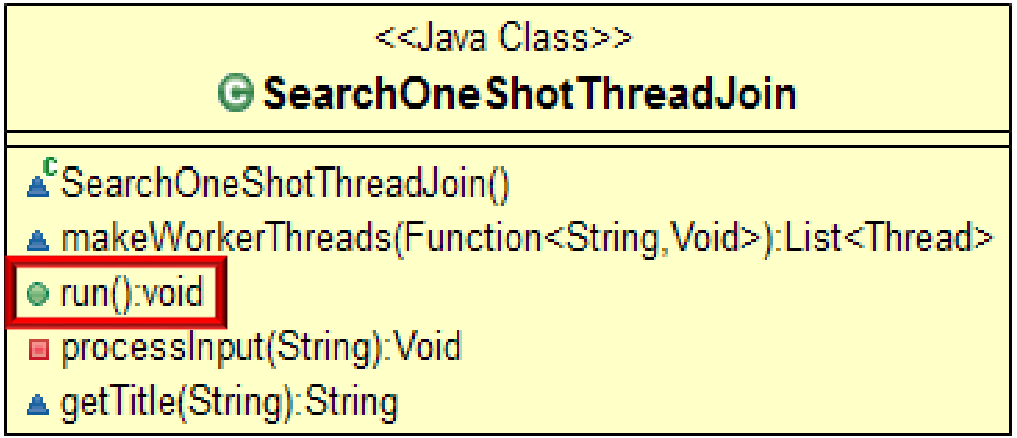
- Showcases Java FP features

```
public void run() {
```



See ThreadJoinTest/updated/src/main/java/ThreadJoinTest.java

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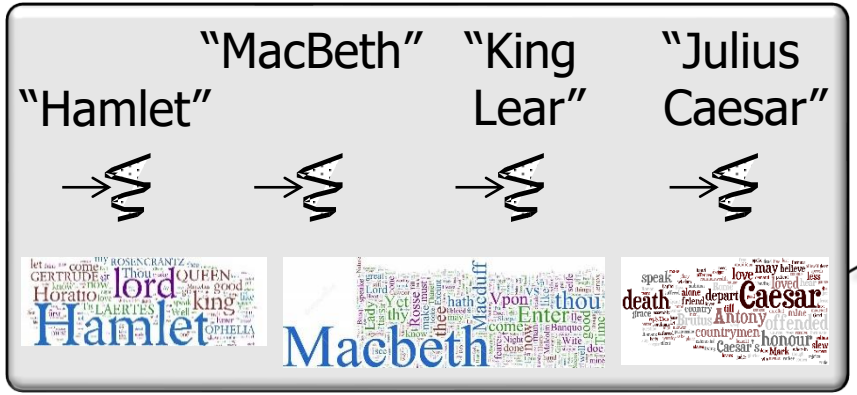

Start a group of threads that search for phrases in parallel

Example of Starting & Joining Java Threads

- Showcases Java FP features

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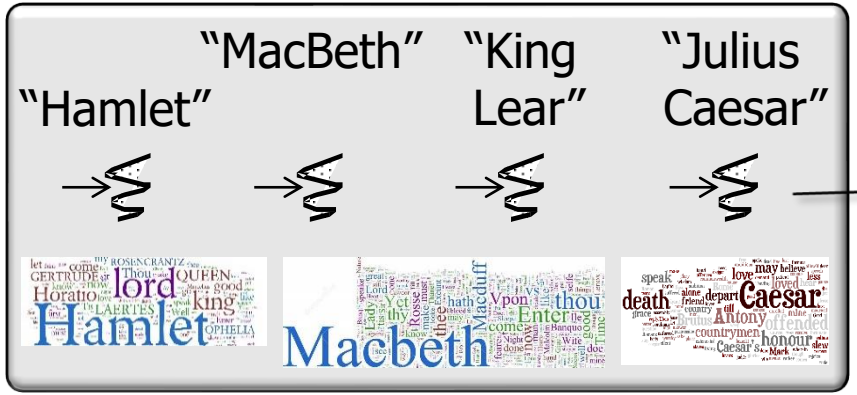

A Java thread is a unit of computation that runs in the context of a process

See docs.oracle.com/javase/tutorial/essential/concurrency/runthread.html

Example of Starting & Joining Java Threads

- Showcases Java FP features, e.g.
  - Flexibly create worker threads via a factory method

```
public void run() {
  List<Thread> workerThreads =
    makeWorkerThreads
      (this::processInput);
  ...
```

Factory method makes a list of worker threads

Example of Starting & Joining Java Threads

- Showcases Java FP features, e.g.
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  - Pass a reference to a method expecting a functional interface

```
public void run() {
   List<Thread> workerThreads =
     makeWorkerThreads
        (this::processInput);
   ...
```

This method searches for phrases in one work of Shakespeare

```
Void processInput(String input)
{ ... }

List<Thread> makeWorkerThreads
   (Function<String, Void> task)
{ ... }
```

Example of Starting & Joining Java Threads

- Showcases Java FP features, e.g.
  - Flexibly create worker threads via a factory method
  - Pass a reference to a method expecting a functional interface

```
public void run() {
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  ...
```

