

## Java Foundation with Data Structures

### Lecture 4 : Loops, Keywords, Associativity and Precedence

#### *for loop*

Loop statements allows us to execute a block of statements several number of times depending on certain condition. **for** loop is kind of loop in which we give initialization statement, test expression and update statement can be written in one line.

Inside for, three statements are written –

- a. Initialization – used to initialize your loop control variables. This statement is executed first and only once.
- b. Test condition – this condition is checked everytime we enter the loop. Statements inside the loop are executed till this condition evaluates to true. As soon as condition evaluates to false, loop terminates and then first statement after for loop will be executed next.
- c. Updation – this statement updates the loop control variable after every execution of statements inside loop. After updation, again test conditon is checked. If that comes true, the loop executes and process repeats. And if condition is false, the loop terminates.

```
for (initializationStatement; test_expression; updateStatement) {  
    // Statements to be executed till test_expression is true  
}
```

#### **Example Code :**

```
public static void main(String[] args) {  
    for(int i = 0; i < 3; i++) {  
        System.out.print("Inside for loop : ");  
        System.out.println(i);  
    }  
    System.out.println("Done");  
}
```

**Output:**

Inside for Loop : 0  
Inside for Loop : 1  
Inside for Loop : 2  
Done

In for loop its not compulsory to write all three statements i.e. initializationStatement, test\_expression and updateStatement. We can skip one or more of them (even all three)

Above code can be written as:

```
public static void main(String[] args) {  
    int i = 1;        //initialization is done outside the for loop  
    for(; i <=5; i++) {  
        System.out.println(i);  
    }  
}
```

OR

```
public static void main(String[] args) {  
    int i = 1;        //initialization is done outside the for loop  
    for(; i <=5; ) {  
        System.out.println(i);  
        i++;        // update Statement written here  
    }  
}
```

We can also skip the test\_expression. See the example below :

## Variations of for loop

- The three expressions inside for loop are optional. That means, they can be omitted as per requirement.

**Example code 1:** Initialization part removed –

```
public static void main(String[] args) {  
    int i = 0;  
    for( ; i < 3; i++) {  
        System.out.println(i);  
    }  
}
```

```
    }  
}
```

**Output:**

```
0  
1  
2
```

**Example code 2:** Updation part removed

```
public static void main(String[] args) {  
    for(int i = 0; i < 3; ) {  
        System.out.println(i);  
        i++;  
    }  
}
```

**Output:**

```
0  
1  
2
```

**Example code 3:** Condition expression removed , thus making our loop infinite –

```
public static void main(String[] args) {  
    for(int i = 0; ; i++) {  
        System.out.println(i);  
    }  
}
```

**Example code 4:**

We can remove all the three expression, thus forming an infinite loop-

```
public static void main(String[] args) {  
    for( ; ; ) {  
        System.out.print("Inside for loop");  
    }  
}
```

- **Multiple statements inside for loop**

We can initialize multiple variables, have multiple conditions and multiple update statements inside a *for loop*. We can separate multiple statements using comma, but not for conditions. They need to be combined using logical operators.

**Example code:**

```
public static void main(String[] args) {  
    for(int i = 0, j = 4; i < 5 && j >= 0; i++, j--) {  
        System.out.println(i + " " + j);  
    }  
}
```

**Output:**

```
0 4  
1 3  
2 2  
3 1  
4 0
```

### *break and continue*

1. **break statement:** The break statement terminates the loop (for, while and do. while loop) immediately when it is encountered. As soon as break is encountered inside a loop, the loop terminates immediately. Hence the statement after loop will be executed next.
2. **continue statement:** The continue statement skips some statements inside the loop. The continue statement is used with decision making statement such as if...else. (caution always update the counter in case of while loop else loop will never end)

```
while(test_expression) {  
    // codes  
    if (condition for break) {  
        break;  
    }  
    //codes
```

```
}
```

```
for (initializationStatement; test_expression; updateStatement) {  
    // codes  
    if (condition for break) {  
        break;  
    }  
    //codes  
}
```

#### ◆ **break**

- Example: (using break inside for loop)

```
public static void main(String[] args) {  
    for(int i = 1; i < 10; i++) {  
        System.out.println(i);  
        if(i == 5) {  
            break;  
        }  
    }  
}
```

#### **Output:**

```
1  
2  
3  
4  
5
```

- Example: (using break inside while loop)

```
public static void main(String[] args) {  
    int i = 1;  
    while (i <= 10) {  
        System.out.println(i);  
        if(i==5)  
        {  
            break;  
        }  
        i++;  
    }  
}
```

```
}
```

### Output:

```
1
2
3
4
5
```

- Inner loop break:

When there are two more loops inside one another. Break from innermost loop will just exit that loop.

