Visualize the Java Sequential SearchStreamGang printPhrases() Method

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Learning Objectives in this Part of the Lesson

- Know how to apply sequential streams to the SearchStreamGang program
- Understand the SearchStreamGang printPhrases() method

```java
void printPhrases(List<List<SearchResults>> listOfListOfSearchResults) {
    Map<String, List<SearchResults>> resultsMap =
        listOfListOfSearchResults
        .stream()
        .flatMap(List::stream)
        .collect(groupingBy(SearchResults::getTitle,
                             TreeMap::new, toList()));

    resultsMap.forEach((key, value) -> {
        System.out.println("Title \"" + key + "\" contained");
        value.forEach(SearchResults::print);
    }); ...}
```

Visualizing printPhrases()
Visualizing `printPhrases()`

- `SearchStreamGang.printPhrases()` displays phrases associated with each play...

**Title "The Tragedy of Hamlet, Prince of Denmark" contained**
"It shall be so. Madness in great ones must not unwatch'd go." at [89594]
"Give every man thine ear, but few thy voice" at [26207]
"There is nothing either good or bad but thinking makes it so" at [62609]
"To be, or not to be- that is the question" at [83061]
"Neither a borrower nor a lender be" at [26556]
"The lady doth protest too much, methinks" at [102267]
"Get thee to a nunnery" at [86071|86953]
"Brevity is the soul of wit" at [54747]

**Title "The Tragedy of Julius Caesar" contained**
"The fault, dear Brutus, is not in our stars, but in ourselves that we are underlings" at [12243]
"Friends, Romans, countrymen, lend me your ears" at [76850]
"But for mine own part, it was Greek to me" at [19356]
"Beware the Ides of March" at [6412|6495|6703]
"The evil that men do lives after them, The good is oft interred with their bones" at [76950]
...

This method shows the `flatMap()` & `collect(groupingBy())` aggregate operations.
Visualizing `printPhrases()`

- `printPhrases()` uses a stream that converts a list of lists of search results into a map that associates phrases with the works where they were found.

Input a list of lists of search results

List<List<SearchResults>>

stream()

Some lists of search results may be empty if no phrases matched an input string.
Visualizing `printPhrases()`

- `printPhrases()` uses a stream that converts a list of lists of search results into a map that associates phrases with the works where they were found.

```
List<List<SearchResults>>
```

Convert list to a (sequential) stream of lists of search results.
printPhrases() uses a stream that converts a list of lists of search results into a map that associates phrases with the works where they were found.

Output a stream of lists of search results

List<List<SearchResults>>

Stream<List<SearchResults>>
printPhrases() uses a stream that converts a list of lists of search results into a map that associates phrases with the works where they were found.

**Visualizing printPhrases()**

**Input a stream of lists of search results**

List\(\langle\text{List\langle SearchResults\rangle}\rangle\)

Stream\(\langle\text{List\langle SearchResults\rangle}\rangle\)

\(\text{stream()}\)

\(\text{flatMap(List::stream)}\)
Visualizing `printPhrases()`

- `printPhrases()` uses a stream that converts a list of lists of search results into a map that associates phrases with the works where they were found.

```
List<List<SearchResults>>
```

```
Stream<List<List<SearchResults>>>
```

- Flatten the stream of lists of search results to a stream of search results.
Visualizing `printPhrases()`

- `printPhrases()` uses a stream that converts a list of lists of search results into a map that associates phrases with the works where they were found.

Empty lists will occur if no phrases match in an input string (Shakespeare work).
Visualizing `printPhrases()`

- `printPhrases()` uses a stream that converts a list of lists of search results into a map that associates phrases with the works where they were found.

Output a stream of non-empty search results

List<List<SearchResults>>

Stream<List<SearchResults>>

Stream<SearchResults>

```
Output a stream of non-empty search results
```

```
List<List<SearchResults>>>
Stream<List<SearchResults>>>
Stream<SearchResults>
```

```
stream()
flatMap(List::stream)
```

```
• printPhrases() uses a stream that converts a list of lists of search results into a map that associates phrases with the works where they were found
```
Visualizing `printPhrases()`

- `printPhrases()` uses a stream that converts a list of lists of search results into a map that associates phrases with the works where they were found.

**Input a stream of non-empty search results**

```
List<List<SearchResults>>
Stream<List<SearchResults>>
Stream<SearchResults>
```

```
stream()
flatMap(List::stream)
collect(groupingBy(...))
```
• **printPhrases()** uses a stream that converts a list of lists of search results into a map that associates phrases with the works where they were found.
Visualizing `printPhrases()`

- `printPhrases()` uses a stream that converts a list of lists of search results into a map that associates phrases with the works where they were found.

```java
Stream<List<SearchResults>>
stream()
flatMap(List::stream)
collect(groupingBy(...))
```

Create a map that groups phrases according to the works where they appear.
End of Visualize the Java Sequential SearchStreamGang printPhrases() Method