String Formatting and Regular Expressions

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Overview

- Moving beyond string concatenation
- StringJoiner class
- Creating strings with format specifiers
- Writing formatted content to a stream
- Regular expressions
- String class support for regular expressions
- Regular expression classes

More Powerful Solutions to Creating String Representations

The need for more powerful string creation

- Concatenating strings is often not enough
  - Very focused on creation details
  - Numeric conversions awkward
- StringBuilder has the same issues

Options for more powerful string creation

- StringJoiner
  - Simplifies joining a sequence of values
- String formatting
  - Can specify desired appearance without dealing with creation details

StringJoiner

StringJoiner has a specific purpose

- Simplify composing a string comprised of a sequence of values

How it works

- Construct the StringJoiner
  - Specify string to separate values
  - Optionally specify start/end strings
- Add values
- Retrieve the resulting string

StringJoiner with Separator

```
StringJoiner sj = new StringJoiner(", ");
sj.add("alpha");
sj.add("theta");
sj.add("gamma");
String theResult = sj.toString();
```

```
alpha, theta, gamma
```

StringJoiner Chaining Method Calls

```
StringJoiner sj = new StringJoiner(", ");
sj.add("alpha")
String theResult = sj.toString();
```

```
alpha, theta, gamma
```

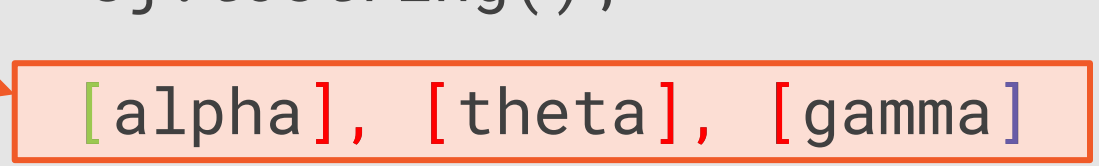
StringJoiner with Start and End Values

```
StringJoiner sj = new StringJoiner(", "                );
sj.add("alpha");
sj.add("theta");
sj.add("gamma");
String theResult = sj.toString();
```

```
{alpha, theta, gamma}
```

StringJoiner with More Involved Separator

```
StringJoiner sj = new StringJoiner("], [" );
sj.add("alpha");
sj.add("theta");
sj.add("gamma");
String theResult = sj.toString();
```



StringJoiner Edge Case Handling

toString when only one value added

- When constructed with separator only
  - Returns the added value
- When constructed with start/end strings
  - Returns added value within start/end

Handling a Single Value

```
StringJoiner sj1 = new StringJoiner(", ");
sj1.add("alpha");
String theResult1 = sj1.toString();
```

alpha

```
StringJoiner sj2 = new StringJoiner(", ", "{", "}");
sj2.add("alpha");
String theResult2 = sj2.toString();
```

{alpha}

StringJoiner Edge Case Handling

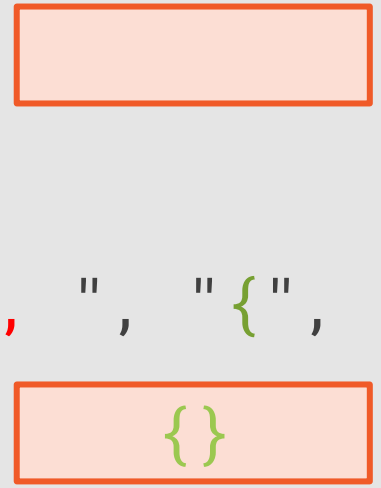
toString when no values added

- When constructed with separator only
  - Returns empty string
- When constructed with start/end strings
  - Returns string with start/end only

Handling No Added Values

```
StringJoiner sj1 = new StringJoiner(", ");
String theResult1 = sj1.toString();
```

```
StringJoiner sj2 = new StringJoiner(", ", "{", "}");
String theResult2 = sj2.toString();
```



Can Customize Empty Handling

Can specify a special string for empty case

- Specified with setEmptyValue method
- Used only when add method not called

Customizing Empty Handling

```
StringJoiner sj1 = new StringJoiner(", ");
sj1.setEmptyValue("EMPTY");
String theResult1 = sj1.toString();
```

