Java SearchWithParallelSpliterator Example: trySplit()

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Learning Objectives in this Part of the Lesson

- Be aware of how a parallel spliterator can improve parallel stream performance
- Know the intent of—& fields in—the PhraseMatchSpliterator
- Recognize the PhraseMatchSpliterator constructor & tryAdvance() method implementation
- Understand the PhraseMatchSpliterator trySplit() method implementation

```
class PhraseMatchSpliterator implements Spliterator<Result> {
  Spliterator<Result> trySplit() {
    if (mInput.length() <= mMinSplitSize) return null;
    int startPos, splitPos = mInput.length() / 2;
    if ((startPos = computeStartPos(splitPos)) < 0) return null;
    if ((splitPos = tryToUpdateSplitPos(startPos, splitPos)) < 0)
      return null;
    return splitInput(splitPos);
    ...
```

This method is used with the SearchWithParallelSpliterators class

Analysis of the PhraseMatch Spliterator trySplit() Method

Analysis of the PhraseMatchSpliterator trySplit() Method

- The streams framework uses trySplit() partition a work of Shakepeare into chunks that can be searched in parallel

```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  Spliterator<Result> trySplit() { ... }

  int computeStartPos(int splitPos) { ... }

  int tryToUpdateSplitPos(int startPos,
                          int splitPos) { ... }

  PhraseMatchSpliterator splitInput(int splitPos) { ... }

  ...
```

These methods are used for parallel streams

Analysis of the PhraseMatchSpliterator trySplit() Method

- The streams framework uses trySplit() partition a work of Shakepeare into chunks that can be searched in parallel

```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  Spliterator<Result> trySplit() { ... }

  int computeStartPos(int splitPos) { ... }

  int tryToUpdateSplitPos(int startPos,
                          int splitPos) { ... }

  PhraseMatchSpliterator splitInput(int splitPos) { ... }

  ...
```

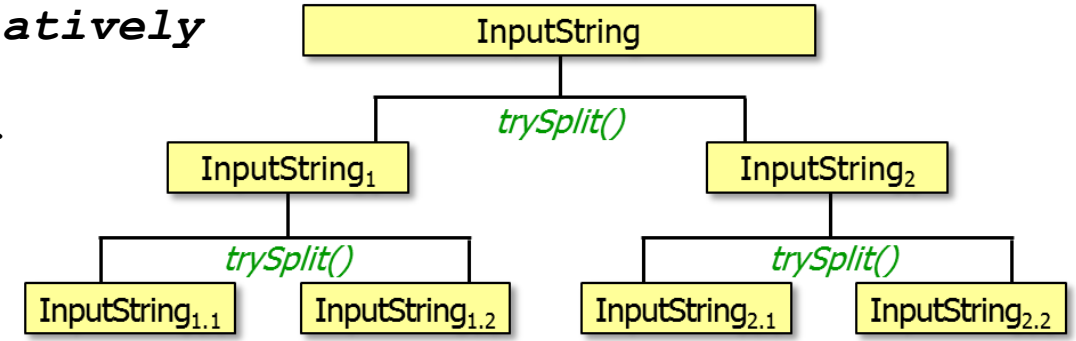
These methods are used for parallel streams

There is *no* synchronization in any of these methods!!!

Analysis of the PhraseMatchSpliterator trySplit() Method

- The streams framework uses trySplit() partition a work of Shakepeare into chunks that can be searched in parallel

```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  Spliterator<Result> trySplit() {
    if (input is below minimum size) return null
    else {
      split input in 2 relatively
        even-sized chunks
      return a spliterator
        for "left chunk"
    }
  }
  ...
```

