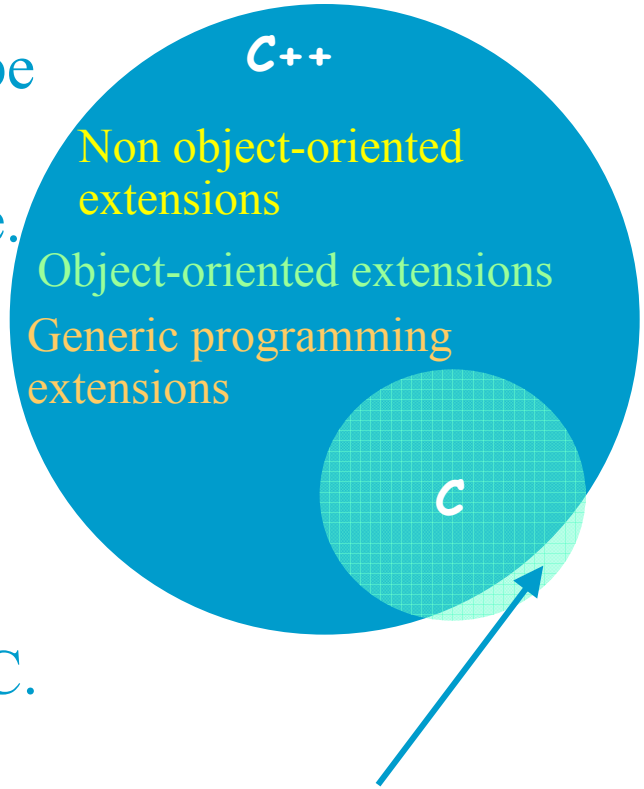
2 C++ As a Better C

C++ As a Better C

- C++ was developed from the C programming language, by adding some features to it. These features can be collected in three groups:
  1. Non-object-oriented features, which can be used in coding phase. These are not involved with the programming technique.
  2. Features which support object-oriented programming.
  3. Features which support generic programming.
- With minor exceptions, C++ is a superset of C.



Minor exceptions:
C code that is not C++

C++'s Enhancements to C (Non Object-Oriented)

►Caution: The better one knows C, the harder it seems to be to avoid writing C++ in C style, thereby losing some of the potential benefits of C++.

►1. Always keep object-oriented and generic programming techniques in mind.

►2. Always use C++ style coding technique which has many advantages over C style.

►Non object-oriented features of a C++ compiler can be also used in writing procedural programs.

C++'s Enhancements to C (Non-OO)

- Comment Lines
- /* This is a comment */
- // This is a comment
- C++ allows you to begin a comment with // and use the remainder of the line for comment text.
- This increases readability.

Declarations and Definitions in C++

►Remember; there is a difference between a declaration and a definition

►A declaration introduces a name – an identifier – to the compiler. It tells the compiler "This function or this variable exists somewhere, and here is what it should look like."

►A definition, on the other hand, says: "Make this variable here" or "Make this function here." It allocates storage for the name.

Example

```
extern int i;              // Declaration
int i;                     // Definition

struct ComplexT{           // Declaration
    float re,im;
};
ComplexT c1,c2;            // Definition
void func( int, int);      // Declaration     (its body is a definition)
```

► In C, declarations and definitions must occur at the beginning of a block.

► In C++ declarations and definitions can be placed anywhere an executable statement can appear, except that they must appear prior to the point at which they are first used. This improve the readability of the program.

► A variable lives only in the block, in which it was defined. This block is the **scope** of this variable.

C++'s Enhancements to C (Non-OO)


```
int a=0;
for (int i=0; i < 100; i++){   // i is declared in for loop
        a++;
        int p=12;              // Declaration of p
        ...                    // Scope of p
}                              // End of scope for i and p
```

- Variable i is created at the beginning of the for loop once.
- Variable p is created 100 times.

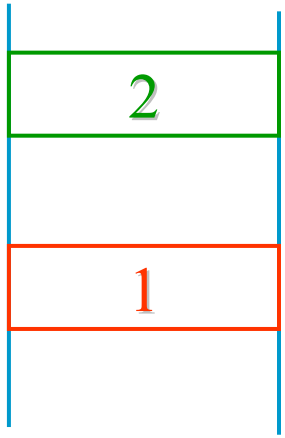
C++'s Enhancements to C (Non-OO)

- Scope Operator **::**

A definition in a block can hide a definition in an enclosing block or a global name. It is possible to use a hidden global name by using the scope resolution operator ::

```
int y=0;        // Global y
int x=1;        // Global x
void f(){       // Function is a new block
   int x=5;     // Local  x=5, it hides global x
   ::x++;       // Global x=2
   x++;         // Local x=6
   y++;         // Global y=1
}
```

```
int x=1;
void f(){
   int x=2;      // Local  x
   ::x++;        // Global x is 2
}
```



```
int i=1;
main(){
   int i=2;
   {
          int n=i ;
          int i = 3 ;
          cout << i << " " << ::i << endl ;
          cout << n << "\n" ;
    }
  cout << i << " " << ::i << endl;
  return 0 ;
}
```

```
3 1
2
2 1
```

