OOP C++

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Content(long session 😁)

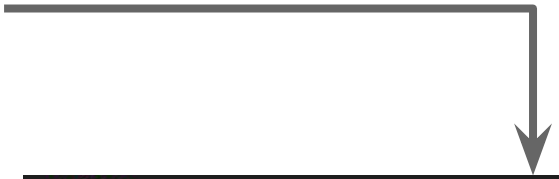
-Thinking with c++
-Enum
-Initialization
-struct/class
-OOP
-constructor
-Destructor
-delegation

Thinking with c++

```c
// C
char name[]="Moatasem";
char lname[]="Elsayed";
strcat(name,lname);
```

```cpp
//C++
std::string Name="Moatasem";
std::string lName="Elsayed";
Name+=lName;
```

```c
// C
int arr[]={10,12,310,100,200};
int max=arr[0];
for(int i=1;i<sizeof(arr)/sizeof(arr[0]);i++)
{
    if(arr[i]>max)
    {
        max=arr[i];
    }
}
std::cout <<max<<std::endl;
```



```cpp
//C++
std::cout << *std::max_element(std::begin(arr),std::end(arr));
```

Write a program to sort array ?

```
int i, j, a, n, number[30];
printf("Enter the value of N \n");
scanf("%d", &n);

printf("Enter the numbers \n");
for (i = 0; i < n; ++i)
    scanf("%d", &number[i]);

for (i = 0; i < n; ++i)
{

    for (j = i + 1; j < n; ++j)
    {

        if (number[i] > number[j])
        {

            a =  number[i];
            number[i] = number[j];
            number[j] = a;

        }

    }

}
```

```
int s[] = {5, 7, 4, 2, 8, 6, 1, 9, 0, 3};

std::sort(std::begin(s), std::end(s));
for(auto& i :s)
{
    std::cout <<i<<" ";//0 1 2 3 4 5 6 7 8 9
}
```

C++ is OOP language

```c
//C
void fun(){
    std::cout <<"Hello World"<<std::endl;
}
```

```c
//C++
class Greeting{

public:
    void fun(){
        std::cout <<"Hello World"<<std::endl;
    }
};
```

4- Initialization

Initialization of a variable provides its initial value at the time of construction.

The initial value may be provided in the initializer section of a declarator or a new expression. It also takes place during function calls: function parameters and the function return values are also initialized.

For each declarator, the initializer may be one of the following:

(*expression-list* **)**	(1)
= *expression*	(2)
{ *initializer-list* **}**	(3)

1) comma-separated list of arbitrary expressions and braced-init-lists in parentheses

2) the equals sign followed by an expression

3) braced-init-list: possibly empty, comma-separated list of expressions and other braced-init-lists

Depending on context, the initializer may invoke:

- Value initialization, e.g. `std::string s{};`
- Direct initialization, e.g. `std::string s("hello");`
- Copy initialization, e.g. `std::string s = "hello";`
- List initialization, e.g. `std::string s{'a', 'b', 'c'};`
- Aggregate initialization, e.g. `char a[3] = {'a', 'b'};`
- Reference initialization, e.g. `char& c = a[0];`

If no initializer is provided, the rules of default initialization apply.

Example on Initializatio

```
//construcotr(int number, int value)
std::vector<int>v(2,3);// 3 3
//initliaizer_list
std::vector<int>v2{2,3};// 2 3
```

```
struct Data{
    int temp;
};
int main()
{
    // 1- all of them can assign value
    int n;      //default
    int x=10;  // copy
    int y(10); // direct
    int z{10}; // value

    // 2- {} narrow conversion
    float dec=3.5;
    int value{dec};

    // 3- vexing parse
    int v{};
    int v2(); //prototype
    int v3=0;

    // 4- synthesize constructor
    Data d; //garbage
    Data d2{}; //zeros
    std::cout <<d.temp<<std::endl;
    std::cout <<d2.temp<<std::endl;
    return 0;
```

Enum (C Style)

```
enum Traffic
{
    RED,
    YELLOW,
    GREEN

};
int main()
{
    Traffic obj;
    std::cout << obj << std::endl; // 1- default =0
    std::cout << RED << std::endl; // 2- classic enum ->access direct
    int x = RED;                   // 3- class enum -> convert enum to int
    std::cout << x << std::endl;
    // Traffic obj2=1;          // 4-  #ERROR  cannot convert int to classic enum
    return 0;
}
```

Enum Class

```cpp
enum class Traffic : unsigned char                    // 1- specifiy size optional
{
    RED,
    YELLOW,
    GREEN

};
int main()
{
    Traffic obj;
    // std::cout << obj << std::endl;                 // 2- cannot print obj till operator overloading exist
    std::cout <<(int)obj<<std::endl;                  // 3- to print use casting --- till we explain static_cast<int>(obj)

    // std::cout << RED << std::endl;                 // 4- #ERROR you cannot access literals without class name
    std::cout <<(int) Traffic::RED << std::endl;      // 5- access enum class

    // int x = Traffic::RED;                          // 6- cannot convert from enum to int
    // Traffic obj2=1;                                // 7-  #ERROR  cannot convert int to classic enum

  int y= static_cast<int>(Traffic::RED);              // 8- conversion happen through casting
   Traffic obj2 = static_cast<Traffic>(1);
   std::cout <<(int)obj2 <<" "<<y<<std::endl;
   //auto compelet
   Traffic::
    return 0
}
```

GREEN
RED
YELLOW

enum class Traffic::GREEN = 2U

File: test.cpp

When we use you classic enum over enum class ?

```
//-----------------------------------------------------------
//! \namespace Software Update
//!
//! \brief Software Update namespace        You, now • Uncc
//!
enum SwUpdateParam { DigBridge, OtaBridge, FlashingApp };
//
```

If no need for that then use enum class whenever you need to use enum

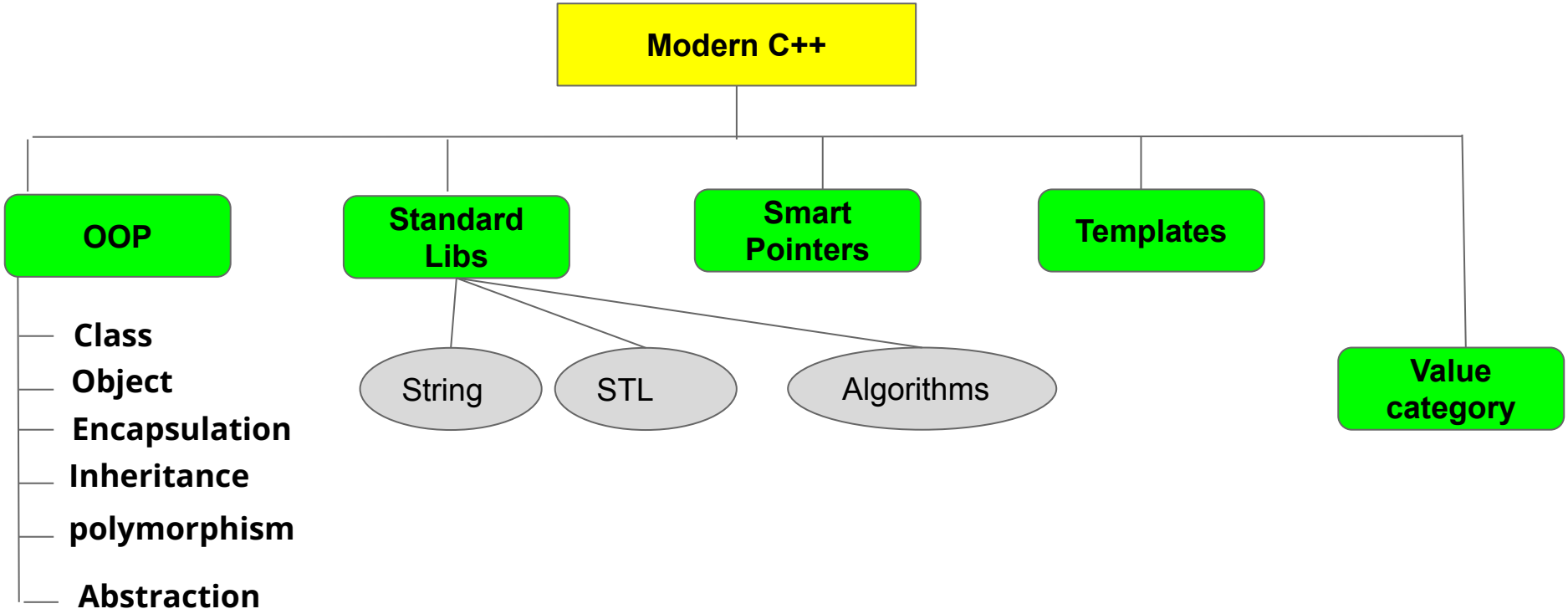
```
std::string SwUpdateJsonParse::converKeyToString(SwUpdateParam key) {
#define MYCase(X) \
    case X:       \
        return std::string(#X)
    switch (key) {
        MYCase(DigBridge);
        MYCase(OtaBridge);
        MYCase(FlashingApp);
    }       You, 2 days ago • [artf1991561] configure Receiving ISO fr
#undef MYCase
    return "";
}
```

