C++ Complete

Vol:3

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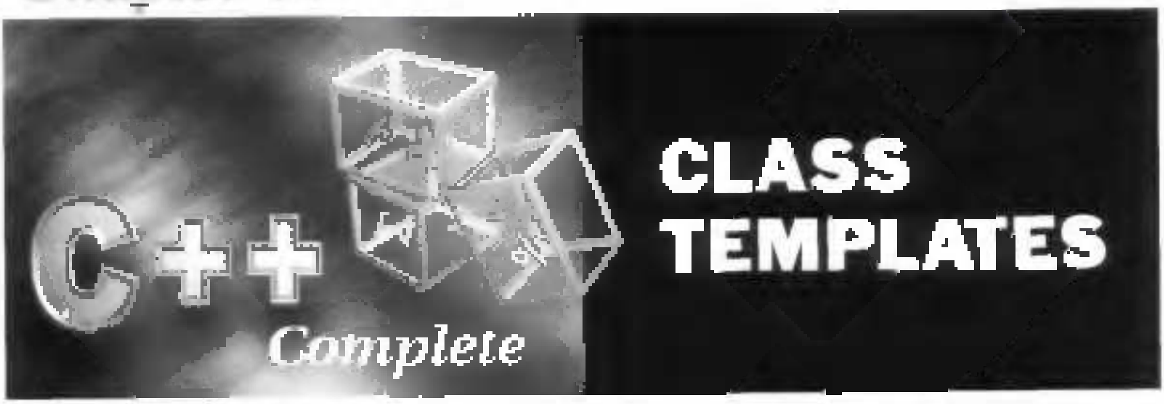


CLASS TEMPLATES

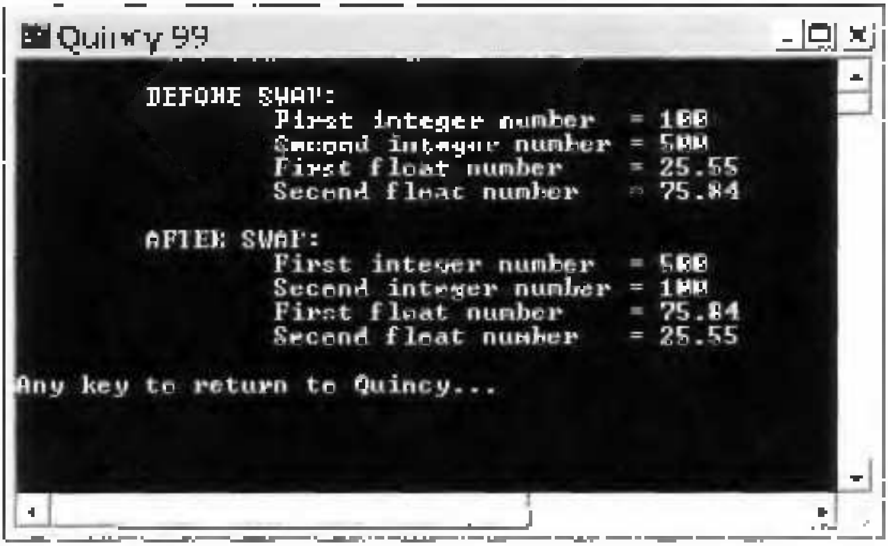
template ဆိုတာကို generic function တွေကို create လုပ်ဖို့အတွက်သုံးတဲ့ container တစ်ခုပါ။ ဒါ့ပြင် generic function ဆိုတာကတော့ မတူညီတဲ့ data အမျိုးအစားများနဲ့ အလုပ်လုပ်နိုင်တဲ့ function တစ်ခုဖြစ်ပါတယ်။ generic function တစ်ခုကို execute လုပ်မယ်ဆိုရင် compiler ကနေ ဖန်တီးပေးတဲ့ data type ကိုလိုက်ပြီး ပြောင်းလဲနိုင်ပါတယ်။ ဒီလိုဆို generic function ဟာ အလိုအလျောက် overload လုပ်ပေးနိုင်ပါတယ်။ ဥပမာအားဖြင့် generic function တစ်ခုကို create လုပ်ဖို့ template ဆိုတဲ့ keyword ကိုအသုံးပြုရပါမယ်။ template ဆိုတာ generic function တစ်ခု ဘယ်လိုလုပ်ဆောင်ရမယ်ဆိုတဲ့ framework တစ်ခုဖြစ်ပါတယ်။ program တစ်ခုလုံးမှာ အသုံးပြုနိုင်ပြီး compiler ကနေဖန်တီးပေးမယ့် template တစ်ခုရဲ့ပုံစံကတော့ –

```
template    <class X>
return type    function name (parameter list)
{
        // body of function
}
```

33.3 Create a Generic Function

```
// Listing 11.1: Creating a generic function
#include <iostream>

template <class X>

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

int main( )
{
        int     i1= 100, i2= 500;
        float   f1= 25.55, f2= 75.34;

        cout << "\n\tBEFORE SWAP "
             << "\n\t\tFirst integer number   = " << i1
             << "\n\t\tSecond integer number = " << i2
             << "\n\t\tFirst float number     = " << f1
             << "\n\t\tSecond float number    = " << f2 << endl;

        swap (i1, i2);          // swapping integers
        swap(f1, f2);           // swapping floats

        cout << "\n\tAFTER SWAP "
            << "\n\t\tFirst integer number    = " << i1
            << "\n\t\tSecond integer number = " << i2
            << "\n\t\tFirst float number      = " << f1
            << "\n\t\tSecond float number     = " << f2  << endl;

        return 0;
}
```

Ex1101.cpp ကို လေ့လာကြည့်မယ်ဆိုရင် X ဟာ data type မဟုတ်ဘဲ generic function ထဲမှာ အသုံးပြုတဲ့ placeholder သာ ဖြစ်ပြီး function body အတွင်းမှာ အသုံးပြုထားပါတယ်။ program ကို run တဲ့အခါမှာ compiler ဟာ actual data type တစ်ခုကို placeholder နေရာမှာ အစားထိုးပေးပါတယ်။ class ဆိုတဲ့ keyword ဟာ Ex1101.cpp program ထဲက variable (2) ခုရဲ့တန်ဖိုးတွေ ဖလှယ်ပေးဖို့အတွက် generic function တစ်ခုကို create လုပ်ပေးလျက်ရှိပါတယ်။ program ရဲ့ output မှာတော့ variable တန်ဖိုးတွေ ဖလှယ်ထားတာကို တွေ့ရမှာ ဖြစ်ပါတယ်။ program ကို run လိုက်မယ်ဆိုရင် ပုံ (၁၁-၁) မှာ ပြထားတဲ့အတိုင်း မြင်ရမှာပါ။



```
        BEFORE SWAP:
                First integer number  = 100
                Second integer number = 500
                First float number    = 25.55
                Second float number   = 75.84

        AFTER SWAP:
                First integer number  = 500
                Second integer number = 100
                First float number    = 75.84
                Second float number   = 25.55

Any key to return to Quincy...
```

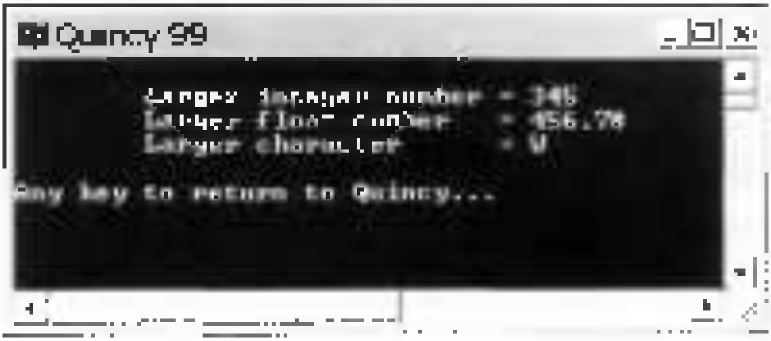
ပုံ (၁၁-၁)

Create a Generic Function 'Larger'

```
// Listing 11.2: Creating a generic function 'Larger'
#include <iostream>

template <class   X>
```

```
X  Larger (X  a, X  b)
{
        return  a > b ? a : b;
}


int  main( )
{
    cout  <<  "\n\tLarger integer number  = " <<  Larger(12,345)
          <<  "\n\tLarger float number      = " <<  Larger(12.34, 456.78)
          <<  "\n\tLarger character         = " <<  Larger('W', 'V')
          <<  endl;
    return 0;
}
```

Ex1102.cpp program ကို run [illegible]

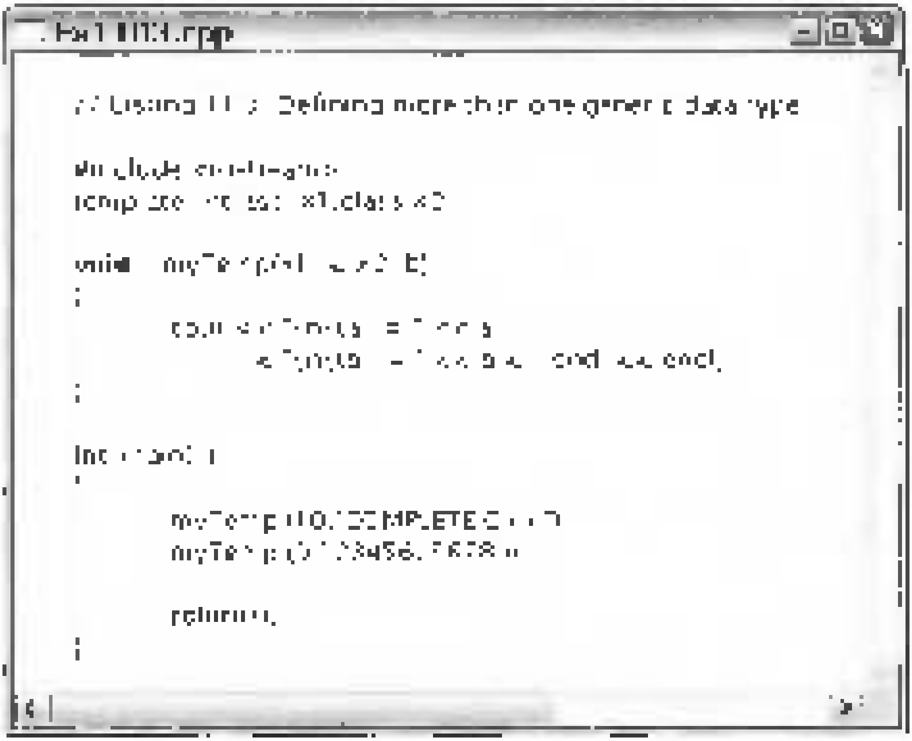


```
        Larger integer number = 345
        Larger float number   = 456.78
        Larger character      = V

Any key to return to Quincy...
```

[illegible]

Defining More than One Generic Data Type

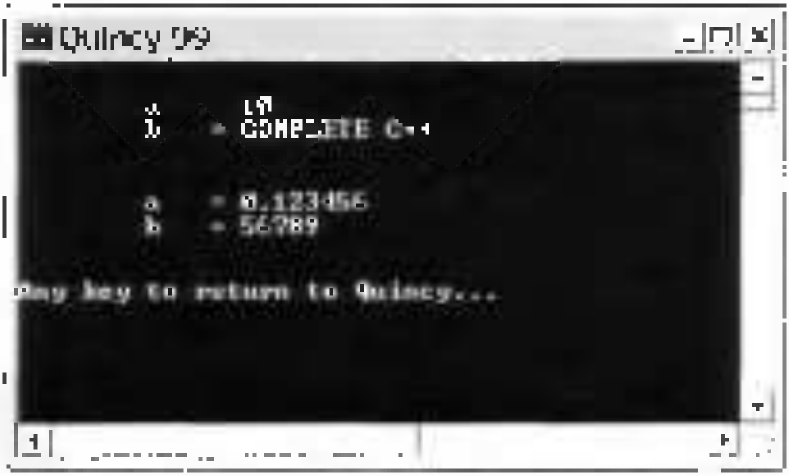
[illegible] generic function [illegible] data type [illegible] data type [illegible] comma [illegible] Ex1103.cpp program [illegible] generic data type (2) [illegible] create [illegible] function [illegible]



```
// Using [illegible] : Defining more than one generic data type

#include <iostream.h>
template <class x1, class x2>

void  myTemp(x1 a, x2 b)
{
	cout << "\n a = " << a
		<< "\n b = " << b << endl << endl;
}

int main()
{
	myTemp(10, "COMPLETE C++");
	myTemp(0.123456, 56789);

	return 0;
}
```

[illegible]

Ex11 03.cpp program [illegible] run [illegible]



```
        a    = 10
        b    = COMPLETE C++


        a    = 0.123456
        b    = 56789

Any key to return to Quincy...
```

[illegible]

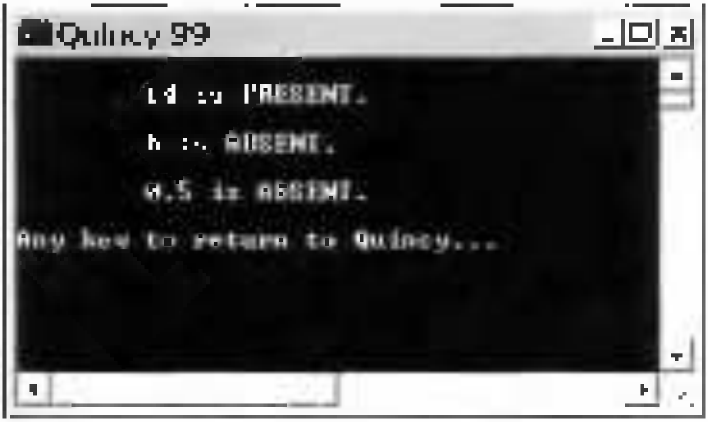
Exe03.cpp program [illegible] myTempl( ) function [illegible] instance [illegible] compiler [illegible] generate [illegible] placeholder type (2) [illegible] X1 [illegible] X2 [illegible] (int, char) [illegible] (double, int) data type [illegible] generic function [illegible] overloaded function [illegible] function [illegible] overload [illegible] function [illegible] body [illegible] generic function [illegible] action [illegible]

၁၁.၂ Search an Array Using a Generic Function

```
// Listing 11.4: Searching an array for an object
#include <iostream>
#include <cstring>

template <class X>

void   find(X  obj, X  *list, int  size)
{
       for (int i=0; i<size; i++)
              if (list[i] == obj)
              {
                     cout << "\n" << obj << " is PRESENT.\n" ;
                     return ;
              }
       cout << "\n" << obj << " is ABSENT.\n" ;
}

int   main( )
{
       int        a[ ] = {10,14,19,25,56};
```

```
        char    *c  =  "This is a test";
        double  d[ ] = {1.1,5.5,10.6,25.5};

        find(14,a,5);

        find('b',c,(int) strlen(c));

        find(0.5,d,4);

        return 0;
}
```

[illegible] Ex1104.cpp program [illegible] generic function find( ) [illegible] parameter 1st [illegible] argument (4) [illegible] pass [illegible] find(14,a,5) [illegible] array a[ ] [illegible] element (5) [illegible] 14 [illegible] find( ) [illegible] 14 is PRESENT. [illegible] message [illegible] prompt [illegible] 14 is ABSENT [illegible] display [illegible] find( ) function [illegible] program [illegible] run [illegible]



```
        14 is PRESENT.
        b is ABSENT.
        0.5 is ABSENT.
Any key to return to Quincy...
```

[illegible]

၁၁.၄ A Simple Class Template

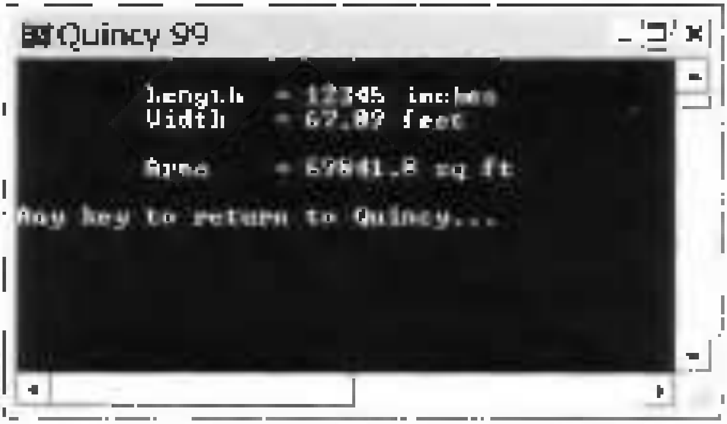
generic function [illegible] define [illegible] generic class [illegible] generic class [illegible] general form [illegible]

```
template  <class  dtype>
class   className
{
        // . . .
  public:
        // . . .
};
```

```
// Listing 11.5: Creating a class template
#include <iostream>

template <class  L1, class  L2>
class  Area
{
        L1        length;
        L2        width;

   public:
        Area (L1 l, L2 w)
              { length = l; width = w; }

        float  display( )
        {
              cout << "\n\tLength  = " << length << " inches";
              cout << "\n\tWidth   = " << width  << " feet";
              return  length*width/12 ;
        }
};
```

```
int  main( )
{
        float       a = 12345;        //  inches
        float       b = 67.89;         //  feet

        Area <float, float>  mt(a, b);
        cout << "\n\n\tArea     = " << mt.display( ) << " sq ft\n";

        return 0;
}
```

Ex1105.cpp program ကို run လိုက်မယ်ဆိုရင် ပုံ (၁၁.၆) မှာပြထားသည့်အတိုင်း မြင်ရမှာပါ



```
        Length    = 12345  inches
        Width     = 67.89 feet

        Area      = 69841.8 sq ft
Any key to return to Quincy...
```

ပုံ (၁၁.၆)

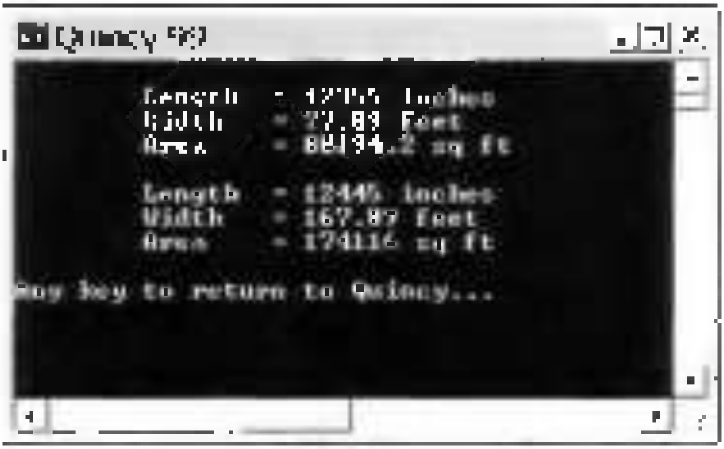
၁၁.၄ Default Values for Parameters of a Specific Type

ကျွန်တော်တို့ class template တစ်ခုကို create လုပ်တဲ့အခါမှာ template parameter list ထဲက default argument တစ်ခုကို သတ်မှတ်ပေးလို့လည်းရပါတယ်။ ဥပမာ Ex1106.cpp program ကကြည့်ပါ

Ex1105.cpp program ကို ဖြစ်ပေသည်။ template parameter list မှ တတိယမြောက် argument ကို integer ၏ type သတ်မှတ်ပြီး value ကို 10 ဖြင့်သတ်မှတ်ပေးထားပါသည်။

```
// Listing 11.6. Default values for parameters of a specific type
#include <iostream.h>

template <class  L1, class  L2, int  add = 10>

class  Area
{
        L1      length;
        L2      width;

   public:
        Area (L1 l, L2 w)
                {  length = l + add;  width = w + add;  }

        float  display( )
        {
                cout << "\n\tLength   = " << length << " inches";
                cout << "\n\tWidth    = " << width  << " feet";
                return   ( length*width/12 ) ;
        }
};

int  main( )
{
        float  a = 12.345;        // inches
        float  b = 67.89;         // feet

        Area <float, float>    int1(a, b);
        cout << "\n\tArea      = " << int1.display( ) << " sq ft\n";
        Area <float, float,100> int2(a, b);
        cout << "\n\tArea      = " << int2.display( ) << " sq ft\n";
        return 0;
}
```

Ex1106.cpp program [illegible] main( ) function [illegible] a = 12345 [illegible] b = 67.89 [illegible] initialize [illegible] mt1(a, b) [illegible] template function [illegible] call [illegible] class Area [illegible] length = l + add<default> = 12345 + 10 = 12355 [illegible] width = w + add<default> = 67.89 + 10 = 77.89 [illegible] assign [illegible] default value [illegible] mt2(a, b) [illegible] call [illegible] length = l + add = 12345 + 100 = 12445 [illegible] width = w + add = 67.89 + 100 = 167.89 [illegible] assign [illegible] template definition [illegible] default value [illegible] Ex1106.cpp program [illegible] run [illegible]



```
        Length   = 12355 inches
        Width    = 77.89 feet
        Area     = 80194.2 sq ft

        Length   = 12445 inches
        Width    = 167.89 feet
        Area     = 174116 sq ft

Any key to return to Quincy...
```