- Like in C, in C++ the same operator may have more than one meaning. The scope operator has also many different tasks.

inline functions

- In C, macros are defined by using the #define directive of the preprocessor.
- In C++ macros are defined as normal functions. Here the keyword inline is inserted before the declaration of the function.
- Remember the difference between normal functions and macros:
- A normal function is placed in a separate section of code and a call to the function generates a jump to this section of code.
- Before the jump the return address and arguments are saved in memory (usually in stack).

inline functions *Con't*

- When the function has finished executing, return address and return value are taken from memory and control jumps back from the end of the function to the statement following the function call.
- The advantage of this approach is that the same code can be called (executed) from many different places in the program. This makes it unnecessary to duplicate the function's code every time it is executed.
- There is a disadvantage as well, however.
- The function call itself, and the transfer of the arguments take some time. In a program with many function calls (especially inside loops), these times can add up and decrease the performance.

inline functions *Con't*

```
#define sq(x) (x*x)
inline int SQ(int x){return (x*x); }
#define max(x,y) (y<x ? x : y)
inline int max(int x,int y){return (y<x ? x : y); }
```

- An inline function is defined using almost the same syntax as an ordinary function. However, instead of placing the function's machine-language code in a separate location, the compiler simply inserts it into the location of the function call. :

```
int j, k, l ;  // Three integers are defined
…….      // Some operations over k and l
j = max( k, l )  ; // inline function max is inserted
j= (k<l ? k : l)
```

inline functions *Con't*

- The decision to inline a function must be made with some care.
  - If a function is more than a few lines long and is called many times, then inlining it may require much more memory than an ordinary function.
  - It's appropriate to inline a function when it is short, but not otherwise. If a long or complex function is inlined, too much memory will be used and not much time will be saved.

inline functions *Con't*

- Advantages
  - Debugging
  - Type checking
  - Readable

Default Function Arguments

- A programmer can give default values to parameters of a function. In calling of the function, if the arguments are not given, default values are used.

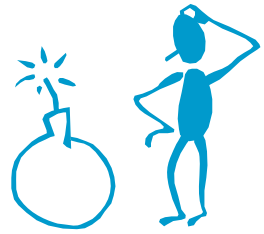
```
int exp(int n,int k=2){
    if(k == 2)
      return (n*n) ;
    else
      return ( exp(n,k-1)*n ) ;
}
```

exp(i+5)
// (i+5)* (i+5)
exp(i+5,3)
// (i+5)^3

Example

- In calling a function argument must be given from left to right without skipping any parameter

```
void f(int i, int j=7) ; // right

void g(int i=3, int j) ; // wrong

void h(int i, int j=3,int k=7) ; // right

void m(int i=1, int j=2,int k=3) ; // right

void n(int i=2, int j,int k=3) ; // right ? wrong
```



Example

void n(int i=1, int j=2,int k=3) ;

- n() → n(1,2,3)
- n(2) → n(2,2,3)
- n(3,4) → n(3,4,3)
- n(5,6,7) →n(5,6,7)

Function Declarations and Definitions

►C++ uses a stricter type checking.

►In function declarations (prototypes) the data types of the parameters must be included in the parentheses.

```
char grade (int, int, int);    // declaration

int main()
{
   :
}
char grade (int exam_1, int exam_2, int final_exam) // definition
{
  :              // body of function
}
```

Function Declarations and Definitions

- In C++ a return type must be specified; a missing return type does not default to **int** as is the case in C.
- In C++, a function that has no parameters can have an empty parameter list.

```
int print (void);     /* C style  */
int print();          // C++ style
```

Reference Operator — &

- This operator provides an alternative name for storage
- There are two usages of the operator

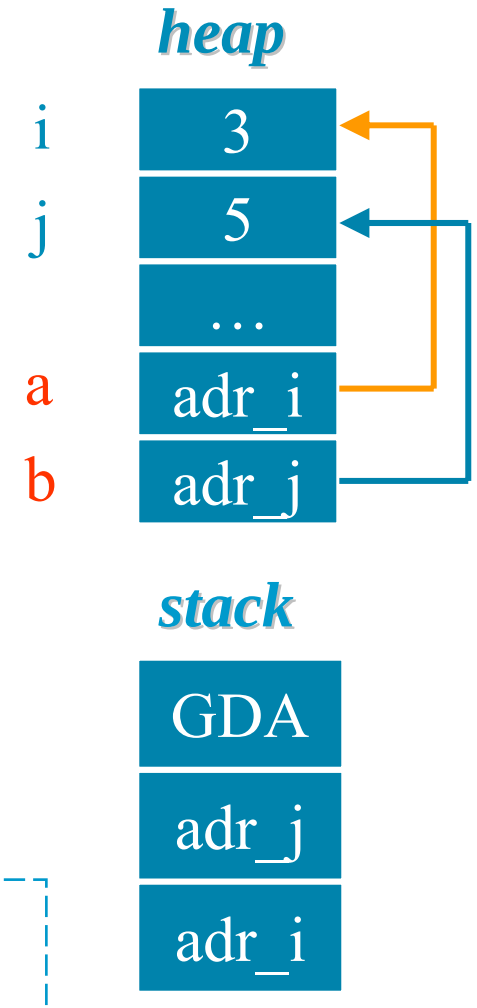
1.
```
int n ;

int& nn = n ;

double a[10] ;

double& last = a[9] ;

const char& new_line = '\n' ;
```

