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Class 7
Java - Boolean Algebra

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1 Boolean Algebra

In the classical algebra, we deal with sets of numbers and operations over them. Example for sets:

- $\mathbb{N} = \{1, 2, 3, ...\}$

- $\mathbb{Z} = \{..., -3, -2, -1, 0, 1, 2, 3, ...\}$

- $\mathbb{R} = \{..., -1.1, ..., -1, ..., 0, ..., 1, ..., 1.1, ...\}$

In Java, we can work with these numbers using integer or double variables.
$int\ a\ =\ 1;$
$int\ b\ =\ 2 + 3;$
The operations for this algebra include:

- $+, -, \times, \div, ...$

In Java, we can operate over numbers using arithmetic operators.
$int\ c\ =\ a + b;$
$int\ d\ =\ c * b;$

In the Boolean algebra, we work with a new set

$$\mathbb{B} = \{true, false\}$$

which contains only two values: $true$ and $false$. In Java, we can work with these values using boolean variables.
$boolean\ a\ =\ true;$
$boolean\ b\ =\ 1 > 0;$
$boolean\ c\ =\ 1 == 1;$
The operations over this set are three and are defined the following manner:

- AND (&&)

    - $true\ \&\&\ true = true$
    - $true\ \&\&\ false = false$
    - $false\ \&\&\ true = false$
    - $false\ \&\&\ false = false$

- OR (||)

    - $true\ ||\ true = true$
    - $true\ ||\ false = true$
    - $false\ ||\ true = true$
    - $false\ ||\ false = false$

- NOT (!)

    - $!\ true = false$
    - $!\ false = true$

In Java, we can operate over booleans using boolean operators.
$boolean\ d = true\ \&\&\ false;$
$boolean\ e = true\ ||\ true;$
$boolean\ f = d\ \&\&\ e;$
$boolean\ g = d\ ||\ e;$

2   Exercises

1. Write a program that takes a bi-dimensional coordinate (x, y) and outputs which quadrant it belongs to.

2. The Brazilian electoral legislation defines the following rules for the eligibility to vote. If the citizen is

   - younger than 16, then they **may not** vote;
   - between 16 (inclusive) and 18 (exclusive) years old or older than 64 years old, then they **may** vote;
   - between 18 (inclusive) and 65 (exclusive) years old, then they **must** vote.

   Now write a program that informs a citizen's eligibility to vote, based on their age.

3. The body mass index (bmi) is calculated according to the following formula: $bmi = \frac{mass(Kg)}{height^2(m)}$. Based on the result, a person is classified according to the following table:

Gender	bmi	Class
Male	$bmi \leq 20.7$	underweight
	$20.7 < bmi \leq 26.4$	normal
	$26.4 < bmi \leq 31.1$	overweight
	$31.1 < bmi$	obese
Female	$bmi \leq 19.1$	underweight
	$19.1 < bmi \leq 25.8$	normal
	$25.8 < bmi \leq 32.3$	overweight
	$32.3 < bmi$	obese

3   Summary

- Truth Tables:

OR (||)	True	False
True	True	True
False	True	False

AND (&&)	True	False
True	True	False
False	False	False

NOT (!)	
True	False
False	True

- Next Lesson: While

4   References

- W3C Tutorial:

  - https://www.w3schools.com/java/java_booleans.asp

- Exercises: https://www.w3schools.com/java/exercise.asp

  - Java Booleans