Refactoring Lab:
To Java 17 and beyond

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KCDC

speakerdeck.com/boyarsky

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Jeanne Boyarsky

Java 17 Cert Book Author

Jeanne Boyarsky is a Java Champion from New York City and has been a Java developer for more than 20 years. She has co-authored Wiley's Oracle Java 8/11/17 certification books. Jeanne also serves as her team's Scrum Master. She volunteers at CodeRanch and mentors the programmers on a high school robotics team in her free time. Jeanne has spoken at numerous conferences including Dev Nexus, KCDC, QCon, and Oracle Code One.

- **Refactoring Lab: To Java 17 and beyond**
- **Refactoring to Java 17 and beyond**

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Pause for a Commercial

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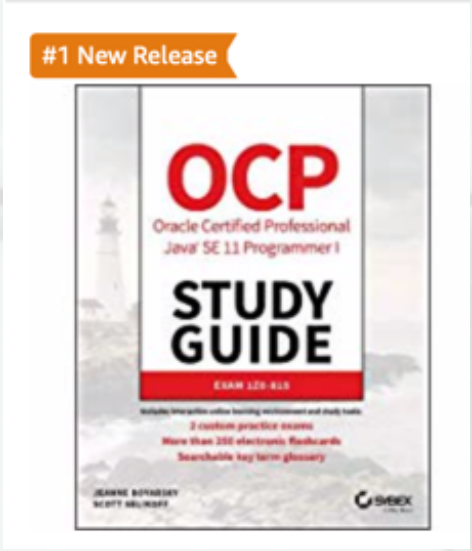
Another Commercial



Java certs: 8/11/17

Book giveaway at end!

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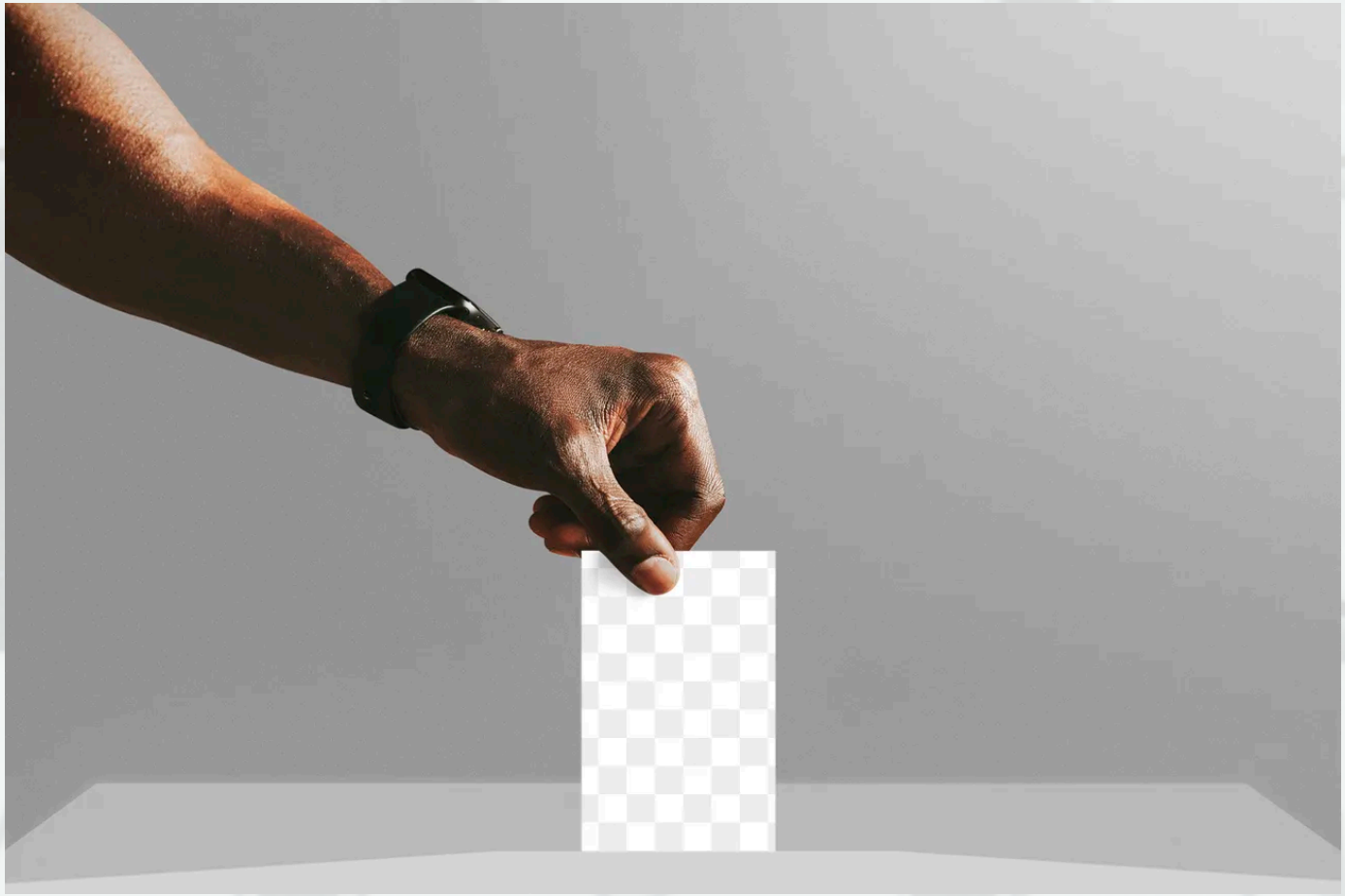
Materials

https://github.com/boyarsky/2022-kcdc-java-refactoring

Disclaimer

- A bit of the material is from my books.

Version of Java?



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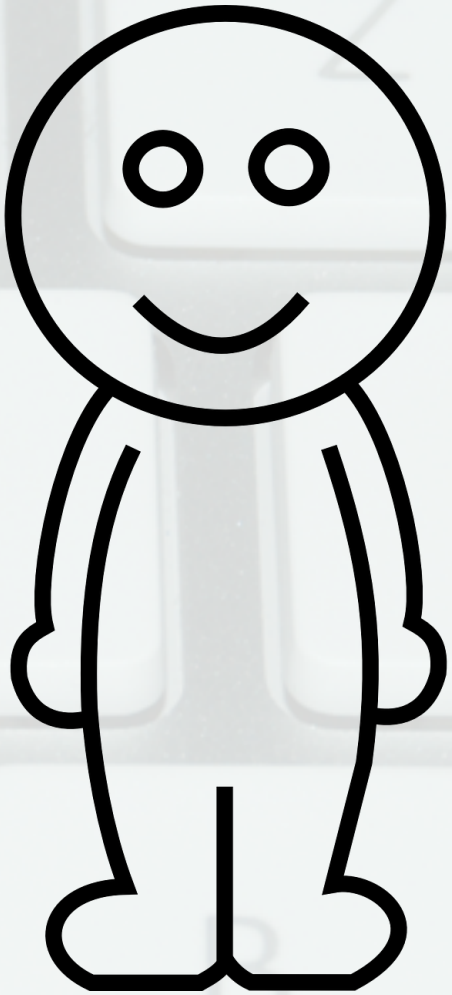
Introductions