Struct

Function

Identifier is the type

```
2  using namespace std;
3
4  struct Data{
5      int x;
6      int y;
7      void fun(){
8          std::cout <<"HEllo"<<std::endl;
9      }
10 };
11 int main()
12 {
13     Data d;
14     d.fun();
15
16     return 0;
17 }
```

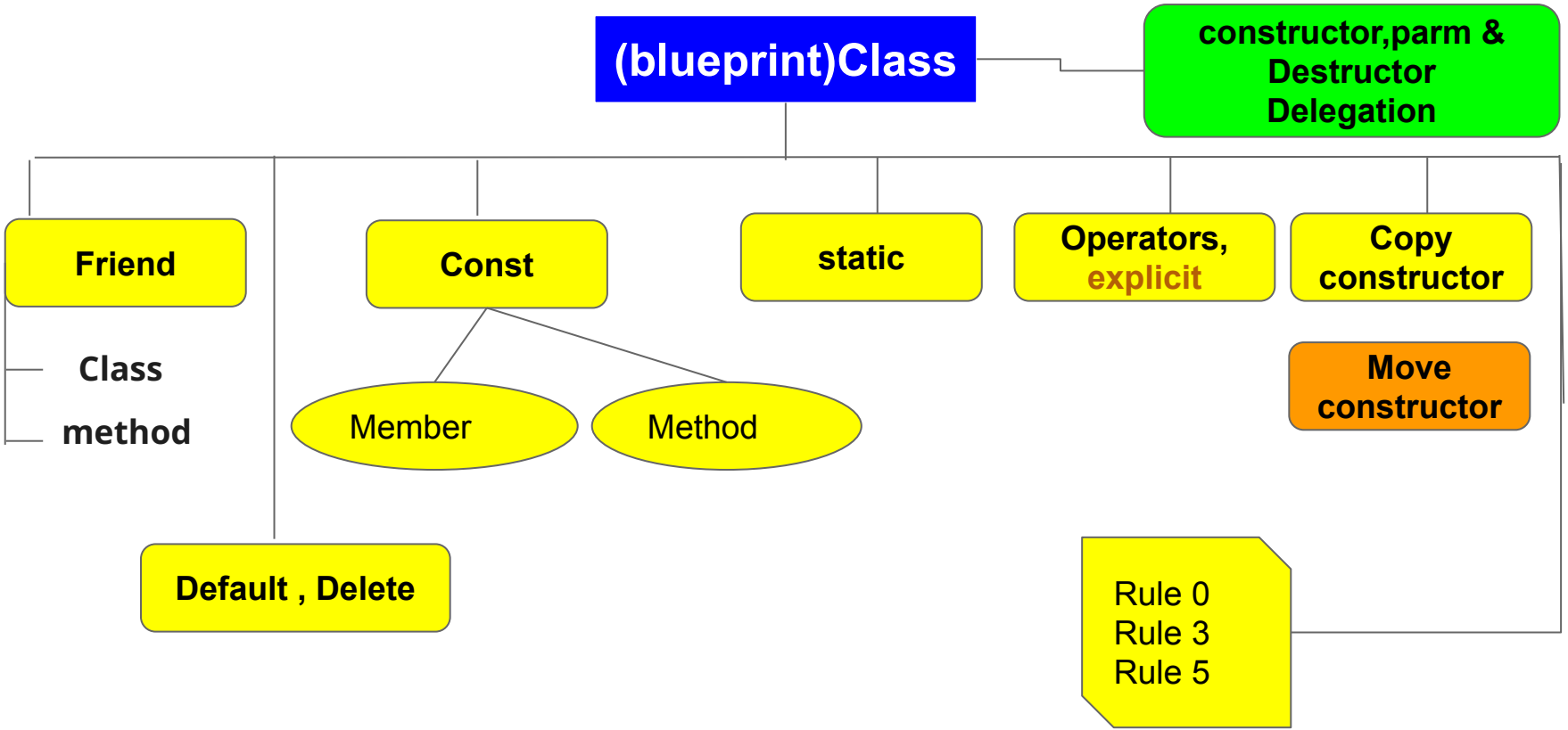

Modern C++
OOP
Standard Libs
Smart Pointers
Templates
Value category
Class
Object
Encapsulation
Inheritance
polymorphism
Abstraction
String
STL
Algorithms

OOP

Object-oriented programming (OOP) is a computer programming model that organizes software design around data, or objects, rather than functions and logic.

An object can be defined as a data field that has unique attributes and behavior.

Features of class



Class blueprint

Encapsulation

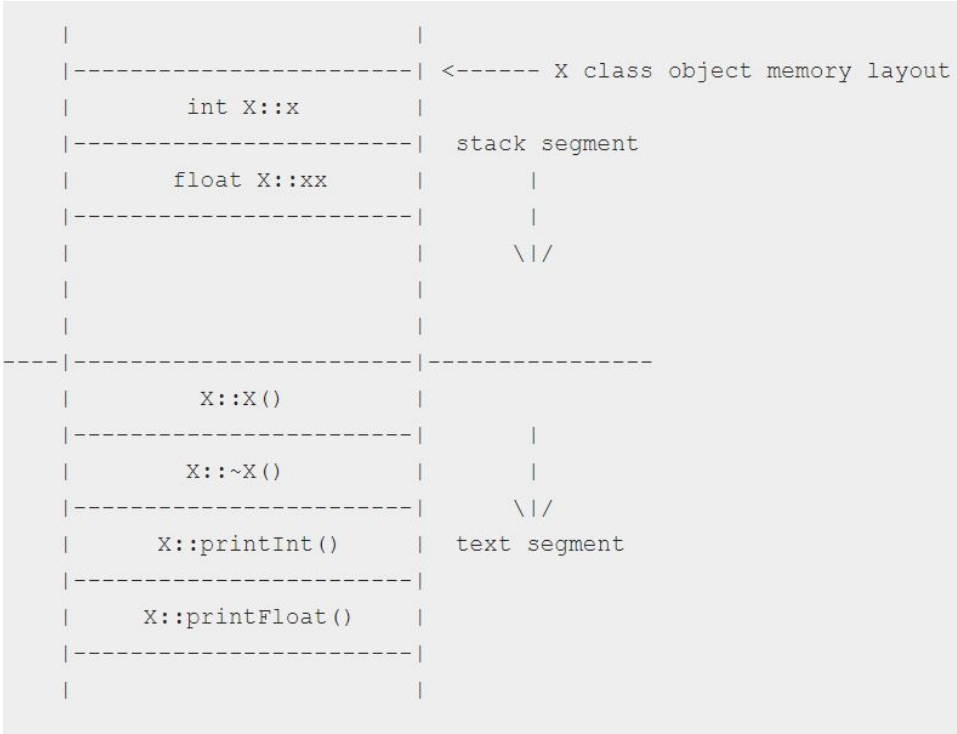

```
9  class LED{
10
11      public:
12          void TurnLedOn();
13          void TurnLedOff();
14      private:
15      uint8_t ledPin=10;
16  };
17  void LED::TurnLedOn()
18  {
19      std::cout <<"LED is HIGH "<<ledPin<<std::endl;
20  }
21
22  void LED::TurnLedOff()
23  {
24      std::cout <<"LED is LOW "<<ledPin<<std::endl;
25
26  }
27
28  int main() {
29    LED d;                    //1- create object in stack
30    d.TurnLedOn();            //2- access only public section
31    d.TurnLedOff();
32    // d.ledPin=12;           //3- ERROR LED::ledPin' is private within this co
33    LED().TurnLedOff();       //4- temp object
```

```
std::cout<<sizeof(d)<<std::endl;  // 5- sizeof datatypes + vptr if exist  + padding
LED *ptr=&d;
ptr->TurnLedOff();                //6- access through pointer
```