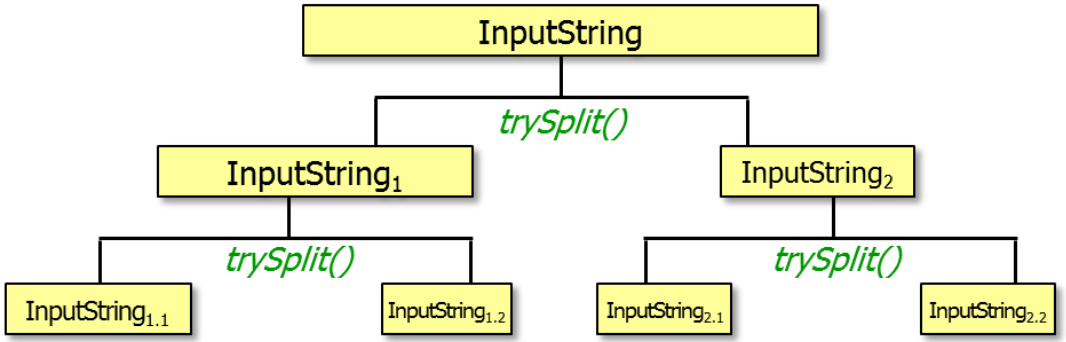


trySplit() attempts to split the input "evenly" so phrases can be matched in parallel

Analysis of the PhraseMatchSpliterator trySplit() Method

- The streams framework uses trySplit() partition a work of Shakepeare into chunks that can be searched in parallel

```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  Spliterator<Result> trySplit() {
```



Splits don't needn't be perfectly equal in order for the spliterator to be efficient

Analysis of the PhraseMatchSpliterator trySplit() Method

- The streams framework uses trySplit() partition a work of Shakepeare into chunks that can be searched in parallel

```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  Spliterator<Result> trySplit() {
    if (mInput.length() <= mMinSplitSize) return null;
    int startPos,
        splitPos = mInput.length() / 2;

    if ((startPos = computeStartPos(splitPos)) < 0) return null;

    if ((splitPos = tryToUpdateSplitPos(startPos, splitPos)) < 0)
      return null;

    return splitInput(splitPos); ...
```

This code is heavily commented, so please check it out

Analysis of the PhraseMatchSpliterator trySplit() Method

- The streams framework uses trySplit() partition a work of Shakepeare into chunks that can be searched in parallel

```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  Spliterator<Result> trySplit() {
    if (mInput.length() <= mMinSplitSize) return null;
    int startPos,
        splitPos = mInput.length() / 2;

    if ((startPos = computeStartPos(splitPos)) < 0) return null;

    if ((splitPos = tryToUpdateSplitPos(startPos, splitPos)) < 0)
      return null;

    return splitInput(splitPos); ...
```

Bail out if input is too small to split further

Analysis of the PhraseMatchSpliterator trySplit() Method

"... Therefore, since brevity is the soul of" "wit, And tediousness the limbs and outward..."


```
class PhraseMatchSpliterator implements Spliterator<Result> {
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  Spliterator<Result> trySplit() {
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    if ((startPos = computeStartPos(splitPos)) < 0) return null;

    if ((splitPos = tryToUpdateSplitPos(startPos, splitPos)) < 0)
      return null;

    return splitInput(splitPos); ...
```

Initial guess at the split position

Analysis of the PhraseMatchSpliterator trySplit() Method

"... Therefore, since brevity is the soul of" "wit, And tediousness the limbs and outward..."


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  ...
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        splitPos = mInput.length() / 2;

    if ((startPos = computeStartPos(splitPos)) < 0) return null;

    if ((splitPos = tryToUpdateSplitPos(startPos, splitPos)) < 0)
      return null;

    return splitInput(splitPos); ...
```

Initial guess at where to start the search

Analysis of the PhraseMatchSpliterator trySplit() Method

"... Therefore, since brevity is the soul of" "wit, And tediousness the limbs and outward..."


