CS1101 Programming and Problem Solving

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Spring 2023

Logistics

- **ZY-1** and **ZY-2A** on **zyBook > Assignments**
  - Due: Saturday, Jan 21, at 11:59pm

- **PA01 – W, A, B, C** on **zyBook > Chap 11**
  - Due: Thursday, Jan 26, at 11:59pm

11.3 PA01-W: String Input/Output (5 pts) Lab
11.4 PA01-A: Read Programming Style Guide Document (5 points) Lab
11.5 PA01-B: Basic Input/Output (15 pts) Lab
11.6 PA01-C: Eiffel Tower (15 points) Lab

Recap – Expression

A simple value or set of operations that produces a value

- **Operator** → indicates the operation to be performed
- **Operand** → value in the expression

Q: Evaluate the following expressions

- `2 + 2.2 + 2 * 2 + 2` → **`10.2`**
- `2 + (int) 2.2 + 2 * 2 + 2` → **`10`**
- `2 + "(int) 2.2" + 2 * 2 + 2` → **`"2(int) 2.242"`**

```
Step 1: Evaluate 2 * 2
      → 2 + "(int) 2.2" + 4 + 2

Step 2: Concatenate 2 + "(int) 2.2"
      → "2(int) 2.2" + 4 + 2

Step 3: Concatenate "2(int) 2.2" + 4
      → "2(int) 2.24" + 2

Step 4: Concatenate "2(int) 2.24" + 2
      → "2(int) 2.242"
```

More Practice on String Concatenation

- `"hi " + "there"` → `"hi there"`
- `"hello" + 2023` → `"hello2023"`
- `"abc" + 1 + 2` → `"abc12"` ("abc" + 1 is evaluated first)
- `1 + 2 + "abc"` → `"3abc"` (1 + 2 is evaluated first)
- `"abc" + 9 * 5` → `"abc45"`
- `"1" + 1` → `"11"`
- `4 - 1 + "abc"` → `"3abc"`

The code works, but is redundant

( ) are used to wrap the expressions so that the numbers can be added up first

```
public class Receipt {
    public static void main(String[] args) {
        // Calculate total owed, assuming 7% tax and 18% tip.
        System.out.println("Subtotal: " + (38.0 + 40.0 + 30.0));
        System.out.println("Tax: " + ((38.0 + 40.0 + 30.0) * 0.07));
        System.out.println("Tip: " + ((38.0 + 40.0 + 30.0) * 0.18));
        System.out.println("Total: " + ((38.0 + 40.0 + 30.0) +
                                        (38.0 + 40.0 + 30.0) * 0.07 +
                                        (38.0 + 40.0 + 30.0) * 0.18));

    }
}
```

Subtotal

tax

tip

Variables

zyBook Chap 2.3, 2.4

Variable

A variable is a **memory location** with a **name** and a **type** that stores a **value**.

- E.g., a variable year of type int and a value of 2023

Steps for Using a Variable

1. **Declare** variable
   - Specify its **type** and **name**
2. **Initialize** variable
   - Store a **value** into it
3. **Use** variable
   - Use it as part of an expression/argument

Step 1 – Declare Variable

- The variable declaration sets aside memory for storing a value
- Syntax: **<type> <varName>;** (stores no value yet)

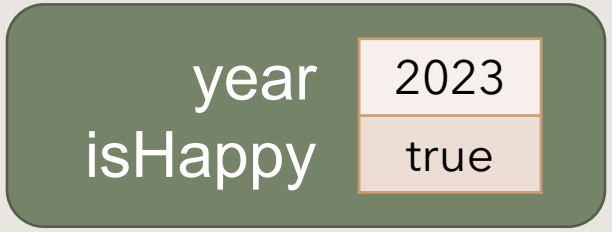
```
int year;
boolean isHappy;
```

- Naming convention:
  - Start with lowercase letters, capitalize the first letter of the attached words

Step 2 – Assign Value to Variable

- Variable assignment stores a value into a variable
  - The value can be a number or an expression
  - The first time a value is assigned to a variable is also known as initializing the variable
- Syntax: **`<name> = expression;`**
  - read as "<name> **gets** expression" OR "<name> is **assigned** expression"
  - The **=** sign is the command for **assignment**.

```
year = 2023;
isHappy = true;
```



Combine Declaration & Initialization

- You can declare and initialize a variable in a single statement

```
<type> <name> = expression;
```

```
// Approach 1
int year;    // Declare
year = 2023; // Initialize


// Approach 2 – Usually preferred
int year = 2023;    // Declare and initialize
```

Step 3 – Use Variable

- Once given a value, a variable can be used in expressions:

```
int x = 4;
System.out.println("The value of x is: " + x); // The value of x is: 4
```

- We can assign a value to a variable more than once:

```
int x = 4;  // x = 4
x = 4 + 5;  // x = 9
```

- We can reassign the value based on the variable's current value:

```
int x = 4;  // x = 4
x = x + 4;  // x = 8
```

The **right-hand side** expression is **evaluated first**, and then its result is **assigned** to the variable **on left**.