Memory layout

Taken from : http://www.vishalchovatiya.com/memory-layout-of-cpp-object/

```
class X {
    int     x;
    float   xx;

public:
    X() {}
    ~X() {}

    void printInt() {}
    void printFloat() {}
};
```



External vs inline function

```
4
5   class X {
6   public:
7       int x=10;
8       void PrintInt();
9   };
10  void X::PrintInt(){
11
12  }
13  int main()
14  {
15
16      return 0;
17  }
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL GITLENS

```
moatasem@CAI1-L14000:~/vsomeIp$ objdump -t --demangle a.out | grep -i "/*PrintInt*"
00000000000011d5 l     F .text  0000000000000019              _GLOBAL__sub_I__ZN1X8PrintIntEv
000000000000116a g     F .text  000000000000000f              X::PrintInt()
moatasem@CAI1-L14000:~/vsomeIp$
```

Inline function

```
4
5   class X {
6   public:
7       int x=10;
8       void PrintInt()
9       {
10          cout << " In class A\n";
11      }
12  };
13
14  int main()
15  {
16      X obj;
17      obj.PrintInt();
18      return 0;
19  }
20
```

```
OBLEMS   OUTPUT   DEBUG CONSOLE   TERMINAL   GITLENS

patasem@CAI1-L14000:~/vsomeIp$ objdump -t --demangle a.out | grep -i "/*PrintInt*"
0000000000001258  w    F .text  0000000000000026              X::PrintInt()
patasem@CAI1-L14000:~/vsomeIp$
```

```
4
5   class X {
6   public:
7       int x=10;
8       void PrintInt()
9       {
0           cout << " In class A\n";
1       }
2   };
3
4   int main()
5   {
6
7       return 0;
```

```
BLEMS   OUTPUT   DEBUG CONSOLE   TERMINAL   GITLENS

moatasem@CAI1-L14000:~/vsomeIp$ g++ -g test.cpp -std=c++14 -O0 && ./a.out
moatasem@CAI1-L14000:~/vsomeIp$ objdump -t --demangle | grep -i PrintInt
moatasem@CAI1-L14000:~/vsomeIp$
```

Constructor(default - param)

What is “this “ ?

```
21          Data d;
   0x00000000080011be <+27>:    lea    -0xc(%rbp),%rax
   0x00000000080011c2 <+31>:    mov    %rax,%rdi
   0x00000000080011c5 <+34>:    callq  0x800118a <Data::Data()>

22          return 0;
=> 0x00000000080011ca <+39>:    mov    $0x0,%eax

23      }
   0x00000000080011cf <+44>:    mov    -0x8(%rbp),%rdx
   0x00000000080011d3 <+48>:
--Type <RET> for more, q to qui
Quit
(gdb) p &d
$1 = (Data *) 0x7fffffed9b4
(gdb) p %rax
A syntax error in expression, n
(gdb) p $rax
$2 = 140737488279988
(gdb)
```


```
class LED{

    public:
        LED()=default; // LED(){}     //1- Default
        LED(int pin);                 //2-paramter
        void TurnLedOn();
        void TurnLedOff();
    private:
    uint8_t ledPin=10;
};

LED::LED(int pin) :ledPin(pin) // 3- initializer list
{
    std::cout <<"Constructor "<<ledPin<<std::endl;
    // ledPin=pin;    //4- instead of initializer list
}
```

Once you create parameterized constructor , you need to create default

```
4
5  class Data {
6  public:
7      bool flag=1;
8      int value=0;
9      Data(bool flag);
10
11     void PrintInt()
12     {
13         cout << " In class A\n";
14     }
15 };
16 Data::Data(bool flag)
17 {
18     this->flag=flag;
19 }
20
21 int main()
22 {
23     Data d;
24     return 0;
25 }
26
```

```
test.cpp: In function 'int main()':
test.cpp:23:10: error: no matching function for call to 'Data::Data()'
   23 |     Data d;
      |          ^
```

Initializer list of constructor

```
5  class Data {
6  public:
7      bool flag=1;
8      int value=0;
9      Data(bool flag);
10
11     void PrintInt()
12     {
13         cout << " In class A\n";
14     }
15 };
16 Data::Data(bool flag)
17 {
18     this->flag=flag;
19 }
```

```
(gdb) disassemble /s 0x800118a
Dump of assembler code for function Data::Data(bool):
test.cpp:
16      Data::Data(bool flag)
   0x000000000800118a <+0>:     endbr64
   0x000000000800118e <+4>:     push   %rbp
   0x000000000800118f <+5>:     mov    %rsp,%rbp
   0x0000000008001192 <+8>:     mov    %rdi,-0x8(%rbp)
   0x0000000008001196 <+12>:    mov    %esi,%eax
   0x0000000008001198 <+14>:    mov    %al,-0xc(%rbp)
   0x000000000800119b <+17>:    mov    -0x8(%rbp),%rax
   0x000000000800119f <+21>:    movb   $0x1,(%rax)
   0x00000000080011a2 <+24>:    mov    -0x8(%rbp),%rax
   0x00000000080011a6 <+28>:    movl   $0x0,0x4(%rax)

17      {
18          this->flag=flag;
   0x00000000080011ad <+35>:    mov    -0x8(%rbp),%rax
   0x00000000080011b1 <+39>:    movzbl -0xc(%rbp),%edx
   0x00000000080011b5 <+43>:    mov    %dl,(%rax)

19      }
   0x00000000080011b7 <+45>:    nop
```

Initializer list of constructor

Mandatory Usage (ref, const, base)

```
5   class Data {
6   public:
7       bool flag=1;
8       int value=0;
9       Data(bool flag);
0
1       void PrintInt()
2       {
3           cout << " In class A\n";
4       }
5   };
6   Data::Data(bool flag):flag(flag)
7   {
8   }
```

```
(gdb) disassemble /s Data::Data(bool)
Dump of assembler code for function Data::Data(bool):
test.cpp:
16      Data::Data(bool flag):flag(flag)
   0x000000000800118a <+0>:     endbr64
   0x000000000800118e <+4>:     push   %rbp
   0x000000000800118f <+5>:     mov    %rsp,%rbp
   0x0000000008001192 <+8>:     mov    %rdi,-0x8(%rbp)
   0x0000000008001196 <+12>:    mov    %esi,%eax
   0x0000000008001198 <+14>:    mov    %al,-0xc(%rbp)
   0x000000000800119b <+17>:    mov    -0x8(%rbp),%rax
   0x000000000800119f <+21>:    movzbl -0xc(%rbp),%edx
   0x00000000080011a3 <+25>:    mov    %dl,(%rax)
   0x00000000080011a5 <+27>:    mov    -0x8(%rbp),%rax
   0x00000000080011a9 <+31>:    movl   $0x0,0x4(%rax)

17      {
18      }
   0x00000000080011b0 <+38>:    nop
   0x00000000080011b1 <+39>:    pop    %rbp
   0x00000000080011b2 <+40>:    retq
End of assembler dump.
```

What is happening here ?