Example Code 1:

```
public static void main(String[] args) {
    for (int i=1; i <=3; i++) {
        System.out.println(i);
        for (int j=1; j<= 5; j++)
        {
            System.out.println("in");
            if(j==1)
            {
                break;
            }
        }
    }
}
```

### Output:

```
1
in...
2
in...
3
in...
```

Example Code 2:

```

public static void main(String[] args) {
    int i=1;
    while (i <=3) {
        System.out.println(i);
        int j=1;
        while (j <= 5)
        {
            System.out.println("in");
            if(j==1)
            {
                break;
            }
            j++;
        }
        i++;
    }
}

```

Output:

```

1
in...
2
in...
3
in...

```

## ◆ Continue

The **continue** keyword can be used in any of the loop control structures. It causes the loop to immediately jump to the next iteration of the loop.

- Example: (using for loop)

```

public static void main(String[] args){
    for (int i=1; i <= 5; i++) {
        if(i==3)
        {
            continue;
        }
    }
}

```

```

        System.out.println(i);
    }
}

```

Output:

```

1
2
4
5

```

- **Example: (using while loop)**

```

public static void main(String[] args){
    int i=1;
    while (i <= 5) {
        if(i==3)
        {
            i++;
            // if increment isn't done here then loop will run
            infinite time for i=3
            continue;
        }
        System.out.println(i);
        i++;
    }
}

```

Output:

```

1
2
4
5

```

## Scope of variables

Scope of variables is the curly brackets {} inside which they are defined. Outside which they aren't known to the compiler. Same is for all loops and conditional statement (if).

### ◆ Scope of variable - for loop



```

for (initializationStatement; test_expression; updateStatement) {
    // Scope of variable defined in loop
}

```

Example:

```

public static void main(String[] args) {
    for (int i=0; i<5; i++) {
int j=2;    // Scope of i and j are both inside the loop they can't be used outside
    }
}

```

### ❖ Scope of variable for while loop

```

while(test_expression) {
    // Scope of variable defined in loop
}

```

```

public static void main(String[] args) {
    int i=0;
    while(i<5)
    {
        int j=2; // Scope of i is main and scope of j is only the loop
        i++;
    }
}

```

### ❖ Scope of variable for conditional statements

```

if(test_expression) {
    // Scope of variable defined in the conditional statement
}

```

```

public static void main(String[] args) {
    int i=0;
    if (i<5)
    {
        int j=5;    // Scope of j is only in this block
    }
    // cout<<j; ❌ This statement if written will give an error because

```

scope of j is inside if and is not accessible outside if.

```
}
```

## Increment Decrement operator

### Explanation

*Pre-increment* and *pre-decrement* operators' increments or decrements the value of the object and returns a reference to the result.

*Post-increment* and *post-decrement* creates a copy of the object, increments or decrements the value of the object and returns the copy from before the increment or decrement.

### Post-increment(a++):

This increases value by 1, but uses old value of a in any statement.

### Pre-increment(++a):

This increases value by 1, and uses increased value of a in any statement.

### Post-decrement(a--):

This decreases value by 1, but uses old value of a in any statement.

### Pre-decrement(--a):

This decreases value by 1, and uses decreased value of a in any statement.

```
public static void main(String[] args) {  
    int l=1, J=1, K=1, L=1;  
    cout<<l++<<' '<<J-- <<' '<<++K<<' '<< --L<<endl;  
    cout<<l<<' '<<J<<' '<<K<<' '<<L<<endl;  
}
```

Output:

```
1 1 2 0  
2 0 2 0
```

## Bitwise Operators

Bitwise operators are used to perform operations at bit level. Following is the summary of various bitwise operations:

Operator	Name	Example	Result	Description
$a \& b$	and	$4 \& 6$	4	1 if both bits are 1.
$a   b$	or	$4   6$	6	1 if either bit is 1.
$a \wedge b$	xor	$4 \wedge 6$	2	1 if both bits are different.
$\sim a$	not	$\sim 4$	-5	Inverts the bits. (Unary bitwise compliment)
$n \ll p$	left shift	$3 \ll 2$	12	Shifts the bits of $n$ left $p$ positions. Zero bits are shifted into the low-order positions.
$n \gg p$	right shift	$5 \gg 2$	1	Shifts the bits of $n$ right $p$ positions. If $n$ is a 2's complement signed number, the sign bit is shifted into the high-order positions.
$n \ggg p$	right shift	$-4 \ggg 28$	15	Shifts the bits of $n$ right $p$ positions. Zeros are shifted into the high-order positions.

