

Comparative study of C, Objective C, C++ programming language

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Abstract

The C programming language was derived in the early 1970s as a system implementation language for the nascent UNIX operating system. It is derived from the type-less language BCPL. The extension in standard ANSI C i.e., adding concept of classes, object, etc developed a new language known as Objective-C. After few years C adapts some features of Objective-C and a language come into existence known as C with classes, later it is known as C++. This paper studies about the languages, influence of one language to another and comparative study of the languages.

I. Introduction

This paper is about the comparison of the C, Objective C & C++ programming language, the influences of one language on another, and the conditions under which they were created.

C is a general-purpose programming language initially developed by Dennis Ritchie between 1969 and 1973 at Bell labs. Its design provides constructs that map efficiently to typical machine instructions, and therefore it found lasting use in applications that had formerly been coded in assembly language, most notably system software like the Unix computer operating system. In 1989 the Institute published the standard ANSI X3.159-1989 "Programming Language C" (generally called "ANSI C" or "C89").

The Objective-C language is a simple computer language designed to enable sophisticated object-oriented programming. Objective-C is defined as a small but powerful set of extensions to the standard ANSI C language.

Its additions to C are mostly based on Smalltalk, one of the first object-oriented programming languages.

Objective-C is designed to give C full object-oriented programming capabilities, and to do so in a simple and straightforward way.

It is the main programming language used by Apple for the OS X and iOS operating systems and their respective APIs, Cocoa and Cocoa Touch.

Originally developed in the early 1980s, it was selected as the main language used by

NeXT for its NeXTSTEP operating system, from which OS X and iOS are derived. Generic Objective-C programs that do not use these libraries can also be compiled for any system supported by GCC or Clang.

C++ is a statically typed, free-form, multi-paradigm, compiled, general-purpose programming language. It is regarded as an intermediate-level language, as it comprises a combination of both high-level and low-level language features. Developed by Bjarne Stroustrup starting in 1979 at Bell Labs, it adds object oriented features, such as classes, and other enhancements to the C programming language and the objective c programming language. Originally named C with Classes, the language was renamed C++ in 1983, as a pun involving the increment operator.

II. History

C

The initial development of C occurred at AT&T Bell Labs between 1969 and 1973;^[1] according to Ritchie, the most creative period occurred in 1972. It was named "C" because its features were derived from an earlier language called "B", which according to Ken Thompson was a stripped-down version of the BCPL programming language.

K&R C

In 1978, Brian Kernighan and Dennis Ritchie published the first edition of *The C Programming Language*.^[9] This book, known to C programmers as "K&R", served for many years as an informal specification of the language. The version of C that it describes is commonly referred

to as K&R C. The second edition of the book covers the later ANSI C standard.

K&R introduced several language features:

- standard I/O library
- long int data type
- unsigned int data type

Objective-C

Objective-C was created primarily by Brad Cox and Tom Love in the early 1980s at their company Stepstone. Both had been introduced to Smalltalk while at ITT Corporation's Programming Technology Center in 1981. Cox was intrigued by problems of true reusability in software design and programming. He realized that a language like Smalltalk would be invaluable in building development environments for system developers at ITT. However, he and Tom Love also recognized that backward compatibility with C was critically important in ITT's telecom engineering milieu.^[2] Cox began writing a pre-processor for C to add some of the capabilities of Smalltalk. He soon had a working implementation of an object-oriented extension to the C language, which he called "OOPC" for Object-Oriented Pre-Compiler.^[3]

Love and Cox eventually formed a new venture, Productivity Products International (PPI), to commercialize their product, which coupled an Objective-C compiler with class libraries. In 1986, Cox published the main description of Objective-C in its original form in the book *Object-Oriented Programming, An Evolutionary Approach*.

C++

Stroustrup found that Simula had features that were very helpful for large software development, but the language was too slow for practical use, while BCPL was

fast but too low-level to be suitable for large software development. When Stroustrup started working in AT&T Bell Labs, he had the problem of analyzing the UNIX kernel with respect to distributed computing. Remembering his Ph.D. experience, Stroustrup set out to enhance the C language with Simula-like features. C was chosen because it was general-purpose, fast, portable and widely used. Besides C and Simula, some other languages that inspired him were ALGOL 68, Ada, CLU and ML.

In 1983, the name of the language was changed from C with Classes to C++ (+ being the increment operator in C). New features were added including virtual, function name and operator overloading, references, constants, user-controlled free-store memory control, improved type checking, and BCPL style single-line comments with two forward slashes (//).

III. Influences

C is influenced by languages like Assembly, B (BCPL, CPL), ALGOL68, FORTRAN i.e., these languages helped in developing C. C is the parent language of many other languages or mostly of all the languages.

