Software Engineering

Ph.D. Ivan Sergeevich Makarov

Moscow Institute of Physics and Technology

C++ Definition

C++ is a compiled general-purpose programming language based on a strong static typing system, that supports multiple programming paradigms and provides low-level and high-level tools and features.

- Source code, compiler, machine code, instructions
- Executable code, runtime environment, processor
- Narrow specialization, several strong competitors
- Static and dynamic typing, compile time, runtime
- Combination of multiple programming paradigms
- Low-level instruments and convenient abstractions

C++ History

- C++ originally designed as a set of extensions for C
- C++ is not a subset or superset of C at present time
- C++ inherited Ada, Algol, Fortran, Modula, Simula
- C++ influenced C#, Java, Python and many others

The first C++ commercial release took place on October 14, 1985.

C++ Standards

- C++98 – fundamental standard
- C++03 – patch
- Technical Report 2005, Boost
- C++11 – language core +30%, standard library +100%
- C++14 – patch
- C++17 – patch
- C++20 – latest implemented standard
- C++23 – expected standard
- C++26 – expected standard

C++ Application

- Operating and embedded systems
- Software frameworks and libraries
- High performance computing systems
- Mathematical and physical modeling
- Game engines and game development
- Low latency financial trading systems
- Highly reliable systems for military

A balance of compactness and efficiency, a combination of low-level and high-level tools and features, a bunch of parallel programming, interprocess communication, network communication technologies.

Programming Paradigms

- Declarative programming – expectations
- Functional programming – functions, compositions
- Imperative programming – statements
- Procedural programming – subroutines
- Structured programming – selections, iterations
- Object-oriented programming – classes
- Generic programming – templates
- Parallel programming – processes, threads
- Event-driven programming – events, handlers

C++ provides an ultimate, but often dangerous freedom of action.

Additional Libraries

C++ standard library and Boost libraries provide many useful tools.

- Google Test – testing framework
- IntelTBB – parallel computing
- OpenCV – image processing
- Protobuf – data serialization
- QuantLib – quantitative finance
- Qt – graphical user interface
- SFML – general multimedia

Developer Tools

- Compilers – Clang, GCC, MinGW, Visual C++
- IDEs – CLion, Dev C++, Visual Studio, XCode
- Code editors – Geany, Vim, Visual Studio Code
- Debuggers, profilers – GDB, Valgrind, VTune
- Build automation systems – CMake, MSBuild
- Version control systems – Git, SVN, Mercurial
- Hosting cloud services – GitHub, Bitbucket
- Git GUI clients – GitHub Desktop, SmartGit
- Project management systems – Asana, Jira