

enum

```
enum Color {
    COL_OR_RED, // assigned
    0
    COL_OR_BLUE // assigned
    1
};
Color color= COL_OR_RED;
// input/ output
int input{};
std::cin >> input;
Color color= static_cast<
    Color> (input)
```

Prefer enum class if possible (C++11)

enum class (C++11)

```
enum class Color {
    RED,
    BLUE
};
Color color= Color::RED;
std::cout << static_cast<
    int>(color);
```

typedef

```
typedef double distance_t;
using distance_t = double; //
C++11
```

struct

```
struct Employee {
    short id;
    int age;
};
Employee joe = {1, 42}; //
initializer list
joe.age = 43; // member
selection operator
```

std::vector

```
#include <vector>
std::vector<int> tab {1, 2,
    3, 4};
tab[0] // or tab.at(0) with
bounds checking
tab.size()
tab.reserve(3); // expensive
// capacity & stack-like
behavior
std::vector<int> stack;
stack.reserve(5); // set
capacity
stack.push_back(3);
int x = stack.back(); // top of
stack
stack.pop_back();
```

capacity = allocated memory

length = active values

Setting capacity avoid resizing the array

std::tuple - C++11

```
#include <tuple>
// using namespace std;
tuple<int, double> t = make_tuple(3, 6.7);
int a = get<0>(t);
// std::tuple<int, double>
foo();
int a;
double b;
std::tie(a,b) = foo()
auto [a, b] = foo(); // C++17
```

std::array - C++11

```
#include <array>
std::array<int, 3> tab {1, 2,
    3};
tab[0] // or tab.at(0) with
bounds checking
tab.size() // length not
sizeof()
```

References

```
int value=5;
int &ref= value; // non-const
ref
const int value=5;
const int &ref= value; //
treats value as const
```

**References are similar to const pointers
(cannot change address)**

Pointers

```
int value=5;
int *const p=&value; //const
pointer
const int value=5;
const int *p; // non-const
pointer to const int
// const pointer to const value
const int *const p=&value;
// int foo(int x);
int (*ptr)(int); // function
pointer
int (*const ptr)(int) = foo; //
const pointer
#include <functional>
std::function<int(int)>
ptr = foo; // C++11
ptr(5); // implicit dereference
or (*ptr)(5)
```

new & delete (dynamic allocation)

```
// scalar version
int *p=new int(3);
delete p;
// array version
int *p = new int[3] {1, 2, 3};
// C++11 syntax
delete[] p;
```

Classes

```
class Foo {
private:
    // non-static member
    initialization
    int m_value = 10; //
C++11
    // static member variable
    //
    static int m_id;
public:
    // constructor and
    destructor
    Foo(int value) :m_val -
ue( value);
    ~Foo();
    // copy constructor
    Foo (const Foo& foo)
                                :m
_val ue( foo.m_ value);
    // static member function
    static int get_id(); //
see definition
    // const member function
    void print() const;
    // friend function
    friend void reset(Foo
&foo);
};
Foo(6); // anonymous object
// static
int Foo::m_id=0;
int Foo::g et_id() { return
m_id; } // no static
int id = Foo::g et_id();
// const member function
void Foo::p rint() const {
whatever }
const Foo foo;
foo.pr int(); // no constness
violation
// friend function
```

Classes (cont)

```
> friend void reset(Foo &foo) { foo.m_val-
ue=0; }
```

- 1) no implicit default constructor if at least one constructor provided
- 2) implicit copy constructor and overloaded operator= use memberwise initialization (shallow copy)

std::initializer_list (C++11)

```
#include <initializer_list>
int m_size;
int *m_array;
// prevent shallow copy (dynamic
mem alloc)
Foo(const Foo& foo) = delete;
Foo& operator= (const Foo& foo)
= delete;
Foo(const std::i nit ial ize -
r_l ist <in t>& list)
    :m_ siz e(s tat ic_ -
cas t<i nt> (li st.s ize))
{
    // deep copy with for-
each loop
    int count=0;
    for (auto& value : list)
        m_a rra y[c -
ount++] = value;
}
Foo& operator= (const std::i -
nit ial ize r_l ist <in t>
&list)
{
    // same but delete[]
m_array
    // if same size (no need
for new or delete)
    // deep copy
}
Foo foo { 1, 2, 3, 4 }; // call
constr uctor
Foo foo = { 1, 2, 3, 4 }; //
call operator=
```

For-each loops - C++11

```
for (int num : tab)
for (auto num : tab) // avoid
type conversion
for (auto &num : tab) // avoid
copy
for (const auto &num : tab) //
read-only
```

For-each loops don't work with array
decayed to pointer (fixed or dynamic)

std::rand()

```
#include <cstdlib>
#include <ctime>
std::s tan d(s tat ic_ cas t<u -
nsigned int>(s td: :ti me( nul -
lpt r))); // seed with time
std::r and(); // [0, RAND_MAX]
// [min, max]
return min + (std::r an d() %
(m ax- min+1))
//better
static constexpr double fraction
{1.0/( RAN D_M AX+ 1.0)};
return min + static _ca st< -
int >(( max -mi n+1.0) *(s -
td: :ra nd( ) *f rac tion))
```

% is biased towards low numbers

Input validation with std::cin

```
// extraneous input
std::c in.i gn ore (32767,
'\n'); // clears buffer
// extraction failure
if (std::: cin.fa il()) { // type
or overflow
    std ::c in.c le ar(); //
back to normal mode
    std ::c in.i gn ore -
(32767, '\n');
}
// switch -like validation
```

Input validation with std::cin (cont)

```
> int x {};  
do {  
    std::cin >> x;  
} while (x<0);
```

std::cerr and assert

```
#include <cstdlib> // for exit  
std::cerr << " Error messag e";  
exit(1);  
#include <cassert>  
assert (x==0); // combines cerr  
and exit  
assert (x==0 && " Error messag -  
e");  
// check at compil e-time  
static _as ser t (x==0, " Error  
messag e"); // C++11
```

Operator overloading

```
int m_value;  
int *m_array= nullptr;  
// ret by value (ref to out of  
scope var)  
friend Foo operator+ (const Foo  
&foo, const Foo& bar);  
  
// subscript []  
// ret by ref to assign (l-  
value)  
int& operator[] (const int idx)  
{ return m_array[idx]; }  
  
// overload int typecast  
operator int() const { return  
m_value; }  
// std::cout  
std::ostream& operator<< -  
<(std::ostream& out, const  
Foo &foo)  
{
```

Operator overloading (cont)

```
> out << m_value;  
    return out;  
}  
// std::cin  
std::istream& operator>>(std::istream& in,  
Foo &foo)  
{  
    in >> m_value;  
    return in;  
}  
// increment operator as member function  
Foo& operator++(); // prefix, ++x  
Foo operator++(int) // postfix, x++  
{  
    Foo tmp(foo);  
    // call implicit copy constructor  
    // or assignment with tmp = foo  
    // but beware of shallow copy  
    // increment this  
    return tmp; // return by value  
}
```

1) unary op or if modif to left operand
-> member function
no modif, binary as friend or regular one
2) [], =, (), -> as member