EMPTY

```
StringJoiner sj2 = new StringJoiner(", ", "{", "}");
sj2. setEmptyValue("EMPTY");
String theResult2 = sj2.toString();
```

EMPTY

Custom Empty Handling

```
StringJoiner sj1 = new StringJoiner(", ");
sj1.setEmptyValue("EMPTY");
sj1.add("");
String theResult1 = sj1.toString();
```

```
StringJoiner sj2 = new StringJoiner(", ", "{", "}");
sj2. setEmptyValue("EMPTY");
sj2.add("");
String theResult2 = sj2.toString();
```

Constructing Strings with Format Specifiers

Format specifiers

- Focus is on describing the desired result
  - Not concerned with the how
- Can control many aspects of appearance
  - Positioning
  - Decimal places
  - Representation

Some methods supporting format specifiers

- String.format
- System.out.printf
- Formatter.format

Concatenation vs. Formatting

```
int david = 13, dawson = 11, dillon = 4, gordon = 2;
```

```
My nephews are 13, 11, 4, and 2 years old
```

```
String s1 =
  "My nephews are " + david + ", " + dawson
  + ", " + dillon + ", and " + gordon + " years old";


String s2 = String.format(
  "My nephews are %d, %d, %d, and %d years old",
  david, dawson, dillon, gordon);
```

Concatenation vs. Formatting

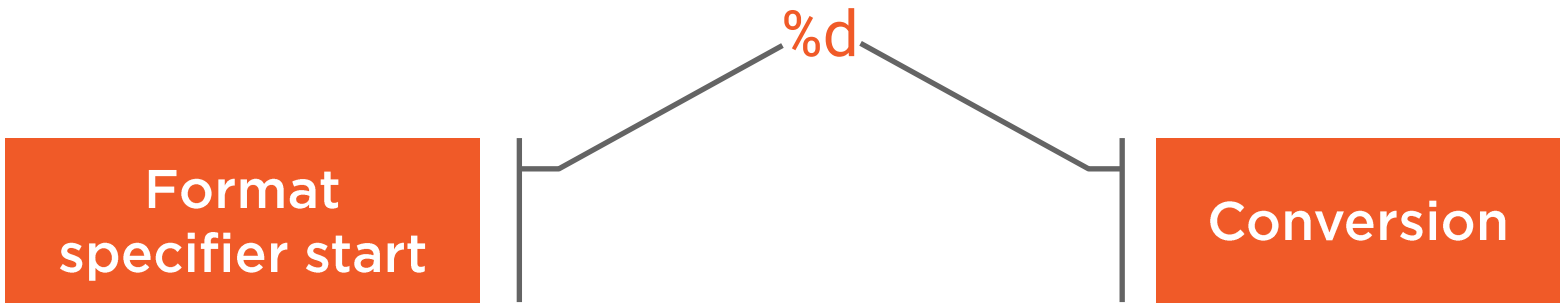
```
int david = 13, dawson = 11, dillon = 4, gordon = 2;

double avgDiff = ((david - dawson) +
  (dawson - dillon) + (dillon - gordon)) / 3.0d;


String s3 =
  "The average age between each is "
```