```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  int computeStartPos(int splitPos) {

    int phraseLength = mPhrase.length();

    int startPos = splitPos - phraseLength;

    if (startPos < 0 || phraseLength > splitPos)
      return -1;
    else
      return startPos;
}
```

Identify the position to start determining if a phrase spans the split position

Analysis of the PhraseMatchSpliterator trySplit() Method

"... Therefore, since brevity is the soul of" "wit, And tediousness the limbs and outward..."


```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  int computeStartPos(int splitPos) {

    int phraseLength = mPhrase.length();

    int startPos = splitPos - phraseLength;

    if (startPos < 0 || phraseLength > splitPos)
      return -1;
    else
      return startPos;
}
```

Store the length of the phrase

Analysis of the PhraseMatchSpliterator trySplit() Method

"... Therefore, since brevity is the soul of" "wit, And tediousness the limbs and outward..."


```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  int computeStartPos(int splitPos) {

    int phraseLength = mPhrase.length();

    int startPos = splitPos - phraseLength;

    if (startPos < 0 || phraseLength > splitPos)
      return -1;
    else
      return startPos;
}
```

Compute the initial startPos by subtracting the phrase length from the splitPos

Analysis of the PhraseMatchSpliterator trySplit() Method

"... Therefore, since brevity is the soul of" "wit, And tediousness the limbs and outward..."


```
class PhraseMatchSpliterator implements Spliterator<Result> {
   ...
   int computeStartPos(int splitPos) {

     int phraseLength = mPhrase.length();

     int startPos = splitPos - phraseLength;

     if (startPos < 0 || phraseLength > splitPos)
       return -1;
     else
       return startPos;
}
```

Fail if phrase is too long for this input segment

Analysis of the PhraseMatchSpliterator trySplit() Method

"... Therefore, since brevity is the soul of" "wit, And tediousness the limbs and outward..."


```
class PhraseMatchSpliterator implements Spliterator<Result> {
   ...
   int computeStartPos(int splitPos) {

     int phraseLength = mPhrase.length();

     int startPos = splitPos - phraseLength;

     if (startPos < 0 || phraseLength > splitPos)
       return -1;
     else
       return startPos;
}
```

Return the computed start position

Analysis of the PhraseMatchSpliterator trySplit() Method

"… Therefore, since brevity is the soul of wit" ", And tediousness the limbs and outward…"


```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  Spliterator<Result> trySplit() {
    if (mInput.length() <= mMinSplitSize) return null;
    int startPos,
        splitPos = mInput.length() / 2;

    if ((startPos = computeStartPos(splitPos)) < 0) return null;

    if ((splitPos = tryToUpdateSplitPos(startPos, splitPos)) < 0)
      return null;

    return splitInput(splitPos); ...
```

Update splitPos if phrase spans the initial splitPos

Analysis of the PhraseMatchSpliterator trySplit() Method

"... Therefore, since brevity is the soul of" "wit, And tediousness the limbs and outward..."


```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  int tryToUpdateSplitPos(int startPos, int splitPos) {
    int endPos =
      splitPos + mPattern.toString().length();
    if (endPos >= mInput.length()) return -1;
    CharSequence substr =
      mInput.subSequence(startPos, endPos);
    Matcher pm = mPattern.matcher(substr);
    if (pm.find()) splitPos = startPos
      + pm.start() + pm.group().length();
    return splitPos;
  }
```

Don't split a string across a phrase

Analysis of the PhraseMatchSpliterator trySplit() Method

"... Therefore, since brevity is the soul of" "wit, And tediousness the limbs and outward..."


```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  int tryToUpdateSplitPos(int startPos, int splitPos) {
    int endPos =
      splitPos + mPattern.toString().length();
    if (endPos >= mInput.length()) return -1;
    CharSequence substr =
      mInput.subSequence(startPos, endPos);
    Matcher pm = mPattern.matcher(substr);
    if (pm.find()) splitPos = startPos
      + pm.start() + pm.group().length();
    return splitPos;
  }
```

Set endPos to the very end of the input that could match the pattern

Analysis of the PhraseMatchSpliterator trySplit() Method

"... Therefore, since brevity is the soul of" "wit, And tediousness the limbs and outward..."