[illegible]

၁၁.၅ Using a Linked-list Template

```
// Listing 11.7. A Linked list of integers
#include <iostream>
#include "linklist.h"

int main( )
{
```

```
LinkedList <int> IntList;
for (int i = 0; i < 10; i++)
        IntList.AppendEntry(i);

int* ip = IntList.FirstEntry();
cout << "\n\n";

while (ip)
{
        cout << *ip << ' ';
        if (*ip == 0 || *ip == 5 || *ip == 8)
                IntList.RemoveEntry();
        ip = IntList.NextEntry();
}

cout << "\n\n";
while ((ip = IntList.NextEntry()) != 0)
        cout << *ip << ' ';

cout << endl;
return 0;
}
```

Ex1107.cpp program [illegible] LinkedList object [illegible] type (int) parameter [illegible] declare [illegible] for loop [illegible] AppendEntry( ) [illegible] call [illegible] list [illegible] integer (10) [illegible] list [illegible] first integer [illegible] FirstEntry( ) function [illegible] point [illegible] while loop [illegible] display [illegible] 0, 5 [illegible] 8 [illegible] RemoveEntry() call [illegible] NextEntry( ) call [illegible] list [illegible] integer [illegible] list [illegible] integer [illegible] display [illegible] integer (3) [illegible] LinkedList.h header [illegible] call [illegible] Ex1107.cpp program [illegible] #include "LinkedList.h" [illegible] program [illegible] run [illegible]

```
// linklist.h

#ifndef     LINKLIST_H
#define     LINKLIST_H

template <class T>  class   LinkedList;
template <class T>
// The linked-list entry
class   ListEntry
{
        T thisentry;
        ListEntry* nextentry;
        ListEntry* preventry;
        ListEntry(T& entry);
        friend class LinkedList<T>;
};

template <class T>
// Construct a linked list entry.
ListEntry<T> :: ListEntry(T &entry)
{
        thisentry = entry;
        nextentry = 0;
        preventry = 0;
}

template <class T>
// The linked list
class   LinkedList
{
        // The list head.
        ListEntry<T>* firstentry;
        ListEntry<T>* lastentry;
        ListEntry<T>* iterator;
        void    RemoveEntry(ListEntry<T> *lentry);
        void    InsertEntry(T& entry, ListEntry<T> *lentry);
```

```
public:
        LinkedList();
        ~LinkedList();
        void    AppendEntry(T& entry);
        void    RemoveEntry(int pos = -1);
        void    InsertEntry(T& entry, int pos = -1);
        T* FindEntry(int pos);
        T* CurrentEntry();
        T* FirstEntry();
        T* LastEntry();
        T* NextEntry();
        T* PrevEntry();
};

template <class T>
// Construct a linked list.
LinkedList<T> :: LinkedList()
{
        iterator = 0;
        firstentry = 0;
        lastentry = 0;
}

template <class T>
// Destroy a linked list.
LinkedList<T> :: ~LinkedList()
{
         while (firstentry)     RemoveEntry(firstentry);
}

template <class T>
// Append an entry to the linked list.
void    LinkedList<T> :: AppendEntry(T& entry)
{
        ListEntry<T>* newentry = new ListEntry<T>(entry);
        newentry->preventry = lastentry;
        if (lastentry)
```

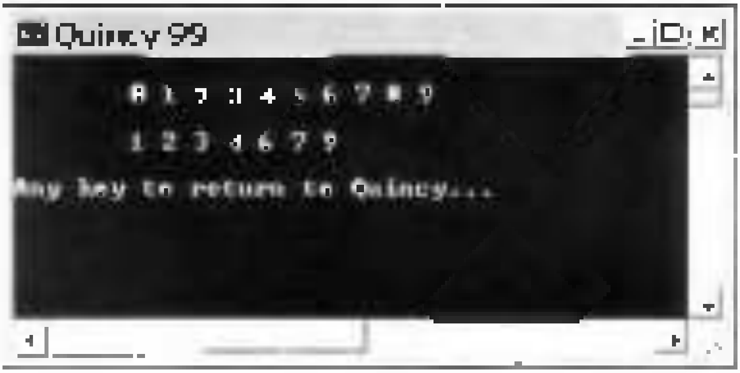
```
                lastentry->nextentry = newentry;
        if (firstentry == 0)
                firstentry = newentry;
        lastentry = newentry;
}

template <class T>
// Remove an entry from the linked list.
void    LinkedList<T> :: RemoveEntry(ListEntry<T>* lentry)
{
        if (lentry == 0)        return;
        if (lentry == iterator)
                iterator = lentry->preventry;

        // Repair any break made by this removal.
        if (lentry->nextentry)
                lentry->nextentry->preventry = lentry->preventry;
        if (lentry->preventry)
                lentry->preventry->nextentry = lentry->nextentry;

        // Maintain list head if this is last and/or first.
        if (lentry == lastentry)
                lastentry = lentry->preventry;
        if (lentry == firstentry)
                firstentry = lentry->nextentry;

        delete lentry;
}


template <class T>
// Insert an entry into the linked list.
void    LinkedList<T> :: InsertEntry(T& entry, ListEntry<T>* lentry)
{
        ListEntry<T>* newentry = new ListEntry<T>(entry);
        newentry->nextentry = lentry;
```

```
          if (lentry)
          {
                    newentry->preventry = lentry->preventry;
                              lentry->preventry = newentry;
          }

           if (newentry->preventry)
                    newentry->preventry->nextentry = newentry;
           if (lentry == firstentry)
                    firstentry = newentry;
}

template <class T>
// Remove an entry from the linked list
void   LinkedList<T> :: RemoveEntry(int pos)
{
          FindEntry(pos);
          RemoveEntry(iterator);
}

template <class T>
// Insert an entry into the linked list.
void   LinkedList<T> :: InsertEntry(T& entry, int pos)
{
          FindEntry(pos);
          InsertEntry(entry, iterator);
}

template <class T>
// Return the current linked-list entry.
T* LinkedList<T> ::CurrentEntry()
{
          return iterator ? &(iterator->thisentry) : 0;
}

template <class T>
// Return a specific linked-list entry.
```

```
T* LinkedList<T>::[illegible](int pos)
{
        if (pos != -1)
        {
                iterator = firstentry;

                if (iterator)
                {
                        while (pos--)
                                iterator = iterator->nextentry;
                }
        }

        return CurrentEntry();
}

template <class T>
// Return the first entry in the linked list.
T* LinkedList<T>::FirstEntry()
{
        iterator = firstentry;
        return CurrentEntry();
}


template <class T>
// Return the last entry in the linked list.
T* LinkedList<T>::LastEntry()
{
        iterator = lastentry;
        return CurrentEntry( );
}


template <class T>
// Return the next entry in the linked list.
T* LinkedList<T>::NextEntry( )
```

```
{
         if (iterator == 0)
                iterator = firstentry;
        else
                iterator = iterator->nextentry;

        return CurrentEntry( );
}

template <class T>
// Return the previous entry in the linked list.
T* LinkedList<T>::PrevEntry( )
{
         if (iterator == 0)
                iterator = lastentry;
        else
                iterator = iterator->preventry;

        return CurrentEntry( );
}

#endif
```

Ex1207.cpp program [illegible]



```
       0 1 2 3 4 5 6 7 8 9
       1 2 3 4 6 7 9
Any key to return to Quincy...
```

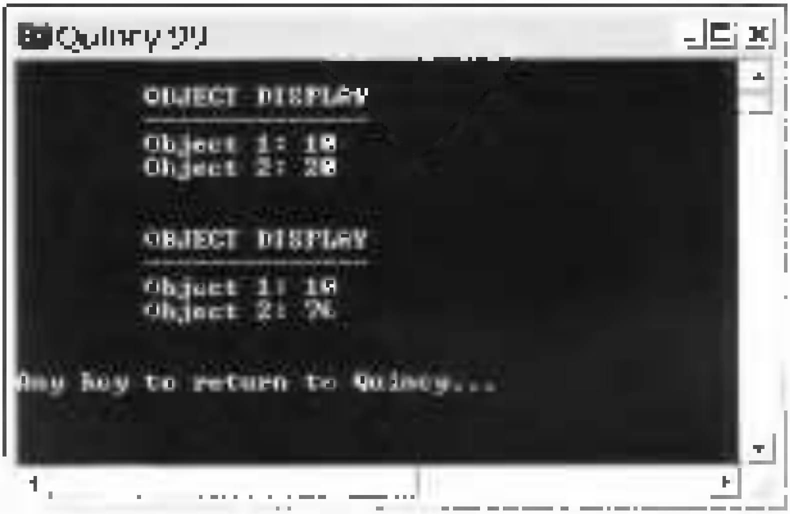
[illegible]

၁၁.၆ Partial Template Specialization

template partial specialization ဆိုတာ primary class template ရဲ့ [illegible] paramter [illegible] special parameter [illegible] template [illegible] primary class template ထဲမှာ object (2) ခုကို parameter [illegible] pass [illegible] object [illegible] display [illegible] object [illegible] char value [illegible] integer value [illegible] object [illegible] template [illegible] create [illegible] template partial specialization [illegible] Ex1108.cpp program [illegible]

```
// Listing 11.8: Template partial specialization
#include <iostream>

template <class T1, class T2>
class   MyTemp
{
        T1  obj1;       T2  obj2;
   public:
        MyTemp (T1 o1, T2 o2) : obj1(o1), obj2(o2){        }
        void   display( )
        {
                cout << "\n\tOBJECT DISPLAY\n\t--------------\n"
                      << "\tObject 1: " << obj1 << "\n\tObject 2: "
                     << obj2  << endl  << endl;
        }
};

template   <class T>
class  MyTemp <T, char>
{
        T  obj1, obj2;
   public:
        MyTemp(T o1, char c) : obj1(o1), obj2(o1)
                {obj2 += (int) c;}
        void  display( )
                {
                        cout << "\n\tOBJECT DISPLAY\n"
                             << "\t---------------\n"
                             << "\n\tObject 1: " << obj1 << endl
                             << "\tObject 2: " << obj2 << endl
                             << endl;
                }
};

int  main( )
{
        MyTemp <int, int>       mt1(10, 20);
        MyTemp <int, char>   mt2(10, 'B');          // 'B' = 66

        mt1.display( );
        mt2.display( );
        return  0;
}
```

Ex1106.cpp program [illegible] run [illegible]

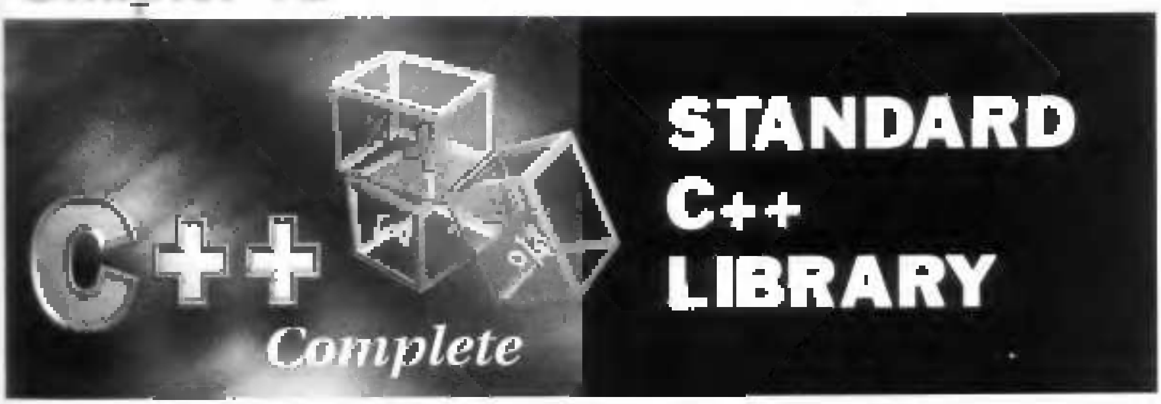


```
        OBJECT DISPLAY
        ---------------
        Object 1: 10
        Object 2: 20

        OBJECT DISPLAY
        ---------------
        Object 1: 10
        Object 2: 66

Any key to return to Quincy...
```

[illegible]

Class Templates

Chapter 12

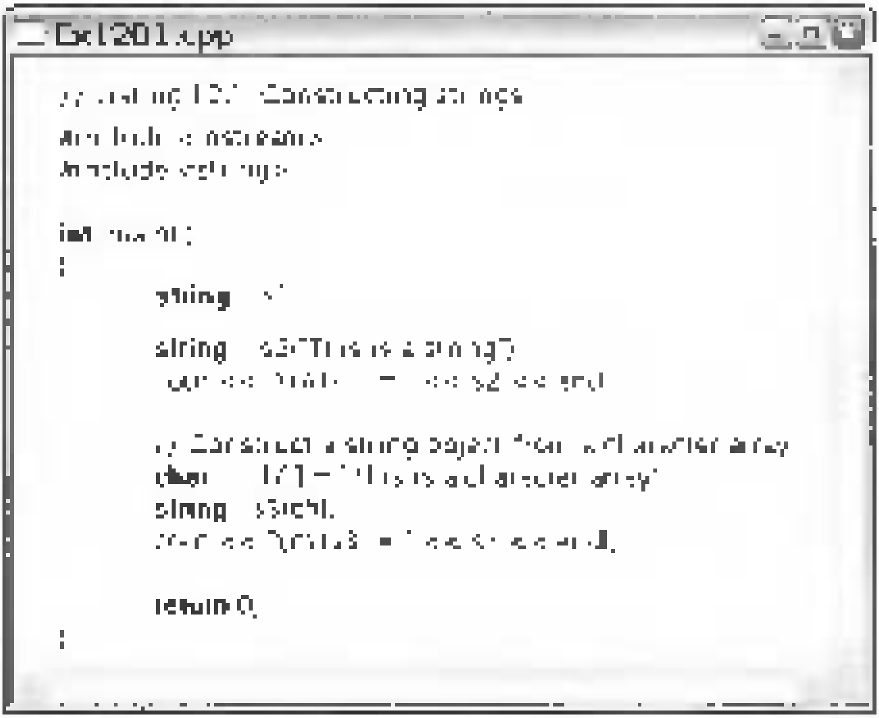


BASIC language လိုဘာသာစကားတွေကနေပြီး C language ကို ဆက်လက်လေ့လာခဲ့ကြသူ အခါ C မှာ string operator တွေအစားမှာ strcpy( ) နဲ့ strcmp( ) function လိုမျိုး (2) ခုတို့ဖြင့် ရှုပ်ထွေးစွာ အသုံးပြုခဲ့ရမှာဖြစ်ပါတယ်။ ထို့အပြင်မှာ C ထက် C++ ကို ဆက်လက်လေ့လာသူတွေအတွက် ပိုမိုအဆင်ပြေစေမည့်အချက်တစ်ခုကတော့ရှိနေပါတယ်။ C++ မှာပါဝင်တဲ့ string class ကြောင့် string object တွေနဲ့အလုပ်လုပ်ရာမှာ ပိုမိုလွယ်ကူစေပါတယ်။ ဒီလို string object တွေကို construct လုပ်ခြင်း, assign လုပ်ခြင်း, concatenate လုပ်ခြင်း, compare လုပ်ခြင်း၊ search လုပ်ခြင်းတို့အတွက် <string> header ကို program မှာ include လုပ်ပေးဖို့ လိုအပ်ပါတယ်။

၁၂.၁ The string Class

၁။ ပုံ (၁၂.၁) မှာဖော်ပြထားတဲ့ Ex1201.cpp program ထဲမှာ string တွေ construct လုပ်ပုံနဲ့ အသုံးပြုနိုင်ပုံတွေကို ဖော်ပြထားတဲ့ program တစ်ခုဖြစ်ပါတယ်။ ပထမဆုံးမှာ string s1; ဆိုတဲ့ statement ဟာ empty string တစ်ခုကို construct လုပ်ပေးမှာပါ။ နောက်တစ်ခုကတော့ string s2("This is a string");

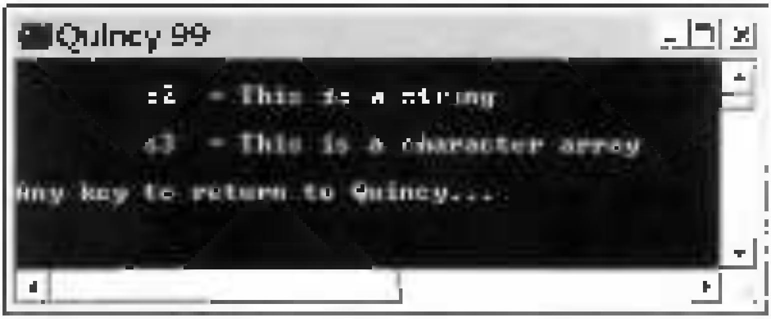
[illegible] string object [illegible] string object s2 [illegible] construct [illegible] ch[ ] [illegible] character array [illegible] string s3(ch); [illegible] string object s3 [illegible] construct [illegible] content [illegible] ch[ ] [illegible] character array [illegible]



```
// Listing 12.1 Constructing strings
#include <iostream>
#include <string>

int main()
{
        string s1;

        string s2("This is a string");
        cout << "\ts2 = " << s2 << endl;

        // Construct a string object from a character array
        char ch[] = "This is a character array";
        string s3(ch);
        cout << "\ts3 = " << s3 << endl;

        return 0;
}
```

[illegible]

[illegible] Ex1201.cpp program [illegible] run [illegible]



```
        s2  = This is a string
        s3  = This is a character array
Any key to return to Quincy...
```

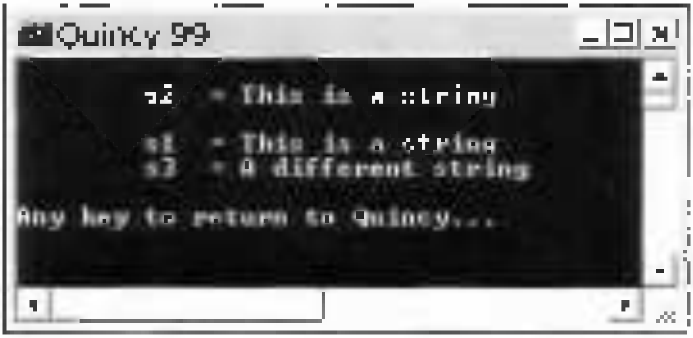
[illegible]

Assigning Strings

[illegible] string object [illegible] construct [illegible] assign [illegible] string s2("This is a string"); [illegible] construct [illegible] string s1 = s2; [illegible] assign [illegible] Ex1202.cpp program [illegible]

```
// Listing 12.2: Assigning strings
#include <iostream>
#include <string>

int main( )
{
        string  s1;
        string  s2("This is a string");
        cout << "\n\ts2  = " << s2 << endl;

        s1 = s2;
        cout << "\n\ts1  = " << s1 << endl;
        string  s3 = "A different string";
        cout << "\ts3  = " << s3 << endl;

        return 0;
}
```

[illegible] Ex1202.cpp program [illegible] run [illegible]



```
        s2  = This is a string

        s1  = This is a string
        s3  = A different string

Any key to return to Quincy...
```

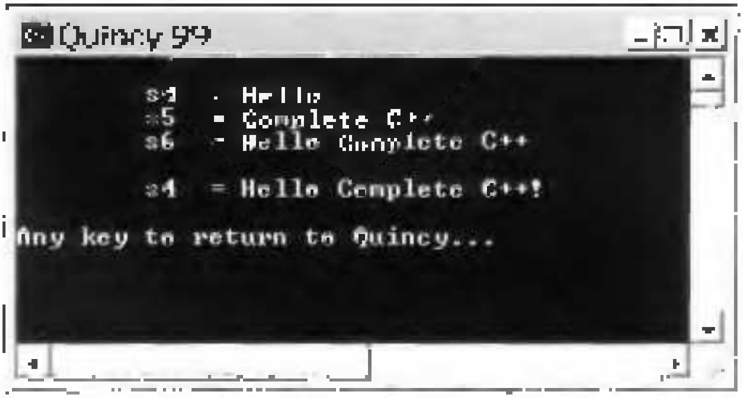
[illegible]

Concatenating Strings

၁။ string object တွေကို concatenation operator + နဲ့ += တို့ကိုအသုံးပြုပြီး ဆက်နွယ်ပေါင်းစပ်ပေး လို့ရပါသည်။ Ex1203.cpp program ကိုလေ့လာကြည့်ပါ။

```
// Listing 12.3: Concatenating strings
#include <iostream>
#include <string>

int main( )
{
        string    s4("Hello ");
        string    s5("Complete C++");
        string    s6 = s4 + s5;

        cout << "\n\ts4   = " << s4  << "\n\ts5  = " << s5
              << "\n\ts6  = " << s6 << endl;
        s4 += s5;
        s4 += '!';
        cout << "\n\ts4  = " << s4 << endl;
        return 0;
}
```