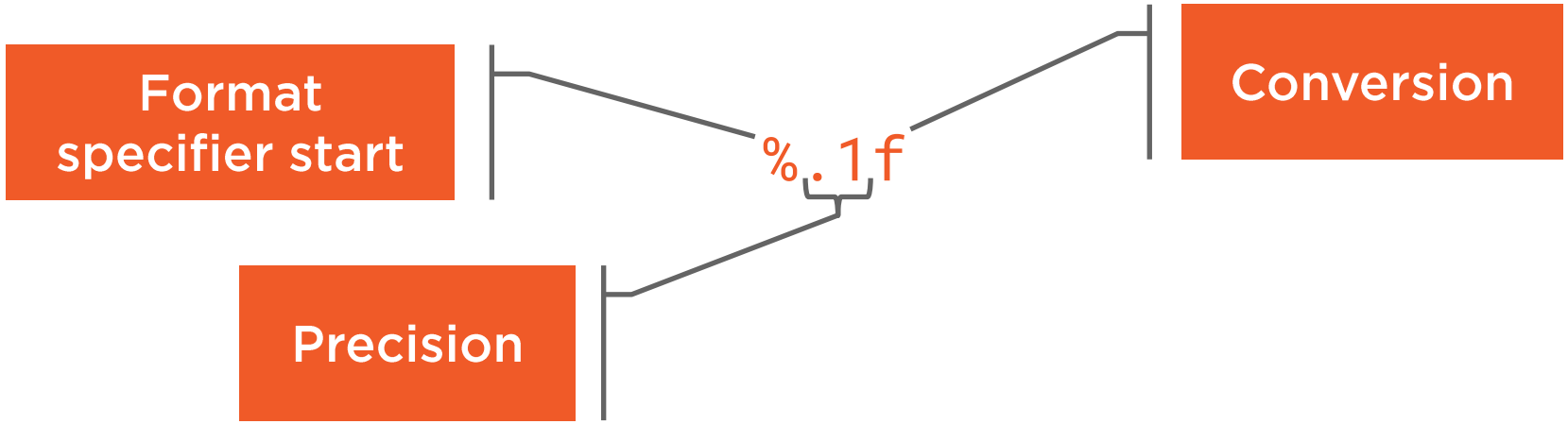
```
The average age between each is 3.6666666666666665 years
```

```
String s4 = String.format(
  "The average age between each is %.1f years"
```

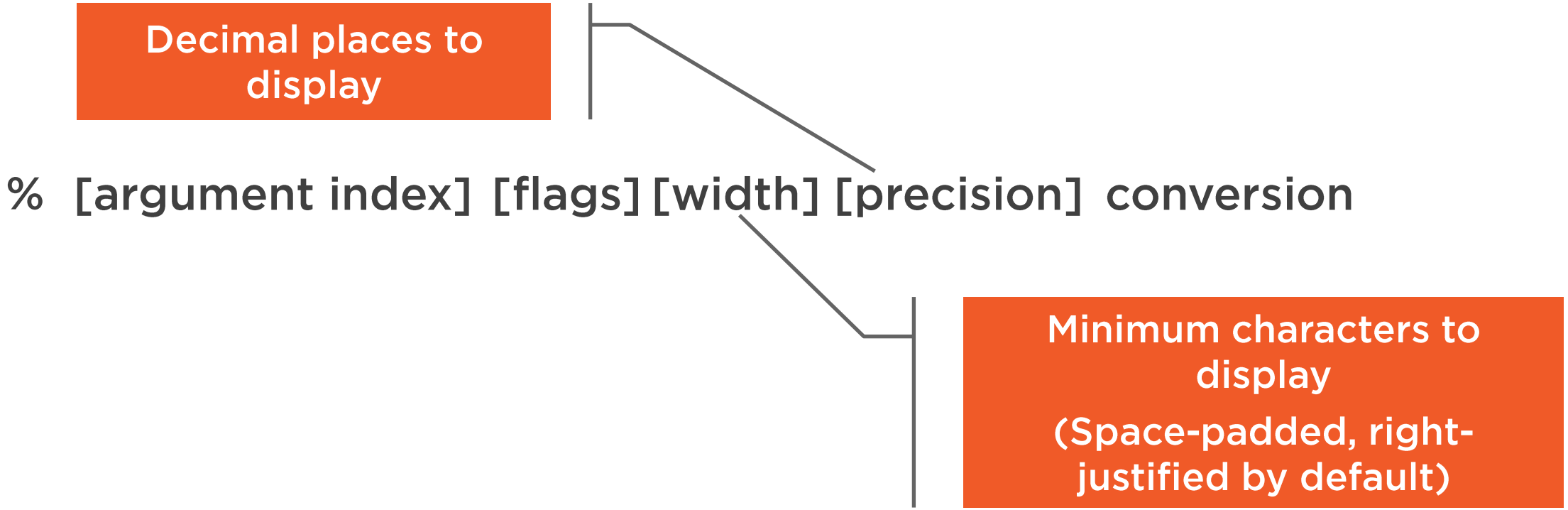
```
The average age between each is 3.7 years
```

