

COP-2210

Computer Programming I

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Text: Big Java: Early Objects, Interactive Edition, 6th Edition

Decision Statements

15. Relational and logical operators

Relational (or *comparison*) operators

Relational operator	Corresponding question
$>$	$> ?$
\geq	$\geq ?$
$<$	$< ?$
\leq	$\leq ?$
$==$	$= ?$
\neq	$\neq ?$

Relational Operators

Examples:

$a < b$

$a \geq b$

$a \neq b$

Return *true* or
false

Relational expressions:
return a *boolean*
value

Logical Operators

Operator	Stand for	Example	Action
&& &	AND	a && b a & b	Returns T if both operands are T; otherwise returns F
 	OR	a b a b	Returns T if at least one operand is T; otherwise returns F
!	NOT	! A	Negates the corresponding operand

Return *true* or
false

&&, || : short circuit

&, | : evaluate both operands

Operators in Java: precedence of operations

Priority	Type	Symbol	Associativity
16		() []	Left to right
16	Unary	var++ var--	Right to left
15	Unary	++var --var	Left to right
14	Unary	~ ! -var +var	Right to left
15	Casting	casting	"
12	Arithmetic	* / %	Left to right
11	Arithmetic	+ -	"
10	Shift	<< >> >>>	"
9	Relational	instanceof < <= > >=	"
8	Relational	== !=	"
7	Bitwise	&	"
6	Bitwise	^	"
5	Bitwise		"
4	Logical	&&	"
3	Logical		"
2	Conditional	?:	Right to left
1	Assignment	= *= /= %= += -= <<= >>= >>>= &= ^= =	Right to left

Relational and Logical Operators: order of operations

$3 + 4 \leq 5 \ || \ 6 * 7 > 19 - 2$

$3 + 4 \leq 5 \ || \ 42 > 19 - 2$

$7 \leq 5 \ || \ 42 > 19 - 2$

$7 \leq 5 \ || \ 42 > 17$

$\text{false} \ || \ 42 > 17$

$\text{false} \ || \ \text{true}$

true

PRACTICE

Consider the program fragment:

```
int x = 11, a = 2, b = 4;
```

```
a+b-2*x/5 >= 1 || 3.1==x && !(a > 7)
```

What would be the value of the expression?



PRACTICE

Program 15_01:

Write a program to evaluate and print the value of the expression:

```
int x = 11, a = 2, b = 4;
```

```
a+b-2*x/5 >= 1 || 3.1==x && !(a > 7)
```



Decision Statements

16. IF statement

if statement

```
if ( <condition> ) <instruction>;
```

OR

```
if ( <condition> )  
{  
  <list of instructions>;  
}
```

If the condition is true, the instructions are executed. If the condition is false, the instructions are skipped.

if statement: *Try it yourself*

// Program 16_01: Testing IF

```
public class Prog16_01
{
    public static void main ( String args[ ] )
    {
        double a=2, b=1;
        //double a=1, b=2;

        if (a > b) System.out.println ( "Hello World! " );

        System.out.println("Good Bye!");
    }
}
```

if statement: *Try it yourself*

// Program 16_02: Testing IF

```
public class Prog16_02
{
    public static void main ( String args[ ] )
    {
        double a=2, b=1;
        //double a=1, b=2;

        if ( a > b )
        {
            System.out.println ( "Hello World! " );
            System.out.println ( "I love JAVA programming!" );
        }

        System.out.println ( "Good Bye! " );
    }
}
```

if else statement

```
if ( <condition> )  
{  
    <list of statements 1>;  
}  
else  
{  
    <list of statements 2>;  
}
```

If the condition is true, the statements in *list 1* are executed. If the condition is false, the statements in *list 2* are executed. Then the flow goes to the instruction in the program just after the *if else*.

No braces are needed in case of only one statement

if else statement: *Try it yourself*

```
// Program 16_03: Testing IF-ELSE
```

```
import javax.swing.*;
```

```
public class Prog16_03
```

```
{
```

```
    public static void main ( String args[ ] )
```

```
    {
```

```
        double a = 2; //double a = -1;
```

```
        if (a > 0)
```

```
        {
```

```
            System.out.println ( "The number is positive" );
```

```
        }
```

```
        else
```

```
        {
```

```
            System.out.println ( "The number is zero or negative" );
```

```
        }
```

```
    }
```

```
}
```

