Primitive Types

Integers

Lecture Contents

- Review of Number Systems
- How to Store a Binary Integer in a Computer
- Java `int` type

Review of Number Systems

- The ***denary*** (a.k.a. ***decimal***) system uses ***place value***, ten digits (0, 1, 2, 3, 4, 5, 6, 7, 8, 9), and a decimal point to represent a number.

millions	*hundred thousands*	*ten thousands*	*thousands*	*hundreds*	*tens*	*ones*		*tenths*	*hundredths*	*thousandths*	*ten thousandths*	*hundred thousandths*	*millionths*
2	8	5	0	7	1	3	.	6	9	4	2	5	3

Review of Number Systems

- The ***binary*** system uses ***place value*** and two digits (0, 1) to represent a value.
- Although we could, we generally don't see a decimal point used with binary numbers.
- For denary, each place value is a power of ten. For binary, each place value is a power of two.

10^4	10^3	10^2	10^1	10^0

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Review of Number Systems

- Be able to convert back and forth between ***binary*** and ***denary***.

75−64 = 11

11−8 = 3

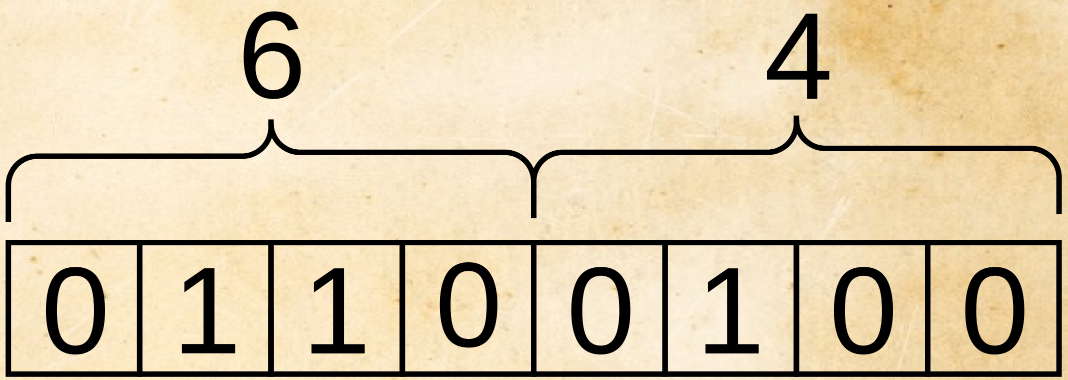
3−2 = 1

1−1 = 0

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	1	0	0	1	0	1	1
128	64	32	16	8	4	2	1

Review of Number Systems

- Be able to convert back and forth between ***binary*** and ***hexadecimal***.



Decimal	Hexa-decimal	Binary
0	0	0000
1	1	0001
2	2	0010
3	3	0011
4	4	0100
5	5	0101
6	6	0110
7	7	0111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111