2 ▶ Parameters Passing: Consider swap() function

```
void swap(int *a, int *b){
    int temp = *a ;
    *a = *b ;
    *b = temp ;  }
```

```
int main(){
   int i=3,j=5 ;
   swap(&i,&j) ;
   cout << i << " " << j << endl ;
}
```

5 3



```
void swap(int& a,int& b){
    int temp = a ;
    a = b ;
    b = temp ;  }
```

```
int main(){
   int i=3,j=5 ;
   swap(i,j) ;
   cout << i << " " << j << endl ;
}
```

```
5 3
```

```
void shift(int& a1,int& a2,int& a3,int& a4){
    int tmp = a1 ;
    a1 = a2 ;
    a2 = a3 ;
    a3 = a4 ;
    a4 = tmp ;
}
```

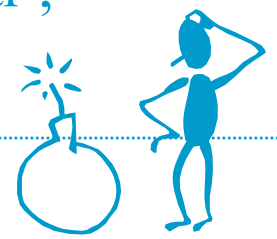
```
int main(){
        int x=1,y=2,z=3,w=4;
        cout << x << y << z << w << endl;
        shift(x,y,z,w) ;
       cout << x << y << z << w << endl;
        return 0 ;
}
```

```
int squareByValue(int a){
        return (a*a) ;
}
```

```
void squareByReference(int& a){
        a *= a ;
}
```

```
int main(){
        int x=2,y=3,z=4 ;
        squareByPointer(&x) ;
        cout << x << endl ;
        squareByReference(y) ;
        cout << y << endl ;
        z = squareByValue(z) ;
        cout << z << endl ;
}
```

```
void squareByPointer(int *aPtr){
        *aPtr = *aPtr**aPtr ;
}
```



```
4
9
16
```

const Reference

►To prevent the function from changing the parameter accidentally, we pass the argument as constant reference to the function.

```
struct Person{                                  // A structure to define persons
    char name [40];                             // Name filed 40 bytes
    int reg_num;                                // Register number 4 bytes
};                                              // Total: 44 bytes

void print (const Person &k)                    // k is constant reference parameter
{
    cout << "Name: " << k.name << endl;         // name to the screen
    cout << "Num: " << k.reg_num << endl;       // reg_num to the screen
}

int main(){
    Person ahmet;                               // ahmet is a variable of type Person
    strcpy(ahmet.name,"Ahmet Bilir");           // name = "Ahmet Bilir"
    ahmet.reg_num=324;                          // reg_num= 324
    print(ahmet);                               // Function call
    return 0;
}
```

Instead of 44 bytes only 4 bytes (address) are sent to the function.

Return by reference

►By default in C++, when a function returns a value: return *expression*; *expression* is evaluated and its value is copied into stack. The calling function reads this value from stack and copies it into its variables.

►An alternative to "return by value" is "return by reference", in which the value returned is not copied into stack.

►One result of using "return by reference" is that the function which returns a parameter by reference can be used on the left side of an assignment statement.

```
int&  max( const int a[], int length) {    // Returns an integer reference
    int i=0;                               // indices of the largest element
    for (int j=0 ; j<length ; j++)
        if (a[j] > a[i])    i = j;
    return a[i];                                   // returns reference to a[i]
}
int main()  {
   int array[ ] = {12, -54 , 0 , 123, 63};         // An array with 5 elements
   max(array,5) = 0;                               // write 0 over the largest element
   :
```

const return parameter

To prevent the calling function from changing the return parameter accidentally, const qualifier can be used.

```
const int&  max( int a[ ], int length)   // Can not be used on the left side of an
{                                        // assignment statement
      int i=0;                           // indices of the largest element
      for (int j=0 ; j<length ; j++)
           if (a[j] > a[i])    i = j;
      return a[i];
}
```

This function can only be on right side of an assignment

```
int main()
{
    int array[ ] = {12, -54 , 0 , 123, 63};      // An array with 5 elements
    int largest;                                 // A variable to hold the largest elem.
    largest = max(array,5);                      // find the largest element
    cout << "Largest element is " << largest << endl;
    return 0;
}
```

Never return a local variable by reference!