၂။ Ex1203.cpp program ကို run လိုက်မယ်ဆိုရင် ပုံ (၁၂-၃) မှာပြထားတဲ့အတိုင်း မြင်ရမှာပါ။



```
        s4   = Hello
        s5   = Complete C++
        s6   = Hello Complete C++

        s4   = Hello Complete C++!

Any key to return to Quincy...
```

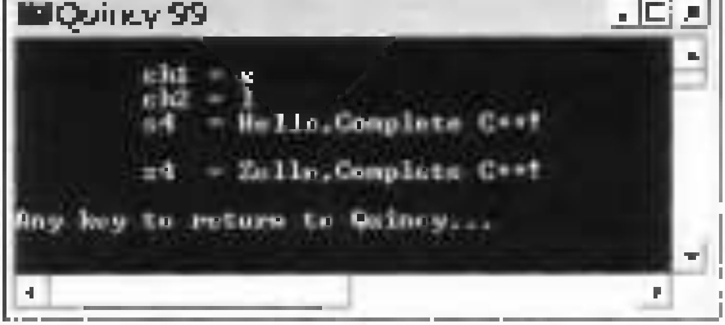
ပုံ (၁၂-၃)

Subscripting Strings

[illegible] string object [illegible] single character [illegible] character [illegible] character [illegible] subscript operator [ ] [illegible] at(n) member function [illegible] Ex1204.cpp program [illegible]

```
// Listing 12.4: Subscripting strings
#include <iostream>
#include <string>

int  main( )
{
        string   s4("Hello Complete C++!");
        char   ch1 = s4[1];
        char   ch2 = s4.at(2);

        s4[5] = ',';
        cout << "\n\tch1 = " << ch1 << "\n\tch2 = " << ch2
             << "\n\ts4  = " << s4 << endl;
        s4.at(0) = 'Z';
        cout << "\n\ts4  = " << s4 << endl;
        return  0;
}
```

[illegible] Ex1204.cpp program [illegible] run [illegible]



```
        ch1 = e
        ch2 = l
        s4  = Hello,Complete C++!

        s4  = Zello,Complete C++!

Any key to return to Quincy...
```

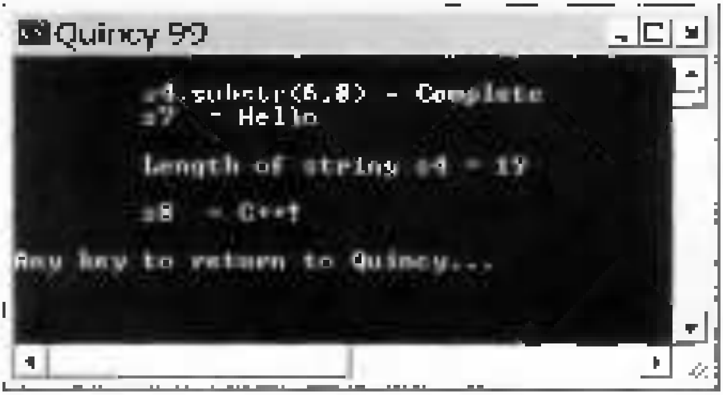
[illegible]

Subtrings

၁။ string object တစ်ခုအနေ substring တစ်ခုကို ခွဲထုတ်ယူချင်ရင် substr( ) function ကိုအသုံးပြုရ ပါတယ်။ Ex1205.cpp program ကိုလေ့လာကြည့်ပါ။

```
// Listing 12.5: Substrings
#include <iostream>
#include <string>

int main( )
{
        string   s4("Hello,Complete C++!");

        cout << "\n\ts4.substr(6,8) = "  << s4.substr(6,8);
        string   s7(s4.substr(0,5));
        cout << "\n\ts7  = " << s7 << endl;
        cout << "\n\tLength of string s4 = "
             << s4.length( ) << endl;
        string   s8(s4.substr(s4.length( )-4,4));
        cout << "\n\ts8  = " << s8 << endl;
        return 0;
}
```

၂။ Ex1205.cpp program ကို run လိုက်မယ်ဆိုရင် ပုံ (၁၂-၆) မှာပြထားတဲ့အတိုင်း မြင်ရမှာပါ။



```
        s4.substr(6,8) = Complete
        s7  = Hello

        Length of string s4 = 19

        s8  = C++!

Any key to return to Quincy...
```

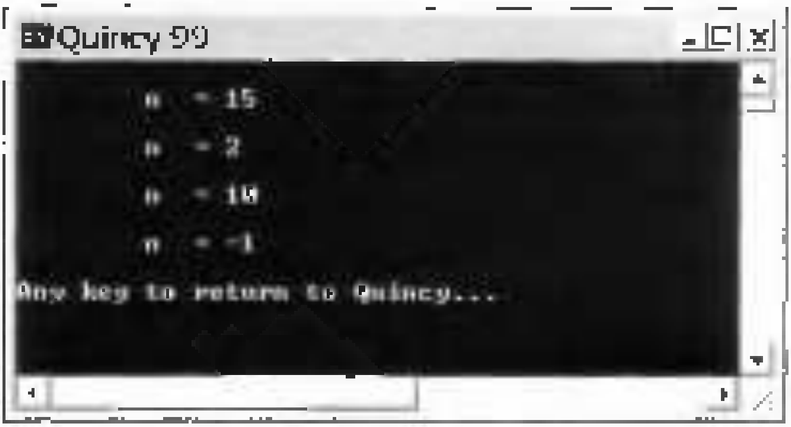
ပုံ (၁၂-၆)

Searching Strings

[illegible] standard C++ library [illegible] string class [illegible] find( ) rfind( ) [illegible] overloaded function [illegible] find( ) function [illegible] string object [illegible] matching substring single character [illegible] character array [illegible] string [illegible] forward search [illegible] search argument [illegible] -1 value [illegible] return [illegible] repeated search argument [illegible] rfind( ) function [illegible] Ex1206.cpp program [illegible]

```
// Listing 12.6  Searching strings
#include <iostream>
#include <string>

int  main( )
{
        string  s4("Hello ");
        string  s5("Complete C++");
        s4 += s5;
        s4 += '!';
        s4[5] = ',';
        s4.at(0) = 'Z';

        // Searching strings
        int  n = s4.find("C++");
        cout << "\n\tn  = " << n << endl;
        n = s4.find('l');
        cout << "\n\tn  = " << n << endl;
        n = s4.rfind('l');
        cout << "\n\tn  = " << n << endl;
        n = s4.find("bye");
        cout << "\n\tn  = " << n << endl;

        return 0;
}
```

၂။ Ex1206.cpp program ကို run လိုက်ပါမည်ဆိုလျှင် ပုံ (၁၂-၃) မှာပြထားသည့်အတိုင်း မြင်ရပါမည်။



```
        n  = 15
        n  = 2
        n  = 10
        n  = -1
Any key to return to Quincy...
```

ပုံ (၁၂-၃)

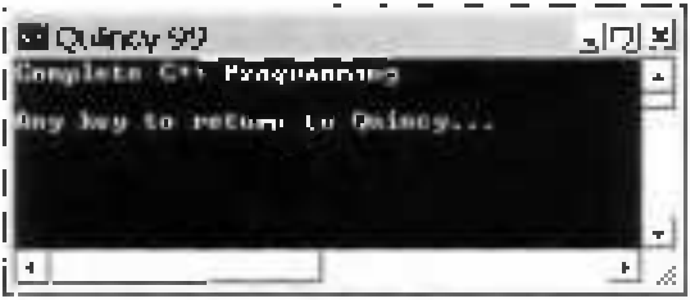
Comparing Strings

၃။ Ex1207.cpp program မှာ string object တွေ နှိုင်းယှဉ်ပုံကိုဖော်ပြ program တစ်ခု ရေးပြထားပါသည်။ လေ့လာကြည့်ပါ။

```
// Listing 12.7: Comparing strings

#include <iostream>
#include <string>

int  main( )
{
          string    s1("C++ ");
          string    s2("Programming ");

          if ("Bye " < s1)
                    if (s2 == "Programming ")
```

```
                if (s2 > s1)
                {
                        string   s3("Complete ");
                        string   s4 = s3 + s1 + s2;
                        cout << s4 << endl;
                }
        return 0;
}
```

[illegible] Ex1207.cpp program [illegible] run [illegible]



```
Complete C++ Programming

Any key to return to Quincy...
```

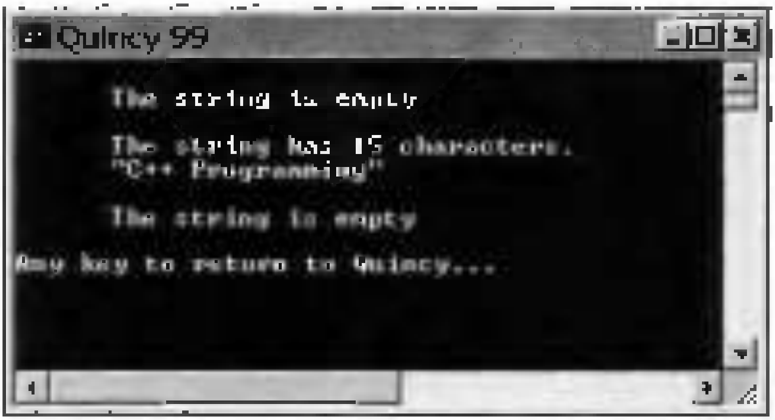
[illegible]

[illegible] The string Member Functions

[illegible] standard C++ string class [illegible] member function (4) [illegible] clear( ) [illegible] empty( ) [illegible] length( ) [illegible] data( ) function [illegible] clear( ) function [illegible] string object [illegible] zero length [illegible] clear [illegible] empty( ) function [illegible] string object [illegible] empty [illegible] check [illegible] empty [illegible] true [illegible] data [illegible] return [illegible] empty [illegible] false [illegible] length( ) function [illegible] string object [illegible] character [illegible] string data buffer [illegible] point [illegible] const pointer [illegible] return [illegible] data( ) member function [illegible] function [illegible] Ex1208.cpp program [illegible]

```
// Listing 12.0: Using the string member functions
#include <iostream>
#include <string>

void   test (const  string&  str)
{
        if (str.empty( ))
                cout << "\n\tThe string is empty\n";
        else
        {
                int   len = str.length( );

                cout << "\n\tThe string has "
                      << len << " characters \n\t\""
                      << str << "\"\n";
        }

}


int  main( )
{
        string   str;
        test(str);

        str = "C++ Programming";
        test(str);

        str.clear( );
        test(str);

        return  0;
}
```

- Ex1200.cpp program ကို run [illegible]



```
        The string is empty

        The string has 15 characters.
        "C++ Programming"

        The string is empty

Any key to return to Quincy...
```

ပုံ (၁၂.၈)

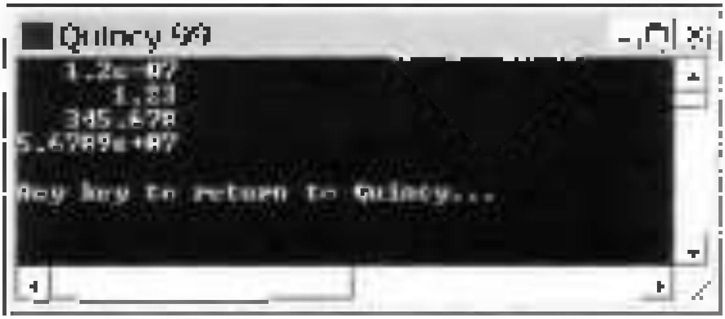
၁၂.၃ Formatted Output

The ios::width( ) Function

၁။ C++ program တစ်ခုကို run လိုက်၍ output ကို fixed column width ဖြင့်ရရှိလိုပါက အသုံးပြုနိုင် width( ) member function ကိုအသုံးပြုရပါမည်။ Ex1209.cpp program မှ array x[ ] value များကို column width (10) ရှိသည့် column များ fixed format သို့မဟုတ် scientific format ဖြင့် right-align အဖြစ် display လုပ်ပြနိုင်ပေသည်။

```
// Listing 12.9: Using width( ) member function
#include <iostream>

int main( )
{
        static double x[ ] =
                { 0.00000012, 1.23, 345.678, 56789012.34 };

        cout.setf(ios::fixed, ios::scientific );
        for (int i = 0; i < 4; i++)
        {
                cout.width(10);
                cout << a[i] << endl;
        }

        return 0;
}
```

[illegible] Ex1/09.cpp program [illegible] run [illegible] argument value [illegible] scientific format [illegible] display [illegible] argument value [illegible] column width [illegible] fixed format [illegible] display [illegible] column width [illegible] argument value [illegible] round (6 decimal places) [illegible]


```
  1.2e+07
     1.23
  345.678
5.6789e+07

Any key to return to Quincy...
```

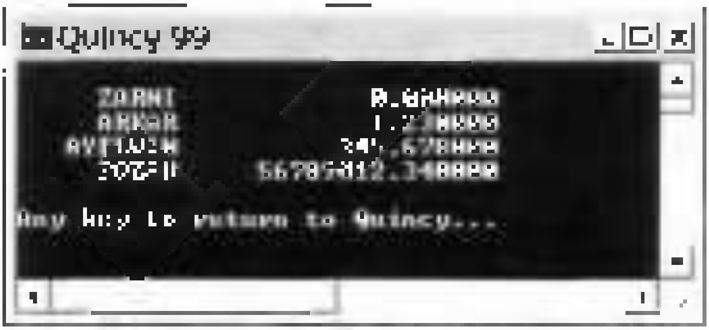
[illegible]

The setw( ) Manipulator

[illegible] data display [illegible] table form [illegible] setw( ) manipulator [illegible] column width [illegible] adjust [illegible] setw( ) function [illegible] <iomanip> header [illegible] program [illegible] include [illegible] cout.setf(ios::fixed) [illegible] argument value [illegible] Ex1/10.cpp program [illegible]

```
// Listing 12.10: The setw( ) manipulator
#include <iostream>
#include <iomanip>

int main( )
{
        static double x[ ] =
                { 0.0000012, 1.23, 345.678, 56789012.34 };

        static char *ch[ ] =
                {"ZARNI", "ARKAR", "AYELWIN", "POZAW"};

        cout.setf(ios::fixed);
        cout << endl;
        for (int i = 0; i < 4; i++)
                cout << setw(10) << ch[i]
                     << setw(20) << x[i] << endl;
        return 0;
}
```

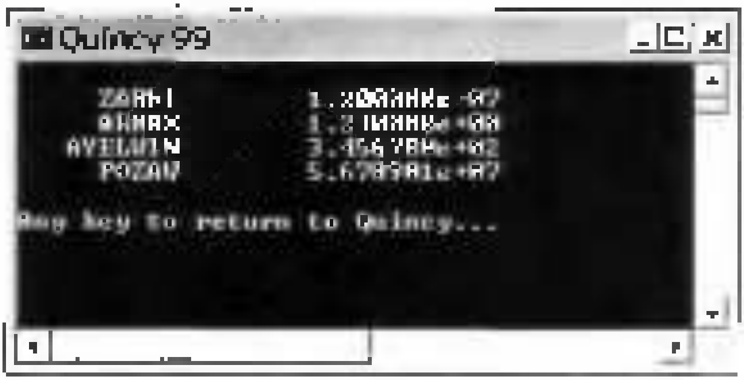
[illegible] Ex1210.cpp program [illegible] run [illegible]



```
     ZARNI            0.000001
     ARKAR            1.230000
   AYELWIN          345.678000
     POZAW     56789012.340000

Any key to return to Quincy...
```

[illegible]

[illegible] cout.setf(ios::fixed) [illegible] cout.setf(ios::scientific) [illegible]



```
     ZARHI          1.200000e-07
     ARMAX          1.234000e+08
   AYELWIN          3.456780e+02
     POZAW          5.678901e+07

Any key to return to Quincy...
```

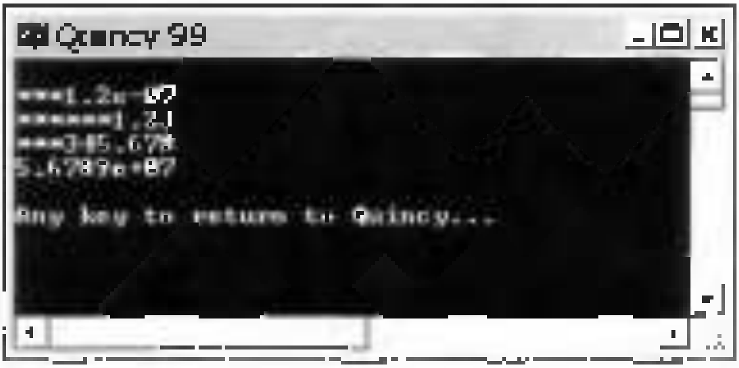
[illegible]

The ios::fill( ) Function

[illegible] program [illegible] fill( ) function [illegible] output [illegible] display [illegible] value [illegible] fill( ) function argument [illegible] Ex1211.cpp program [illegible]

```
// Listing 12.11: The fill( ) function
#include <iostream>

int main( )
{
        static double x[ ] =
                { 0.00000012, 1.23, 345.678, 56789012.34 };

        cout << endl;
        for (int i = 0; i < 4; i++)
        {
                cout.width(10);
                cout.fill('*');
                cout << x[i] << endl;
        }
        return 0;
}
```

[illegible] Ex1211.cpp program [illegible] run [illegible]



```
***1.2e-07
******1.23
***345.679
5.6789e+07

Any key to return to Quincy...
```

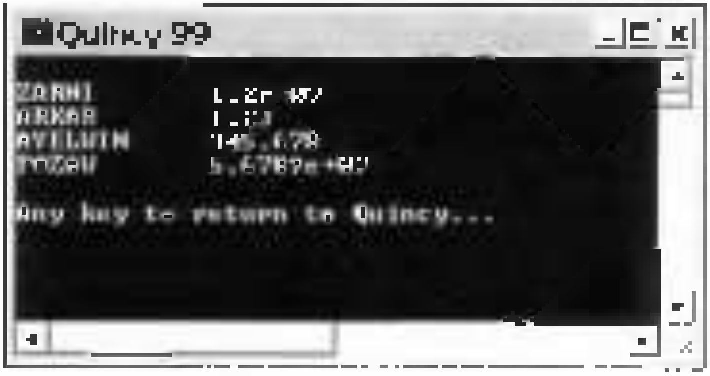
[illegible]

Output Justification

[illegible] program output [illegible] left-justified [illegible] setiosflags (ios::left) manipulator [illegible] Ex1212.cpp program [illegible]

```
// Listing 12.12: The output justification
#include <iostream>
#include <iomanip>

int main( )
{
        static double x[ ] =
                { 0.00000012, 1.23, 345.679, 56789012.34 };

        static char* ch[ ] =
                {"ZARNI", "ARKAR", "AYELWIN", "POZAW"};

        cout << endl;
        for (int i = 0; i < 4; i++)
        {
                cout << setiosflags(ios::left)
                     << setw(12)  << ch[i]
                     << setw(15)  << x[i]    << endl;
        }
        return  0;
}
```

[illegible] Ex1212.cpp program [illegible] run [illegible]



```
ZARNI           1.2e-007
ARKAR           1.23
AYELWIN         345.679
[illegible]     5.6789e+009

Any key to return to Quincy...
```

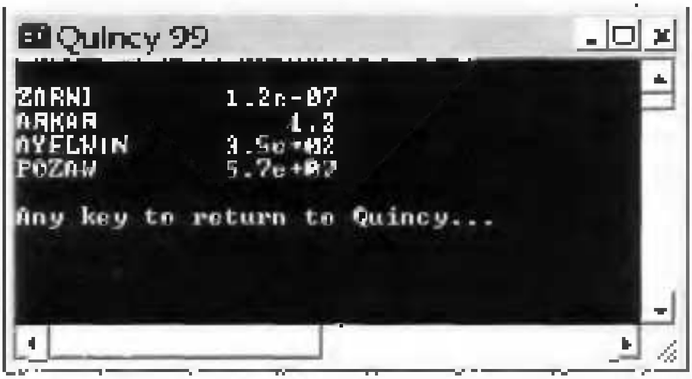
[illegible]

The setprecision Manipulator

[illegible] program output [illegible] value [illegible] right-justified setprecision (1 decimal place) [illegible] Ex1213.cpp program [illegible]

```
// Listing 12.13: The setprecision manipulator
#include <iostream>
#include <iomanip>

int  main( )
{
        static  double  x[ ] =  { 0.00000012, 1.23, 345.679, 5678901234 };
        static char* ch[ ] =
                {"ZARNI", "ARKAR", "AYELWIN", "POZAW"};

        cout << endl;
        for (int i = 0; i < 4; i++)
        {
                cout << setiosflags(ios::left) << setw(10)
                     << ch[i]
                     << setiosflags(ios::right)
                     << setw(10) << setprecision(2)
                     << x[i] << endl;
        }

        return 0;
}
```

၂။ Ex1213.cpp program ကို run လိုက်မယ်ဆိုရင် ပုံ (၁၂.၁၅) မှာပြထားတဲ့အတိုင်း မြင်ရမှာပါ။



```
ZARNI          1.2e-07
ARKAR              1.2
AYELWIN        3.5e+02
POZAW          5.7e+07

Any key to return to Quincy...
```

