CSC 125
Object Oriented Programming

Ch02_Elementary programming

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Variables

- A variable is used to store a piece of data for processing.
- It is called variable because you can change the value stored.
- In reality, a variable is a named storage (memory) location.
- Each variable has a name, a data type, an address, and a value.
- The name (aka. identifier) is needed to uniquely identify and reference each variable.
  - You can use its name to save or retrieve its value.
- A variable can only store value of a particular data type.
  - For example, an `int` variable can store an integer value such as 12 but not a character such as “A”.

Variables (cont.)

- The frequently-used Java data types are:
  - int: to store integers such as 34 and -45.
  - double: to store real numbers such as 34.58, -58.9
  - char: to store a single character, such as 'a', '8'. A char is enclosed by a pair of single quotes.
  - string: to store texts such as “Hello". Strings are enclosed within a pair of double quotes.
- The syntax for declaring a variable is:

```
datatype variableName;
```

or `datatype identifier;`

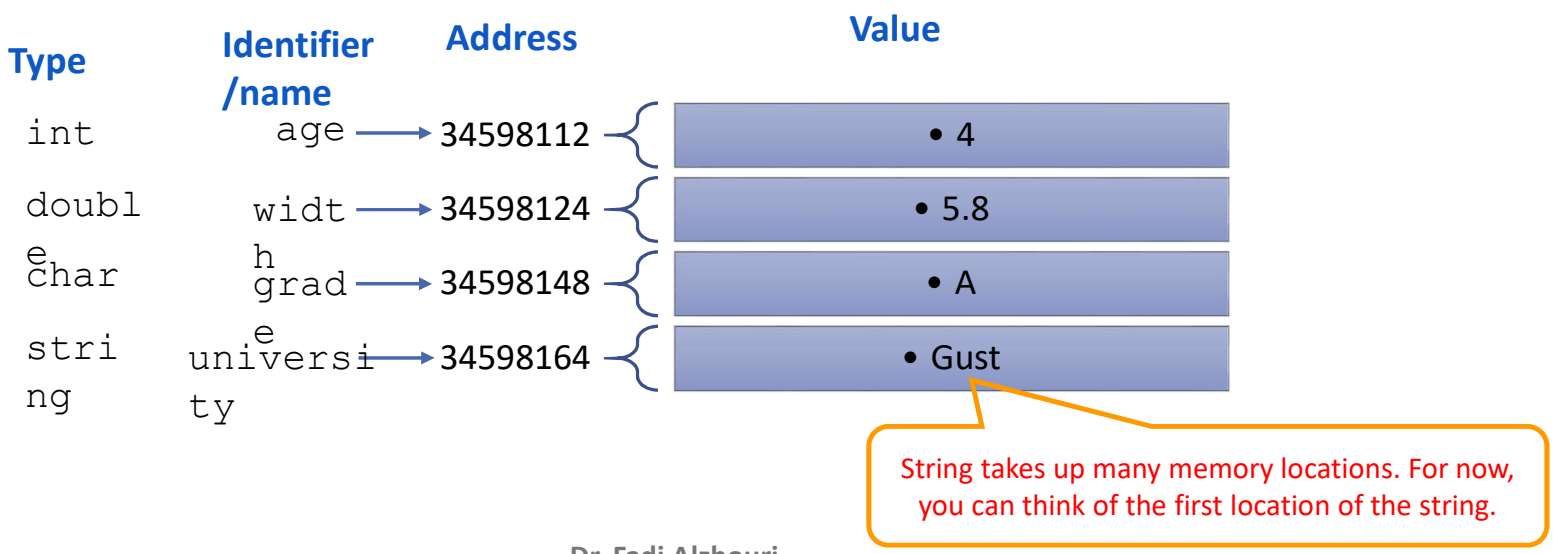
- To declare multiple variables of the same type using one line:

```
datatype identifier1, identifier2,…, identifierN;
```

Variables (cont.)

- Examples:

```
int age; // declare an integer variable named age.
char grade; // declare a character variable named grade.
```



Identifiers (or Names)

- Identifiers are the names that identify variables, methods, and classes.
- All identifiers must obey the following rules in Java:
  - It is a sequence of characters that consists of letters, digits, underscores (_), and dollar signs ($).
  - It must start with a letter, an underscore (_), or a dollar sign ($) but it cannot start with a digit.
  - It cannot be a reserved word (such as class).
  - An identifier cannot be true, false, or null.
  - It can be of any length.