- Since a function that uses "return by reference" returns an actual memory address, it is important that the variable in this memory location remain in existence after the function returns.
- When a function returns, local variables go out of existence and their values are lost.

```
int&  f( ) {                    // Return by reference
    int i;                      // Local variable. Created in stack
    :
    return  i;                  // ERROR! i does not exist anymore.
}
```

Local variables can be returned by their values

```
int  f( ) {                     // Return by value
    int i;                      // Local variable. Created in stack
    :
    return  i;                  // OK.
}
```

new/delete

►In ANSI C, dynamic memory allocation is normally performed with standard library functions *malloc* and *free*.

►The C++ *new* and *delete* operators enable programs to perform dynamic memory allocation more easily.

►The most basic example of the use of these operators is given below. An int pointer variable is used to point to memory which is allocated by the operator new. This memory is later released by the operator delete.

in C:
```
int *p ;
p = (int *) malloc(N*sizeof(int)) ;
free(p) ;
```

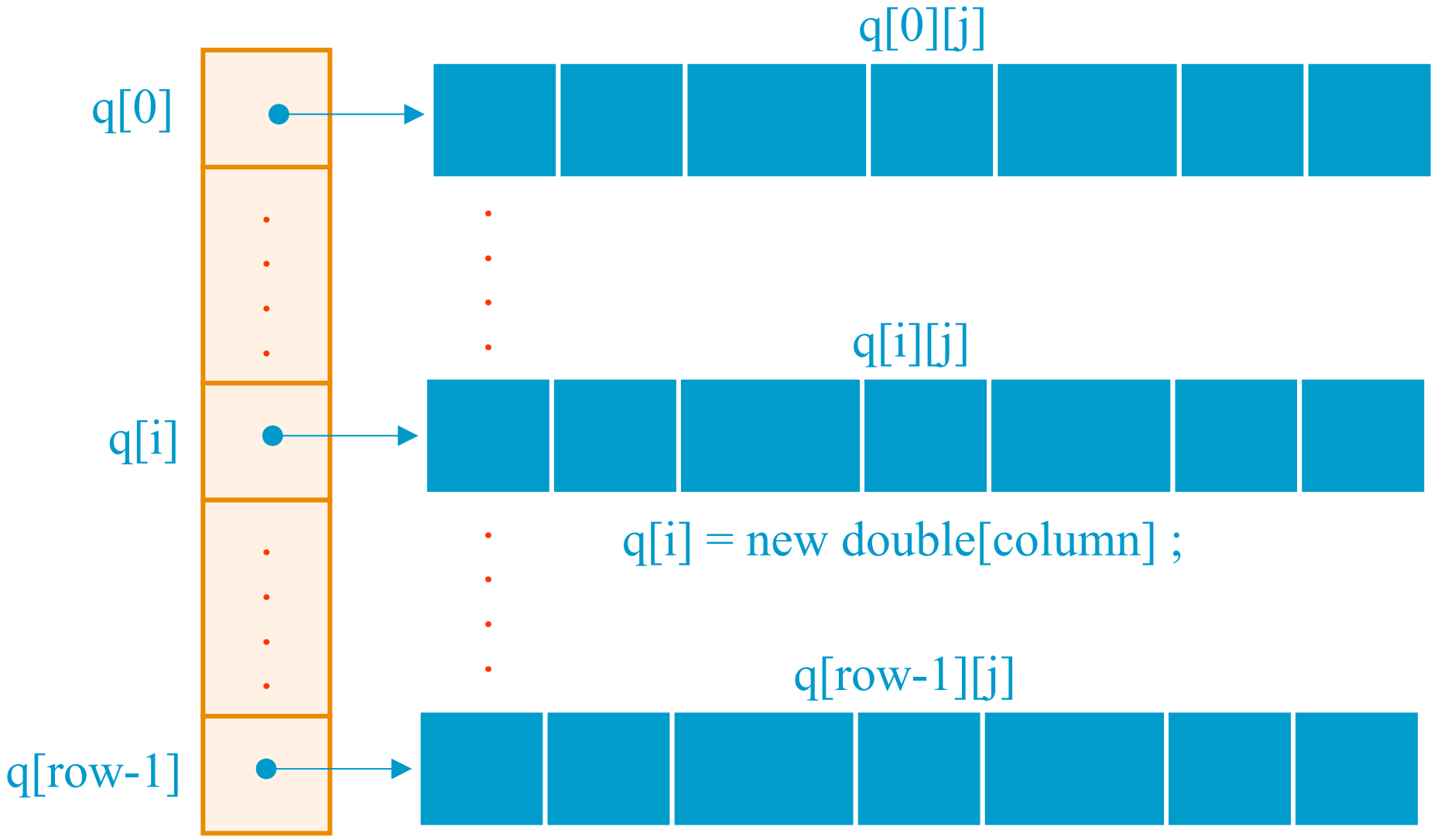
in C++:
```
int *p ;
p = new int[N] ;
delete []p ;
```

```
int *p,*q ;
p = new int[9] ;
q = new int(9) ;
```

