Java in Education

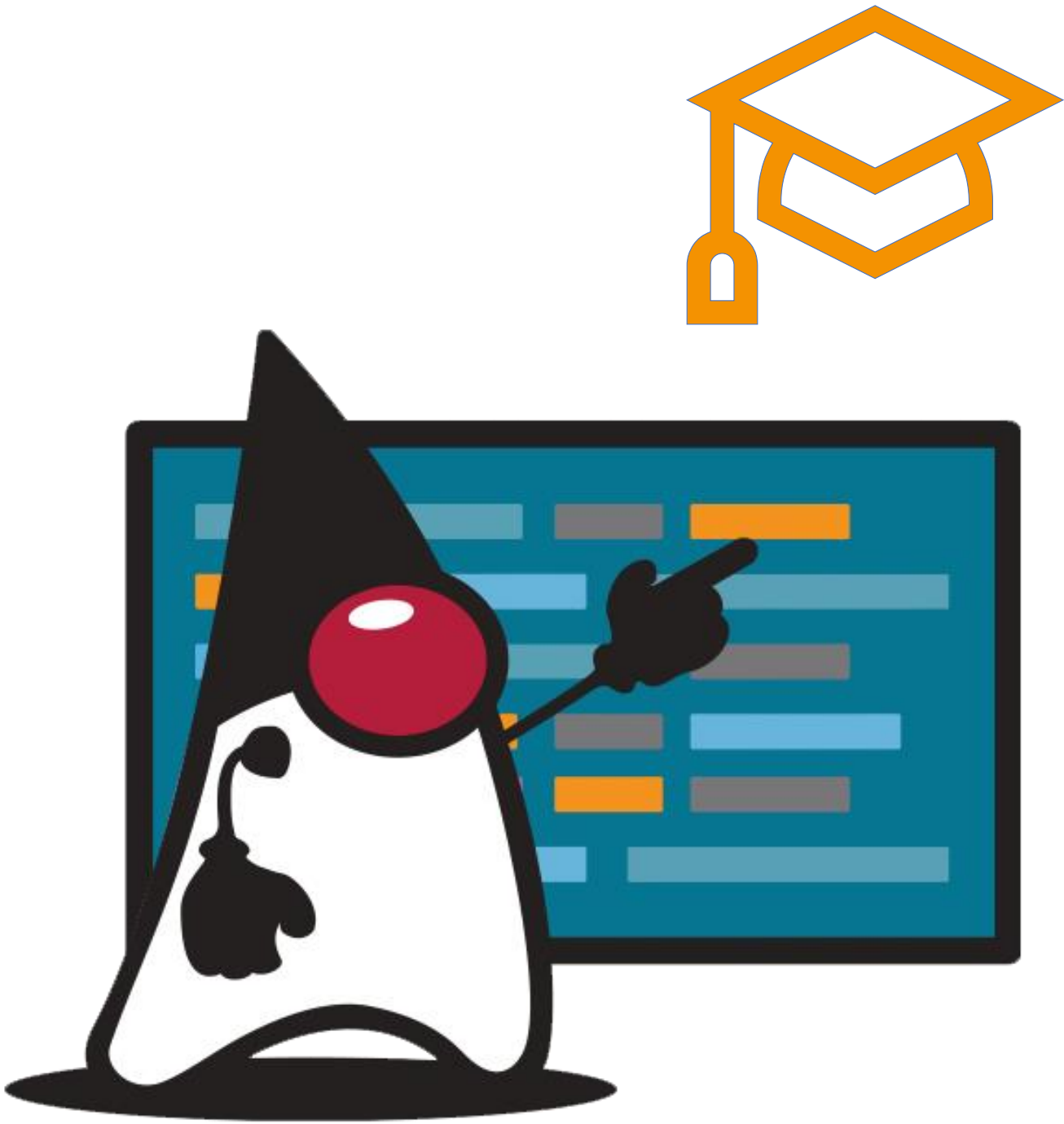
<Insert your name here if using>

JUG Presentation

For CS Instructors and Students

Prepared by Ken Fogel & the JCP Executive Committee (EC) Java in Education Working Group