Lecture Contents

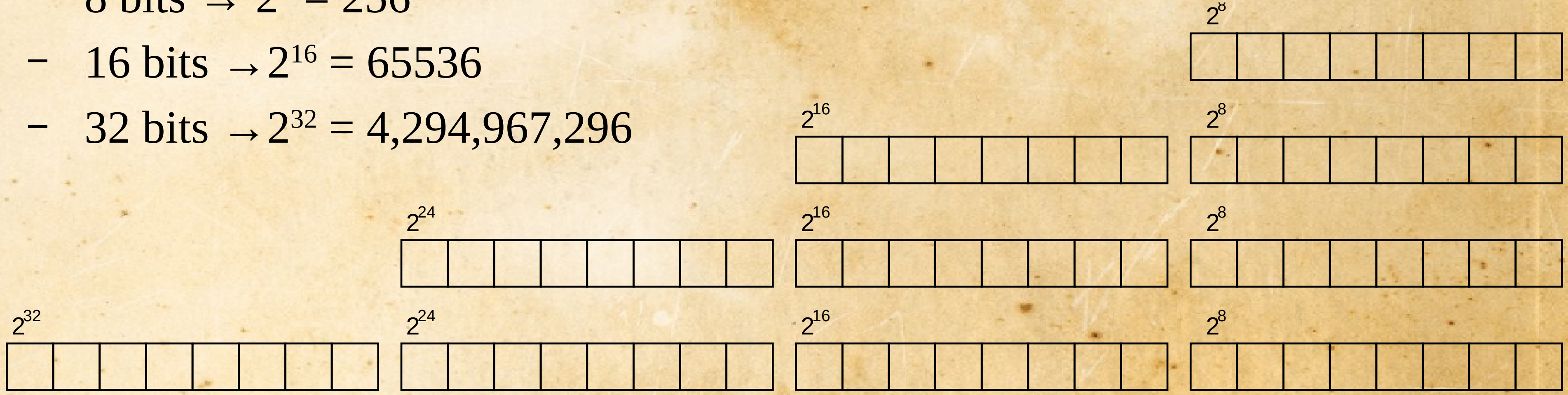
- Review of Number Systems
- **How to Store a Binary Integer in a Computer**
- Java `int` type

How to Store a Binary Integer in a Computer

- Modern computers organize ***bits*** into ***bytes*** (8 bits = 1 byte).
- Computer hardware is designed to operate on a set number of bytes.
  - The more bytes we operate on at once, the more complex the hardware must be.
- How many bytes should we use to store each integer?

How to Store a Binary Integer in a Computer

- Modern computers organize ***bits*** into ***bytes*** (8 bits = 1 byte).
- Computer hardware is designed to operate on a set number of bytes
- How many bytes should we use to store each integer?
  - 8 bits $\rightarrow$ $2^8 = 256$
  - 16 bits $\rightarrow 2^{16} = 65536$
  - 32 bits $\rightarrow 2^{32} = 4{,}294{,}967{,}296$



How to Store a Binary Integer in a Computer

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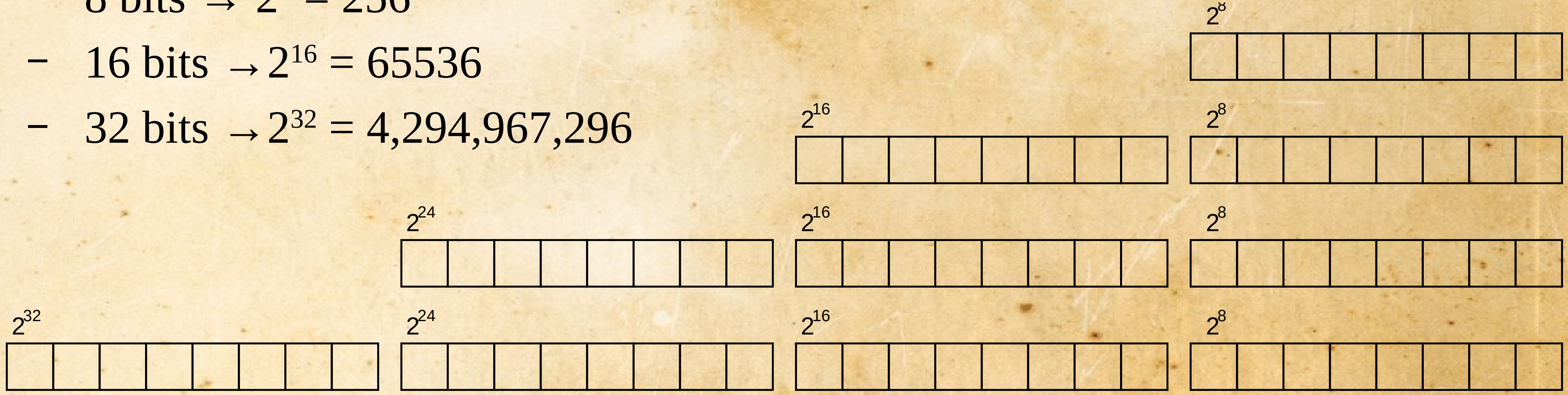