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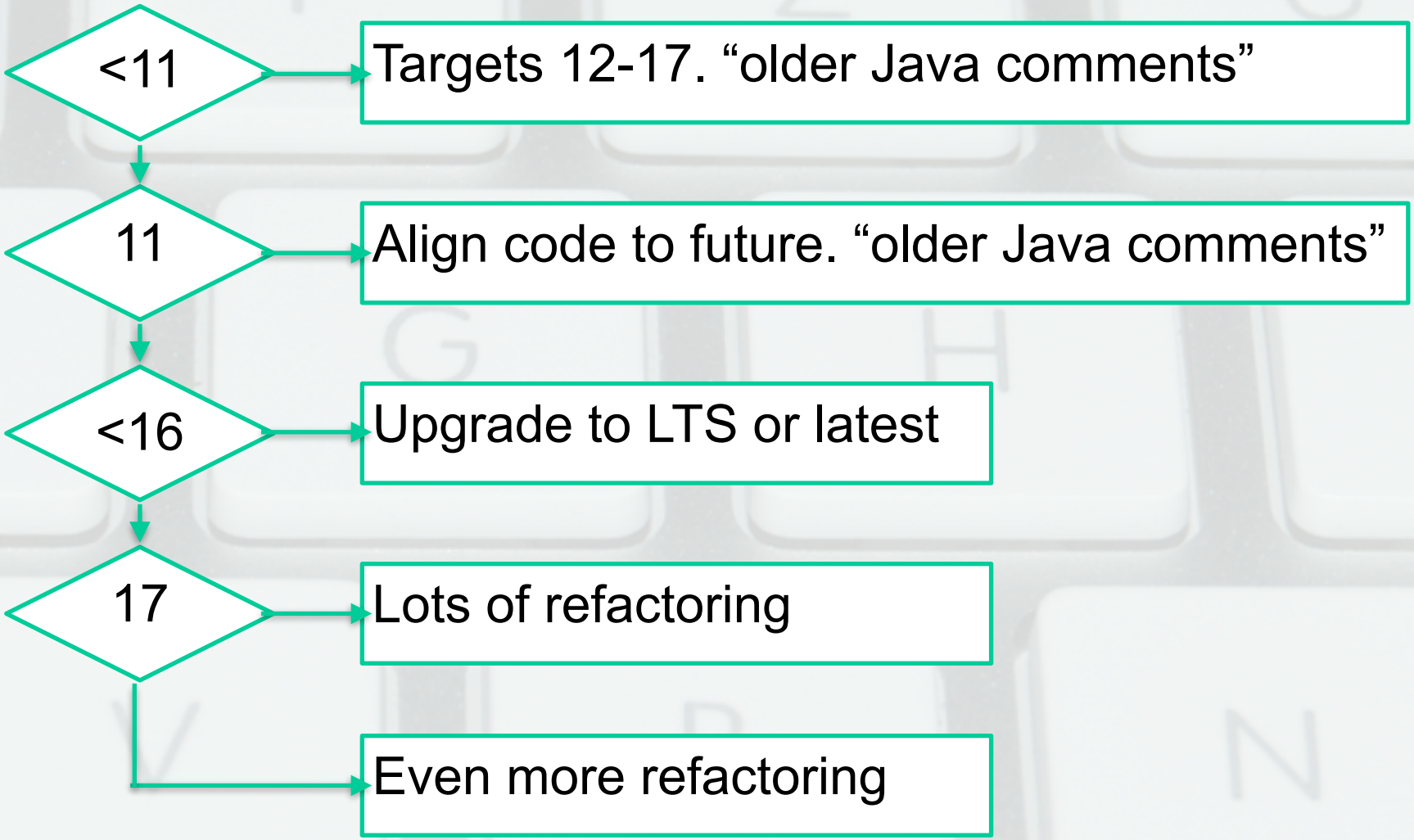
Version of Java?



Refactoring

- We are writing legacy code now!
- Refactor for future compatibility

Agenda

Module	Topics
1	Text blocks and Strings
2	Records and Sealed classes
3	Instanceof and Switch Expressions
4	API changes

Module Flow

- Review lab from previous module
- Lecture
- Review questions
- Hands on exercises
- 10 minute break

This means if a colleague needs to call you, the last 15-20 minutes of each hour is best.

Required Software for Lab

Option 1

- Java 17+ - http://jdk.java.net/17/
- IDE of your choice

Option 2

https://www.jdoodle.com/online-java-compiler/

Text blocks and Strings

Example: REST API Params

```
public String getJson(String search) {
    String json = "{" +
            "    \"query\": \"%s\"" +
            "    \"start\": \"1\"," +
            "    \"end\": \"10\"" +
            "}";
    return String.format(json, search);
}
```

This is hard to read

Take Two

```
public String getJson(String search) {
    Path path = Path.of(
       "src/main/resources/query.json");
    String json = null;
    try {
        json = Files.readString(path);
    } catch (IOException e) {
        throw new UncheckedIOException(e);
    }
    return String.format(json, search);
}
```

Now the String is far away

Text Block

15

```
public String getJson(String search) {
    String json = """
                  {
                  "query": "%s"
                  "start": "1"
                  "end": "10"
                  }""";
    return String.format(json, search);
}
```

It's a string literal!

Adds line breaks, but still works

Text Block Syntax


```
String textBlock = """
    kcdc,Kansas City,"session,workshop"
    meetup,Various,lecture
    """;
```

start block

incidental whitespace

end block

Essential Whitespace

15

```
String textBlock = """
        <session>
            <speaker>
                Jeanne Boyarsky
            </speaker>
        </session>
        """;
```

incidental whitespace

essential whitespace

Ending lines

15

```
String textBlock = """
        <session>
            <speaker>
                Jeanne Boyarsky     \s
            </speaker>
            <title>
                Becoming one of the first Java 17 \
                certified programmers \
                (and learning new features)
            </title>
        </session>
        """;
```

new escape character
keeps trailing whitespace

tab

continue on next line
without a line break

New lines


```
String textBlock = """
        <session>\n
            <speaker>
                Jeanne\nBoyarsky
            </speaker>
        </session>""";
```

Two new lines
(explicit and implicit)

One new line (explicit)

no line break at end

Escaping Three Quotes

15

```
String textBlock = """
        better \"""
        but can do \"\"\"
        """;
```

Indent

12

```
String option1 = "    a\n    b\n    c\n";
String option2 = "a\nb\nc\n".indent(3);
String option3 = """
         a
         b
         c
         """.indent(3);
String option4 = """
             a
             b
             c
         """;
```

Which do you like best?

Also normalizes (bye \r)

Transform

12

```
String option1 = “chiefs".transform(
    s -> s.toUpperCase());

String option2 = """
         chiefs
         """.transform(s -> s.toUpperCase());
```

Which do you like best?

Strip Indent

15

Method	From beginning	From end	Per line
strip()	Leading	Trailing	No
stripIndent()	Incidental	Incidental	Yes
stripLeading()	Leading	n/a	No
stripTrailing()	n/a	Trailing	No