Many later languages have borrowed directly or indirectly from C, including: C#, D, Go, Java, JavaScript, Limbo, LPC, Perl, PHP, Python, and Unix's C Shell. The most pervasive influence on these languages has been syntactical, and they tend to combine the recognizable expression and statement syntax of C with underlying type systems and data models that can be radically different.

Objective-C is influenced by C, Smalltalk. It is a powerful set of extensions to the Standard ANSI C Language. It is designed & developed to give C full object-oriented

programming capabilities, and to do so in a simple and straightforward way. JAVA, Objective-J & other languages have some features of it.

C++ is influenced by C, Simula, Ada, etc. C adapts the features of classes, inheritance, etc from Objective-C. C++ is firstly known as C with classes, later it gets its name C++. JAVA, ADA, PHP, C99, C# languages are influenced by it.

IV. Comparative study of languages

In early times programming or coding is done with the help of binary digits. All the characters have their binaries. In those days coding is very difficult because all the coding is done on binary or in assembly language. In these languages memory register is directly used so remembering all the register names and commands and binary values is not an easy work. If any changes a programmer wants to do in that program then doing changes is much more difficult from making a new program. So programmer's requires a language which minimise their task and make coding easier for them.

After some time C Language was derived in 1970's the purpose of discovering this language is to make programming easier for programmer. In C Language simple English is used for coding. No binaries as well as no need to remember the name of register. In C Language syntaxes are written in very simple language which is easy to understand as well as to remember. C Language is derived from or influenced form the Assembly Language so it is machine oriented or machine dependent i.e., the program can only run in that system on which it is design. It cannot be port to any other system which is having different configuration from the system on

which it is design. Other problem is that C Language is procedural language i.e., it has its set rule for defining and declaring all the variables, functions, etc... For example first line of void main () is always used for variable declaration. All the variables are only declared in this line only not else anywhere in the program.

By developing C Language problem of writing language is solved but now some new problems are arises. To overcome these problems a new language is derived in 1980's that is Objective-C Language.

Objective-C Language is object oriented language. In this language no rules are described. In this language there are no rules for name of variable, for declaring variables or for doing any task. In this language printing is done just by writing the sentence in square brackets. In this language all the work is done in classes that why it an object oriented language. But this language is not easy to learn or understand because in this there are no set rules for defining any variable or function.

But the advantage of this language is that it gives the concept of objects. By using programming becomes very easy.

To overcome problems of Objective-C language new language is derived in 1980's. With concept of object oriented and some predefined rules or functionalities a language is designed known as C with classes. Later this language gets its originals name i.e., C++.

C++ is a language which is semi dependent on machine and which is easy to understand. C++ is different from C in terms of syntaxes, header files, some rules and many more things.

For example: - In C if return type of main () is declared integer (int) then return keyword must be used to return a value but in C++ no need to use return keyword.

C++ uses the objected oriented concepts that why it is also known as Object Oriented Programming Language. In this language all the work is done in classes so making changes are much easier from C language.

Basis	C	Objective-C	C++
Paradigm(s)	Imperative (Procedural), Structured	Reflective, class-based object oriented	Multi-paradigm, procedural, object-oriented, functional, generic
Appeared in	1972	1983	1985
Designed by	Dennis Ritchie	Brad Cox &Tom Love	Bjarne Stroustrup
Developer	Dennis Ritchie & Bell Labs(creators); ANSI X3J11 (ANSI C);ISO/IEC JTC1/SC22/WG14(ISO C)	Apple	Bjarne Stroustrup Bell Labs ISO/IEC JTC1/SC22/WG21
Approach used	Top down approach	----	Bottom up approach
File name extension	.h, .c	.h, .m, .mm	.h, .hh, .cpp, .hpp, .cxx, .c++

Syntax	Very complex	Easiest	Moderate
Inheritance feature	No such feature	Supports all types of inheritance excluding multiple inheritance	Supports all types of inheritance
Emphasis on	Functions	Both(function & data)	Data
Function Declaration	Functions can be declared at the point of use	Totally class-based so function are declared in the classes	Functions must be prototyped before main
Concept of overloading	Doesn't support overloading	Supports overloading	Supports overloading
Header files	Need to include them	No need	Need to include them
Concept of garbage collection	For de-allocating memory free() is used	Automatic garbage collection	For de-allocating memory delete () is used
Keywords	32	12	98
Use of return keyword	Main() doesn't automatically returns zero(0)	No concept of main() & return	Main() automatically return zero(0)

Fig. 1 Table showing comparative study of the languages

V. Conclusion

This paper studies about the languages, their history, and influence of one language to another. The purpose of developing C Language is to give programmer a coding friendly language. But this language has some drawbacks also. To overcome these drawbacks new language Objective-C is derived. It is influenced by C. Objective-C also has some issues to overcome these issues C++ is derived. It has features of C and Objective-C both. Since all these languages are derived from one another but they have some dissimilarity also.

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