

# The Brainfuck Language

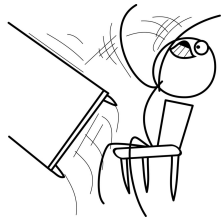
## Programming Languages Lab

Samuele Buro

Programming Languages (AY 2020-21)

University of Verona

December 2, 2020



# Brainfuck (Syntax)

# Brainfuck (Syntax)

**Syntax:** All well-structured programs belong to the following set

$$\{ >, <, +, -, ., ,, [, ] \}^+$$

# Brainfuck (Syntax)

**Syntax:** All well-structured programs belong to the following set

$$\{ >, <, +, -, ., ,, [, ] \}^+$$

Thus, this is a valid program:

$$P \equiv [<+>-]$$

# Brainfuck (Syntax)

**Syntax:** All well-structured programs belong to the following set

$$\{ >, <, +, -, ., ,, [, ] \}^+$$

Thus, this is a valid program:

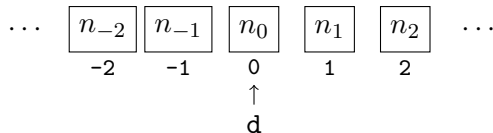
$$P \equiv [<+>-]$$

You now know all the valid Brainfuck programs... but you still don't know their meaning!

# Brainfuck (Semantics)

A program is a sequence of commands (one for each symbol) that **alter** an initial configuration.

**Initial configuration:**



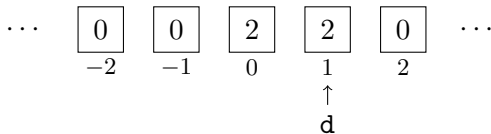
# Brainfuck (Semantics) – (don't read)

## Semantics:

- 
- > Increment the data pointer (to point to the next cell to the right)
  - < Decrement the data pointer (to point to the next cell to the left)
  - + Increment (increase by one) the byte at the data pointer
  - Decrement (decrease by one) the byte at the data pointer
  - . Output the byte at the data pointer
  - , Accept one byte of input, storing its value in the byte at the data pointer
  - [ If the byte at the data pointer is zero, then instead of moving the instruction pointer forward to the next command, jump it forward to the command after the matching ] command
  - ] If the byte at the data pointer is nonzero, then instead of moving the instruction pointer forward to the next command, jump it back to the command after the matching [ command
-

# Brainfuck (Semantics)

Execution of  $P \equiv [<+>-]$  from the following initial configuration:

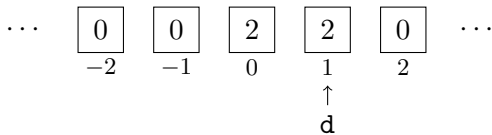


The active command is the colored one:

[<+>-]

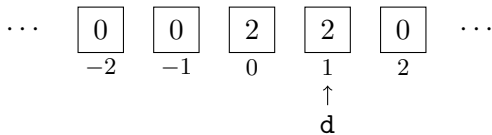


# Brainfuck (Semantics)



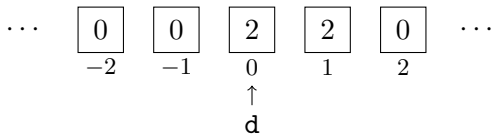
[<+>-]

# Brainfuck (Semantics)



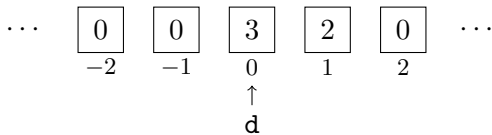
[<+>-]

## Brainfuck (Semantics)



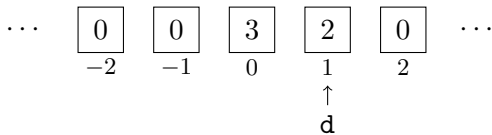
[<+>-]

# Brainfuck (Semantics)



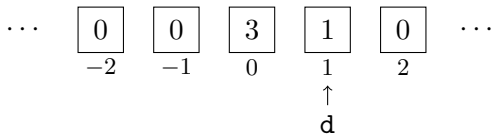
[<+>-]

# Brainfuck (Semantics)



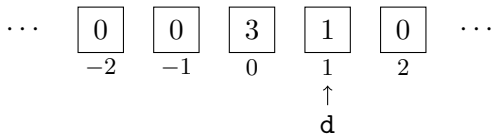
[<+>-]

## Brainfuck (Semantics)



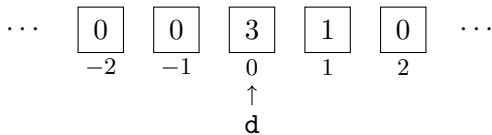
[<+>-]

# Brainfuck (Semantics)



[<+>-]

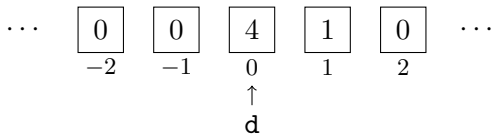
## Brainfuck (Semantics)



[<+>-]

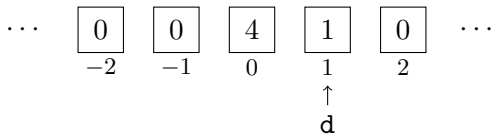


## Brainfuck (Semantics)



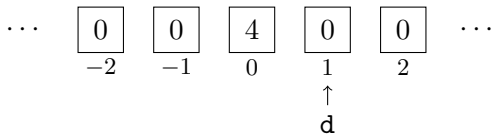
[<+>-]

# Brainfuck (Semantics)



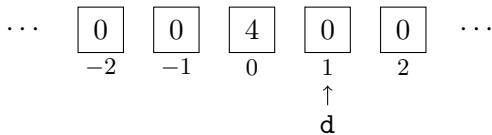
[<+>-]

# Brainfuck (Semantics)



[<+>-]

## Brainfuck (Semantics)



[<+>-]