

# Big-O notation

## Competitive Programming: Core Skills

Artur Riazanov

SPbSU

# Introduction

- In this video we will master powerful technique for measuring the number of atomic operations an algorithm does.

# Introduction

- In this video we will master powerful technique for measuring the number of atomic operations an algorithm does.
- The problem is that the number of operations depends on input.

# Introduction

- In this video we will master powerful technique for measuring the number of atomic operations an algorithm does.
- The problem is that the number of operations depends on input.
- We will learn how to measure [the dependence](#).

# What is atomic operation?

When we estimate the number of operation it's useful to define what operation is.

# What is atomic operation?

When we estimate the number of operation it's useful to define what operation is.

- Arithmetic operations (  $+$ ,  $-$ ,  $*$ ,  $/$ ,  $\%$ ,  $<$ ,  $>$ ,  $=$  )

# What is atomic operation?

When we estimate the number of operation it's useful to define what operation is.

- Arithmetic operations (  $+$ ,  $-$ ,  $*$ ,  $/$ ,  $\%$ ,  $<$ ,  $>$ ,  $=$  )
- Logical operations ( or, and, not, xor )

# What is atomic operation?

When we estimate the number of operation it's useful to define what operation is.

- Arithmetic operations (  $+$ ,  $-$ ,  $*$ ,  $/$ ,  $\%$ ,  $<$ ,  $>$ ,  $=$  )
- Logical operations ( or, and, not, xor )
- Accessing a value from an array



# What is atomic operation?

When we estimate the number of operation it's useful to define what operation is.

- Arithmetic operations (  $+$ ,  $-$ ,  $*$ ,  $/$ ,  $\%$ ,  $<$ ,  $>$ ,  $=$  )
- Logical operations ( or, and, not, xor )
- Accessing a value from an array
- Defining a new variable

# What is atomic operation?

When we estimate the number of operation it's useful to define what operation is.

- Arithmetic operations (  $+$ ,  $-$ ,  $*$ ,  $/$ ,  $\%$ ,  $<$ ,  $>$ ,  $=$  )
- Logical operations ( or, and, not, xor )
- Accessing a value from an array
- Defining a new variable

# Which operations are not atomic?

Some operations seem simple but in fact they are pretty complicated and require much more time that atomic operations do.

- Comparing strings, vectors (C++) or lists (Python)

# Which operations are not atomic?

Some operations seem simple but in fact they are pretty complicated and require much more time that atomic operations do.

- Comparing strings, vectors (C++) or lists (Python)
- Defining a vector or list with many elements

# Which operations are not atomic?

Some operations seem simple but in fact they are pretty complicated and require much more time that atomic operations do.

- Comparing strings, vectors (C++) or lists (Python)
- Defining a vector or list with many elements
- Concatenating two strings

# Which operations are not atomic?

Some operations seem simple but in fact they are pretty complicated and require much more time that atomic operations do.

- Comparing strings, vectors (C++) or lists (Python)
- Defining a vector or list with many elements
- Concatenating two strings

Strings, vectors and lists consists of small elements therefore the operations above are applied for each elements of a big object (each symbol of a string, each element of a vector/list).

# Substring

```
 $n = \text{length}(s); m = \text{length}(t)$   
for  $i$  in  $\text{range}(m-n+1):$   $(0, 1, \dots, m - n)$   
     $\text{match} = \text{True}$   
    for  $j$  in  $\text{range}(n):$   
        if  $s[j] \neq t[i+j]:$  contradiction!  
             $\text{match} = \text{False}$   
            break no need to check latter symbols  
if  $\text{match}:$   
    break
```