Opportunities

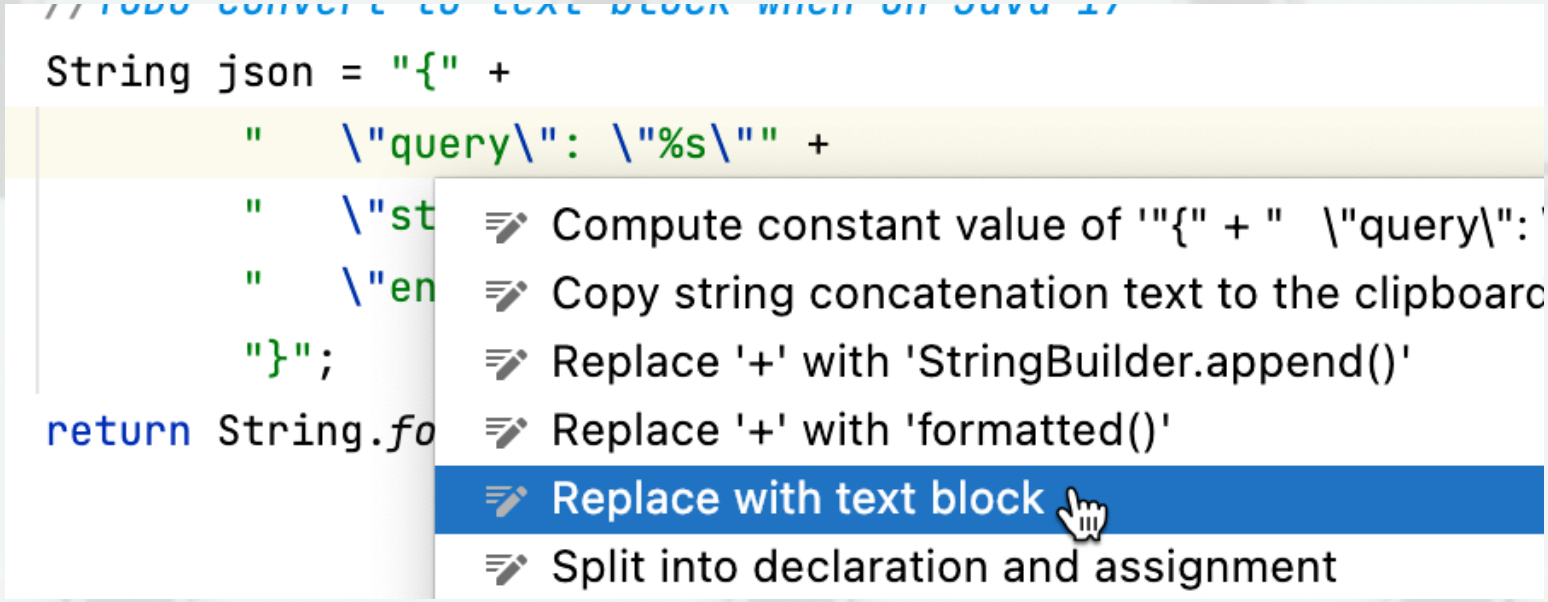
15

- Externalized data
- Expected values in JUnit

- Formats - CSV, GraphQL, JSON, SQL, Text, XML, YAML, etc

- Others?

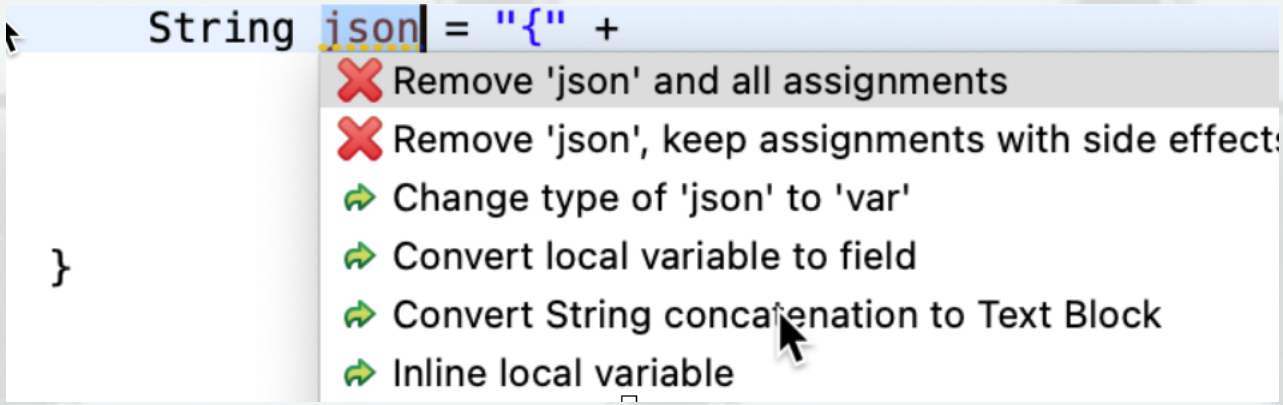
IDE Support




```
String json = """
        {   "query": "%s"   "start": "1",   "end": "10"}""";
```

Literal refactoring - no \n

IDE Support




```
String json = """
        {\
            "query": "%s"\
            "start": "1",\
            "end": "10"\
        }""";
```

Preserve lines but still no \n

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On older Java?

```
public String getJson(String search) {
    //TODO convert to text block when on Java 17
    String json = "{" +
            "    \"query\": \"%s\"" +
            "    \"start\": \"1\"," +
            "    \"end\": \"10\"" +
            "}";
    return String.format(json, search);
}
```

Hard to read but positions for future

Module 1 - Question 1

Which is true about this text block?

```
String sql = """
             select *
             from mytable
             where weather = 'snow';
             """;
```

A. Has incidental whitespace

B. Has essential whitespace

C. Both A and B

D. Does not compile

Module 1 - Question 1

Which is true about this text block?

```
String sql = """
        select *
        from mytable
        where weather = 'snow';
        """;
```

A

A. Has incidental whitespace

B. Has essential whitespace

C. Both A and B

D. Does not compile

Module 1 - Question 2

Which is true about this text block?

```
String sql = """select *
        from mytable \
        where weather = 'snow';
        """;
```

A. Has incidental whitespace

B. Has essential whitespace

C. Both A and B

D. Does not compile

Module 1 - Question 2

Which is true about this text block?

```
String sql = """select *
        from mytable \
        where weather = 'snow';
        """;
```

A. Has incidental whitespace

B. Has essential whitespace

C. Both A and B

D. Does not compile

D

(no line break after opening quotes)

Module 1 - Question 3

Which is true about this text block?

```
    String sql = """
                 select *     \s
                 from mytable      \s
                 where weather = 'snow';
""";
```

A. Has incidental whitespace

B. Has essential whitespace

C. Both A and B

D. Does not compile

Module 1 - Question 3

Which is true about this text block?

```
String sql = """
             select *     \s
             from mytable      \s
             where weather = 'snow';
""";
```

B

A. Has incidental whitespace

B. Has essential whitespace

C. Both A and B

D. Does not compile

Module 1 - Question 4

Which is true about this text block?

```
String sql = """select * from mytable;""";
```

A. Has incidental whitespace

B. Has essential whitespace

C. Both A and B

D. Does not compile

Module 1 - Question 4

Which is true about this text block?

```
String sql = """select * from mytable;""";
```

A. Has incidental whitespace

B. Has essential whitespace

C. Both A and B

D. Does not compile

D

(one line)

Module 1 - Question 5

How many lines does this print out?

```
String sql = """
             select * \n
             from mytable;
             """;
System.out.print(sql);
```

A. 2

B. 3

C. 4

D. Does not compile

Module 1 - Question 5

How many lines does this print out?

```
String sql = """
        select * \n
        from mytable;
        """;
System.out.print(sql);
```

C

A. 2

B. 3

C. 4

D. Does not compile

Module 1 - Question 6

How many lines does this print out?

```
String sql = """
        select * \
        from mytable;""".stripIndent();
System.out.print(sql);
```

A. 1

B. 2

C. 3

D. Does not compile

Module 1 - Question 6

How many lines does this print out?

```
String sql = """
        select * \
        from mytable;""".stripIndent();
System.out.print(sql);
```

A. 1

B. 2

C. 3

D. Does not compile

A

Module 1 - Question 7

How many lines does this print out?

```
String sql = """
             select *     \s
             from mytable;
         ".stripIndent();
System.out.print(sql);
```

A. 1

B. 2

C. 3

D. Does not compile

Module 1 - Question 7

How many lines does this print out?

```
String sql = """
        select *     \s
        from mytable;
   ".stripIndent();
System.out.print(sql);
```

A. 1

B. 2

C. 3

D. Does not compile

D

(only one closing quote, not three)

Module 1 - Question 8

How many whitespace characters are removed by strip()?

```
String sql = """
             select "name"
             from mytable;
           """;
```

A. 1

B. 2

C. 3

D. Does not compile

Module 1 - Question 8

How many whitespace characters are removed by strip()?

```
String sql = """
             select "name"
             from mytable;
         """;
```

A. 1

B. 2

C. 3

D. Does not compile

C

(two leading whitespace + new line at end)

Module 1 - Question 9

How many whitespace characters are removed by stripIndent()?

```
String sql = """
             select "name"
             from mytable;
           """;
```

A. 0

B. 1

C. 2

D. 3

Module 1 - Question 9

How many whitespace characters are removed by stripIndent()?

```
String sql = """
             select "name"
             from mytable;
         """;
```

A. 0

B. 1

C. 2

D. 3

A

(strip indent only gets rid of incidental whitespace, which text block already takes care of)

Module 1 - Question 10

How many escapes can be removed without changing the behavior?

```
String sql = """
             select \"name\"
             from mytable \
             where value = '\"\"'
           """;
```