Naming Conventions

- Choose meaningful and descriptive names.
- Class names:
  - Capitalize the first letter of each word in the name.
  - For example, the class name `ComputeExpression`.
- Variable name is made up of one or several words with no spaces between words.
  - The first word is in lowercase, while the remaining words are initial-capitalized.
  - This convention is called ***camel-notation.***
  - For examples: radius, area, fontSize, studentName.

Naming Conventions (cont.)

- Java is case-sensitive.
- This means that identifiers (names) are treated as distinct if they differ in case.
- Example: these two are not considered the same:

```
firstName;
firstname;
```

Naming Conventions (cont.)

- Naming examples: which identifier (name) is valid?

```
num 1
1day
myage
$sign
last_Name
_name
first Name
x*y
```

Constants

- Constant indicates a data element whose value cannot change.
- It is declared with the keyword final.
- Their values cannot be changed during program execution.
- A constant must be declared and initialized in the same statement.
- By convention, all letters in a constant are in uppercase.
- Syntax:

```
final datatype identifier = value;
```

- For examples:

```
    final double PI = 3.14159265;  // Declare and
initialize the constant
```

Assignment (=)

- An assignment statement evaluates the RHS (Right-Hand Side) and assigns its value to the variable of the LHS (Left-Hand Side).
- It does not mean equality. It is called assignment operator
- Syntax:

```
        variable = value;
    or variable = expression;
```

- For examples:

```
int number1;
number1 = 5;
int sum;
sum = number1 + 1;
```

Assign value

Assign expression

Print text messages:

- Use `System.out.println()` or `System.out.print()` to print text messages to the display console.

- Syntax:
  - `System.out.println(aString);` //prints aString, and advances the cursor to the beginning of the next line.
  - `System.out.print(aString);` // prints aString but places the cursor after the printed string.
  - `System.out.println();` // without parameter prints a newline.

Exercise 1:

- Write a Java program to calculate the area of a circle given its radius.

Exercise 1(cont.):

- Write a Java program to calculate the area of a circle given its radius.

```java
/*****************************************************************
Declaring and Using Variables
Author: Dr. Fadi Alzhouri
*****************************************************************/
public class Main
{
    public static void main(String[] args) {

        double radius; // Declare radius
        double area; // Declare area

        radius = 5; // radius is 5

        area = radius * radius * 3.14159; // Compute area

        // Display results
        System.out.println("The area of the circle is " + area);
    }
}
```

Declare variables

```
The area of the circle is 78.53975
```

Exercise 2:

- Write a Java program to calculate the area of a circle given its radius and PI.

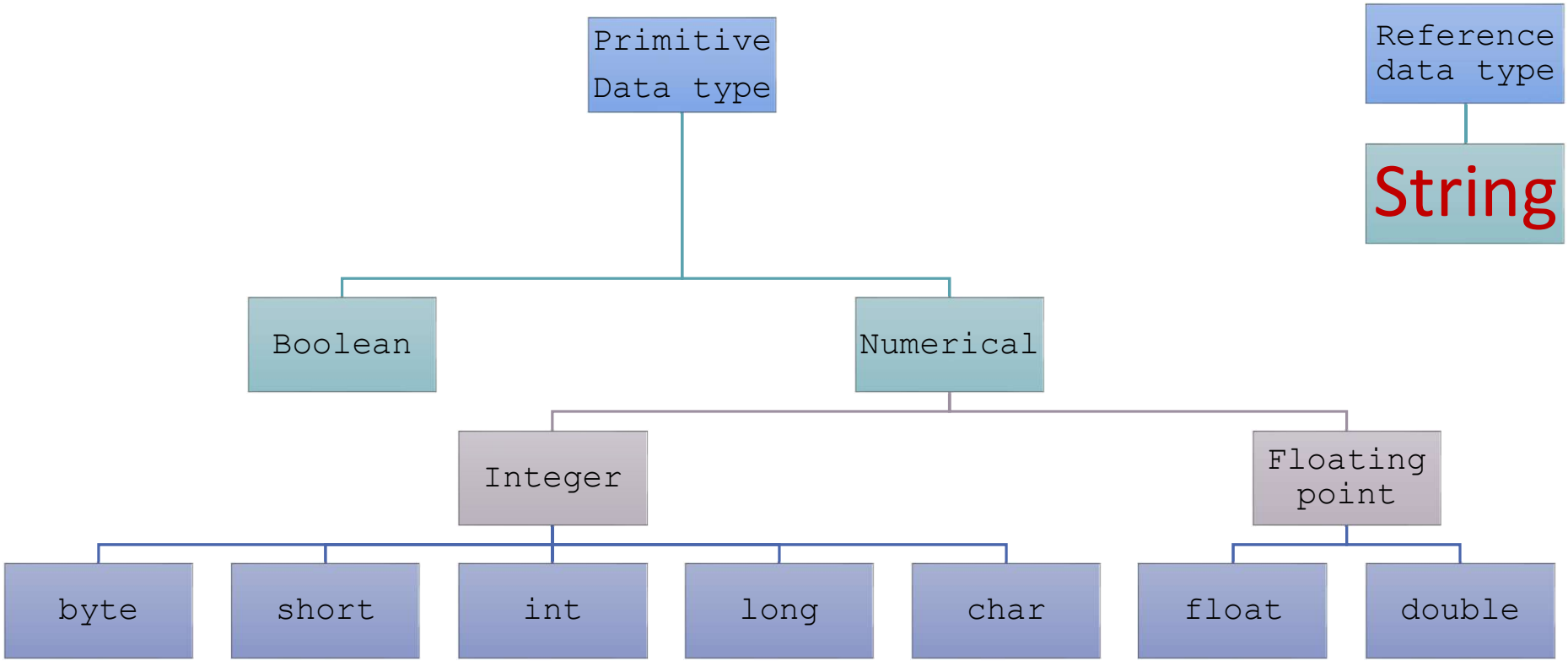
```java
/*****************************************************************
Declaring and Using Variables
Author: Dr. Fadi Alzhouri
Example 2: constant
*****************************************************************/
public class Main
{
    public static void main(String[] args) {

        final double PI = 3.14159;

        double radius; // Declare radius
        double area; // Declare area

        radius = 5; // radius is 5

        area = radius * radius * PI; // Compute area

        // Display results
        System.out.println("The area of the circle is " + area);
    }
}
```