```
public : Thing(int _foo, int _bar){
    member1 = _foo;
```

```
class Data {
public:
    bool flag=1;
    int value=0;
    Data(bool flag);

    void PrintInt()
```

```
(gdb) disassemble /s 0x800118a
Dump of assembler code for function Data::Data(bool):
test.cpp:
16      Data::Data(bool flag)
   0x000000000800118a <+0>:     endbr64
   0x000000000800118e <+4>:     push   %rbp
   0x000000000800118f <+5>:     mov    %rsp,%rbp
   0x0000000008001192 <+8>:     mov    %rdi,-0x8(%rbp)
   0x0000000008001196 <+12>:    mov    %esi,%eax
   0x0000000008001198 <+14>:    mov    %al,-0xc(%rbp)
   0x000000000800119b <+17>:    mov    -0x8(%rbp),%rax
```

```
rc/service/receiver/DiagReceiver.cpp:57:5: performance: Variable 'm_Command1_CreateUploadLog' is assigned in constructor body. Consider performing initialization in initialization list. [useInitializationList]
    m_Command1_CreateUploadLog = std::make_shared<Command1_CreateUploadLog>();
    ^
rc/service/receiver/DiagReceiver.cpp:58:5: performance: Variable 'm_command2_checkNetwork' is assigned in constructor body. Consider performing initialization in initialization list. [useInitializationList]
    m_command2_checkNetwork = std::make_shared<Command2_NetworkConnection>();
    ^
rc/service/receiver/DiagReceiver.cpp:59:5: performance: Variable 'm_Command3_handleLogUpload' is assigned in constructor body. Consider performing initialization in initialization list. [useInitializationList]
    m_Command3_handleLogUpload = std::make_shared<Command3_handleLogUpload>();
    ^
rc/service/receiver/DiagReceiver.cpp:60:5: performance: Variable 'm_Command4_diagAction' is assigned in constructor body. Consider performing initialization in initialization list. [useInitializationList]
    m_Command4_diagAction = std::make_shared<Command4_DiagAction>();
    ^
rc/service/receiver/DiagReceiver.cpp:61:5: performance: Variable 'm_Command6_playVoi                    constructor body. Consider performing initialization in initialization list. [useInitializationList]
    m_Command6_playVoice = std::make_shared<Command6_playVoice>();
    ^
```

cppcheck

Delegation

```
moatasem@CAI1-L14000:~/vsomeIp$ ./a.out
Default
1 Param
2 Param
moatasem@CAI1-L14000:~/vsomeIp$
```

```
};
Data::Data()
{
    std::cout <<"Default"<<std::e
}
Data::Data(bool flag):flag(flag),Data()
{
```

class Data

a delegating constructor cannot have other mem-initializers C/C++(2447)

View Problem (Alt+F8) Quick Fix... (Ctrl+.)

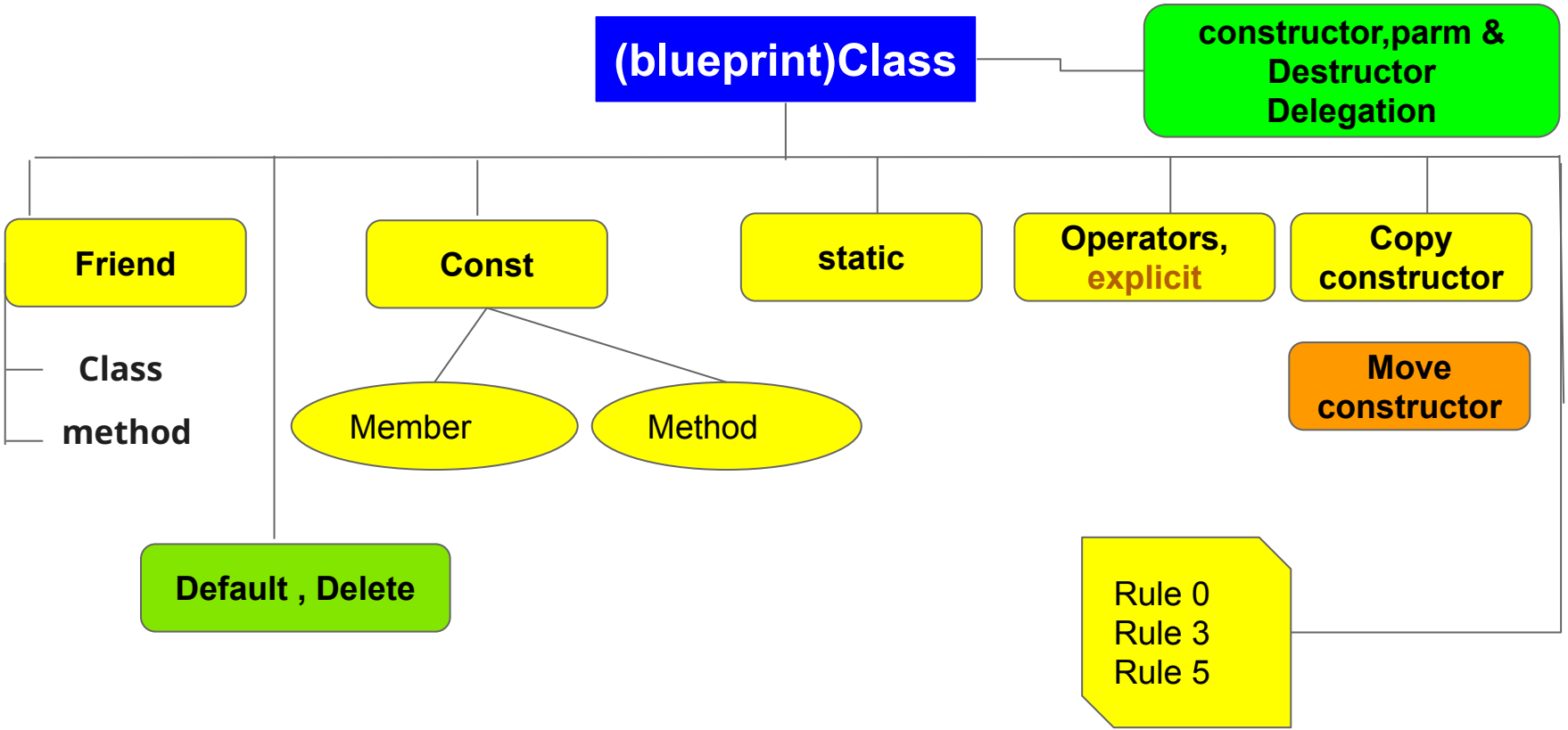
```
class Data {
public:
    bool flag=1;
    int value=0;
    Data();
    Data(bool flag);
    Data(bool flag,int value);

    void PrintInt()
    {
        cout << " In class A\n";
    }
};
Data::Data()
{
    std::cout <<"Default"<<std::endl;
}
Data::Data(bool flag):Data()
{
    this->flag=flag;
    std::cout <<"1 Param"<<std::endl;
}

Data::Data(bool flag,int value):Data(flag)
{
    this->value=value;
    std::cout <<"2 Param"<<std::endl;
}
```

Delete

```
class Data {
public:
    bool flag=1;
    int value=0;
    Data()=delete;
    Data(int flag);
    void PrintInt()
    {
        cout << " In class A\n";
    }
};
Data::Data()
{
    std::cout <<"Default"<<std::endl;
}