▶ Two Dimensional Array

1.
```
double ** q ;
q = new double*[row] ; // matrix size is rowxcolumn
for(int i=0;i<row;i++)
    q[i] = new double[column] ;
.....
for(int i=0;i<row;i++)
   delete []q[i] ;
delete []q ;
```

i^{th} row j^{th} column: q[*i*][*j*]

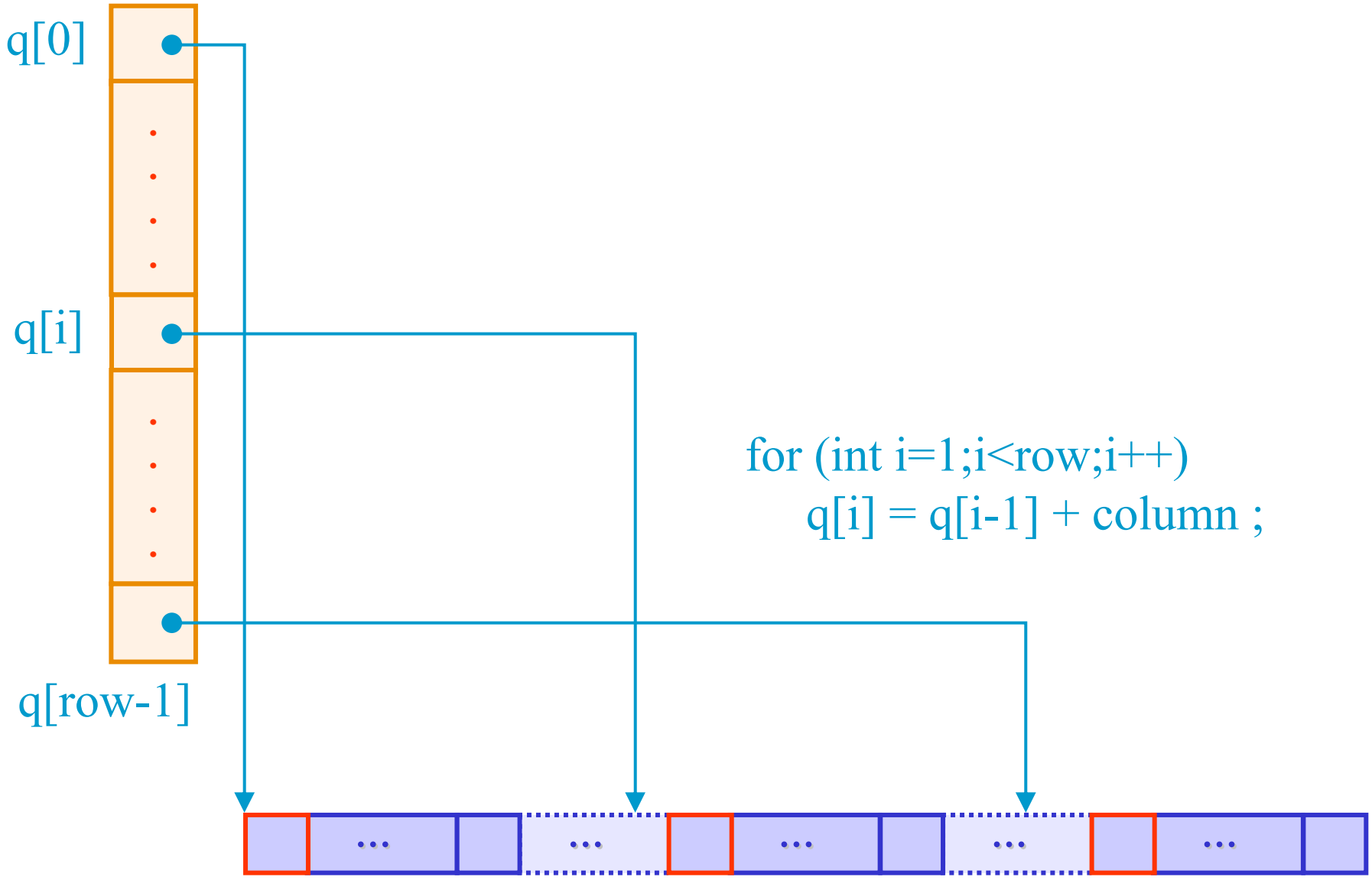

q[0][j]
q[0]
q[i][j]
q[i]
q[i] = new double[column] ;
q[row-1][j]
q[row-1]

▶ Two Dimensional Array

2. double **q;

```
p = new double*[row] ; // matrix size is rowxcolumn
q[0] = new double[row*column] ;
for(int i=1;i<row;i++)
    q[i] = q[i-1] + column ;
…..
delete []q[0] ;
delete []q ;
```

i^{th} row j^{th} column: q[*i*][*j*]


q[0]
q[i]
q[row-1]
for (int i=1;i<row;i++)
q[i] = q[i-1] + column ;
q[0] = new double[row*column] ;

```
double ** q ;
memoryAlign  = column % 4;
memoryWidth = ( memoryAlign == 0 ) ?
                        column : (column+4 -memoryAlign)        ;
q[0] = new double[row*memoryWidth] ;
for(int i=0;i<row;i++)
    q[i] = q[i-1] + memoryWidth ;
…..
delete []q[0] ;
delete []q ;
```

