HIGHER SCHOOL OF ECONOMICS
NATIONAL RESEARCH UNIVERSITY

Introduction to Programming

Welcome to the Course!

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Lecturer

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by appointment

Drop me a line whenever you have questions or even if you just want to talk!

The Team

Sergey Shershakov

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Ilya Kostyuchenko

George Marshalko

There is simply no substitute for hard work
when it comes to achieving success.

COURSE GENERAL INFORMATION

What is Introduction to Programming-2?

- Learn how to write powerful and elegant code in C++.
- Problem solving oriented course with a lot of practical tasks.
- Based on the “classical” C++ but involving modern standards features.
- Incorporating basic data structures and algorithms — bridge to the 4th module.

Why Learn C++?

- Popularity.
- Multi-Paradigmatic High-Level Language.
- Extremely Powerful (and Dangerous — Isn't it intriguing?)
- Influenced the creation of a family of C++-styled programming languages such as Java, C#, …
  - excellent choice to be a first deeply studied language.

Why Learn C++? — TIOBE Index

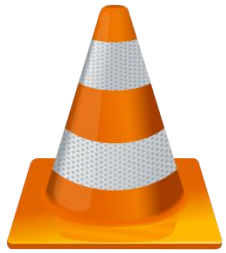
Long Tem History

Programming Language	2019	2014	2009	2004	1999	1994	1989
Java	1	2	1	1	14	-	-
C	2	1	2	2	1	1	1
C++	3	4	3	3	2	2	3
Python	4	7	5	10	20	21	-

