

Object Oriented Programming Using C++

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Programming Language

- Business logic implementation
- Application Development(CUI, GUI, Library application etc.)
- Building blocks of the language
 1. Syntax and Semantics
 2. Data types
 3. Tokens
 4. Built-in features
 5. Standard library and run-time system
- Examples
 - C, C++, Java, C#, Python, Go, Scala etc.

Token

- Program is collection of statements.
- Statement is an instruction given to the computer.
- Every instruction is made from token.
- Token is basic unit of a program.
- Following are tokens in C:
 1. Identifier
 2. Keyword
 3. Constant / Literal
 4. Operator
 5. Punctuator/Separator

Types of programming languages

1. Machine level programming language.
2. Low level programming language.
3. High level programming language.

Programming Language Paradigms

1. Procedure Oriented Programming Languages.

- FORTRAN, ALGOL, COBOL, BASIC, Pascal, C etc.

2. Object Oriented Programming Languages.

- **Simula**, Smalltalk, C++, Java, C# etc.

3. Object Based Programming Languages.

- **Ada**, Modula-2, Visual Basic, Java Script

4. Functional Oriented Programming Languages.

- **LISP**, Python, Scala, Haskell etc.

Object Oriented Programming Structure

- "Object-Oriented Programming" (OOP) was coined by **Alan Kay**.
- According to Alan Kay, the essential ingredients of OOP are:
 - Message passing
 - Encapsulation
 - Dynamic binding
- Grady Booch is inventor of UML(Unified Modelling Language).
- According to Grady Booch, there are 4 major and 3 minor pillars of oops.

Major Pillars Of OOPS

- Following are the four **major pillars** of oops:
 1. **Abstraction** – To achieve simplicity
 2. **Encapsulation** – To achieve data hiding
 3. **Modularity** – To minimize module dependency
 4. **Hierarchy** – To achieve reusability
- By major, we mean that a language without any one of these elements is not object oriented.

Minor Pillars Of OOPS

- Following are the three **minor pillars** of oops:
 1. **Typing** – To reduce maintenance of the system
 2. **Concurrency** – To utilize hardware resources efficiently
 3. **Persistence** – To maintain state of object on secondary storage.
- By minor, we mean that each of these elements is a useful, but not essential, to classify language object oriented.

C++ Introduction

- **C++** is a general-purpose programming language created by **Bjarne Stroustrup** in **1979**.
- It is a pure C programming language in addition with Classes.
- It is **object oriented programming language** which is derived from **C and Simula**.
- Extension of C++ source file should be .cpp.
- Initial name of the language was **"C with Classes"**.
- C++ is standardized by the International Organization for Standardization(ISO).
- C++98, C++03, C++11, C++14, C++17, C++20, C++23 are C++ standards.
- Reference Website : <https://en.cppreference.com/w/cpp>

C++ Programming: Language Keywords

- Keywords are the reserved words that we can not use as identifier
- Reference : <https://en.cppreference.com/w/cpp/keyword>
- According to C++ 98, there are 74 keywords in C++.
 - C++98 : 74 keywords
 - C++11 : 10 keywords

