# 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.
$int\ a\ =\ true;$
$int\ b\ =\ 1 > 0;$
$int\ c\ =\ 1 == 1;$
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