Data::Data(int flag)
{

}

int main(
{
    Data d;
    return 0;
}
```

```
Data d
the default constructor of "Data" cannot be referenced -- it is a deleted function
View Problem (Alt+F8)    Quick Fix... (Ctrl+.)
```

Features of class



Const member

1- initialize in class itself

2- initialized in initializer list of constructor

```
class Data
{
    const int value1 ;          // 1-assign in constructor
    const int value2 = 10;      // 2-assign here it will replace with constructor

public:
    Data(int value1) : value1(value1)
    {
    }
    // Data(){}                 //3- Error should initliaize const member value1
};
```

```
test.cpp:
14          Data(int value1) : value1(value1)
   0x0000000000001236 <+0>:     endbr64
   0x000000000000123a <+4>:     push   %rbp
   0x000000000000123b <+5>:     mov    %rsp,%rbp
   0x000000000000123e <+8>:     mov    %rdi,-0x8(%rbp)
   0x0000000000001242 <+12>:    mov    %esi,-0xc(%rbp)
   0x0000000000001245 <+15>:    mov    -0x8(%rbp),%rax
   0x0000000000001249 <+19>:    mov    -0xc(%rbp),%edx
   0x000000000000124c <+22>:    mov    %edx,(%rax)
   0x000000000000124e <+24>:    mov    -0x8(%rbp),%rax
   0x0000000000001252 <+28>:    movl   $0xa,0x4(%rax)

15          {
16          }
   0x0000000000001259 <+35>:    nop
```

```
(gdb) p &d.value1
$1 = (const int *) 0x7fffffed9a0
(gdb) p &d.value2
$2 = (const int *) 0x7fffffed9a4
(gdb) x/32w &d
0x7fffffed9a0: 2        10       -1138036736
0x7fffffed9b0: 0        0        -12763005
0x7fffffed9c0: -10892416        32767    -75
0x7fffffed9d0: 72704    1        134222217
```

Const method

1- normal instance can call everything
2- const instance see only const methods
3- const method cannot write on attributes

Mutable

```
    mutable int x;
public:
    Data()
    {
    }
    void fun(int temp) const{
        x=10;
```

```
8   class Data
9   {
10  private:
11      int x;
12  public:
13      Data()
14      {
15      }
16      void fun(int temp) const{
17          // x=10;      //1- cant change member method
18          int value;   //2- create local variable
19          value=temp; // 3- access local
20          temp=12;    // 4- access param
21          std::cout <<"Hello from const method"<<std::endl;
22      }
23      void method1(){}
24  };
25  int main()
26  {
27
28      Data d;
29      d.fun(2);    // 5- normal instance can access const
30      d.method1(); // 6- normal instance cann access non-const method
31
32      const Data k;
33      k.fun(2);     //7- const instance can access only const method
34      return 0;
35  }
```

Overload const method

```
    }
    void fun(int temp) const{
        std::cout <<"Hello from const method"<<std::endl;
    }
    void fun(int temp) {
        std::cout <<"Hello from  method"<<std::endl;
    }
    void method1(){}
};
int main()
{

    Data d;
    d.fun(1); //Hello from  method

    const Data k;
    k.fun(1); //Hello from  const method

    return 0;
}
```

```
moatasem@CAI1-L14000:~/vsomeIp$ g++ -g test.cpp -fverbose-asm -std=c++14
moatasem@CAI1-L14000:~/vsomeIp$ objdump -t --demangle | grep fun
0000000000012b0  w    F .text  000000000000003e              Data::fun(int) const
0000000000012ee  w    F .text  000000000000003e              Data::fun(int)
moatasem@CAI1-L14000:~/vsomeIp$ objdump -t | grep fun
0000000000012b0  w    F .text  000000000000003e              _ZNK4Data3funEi
0000000000012ee  w    F .text  000000000000003e              _ZN4Data3funEi
moatasem@CAI1-L14000:~/vsomeIp$ objdump -d --demangle | grep fun
    11fc:       e8 ed 00 00 00          callq  12ee <Data::fun(int)>
    1219:       e8 92 00 00 00          callq  12b0 <Data::fun(int) const>
0000000000012b0 <Data::fun(int) const>:
0000000000012ee <Data::fun(int)>:
```

Rule 9–3–1 (Required) const member functions shall not return non-const pointers or references to *class-data*.

```
class Data
{
public:
    Data(int32_t& b_) : a(new int32_t[10]), b(b_)
    {
    }
    int32_t* getA() const // Non-compliant
    // Returns non const pointer to data
    {
        return a;
    }
    int32_t* getB() const // Non-compliant
    // Returns non const pointer to data
    {
        return &b;
    }
    const int32_t* getC() const // Compliant
    // Returns const pointer to data
    {
        return &b;
    }

private:
    int32_t* a;
    int32_t& b;
};
```

Rule 9–3–2 (Required) Member functions shall not return non-const *handles* to *class-data*.

Rationale

By implementing class interfaces with member functions the implementation retains more control over how the object state can be modified and helps to allow a class to be maintained without affecting clients. Returning a *handle* to *class-data* allows for clients to modify the state of the object without using any interfaces.

Example

```
class C
{
public:
   int32_t & getA ()  // Non-compliant
   {
      return a;
   }
private:
   int32_t a;
};

void b ( C & c )
{
   int32_t & a_ref = c.getA ();
   a_ref = 10;                    // External modification of private C::a
}
```

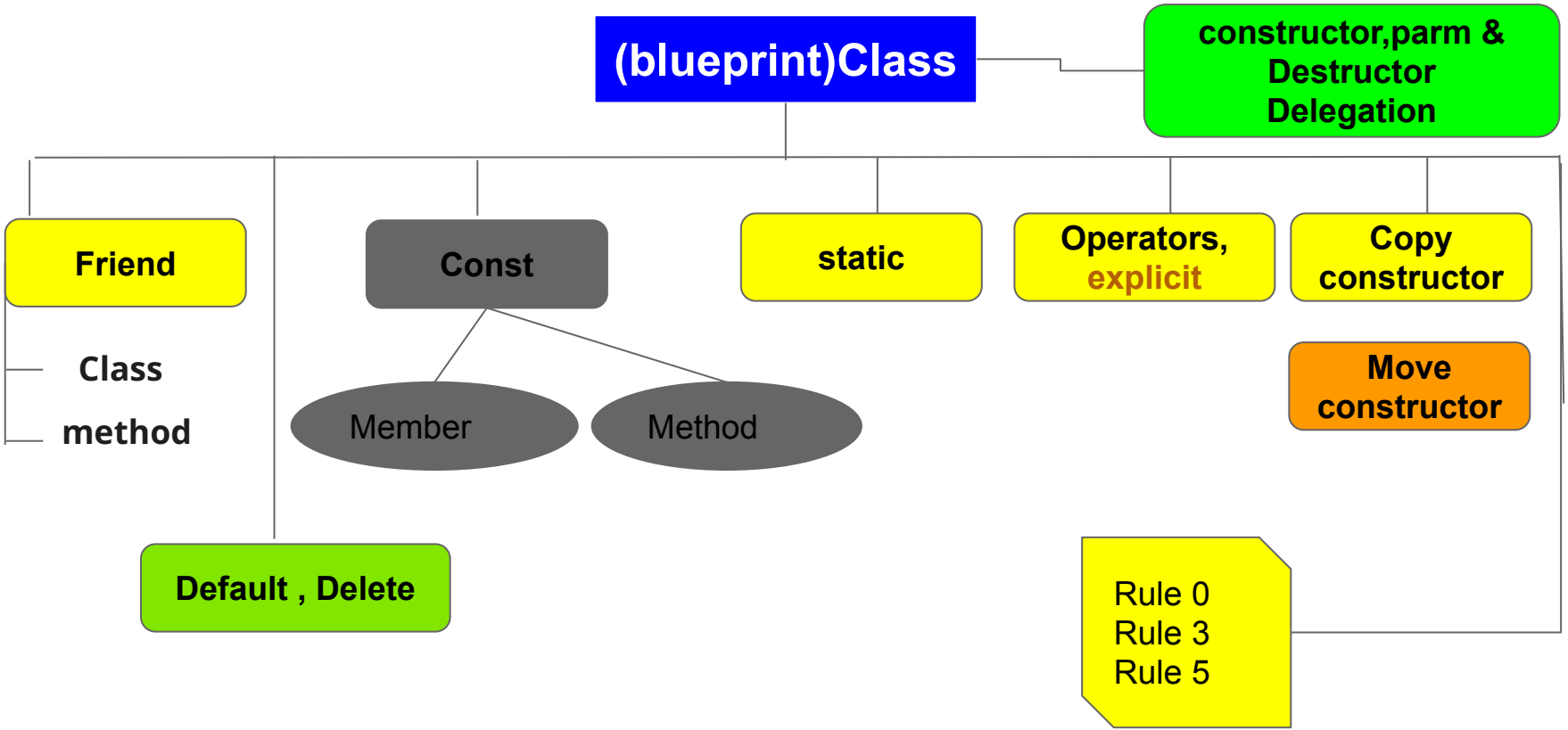
Good Practis

Const as Much as Possible

`const` tells the compiler that a variable or method is immutable. This helps the compiler optimize the code and helps the developer know if a function has a side effect. Also, using `const &` prevents the compiler from copying data unnecessarily. The comments on `const` from John Carmack are also a good read.