A. 2

B. 3

C. 4

D. Does not compile

Module 1 - Question 10

How many escapes can be removed without changing the behavior?

```
String sql = """
             select \"name\"
             from mytable \
             where value = \"\""'
           """;
```

A. 2

B. 3

C. 4

D. Does not compile

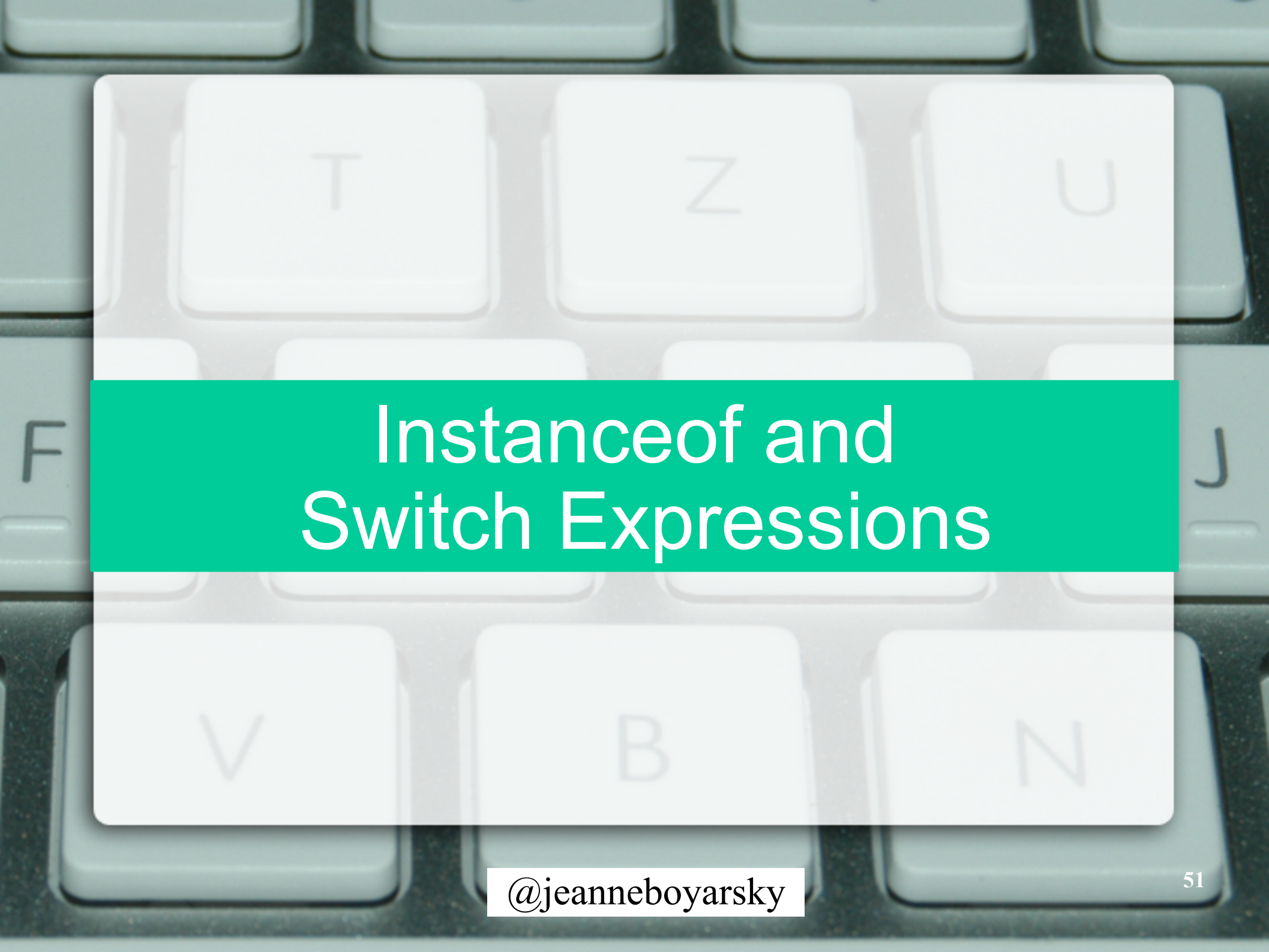
B

(two around "name" and the second on value)

Lab & Break

https://github.com/boyarsky/2022-kcdc-java-refactoring

Note: If using JDoodle, comment out code that reads from file



Instanceof and Switch Expressions

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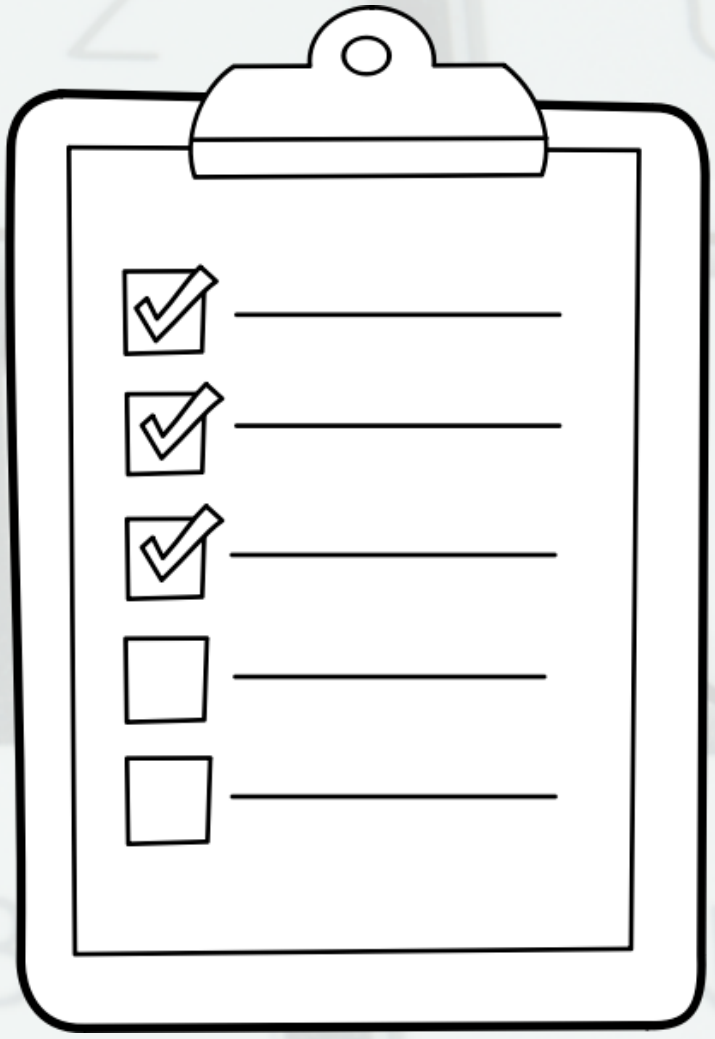
Lab Review

- Any questions?



Casting

```
if (num instanceof Integer) {
    Integer numAsInt = (Integer) num;
    System.out.println(numAsInt);
}
if (num instanceof Double) {
    Double numAsDouble = (Double) num;
    System.out.println(numAsDouble.intValue());
}
```

Casting

16

```
if (num instanceof Integer numAsInt) {
    System.out.println(numAsInt);
}
if (num instanceof Double numAsDouble) {
    System.out.println(numAsDouble.intValue());
}
```

Pattern variable

Flow Scope

16

```
if (num instanceof Double d1
    && d1.intValue() % 2 == 0) {

    System.out.println(d1.intValue());
}

if (num instanceof Double d2
    || d2.intValue() % 2 == 0) {

    System.out.println(d2.intValue());
}
```

Compiles

Does not compile because d2 might not be double

Does this compile?

16

```
if (num instanceof Double n)
    System.out.println(n.intValue());

if (num instanceof Integer n)
    System.out.println(n);
```

Yes. Only in scope for if statement

Does this compile?

16

```
if (num instanceof Double n)
     System.out.println(n.intValue());

System.out.println(n.intValue());
```

No. If statement is over

Does this compile?