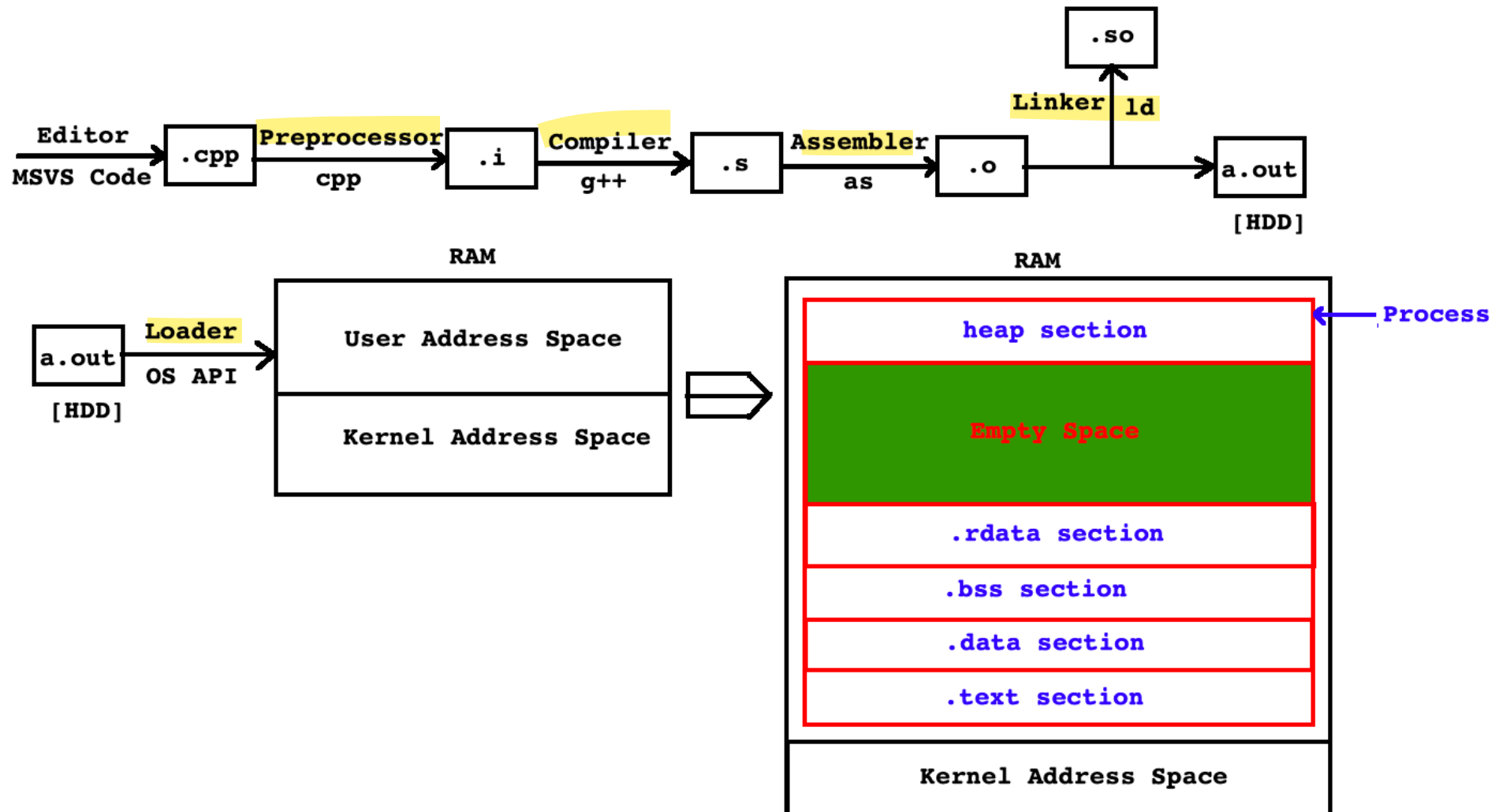
Data Type

- Data type of any variable decides 4 things:
 1. Memory
 2. Nature
 3. Operation
 4. Range
- Types of data type:
 1. Fundamental data types
 2. Derived data types
 3. User Defined data types

Data Type

Fundamental Data Types	Derived Data Types	User Defined Data Types
void(Not Mentioned)	Array	enum
bool(1 byte)	Function	union
char(1 byte)	Pointer	structure
wchar_t(2 bytes)	Reference	class
int(4 bytes)		
float(4 bytes)		
double(8 bytes)		

Flow of execution



Flow of execution

- “.text” section : It contains the executable instruction codes and is shared among every process running the same binary.
- “.bss” section : BSS stands for ‘Block Started by Symbol’. It holds un-initialized global and static variables.
- “.data” section : Contains the initialized global and static variables and their values. It is usually the largest part of the executable. It usually has READ/WRITE permissions.
- “.rdata” section : Also known as .rodata (read-only data) section. This contains constants and string literals.
- “Heap section” : It is used to allocate memory for variables dynamically.
- “Empty space” : Since size of stack and heap is not fixed, it may grow/shrink at runtime.

Access Specifier

- If we want to control visibility of the members of a structure/class then we should use access specifier.
- Private, protected and public are access specifiers in C++.

Access Specifier	Same Class	Derived Class	Non Member Function
private	A	NA	NA
protected	A	A	NA
public	A	A	A

- In C++, structure members are by default public and class members are by default private.

Data Member

- A variable declared inside class/class scope is called data member.
- Data member is also called as field/attribute/property.

```
class Complex{  
private:  
    int real; //Data Member  
    int imag; //Data Member  
};
```

- Only data member get space once per object and according to order of their declaration inside class.
- Only by understanding problem statement, we can decide data members inside class/structure.

Member Function

- A function defined/implemented inside class/class scope is called member function.
- Member function is also called as method/operation/behavior/operation.

```
class Complex{  
public:  
    void acceptRecord( void ){ //Member Function  
    }  
    void printRecord( void ){ //Member Function  
    }  
};
```

- Member function do not get space inside object. All the objects of same class share single copy of member function.

Class

- class is a keyword in C++.
- It is a collection of data member and member function.
- It is a basic unit of encapsulation.
- Class can contain:
 - Data members
 1. Non static data members
 2. Static data members
 - Member Functions
 1. Non static member functions
 2. Static member functions
 - Nested Types

Class

- Some member functions are special: under certain circumstances they are defined by the compiler:
 1. **Constructor**
 2. **Destructor**
 3. **Copy constructor**
 4. **Assignment operator function**
- A class from which, we can create object is called concrete class. In words, we can instantiate concrete class.
- A class from which, we can not create object is called abstract class. In words, we can not instantiate abstract class.
- A member function of a class, which is having a body is called concrete method.
- A member function of a class, which dp not have a body is called abstract method.

Instance and Instantiation

- Variable or instance of a class is called object.
- Process of creating object from a class is called instantiation.
- Syntax :
 1. `class ClassName identifier; //or`
 2. `ClassName identifier;`
- As shown above, during instantiation, use of class keyword is optional.
- Example:
 - `Complex c1;`
 - Here class Complex is instantiated and name of instance is c1.
- Global variable/Local Variable/Function Parameter / Member function do not get space inside object.

Message Passing

- Process of calling member function on object is called message passing.
- Consider following example:

```
Complex c1;  
c1.acceptRecord( ); //Message Passing  
c1.printRecord( );  //Message Passing
```

- or

```
Complex c1;  
c1.Complex::acceptRecord( ); //Message Passing  
c1.Complex::printRecord( );  //Message Passing
```

Thank you