How to Store a Binary Integer in a Computer

- Java programmers can choose from the following ***types*** for storing integers

type	bits	numerical range
byte	8	-128 to +127
short	16	-32768 to +32767
int	32	-2,147,483,648 to +2,147,483,647
long	64	-9,223,372,036,854,775,808 to 9,223,372,036,854,775,807

  - For this course, unless you have a specific reason, always use the type **`int`** to store integers.

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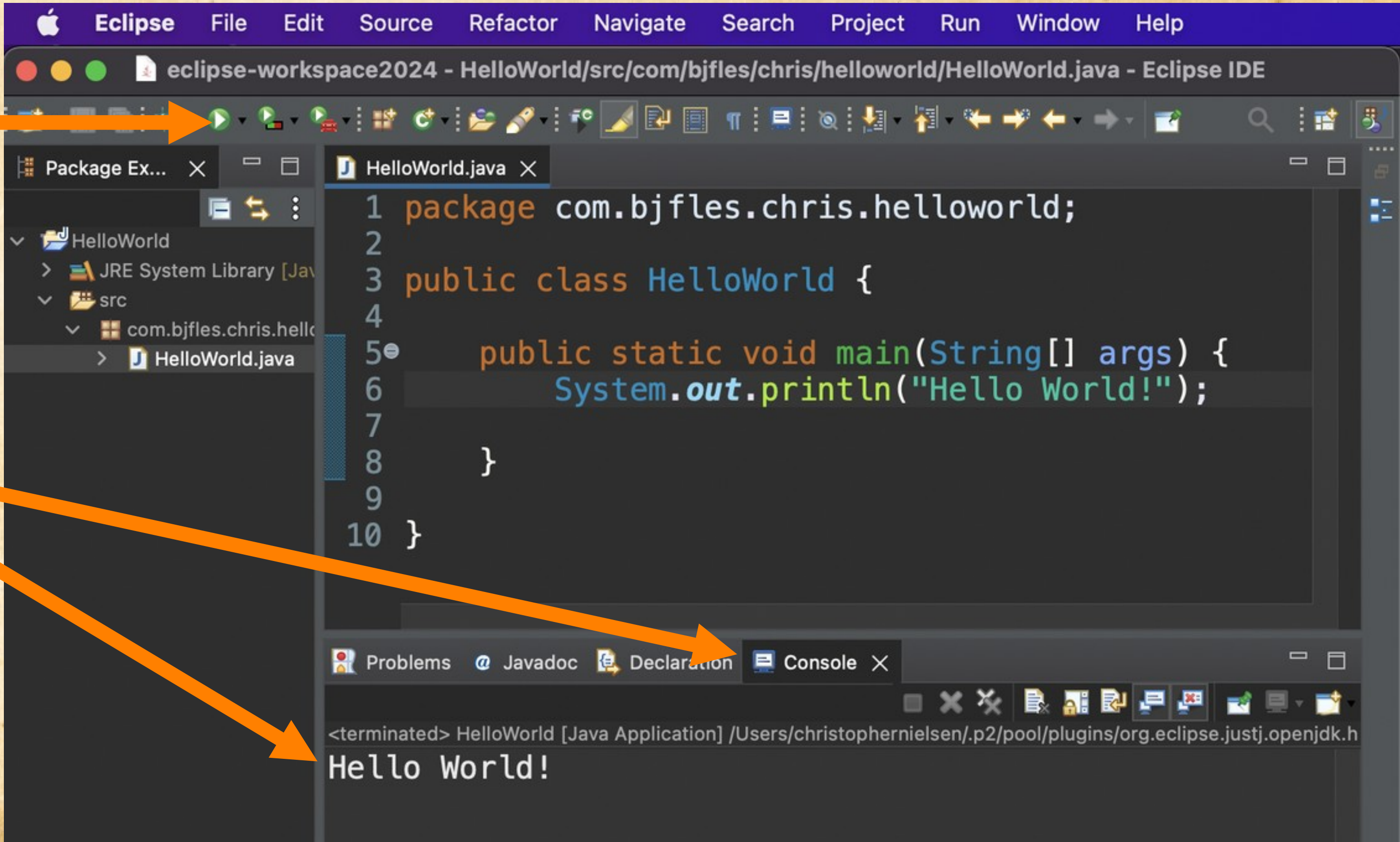
- Review of Number Systems
- How to Store a Binary Integer in a Computer
- **Java `int` type**