16

```
if (!(num instanceof Double n)) {
    return;
}
System.out.println(n.intValue());
```

Yes. Returns early so rest is like an else

Does this compile?

16

```
if (!(num instanceof Double n)) {
    return;
}
System.out.println(n.intValue());

if (num instanceof Double n)
    System.out.println(n.intValue());
```

No. n is still in scope

Originally

```
public String getLocation(String store) {
    String result = "";
    switch (store) {
        case "Hallmark":
            result = "KC";
            break;
        case "Crayola":
            result = "PA";
            break;
        default:
            result = "anywhere";
    }
    return result;
}
```

You remembered the breaks, right?

Switch Expressions


```
public String getLocation(String store) {
    return switch (store) {
        case "Hallmark" -> "KC";
        case "Crayola" -> "PA";
        default -> "anywhere";
    };
}
```

Arrow labels

No break keyword

More features

14

```
String output = switch(store) {
    case "Hallmark" -> "KC";
    case "Legoland" -> {
        int random = new Random().nextInt();
        String city = random % 2 == 0
            ? "KC" : "Carlsbad";
        yield city;
    }
    default -> throw new
        IllegalArgumentException("Unknown");
};
System.out.println(output);
```

Block

yield

throws exception
so no return value
needed

Is this legal?

14

```
private void confusing() {
    this.yield();
}

private void yield() {
    String store = "Legoland";

    String output = switch(store) {
        case "Legoland" -> {
            yield "Carlsbad";
        }
        default -> "other";
    };
    System.out.println(output);
}
```

Yes. yield is like var

How about now?

14

```
private void confusing() {
    yield();
}

private void yield() {
    String store = "Legoland";

    String output = switch(store) {
        case "Legoland" -> {
            yield "Carlsbad";
        }
        default -> "other";
    };
    System.out.println(output);
}
```

No

to invoke a method called yield, qualify the yield with a receiver or type name

Yield with Switch Stmt

14

```
Position pos = Position.TOP;

int stmt = switch(pos) {
    case TOP: yield 1;
    case BOTTOM: yield 0;
};

int expr = switch(pos) {
    case TOP -> 1;
    case BOTTOM -> 0;
};
```

Same!

@jeanneboyarsky

Missing value

14

```
enum Position { TOP, BOTTOM };


Position pos = Position.TOP;

int stmt = switch(pos) {
    case TOP: yield 1;
};

int expr = switch(pos) {
    case BOTTOM -> 0;
};
```

Does not compile because assigning value

(poly expression)

Pattern matching for switch

19 preview

```
public int toInt(Object obj) {
    return switch (obj) {
        case Integer i -> i;
        case Double d -> d.intValue();
        case String s -> Integer.parseInt(s);

        default -> throw new
            IllegalArgumentException("unknown type");
    };
}
```

Reminder: Syntax can change

But wait, there's more

19 preview

```
static void printOddOrEven(Object obj) {
    switch (obj) {

        case Integer i when i % 2 == 1 ->
            System.out.println("odd");

        case Integer i when i % 2 == 0 ->
            System.out.println("even");

        default -> System.out.println("not an int");
    };
}
```

Reminder: Feature can still change

Opportunities

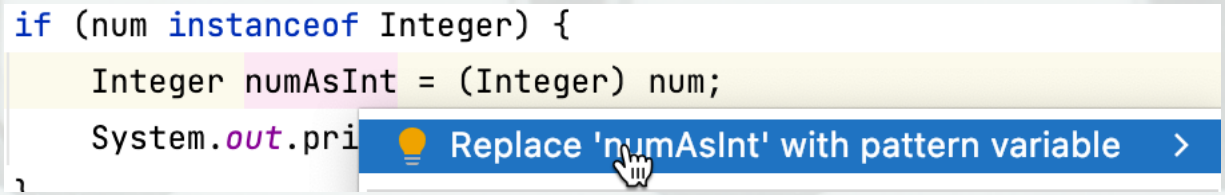
16

- Library code
- Equals methods

```
public boolean equals(Object anObject) {
    if (this == anObject) {
        return true;
    }
    return (anObject instanceof String aString)
            && (!COMPACT_STRINGS || this.coder == aString.coder)
            && StringLatin1.equals(value, aString.value);
}
```

- Many if/else chains!
- Switch statements with many breaks
- Sets the stage for advanced matching
- Others?

IDE Support




```
if (num instanceof Integer numAsInt) {
    System.out.println(numAsInt);
}
```

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IDE Support


```
String result = switch (store) {
    case "Hallmark" -> "KC";
    case "Crayola" -> "PA";
    default -> "anywhere";
};
return result;
```

On older Java?

```
public String getLocation(String store) {
    //TODO convert to switch expression on Java 17
    String result = "";
    switch (store) {
        case "Hallmark":
            result = "KC";
            break;
        case "Crayola":
            result = "PA";
            break;
        default:
            result = "anywhere";
    }
    return result;
}
```

On older Java?

```
//TODO convert to pattern var when on Java 17

if (num instanceof Double) {
     Double numAsDouble = (Double) num;
     System.out.println(numAsDouble.intValue());
}
```

Positions for future

Module 2 - Question 1

What is output?

```
char ch = 'b';

int count = 0;
switch (ch) {
    case 'a' -> count++;
    case 'b' -> count+=2;
    case 'c' -> count+=3;
 }

 System.out.println(count);
```

A. 1
B. 2
C. 5
D. Does not compile

Module 2 - Question 1

What is output?

```
char ch = 'b';

int count = 0;
switch (ch) {
    case 'a' -> count++;
    case 'b' -> count+=2;
    case 'c' -> count+=3;
 }

 System.out.println(count);
```

B

A. 1
B. 2
C. 5
D. Does not compile

Module 2 - Question 2

How many changes are needed to have this code print 2?

```
char ch = 'b';

int value = switch (ch) {
    case 'a' -> 1;
    case 'b' -> yield 2;
    case 'c' -> 3;
 }

 System.out.println(value);
```

A. 1
B. 2
C. 3
D. 4

Module 2 - Question 2

How many changes are needed to have this code print 2?

```
char ch = 'b';

int value = switch (ch)
    case 'a' -> 1;
    case 'b' -> yield 2;
 }

 System.out.println(value);
```

A. 1
B. 2
C. 3
D. 4

C

(remove yield, add default and add semicolon at end of switch)

Module 2 - Question 3

How many lines need changing to make this code compile?

```
char ch = 'b';

int value = switch (ch) {
    case 'a' : yield 1;
    case 'b' : { yield 2; }
    case 'c' -> yield 3;
    default -> 4;
};
System.out.println(value);
```

A. 1
B. 2
C. 3
D. 4

Module 2 - Question 3

How many lines need changing to make this code compile?

```
char ch = 'b';

int value = switch (ch)
    case 'a' : yield 1;
    case 'b' : { yield 2; }
    case 'c' -> yield 3;
    default -> 4;
};
System.out.println(value);
```

A. 1
B. 2
C. 3
D. 4

B

(case c is invalid because can't use yield there. Also case c/default invalid because can't mix and match : and ->

Module 2 - Question 4

What can fill in the blank to have the code print 2?

```
char ch = 'b';

______ value = switch (ch) {
    case 'a' -> 1;
    case 'b' -> 2L;
    case 'c' -> 3.0;
    default -> 4;
};
System.out.println(value);
```

A. int
B. Object
C. Either A or B
D. None of the above

Module 2 - Question 4

What can fill in the blank to have the code print 2?

```
char ch = 'b';

_____ value = switch (ch) {
    case 'a' -> 1;
    case 'b' -> 2L;
    case 'c' -> 3.0;
    default -> 4;
};
System.out.println(value);
```

B

A. int
B. Object
C. Either A or B
D. None of the above

Module 2 - Question 5

What does the following output?

```
char ch = 'b';

switch (ch) {
    case 'a' -> System.out.println(1);
    case 'b' -> System.out.println(2);
    case 'c' -> { System.out.println(3); }
};
```