Function Overloading

- Function Overloading

```
double average(const double a[],int size) ;
double average(const int a[],int size) ;
double average(const int a[], const double b[],int size) ;
```

1.
```
double average(const int a[],int size) {
        double sum = 0.0 ;
       for(int i=0;i<size;i++)   sum += a[i] ;
      return ((double)sum/size) ;
}
```

2.
```
double average(const double a[],int size) {
        double sum = 0.0 ;
        for(int i=0;i<size;i++)   sum += a[i] ;
        return (sum/size) ;
}
```

3.
```
double average(const int a[],const double b[],int size) {
        double sum = 0.0 ;
        for(int i=0;i<size;i++)   sum += a[i] + b[i] ;
        return (sum/size) ;
}
```

```
int main() {
        int         w[5]={1,2,3,4,5} ;
        double   x[5]={1.1,2.2,3.3,4.4,5.5} ;
    1   cout << average(w,5) ;
    2   cout << average(x,5) ;
    3   cout << average(w,x,5) ;
        return 0 ;
}
```

Function Templates

- Function Templates

```
template <typename T>
void printArray(const T *array,const int size){
        for(int i=0;i < size;i++)
            cout << array[i] << " " ;
        cout << endl ;
}
```

```
int main() {
        int         a[3]={1,2,3} ;
        double   b[5]={1.1,2.2,3.3,4.4,5.5} ;
       char       c[7]={‘a’, ‘b’, ‘c’, ‘d’, ‘e’ , ‘f’, ‘g’} ;
  1 printArray(a,3)          ;
  2 printArray(b,5)          ;
  3 printArray(c,7)          ;
  return 0 ;
}
```

```
void printArray(int *array,cont int size){
        for(int i=0;i < size;i++)
            cout << array[i] << "," ;
        cout << endl ;
}
void printArray(char *array,cont int size){
        for(int i=0;i < size;i++)
            cout << array[i] ;
        cout << endl ;
}
```

Operator Overloading

- In C++ it is also possible to overload the built-in C++ operators such as +, -, = and ++ so that they too invoke different functions, depending on their operands.
- That is, the + in **a**+**b** will add the variables if **a** and **b** are integers, but will call a different function if **a** and **b** are variables of a user defined type.

Operator Overloading: Rules

- You can't overload operators that don't already exist in C++.
- You can not change numbers of operands. A binary operator (for example +) must always take two operands.
- You can not change the precedence of the operators.

  * comes always before +

- Everything you can do with an overloaded operator you can also do with a function. However, by making your listing more intuitive, overloaded operators make your programs easier to write, read, and maintain.
- Operator overloading is mostly used with objects. We will discuss this topic later more in detail.

Operator Overloading

►Functions of operators have the name operator and the symbol of the operator. For example the function for the operator + will have the name operator+:

```
struct SComplex{
 float real,img;
};
SComplex operator+(SComplex v1, SComplex v2){
  SComplex result;
  result.real=v1.real+v2.real;
  result.img=v1.img+v2.img;
  return result;
}
```

```
int main(){
  SComplex c1={1,2},c2 ={5,1};
  SComplex c3;
  c3=c1+c2;   // c1+(c2)
}
```

namespace

►When a program reaches a certain size it's typically broken up into pieces, each of which is built and maintained by a different person or group.

►Since C effectively has a single arena where all the identifier and function names live, this means that all the developers must be careful not to accidentally use the same names in situations where they can conflict.

►The same problem come out if a programmer try to use the same names as the names of library functions.

►Standard C++ has a mechanism to prevent this collision: the namespace keyword. Each set of C++ definitions in a library or program is "wrapped" in a namespace, and if some other definition has an identical name, but is in a different namespace, then there is no collision.

namespace

```
namespace programmer1{     // programmer1's namespace
    int iflag;             // programmer1's iflag
    void g(int);           // programmer1's g function
    :                      // other variables
}                          // end of namespace

namespace programmer2{     // programmer2's namespace
    int iflag;             // programmer2's iflag
    :
}                          // end of namespace
```

Accessing Variables

```
programmer1::iflag = 3;          // programmer1's iflag
programmer2::iflag = -345;       // programmer2's iflag
programmer1::g(6);               // programmer1's g function
```

If a variable or function does not belong to any namespace, then it is defined in the global namespace. It can be accessed without a namespace name and scope operator.