Format Specifiers





Parts of a Format Specifier



Common Format Conversions

	Meaning	Type	Example Value	Result
d	Decimal	Integral	32	32
o	Octal	Integral	32	40
x X	Hex	Integral	32	20
f	Decimal	Floating Point	123.0	123.000000
e E	Scientific Notation	Floating Point	123.0	1.230000e+02
s	String	General	“Hello”	Hello
			Implements Formattable	*Return value of format method*
			Other classes	*Return value of toString method*

Format Flags

Flag	Meaning
#	Include radix

Format Flag:

```
String s1 = String.format("%d", 32);
```
32

```
String s2 = String.format("%o", 32);
```
40

```
String s3 = String.format("%x", 32);
```
20

```
String s4 = String.format("%#o", 32);
```
040

```
String s5 = String.format("%#x", 32);
```
0x20

```
String s6 = String.format("%#X", 32);
```
0X20

Format Flags

Flag	Meaning
#	Include radix
0	Zero-padding
-	Left justify

Format Flags: 0 and -

```
s1 = String.format("W:%d X:%d", 5, 235);
s2 = String.format("Y:%d Z:%d", 481, 12);
```

```
W:5 X:235
Y:481 Z:12
```

```
s3 = String.format("W:%4d X:%4d", 5, 235);
s4 = String.format("Y:%4d Z:%4d", 481, 12);
```

```
W:   5 X: 235
Y: 481 Z:  12
```

```
s5 = String.format("W:%04d X:%04d", 5, 235);
s6 = String.format("Y:%04d Z:%04d", 481, 12);
```

```
W:0005 X:0235
Y:0481 Z:0012
```

```
s7 = String.format("W:%-4d X:%-4d", 5, 235);
s8 = String.format("Y:%-4d Z:%-4d", 481, 12);
```

```
W:5    X:235
Y:481  Z:12
```

Format Flags

Flag	Meaning
#	Include radix
0	Zero-padding
-	Left justify
,	Include grouping separator

Format Flag: ,

```
s1 = String.format("%d", 1234567);
```

```
1234567
```

```
s2 = String.format("%,d", 1234567);
```

```
1,234,567
```

```
s3 = String.format("%,.2f", 1234567.0);
```

```
1,234,567.00
```

Format Flags

Flag	Meaning
#	Include radix
0	Zero-padding
-	Left justify
,	Include grouping separator
space	Leave space for positive numbers
+	Always shown sign
(	Enclose negative values in parenthesis

Format Flags: Space, +, and (

```
s1 = String.format("%d", 123);
s2 = String.format("%d", -456);

s3 = String.format("% d", 123);
s4 = String.format("% d", -456);

s5 = String.format("%+d", 123);
s6 = String.format("%+d", -456);

s7 = String.format("%(d", 123);
s8 = String.format("%(d", -456);
s9 = String.format("% (d", 123);
```

```
123
-456

 123
-456

+123
-456

123
(456)
 123
```

Argument Index

Index	Meaning
Not specified	Corresponds sequentially to argument
$*index*	Index of argument to use
<	Corresponds to same argument as previous format specifier

Argument Index

```
s1 = String.format("%d %d %d", 100, 200, 300);
```

```
100 200 300
```

```
s2 = String.format("%$3d %$1d %$2d", 100, 200, 300);
```

```
300 100 200
```

```
s3 = String.format("%$2d %<04d %$1d", 100, 200, 300);
```

```
200 0200 100
```

Writing Formatted Content to a Stream

Formatter class

- Provides formatting capabilities
- Writes content to any type that implements Appendable interface

Writer stream class

- Implements Appendable interface

Writing Formatted Content to a Stream

```
void doWrite(int david, int dawson, int dillon,
             int gordon, double avgDiff) throws IOException {

  BufferedWriter writer =
      Files.newBufferedWriter(Paths.get("myFile.txt"));

  try(Formatter f = new Formatter(writer)) {

    f.format("My nephews are %d, %d, %d, and %d years old",
             david, dawson, dillon, gordon);

    f.format("The average age between each is %.1f years",
             avgDiff);
  }
}
```