A. 1

B. 2

C. 3

D. Does not compile

Module 2 - Question 5

What does the following output?

```
char ch = 'b';

switch (ch) {
    case 'a' -> System.out.println(1);
    case 'b' -> System.out.println(2);
    case 'c' -> { System.out.println(3); }
};
```

A. 1

B. 2

C. 3

D. Does not compile

B

Module 2 - Question 6

What does the following print?

```
Object robot = "694";

if (robot instanceof String s) {
    System.out.print("x");
}
if (robot instanceof Integer s) {
    System.out.print("y");
}
System.out.println(robot);
```

A. x694
B. xy694
C. y694
D. Does not compile

Module 2 - Question 6

What does the following print?

```
Object robot = "694";

if (robot instanceof String s) {
    System.out.print("x");
}
if (robot instanceof Integer s) {
    System.out.print("y");
}
System.out.println(robot);
```

A

A. x694
B. xy694
C. y694
D. Does not compile

@jeanneboyarsky

Module 2 - Question 7

Which lines have s in scope?

```
Object robot = "694";

if (robot instanceof String s) {
    // line 1
}
if (robot instanceof int i) {
    // line 2
}

// line 3
```

A. 1
B. 1 and 3
C. 1, 2 and 3
D. Does not compile

Module 2 - Question 7

Which lines have s in scope?

```
Object robot = "694";

if (robot instanceof String s) {
   // line 1
}
if (robot instanceof int i) {
   // line 2
}

// line 3
```

A. 1
B. 1 and 3
C. 1, 2 and 3
D. Does not compile

D

(int needs to be Integer)

Module 2 - Question 8

What is true about this class?

```
class Sword {
    int length;

    public boolean equals(Object o) {
        if (o instanceof Sword sword) {
            return length == sword.length;
        }
        return false;
    }
    // assume hashCode properly implemented
}
```

A. equals() is correct
B. equals() is incorrect
C. equals() does not compile

Module 2 - Question 8

What is true about this class?

```
class Sword {
    int length;

    public boolean equals(Object o) {
        if (o instanceof Sword sword) {
            return length == sword.length;
        }
        return false;
    }
    // assume hashCode properly implemented
}
```

A

A. equals() is correct
B. equals() is incorrect
C. equals() does not compile

Module 2 - Question 9

How many if statements fail to compile?

```
Number n = 4;

if (n instanceof Integer x) {}
if (n instanceof Integer x
  && x.intValue() > 1) {}
if (n instanceof Integer x
  || x.intValue() > 1) {}
if (n instanceof Integer x
  || x.toString().isEmpty()) {}
```

A. 0
B. 1
C. 2
D. 3

Module 2 - Question 9

How many if statements fail to compile?

```
Number n = 4;

if (n instanceof Integer x) {}
if (n instanceof Integer x
  && x.intValue() > 1) {}
if (n instanceof Integer x
  || x.intValue() > 1) {}
if (n instanceof Integer x
  || x.toString().isEmpty()) {}
```

C

(the last two because X could be null)

A. 0
B. 1
C. 2
D. 3

@jeanneboyarsky

Module 2 - Question 10

What does printLength(3) print?

```
class Sword {
    int length = 8;

    public void printLength(Object x) {
        if (x instanceof Integer length) {
            length = 2;
        }
        System.out.println(length);
    }

}
```

A. 2
B. 3
C. 8
D. Does not compile

Module 2 - Question 10

What does printLength(3) print?

```
class Sword {
    int length = 8;

    public void printLength(Object x) {
        if (x instanceof Integer length) {
            length = 2;
        }
        System.out.println(length);
    }

}
```

C

A. 2
B. 3
C. 8
D. Does not compile

@jeanneboyarsky

Lab & Break

https://github.com/boyarsky/2022-kcdc-java-refactoring

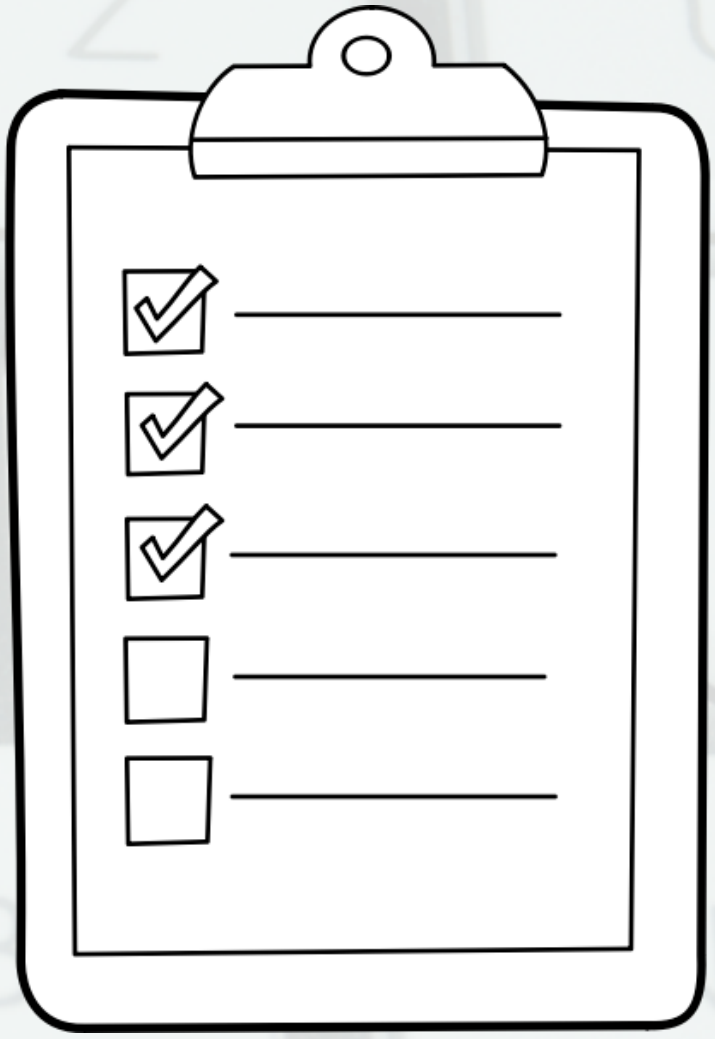
Records and Sealed Classes

Book Giveaway

@jeanneboyarsky

Lab Review

- Any questions?



Originally

```
public class Book {

    2 usages
    private String title;
    2 usages
    private int numPages;

    public Book(String title, int numPages) {
        this.title = title;
        this.numPages = numPages;
    }

    public String getTitle() {
        return title;
    }

    public int getNumPages() {
        return numPages;
    }
```

Ran out of room on screen!

Record


```
public record Book (String title, int numPages) {
}
```

New type

Automatically get
* final record
* private final instance variables
* public accessors
* constructor taking both fields
* equals
* hashCode

Using the Record


```
Book book = new Book("Breaking and entering", 289);

System.out.println(book.title());
System.out.println(book.toString());
```

No “get”

Outputs:
Breaking and entering
Book[title=Breaking and entering, numPages=289]

Add/change methods


```
public record Book (String title, int numPages) {

    @Override
    public String title() {
        return '"' + title + '"';
    }

    public boolean isLong() {
        return numPages > 300;
    }

}
```

Change behavior

Custom method

Not really immutable

16

```
public record Book (String title, int numPages,
    List<String> chapters) {
}


Book book = new Book("Breaking and entering", 289,
    chapters);

chapters.add("2");
book.chapters().add("3");
System.out.println(book.chapters());
```

Prints [1,2,3] because shallow immutability

Now immutable

16

```
public record Book (String title, int numPages,
    List<String> chapters) {

    public Book {
        chapters = List.copyOf(chapters);
    }
}
```

