Introductory Programming and Object-oriented Concepts Using Java

Control Structures
Selection

Unit 3

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Control Structures

- Sequence
  - One statement at a time
  - Top down
- **Decision – branching**
- Iteration – loop, iteration, repetition

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Using Scanner class for Input

- Alternate way to input values
- Makes use of pre-written code in a class
- Scanner class is in a package (folder) called java.util

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Input Using Scanner Class

```
import java.util.Scanner;

public class ScannerInput {
  public static void main(String[ ] args) {
      Scanner console= new Scanner(System.in);
      System.out.print("Enter name: ");
      String name = console.nextLine();
      System.out.println( name );
  }
}
```

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Other Input methods in Scanner class

- To read in an integer value

  int num = console.nextInt();

- To read in a double value

  double d = console.nextDouble();

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Scanner class Example – Body Mass Index (BMI)

import java.util.Scanner;
public class ScannerInput {
  public static void main(String[ ] args) {
        Scanner console= new Scanner(System.in);
        System.out.print("Enter your weight: ");
        double wt = **console.nextDouble();**
        System.out.print("Enter your height: ");
        double ht = **console.nextDouble();**
        double bmi = wt / (ht * ht);
        System.out.println("Your BMI is " + bmi);
  }
}
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Selection statements in Java

- if statement
- if else statement
- nested if else
- switch statement
- conditional expression ? :

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Introduction to Selection

- Problem
  – Refer to slide 6, after displaying the BMI, how do you display if the person is normal weight or overweight?
  – A person is overweight if the BMI is greater than 24.9
- How do we write such statements in Java?

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Selection in Java

- Comparison operators
    >, <, >=, <=, ==, !=
- Result of comparison
    – true, false (not yes, no)
    – boolean data type
    – 5 > 0? true
    – -1 > 0?false
- Java statement
    if (x > 0)

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if statement

if (boolean expression)
{
    statement/s;
}

keyword

- Boolean expression results in true / false
- If result is true, statements in the braces executed.

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Boolean data type

- boolean type
    – 2 values
        - true
        - false
    – Lowercase
- E.g.   boolean result;
            result = 5 > 0;
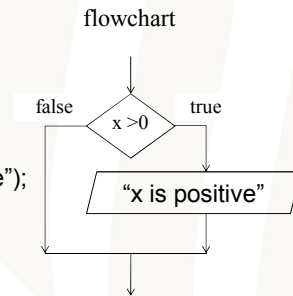   System.out.println(result);

Output: true

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Relational Operators

- greater than   >
    greater than or equal>=
- less than   <
    less than or equal   <=
- equal   ==
    not equal   !=

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Example

```
int x = 5;
if (   x > 0  )
{
   System.out.println("x is positive");
}
```

flowchart

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if else statement

```
int x = 5;
if (   x > 0  )
{
        System.out.println("x is positive");
}
else
{
        System.out.println("x is not positive");
}
```
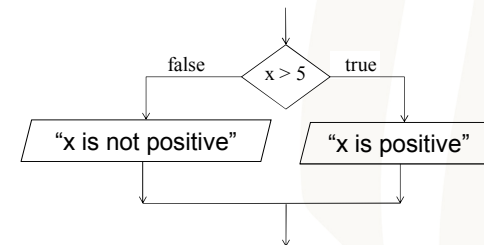
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if else statement

```
int x = 5;
if (   x > 0  )
    System.out.println("x is positive");
else
    System.out.println("x is not positive");
```

• If there is only one statement in the body of an if or else statement, braces are not required.

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if else statement - flowchart

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BMI Example

```
…
double bmi = wt / (ht * ht);
System.out.println("Your BMI is " + bmi);
if ( bmi > 24.9 )
    System.out.println("You are overweight!");
else
    System.out.println("Your weight is normal!");
```

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Equality Operator

- Use == to compare equality for primitive types
  - E.g.   if (x == 0)
  - E.g.   if (gender=='M')

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Character Comparison

- Follows the unicode character set
- Unicode for 'A' is 65, 'a' is 97
- Therefore,
          if ('A' < 'a')
  evaluates to true

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String Comparison

- To compare equality of strings, use .equals() for String types
- Example
  ```
  String gender="male";
  if (gender.equals("male"))
      System.out.println("Need to serve NS");
  ```
- For inequality, use ! equals()
- Example
  ```
  if ( ! gender.equals("female"))
      System.out.println("Need to serve NS");
  ```

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BMI Example – Further classification

- BMI can be further classified as follows:
  - Underweight: less than 18.5
  - Normal weight: 18.5–24.9
  - Overweight: 25–29.9
  - Obesity: 30 or greater
- How do we write java statements to display the above classification based on the BMI?

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Nested If

- Nested selection statements are if statements within a set of if statements.