What value of b is displayed?

```
public class Prog16_04
{
    public static void main(String[] args)
    {
        int a = 1, b = 0;

        if (a == 1)
            b = 2;
        else
            a = 3;
            b = a;

        System.out.println("This is b: " + b);
    }
}
```


What value of b is displayed?

```
public class Prog16_05
{
    public static void main(String[] args)
    {
        int a = 1, b = 0;

        if (a == 1)
            b = 2;
        else
        {
            a = 3;
            b = a;
        }

        System.out.println("This is b: " + b);
    }
}
```

PRACTICE

Program 16_06:

Write a program to calculate and print the value of $f(x)$
(ask the user for the value of x)

$$f(x) = \begin{cases} x^2 & \text{if } x \leq 0 \\ \sqrt{x} & \text{if } x > 0 \end{cases}$$



Nested *if*

Example

```
if (number > 0)
{
    System.out.println ( "positive number!" );
}
else
    if (number == 0)
    {
        System.out.println ( "the number is zero!" );
    }
    else
    {
        System.out.println ( "negative number!" );
    }
```

Nested if: *Try it yourself*

```
import java.util.Scanner;
public class Prog16_07 {

    public static void main(String[] args) {
        Scanner in = new Scanner(System.in);
        int n = in.nextInt();

        if (n > 0) //positive number
        {
            System.out.print("The number is positive");

            if (n >= 1 && n <= 100) {
                System.out.println(" and is between 1 and 100");
            }
        }
        else {
            System.out.println("The number is zero or negative");
        }
    }
}
```

Nested if: *Try it yourself*

```
If (number > 0)    // Version 1
    ... "positive number!";

else
    if (number == 0)
        ... "the number is zero!";

    else
        ... "negative number!";
```

```
If (number > 0)    // Version 2
    ... "positive number!";

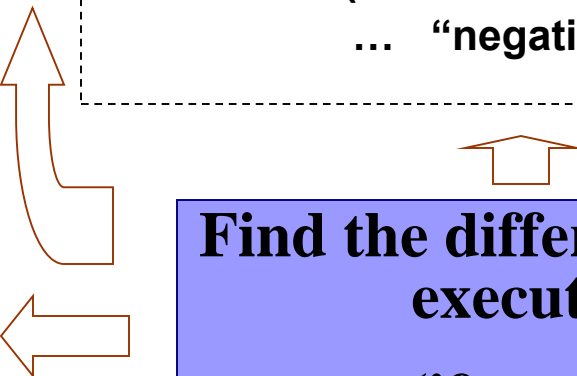
else
    if (number == 0)
        ... "the number is zero!";

    else
        if (number < 0)
            ... "negative number!";
```

```
If (number > 0)    // Version 3
    ... "positive number!";

if (number == 0)
    ... "the number is zero!";

if (number < 0)
    ... "negative number!";
```



**Find the differences in
execution
(if any)**

Nested if: Answer to *Try it yourself*

```
If (number > 0)    // Version 1
    ... "positive number!";

else
    if (number == 0)
        ... "the number is zero!";

    else
        ... "negative number!";
```

```
If (number > 0)    // Version 2
    ... "positive number!";

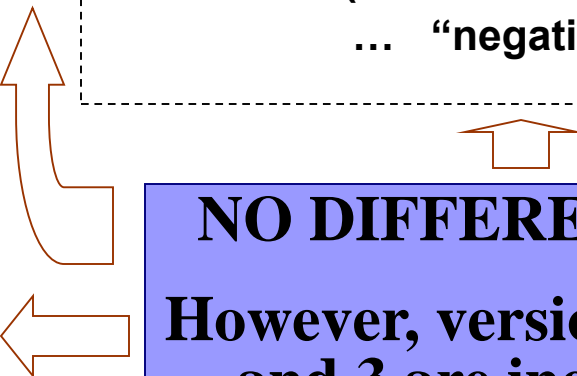
else
    if (number == 0)
        ... "the number is zero!";

    else
        if (number < 0)
            ... "negative number!";
```

```
If (number > 0)    // Version 3
    ... "positive number!";

if (number == 0)
    ... "the number is zero!";

if (number < 0)
    ... "negative number!";
```



NO DIFFERENCES!
However, versions 2
and 3 are inefficient

PRACTICE

Program 16_08:

Write a program that determines if a user was born before 1990, in the 90s, or after 1999.

(input: year the user was born)



PRACTICE

Program 16_09:

Write a program that displays in increasing order two numbers entered by the user.



PRACTICE

Program 16_10:

Write a program that displays in increasing order three numbers entered by the user.