Compact constructor

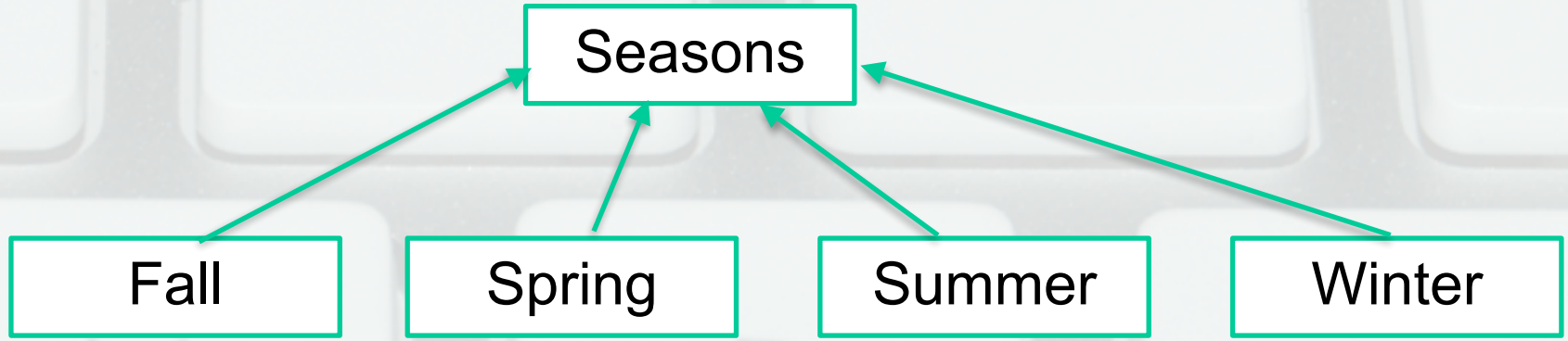
Must match record access modifier

Sealed classes

17

```
public abstract sealed class Seasons
    permits Fall, Spring, Summer, Winter { }

final class Fall extends Seasons {}
final class Spring extends Seasons {}
final class Summer extends Seasons {}
final class Winter extends Seasons {}
```



Subclass modifiers

Modifer	Meaning
final	Hierarchy ends here
non-sealed	Others can subclass
sealed	Another layer

Sealed interface

17

```
public sealed interface TimeOfDay
    permits Morning, Afternoon, Evening {
     boolean early();
}
public non-sealed class Morning implements TimeOfDay {
     public boolean early() { return true; }
}
public non-sealed class Afternoon implements TimeOfDay {
     public boolean early() { return false; }
}
public record Evening(int hour) implements TimeOfDay {
     public boolean early() { return false; }
}
```


Records are implicitly final

instanceof

17

```
public class InstanceOf {
 static sealed class BoolWrapper
    permits TrueWrapper, FalseWrapper { }
 static final class TrueWrapper extends BoolWrapper {}
 static final class FalseWrapper extends BoolWrapper {}
 public static void main(String[] args) {
   Map<?, ?> map = new HashMap<>();
   String string = "";
   BoolWrapper boolWrapper = new TrueWrapper();

   System.out.println(map instanceof List);          // false
   System.out.println("" instanceof List);           // error
   System.out.println(boolWrapper instanceof List); // error
}
```

instanceof

19 preview

```
sealed interface Season permits Winter,
    Spring, Summer, Fall{}

final class Winter implements Season {}
final class Spring implements Season {}
final class Summer implements Season {}
final class Fall implements Season {}

public String sealed(Season season) {
    return switch (season) {
        case null -> "null";
        case Winter w -> "Winter";
        case Spring s -> "Spring";
        case Summer s -> "Summer";
        case Fall f -> "Fall";
    }; }
```

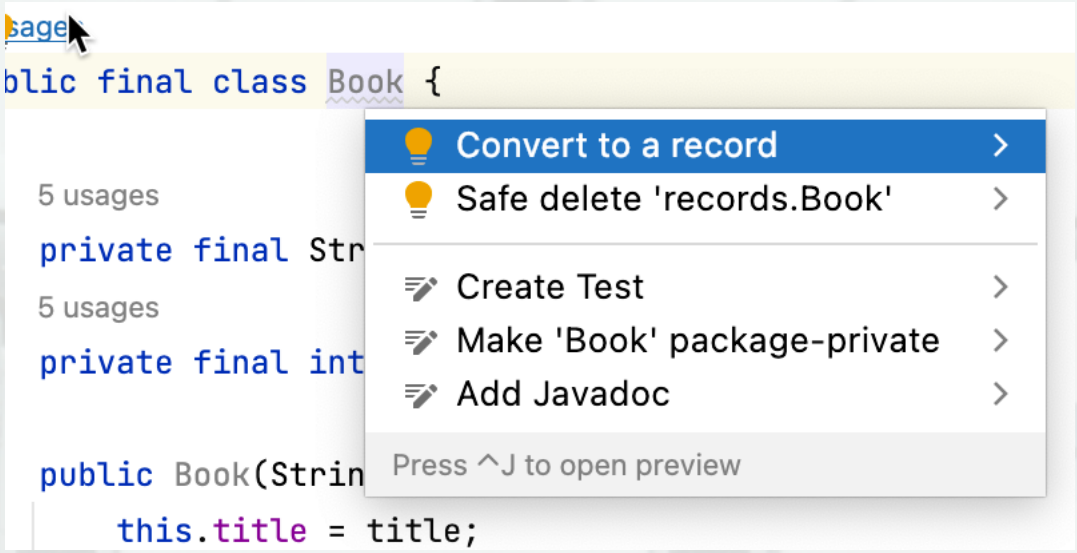
Also “when”

Opportunities

17

- Immutable POJOs
- Don’t have to write equals/ hashCode
- Vs reflection - EqualsBuilder
- Make code coverage tool happy
- Library design
- Others?

IDE Support




```
public record Book(String title, int numPages) {
}
```

Had to make instance variables final. Also didn't remove my equals() even though generated by IntelliJ

On older Java?

```
//TODO convert to record when on Java 17
public final class Book {
    private String title;
    private int numPages;

    public Book(String title, int numPages) {
        this.title = title;
        this.numPages = numPages;
    }
    public String title() {
        return title;
    }
    public int numPages() {
        return numPages;
    }
    // hash code, equals
```

Be sure to use al fields for equals/ hashCode

Module 3 - Question 1

How many lines need to be removed for this code to compile?

```
public record BBQ(String type) {}

public static void main(String[] args) {
    BBQ bbq = new BBQ("chicken");
    System.out.println(bbq.setType("pork"));
    System.out.println(bbq.getType());
    System.out.println(bbq.equals(bbq));
}
```

A. 0
B. 1
C. 2
D. None of the above

Module 3 - Question 1

How many lines need to be removed for this code to compile?

```
public record BBQ(String type) {}

public static void main(String[] args) {
    BBQ bbq = new BBQ("chicken");
    System.out.println(bbq.setType("pork"));
    System.out.println(bbq.getType());
    System.out.println(bbq.equals(bbq));
}
```

C

(no setters and getter should be type())

A. 0
B. 1
C. 2
D. None of the above

Module 3 - Question 2

What does this output?

```
public record BBQ(String type) {
     BBQ {
          type = type.toUpperCase();
     }
}

public static void main(String[] args) {
     BBQ bbq = new BBQ("chicken");
     System.out.println(bbq.type());
}
```

A. chicken
B. CHICKEN
C. Does not compile
D. None of the above

Module 3 - Question 2

What does this output?

```
public record BBQ(String type) {
    BBQ {
        type = type.toUpperCase();
    }
}

public static void main(String[] args) {
    BBQ bbq = new BBQ("chicken");
    System.out.println(bbq.type());
}
```

C

(compact constructor must be public because record is)

A. chicken
B. CHICKEN
C. Does not compile
D. None of the above

Module 3 - Question 3

What does this output?

```
record BBQ(String type) {
     BBQ {
          type = type.toUpperCase();
     }
}

public static void main(String[] args) {
     BBQ bbq = new BBQ("chicken");
     System.out.println(bbq.type());
}
```

A. chicken
B. CHICKEN
C. Does not compile
D. None of the above

Module 3 - Question 3

What does this output?

```
record BBQ(String type) {
    BBQ {
        type = type.toUpperCase();
    }
}

public static void main(String[] args) {
    BBQ bbq = new BBQ("chicken");
    System.out.println(bbq.type());
}
```