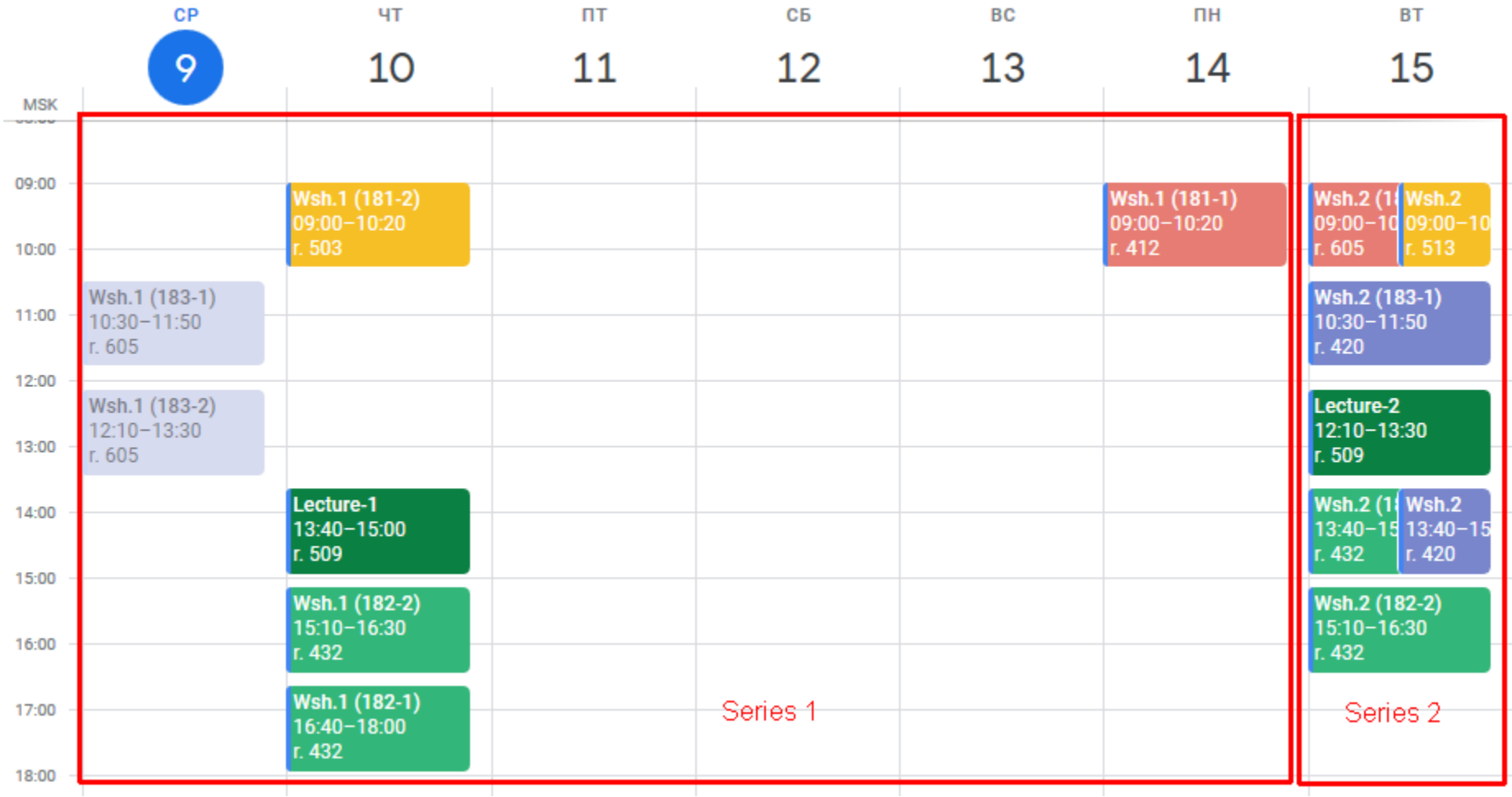
https://www.tiobe.com/tiobe-index/

Why C++: Companies

Why C++: Software



Logistics: Timetable



Logistics: Ongoing Activity and Assignments

- Working during practical classes.
- Solving problems by developing programs:
  - small and a few of large ones;
  - submitting to Я.Контест.
- Writing in-class tests.

Gives you points that constitute *OA* grade!

Logistics: Grading Details

The final grade P_2 for this part of the whole course:

$$P_2 = 0.4 \cdot E_2 + 0.6 \cdot OA$$

The ultimate grade for the whole course:

$$G = 0.7 \cdot \min(P_1, P_2) + 0.3 \cdot \max(P_1, P_2)$$

Logistics

Course Homepage:
http://wiki.cs.hse.ru/Introduction_to_programming_2

Telegram Channel (for announcements):
https://t.me/joinchat/AAAAAEhINr5SweyzcOrxow

Telegram Group (for discussions):
https://t.me/joinchat/DNq14VSd_oqlyGQrdXby4w

Lateness Policy: No late work will be accepted

Honor Code: Do not cheat, repercussions are severe!

Development

- You may use any setting of OS/Compiler/IDE/Editor/Debugger
- We refer to:
  - C++11 Standard implemented by gcc (ver. 4.8.1+)
    - MinGW ver. 8.1 port for gcc for Window is OK;
  - CMake as a (meta-)building system;
  - Qt Creator as a powerful minimalistic free IDE
    - CLion, CodeBlocks, MS VS are also OK, but on your own risk!

- You are strongly advised to bring your own laptop for all practical classes and especially control tests!

C++ HISTORY

Assembly Code

```
section   .text
global    _start          ;must be declared for linker (ld)

_start:                   ;tell linker entry point
  mov edx,len             ;message length
  mov ecx,msg             ;message to write
  mov ebx, 1              ;file descriptor (stdout)
  mov eax, 4              ;system call number (sys_write)
  int  0x80               ;call kernel
  mov eax, 1              ;system call number (sys_exit)
  int  0x80               ;call kernel

section .data
msg db 'Hello, world!',0xA            ;our dear string
len equ $ - msg           ;length of our dear string
```

Assembly Code

- Simple instructions
- Extremely fast (if written properly)
- Gives one complete control over your program

Why don’t we always use assembly?

- Requires lots of code to do simple tasks.
- Hard to understand other people’s code.
- Extremely unportable.