Version 2.4



Myths & Benefits of Learning Java

- Java can be a steep learning curve for a beginner
  - *Only if the instructor themselves had a steep curve in learning the language*

Myths & Benefits of Learning Java

- Java is not suitable for lightweight, quick tasks
  - Better suited for larger and more complex applications.
  - *Have you seen Multi-File Source-Code and under Linux have you tried shebang execution?*
  - *This Just In!* ***– Paving the on-ramp***

Myths & Benefits of Learning Java

- Oracle Java Development Kit (JDK), is not open source
  - *OpenJDK is a completely open source implementation of the JDK*
  - *Continuing development of Java is done in the OpenJDK project by Oracle Java developers*

Myths & Benefits of Learning Java

- Java is an “old” language (Java 1996 & Python 1991)
  - *also means it’s established, widely used and well-documented*

Myths & Benefits of Learning Java

- More Java programmers than any other type of programmer in the world
  - *easy to find people who can help you out and mentor you*

Myths & Benefits of Learning Java

- *Java (and its JVM variant Kotlin) are the basis of Android development*

Java Language Enhancements

This presentation looks at enhancements to the Java language

These enhancements help dispel some of the myths surrounding Java.

It is about why Java should be the language taught at all levels in schools today.

JShell - Read-Evaluate-Print Loop (REPL) JDK 9

- A tool for simplifying instruction.
- Execution as you enter code and press return.
- Immediate response line by line.
- You can also write entire methods first and then execute them.
- Ideal in teaching Java one line at a time.

JEP 458 - Launch Multi-File Source-Code Programs JDK 22

- Addresses the overhead of running code
  - **Traditional Style**
    - Two-step to execution
      - `javac`
      - `java -jar`

JEP 458 - Launch Multi-File Source-Code Programs JDK 22

- **Multi-File Source-Code Style**
  - One-step to execution
    - `java`
      - If the file has a public class with a main it compiles and executes
      - Now you can have multiple class files in the same folder or in a subfolder
      - You can even include jar files
- No need to master an IDE

Preview Features

- New features in the Java language are not immediately available
- They are designated Preview features and a switch on the command line or in your IDE must be set.

```
javac --source 23 --enable-preview Main.java
java --enable-preview Main
```

- Or using the source code launcher

```
java --enable-preview Main.java
```

Too many decorations!

```
public class HelloWorld {
    public static void main(String[] args) {
        System.out.println("Hello, World!");
    }
}
```

Java 23 - Implicitly Declared Classes and Instance Main Methods

- The most common complaint about Java is its unsuitability, as compared to other languages, for beginners
- The ultimate simplification
  - no need for any class declaration
  - no need for access control declarations

Java 23 - Implicitly Declared Classes and Instance Main Methods

- **`main`** can be expressed as an instance method.
- Can be used in any Java program, not just implicit classes.

Java 23 - Implicitly Declared Classes and Instance Main Methods

Here are complete Java programs:

```
void main() {
    println("Hello, World!");
}
```

How about some input:

```
void main() {
    String name = readln("Name: ");
    println("Pleased to meet you, " +
                    name);
}
```

Java 23 - Implicitly Declared Classes and Instance Main Methods

Say goodbye to most “import” statements when starting out!

There is now an implicit

```
import module java.base;
```

Java 23 - Implicitly Declared Classes and Instance Main Methods

`java.base` includes:

`java.io`	`java.lang`
`java.math`	`java.net`
`java.nio`	`java.security`
`java.text`	`java.time`
`java.util`	`javax.crypto`

For Example, you can use Collections, Files, and BigDecimal without an import statement.