Declare constant

Data Types:

- The Data type determines:
  - The size of the variable.
  - The range of its values
  - And the set of operations that can be applied.

Data Types in Java:



Numeric Types:

1 byte

	Name	Range	Storage Size	
Integer	byte	-2^7 to 2^7-1 (-128 to 127)	8-bit signed	byte type
	short	-2^{15} to $2^{15}-1$ (-32768 to 32767)	16-bit signed	short type
	int	-2^{31} to $2^{31}-1$ (-2147483648 to 2147483647)	32-bit signed	int type
	long	-2^{63} to $2^{63}-1$ (i.e., -9223372036854775808 to 9223372036854775807)	64-bit signed	long type
real	float	Negative range: $-3.4028235E+38$ to $-1.4E-45$ Positive range: $1.4E-45$ to $3.4028235E+38$	32-bit IEEE 754	float type
	double	Negative range: $-1.7976931348623157E+308$ to $-4.9E-324$ Positive range: $4.9E-324$ to $1.7976931348623157E+308$	64-bit IEEE 754	double type
	char	16 bits		
	boolean	true/false		

8 bytes

1 byte

Int Data Type:

- Write a program to calculate the area of a rectangle. Assume its width is 10 and height is 5.

```java
/*********************************************************************
Declaring and Using Variables
Author: Dr. Fadi Alzhouri
Example 3: int data type
*********************************************************************
public class Rectangle
{
    public static void main(String[] args) {

        int width = 10;
        int height = 5;
        int area;

        area = width * height;
        // Display results
        System.out.println("The area of the rectangle is " + area);
    }
}
```

```
The area of the rectangle is 50
```

Input From Keyboard: "Scanner"

- You can read input from keyboard via a class called Scanner in package java.util
- To import this object, use the following statement:

```
import java.util.Scanner;
```

- To create a scanner object, use the following:

```
Scanner input = new Scanner(System.in);
```

- To prompt the user to enter an integer number.

```
int number = input.nextInt();
```

Integer data type

Input From Keyboard: "Scanner“ (cont.)

- You can also use the methods listed in Table 2.2 to read a number of the other data types.

TABLE 2.2 Methods for `Scanner` Objects

Method	*Description*
`nextByte()`	reads an integer of the `byte` type.
`nextShort()`	reads an integer of the `short` type.
`nextInt()`	reads an integer of the `int` type.
`nextLong()`	reads an integer of the `long` type.
`nextFloat()`	reads a number of the `float` type.
`nextDouble()`	reads a number of the `double` type.

If you enter a value with an incorrect range or format, a runtime error would occur.

Int Data Type Again:

- Write a program to calculate the area of a rectangle. Prompt the user to enter the width and the height.