```
// Bad Idea
class MyClass
{
public:
  void do_something(int i);
  void do_something(std::string str);
};


// Good Idea
class MyClass
{
public:
  void do_something(const int i);
  void do_something(const std::string &str);
};
```

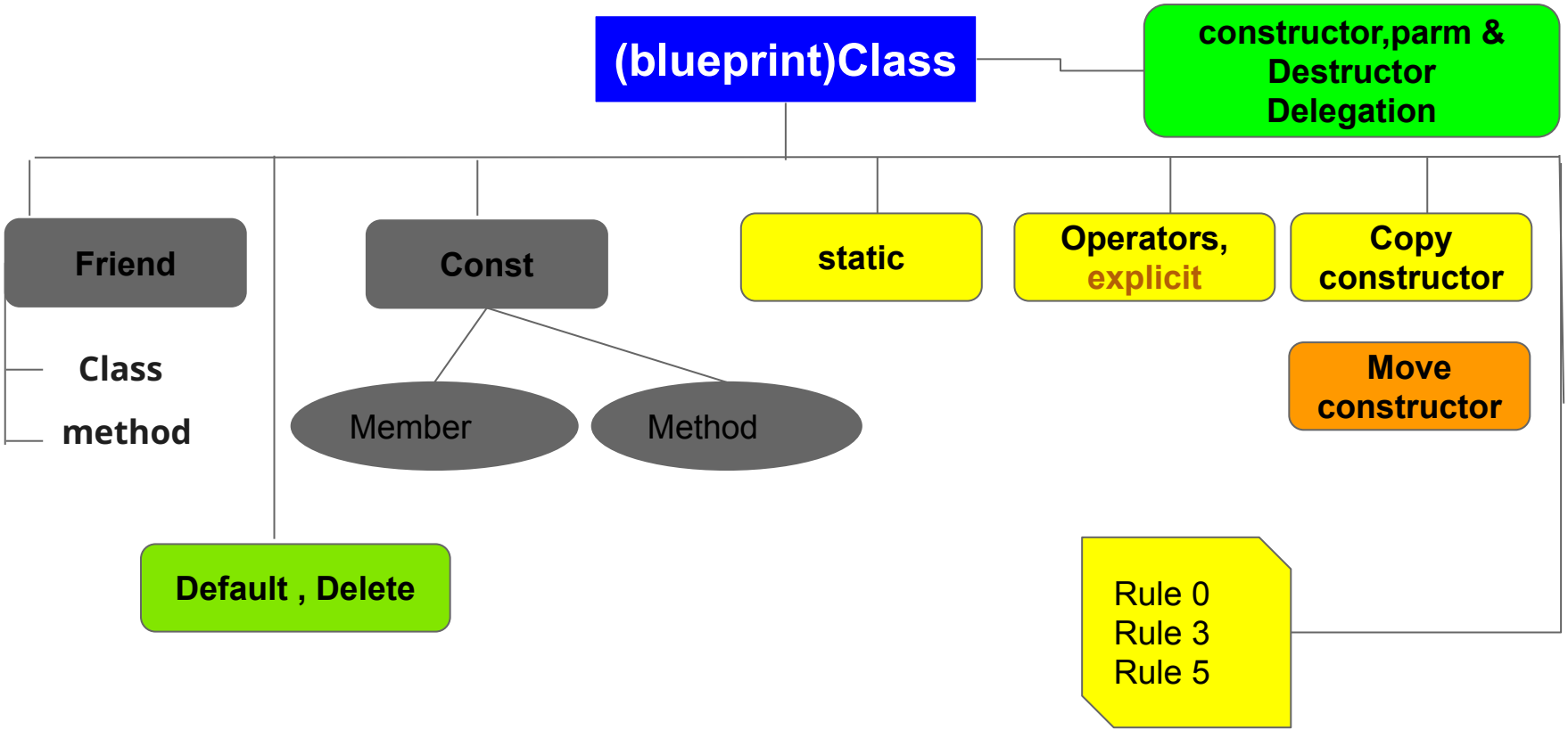
Features of class



Friend class

```
7
8   class Test; //forward decleration
9   class Data
10  {
11  public:
12      Data()
13      {
14      }
15  private:
16      friend class Test; //1- giving permisiion to access the private member
17      int value=0;
18  };
19  class Test{
20  public:
21      void fun(){
22          d.value=12;     //2- works
23      }
24  private:
25      Data d;
26  };
```

Features of class

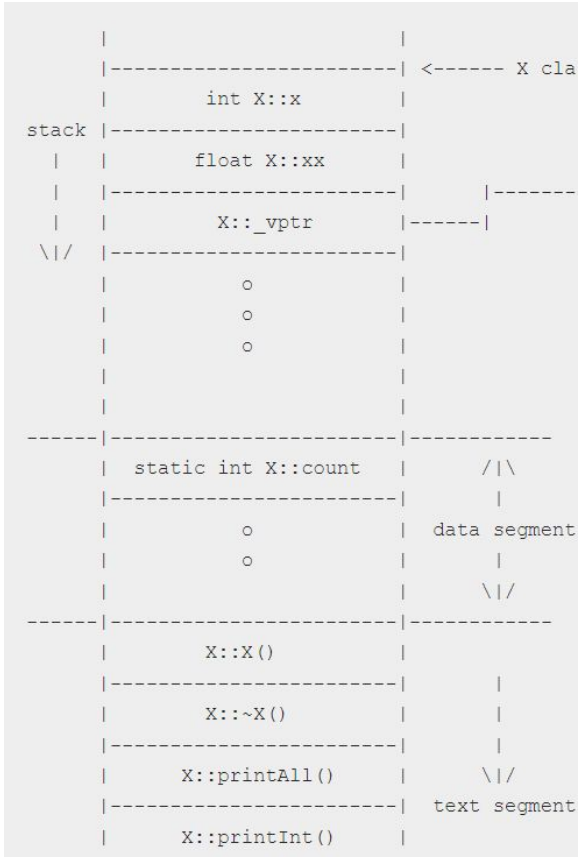


Static member

```
class Data
{
public:
    Data()
    {
        value++;
    }
    void print(){
        std::cout <<value2<<std::endl;
        std::cout <<value<<std::endl;
    }
static int valuep;
private:
    // static member not related to instance related to class itself
    static int value;            // 1- must be defined outside
    static const int value2=5;   // 2- can be defined here if const
    // static const int value3;  //3- ERROR Data(int m):value3(m)