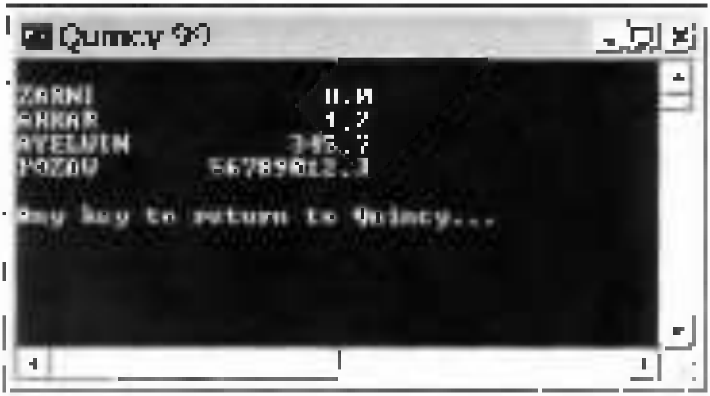
ပုံ (၁၂.၁၅)

Aligning Decimal Points

၁။ ပုံ (၁၂.၁၅) မှာပြခဲ့တဲ့ program output မှာ ဖော်ပြထားတဲ့ floating-point value တွေကို decimal-aligned လုပ်ချင်ရင် Ex1214.cpp program မှာ ရေးထားတဲ့အတိုင်းရေးပါ။

```
// Listing 12.14: Scientific and fixed notation
#include <iostream>
#include <iomanip>

int main( )
{
	static double x[ ] =
		{ 0.00000012, 1.23, 345.678, 56789012.34 };
	static char* ch[ ] =
		{"ZARNI", "ARKAR", "AYELWIN", "POZAW"};

	cout << endl;
	for (int i = 0; i < 4; i++)
	{
		cout << setiosflags(ios::left) << setw(10)
			<< ch[i]
			<< resetiosflags(ios::left) << setiosflags(ios::fixed)
			<< setiosflags(ios::right)   << setw(12)
			<< setprecision(1)           << x[i] << endl;
	}
	return 0;
}
```

Ex1214.cpp program ကို run [illegible]



```
ZARNI              0.0
ARKAR              1.2
AYELWIN          345.7
POZAW       56789012.3

Any key to return to Quincy...
```

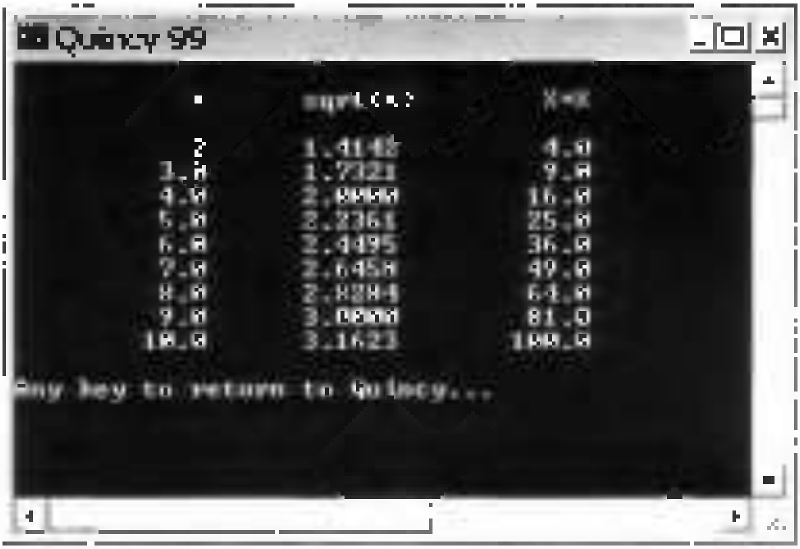
[illegible]

The Table of Square Roots and Squares

[illegible] Ex1215.cpp program [illegible] 2 [illegible] 10 [illegible] (9) [illegible] square root [illegible] square [illegible] display [illegible] program [illegible]

```
// Listing 12.15: A table of square roots and squares
#include <iostream>
#include <iomanip>
#include <cmath>

int main( )
{
        double  x;

        cout << "\n\t   X      sqrt(X)        X*X\n\n";

        for (x = 2; x <= 10; x++)
        {
                cout << resetiosflags(ios::left)
                       << setw(12)  << setprecision(1)
                       << x
                       << setiosflags(ios::fixed)
                       << setw(12)  << setprecision(4)
                      << sqrt(x)
                      << setiosflags(ios::fixed)
                      << setw(12)  << setprecision(1)
                      << x*x << endl;
        }
        return 0;
}
```

[illegible] Ex1215.cpp program [illegible] run [illegible]



```
     x          sqrt(x)          X*X

     2          1.4142           4.0
   3.0          1.7321           9.0
   4.0          2.0000          16.0
   5.0          2.2361          25.0
   6.0          2.4495          36.0
   7.0          2.6458          49.0
   8.0          2.8284          64.0
   9.0          3.0000          81.0
  10.0          3.1623         100.0

Any key to return to Quincy...
```

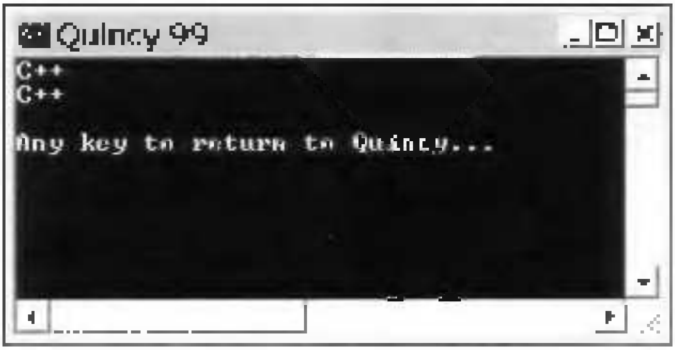
ပုံ ၁၂.၁၅

၁၂.၇ Output Member Functions

[illegible] std::ostream class [illegible] single character [illegible] display [illegible] put( ) member function [illegible] output object stream [illegible] display [illegible] overloaded << insertion operator [illegible] Ex1216.cpp program [illegible]

```
// Listing 12.16: Output member function
#include <iostream>

int main( )
{
        cout.put('C');
        cout.put('+');
        cout.put('+');
        cout << endl;
        cout << 'C';
        cout << '+';
        cout << '+';
        cout << endl;

        return 0;
}
```

၂။ Ex1216.cpp program ကို run လိုက်မည်ဆိုပါက ပုံ (၁၂.၁၈) မှာပြထားသည့်အတိုင်း ဖြစ်ရမည်။



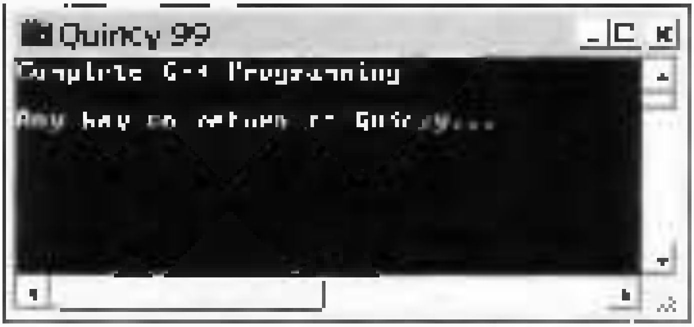
```
C++
C++

Any key to return to Quincy...
```

ပုံ (၁၂.၁၈)

၃။ write( ) member function သည် output data ကို binary format အနေနဲ့ stream ထဲ ထည့်ပေးပါတယ်။ Ex1217.cpp program ကို run လိုက်ရင် message ကို display လုပ်ပေးပြီး alarm မြည်သံကိုကြားရမှာ၊ နောက်ပြီး next line ကို ရောက်သွားမှာဖြစ်ပါတယ်။

```
// Listing 12.17: Output member function
#include <iostream>

int main( )
{
        static struct
        {
                char  ch[40];
                int   alarm;
                int   eol;
        } msg = {"Complete C++ Programming",'\a','\n'};

        cout.write (reinterpret_cast <char*>(&msg), sizeof msg);
        return 0;
}
```

၂။ Ex1217.cpp program ကို run [illegible]



```
Complete C++ Programming

Any key to return to Quincy...
```

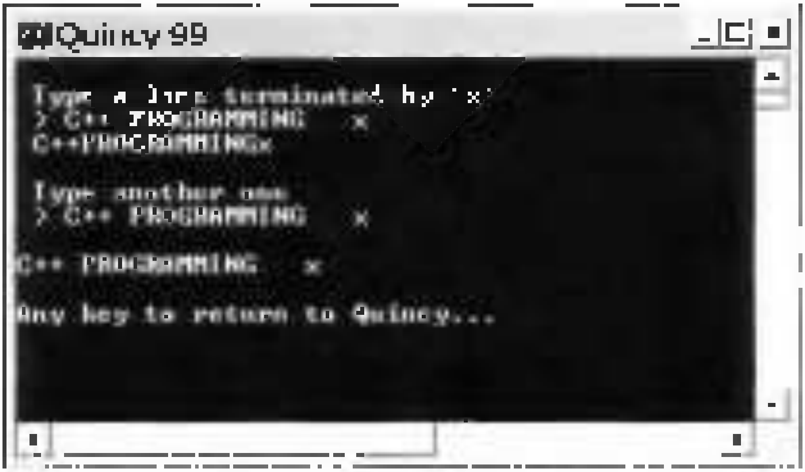
ပုံ [illegible]

၁၂.၄ Input Member Functions

၁။ C++ program [illegible] >> extraction operator [illegible] data input [illegible] data input [illegible] white space [illegible] data [illegible] get( ) member function [illegible] Ex1218.cpp program [illegible] >> extraction operator [illegible] get( ) function [illegible]

```
// Listing 12.18: Input member function
#include <iostream>

int main( )
{
        char line[25], ch = 0, *lp;
        cout << "\n Type a line terminated by 'x'" << "\n> ";
        lp = line;

        while (ch != 'x')
        {
                cin >> ch;      *lp++ = ch;
         }
        *lp = '\0';
        cout << ' ' << line;
        cout << "\n\n Type another one\n > ";
        lp = line;
        ch = 0;
        while (ch != 'x')
        {
                cin.get(ch);      *lp++ = ch;
        }
        *lp = '\0';
        cout << line << endl;
        return 0;
}
```

Ex1210.cpp program ကို run [illegible] ([illegible]) [illegible]



```
 Type a line terminated by 'x'
 > C++ PROGRAMMING   x
 C++PROGRAMMINGx

 Type another one
 > C++ PROGRAMMING   x

C++ PROGRAMMING   x

Any key to return to Quincy...
```

[illegible]

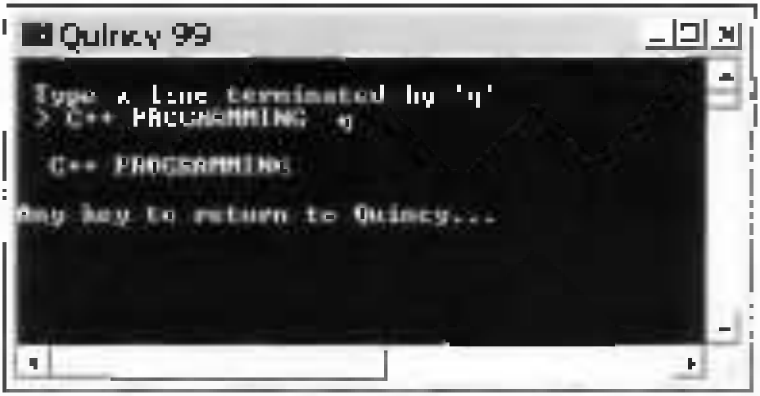
၃။ [illegible] C++ program ကို run [illegible] input data [illegible] ENTER [illegible] output display [illegible] Ex1219.cpp program [illegible]

```
// Listing 12.19: Input member function
#include <iostream>

int  main( )
{
          char   line[40];

          cout << "\n Type a line terminated by carriage return\n > ";
          cin.get(line, 40);
          cout << "\n  " << line << endl;

          return 0;
}
```

၄။ [illegible] input data [illegible] password [illegible] output display [illegible] Ex1220.cpp program [illegible]

```
// Listing 12.20: Input member function
#include <iostream>

int  main( )
{
          char  line[40];

          cout << "\n Type a line terminated by 'q'\n > ";
          cin.getline(line, 25, 'q');
          cout << "  " << line << endl;

          return  0;
}
```

[illegible] Ex1220.cpp program [illegible] run [illegible]



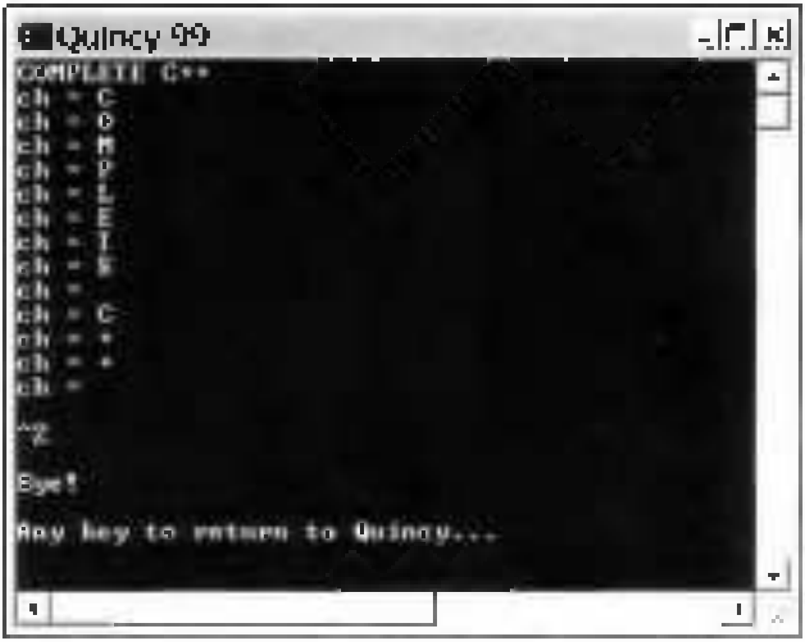
```
Type a line terminated by 'q'
> C++ PROGRAMMING  q

 C++ PROGRAMMING

Any key to return to Quincy...
```

[illegible]

More on the get( ) Function

```
// Listing 12.21  More on the get( ) function
#include <iostream>
int main( )
{
        char  ch;

        while  ((ch = cin.get( )) != EOF)
                cout << "ch = " << ch << endl;
        cout << endl << "Bye!" << endl;

        return 0;
}
```

Ex1221.cpp program [illegible] run [illegible] program [illegible] cin.get( ) [illegible] string object [illegible] character [illegible] display [illegible] ENTER key [illegible] ch = <blank> [illegible] data input အနေဖြင့်ပေးသွင်း CTRL + Z +ENTER key ကိုနှိပ်လိုက်သောအခါ Bye! ဆိုသည့် message ကို display လုပ်ပြီး program stop ဖြစ်သွားပါမည်။



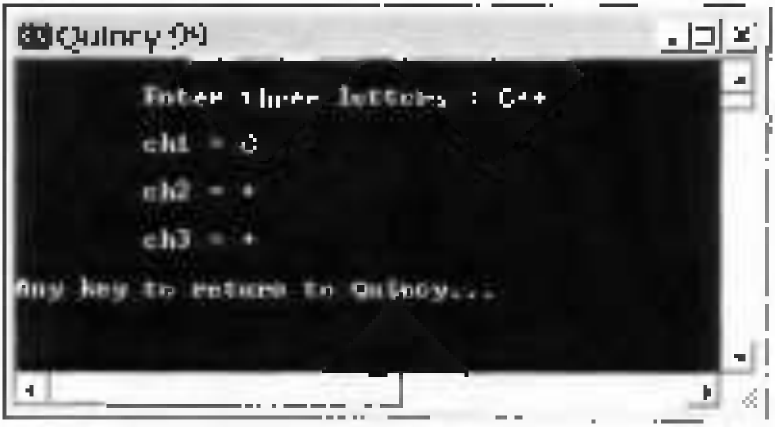
```
COMPLETE C++
ch = C
ch = O
ch = M
ch = P
ch = L
ch = E
ch = T
ch = E
ch =
ch = C
ch = +
ch = +
ch =

^Z

Bye!

Any key to return to Quincy...
```

ပုံ ၁၂.၂၁

Using the get( ) Function with Parameters

```
// Listing 12.22: Using the get( ) function with parameters
#include <iostream>

int main( )
{
        char  ch1, ch2, ch3;

        cout << "\n\nEnter three letters : ";
        cin.get(ch1).get(ch2).get(ch3);
        cout << "\n\tch1 = " << ch1 << endl
             << "\n\tch2 = " << ch2 << endl
             << "\n\tch3 = " << ch3 << endl;

        return 0;
}
```

Ex1222.cpp program [illegible]



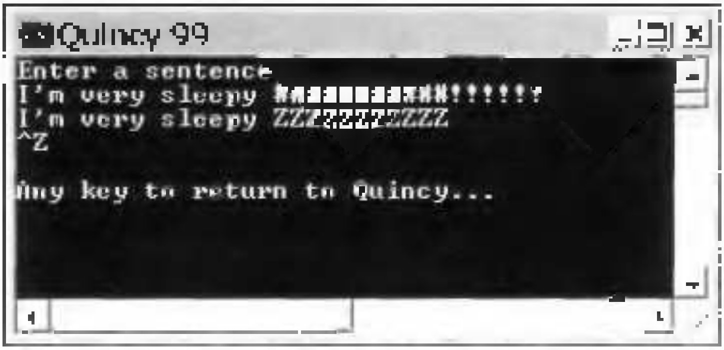
```
        Enter three letters : C++
        ch1 = C
        ch2 = +
        ch3 = +
Any key to return to Quincy...
```

[illegible]

Using the peek( ), putback( ), and ignore( ) Functions

```
// Listing 12.23: Using peek( ), putback( ), and ignore( ) functions
#include <iostream>

int main( )
{
        char ch;
        cout << "Enter a sentence\n";
        while (cin.get(ch))
        {
                if (ch == '#')
                        cin.putback('Z');
                else
                        cout << ch ;

                while (cin.peek( ) == '!')
                        cin.ignore(1,'!');
        }
        return 0;
}
```

Ex1223.cpp program ကို run လိုက်သောအခါ ပုံ (၁၂ - ၂၃) မှာ ဖော်ပြထားသည့်အတိုင်း ရရှိမည်။



```
Enter a sentence
I'm very sleepy ##########!!!!!!
I'm very sleepy ZZZZZZZZZZ
^Z

Any key to return to Quincy...
```

ပုံ (၁၂ - ၂၃)

Chapter 13

FILE I/O STREAMS

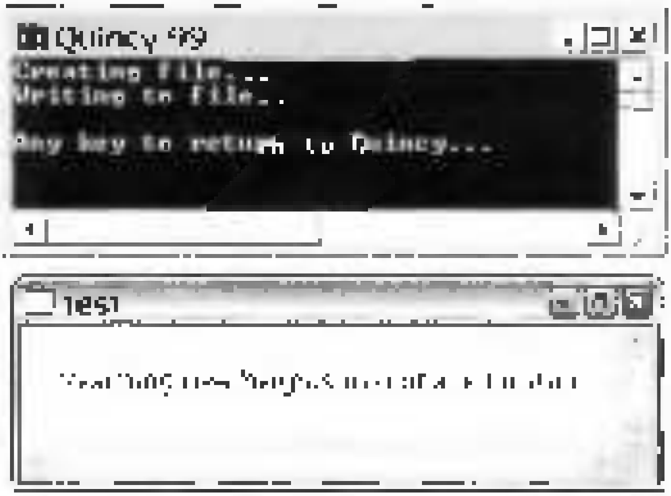
data [illegible] disk [illegible] disk [illegible] C++ input/ output system [illegible] standard C++ library [illegible] disk [illegible] manage [illegible] I/O class [illegible] C++ [illegible] I/O operation [illegible] stream [illegible] stream [illegible] data flow [illegible] stream [illegible] data flow [illegible] stream [illegible] class [illegible] class [illegible] member function [illegible] definition [illegible] stream [illegible] ifstream class object [illegible] input disk [illegible] write [illegible] extraction >> operator [illegible] istream class [illegible] member [illegible] insertion << operator [illegible] ostream class [illegible] member [illegible] istream [illegible] ostream class [illegible] ios class [illegible] derive [illegible] derived class [illegible] input/ output [illegible] class [illegible] input [illegible] ifstream [illegible] output [illegible] ofstream class object [illegible] <ofstream> [illegible] <ifstream> class object [illegible] <fstream> header [illegible]

၁၃.၁ The fstream Class

[illegible] Ex1301.cpp program [illegible] test.txt [illegible] output [illegible] string [illegible] write [illegible] program [illegible]

```
// Listing 13.1 Writing strings to a file
#include <fstream>

int main( )
{
        cout << "Creating file...\n" ;
        ofstream   outfile("test.txt");
        cout << "Writing to file...\n" ;
        outfile << "\n\tReaching new heights in global education. \n";
        return 0;
}
```

Ex1301.cpp program [illegible] outfile [illegible] ofstream class object instance [illegible] construct [illegible] object [illegible] test.txt [illegible] initialize [illegible] program [illegible] run [illegible] output [illegible] screen [illegible] test.txt [illegible]



```
Creating file...
Writing to file...

Any key to return to Quincy...
```

```
Reaching new heights in global education.
```

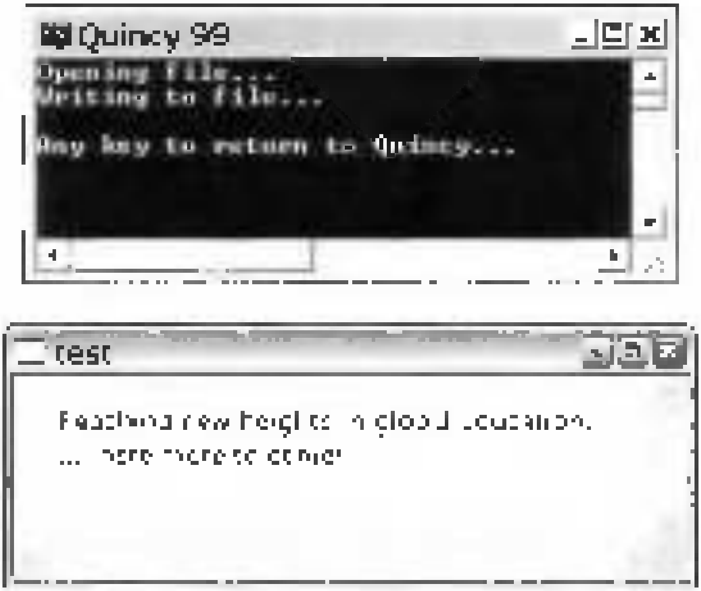
ပုံ [illegible]

၁၃.၂ Appending to an Output File

၁။ [illegible] test.txt output [illegible] string [illegible] ios::app [illegible] Ex1302.cpp program [illegible]

```
// Listing 13.2: Appending to an output file
#include <fstream>

int main( )
{
        cout << "Opening file...\n" ;
        ofstream   outfile("test.txt", ios::app);
        cout << "Writing to file...\n" ;
        outfile << "\n... here more to come!";
        return 0;
}
```

၂။ Ex1302.cpp program [illegible] output [illegible] screen [illegible] test.txt [illegible] string [illegible]



```
Opening file...
Writing to file...

Any key to return to Quincy...
```

Reaching new heights in global education.
... here more to come!