Int Data Type Again (cont.):

```java
/*****************************************************************
Declaring and Using Variables
Author: Dr. Fadi Alzhouri
Example 4: read integer value from keyboard
*****************************************************************/
import java.util.Scanner;
public class Rectangle2
{
    public static void main(String[] args) {
        // Create a Scanner object
        Scanner input = new Scanner(System.in);

        // Prompt the user to enter a width
        System.out.print("Enter a width: ");
        int width = input.nextInt();
        // Prompt the user to enter a height
        System.out.print("Enter a height: ");
        int height = input.nextInt();
        int area;

         area = width * height;
         System.out.println("The area of the rectangle is " + area);
    }
}
```

Part of java API

Create scanner object

call nextInt method

```
Enter a width: 12
Enter a height: 4
The area of the rectangle is 48
```

Float and Double Data Types: Real Values

- Float and Double are used to represent real numbers (decimal values).
- They allow you to work with fractions, scientific measurements.
- Float is a single precision (32 bit = 4 bytes)
- Double is a double precision (64 bit = 8 bytes).
- The double type values are more accurate than the float type values
- Recommendation: use double in general. Use float only if you wish to conserve storage and do not need the precision of double.

Float and Double Data Types: Real Values (cont.)

- Write a code that calculates the area of any circle.

Float and Double Data Types: Real Values (cont.)

```java
*****************************************************************/
import java.util.Scanner;
public class Main
{
    public static void main(String[] args) {

         final double PI = 3.14159;

        // Create a Scanner object
        Scanner value = new Scanner(System.in);

        // Prompt the user to enter a radius
        System.out.print("Enter a width: ");
        double radius = value.nextDouble();

        double area = radius * radius * PI; // Compute area

        System.out.println("The area for the circle of " + " radius "
        + radius + " is " + area);
    }
}
```

```
Enter a width: 5.8
The area for the circle of  radius 5.8 is 105.6830876
```

Boolean Data Type:

- It only accepts two values: true and false
- It is mostly used for control or decision-making structures.
- It is not applicable to arithmetic operations (such as addition and multiplication).

```
8  ************************************************************
9  public class Main
10 {
11     public static void main(String[] args) {
12         boolean active = true;
13         System.out.println("active is " + active);
14     }
15 }
```

```
active is true
```

Char Data Type:

- char: meant for a single character, such as 'a', ’8’, and ‘$’.
- Data type char represents an individual character value for example a letter, digit, or special symbol that can be typed at the keyboard.
- A char is enclosed by a pair of single quotes.
- Note: char '1' is different from int 1.
- A char is 16-bit character or 16-bit unsigned integer.
- char can be treated as its underlying integer in the range of [0, 65535] in arithmetic operations.
- You can treat a char as an int, you can also assign an integer value in the range of [0, 65535] to a char variable.

Char Data Type (cont.):

- Example:

```
10 public class Main
11 {
12     public static void main(String[] args) {
13
14         char grade = 'A';
15         System.out.print("Your grade is " + grade);
16     }
17 }
```

```
Your grade is A
```

Char Data Type (cont.):

- Example 2:

```java
/*************************************************************
Declaring and Using Variables
Author: Dr. Fadi Alzhouri
Example 6: char vs integer
*************************************************************/
public class Main
{
    public static void main(String[] args) {

        char grade = 'A';
        System.out.println("Your grade is " + grade);

        grade = 100;
        System.out.println("Your grade is " + grade);
    }
}
```

```
Your grade is A
Your grade is d
```

Variable Initialization & Literals:

- Initialization: Assigning a value to a variable at the time of declaration or before its use. This value is called literal.
- It can be assigned directly to a variable; or used as part of an expression.

```
char grade = 'A';                    // character literal
int sum = 0;                         // integer literal
int number = -20;                    // integer literal
double total = 99.999;               // double literal
total = total + 32.45;               // double literal

boolean isValid = true;
```

Literal

String Data Type:

- A String is a sequence of characters enclosed by double quotes (e.g., "Hello").
- String is not a primitive data type.
- Examples:

```
String course = “OOP";
String grade = “A”;
String greeting = “Hi folks”;
String street = “4”;
```

First letter must be capitalized

String Data Type (cont.):

- Example 2:

```java
/*************************************************************
Declaring and Using Variables
Author: Dr. Fadi Alzhouri
Example 7: string type
*************************************************************/
public class Main
{
    public static void main(String[] args) {

        String firstName = "Sara";
        String lastName = "Adam";
        System.out.println("Your name is "+ firstName + " " + lastName);
    }
}
```

```
Your name is Sara Adam
```