Java 23 - Implicitly Declared Classes and Instance Main Methods

Here is a complete program! *

```
void main() {
    var authors = List.of("James",
            "Bill", "Guy", "Alex",
            "Dan", "Gavin");
    for (var name : authors) {
        println(name + ": " +
                name.length());
    }
}
```

* From https://openjdk.org/jeps/477

var – reduction of redundancy reduction JDK 10

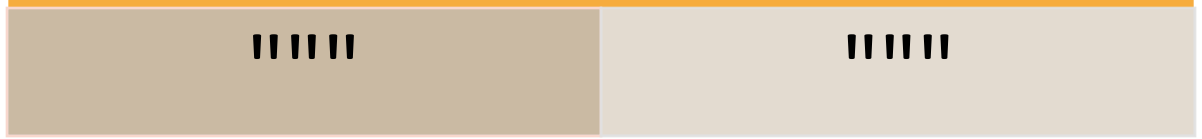
No more:	• `MyClass m = new MyClass();`
It now becomes:	• `var m = new MyClass();`
Encourages only creating objects with initialization	• Will reduce the occurrence of the dreaded NullPointerException

text blocks (15)

Finally, what you enter into your source code is what you get

Especially useful for Strings that contain HTML, XML and JSON

Who doesn’t like writing three quotation marks in a row?



Old School Concatenation

```
String htmlStr = "<html><head><link rel='stylesheet' "
    + "href='styles/main.css' "
    + "type='text/css'/><title>The Learning Servlet</title></head>"
    + "<body><h1>GET method</h1>"
    + "<form id='form:index' action='index.html'>"
    + "<br/><input type='submit' value='Return to Home page'/></form>"
    + "</body></html>";
```

New School Text Block JDK 15

```
String htmlStr = """
    <html>
        <head>
            <link rel='stylesheet'href='styles/main.css' type='text/css’/>
            <title>The Learning Servlet</title>
        </head>
        <body>
            <h1>GET method</h1>
            <form id='form:index' action = 'index.html'>
                <br/>
                <input type= 'submit' value='Return to Home page' />
            </form>
        </body>
    </html>""";
```

But wait, there is more . . . String formatted JDK 15

```
out.println("""
    <html>
      <head>
        <title>Just Servlet Output</title>
        <link rel='stylesheet' href='styles/main.css' type= 'text/css'/>
        </head>
      <body>
        <h1>Thanks for joining our email list</h1>
        <p>Here is the information that you entered:</p>
        <label>Email:</label>
        <span>%s</span>
      </body>
    </html>""".formatted(user.getEmailAddress()));
```

switch – an expression & without a break JDK 14

- A switch that can be explained sensibly
- Reduction in duplication of code when used to set a value
- Switch expressions or switch rules
- The end of break, all cases terminate!

Which would you prefer to learn or teach?

```
double value = 0;
switch (point) {
    case NORTH:
        value = 12.12;
        break;
    case SOUTH:
        value = 14.14;
        break;
    case EAST:
        value = 16.16;
        break;
    case WEST:
        value = 18.18;
        break;
}
```

```
double value = switch (point) {
    case NORTH -> 12.12;
    case SOUTH -> 14.14;
    case EAST -> 16.16;
    case WEST -> 18.18;
    default -> 0.0;
};
```

Java 21 The pattern matching switch.

```
Object x = "4";
String designation = switch (x) {
    // case Integer i when i > 4 && i < 12 -> "child";
    case Integer i when i < 12 -> "child";
    case Integer i when i < 18 -> "teenager";
    case Integer i when i < 25 -> "young adult";
    case Integer i when i < 65 -> "adult";
    case Integer i when i >= 65 -> "senior";
    default -> "Not an Integer";
};
System.out.printf("Designation is %s%n", designation);
```

records – boilerplate reduction with immutable flavouring and a dash of compact constructor JDK 16

Data objects are known for boilerplate code:

- Initializing constructors, setters, getters, equals, hashCode, and toString

To the rescue is the immutable record

More than just a simplification of a bean

It’s the path to objects defaulting to immutability

And then there is the compact constructor

- Validating initial values without a separate constructor

No setters, just simple getters.
Implied equals, hashCode and toString.
And what a lovely compact constructor for validation.

```
public record Person(String firstName,
                     String lastName,
                     int age,
                     String postion,
                     LocalDate birthday) {
    public Person{
        if (age < 18) {
            throw new IllegalArgumentException("Too young");
        }
    }
}
```

Virtuous Virtual Threads
Java threads, not OS threads
JDK 21.

```
public class VirtualThreadClass extends Thread { . . }

public void perform() {
      for (int i = 0; i < 5; ++i) {
         Thread.ofVirtual().name("Thread # " + i).
            start(new VirtualThreadClass());
}
```

What's Pushing Java Aside?

JavaScript

- Little to download
- Available in the browsers on every school PC

Python

- Associated with the two big trends:
  - Big Data
  - AI/ML
- Online Jupyter notepad is popular

Let's Compare Python to Java

On the next slides is the same program in Python and Java

These programs request three floating point values

- Amount of money borrowed called the loan
- The annual percentage rate (APR) for interest on the borrowed money
- The length of the load expressed in months called the term

From these values the program calculates the monthly repayment and displays it

```
loan = input("           loan: ")
interest = input("       interest: ")
term = input("           term: ")
tempInterest = float(interest) / 12
result = float(loan)*(tempInterest / (1 - ((1 + tempInterest) ** -float(term))))
print("Monthly Payment: %.2f" % result)
```

Basic Java using JEP477 Preview

```
// Runs with java --enable-preview JavaCalculator02.java
// using Java 23

void main() {
   var loan = Double.parseDouble(readln("Loan: "));
   var interest = Double.parseDouble(readln("Interest: "));
   var term = Double.parseDouble(readln("Term: "));
   var tempInterest = interest / 12.0;
   var result = loan *
      (tempInterest / (1.0 - Math.pow((1.0 + tempInterest), -term)));
   println("Monthly Payment: " + String.format("%.2f", result));
}

// Only difference to Python is void main() { & } – 2 lines
// and conversion of string to double using Double.parseDouble
```