- You can nest as many if…else statements as you want.

```
if ( < condition1 > ) {
    if ( < condition2 > ) {
        statement1;
    }
    else {
        statement2;
    }
}
else {
    statement3;
}
```

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Example of nested if

```
int x=0;
if ( x > 0)
    System.out.println("positive");
else
    if ( x < 0 )
        System.out.println("negative");
    else
        System.out.println("zero");
```

Nested if inside else

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Another Example

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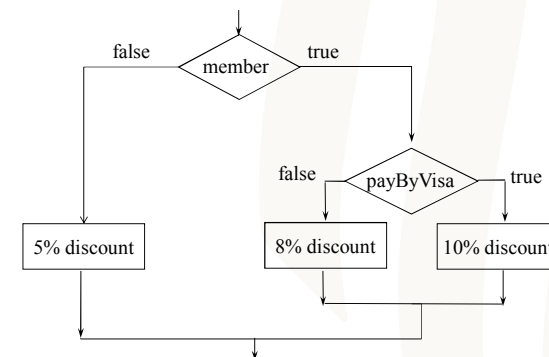
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Nested If

```
if ( member) {
    if ( payByVisa) {
        System.out.println("10% discount");
    } else {
        System.out.println("8% discount");
    }
} else {
        System.out.println("5% discount");
    }
```

* the braces can be omitted, since there is only 1 statement in the body of each if…else block

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BMI Example

```
…
double bmi = wt / (ht * ht);
System.out.println("Your BMI is " + bmi);
if ( bmi < 18.5 )
    System.out.println("You are underweight!");
else if ( bmi < 25)
    System.out.println("Your weight is normal!");
else if ( bmi < 30)
    System.out.println("You are overweight");
else
    System.out.println("You need a lot of exercise!");
```

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Logical Operators

* logic **AND**   &&
* logic **OR** ||
* logic **NOT**   !

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logic AND   &&

Truth Table for **AND**

price is low	book is interesting	buy the book
x	y	x && y
true	true	true
false	true	false
true	false	false
false	false	false

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logic OR ||

Truth Table for **OR**

it is very sunny	it is raining	bring umbrella
x	y	x || y
false	**false**	**false**
true	true	true
false	true	true
true	false	true

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Example – Logical && operator

```
int a = 5;
int b = 4;
int c = 1;
if  (a > b && b > c)
{
        System.out.println("a is the biggest");
}
```

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Example – Logical || operator

```
int a = 5;
int b = 4;
int c = 1;

if ( a > b || a > c )
{
    System.out.println("a is one of the biggest");
}
```

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logic NOT   !

- ! Stands for negation
    - ! true → false
    - ! false → true
- Example
  String reply = "yes";
  if (! reply.equals("yes"))
      System.out.println("reject");

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BMI Example – Validation of Input

- To validate input
  - Both weight and height must be positive

```
…
if ( wt <=0 || ht <=0 )
    System.out.println("Wt and ht must be positive!");
else
{
  double bmi = wt / (ht * ht);
  System.out.println("Your BMI is " + bmi);
  if ( bmi < 18.5 )
    …
}
```

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Example: Using Logical operators

- Display if a integer number is one of the following:
  - positive even
  - negative even
  - positive odd
  - negative odd

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Solution 1: Without Logical Operator

```
if ( num%2==0)
  if (num >= 0)
      System.out.println("+ve even");
  else
      System.out.println("-ve even");
else
  if (num >=0)
      System.out.println("+ve odd");
  else
      System.out.println("–ve odd");
```

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Solution 2: Using Logical Operator

```
if ( num%2==0 && num >= 0)
    System.out.println("+ve even");
else if (num%2==0 && num < 0)
    System.out.println("-ve even");
else if (num%2 != 0 && num >=0)
    System.out.println("+ve odd");
else if ( num%2 != 0 && num < 0)
    System.out.println("–ve odd");
```

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Solution 3: Using Logical Operator

```
if ( num%2==0 && num >= 0)
    System.out.println("+ve even");
else if (num%2==0)
    System.out.println("-ve even");
else if (num >= 0)
    System.out.println("+ve odd");
else
    System.out.println("–ve odd");
```

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Precedence of operators

postfix operators	[ ] . (params) expr++ expr--
unary operators	++expr – –expr +expr -expr ~ !
creation or cast	new (type)expr
multiplicative	* / %
additive	+ -
relational	< > <= >= instanceof
equality	== !=
logical AND	&&
logical OR	||
conditional	? :
assignment	= += -= *= /= %= &= ^=

What is the result of the following expression?
boolean result = 2 * 7 % 6 / 2 +3 > ((3 + 6/2) / 3) / 2 + 3;

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Redundant Comparison

- Comparing boolean variables
    ```
    boolean raining = true;
    if ( raining == true)
        System.out.println("Bring umbrella!");
    ```
- Boolean variables already evaluate to true/false. Use this:
    ```
    if ( raining )
        System.out.println("Bring umbrella!");
    ```

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Redundant Comparison

```
int x = 5;

if (   x > 0   )
    System.out.println("x is positive");
else if ( x <= 0)
    System.out.println("x is not positive");
```

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Redundant Comparison

```
//input from argument
if ( mark >= 0 && mark <50)                    Where?
   System.out.println("fail");
else if ( mark >=50 && mark <=70)
   System.out.println("Credit");
else if ( mark > 70 && mark <= 100)
   System.out.println("Distinction");
```

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The **switch** statement

variable can be any primitive type or a String

```
switch ( variable name )
{
   case value1:     statements;
                    break;
   case value2:     statements;
                    break;
   case value4:     statements;
                    break;         // and so on
   default:         statements;
}
```

*The **default** is optional.