High-level program

- The idea is:
  - to write a program in a more intuitive language, mostly platform-independent
  - to translate the program into the low-level form that is appropriate to the CPU

C

- The C Programming Language:
  - created in 1972
  - fast, simple, cross-platform
  - the most used programming language so far

Ken Thompson and Dennis Ritchie

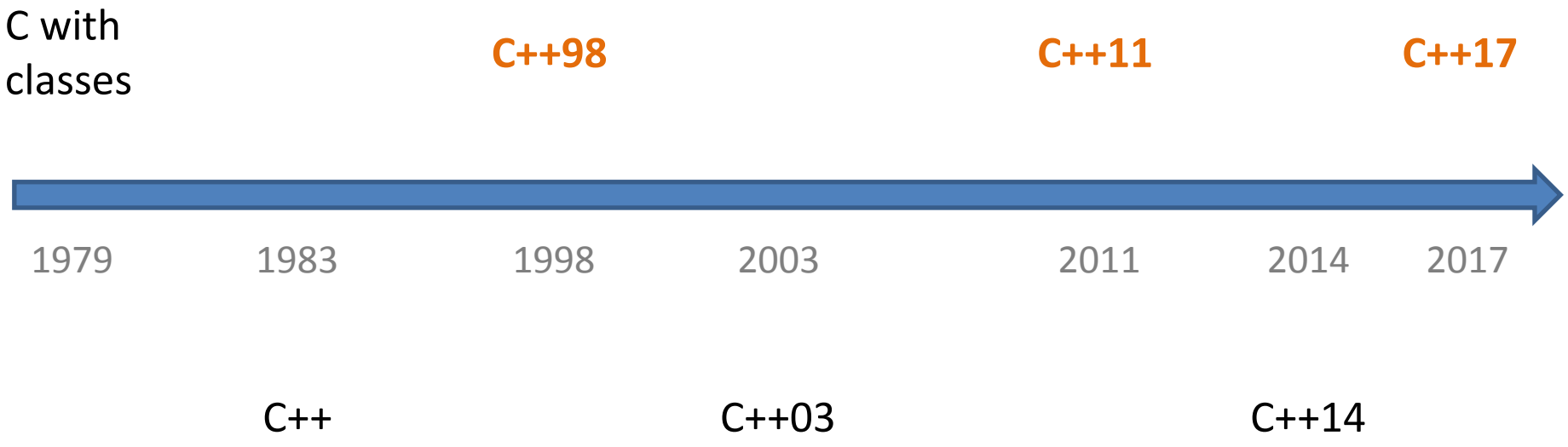
- Some weakness:
  - No objects or classes
  - Difficult to write code that worked generically
  - Tedious when writing large programs

Bjarne Stroustrup and C++

- The first version of C++ was created as an extension of C “with classes”
- It was designed to:
  - be fast
  - be simple to use
  - be cross-platform
  - have high-level features