B

A. chicken
B. CHICKEN
C. Does not compile
D. None of the above

Module 3 - Question 4

How many compiler errors are in the following code?

```
public final record BBQ(String type) {
    { type = ""; }
    public BBQ(String type) {
        type = type.toUpperCase();
    }
    public void type() { return ""; }
    public String toString() { return ""; }
}
```

A. 1
B. 2
C. 3
D. 4

Module 3 - Question 4

How many compiler errors are in the following code?

```
public final record BBQ(String type) {
    { type = ""; }
    public BBQ(String type) {
        type = type.toUpperCase();
    }
    public void type() { return ""; }
    public String toString() { return ""; }
}
```

C

(no instance initializer allowed, compact constructor syntax wrong, type() must return String)

A. 1
B. 2
C. 3
D. 4

Module 3 - Question 5

What does this output?

```
public record BBQ(String type)
     implements Comparable<BBQ> {

     public int compareTo(BBQ bbq) {
          return type.compareTo(bbq.type);
     } }
public static void main(String[] args) {
     BBQ beef = new BBQ("beef");
     BBQ pork = new BBQ("pork");
     System.out.println(pork.compareTo(beef));
}
```

A. Negative #
B. Positive #
C. 0
D. Does not compile

Module 3 - Question 5

What does this output?

```
public record BBQ(String type)
    implements Comparable<BBQ> {

    public int compareTo(BBQ bbq) {
        return type.compareTo(bbq.type);
    } }
public static void main(String[] args) {
    BBQ beef = new BBQ("beef");
    BBQ pork = new BBQ("pork");
    System.out.println(pork.compareTo(beef));
}
```

B

A. Negative #
B. Positive #
C. 0
D. Does not compile

Module 3 - Question 6

What does this output?

```
static sealed interface Weather permits Wet, Dry{
    boolean needUmbrella(); }
static non-sealed class Wet implements Weather {
    public boolean needUmbrella() { return true; } }
static record Dry(boolean needUmbrella)
  implements Weather {}

public static void main(String[] args) {
    Weather weather = new Dry(false);
    System.out.println(weather.needUmbrella());
}
```

A. true
B. false
C. Does not compile
D. None of the above

Module 3 - Question 6

What does this output?

```
static sealed interface Weather permits Wet, Dry{
    boolean needUmbrella(); }
static non-sealed class Wet implements Weather {
    public boolean needUmbrella() { return true; } }
static record Dry(boolean needUmbrella)
  implements Weather {}

public static void main(String[] args) {
    Weather weather = new Dry(false);
    System.out.println(weather.needUmbrella());
}
```

B

A. true
B. false
C. Does not compile
D. None of the above

Module 3 - Question 7

Which of the following are true? (Choose all that apply)

A. There is only one hyphenated modifier in Java (non-sealed)

B. A sealed interface may permit another interface.

C. Sealed records are allowed

D. Sealed enums are allowed

Module 3 - Question 7

Which of the following are true? (Choose all that apply)

A. There is only one hyphenated modifier in Java (non-sealed)

B. A sealed interface may permit another interface.

C. Sealed records are allowed

D. Sealed enums are allowed

A, B

Module 3 - Question 8

Given the following, where could Android be? (Choose all that apply)

```
package general;
static sealed class Phone
  permits IPhone, Android { }
```

A. In the same file as Phone

B. In the same package as Phone within a module

C. In a different package from Phone, but in the same module

D. In a different module

Module 3 - Question 8

Given the following, where could Android be? (Choose all that apply)

```
package general;
static sealed class Phone
  permits IPhone, Android { }
```

A, B

A. In the same file as Phone

B. In the same package as Phone within a module

C. In a different package from Phone, but in the same module

D. In a different module

Module 3 - Question 9

Given the following, where could Android be? (Choose all that apply)

```
package general;
static sealed class Phone
  permits mac.IPhone, google.Android { }
```

A. In the same file as Phone

B. In the same package as Phone within a module

C. In a different package from Phone, but in the same module

D. In a different module

Module 3 - Question 9

Given the following, where could Android be? (Choose all that apply)

```
package general;
static sealed class Phone
  permits mac.IPhone, google.Android { }
```

C,D

A. In the same file as Phone

B. In the same package as Phone within a module

C. In a different package from Phone, but in the same module

D. In a different module

Module 3 - Question 10

How many compiler errors are in this code?

```
public sealed class Phone {

    class IPhone extends Phone {
    }

    class Android extends Phone {
    }
}
```

A. 0
B. 1
C. 2
D. 3

Module 3 - Question 10

How many compiler errors are in this code?

```
public sealed class Phone {

    class IPhone extends Phone {
    }

    class Android extends Phone {
    }
}
```

C

(extending classes need to be sealed/non-sealed final)

A. 0
B. 1
C. 2
D. 3

Lab & Break

https://github.com/boyarsky/2022-kcdc-java-refactoring

Note: If using JDoodle, combine into one file


APIs

toList()


```
public List<String> listLonger(
    Stream<String> stream) {

     return stream.collect(Collectors.toList());
}

public List<String> listShorter(
    Stream<String> stream) {

     return stream.toList();
}
```

Teeing Collector

12

```
record Separations(String spaceSeparated,
    String commaSeparated) {}

var list = List.of("x", "y", "z");
Separations result = list.stream()
        .collect(Collectors.teeing(
              Collectors.joining(" "),
              Collectors.joining(","),
              (s, c) -> new Separations(s, c)));

System.out.println(result);
```

Formatting a String


```
String firstName = "Jeanne";
String lastName = "Boyarsky";
String str = String.format(
    "Hi %s %s!", firstName, lastName);
System.out.println(str);

System.out.println("Hi %s %s!".formatted(
     firstName, lastName));
```

Outputs:
Hi Jeanne Boyarsky!
Hi Jeanne Boyarsky!

Common Conversions

Conversion	What it does
%s	Formattable as String
%d	Decimal integer (no dot)
%c	Char
%f	Float (decimal)
%n	New line

Many more out of scope. Examples:

- %e - scientific notation
- %t - time
- %S - converts to all uppercase

Conversion Examples

12

Code	Output
`"%d%%".formatted(1.2)`	exception
`"%d%%".formatted(1)`	1%
`"%s%%".formatted(1)`	1%
`"%s%%".formatted(1.2)`	1.2%
`“%f%%".formatted(1.2)`	1.200000f

Formatting a Number

Char	What it does
-	Left justified
+	Always include +/-
space	Leading space if positive

Char	What it does
0	Zero padded
,	Group numbers
(	Negative # in parens

Flag Examples

12

Code	Output
`"%,d".formatted(1234)`	1,234
`"%+d".formatted(1234)`	1234
`“% d".formatted(1234)`	1234
`“%,(d”.formatted(-1234)`	(1,234)
`“%,f”.formatted( 1.23456789)`	1.234568

Compact Number

12

```
NumberFormat defaultFormat =
NumberFormat.getCompactNumberInstance();
NumberFormat shortFormat = NumberFormat
    .getCompactNumberInstance(
        Locale.US, NumberFormat.Style.SHORT);
NumberFormat longFormat = NumberFormat
    .getCompactNumberInstance(
        Locale.US, NumberFormat.Style.LONG);

System.out.println(defaultFormat.format(1_000_000));
System.out.println(shortFormat.format(1_000_000));
System.out.println(longFormat.format(1_000_000));
```

```
1M
1M
1 million
```

New Files.mismatch()

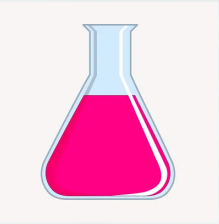
12

```
Path kcdc = Path.of("files/kcdc.txt");
Path kc = Path.of("files/kc.txt");

System.out.println(Files.mismatch(kcdc, kc));
System.out.println(Files.mismatch(kcdc, kcdc));
```

11 (index of first character different)
-1 (same file contents regardless of whether exists)

Wed Lab Version



- More APIs
- Hands on practice

Lab

https://github.com/boyarsky/2022-kcdc-java-refactoring