Java **`int`** Type

Ensure you were able to get the "`HelloWorld`" assignment completed.

Click here to run.

Check the output in the console.

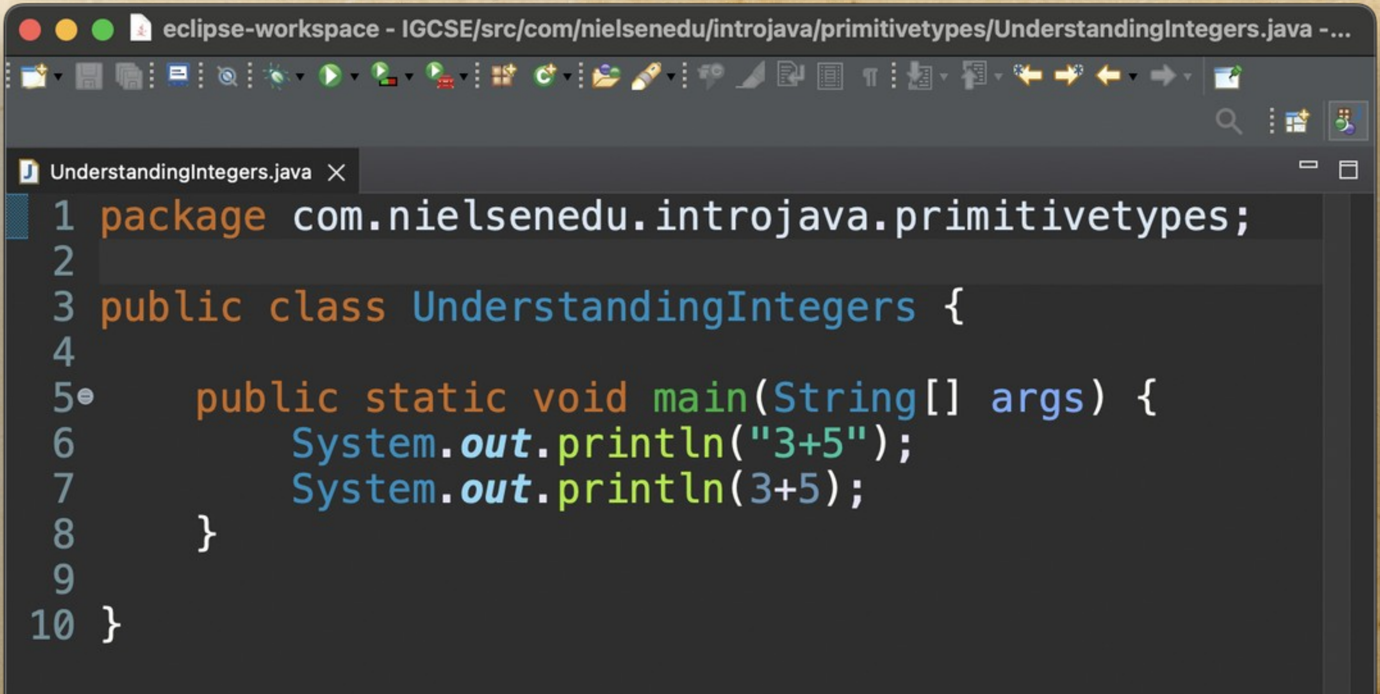


```java
package com.bjfles.chris.helloworld;

public class HelloWorld {

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

    }

}
```

```
<terminated> HelloWorld [Java Application] /Users/christophernielsen/.p2/pool/plugins/org.eclipse.justj.openjdk.h
Hello World!
```

Java **`int`** Type

- Create a new class named “`UnderstandingIntegers`”
  - What output do you expect from the program, below?