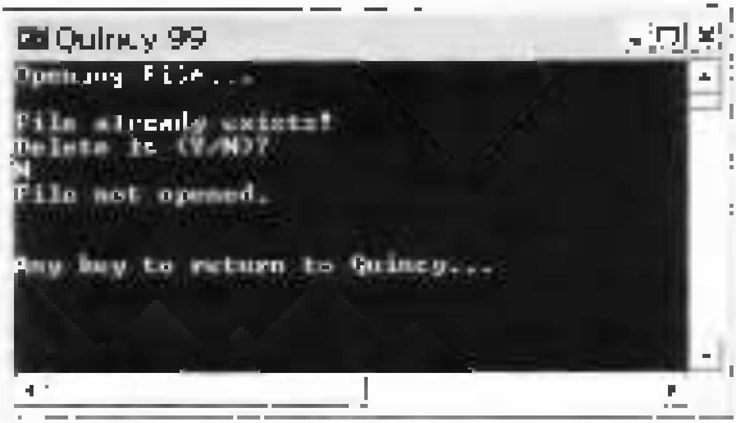
ပုံ (၁၃-၂)

၁၃.၃ Avoiding to Open an Existing File

[illegible] Ex1303.cpp program [illegible] override [illegible] fail( ) member function [illegible]

```
// Listing 13.3 Avoiding opening an existing file
#include <fstream>

int main( )
{
        cout << "Opening file...\n";
        ofstream    outfile("test.txt", ios::noreplace);
        if (outfile.fail( ))
        {
                cout << endl << "File already exists!\n"
                      << "Delete it (Y/N)?" << endl;

                char  ch;
                cin >> ch;
                if ((ch == 'Y') || (ch == 'y'))
                {
                        ofstream    outfile("test.txt");
                        outfile << "These are test data.\n"
                                << "New file created.\n";
                }
                else
                        cout << "File not opened.\n";
        }
        cout << endl;
        return 0;
}
```

[illegible] Ex1303.cpp program [illegible] fail( ) member function [illegible] message prompt [illegible] N [illegible] test.txt [illegible] override [illegible]



```
Opening file...

File already exists!
Delete it (Y/N)?
N
File not opened.


Any key to return to Quincy...
```

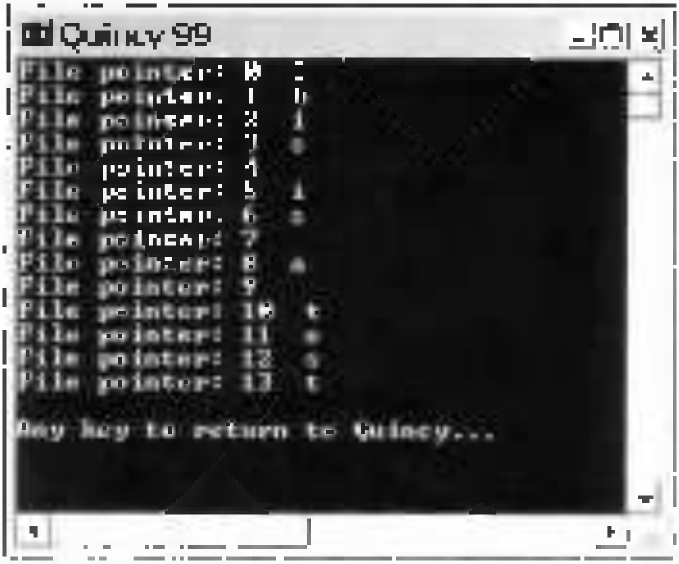
[illegible]

၁၃.၄ The ofstream( ) Function

။ Ex1304.cpp program [illegible] file pointer tellp( ) နှင့် put( ) function [illegible] input data [illegible] device [illegible] screen [illegible] inputdata [illegible] display [illegible] program [illegible]

```
// Listing 13.4: Using ofstream( ) member function
#include <fstream>
#include <string>

int main( )
{
        string   str("This is a test");

        // Create an output stream object
        ofstream  outFile;

        // Associate a file with the stream
        outFile.open("test.txt");
        // Write a string one character at a time
        for  (int  x=0; x<14; ++x)
        {
                cout << "File pointer: " << outfile.tellp( );
                outfile.put(str[x]);
                cout << "  " << str[x] << endl;
        }

        // Close up the file
        outfile.close( );

        return  0;
    }
```

[illegible] Ex1304.cpp program [illegible] run [illegible] file pointer [illegible] input data [illegible] screen [illegible] display [illegible] test.txt [illegible] information [illegible] This is a test [illegible]



```
File pointer: 0  T
File pointer: 1  h
File pointer: 2  i
File pointer: 3  s
File pointer: 4
File pointer: 5  i
File pointer: 6  s
File pointer: 7
File pointer: 8  a
File pointer: 9
File pointer: 10  t
File pointer: 11  e
File pointer: 12  s
File pointer: 13  t

Any key to return to Quincy...
```

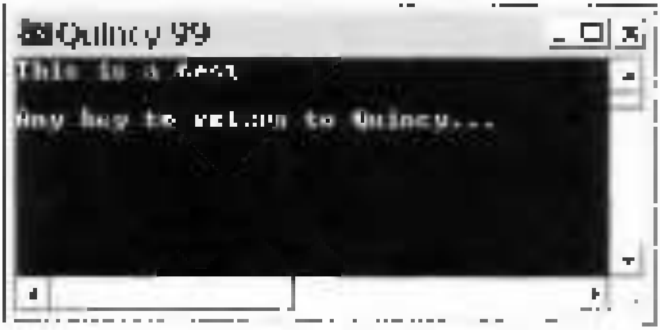
[illegible]

၁၃.၅ Reading Strings from a File

[illegible] Ex1304.cpp program [illegible] run [illegible] test.txt [illegible] data [illegible] read [illegible] Ex1305.cpp [illegible]

```
// Listing 13.5  Reading strings from a file
#include <fstream>

int  main( )
{
        const  int  MAX = 80;
        char       buffer[MAX];

        ifstream    infile("test.txt");
        while (infile)
        {
                infile.getline (buffer,MAX);
                cout  <<  buffer;
        }
        cout << endl;
        return  0;
}
```

[illegible] Ex1305.cpp program [illegible] run [illegible] test.txt [illegible] data [illegible] program [illegible] screen [illegible] display [illegible]



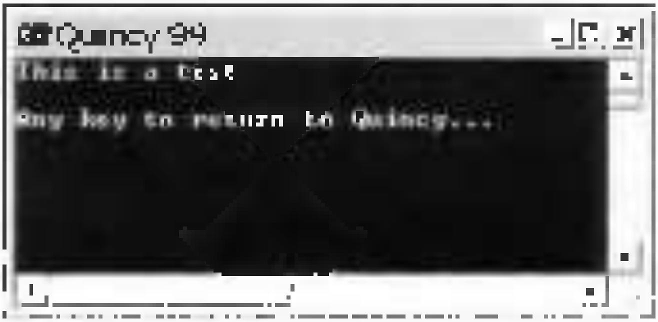
```
This is a test.

Any key to return to Quincy...
```

[illegible]

၁၃.၆ Reading until End-of-File

[illegible] open [illegible] eof( ) member function [illegible] Ex1306.cpp program [illegible] Ex1306.cpp program [illegible] run [illegible] ပုံ(၁၃.၆) [illegible]

```
// Listing 13.6: Testing End-of-file
#include <fstream>

int  main( )
{
        ifstream   outfile("test.txt");

        while (!outfile.eof())
        {
                char  ch;

                outfile.get(ch);
                if (!outfile.eof( ))
                        cout << ch;
        }
        cout << endl;
        return  0;
}
```



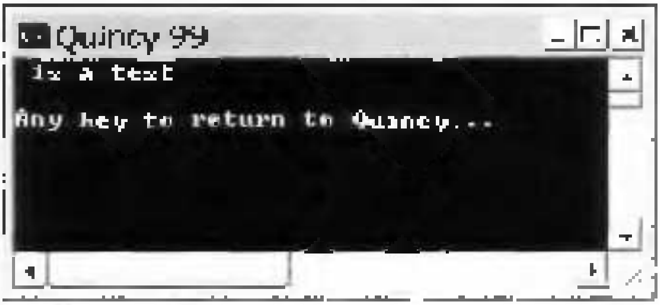
```
This is a test

Any key to return to Quincy...
```

ပုံ(၁၃.၆)

၁၃.၇ The seekg( ) Member Function

ဖိုင်တစ်ခုကို open လုပ်လိုက်ပြီးသော information တွေကို user ကြိုက်သည့်နေရာမှစ၍ ပေါ်စေနိုင်ရန် screen ဆီ display လုပ်နိုင်ရန်အတွက် seekg( ) member function ကိုအသုံးပြုရပါမည်။ Ex1307.cpp program ကိုလေ့လာကြည့်ပါ။ ဒီ program ကို run လိုက်မယ်ဆိုရင် ပုံ (၁၃-၇) မှာပြထားသည့်အတိုင်းတွေ့ရပါမည်။

```
// Listing 13.7: Seeking within a file
#include <fstream>
int main( )
{
        ifstream   outfile("test.txt");
        outfile.seekg(4);
        while  (!outfile.eof())
        {
                char   ch;
                outfile.get(ch);
                if  (!outfile.eof( ))    cout << ch;
        }
        cout << endl;
        return  0;
}
```



```
 is a text

Any key to return to Quincy...
```

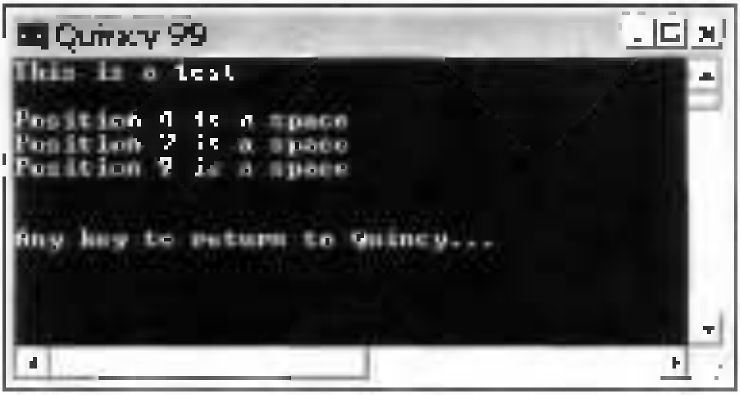
ပုံ (၁၃-၇)

၁၃.၈ The tellg( ) Member Function

[illegible] information [illegible] white space [illegible] tellg( ) member function [illegible] Ex1308.cpp program [illegible]

```
// Listing 14.8: The tellg( ) member function
#include <fstream>

int  main( )
{
        ifstream    f1("test.txt");
        while  (!f1.eof( ))
        {
                char  c1;
                f1.get(c1);
                if (!f1.eof( ));        cout << c1;
        }
        cout << endl << endl;

        ifstream    f2("test.txt");
        while (!f2.eof( ))
        {
                char  c2;
                streampos here = f2.tellg();
                f2.get(c2);
                if (c2 == ' ');
                        cout << "Position " << here << " is a space\n";
        }
        cout << endl;
        return 0;
}
```

[illegible] Ex1308.cpp program [illegible] run [illegible]



```
This is a test

Position 4 is a space
Position 7 is a space
Position 9 is a space


Any key to return to Quincy...
```

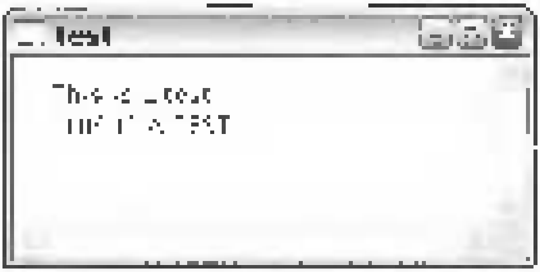
[illegible]

၁၃.၉ Read and Write a Stream File

[illegible] program [illegible] read/ write access [illegible] database [illegible] record [illegible] read/ write access [illegible] program [illegible] ios::openmode argument [illegible] ifstream constructor [illegible] ostream object instance [illegible] declare [illegible] constructor [illegible] ifstream::rdbuf( ) member function [illegible] return value [illegible] initialize [illegible] ostream object [illegible] write [illegible] Ex13009.cpp program [illegible]

```
// Listing 13.9 Reading and writing a stream file
#include <fstream>
#include <cctype>

int main( )
{
        char*   fname = "test.txt";
        // Read the file into an array
        ifstream   infile(fname, ios::in | ios::out | ios::binary);
        ostream  outfile(infile.rdbuf());
        char    ch[100];
        int     i = 0;

        // Write the array from the file
        while (!infile.eof() && i < sizeof ch)
                infile.get(ch[i++]);

        // Write the array to the file
        outfile.seekp(0, ios::end);
        outfile << "\r\n";
        for (int j = 0; j < i-1; j++)
                outfile.put(static_cast<char>(toupper(ch[j])));

        return 0;
}
```

[illegible] Ex1309.cpp program [illegible] test.txt [illegible] fname [illegible] point [illegible] readwrite access [illegible] define [illegible] while (!infile.eof() && i < sizeof ch) infile.get(ch[i++]); statement [illegible] test.txt [illegible] information [illegible] ch[ ] array [illegible] data [illegible] uppercase letter [illegible] test.txt [illegible] information [illegible] updated data [illegible] Ex1309.cpp program [illegible] run [illegible] output [illegible] screen [illegible] test.txt [illegible] information [illegible]



```
This is a test
THIS IS A TEST
```

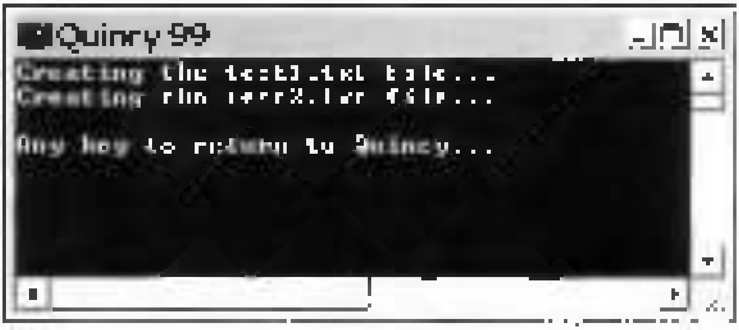
[illegible]

၁၃.၁၀ Opening and Closing a Stream File

၁။ C++ program တစ်ခုမှာ ifstream သို့မဟုတ် ofstream object တွေကို [illegible] declare လုပ်နိုင်ပါတယ်။ ထိုသို့ declare လုပ်ထားရင် object တစ်ခုတည်းနဲ့ [illegible] object [illegible] open( ) member function ကို [illegible] close( ) member function ကိုအသုံးပြုရပါမယ်။ Ex3010.cpp program မှာ outfile လို့ ofstream object တစ်ခုကို declare လုပ်ပြီး test1.txt ၊ test2.txt ဖိုင် (2) ခုနဲ့ တစ်ခုချင်း ဆက်သွယ်ပြီးတော့ အလုပ်လုပ်သွားတာကို [illegible] ။ လေ့လာကြည့်ပါ။

```
// Listing 13.10: The open( ) and close( ) member functions
#include <fstream>
#include <cctype>

int  main( )
{
         // An ofstream object without a file.
        ofstream  outfile;

        cout << "Creating the test1.txt file...\n";
        outfile.open("test1.txt");
        outfile << "This is TEST1";
        outfile.close( );

        cout << "Creating the test2.txt file...\n";
        outfile.open("test2.txt");
        outfile << "This is TEST2";
        outfile.close( );

        return 0;
}
```

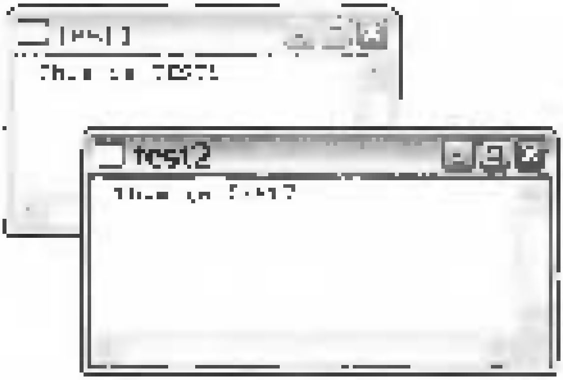
၂။ Ex1310.cpp program [illegible] run [illegible] output [illegible] screen [illegible] prompt [illegible] display [illegible] (ပုံ ၁၃.၁၀) [illegible]



```
Creating the test1.txt file...
Creating the test2.txt file...

Any key to return to Quincy...
```

ပုံ (၁၃.၁၀)

၃။ test1.txt [illegible] test2.txt [illegible] write [illegible] (ပုံ ၁၃.၁၁) [illegible]



```
This is TEST1
```

```
This is TEST2
```

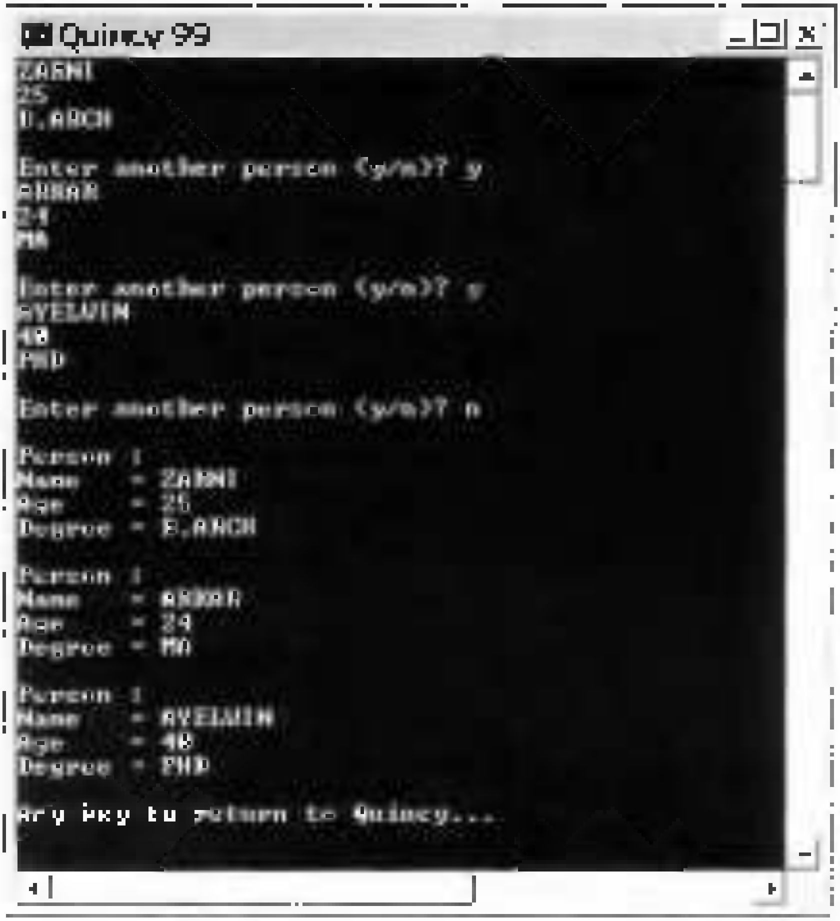
ပုံ (၁၃.၁၁)