};
int Data::value=0;
int Data::valuep=1000;

int main()
{
    Data d;
    Data d2;
    d.print();
    std::cout << Data::valuep;// 4-public can access with Data::valeup
    std::cout << d.valuep;    // 5- public can access with object
}
```

Layout memory

```
class X {
    int          x;
    float        xx;
    static int   count;

public:
    X() {}
    virtual ~X() {}

    virtual void printAll() {}
    void printInt() {}
    void printFloat() {}
    static void printCount() {}
};
```



BSS / Data Segment

```
int Data::value=10;
int Data::valuep=1000;
```

```
0000000000004014 g     O .data  0000000000000004              Data::valuep
0000000000004010 g     O .data  0000000000000004              Data::value
moatasem@CAI1-L14000:~/vsomeIp$
```

```
int Data::value=0;
int Data::valuep=0;
```

```
0000000000004158 g     O .bss   0000000000000004              Data::valuep
0000000000004154 g     O .bss   0000000000000004              Data::value
moatasem@CAI1-L14000:~/vsomeIp$
```

Static const

Constant static members

If a static data member of integral or enumeration type is declared `const` (and not `volatile`), it can be initialized with an initializer in which every expression is a constant expression, right inside the class definition:

```
struct X
{
    const static int n = 1;
    const static int m{2}; // since C++11
    const static int k;
};
const int X::k = 3;
```

```
    static const int value2;   // 2- can be defined here if const
    // static const int value3;  //3- ERROR Data(int m):value3(m)

};
int Data::value=0;
int Data::valuep=0;
const int Data::value2=0;
```

```
00000000000020b0 g     O .rodata        0000000000000004              Data::value2
0000000000004154 g     O .bss   0000000000000004              Data::value
```

```
class foo
{
public :
    static const int value=1 ;
};

int main()
{
    foo d;
```

```
moatasem@CAI1-L14000:~/vsomeIp$ objdump -t --demangle | grep value
moatasem@CAI1-L14000:~/vsomeIp$
```

Tricky

C++

```cpp
#include <iostream>

class foo
{
public :
    static const int f = 5;
};

void bar(const int& b)
{

}

int main()
{
    bar(foo::f); //undefined reference to foo::f
}
```

```cpp
class foo
{
public :
    static const int f ;
};
 const int foo::f = 5;
void bar(const int& b)
{

}

int main()
{
    bar(foo::f);
}
```

.rodata foo::f

```cpp
class Data
{
public:
    static const int vtest = 10;
};
int main()
{
    Data d;
    std::cout << Data::vtest << std::endl; // 10
}
```

It will be const expr in assembly , not represent as Lvalue

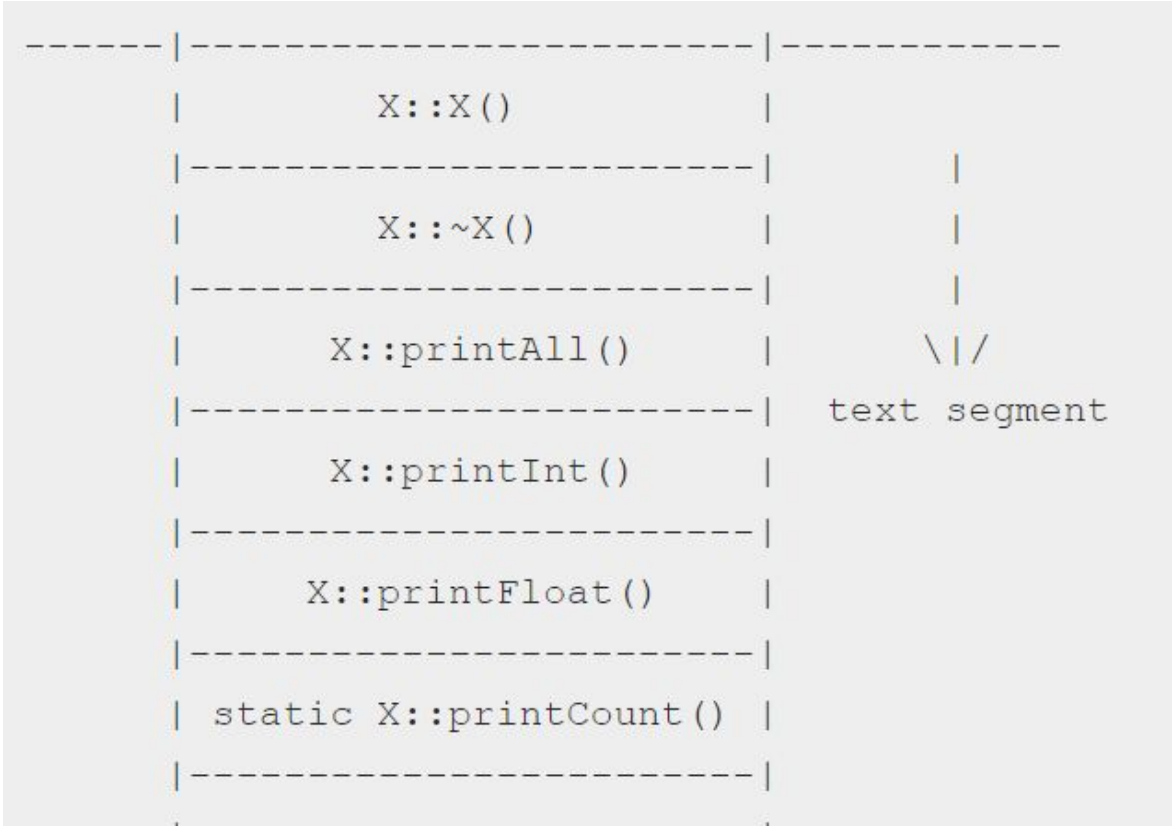
Static method