This declaration makes it easier to access variables and functions, which are defined in a namespace.

```
using programmer1::iflag;        //  applies to a single item in the namespace
iflag = 3;                       //  programmer1::iflag=3;
programmer2::iflag = -345;
programmer1::g(6);
```

```
using namespace programmer1;     // applies to all elements in the namespace
iflag = 3;                       // programmer1::iflag=3;
g(6);                            // programmer1's function g
programmer2::iflag =  -345;
```

namespace


```
#include <iostream>
   namespace F {
      float x = 9;
      }
   namespace G {
      using namespace F;
      float y = 2.0;
         namespace INNER_G {
            float z = 10.01;
      }
}
```

```
int main() {
       float x = 19.1;
      using namespace G;
      using namespace G::INNER_G;
      std::cout << "x = " << x << std::endl;
      std::cout << "y = " << y << std::endl;
      std::cout << "z = " << z << std::endl;
      return 0;
}
```

namespace

```
#include <iostream>
   namespace F {
      float x = 9;
      }
   namespace G {
      using namespace F;
      float y = 2.0;
         namespace INNER_G {
            long x = 5L;
            float z = 10.01;
      }
}
```

```
int main() {
      using namespace G;
      using namespace G::INNER_G;
      std::cout << "x = " << x << std::endl;
      std::cout << "y = " << y << std::endl;
      std::cout << "z = " << z << std::endl;
      return 0;
}
```

namespace

```
#include <iostream>
   namespace F {
      float x = 9;
      }
   namespace G {
      using namespace F;
      float y = 2.0;
         namespace INNER_G {
            long x = 5L;
            float z = 10.01;
      }
}
```

```
int main() {
      using namespace G;
      std::cout << "x = " << x << std::endl;
      std::cout << "y = " << y << std::endl;
      return 0;
}
```

namespace

```
#include <iostream>
   namespace F {
      float x = 9;
      }
   namespace G {
            float y = 2.0;
         namespace INNER_G {
            long x = 5L;
            float z = 10.01;
      }
}
```

```
int main() {
      using namespace G;
      std::cout << "x = " << x << std::endl;
      std::cout << "y = " << y << std::endl;
      return 0;
}
```

namespace

```
#include <iostream>
   namespace F {
      float x = 9;
      }
   namespace G {
            float y = 2.0;
         namespace INNER_G {
            long x = 5L;
            float z = 10.01;
      }
}
```

```
int main() {
      using namespace G::INNER_G;
      std::cout << "x = " << x << std::endl;
      std::cout << "y = " << y << std::endl;
      return 0;
}
```

Standard C++ Header Files

►In the first versions of C++, mostly '.h' is used as extension for the header files.

►As C++ evolved, different compiler vendors chose different extensions for file names (.hpp, .H , etc.). In addition, various operating systems have different restrictions on file names, in particular on name length. These issues caused source code portability problems.

►To solve these problems, the standard uses a format that allows file names longer than eight characters and eliminates the extension.

►For example, instead of the old style of including iostream.h, which looks like this: #include <iostream.h>, you can now write: #include <iostream>

Standard C++ Header Files

►The libraries that have been inherited from C are still available with the traditional '**.h**' extension. However, you can also use them with the more modern C++ include style by puting a "**c**" before the name. Thus:

#include <stdio.h>	become:	#include <cstdio>
#include <stdlib.h>		#include <cstdlib>

►In standard C++ headers all declarations and definitions take place in a namespace : **std**

►Today most of C++ compilers support old libraries and header files too. So you can also use the old header files with the extension '.h'. For a high-quality program prefer always the new libraries.

I/O

- Instead of library functions (printf, scanf), in C++ library objects are used for IO operations.
- When a C++ program includes the **iostream** header, four objects are created and initialized:
  - **cin** handles input from the standard input, the keyboard.
  - **cout** handles output to the standard output, the screen.
  - **cerr** handles unbuffered output to the standard error device, the screen.
  - **clog** handles buffered error messages to the standard error device

Using `cout` Object

To print a value to the screen, write the word **cout**, followed by the insertion operator (<<).

```
#include<iostream>                    // Header file for the cout object
int main() {
   int i=5;              // integer i is defined, initial value is 5
   float f=4.6;          // floating point number f is defined, 4.6
   std::cout << "Integer Number = " << i << " Real Number= " << f;
   return 0;
}
```

Using `cin` Object

The predefined cin stream object is used to read data from the standard input device, usually the keyboard. The cin stream uses the >> operator, usually called the "get from" operator.

```
#include<iostream>
using namespace std;  // we don't need std:: anymore
int main() {
   int i,j;  // Two integers are defined
   cout << "Give two numbers \n";  // cursor to the new line
   cin >> i >> j;              // Read i and j from the keyboard
   cout << "Sum= " << i + j << "\n";
   return 0;
}
```

std namespace

```
#include <string>
#include <iostream>
 using namespace std;
 int main() {
   string test;
   while(test.empty() || test.size() <= 5)
   {
    cout << "Type a string longer string. " << endl;
    cin >> test;
   }
```

printf("%s",test.c_str())

bool Type

The type bool represents boolean (logical) values: true and false

Before **bool** became part of Standard C++, everyone tended to use different techniques in order to produce Boolean-like behavior.