C++ developers

Evolution of C++



Philosophy

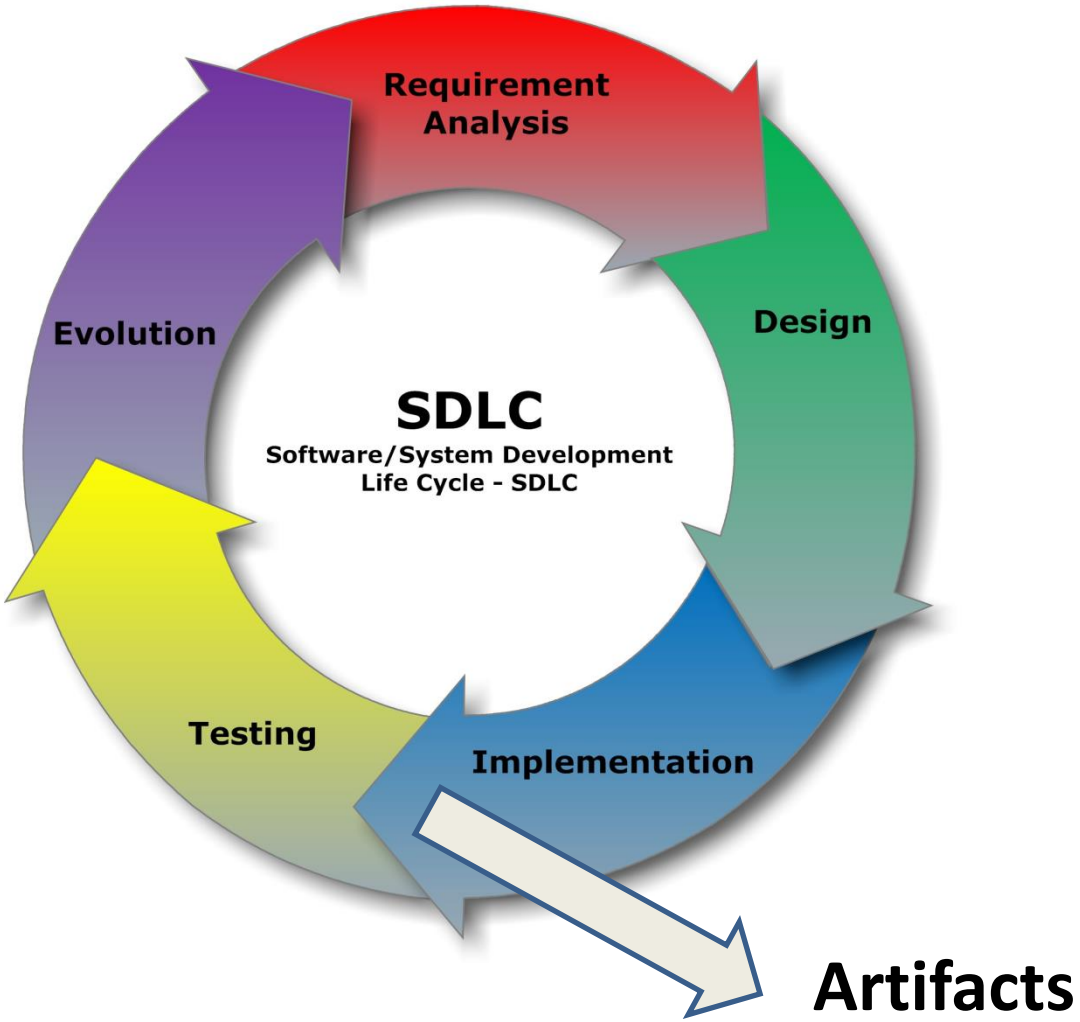
- It must be driven by actual problems and its features should be useful immediately in real world programs.
- Programmers should be free to choose their own style.
- Allowing a useful feature is more important than preventing every possible misuse of C++.
- No implicit violations of the type system.
- User-created types need to have the same support and performance as built-in types.
- Unused features should not negatively impact created executables.
- Enforce safety at compile time whenever possible.

- The Zero Overhead Principle:
  - «What you don't use, you don't pay for»
  - «What you do use, you couldn't hand code any better»

Targets and Building

BUILD YOU FIRST PROGRAM!

Application Development Lifecycle



Targets

- *Calculator* — stand-alone executable
- *Media Player* — pluggable app:
  - *MP Framework* — individual app
  - *MP3 Plugin* (shared lib, dll)
  - *AVI Plugin* (shared lib, dll)
  - …

Targets: Applications and Libraries

- *Application* — normally stand-alone executable (binary) file
- *Library* — contains common piece of compiled code (can also be given in the form of SC)
  - *Static Library* — is to be connected to an app during *linking* stage (compile time)
  - *Shared (Dynamic) Library* — is to be connected to an app during its run (runtime)

- Normally each target consists of a number of units. Each unit contains code related to some specific problem.
  - In source code a unit is represented by one or more source files

Interface and Implementation

Interface:

- *declare* smth w/o *defining* any specific way to implement this;
- specify a *contract* between two different parts;

Implementation:

- carry out exactly what an *interface* declares;
- there can be a number of ways to *implement* the same *interface* and, hence, satisfy the *contract*;

Interface and Implementation in C++

Interface:

- declare a prototype of a function;
- create a new *type*;
- declare a class with pure *virtual* functions — an *interface class*;
- often represented by *header files* (.h, .hpp)

Implementation:

- implement a function by writing its body;
- create a new object of a specific type;
- inherit the interface class and *override* virtual functions;
- often represented by *translation units* (.cpp)

Translation Unit

- *Translation Unit* is a text file with a program in C++, named normally with .cpp extension, that can be compiled by a C++-compiler.

- Header Files (.h, .hpp, …) are not translation units and, hence, cannot be compiled.

  DO NOT EVENT TRY to compile header files!

Building Stages