OOP Python

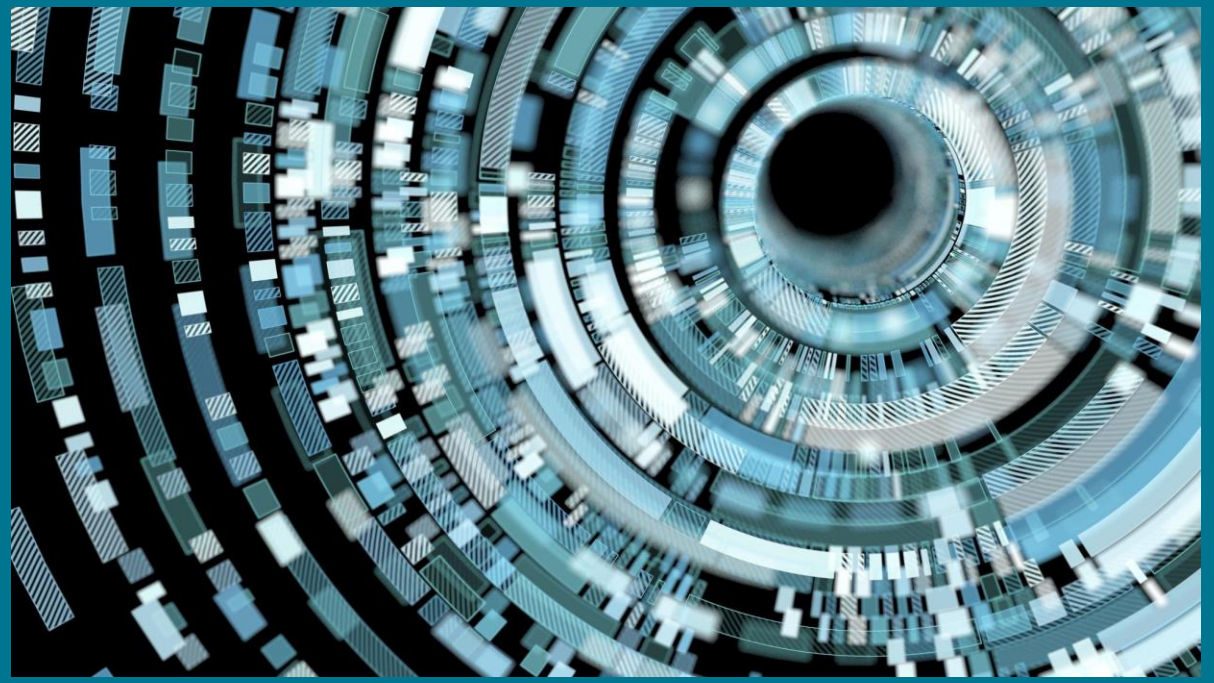
```
class PythonCalculator03:

    def func_input(self):
        loan = float(input("           loan: "))
        interest = float(input("       interest: "))
        term = float(input("           term: "))
        return loan, interest, term

    def func_process(self, input_data):
        (loan, interest, term) = input_data
        temp_interest = float(interest) / 12.0
        return loan * (temp_interest / (1.0 - ((1.0 + temp_interest) ** -term)))

    def func_output(self, result):
        print('Monthly Payment: %.2f' % result)

    def func_work(self):
        input_data = self.func_input()
        result = self.func_process(input_data)
        self.func_output(result)


worker = PythonCalculator03()
worker.func_work()
```

```
// Runs with java --enable-preview JavaCalculator03.java
import static java.io.IO.*;
public class JavaCalculator03 {
   void main() {
      var loan = inputData();
      var result = processData(loan);
      outputResult(result);
   }
   private LoanRecord inputData() {
      var loan = Double.parseDouble(readln("Loan >> "));
      var interest = Double.parseDouble(readln("Interest >> "));
      var term = Double.parseDouble(readln("Term >> "));
      return new LoanRecord(loan, interest, term);
   }
   private double processData(LoanRecord loan) {
      double tempInterest = loan.interest() / 12.0;
      double result = loan.loan() * (tempInterest /
            (1.0 - Math.pow((1.0 + tempInterest), -loan.term())));
      return result;
   }
   private void outputResult(double result) {
      println("Monthly Payment >> " + String.format("%.2f", result));
   }
}
record LoanRecord(double loan, double interest, double term) {}
```

In Java and Python there are 18 lines of code not counting the Java closing braces.

Machine Learning and Big Data
VisiRec JSR 381

- Java is doing machine learning now!
- Amazon's Deep Java Library (DJL) is one of several implementations of this new JSR
- The depth and breadth of Java tooling make it the best platform for ML



Why is Python widely used for AI/ML?

- Python is written in is C such that it can easily interact with C libraries
- As many AI/ML libraries are written in C, Python can more easily interact with them
- A weakness of Java has been interacting with other languages
- With Java 22 we have a Foreign Function & Memory API that will greatly simplify accessing C libraries

The Java Virtual Machine – Home to More Than Java

- Kotlin, Scala, Groovy, Clojure and more
- There is even a Python called Jython that runs on the JVM and supports interoperability between Java and Python

Why teach Java to students?