These produced portability problems and could introduce subtle errors.

Because there's a lot of existing code that uses an **int** to represent a flag, the compiler will implicitly convert from an **int** to a **bool** (nonzero values will produce **true** while zero values produce **false**).

Do not prefer to use integers to produce logical values.

```
bool is_greater;          // Boolean variable: is_greater
is_greater = false;       // Assigning a logical value
int a,b;
……….
is_greater = a > b;       // Logical operation
if (is_greater)  ……       // Conditional operation
```

constant

- In standard C, preprocessor directive #define is used to create constants: #define PI 3.14
- C++ introduces the concept of a named constant that is just like a variable, except that its value cannot be changed.
- The modifier **const** tells the compiler that a name represents a constant:

```
const int MAX = 100;
…
MAX = 5; // Compiler Error!
```

- const can take place before (left) and after (right) the type. They are always (both) allowed and equivalent.

```
int const MAX = 100;  // The same as const int MAX = 100;
```

- Decreases error possibilities.
- To make your programs more readable, use uppercase font for constant identifiers.

Use of constant–1

Another usage of the keyword const is seen in the declaration of pointers. There are three different cases:

a) The data pointed by the pointer is constant, but the pointer itself however may be changed.

```
const char *p = "ABC";
```

p is a pointer variable, which points to chars. The const word may also be written after the type:

```
char const *p = "ABC";
```

Whatever is pointed to by p may not be changed: the chars are declared as const. The pointer p itself however may be changed.

```
*p = 'Z';   // Compiler Error! Because data is constant
p++;    //OK, because the address in the pointer may change.
```

Use of constant–2

b) The pointer itself is a const pointer which may not be changed. Whatever data is pointed to by the pointer may be changed.

```
char * const sp = "ABC"; // Pointer is constant, data may change
*sp = 'Z';          // OK, data is not constant
sp++;               // Compiler Error! Because pointer is constant
```

Use of constant–3

c) Neither the pointer nor what it points to may be changed

The same pointer definition may also be written as follows:

```
char const * const ssp = "ABC";
const char * const ssp = "ABC";
*ssp = 'Z';        // Compiler Error! Because data is constant
ssp++;             // Compiler Error! Because pointer is const
```

►The definition or declaration in which const is used should be read from the variable or function identifier back to the type identifier:

"ssp is a const pointer to const characters"

Casts

►Traditionally, **C** offers the following *cast* construction:

(*typename*) *expression*

Example: f = (float)i / 2;

Following that, C++ initially also supported the *function call style* cast notation:

typename(expression)

Example: Converting an integer value to a floating point value

```
int    i=5;
float  f;
f = float(i)/2;
```

►But, these casts are now called *old-style casts*, and they are deprecated. Instead, four *new-style casts* were introduced.

Casts: static_cast

▶The static_cast<type>(expression) operator is used to convert one type to an acceptable other type.

```
int     i=5;
float  f;
f = static_cast<float>(i)/2;
```

Casts: const_cast

►The const_cast<type>(expression) operator is used to do away with the const-ness of a (pointer) type.

►In the following example p is a pointer to constant data, and q is a pointer to non-constant data. So the assignment q = p is not allowed.

```
const char *p = "ABC";    // p points to constant data
char       *q;            // data pointed by q may change
q = p;      // Compiler Error! Constant data may change
```

If the programmer wants to do this assignment on purpose then he/she must use the const_cast operator:

```
q = const_cast<char *>(p);
*q = 'X';    // Dangerous?
```

Casts: reinterpret_cast

The reinterpret_cast<type>(expression) operator is used to reinterpret byte patterns. For example, the individual bytes making up a structure can easily be reached using a reinterpret_cast

```
struct S{                    // A structure
  int i1,i2;                 // made of two integers
};
int main(){
  S    x;                    // x is of type S
  x.i1=1;                    // fields of x are filled
  x.i2=2;
  unsigned char *xp;         // A pointer to unsigned chars
  xp = reinterpret_cast<unsigned char *> (&x);
  for (int j=0; j<8; j++)    // bytes of x on the screen
    std::cout <<  static_cast<int>(*xp++);
  return 0;
}
```

The structure S is made of two integers (2x4=8 bytes). x is a variable of type S. Each byte of x can be reached by using the pointer xp.

Casts: dynamic_cast

The dynamic_cast<>() operator is used in the context of inheritance and polymorphism. We will see these concepts later. The discussion of this cast is postponed until the section about polymorphism.

- Using the cast-operators is a dangerous habit, as it suppresses the normal type-checking mechanism of the compiler.
- It is suggested to prevent casts if at all possible.
- If circumstances arise in which casts have to be used, document the reasons for their use well in your code, to make double sure that the cast is not the underlying cause for a program to misbehave.