Q: Find out the values of the integers, a, b, c, and d.

➤JAVA

```java
int a = 2;
int b = 3;
int c = 4;
int d = a + b + c;    // d = 2 + 3 + 4 = 9

a = d - a - b;        // a = 9 - 2 - 3 = 4
b = d - b - c;        // b = 9 - 3 - 4 = 2
c = d - a - c;        // c = 9 - 4 - 4 = 1

System.out.println("a: " + a);
System.out.println("b: " + b);
System.out.println("c: " + c);
System.out.println("d: " + d);
```

Scanners

zyBook 1.5

Scanner

What does a `Scanner` do?

- Reads input from various sources (console, files, etc.) and turns the input into data that can be used by your program.

What is the benefit of a `Scanner`?

- Interactive programs!

Interactive Programs

- User output: **`System.out`**
  - `print` and `println` methods print text to the console/terminal

- User input: **`System.in`**
  - Cannot be used directly
  - Use the `Scanner` class to understand the user's input

Importing class – Java Class Libraries

- To use Scanner, need to **import** the class from the **Java Class Library**
  - Java Class Library: a set of Java classes available for you to use
    - Classes are organized into groups, which are called **packages**

- **Import declaration** – goes at the top of your program file
  - `import <package name>.*;`
  - `import <package name>.<class name>;`

Importing class – Scanner

- Requires import
  - `import java.util.*;` OR
  - `import java.util.Scanner;`

- Construction of `Scanner` for console
  - `Scanner <name> = new Scanner(System.in);`
    - Common names: input, console, scnr, …

Tokens

A **single** element of input (e.g., **one word**, **one number**)

- The `Scanner` object reads in user input as tokens
- **Tokens** are separated by **whitespace**, e.g.,
  - Space
  - Tab
  - Newline character '\n'

Scanner Methods

Methods that can be run on Scanner objects.

Method	Description
`nextInt()`	Reads and returns user input as an **int**
`nextDouble()`	Reads and returns user input as a **double**
`next()`	Reads and returns user input as a **String**
`nextLine()`	Reads and returns and **entire line** of user input as a **String**

- Methods wait for the user to type the input and press <Enter>
- Value typed by the user is returned to your program
- You want to prompt the user for input

```java
import java.util.Scanner;

/**
 * Class gets input from users on the number of credit hours they are currently taking.
 *
 * @author Gina Bai
 */
public class CreditHour {

    public static void main(String[] args) {
        // Construct the scanner, which is called input, for the input from console
        Scanner input = new Scanner(System.in);

        // Prompt user for credit hours
        System.out.println("How many credit hours are you currently taking?");

        // Read in the number of credit hours as an integer, and stored it to int creditHour
        int creditHour = input.nextInt();

        // Print message
        System.out.println("You are currently taking " + creditHour + " credit hours.");
    }
}
```

Always do
Step 1: prompt for input
Step 2: read in the input

Error Handling

- `InputMismatchException`
  - If the next token **does not match** the pattern for **the expected type**, or is out of range for the expected type