```
class foo
{
private:
    int m_num=12;
    static int temp;
public :
    static void fun(){
        int value=12;    //1- create local
        // m_num=123;    //2-Error cannot access this
        temp++;          //3- access static members
    }
};
int foo::temp=1;
int main()
{
    foo d;
    foo::fun();          //4- calling from class
    d.fun();             //5- calling from instance
}
```

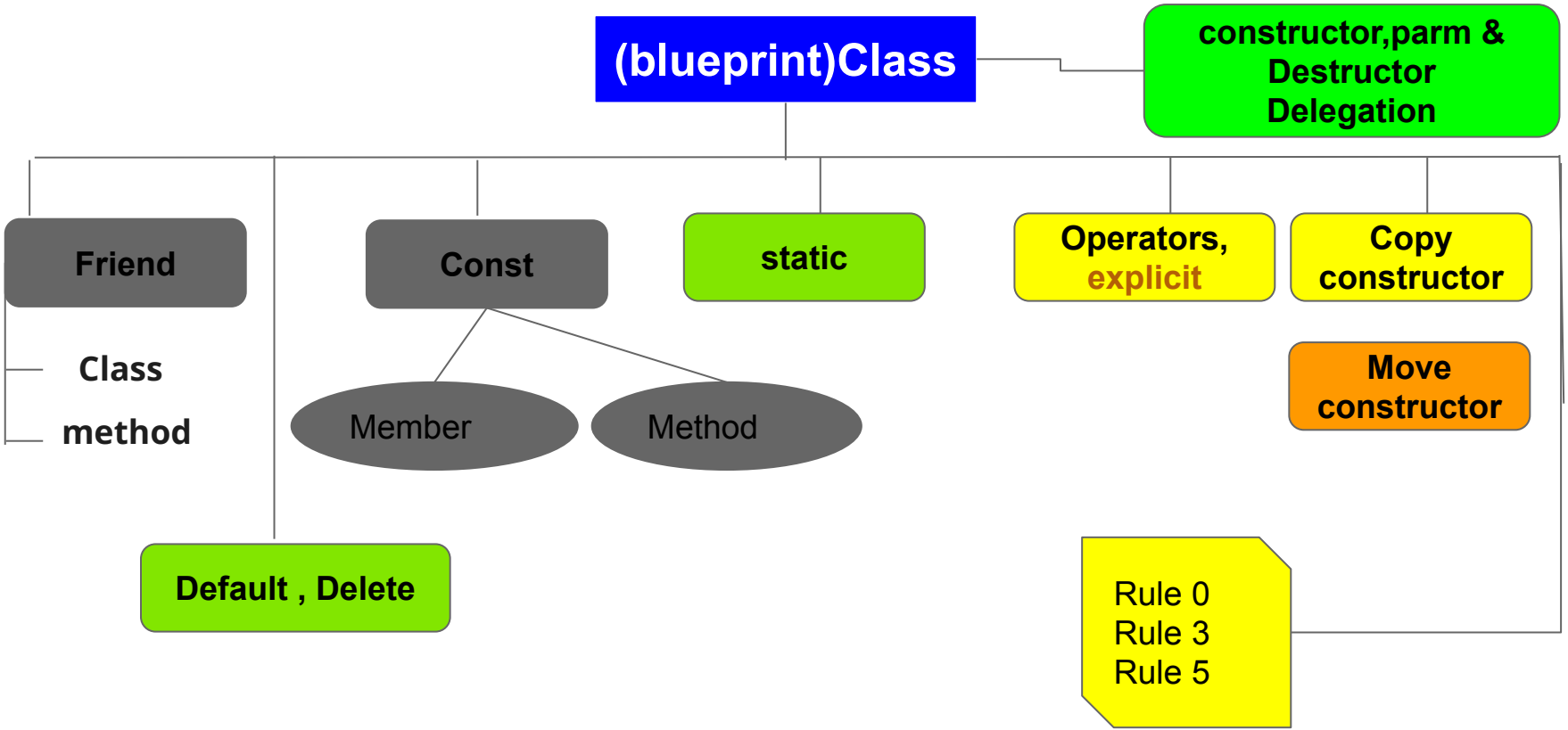
```
    static void test();
};
int foo::temp=1; // no static word
void foo::test() //  no static word
{

}

```

Memory layout

```
class X {
    int          x;
    float        xx;
    static int   count;

public:
    X() {}
    virtual ~X() {}

    virtual void printAll() {}
    void printInt() {}
    void printFloat() {}
    static void printCount() {}
};
```



Features of class



Q&A

Parsing

```
std::string frame="Moatasem  1234  99.9";
```

```
std::string name;
int ID ;
float score ;
std::string frame="Moatasem  1234  99.9";
std::stringstream st(frame);

st>>name>>ID>>score;

std::cout <<name<<std::endl;    //Moatasem
std::cout <<ID<<std::endl;      //1234
std::cout <<score<<std::endl;   //99.9
```

regex

```
//string to be searched
std::string mystr = "Email: moatasem.elsayed@valeo.com ,Mobile:01112932885";
```

d

```
.moatasem@CAI1-L14000:~/vsomeIp$
Email: moatasem.elsayed@valeo.com
Mobile:01112932885
```

Legacy code

```cpp
#include <iostream>
#include <algorithm>
#include <string.h>
#include <vector>
extern "C"
{
    #include "cfile.h"
}
using namespace std;

void fun(int x)
{
    std::cout <<"hello world"<<std::endl;
}
void fun(int x , int y)
{
    std::cout <<"hello world"<<std::endl;
}

int main()
{
    fun(2);
    fun(2,3);
    display();

    return 0;
}
```

```
moatasem@CAI1-L14000:~/vsomeIp$ objdump -t --demangle | grep 'fun\|display'
00000000000012d1 l     F .text  0000000000000019              _GLOBAL__sub_I__Z3funi
00000000000011c9 g     F .text  0000000000000017              display
000000000000121a g     F .text  000000000000003d              fun(int, int)
00000000000011e0 g     F .text  000000000000003a              fun(int)
moatasem@CAI1-L14000:~/vsomeIp$ objdump -t | grep 'fun\|display'
00000000000012d1 l     F .text  0000000000000019              _GLOBAL__sub_I__Z3funi
00000000000011c9 g     F .text  0000000000000017              display
000000000000121a g     F .text  000000000000003d              _Z3funii
00000000000011e0 g     F .text  000000000000003a              _Z3funi
moatasem@CAI1-L14000:~/vsomeIp$
```

Q&A

Convert from decimal to binary?

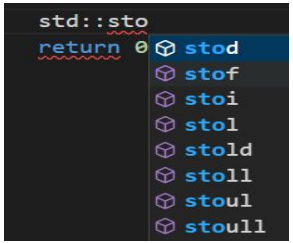
```
12
13  int main()
14  {
15      int x=10;
16      std::cout <<std::bitset<8>(x)<<std::endl;
17      return 0;
18  }
```

Find Number in array ?

```
int s[] = {5, 7, 4, 2, 8, 6, 1, 9, 0, 3};

auto v=std::find(std::begin(s), std::end(s),5);
std::cout <<*v<<std::endl;//5
```

Convert from string to data type ?

```
auto i=std::stol("123");
std::cout << typeid(i).name()<<std::endl;//Long
```



Compare Struct

```
struct Data{
    int x;
    int y;
    bool operator==(const Data& temp)
    {
        return( (temp.x== x) && (temp.y == y));
    }
}d1,d2;
int main()
{
    if(d1 == d2)//Equal
    {
        std::cout <<"Equal"<<std::endl;
    }
```

Method looks like more abstract

```
bool equal_strings(const string& lhs, const string& rhs) {
    // Copy the arguments
    string lhs_copy{lhs};
    string rhs_copy{rhs};

    // Convert to upper case
    transform(begin(lhs_copy), end(lhs_copy), begin(lhs_copy), ::toupper);
    transform(begin(rhs_copy), end(rhs_copy), begin(rhs_copy), ::toupper);

    // Compare the results
    return lhs_copy == rhs_copy;
}
```

Tasks

-check if the character is digit ?

-check if all the array is even ?

-check if there is any value of array is even ?

-**write string class which has**
Members { length - string}

Tasks

1-handle interrupt signal like (ctrl+c)

2-

```
#include <iostream>
int &f() {
    static int x=0;
    std::cout <<x<<std::endl;
    return x;
}
main() {
    f() = 10;
    f()=0;
}
```

3- fill array from 10 to 10000 sequentially

```
{10, 11, 12, 13,
```

4-try and / or

```
int main()
{
    int a = 10;
    if (a < 20 and a > 5)
      cout << "Yes";
    return 0;
```

5- calculate accumulate of array

```
>>> 1+2+3+4+5+6+7+8+9
45
```

Tasks

Create A class that can be use to make backtrace

for calling functions

```
moatasem@CAI1-L14000:~/sta
Enter to [main]
Enter to [fun1]
Enter to [fun2]
Enter to [fun3]
Backtrace as follows :
0- main
1- fun1
2- fun2
3- fun3
Back Trace is Finished
Exit From [fun3]
Exit From [fun2]
Exit From [fun1]
Exit From [main]
```

```
#include "backtrace.hpp"
void fun2(int x);
void fun3(int x);
void fun1(int x)
{
    EnterFn;
    fun2(2);
    ExitFn;
}
void fun2(int x)
{
    EnterFn;
    fun3(3);

    ExitFn;
}
void fun3(int x)
{
    EnterFn;
    PRINT_BT;

    ExitFn;
}

int main()
{
    EnterFn;
    fun1(3);

    ExitFn;
}
```

references

1-http://www.vishalchovatiya.com/

2-MISRA-CPP-2008-STANDARD.pdf

3-https://lefticus.gitbooks.io/cpp-best-practices/content/05-Considering_Maintainability.html

4-www.fluentcpp.com