Many financial institutions depend on Java to run their backend

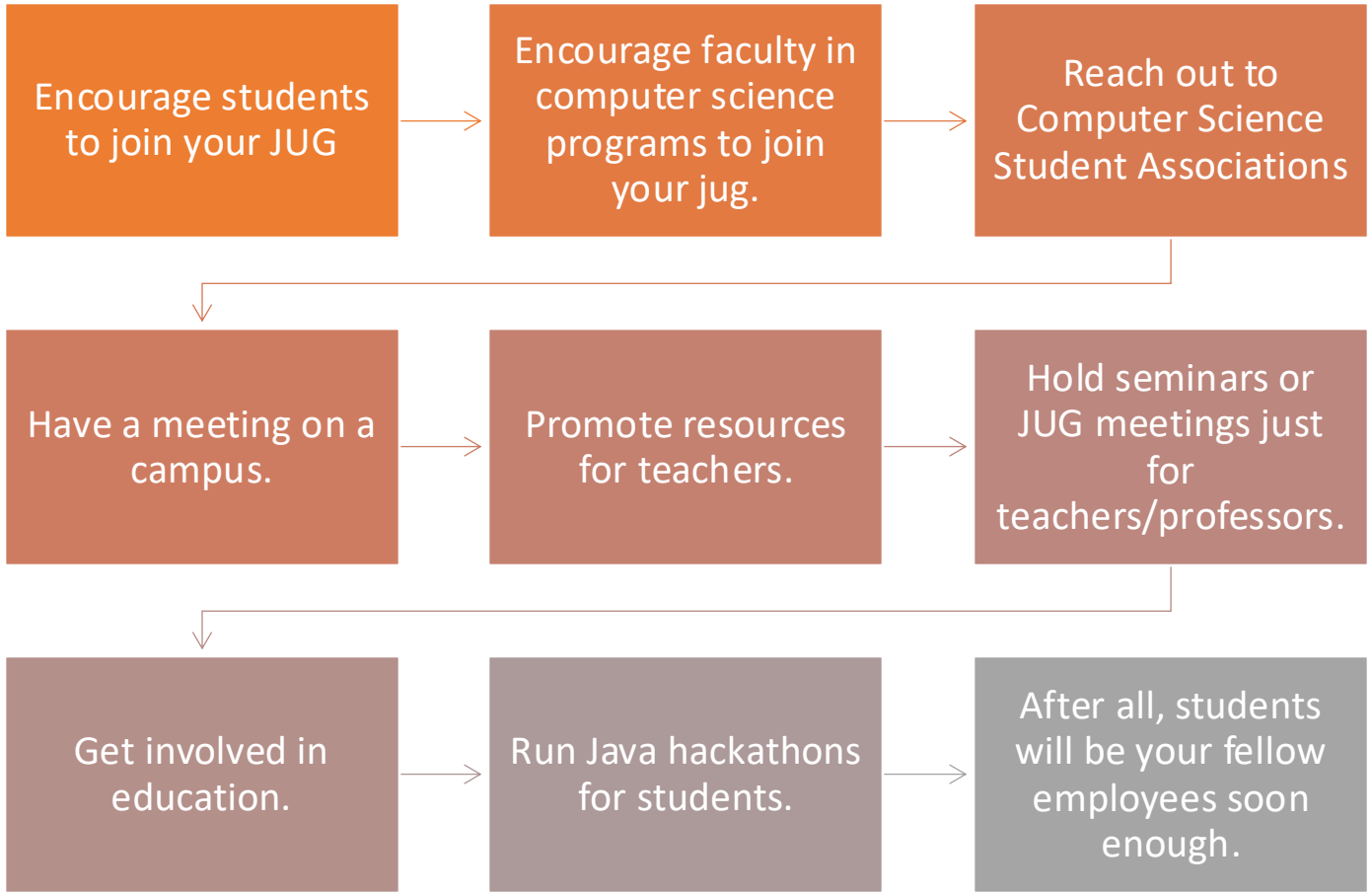
Twitter, LinkedIn, Amazon and others use Java

Your prospects are a function of how well you code

The best language to learn to prepare you to work with any language during your career.

The best language for giving students a clear understanding of what it means to program.

Conclusion – Reach Out To Schools and Teachers/Professors at All Levels



Sample code can be found at:

https://github.com/omniprof/JCP_EC_Education_WG_Presentation