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The **switch** statement

- Example using if … else statement

```
if ( grade == 'A' )
   System.out.println("Premium ");
else if (grade == 'B' )
   System.out.println("Superior");
else if (grade == 'C' )
   System.out.println("Good");
else if (grade == 'D' )
   System.out.println("Acceptable");
else
   System.out.println("Reject");
```
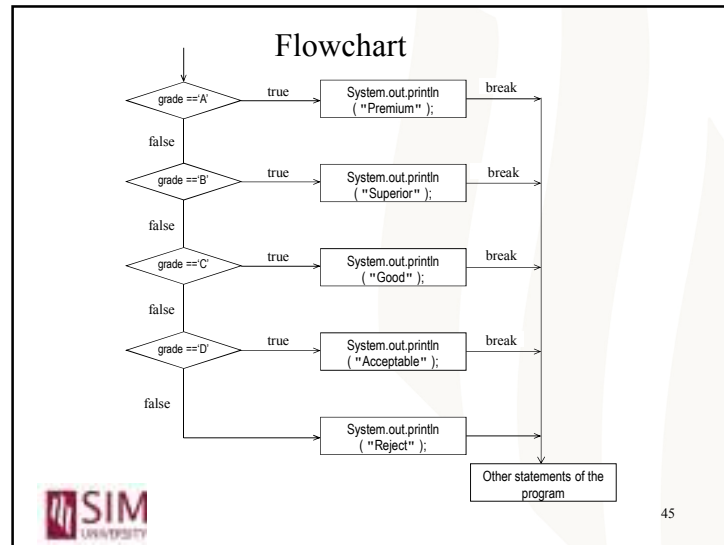
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Using **switch** statement

```
// grade first gets a char value
switch ( grade ) {
   case 'A':  System.out.println("Premium");
              break;
   case 'B':  System.out.println("Superior");
              break;
   case 'C':  System.out.println("Good");
              break;
   case 'D':  System.out.println("Acceptable");
              break;
   default:   System.out.println("Reject");
}
```

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Slide 45 — Flowchart

Flowchart

Slide 46 — The switch statement

The **switch** statement

// grade first gets a char value
switch (grade)
{
   case 'A':   System.out.println("Premium");
               break;
   case 'B':   System.out.println("Superior");
   case 'C':   System.out.println("Good");
               break;
   case 'D':   System.out.println("Acceptable");
               break;
   default: System.out.println("Reject");
}

What is the output?

Slide 47 — Flowchart

Flowchart

Slide 48 — Note on switch statement
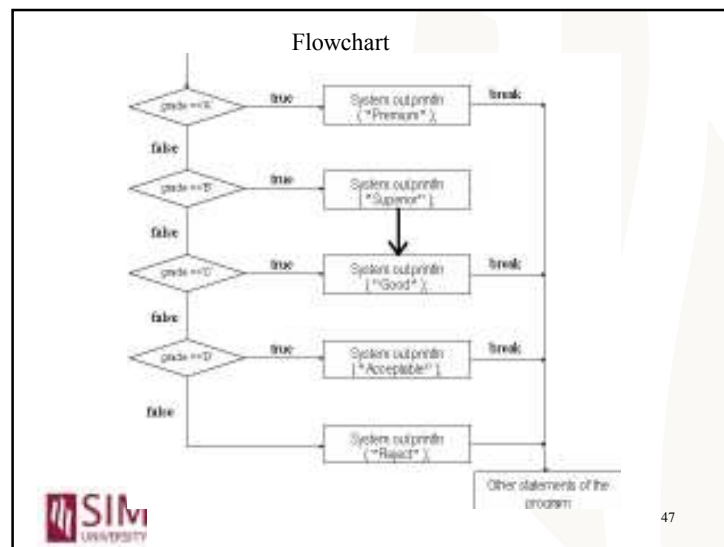
Note on switch statement

- Cannot compare range of values
- Incorrect example:

```
switch ( marks) {
    case > 50 : System.out.println("pass");
            break;
    case <= 60: System.out.println("Credit");
            break;
}
```

? : operator

- Another way of writing a simple if … else
- Example

    if (a > b)

        max = a;

    else

        max = b;

- Can be written as

    max = (a > b) ? a : b;

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