For More on Formatting

Java Formatter documentation

- Detailed format specifier information
  - http://bit.ly/java8formatter

Java 8 date/time formatting

- Pluralsight What's New in Java 8
  - http://bit.ly/psjava8whatsnew

String Matching with Regular Expressions

Regular expressions

- A powerful pattern matching syntax
- Finds/excludes groups of characters
  - `a` –match the letter a
  - `xyz` –match the sequence xyz
  - `\w+` –match 1+ word characters (letter, digit, underscore)
  - `\b` –match word breaks

Java support for regular expressions

- Methods on the String class
- Dedicated classes

String Class Support for Regular Expressions

replaceFirst, replaceAll methods

- Returns a new updated strings
- Pattern identifies which parts to change

split method

- Splits string into an array
- Pattern is the separator between values

match method

- Identifies if string matches the pattern

Using the replaceAll Method

```
String s1 = "apple, apple and orange please";

String s2 = s1.replaceAll("ple", "ricot");
```

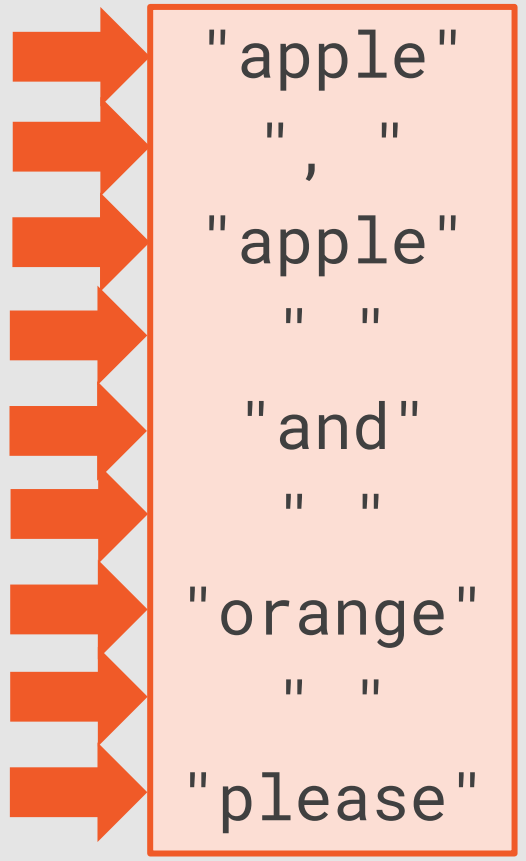
apricot, apricot and orange ricotase

```
String s3 = s1.replaceAll("ple\\b", "ricot");
```

apricot, apricot and orange please

Using the split and match Methods

```
String s1 = "apple, apple and orange please";

String[] parts = s1.split("\\b");


for(String thePart:parts)
    if(thePart.matches("\\w+"))
        System.out.println(thePart);
```




```
apple
apple
and
orange
please
```

Dedicated Regular Expression Classes

Regular expression considerations

- Compilation is processing intensive
- String methods repeat compilation on every use

Pattern class

- Compiles a regular expression
- Factory for Matcher class instances

Matcher class

- Applies compiled expression to a string

Using Pattern and Matcher Classes

```
String value1 = "apple, apple and orange please";

Pattern pattern = Pattern.compile("\\w+");

Matcher matcher = pattern.matcher(value1);

while(matcher.find())
    System.out.println(matcher.group());
```

```
apple
apple
and
orange
please
```

For More on Working with Regular Expression Syntax

Java Pattern class documentation

- Overview of regular expression syntax
  - http://bit.ly/java8pattern

Java tutorial on regular expressions

- http://bit.ly/javaregextutorial

Interactive regular expression console

- https://regex101.com/
- Includes syntax quick reference

Summary

StringJoiner class

- Simplifies combining sequence of values
- Construct with value separator
  - Optionally specify start/end strings
- Add the values and retrieve string
- Can specify special value for empty
  - Empty means no values added

Summary

Format specifiers

- Focus on describing the desired result
- Parts of a specifier
  - % (required)
  - Conversion (required)
  - Precision
  - Flags
  - Argument index

String class supports format specifiers

Formatter class

- Writes formatted content to any class that implements Appendable interface

Summary

Regular expressions

- Powerful pattern matching syntax

String class support

- replaceFirst/All: Create new string
- split: Split string into an array
- match: Check for matching value

Dedicated classes

- Pattern
  - Compiles regular expression
- Matcher
  - Applies pattern to a string