

## 06-Logical Operators

Logical operators in Java are used to perform logical operations on boolean expressions. These operators are crucial for decision-making in programs. Here's a breakdown of the main logical operators:

### 1. Logical AND (& and &&)

- **& (Bitwise AND):** Evaluates both operands.
- **&& (Short-Circuit AND):** Evaluates the second operand only if the first is true.

#### Example:

```
int x = 7, y = 5, a = 5, b = 9;  
boolean result = (x > y) && (a < b);  
System.out.println(result); // Output: true
```

*Explanation:* Both conditions ( $x > y$ ) and ( $a < b$ ) are true, so the result is true.

### 2. Logical OR (| and ||)

- **| (Bitwise OR):** Evaluates both operands.
- **|| (Short-Circuit OR):** Evaluates the second operand only if the first is false.

#### Example:

```
boolean result = (x > y) || (a > b);  
System.out.println(result); // Output: true
```

*Explanation:* The first condition ( $x > y$ ) is true, so the result is true regardless of the second condition.

### 3. Logical NOT (!)

- **!:** Inverts the boolean value of an expression.

#### Example:

```
boolean result = !(x < y);
```

```
System.out.println(result); // Output: true
```

*Explanation:* Since  $(x < y)$  is false,  $!(x < y)$  becomes true.

### 4. Logical XOR (^)

- If precisely one operand is true, the function returns true; if not, it returns false.

#### Example:

```
boolean result = (x > y) ^ (a < b);
```

```
System.out.println(result); // Output: false
```

*Explanation:* Both  $(x > y)$  and  $(a < b)$  are true, so the XOR result is false.

### Example Program Combining All Logical Operators

```
public class LogicalOperatorsExample {  
    public static void main(String[] args) {  
        int x = 7, y = 5, a = 5, b = 9;
```

```

// AND operation

boolean andResult = (x > y) && (a < b);

System.out.println("AND Result: " + andResult); // Output: true


// OR operation

boolean orResult = (x > y) || (a > b);

System.out.println("OR Result: " + orResult); // Output: true


// NOT operation

boolean notResult = !(x < y);

System.out.println("NOT Result: " + notResult); // Output: true


// XOR operation

boolean xorResult = (x > y) ^ (a < b);

System.out.println("XOR Result: " + xorResult); // Output: false
}
}

```

## Key Points

- **Logical AND (&&) and Logical OR (||)**  
are short-circuit operators, meaning they can skip evaluating the second operand if the result is already determined by the first operand.
- **Logical NOT (!)**  
negates the boolean value of an expression.
- **Logical XOR (^)**  
is true only if exactly one of the operands is true.