၁၃.၁၁ Objects I/O

၁။ [illegible] object [illegible] write [illegible] Ex1311.cpp program [illegible] class history object [illegible] data [illegible] history.dat [illegible] write [illegible] screen [illegible] display [illegible]

```
// Listing 13.11: I/O with multiple objects
#include <fstream>

class  history
{
        char   name[30];
        char   degree[30];
        int    age;
   public:
        void   getData( )
               {
                       cin >> name >> age >> degree;
               }

        void   showData( )
               {
                       cout << "\nName   = " << name   << endl
                            << "Age     = "  << age    << endl
                            << "Degree = "   << degree << endl;
               }
};

int  main( )
{
        char       ch;
        history   person;
        fstream  file;

        file.open("history.dat", ios::app | ios::out | ios::in);
        do {
               person.getData( );
               file.write((char*) &person, sizeof person);
               cout << "\nEnter another person (y/n)? ";
               cin >> ch;
        } while (ch == 'y');

        file.seekg(0);
        file.read((char*) &person, sizeof person);
        while (!file.eof( ))
        {
                cout << "\nPerson : ";
                person.showData( );
                file.read((char*) &person, sizeof person);
        }
        return 0;
    }
```

Ex1311.cpp program [illegible] run [illegible] data [illegible] history.dat [illegible] write [illegible] screen [illegible] echo [illegible]



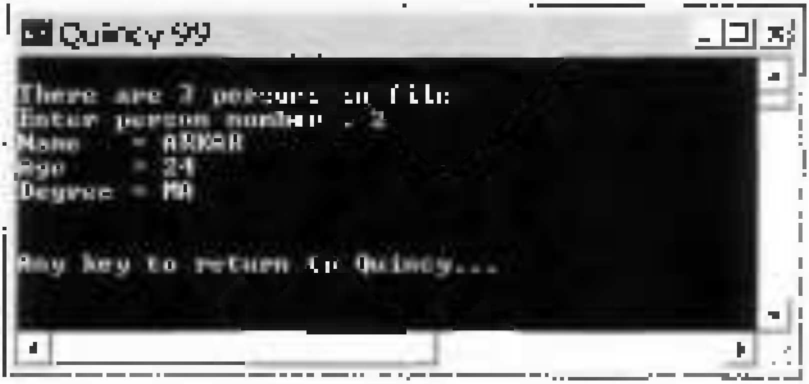
```
ZARNI
25
B.ARCH

Enter another person (y/n)? y
ARKAR
24
MA

Enter another person (y/n)? y
AYELWIN
48
PHD

Enter another person (y/n)? n

Person :
Name   = ZARNI
Age    = 25
Degree = B.ARCH

Person :
Name   = ARKAR
Age    = 24
Degree = MA

Person :
Name   = AYELWIN
Age    = 48
Degree = PHD

Any key to return to Quincy...
```

[illegible]

၇။ Ex3012.cpp program အရဆိုလျှင် history.dat ဖိုင်ထဲတွင်ပါဝင်သော person data များမှ လူနံပါတ်ကို ထည့်ပေးလိုက်လျှင် သိရှိလိုသည့်လူနံပါတ်၏ information တို့ကိုရှာပြီး screen မှာ display လုပ်ပြနိုင်မည်ဖြစ်ပါသည်။

```
// Listing 13.12: Seeking a particular object in a file
#include <fstream>

class   history
{
        char   name[30];
        char   degree[30];
        int     age;

   public:
        void   showData( )
              {
                    cout << "Name    = " << name    << endl
                         << "Age       = " << age      << endl
                         << "Degree  = " << degree  << endl;
              }
};

int  main( )
{
        history   person;
        ifstream infile;

        infile.open("history.dat");
        infile.seekg(0, ios::end);

        int endpos = infile.tellg( );
        int  n = endpos/sizeof (history);

        cout << "\nThere are " << n << " persons in file";
        cout << "\nEnter person number : ";
        cin >> n;
        int pos = (n-1)*sizeof (history);

        infile.seekg(pos);
        infile.read((char*) &person, sizeof person);
        person.showData( );
        cout << endl;

        return 0;
}
```

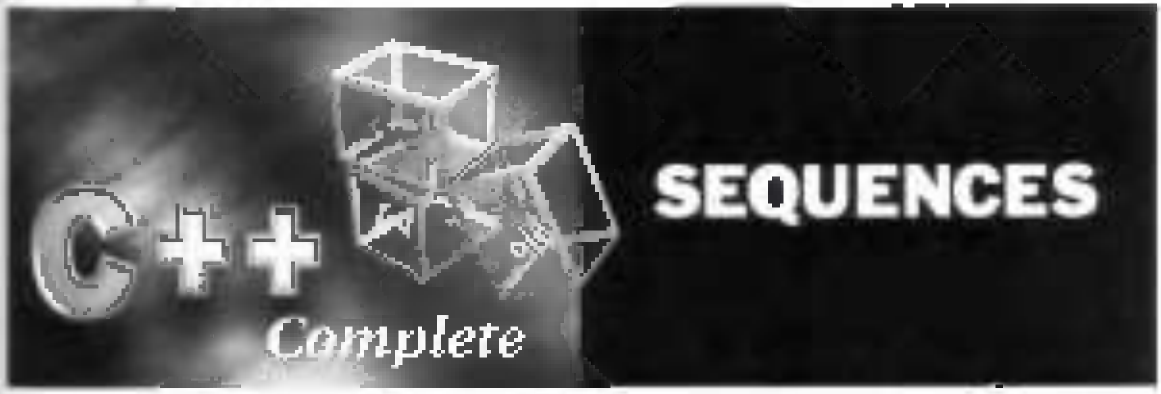
[illegible] Ex1312.cpp program [illegible] run [illegible] person number : 2 [illegible] history.dat [illegible] information [illegible] screen [illegible] display [illegible]



```
There are 3 persons in file
Enter person number : 2
Name   = ARKAR
Age    = 24
Degree = MA


Any key to return to Quincy...
```

[illegible]

Chapter 14



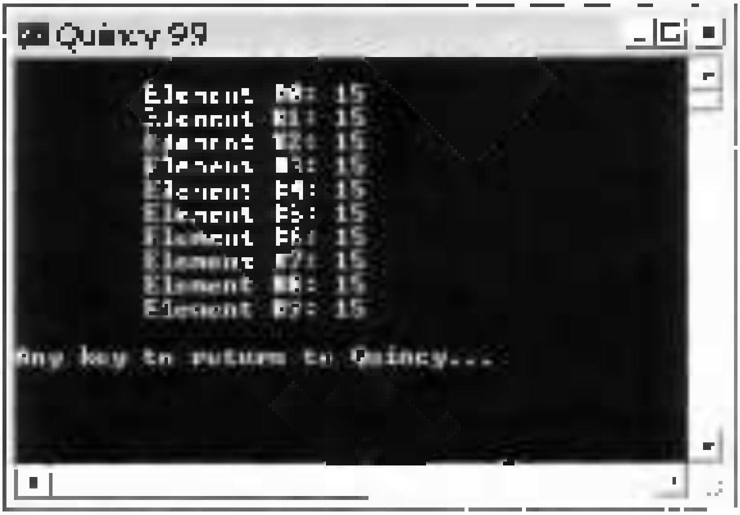
sequence [illegible] Standard Template Library (STL) [illegible] container class template [illegible] object [illegible] linear organization [illegible] store [illegible] array [illegible] name [illegible] sequences [illegible] sequence type [illegible] (၁) vector (၂) deque (၃) list (၄) stack (၅) queue နှင့် (၆) priority_queue type [illegible] (၆) [illegible] vector class type [illegible] sequence [illegible]

၁၄.၁ The vector Class Template

[illegible] vector class template [illegible] array element [illegible] random access [illegible] sequence [illegible] element [illegible] vector [illegible] sequence [illegible] Ex1401.cpp program [illegible] vector object [illegible] create [illegible] content [illegible] screen [illegible] display [illegible] program [illegible]

```
// Listing 14-1: Creating a simple vector
#include <iostream>
#include <vector>

int main( )
{
        // create a 10-element vector object,
        // of which all the elements are initialized to 15
        vector <int> intVec(10, 15);

        // initialize vector element count to zero
        int  kount = 0;

        // iterator object iter points to an element stored in the container
        vector <int>::iterator  iter;

        // display the content of the vector object
        cout << endl;
        for  (iter= intVec.begin( ); iter != intVec.end( ); iter++)
                cout << "\tElement #" << kount++ << ": " << *iter << endl;

        return  0;
}
```

[illegible] Ex1401.cpp program [illegible] 10-element [illegible] intVec [illegible] vector object [illegible] create [illegible] element [illegible] 15 [illegible] initialize [illegible] program [illegible] iterator object [illegible] iter [illegible] vector object [illegible] element [illegible] access [illegible] iterator [illegible] container [illegible] element [illegible] point [illegible] pointer [illegible] for loop [illegible] begin( ) member function [illegible] call [illegible] vector object [illegible] first element [illegible] point [illegible] iterator [illegible] return [illegible] end( ) member function [illegible] call [illegible] vector [illegible] last element [illegible] point [illegible] iterator [illegible] return [illegible] Ex1401.cpp program [illegible] run [illegible] vector element [illegible] 15 [illegible] output [illegible] 15 [illegible]



```
Element #0: 15
Element #1: 15
Element #2: 15
Element #3: 15
Element #4: 15
Element #5: 15
Element #6: 15
Element #7: 15
Element #8: 15
Element #9: 15

Any key to return to Quincy...
```

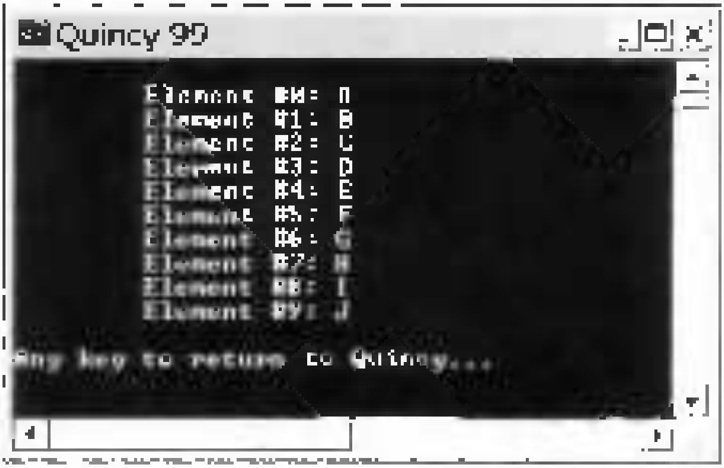
[illegible]

Adding Elements to a Vector

[illegible] Ex1402.cpp program [illegible] empty vector object [illegible] sequence [illegible] new element [illegible] push_back( ) member function [illegible] insert [illegible] program [illegible]

```
// Listing 14.2: Adding elements to a vector
#include <iostream>
#include <vector>

int main( )
{
        // create an empty vector object
        vector<char> charVec;

        // initialize vector element count to zero
        int  count = 0;
        // populate the sequence with the characters 'A' through 'J'
        for (int j=0; j<10; ++j)
                charVec.push_back(65 + j);

        vector<char>::iterator iter;
        cout << endl;

        // display the content of the vector object
        for (iter = charVec.begin( ); iter != charVec.end( ); iter++)
                cout << "\tElement #" << kount++ << ": " << *iter << endl;

        return 0;
}
```

၂။ Ex1402.cpp program ကိုလေ့လာကြည့်မယ်ဆိုရင် ပေးထားတဲ့ charVec ဆိုတဲ့ <char> type vector object တစ်ခုကို create လုပ်ပြီး element တွေကို 'A' ကနေ 'J' အထိ character တွေနဲ့ assign လုပ်ပေးရာမှာ push_back( ) member function ကိုအသုံးပြုပြီး [illegible] data ကို first element [illegible] display လုပ်ပေးတာ [illegible] program ကို run လိုက်မယ်ဆိုရင် ပုံ (၁၄.၂) မှာပြထားသလိုမျိုး vector object ရဲ့ content တွေ [illegible] ကို တွေ့ရမှာဖြစ်ပါတယ်။



```
        Element #0: A
        Element #1: B
        Element #2: C
        Element #3: D
        Element #4: E
        Element #5: F
        Element #6: G
        Element #7: H
        Element #8: I
        Element #9: J

Any key to return to Quincy...
```

ပုံ (၁၄.၂)

Inserting Elements anywhere in a Vector

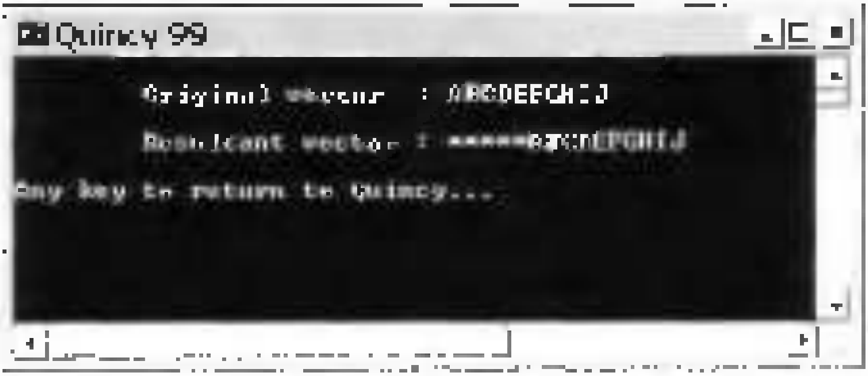
[illegible] insert( ) member function [illegible] vector object [illegible] sequence [illegible] element [illegible] insert [illegible] Ex1403.cpp program [illegible]

```
// Listing 14.3: Inserting elements in a vector
#include <iostream>
#include <vector>

int main( )
{
        // Create and populate the vector
        vector<char> charVec;
        for (int i=0; i<10; i++)   charVec.push_back(65 + i);

        // Display the starting vector
        cout << "\n\tOriginal vector  : ";
        vector<char>::iterator iter;
        for (iter= charVec.begin( ); iter != charVec.end( ); iter++)
                cout << *iter;
        cout << endl << endl;

        // Insert five Xs into the vector starting from the front
        vector<char>::iterator   start = charVec.begin( );
        charVec.insert(start, 5, 'X');

        // Display the result
        cout << "\tResultant vector : ";
        for (iter = charVec.begin( ); iter != charVec.end( ); iter++)
                cout << *iter;
        cout << endl;
        return 0;
}
```

[illegible] Ex1403.cpp program [illegible] insert( ) member function [illegible]

```
vector<char>::iterator   start = charVec.begin( );
charVec.insert(start, 5, '*');
```

original vector [illegible] start = charVec.begin( ); [illegible] asterisk '*' (5) [illegible] start [illegible] insert [illegible] program [illegible] Ex1403.cpp program [illegible] run [illegible] sequence [illegible] asterisk '*' [illegible]



```
        Original vector   : ABCDEFGHIJ
        Resultant vector : *****ABCDEFGHIJ
Any key to return to Quincy...
```

[illegible]

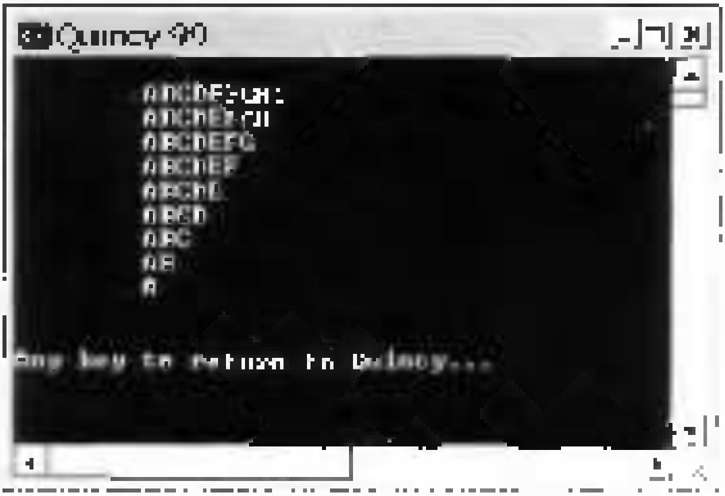
Removing Elements from a Vector

[illegible] Ex1404.cpp program [illegible] ABCDEFGHIJ [illegible] sequence [illegible] element [illegible] program [illegible] pop_back( ) function [illegible]

```
// Listing 14.4  Removing vector elements
#include <iostream>
#include <vector>
```

```
int main( )
{
        vector<char> charVec;
        for (int j=0; j<10; ++j)
                charVec.push_back(65 + j);

        int size = charVec.size( );
        cout << endl;
        for (int k=0; k<size; ++k)
        {
                charVec.pop_back( );
                vector<char>::iterator iter;
                cout << "\t";
                for (iter= charVec.begin( ); iter != charVec.end( ); iter++)
                        cout << *iter;
                cout << endl;
        }
        return 0;
}
```

[illegible] Ex1404.cpp program [illegible] run [illegible]



```
        ABCDEFGHI
        ABCDEFGH
        ABCDEFG
        ABCDEF
        ABCDE
        ABCD
        ABC
        AB
        A

Any key to return to Quincy...
```

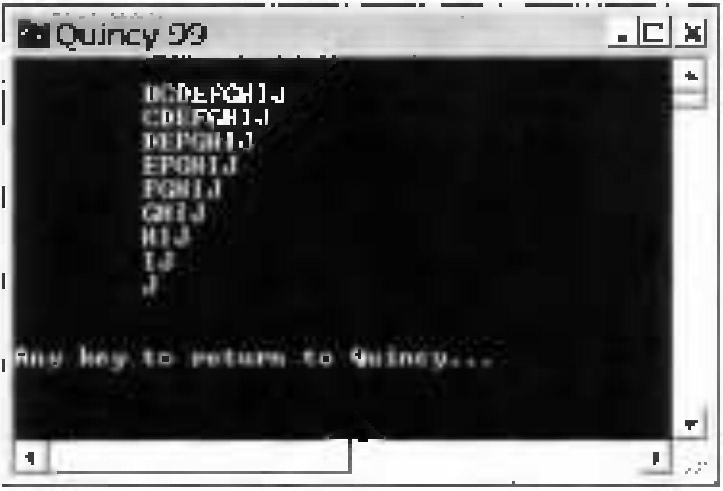
[illegible]

Removing Elements Anywhere within a Vector

၁။ pop_back( ) member function အစားအသုံးပြုနိုင်သော erase( ) member function ဖြင့်ပါ ဘယ်နေရာကမဆို ဖယ်ရှားနိုင်ပါသည်။ Ex1405.cpp program မှာ ABCDEFGHIJ ဆိုတဲ့ sequence ရဲ့ ရှေ့ဆုံးက element တစ်ခုချင်းကို ဖျက်ပေးသွားတဲ့ program ပါ။ erase( ) function အသုံးပြုပုံကို လေ့လာကြည့်ပါ။

```
// Listing 14.5: Removing elements anywhere within a vector
#include <iostream>
#include <vector>

int  main( )
{
        vector<char>  charVec;
        for  (int  x=0; x<10; ++x)
                charVec.push_back(65 + x);
        int   size = charVec.size( );

        cout << endl;
        for  (int  x=0; x<size; ++x)
        {
                vector<char>::iterator   start = charVec.begin( );
                charVec.erase(start);           // erase forward
                vector<char>::iterator iter;

                cout << "\t";
                for  (iter= charVec.begin( ); iter != charVec.end( ); iter++)
                        cout << *iter;
                cout << endl;
        }

        return  0;
}
```

၂။ ပုံ (၁၄-၅) မှာ Ex1405.cpp program ကို run ပြထားပါတယ်။



```
BCDEFGHIJ
CDEFGHIJ
DEFGHIJ
EFGHIJ
FGHIJ
GHIJ
HIJ
IJ
J

Any key to return to Quincy...
```