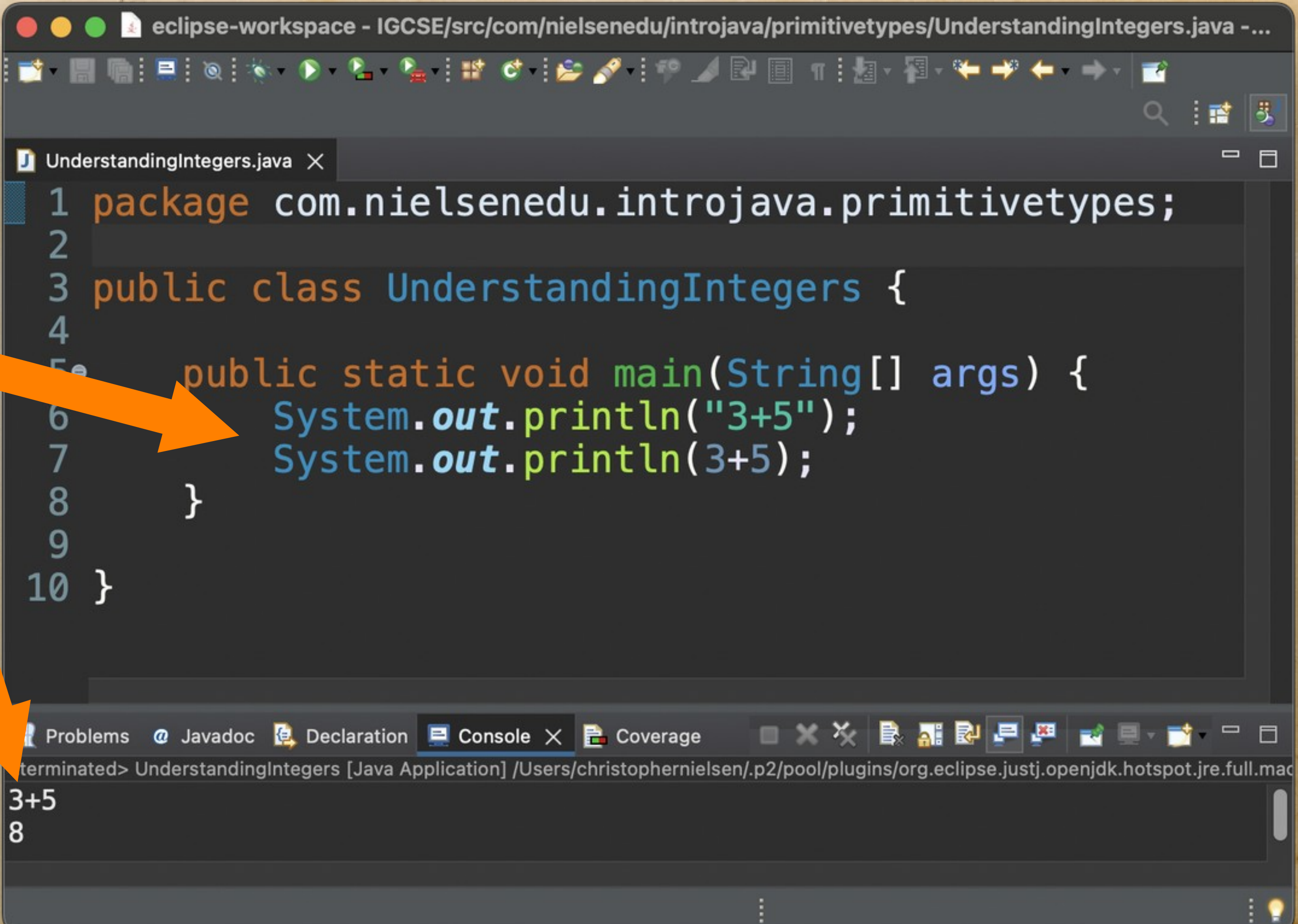
eclipse-workspace - IGCSE/src/com/nielsenedu/introjava/primitivetypes/UnderstandingIntegers.java -...