This functional interface makes it easy to change the function passed to factory method

```
Void processInput(String input)
{ ... }

List<Thread> makeWorkerThreads
  (Function<String, Void> task)
{ ... }
```

Example of Starting & Joining Java Threads

- Showcases Java FP features, e.g.
  - Flexibly create worker threads via a factory method
  - Pass a reference to a method expecting a functional interface
    - Apply a function lambda to create runnable for a thread

```
List<Thread> makeWorkerThreads
   (Function<String, Void> task) {
   List<Thread> workerThreads =
      new ArrayList<>();

   mInputList.forEach(input ->
      workerThreads.add
         (new Thread(()
            -> task.apply(input))));

   return workerThreads;
}
```

This factory method creates a list of threads that will be joined when their processing is done

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```

Create an empty list of threads

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}
```

Create a thread for each input string to perform processing designated by the task parameter

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task.apply() creates a runnable that provides the computation for each of the threads

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Add each new thread to the list

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Return the list of worker threads

Example of Starting & Joining Java Threads

- Showcases Java FP features, e.g.
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  - Start worker threads via forEach() & a method reference

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public void run() {
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  workerThreads
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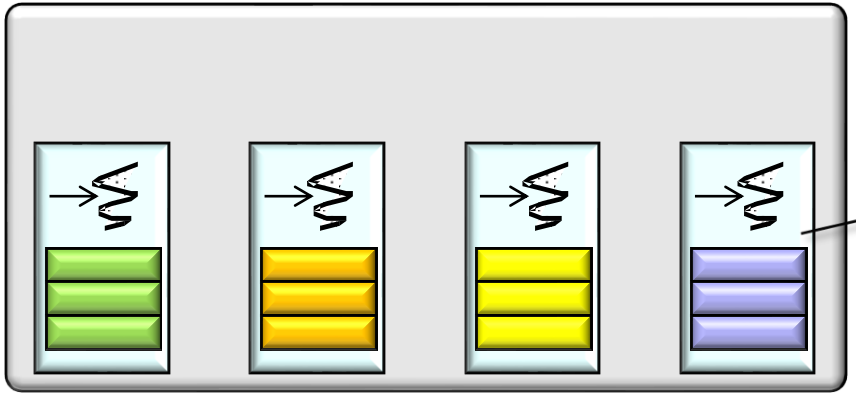

Each worker thread has its own runtime call stack

See en.wikipedia.org/wiki/Call_stack

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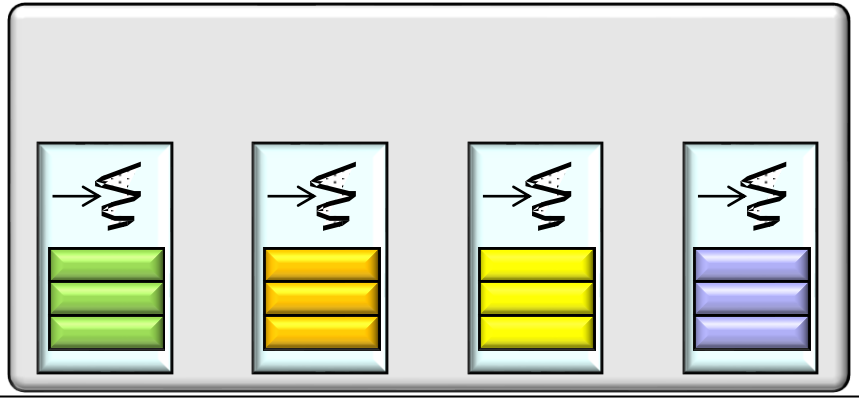
forEach() & method reference start each worker thread to search for phrases in works of Shakespeare



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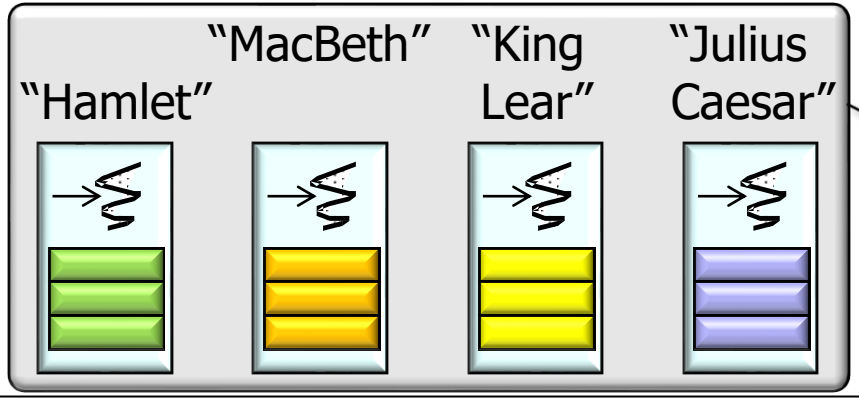

This program uses a "thread-per-work" parallelism model

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  - Wait for worker threads to finish

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public void run() {
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  workerThreads
    .forEach(thread -> {
      ... thread.join(); ...
    } ...
```

Uses forEach() & lambda expression

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Simple form of barrier synchronization

See en.wikipedia.org/wiki/Barrier_(computer_science)

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```

No other Java synchronizers are needed!

End of Applying Java Functional Programming Features to Start & Join Threads