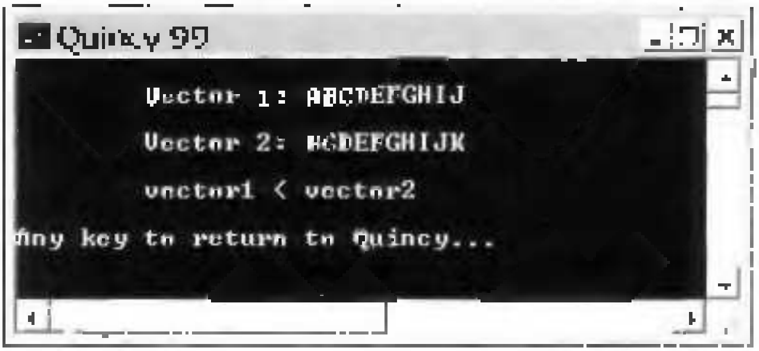
ပုံ (၁၄-၅)

Comparing Vectors

၁။ အောက်မှာဖော်ပြထားတဲ့ Ex1406.cpp program ကတော့ <char> vector object (2) ခုရဲ့ အလိုက်ဘယ်ဟာကြီးလဲဆိုတာကို နှိုင်းယှဉ်နိုင်းတဲ့ program ဖြစ်ပါတယ်။ လေ့လာကြည့်ပါ။

```
// Listing 14.6: Comparing vectors
#include <iostream>
#include <vector>

int main( )
{
        // Create two vector objects
        vector<char> charVec1;
        for (int x=0; x<10; ++x)
                charVec1.push_back(65 + x);
        vector<char> charVec2;
        for (int x=0; x<10; ++x)
                charVec2.push_back(66 + x);
        // Display the vectors.
        cout << "\n\tVector 1: ";
        vector<char>::iterator iter;
        for (iter= charVec1.begin( ); iter != charVec1.end( ); iter++)
                cout << *iter;
        cout << endl;
        cout << "\n\tVector 2: ";
        for (iter= charVec2.begin( ); iter != charVec2.end( ); iter++)
                cout << *iter;
        cout << endl;

        // Compare the vectors.
        if (charVec1 == charVec2)
                cout << "\n\tvector1 == vector2";
        else if (charVec1 < charVec2)
                cout << "\n\tvector1 < vector2";
        else
                cout << "\n\tvector1 > vector2";
        cout << endl;
        return 0;
}
```

၂။ ပုံ (၁၄. ၆) မှာ Ex1406.cpp program ကို run ပြထားပါတယ်။



```
        Vector 1: ABCDEFGHIJ

        Vector 2: BCDEFGHIJK

        vector1 < vector2

Any key to return to Quincy...
```

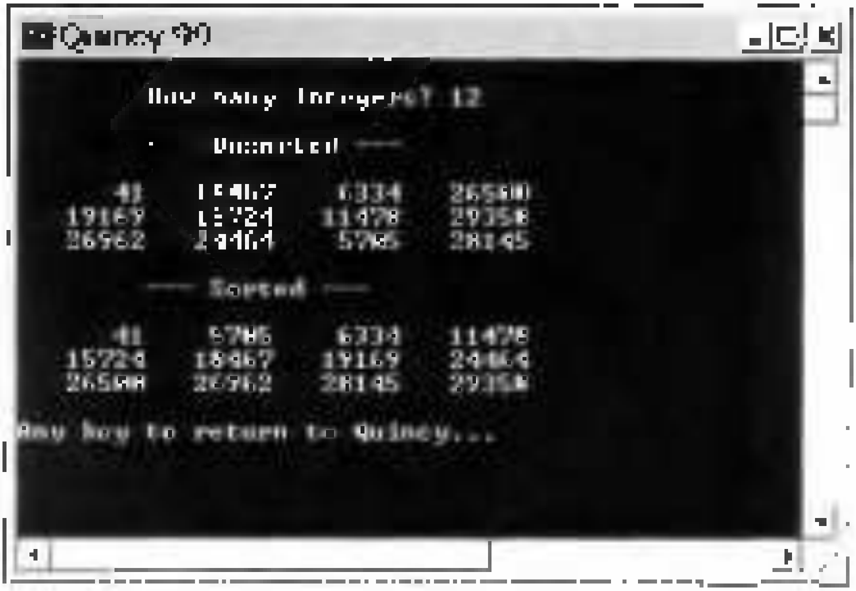
ပုံ (၁၄. ၆)

၁၄.၇ Sorting a Vector of Integers

[illegible] Ex1407.cpp program [illegible] rand( ) function [illegible] generate [illegible] int [illegible] vector sequence [illegible] sort [illegible] program [illegible] sort( ) function [illegible]

```
// Listing 14.7: Sorting a vector of integers
#include <iostream>
#include <iomanip>
#include <vector>
#include <algorithm>

int main( )
{
        int   n;
        int   i;
        cout << "\n\tHow many integers? ";
        cin >> n;

        vector<int> intVec;

        for  (i=0; i < n; i++)
                intVec.insert( intVec.end( ), rand( ));

        cout << "\n\t--- Unsorted ---\n";
        vector<int>::iterator iter;
        int  k=0;

        for  (iter = intVec.begin( ); iter != intVec.end( ); iter++)
        {
                if ((k%4) == 0)   cout << endl;
                k++;
                cout << setw(8) << *iter;
        }
        cout << "\n\n\t--- Sorted ---\n";
        sort(intVec.begin( ), intVec.end( ));

        for (iter = intVec.begin( ); iter != intVec.end( ); iter++)
        {
                if ((k%4) == 0) cout << endl;
                k++;
                cout << setw(8) << *iter;
        }

        cout << endl;
        return 0;
}
```

[illegible] Pr[illegible].cpp program [illegible] run [illegible] How many integers? [illegible] prompt [illegible] 12 [illegible] (12) [illegible] random generate [illegible]



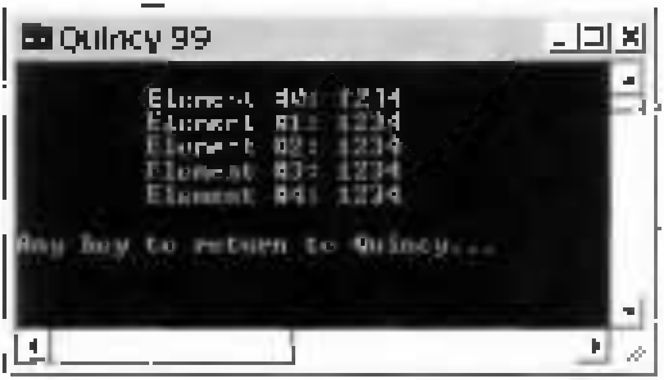
```
        How many integers? 12

        --- Unsorted ---

      41   18467    6334   26500
   19169   15724   11478   29358
   26962   24464    5705   28145

        --- Sorted ---

      41    5705    6334   11478
   15724   18467   19169   24464
   26500   26962   28145   29358
Any key to return to Quincy...
```

[illegible]

၁၄.၃ The deque Class Template

[illegible] deque class template [illegible] vector [illegible] deque sequence [illegible] element [illegible] vector [illegible] array element [illegible] random access [illegible] vector [illegible] array size [illegible] dynamically resize [illegible] 5x1408.cpp program [illegible] deque object [illegible] create [illegible] content [illegible] screen [illegible] display [illegible] program output [illegible] program [illegible] run [illegible]

```
// Listing 14.9  Creating a simple deque
#include <iostream>
#include <deque>

int main( )
{
        deque<int> intDeq(5, 1234);
        int  kount = 0;
        deque<int>::iterator iter;
        cout << endl;
        for (iter = intDeq.begin( ); iter != intDeq.end( ); iter++)
                cout << "\tElement #" << kount++ << ": "
                        << *iter << endl;
        return 0;
}
```



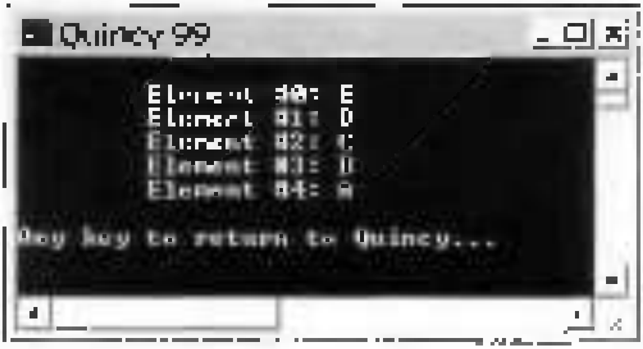
```
        Element #0: 1234
        Element #1: 1234
        Element #2: 1234
        Element #3: 1234
        Element #4: 1234

Any key to return to Quincy...
```

[illegible]

Adding Elements to a Deque

[illegible] Ex1409.cpp program [illegible] empty deque object [illegible] sequence [illegible] new element [illegible] push_front( ) member function [illegible] data [illegible] last element [illegible] insert [illegible] program [illegible] Ex1409.cpp program [illegible] run [illegible]

```
// Listing 14.9: Adding elements to a deque
#include <iostream>
#include <deque>

int main( )
{
        deque<char> charDeq;
        int kount = 0;
        for (int i=0; i<5; ++i)
                charDeq.push_front('A' + i);

        deque<char>::iterator iter;
        cout << endl;
        for (iter= charDeq.begin( ); iter != charDeq.end( ); iter++)
                cout << "\tElement #" << kount++ << ": "
                     << *iter << endl;
        return 0;
}
```



```
        Element #0: E
        Element #1: D
        Element #2: C
        Element #3: B
        Element #4: A

Any key to return to Quincy...
```

[illegible]

Inserting Elements anywhere in a Deque

[illegible] insert( ) member function [illegible] deque object [illegible] sequence [illegible] element [illegible] insert [illegible] Ex1410.cpp program [illegible]

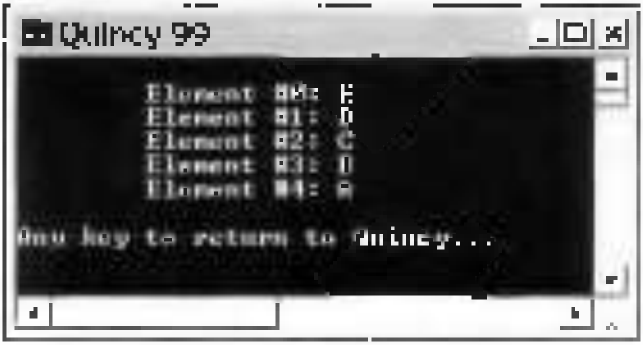
```
// Listing 14.10 Inserting elements anywhere within a deque
#include <iostream>
#include <deque>

int main( )
{
        deque<char> charDeq;
        for (int x=0; x<10; ++x)
                charDeq.push_front(65 + x);

        cout << "\n\tOriginal deque : ";
        deque<char>::iterator iter;
        for (iter= charDeq.begin( ); iter != charDeq.end( ); iter++)
                cout << *iter;
        cout << endl;

        deque<char>::iterator start = charDeq.begin( );
        charDeq.insert(start, 5, '$');

        cout << "\n\tResultant deque: ";
        for (iter= charDeq.begin( ); iter != charDeq.end( ); iter++)
                cout << *iter;

        cout << endl;
        return 0;
}
```

Ex1410.cpp program [illegible] run [illegible]

Adding Elements to a Deque

[illegible] Ex1409.cpp program [illegible] empty deque object [illegible] sequence [illegible] new element [illegible] push_front( ) member function [illegible] data [illegible] last element [illegible] insert [illegible] program [illegible] Ex1409.cpp program [illegible] run [illegible]

```
// Listing 14.9: Adding elements to a deque
#include <iostream>
#include <deque>

int main( )
{
        deque<char> charDeq;
        int  kount= 0;
        for  (int i=0; i<5; ++i)
                charDeq.push_front(65 + i);

        Deque<char>::iterator iter;
        cout << endl;
        for (iter= charDeq.begin( ); iter != charDeq.end( ); iter++)
                cout << "\tElement #" << kount++ << ": "
                     << *iter << endl;
        return  0;
}
```



```
        Element #0: E
        Element #1: D
        Element #2: C
        Element #3: B
        Element #4: A

Any key to return to Quincy...
```

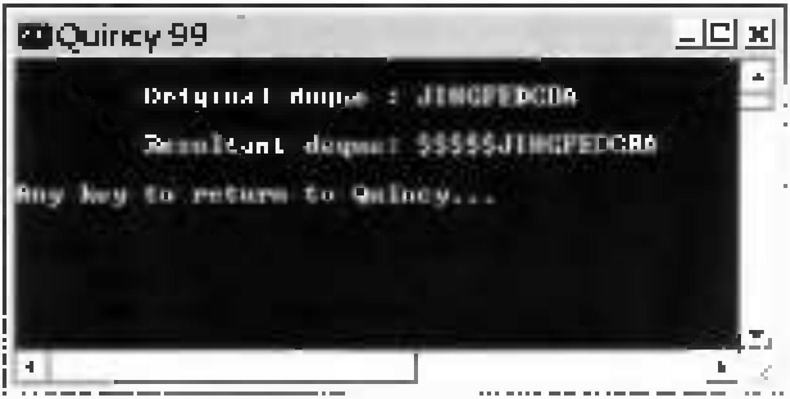
[illegible]

Inserting Elements anywhere in a Deque

[illegible] insert( ) member function [illegible] deque object [illegible] sequence [illegible] element [illegible] insert [illegible] Ex1410.cpp program [illegible]

```
// Listing 14.10: Inserting elements anywhere within a deque
#include <iostream>
#include <deque>

int main( )
{
        deque<char> charDeq;
        for (int x=0; x<10; ++x)
                charDeq.push_front(55 + x);

        cout << "\n\nOriginal deque: ";
        deque<char>::iterator iter;
        for (iter= charDeq.begin( ); iter != charDeq.end( ); iter++)
                cout << *iter;
        cout << endl;

        deque<char>::iterator start = charDeq.begin( );
        charDeq.insert(start, 5, '$');

        cout << "\n\nResultant deque: ";
        for (iter= charDeq.begin( ); iter != charDeq.end( ); iter++)
                cout << *iter;

        cout << endl;
        return 0;
}
```

Ex1410.cpp program [illegible] run [illegible]



```
        Original deque : JIHGFEDCBA
        Resultant deque: $$$$$JIHGFEDCBA
Any key to return to Quincy...
```

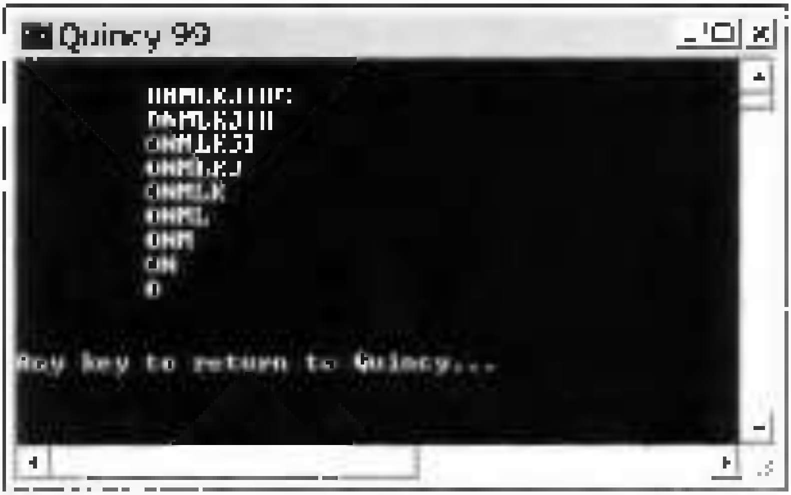
[illegible]

Removing Elements from a Deque

[illegible] Ex14-11.cpp program [illegible] ONMLKJIHG [illegible] sequence [illegible] element [illegible] push_front( ) function [illegible] create [illegible] element [illegible] program [illegible] pop_back( ) function [illegible]

```
// Listing 14.11: Removing elements from a deque
#include <iostream>
#include <deque>

int main( )
{
        deque<char> charDeq;
        for (int x=0; x<10; ++x)
                charDeq.push_front(65 + x);

        int size = charDeq.size( );
        cout << endl;
        for (int x=0; x<size; ++x)
        {
                charDeq.pop_back( );
                cout << '\t';
                deque<char>::iterator iter;
                for (iter= charDeq.begin(); iter != charDeq.end(); iter++)
                        cout << *iter;
                cout << endl;
        }
        return 0;
}
```

Ex14.11.cpp program [illegible] run [illegible]



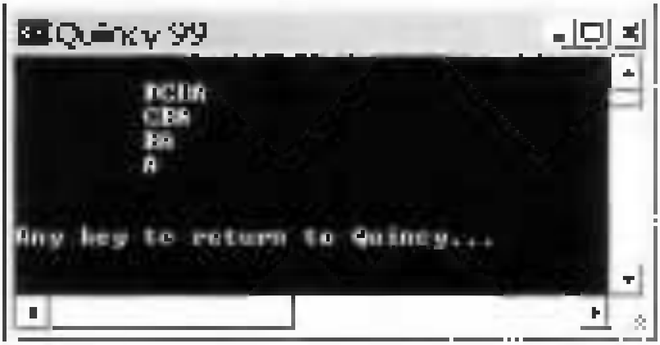
```
	ONMLKJIHG
	ONMLKJIH
	ONMLKJI
	ONMLKJ
	ONMLK
	ONML
	ONM
	ON
	O

Any key to return to Quincy...
```

[illegible]

Removing Elements Anywhere within a Deque

push_front( ) [illegible] erase( ) member function [illegible] deque object [illegible] create [illegible] element [illegible] Ex14.12.cpp program [illegible] program [illegible] run [illegible]

```
// Listing 14.12: Removing elements anywhere within a deque
#include <iostream>
#include <deque>

int main( )
{
        deque<char> charDeq;

        for (int x=0; x<5; ++x)
                charDeq.push_front(65 + x);

        int size = charDeq.size( );
        cout << endl;
        for (int x=0; x<size; ++x)
        {
                deque<char>::iterator start = charDeq.begin( );
                charDeq.erase(start);

                cout << "\t";
                deque<char>::iterator iter;
                for (iter = charDeq.begin( ); iter != charDeq.end( ); iter++)
                        cout << *iter;
                cout << endl;
        }
        return 0;
}
```



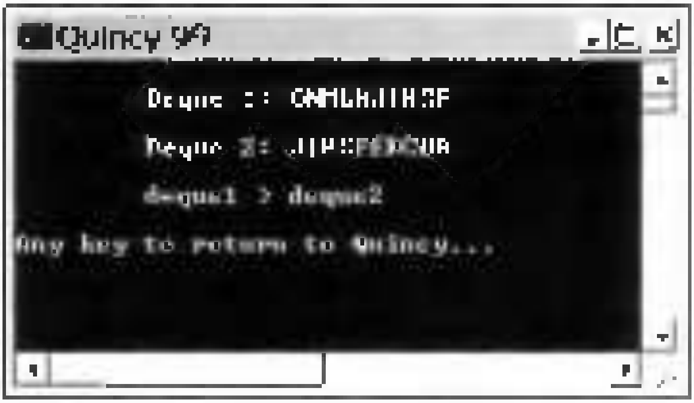
```
        DCBA
        CBA
        BA
        A

Any key to return to Quincy...
```

[illegible]

Comparing Deques

[illegible] Ex14-13.cpp program [illegible] <char> vector object (2) [illegible] program [illegible] run [illegible]

```
// Listing 14.13. Comparing deques
#include <iostream>
#include <deque>

int main( )
{
        deque<char> charDeq1;
        for (int x=0; x<10; x++)     charDeq1.push_front(70 + x);

        deque<char> charDeq2;
        for (int x=0; x<10; x++)     charDeq2.push_front(65 + x);

        cout << "\n\tDeque 1: ";
        deque<char>::iterator iter;
        for (iter= charDeq1.begin( ); iter != charDeq1.end( ); iter++)
                cout << *iter;
        cout << endl;
        cout << "\n\tDeque 2: ";
        for (iter = charDeq2.begin( ); iter != charDeq2.end( ); iter++)
                cout << *iter;
        cout << endl;

        if (charDeq1 == charDeq2)
                cout << "\n\tdeque1 == deque2";
        else if (charDeq1 < charDeq2)
                cout << "\n\tdeque1 < deque2";
        else if (charDeq1 > charDeq2)
                cout << "\n\tdeque1 > deque2";
        cout << endl;
        return 0;
}
```



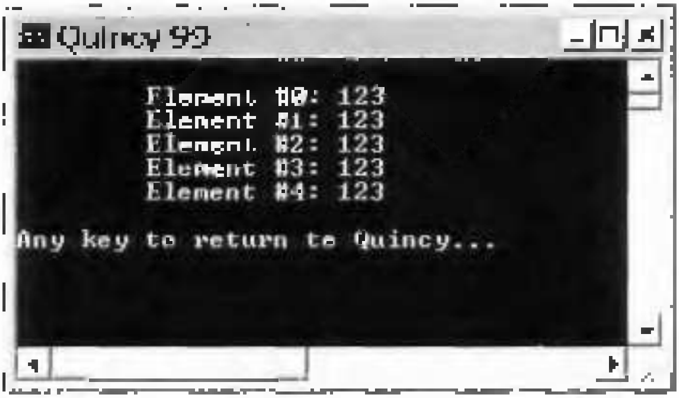
```
        Deque 1: ONMLKJIHGF

        Deque 2: JIHGFEDCBA

        deque1 > deque2

Any key to return to Quincy...
```