- `NoSuchElementException`
  - If the input is exhausted

Escape Sequences

zyBook Chap 2.8

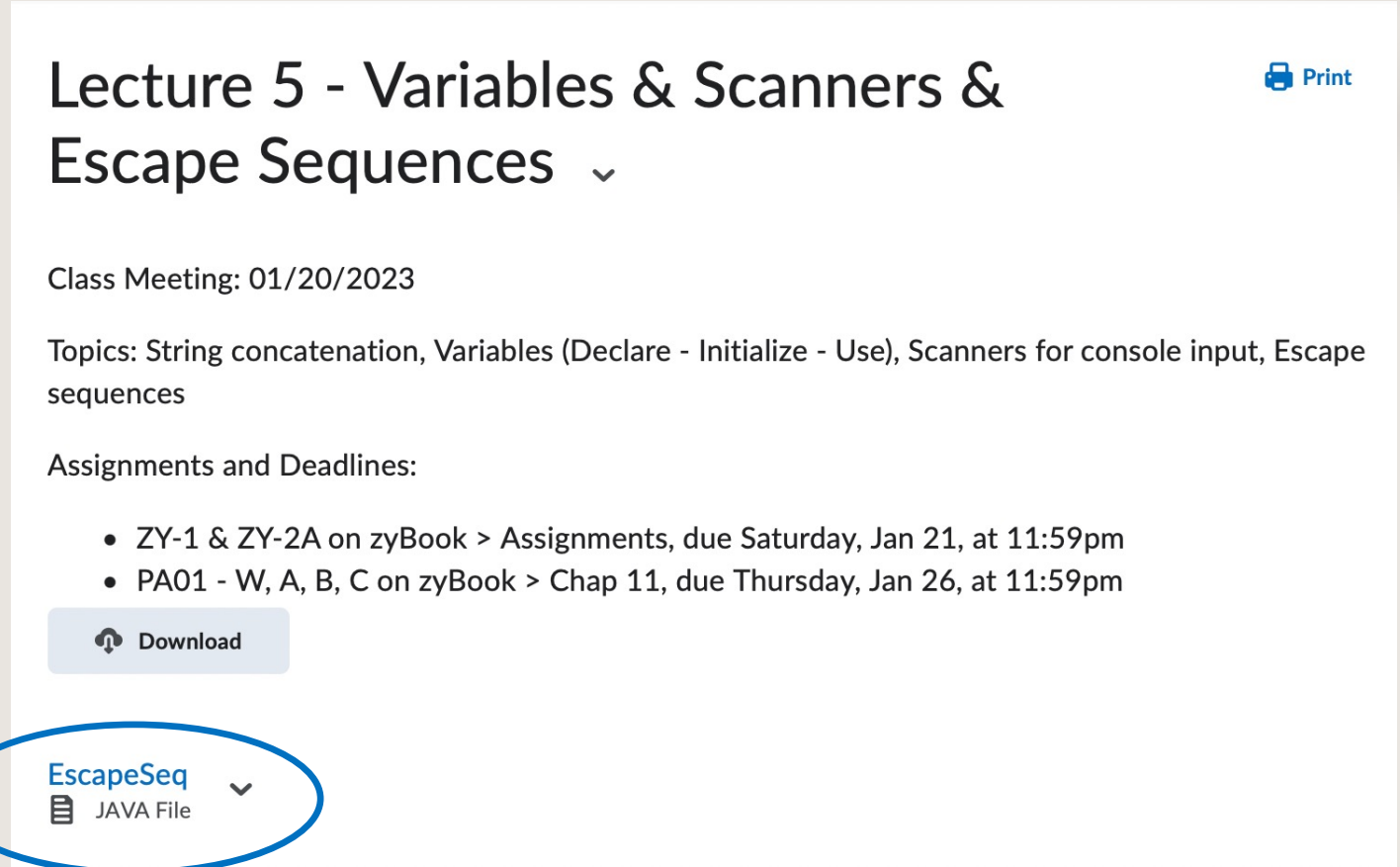
Escape Sequence

- A two-character sequence starting with a backslash \ that represents a special character
- Has special meaning to the compiler

Escape Sequences	Description
`\t`	Insert a **tab** in the text at this point
`\n`	Insert a **newline** in the text at this point
`\'`	Insert a **single quote** character in the text at this point
`\"`	Insert a **double quote** character in the text at this point
`\\`	Insert a **backslash** in the text at this point

In-class Coding Practice

- Brightspace > Lectures > Milestone 1 > Lecture 5



```java
public class EscapeSeq {

    public static void main(String[] args) {

        System.out.println("=== Using \\\" ===");
        System.out.println( "\"Computers are incredibly fast, accurate, and stupid. " +
                            "Human beings are incredibly slow, inaccurate, and brilliant. " +
                            "Together they are powerful beyond imagination.\"- Albert Einstein");

        System.out.println("=== Using \\\' ===");
        System.out.println("char is surrounded with single quotes (\'\')");

        System.out.println("=== Using \\n ===");
        System.out.println("Hello\nWorld");

        System.out.println("=== Using \\t ===");
        System.out.println("Hello\tWorld");

        System.out.println("=== Using double backslashes \\\\ to print a single backslash \\ ===");
    }
}
```

Sample Solution

```
$ javac EscapeSeq.java
$ java EscapeSeq
=== Using \" ===
"Computers are incredibly fast, accurate, and stupid. Human beings are incredibly slow,
inaccurate, and brilliant. Together they are powerful beyond imagination."- Albert Einstein
=== Using \' ===
char is surrounded with single quotes ('')
=== Using \n ===
Hello
World
=== Using \t ===
Hello World
=== Using double backslashes \\ to print a single backslash \ ===
```