UnderstandingIntegers.java

```java
package com.nielsenedu.introjava.primitivetypes;

public class UnderstandingIntegers {

    public static void main(String[] args) {
        System.out.println("3+5");
        System.out.println(3+5);
    }

}
```

Java **`int`** Type

Compare


eclipse-workspace - IGCSE/src/com/nielsenedu/introjava/primitivetypes/UnderstandingIntegers.java -...
UnderstandingIntegers.java
Problems
Javadoc
Declaration
Console
Coverage

```java
package com.nielsenedu.introjava.primitivetypes;

public class UnderstandingIntegers {

    public static void main(String[] args) {
        System.out.println("3+5");
        System.out.println(3+5);
    }

}
```

<terminated> UnderstandingIntegers [Java Application] /Users/christophernielsen/.p2/pool/plugins/org.eclipse.justj.openjdk.hotspot.jre.full.mac

```
3+5
8
```

Java `int` Type

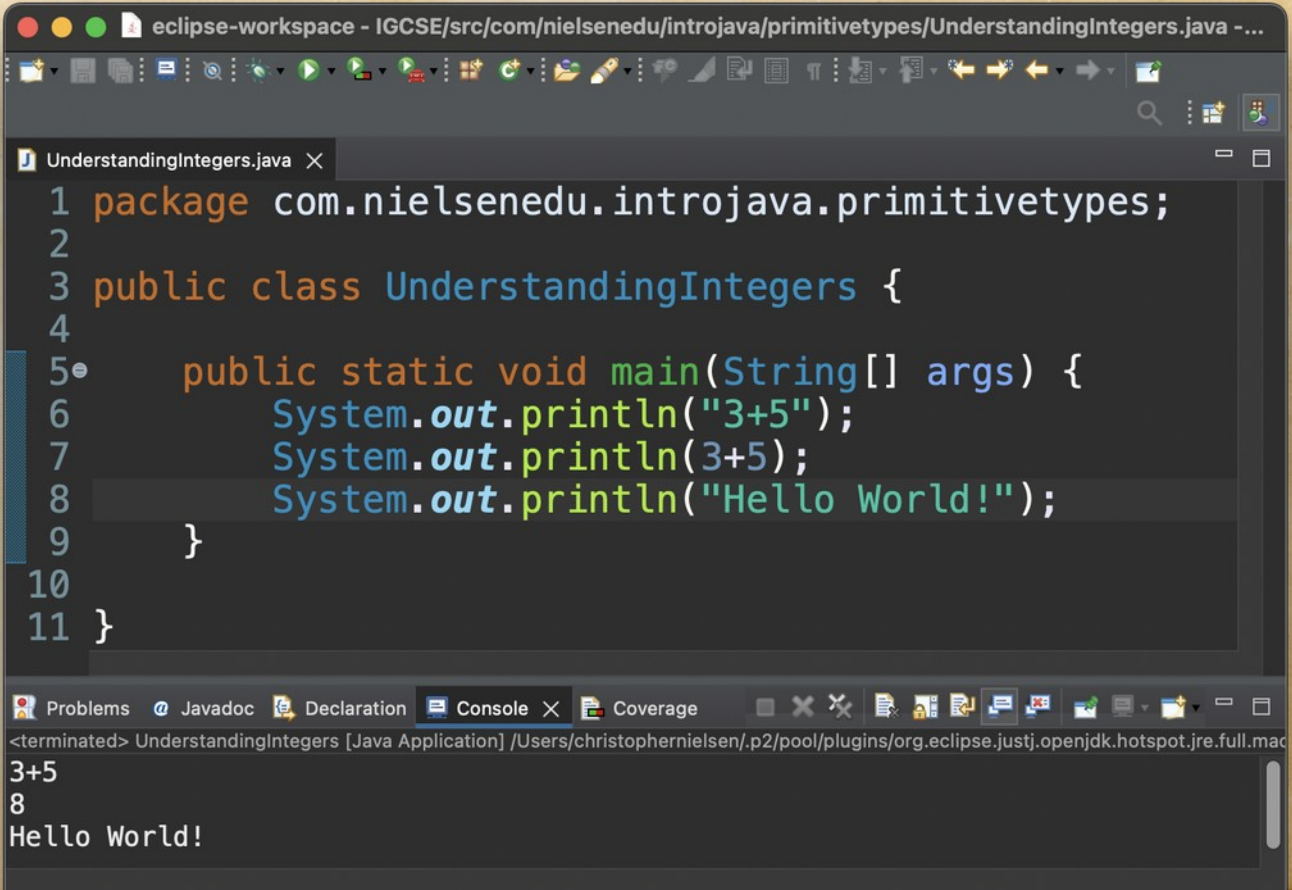
- Anything enclosed double quotation marks (") is NOT considered a number by Java, it is considered a `String`.
  - We will learn about the `String` type later.
  - `System.out.println("3 + 5")` will print exactly what is found within the quotation marks: `3 + 5`.