### Example Code:

```
public static void main(String args[]) {  
    int a = 19; // 19 = 10011  
    int b = 28; // 28 = 11100  
    int c = 0;  
  
    c = a & b; // 16 = 10000  
    System.out.println("a & b = " + c );  
  
    c = a | b; // 31 = 11111  
    System.out.println("a | b = " + c );  
  
    c = a ^ b; // 15 = 01111  
    System.out.println("a ^ b = " + c );  
  
    c = ~a; // -20 = 01100  
    System.out.println("~a = " + c );  
}
```

```

c = a << 2;    // 76 = 1001100
System.out.println("a << 2 = " + c);

c = a >> 2;    // 4 = 00100
System.out.println("a >> 2 = " + c);

c = a >>> 2;    // 4 = 00100
System.out.println("a >>> 2 = " + c);
}

```

## Output

```

a & b = 16
a | b = 31
a ^ b = 15
~a = -20
a << 2 = 76
a >> 2 = 4
a >>> 2 = 4

```

## Precedence and Associativity

- ❓ **Operator precedence** determines which operator is performed first in an expression with more than one operators with different precedence. For example,  $10 + 20 * 30$  is calculated as  $10 + (20 * 30)$  and not as  $(10 + 20) * 30$ .
- ❓ **Associativity** is used when two operators of same precedence appear in an expression. Associativity can be either **Left to Right** or **Right to Left**. For example,  $*$  and  $/$  have same precedence and their associativity is **Left to Right**, so the expression  $100 / 10 * 10$  is treated as  $(100 / 10) * 10$ .

Precedence and Associativity are two characteristics of operators that determine the evaluation order of subexpressions in absence of brackets.

**Note :** We should generally use add proper brackets in expressions to avoid confusion and bring clarity.

### 1) Associativity is only used when there are two or more operators of same precedence.

The point to note is associativity doesn't define the order in which operands of a single operator are evaluated. For example, consider the following program,

associativity of the + operator is left to right, but it doesn't mean f1() is always called before f2(). The output of following program is in-fact compiler dependent.

// Associativity is not used in the below program. Output is compiler dependent.

```
static int x = 0;
public static int F1() {
    x = 5;
    return x;
}
public static int F2() {
    x = 10;
    return x;
}
public static void main(String[] args) {
    int p = F1() + F2();
    System.out.println(x);
}
```

## 2) All operators with same precedence have same associativity

This is necessary, otherwise there won't be any way for compiler to decide evaluation order of expressions which have two operators of same precedence and different associativity. For example, + and – have same associativity.

## 3) There is no chaining of comparison operators in Java

Trying to execute the statement a>b>c will give an error and the code will not compile

Following is the Precedence table along with associativity for different operators.

OPERATOR	DESCRIPTION	ASSOCIATIVITY
( ) [ ] . ++ —	Parentheses (function call) (see Note 1) Brackets (array subscript) Member selection via object name Postfix increment/decrement (see Note 2)	left-to-right
++ — + — ! ~ (type)	Prefix increment/decrement Unary plus/minus Logical negation/bitwise complement	right-to-left

	Cast (convert value to temporary value of <i>type</i> )	
* / %	Multiplication/division/modulus	left-to-right
+ -	Addition/subtraction	left-to-right
<< >>	Bitwise shift left, Bitwise shift right	left-to-right
< <= > >=	Relational less than/less than or equal to Relational greater than/greater than or equal to	left-to-right
== !=	Relational is equal to/is not equal to	left-to-right
&	Bitwise AND	left-to-right
^	Bitwise exclusive OR	left-to-right
	Bitwise inclusive OR	left-to-right
&&	Logical AND	left-to-right
	Logical OR	left-to-right
? :	Ternary conditional	right-to-left
= += -= *= /= %= &= ^=  = <<= >>=	Assignment Addition/subtraction assignment Multiplication/division assignment Modulus/bitwise AND assignment Bitwise exclusive/inclusive OR assignment Bitwise shift left/right assignment	right-to-left