```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  int tryToUpdateSplitPos(int startPos, int splitPos) {
    int endPos =
      splitPos + mPattern.toString().length();
    if (endPos >= mInput.length()) return -1;
    CharSequence substr =
      mInput.subSequence(startPos, endPos);
    Matcher pm = mPattern.matcher(substr);
    if (pm.find()) splitPos = startPos
      + pm.start() + pm.group().length();
    return splitPos;
  }
```

Ensure phrase isn't longer than the input string!

Analysis of the PhraseMatchSpliterator trySplit() Method

"... Therefore, since brevity is the soul of" "wit, And tediousness the limbs and outward..."


```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  int tryToUpdateSplitPos(int startPos, int splitPos) {
    int endPos =
      splitPos + mPattern.toString().length();
    if (endPos >= mInput.length()) return -1;
    CharSequence substr =
      mInput.subSequence(startPos, endPos);
    Matcher pm = mPattern.matcher(substr);
    if (pm.find()) splitPos = startPos
      + pm.start() + pm.group().length();
    return splitPos;
  }
```

"brevity is the soul of wit"

Check to see if the phrase matches within the substring that span the initial splitPos

Analysis of the PhraseMatchSpliterator trySplit() Method

"… Therefore, since brevity is the soul of wit" ", And tediousness the limbs and outward…"


```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  int tryToUpdateSplitPos(int startPos, int splitPos) {
    int endPos =
      splitPos + mPattern.toString().length();
    if (endPos >= mInput.length()) return -1;
    CharSequence substr =
      mInput.subSequence(startPos, endPos);
    Matcher pm = mPattern.matcher(substr);
    if (pm.find()) splitPos = startPos
      + pm.start() + pm.group().length();
    return splitPos;
  }
```

If there's a match update the splitPos to handle phrase spanning newlines

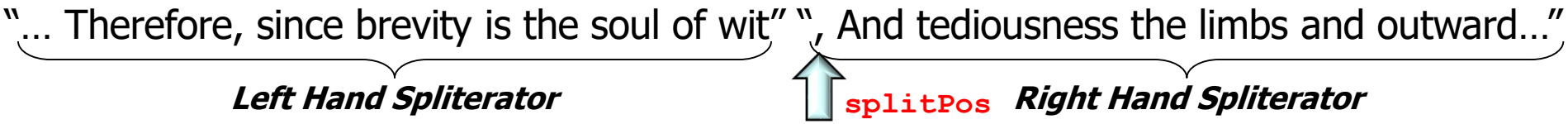
Analysis of the PhraseMatchSpliterator trySplit() Method

"… Therefore, since brevity is the soul of wit" ", And tediousness the limbs and outward…"


```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  int tryToUpdateSplitPos(int startPos, int splitPos) {
    int endPos =
      splitPos + mPattern.toString().length();
    if (endPos >= mInput.length()) return -1;
    CharSequence substr =
      mInput.subSequence(startPos, endPos);
    Matcher pm = mPattern.matcher(substr);
    if (pm.find()) splitPos = startPos
      + pm.start() + pm.group().length();
    return splitPos;
  }
```

Return the final splitPos

Analysis of the PhraseMatchSpliterator trySplit() Method




```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  Spliterator<Result> trySplit() {
    if (mInput.length() <= mMinSplitSize) return null;
    int startPos,
        splitPos = mInput.length() / 2;