Java **`int`** Type

- Integers that are not enclosed double quotation marks (`"`) are considered ***integer literals***.
  - Operations, such as addition, can be performed on these integers.
  - `System.out.println(3 + 5)` will perform the addition calculation, then print the result: `8`.

Java **`int`** Type

- We’ll add more lines to our `UnderstandingIntegers` class...


eclipse-workspace - IGCSE/src/com/nielsenedu/introjava/primitivetypes/UnderstandingIntegers.java -...
UnderstandingIntegers.java
Problems
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```java
package com.nielsenedu.introjava.primitivetypes;

public class UnderstandingIntegers {

    public static void main(String[] args) {
        System.out.println("3+5");
        System.out.println(3+5);
        System.out.println("Hello World!");
    }

}
```

```
<terminated> UnderstandingIntegers [Java Application] /Users/christophernielsen/.p2/pool/plugins/org.eclipse.justj.openjdk.hotspot.jre.full.mac
3+5
8
Hello World!
```

Java **int** Type

- Add each line to your UnderstandingInteger class and observe the output.

```
System.out.println("Hello World!");

System.out.println("Hello " + "World!");

System.out.println("Hello " + World);

System.out.println("3 + 5");

System.out.println("3" + "5");

System.out.println(3 + 5);
```

Java **int** Type

- Add each line to your UnderstandingInteger class and observe the output.

```
System.out.println("Hello World!");

System.out.println("Hello " + "World!");

System.out.println("Hello " + World);

System.out.println("3 + 5");

System.out.println("3" + "5");

System.out.println(3 + 5);
```

```
Hello World!

Hello World!



3 + 5

35

8
```

Java **`int`** Type

```
System.out.println("Hello " + 3);

System.out.println("Hello " + 3 + 5);

System.out.println("Hello " + (3 + 5) );

System.out.println(3 + 5 + " Hello");

System.out.println(3 + (5 + " Hello") );
```

Java **int** Type

```
System.out.println("Hello " + 3);

System.out.println("Hello " + 3 + 5);

System.out.println("Hello " + (3 + 5) );

System.out.println(3 + 5 + " Hello");

System.out.println(3 + (5 + " Hello") );
```

```
Hello 3

Hello 35

Hello 8

8 Hello

35 Hello
```

The addition operation is performed from left to right.

Primitive Types

Integers