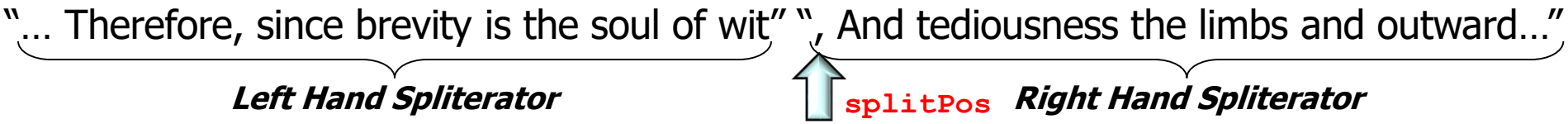
    if ((startPos = computeStartPos(splitPos)) < 0) return null;

    if ((splitPos = tryToUpdateSplitPos(startPos, splitPos)) < 0)
      return null;

    return splitInput(splitPos); ...
```

Create & return a new spliterator

Analysis of the PhraseMatchSpliterator trySplit() Method

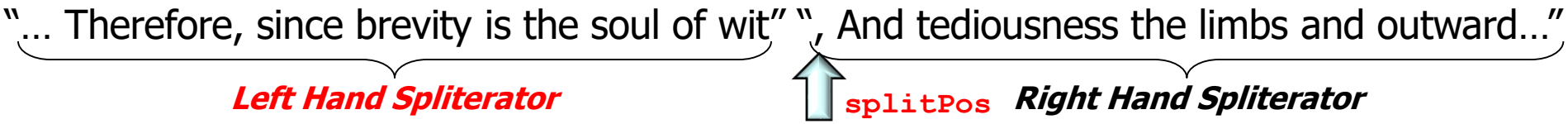



```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  Spliterator<Result> splitInput(int splitPos) {
    CharSequence lhs =
      mInput.subSequence(0, splitPos);
    mInput = mInput.subSequence(splitPos,
                                mInput.length());
    mPhraseMatcher = mPattern.matcher(mInput);
    mOffset = splitPos;
    ...


    return new PhraseMatchSpliterator(lhs, ...); ...
```

Create & return a new spliterator

Analysis of the PhraseMatchSpliterator trySplit() Method

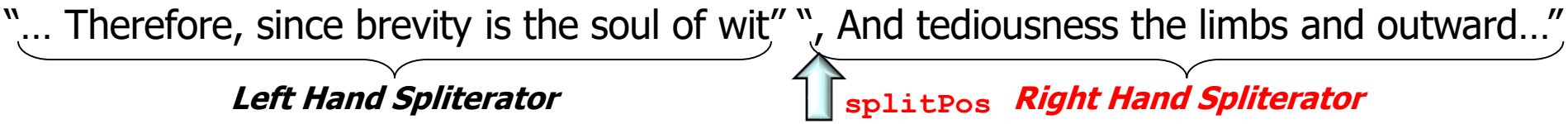



```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  Spliterator<Result> splitInput(int splitPos) {
    CharSequence lhs =
      mInput.subSequence(0, splitPos);
    mInput = mInput.subSequence(splitPos,
                                mInput.length());
    mPhraseMatcher = mPattern.matcher(mInput);
    mOffset = splitPos;
    ...
```

Create a sub-sequence for the left-hand spliterator

```
    return new PhraseMatchSpliterator(lhs, ...); ...
```

Analysis of the PhraseMatchSpliterator trySplit() Method

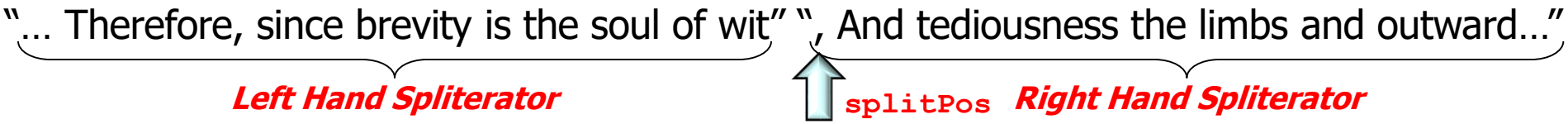



```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  Spliterator<Result> splitInput(int splitPos) {
    CharSequence lhs =
      mInput.subSequence(0, splitPos);
    mInput = mInput.subSequence(splitPos,
                                mInput.length());
    mPhraseMatcher = mPattern.matcher(mInput);
    mOffset = splitPos;
    ...

    return new PhraseMatchSpliterator(lhs, ...); ...
```

Update "this" to reflect changes to "right hand" portion of input

Analysis of the PhraseMatchSpliterator trySplit() Method



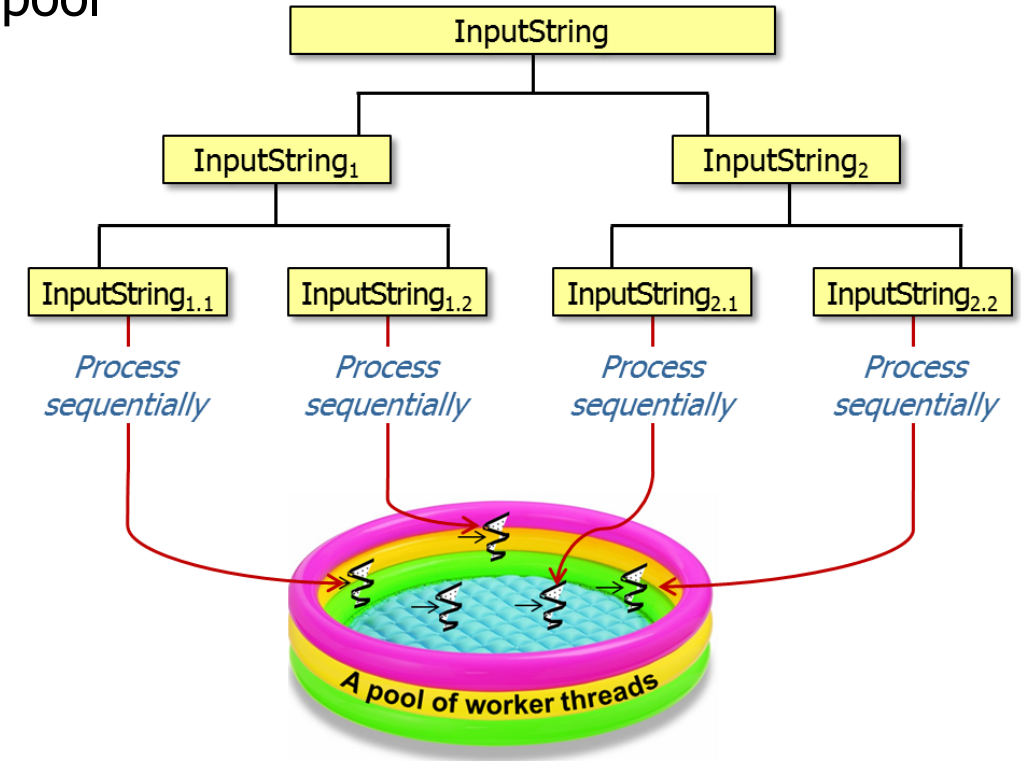

```
class PhraseMatchSpliterator implements Spliterator<Result> {
  ...
  Spliterator<Result> splitInput(int splitPos) {
    CharSequence lhs =
      mInput.subSequence(0, splitPos);
    mInput = mInput.subSequence(splitPos,
                                mInput.length());
    mPhraseMatcher = mPattern.matcher(mInput);
    mOffset = splitPos;
    ...

    return new PhraseMatchSpliterator(lhs, ...); ...
```

This spliterator handles "left hand" portion of input, while "this" object handles "right hand" portion

Analysis of the PhraseMatchSpliterator trySplit() Method

- Java streams framework processes all spliterator chunks for each input string in parallel in the common fork-join pool



This parallelism is in addition to parallelism of input string & phrase chunks!!

End of Java SearchWith ParallelSpliterator Example: trySplit()