ပုံ (၁၄.၁၃)

၁၄.၄ The list Class Template

[illegible] Ex1414.cpp program [illegible] rand( ) function [illegible] generate [illegible] <int> list sequence [illegible] sort [illegible] program [illegible] sort( ) function [illegible] program [illegible]

```
// Listing 14.14: Creating a single list
#include <iostream>
#include <list>

int main( )
{
        list<int> intList(5, 123);
        int count = 0;
        list<int>::iterator iter;
        cout << endl;
        for (iter = intList.begin(); iter != intList.end(); iter++)
                cout << "\tElement #" << count++ << ": "
                        << *iter << endl;
        return 0;
}
```



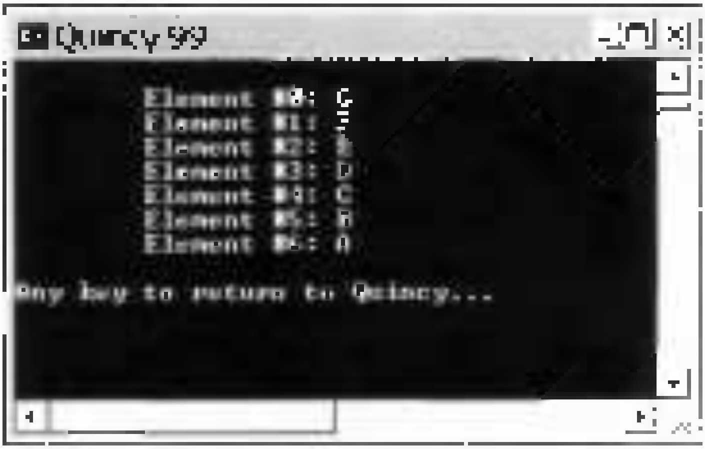
```
        Element #0: 123
        Element #1: 123
        Element #2: 123
        Element #3: 123
        Element #4: 123

Any key to return to Quincy...
```

ပုံ (၁၄. ၁၄)

Adding Elements to a List

အောက်ပါဥပမာပြထားသည့် Ex1415.cpp program ဟာ empty list object တစ်ခုရဲ့ sequence မှာ new element တွေကို push_front( ) member function အသုံးပြုပြီး insert လုပ်ထားသည့် program တစ်ခုဖြစ်ပါတယ်။ လေ့လာကြည့်ပြီးပါက ပုံ (၁၄. ၁၅) မှာ program ရဲ့ run ပုံကြည့်ပါ။

```
// Listing 14.15: Adding elements to a list
#include <iostream>
#include <list>

int main( )
{
        list<char> charList;
        int  kount = 0;

        for (int i=0; i<7; ++i)       charList.push_front(65 + i);
        list<char>::iterator iter;
        cout << endl;
        for (iter = charList.begin( ); iter != charList.end( ); iter++)
                cout << "\tElement #" << kount++ << ": " << *iter << endl;
        return 0;
}
```



```
        Element #0: G
        Element #1: F
        Element #2: E
        Element #3: D
        Element #4: C
        Element #5: B
        Element #6: A

Any key to return to Quincy...
```

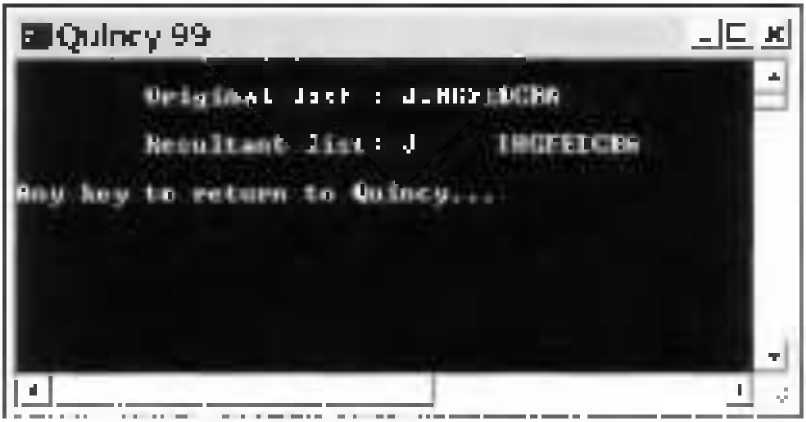
[illegible]

Inserting Elements anywhere in a List

[illegible] insert( ) member function [illegible] list object [illegible] sequence [illegible] blank element [illegible] insert [illegible] Ex1416.cpp program [illegible]

```
// Listing 14.16: Inserting elements anywhere within a list
#include <iostream>
#include <list>

int main( )
{
        list<char> charList;
        for (int x=0; x<10; ++x)
                charList.push_front(65 + x);

        cout << "\n\nOriginal list: ";
        list<char>::iterator iter;
        for (iter = charList.begin( ); iter != charList.end( ); iter++)
                cout << *iter;
        cout << endl;

        list<char>::iterator  start = charList.begin();
        charList.insert( ++start, 5, ' ' );

        cout << "\n\tResultant list: ";
        for (iter= charList.begin( ); iter != charList.end( ); iter++)
                cout << *iter;
        cout << endl;
        return 0;
}
```

ပုံ (၁၄.၁၆) မှာ Ex1416.cpp program [illegible]



```
        Original list : JIHGFEDCBA

        Resultant list: J     IHGFEDCBA
Any key to return to Quincy...
```

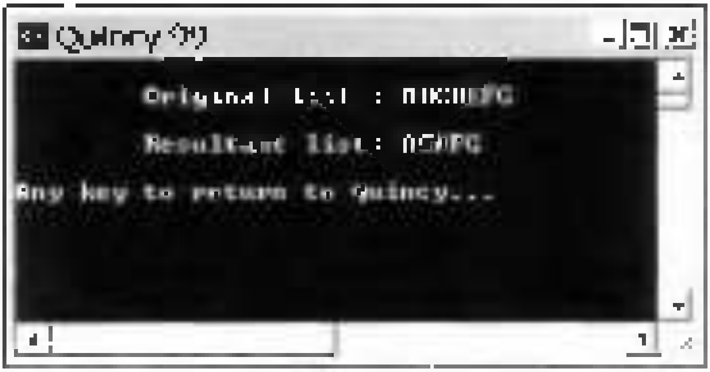
ပုံ (၁၄.၁၆)

Removing Elements from a List

Ex1417.cpp program [illegible] ABCDEFG [illegible] sequence [illegible] elements 'E' [illegible] 'B' [illegible] program [illegible] push_back( ) function [illegible] remove( ) function [illegible]

```
// Listing 14.17: Removing elements from a list
#include <iostream>
#include <list>

int main( )
{
        list<char> charList;
        for (int x=0; x<7; ++x)
                charList.push_back(65 + x);

        cout << "\n\tOriginal list : ";
        list<char>::iterator iter;
        for (iter= charList.begin( ); iter != charList.end( ); iter++)
                cout << *iter;
        cout << endl;

        charList.remove('E');
        charList.remove('B');
        cout << "\n\tResultant list: ";
        for (iter= charList.begin( ); iter != charList.end( ); iter++)
                cout << *iter;
        cout << endl;
        return 0;
}
```

[illegible] Ex1417.cpp program [illegible] run [illegible]



```
        Original list  : ABCDEFG

        Resultant list: ACDFG
Any key to return to Quincy...
```

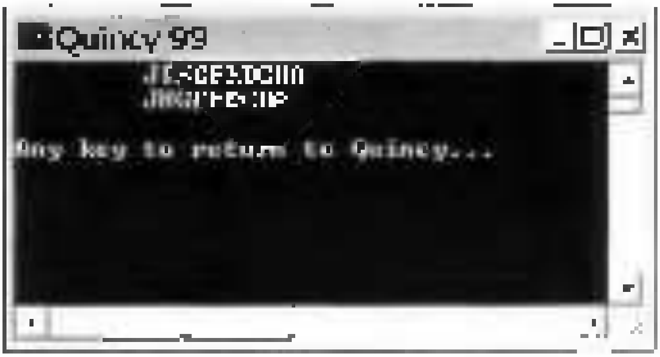
[illegible]

Removing Elements Anywhere within a List

➤ အောက်ဖော်ပြပါ Ex1418.cpp program မှာ JIHGFEDCBA ဆိုတဲ့ sequence ထဲက element 'I' ကိုဖျက်ထားတဲ့ program ဖြစ်ပါတယ်။ erase( ) function အသုံးပြုပုံကို လေ့လာကြည့်ပါ။

```
// Listing 14.18: Removing elements anywhere within a list
#include <iostream>
#include <list>

int main( )
{
        list<char> charList;

        for (int x=0; x<10; ++x)
                charList.push_front(65 + x);

        list<char>::iterator iter;
        cout << '\t';
        for (iter= charList.begin( ); iter != charList.end( ); iter++)
                cout << *iter;
        cout << endl;

        list<char>::iterator  start = charList.begin();
        charList.erase(++start);
        cout << '\t';
        for (iter= charList.begin( ); iter != charList.end( ); iter++)
                cout << *iter;

        cout << endl;
        return 0;
}
```

➤ Ex1418.cpp program ကို run လိုက်မယ်ဆိုရင် ပုံ (၁၄.၁၈) မှာပြထားသလိုမြင်ရမှာ ဖြစ်ပါတယ်။



```
        JIHGFEDCBA
        JIHGFEDCB

Any key to return to Quincy...
```

[illegible]

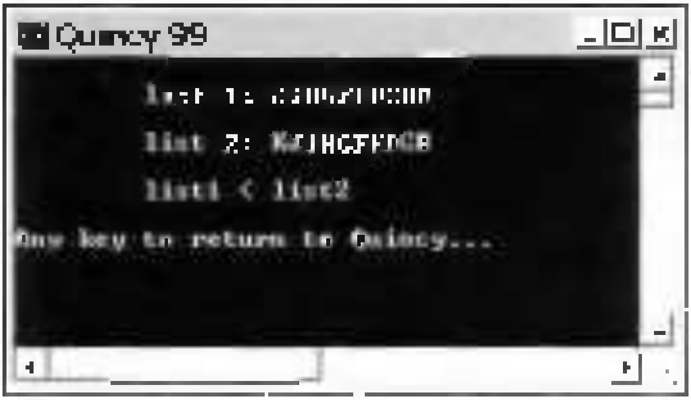
Comparing Lists

[illegible] Ex1419.cpp program [illegible] <char> list object (2) [illegible]

```
// Listing 14.19: Comparing lists
#include <iostream>
#include <list>

int main( )
{
	list<char> charList1;

	for (int x=0; x<10; ++x)
		charList1.push_front(65 + x);

	list<char> charList2;
	for (int x=0; x<10; ++x)
		charList2.push_front(66 + x);

	cout << "\nList 1: ";
	list<char>::iterator iter;
```

```
        for  (iter= charList1.begin( ); iter != charList1.end( ); iter++)
                cout << *iter;
        cout << endl;

        cout << "\n\tlist 2: ";
        for  (iter = charList2.begin( ); iter != charList2.end( ); iter++)
                cout << *iter;
        cout << endl;

        if  (charList1 == charList2)
                cout << "\n\tlist1 == list2";
        else if (charList1 < charList2)
                cout << "\n\tlist1 < list2";
        else if (charList1 > charList2)
                cout << "\n\tlist1 > list2";

        cout << endl;
        return  0;
}
```

၂။ Ex1409.cpp program ကို run လိုက်မယ်ဆိုရင် ပုံ (၁၄.၁၉) မှာပြထားသည့်အတိုင်း မြင်ရမှာပါ။



```
        list 1: [illegible]
        list 2: KJIHGFEDCB
        list1 < list2
Any key to return to Quincy...
```

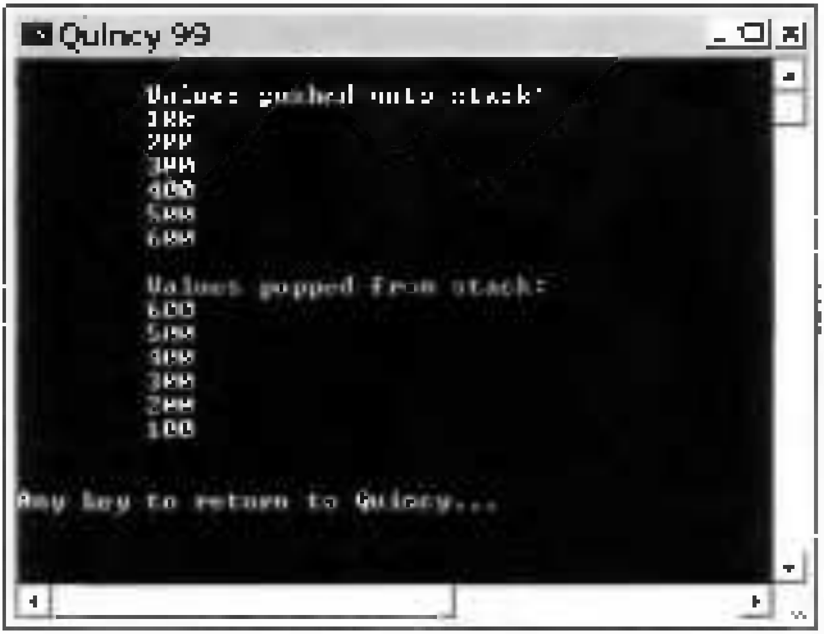
ပုံ (၁၄.၁၉)

၁၄.၅ The stack Container Adaptor

[illegible] Ex1420.cpp program [illegible] push( ) နှင့် pop( ) function [illegible] stack sequence [illegible] program [illegible]

```
// Listing 14.20. Managing a stack
#include <iostream>
#include <list>
#include <stack>

int main( )
{
        stack<int, list<int> > intStack;

        cout << "\n\tValues pushed onto stack:\n";
        for (int x=1; x<7; ++x)
        {
                intStack.push(x*100);
                cout << "\t" << x*100 << endl;
        }

        cout << "\n\tValues popped from stack:\n";
        int size = intStack.size( );
        for (int x=0; x<size; ++x)
        {
                cout << "\t" << intStack.top( ) << endl;
                intStack.pop();
        }
        cout << endl;
        return 0;
}
```

[illegible] Ex1420.cpp program ကို run [illegible]



```
        Values pushed onto stack:
        100
        200
        300
        400
        500
        600

        Values popped from stack:
        600
        500
        400
        300
        200
        100


Any key to return to Quincy...
```

[illegible]

Sorting a Stack of Integers

[illegible] Ex14-21.cpp program [illegible] random generate [illegible] stack sequence [illegible] sort [illegible] program [illegible] push( ) & pop( ) function [illegible]

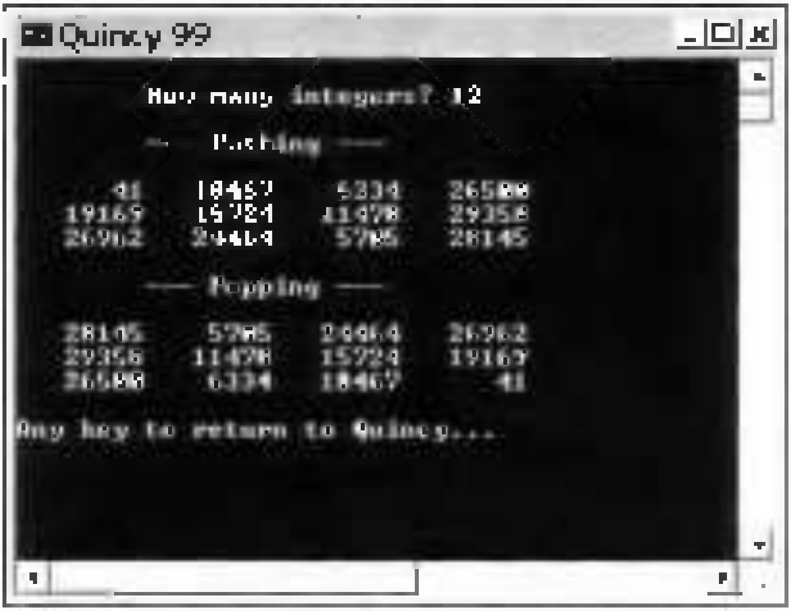
```
// Listing 14.21: Stacking an array of integers
#include <iostream>
#include <iomanip>
#include <stack>

int  main( )
{
        int  n;
```

```
    cout << "\n\tHow many integers? ";
    cin >> n;
    stack<int> intStk;                    // a stack of integers

    cout << "\n\t--- Pushing ---\n";      // push values onto the stack
    for (int i= 0; i < n; i++)
    {
        if ((i%4) == 0)
            cout << endl;
        int rn = rand( );
        cout << setw(8) << rn;
        intStk.push(rn);
    }

    cout << "\n\n\t--- Popping ---\n";
    for (int j = 0; !intStk.empty( );j++)
    {
        if ((j%4) == 0)
            cout << endl;
        cout << setw(8) << intStk.top( );
        intStk.pop( );
    }
    cout << endl;
    return 0;
}
```

၂။ ပုံ (၁၄.၂၁) မှာ Ex1421.cpp program ကို run ပြထားပါတယ်။

၁၄.၆ The queue Container Adaptor

၁။ အောက်မှာဖော်ပြထားတဲ့ Ex1422.cpp program က push( ) function ကိုသုံးပြီး generate လုပ်ထားတဲ့ queue sequence က ဘယ်လိုပေးလဲဆိုတာကို pop( ) function နဲ့ remove လုပ်ပြထားပါတယ်။



```
        How many integers? 12

        —— Pushing ——

     41    18467     6334    26500
  19169    15724    11478    29358
  26962    24464     5705    28145

        —— Popping ——

  28145     5705    24464    26962
  29358    11478    15724    19169
  26500     6334    18467       41

Any key to return to Quincy...
```

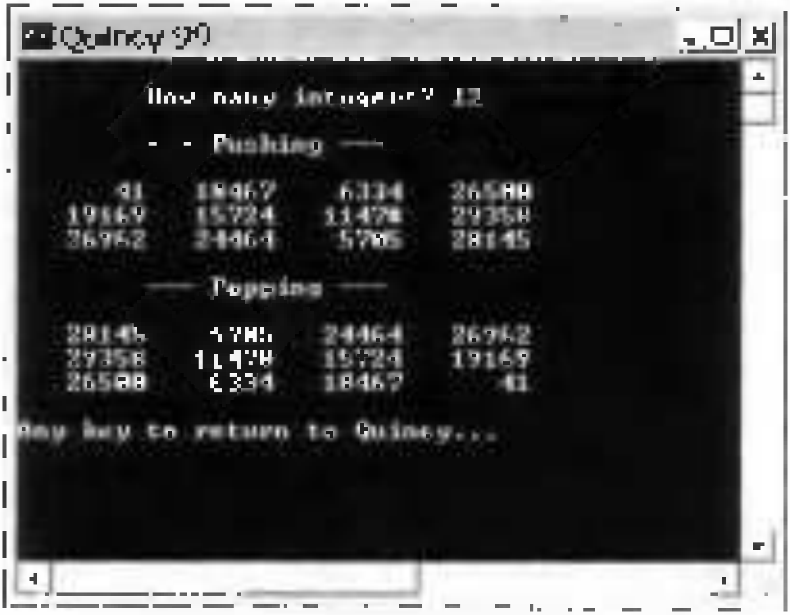
[illegible]

```
// Listing 14.22  Managing a que
#include <iostream>
#include <list>
#include <queue>

int  main( )
{
        queue<int, list<int> > intQue;

        cout << "\nValues pushed onto queue:\n";
        for (int  x=1; x<7; ++x)
        {
                intQue.push(x*100);
                cout << "\t" << x*100 << endl;
        }

        cout << "\n\nValues removed from queue:\n";
        int  size = intQue.size( );
        cout << "\n\tHow many integers? ";
        cin >> n;
        stack<int> intStk;                        // a stack of integers

        cout << "\n\t--- Pushing ---\n";         // push values onto the stack
        for (int i= 0; i < n; i++)
        {
                if ((i%4) == 0)
                        cout << endl;
                int  rn = rand( );
                cout << setw(8) << rn;
                intStk.push(rn);
        }

        cout << "\n\n\t--- Popping ---\n";
        for (int j=0; !intStk.empty( );j++)
        {
                if ((j%4) == 0)
                        cout << endl;
                cout << setw(8) << intStk.top( );
                intStk.pop( );
        }
        cout << endl;
        return 0;
}
```

၂ ပုံ (၁၄-၂၃) မှာ Ex1421.cpp program ကို run ပြထားပါတယ်။

၁၄.၆ The queue Container Adaptor

၁ အောက်မှာဖော်ပြထားတဲ့ Ex1422.cpp program ဟာ push( ) function ကိုသုံးပြီး generate လုပ်ထားတဲ့ queue sequence ထဲက တန်ဖိုးတွေကို pop( ) function နဲ့ remove လုပ်တာကိုပြထားပါတယ်။



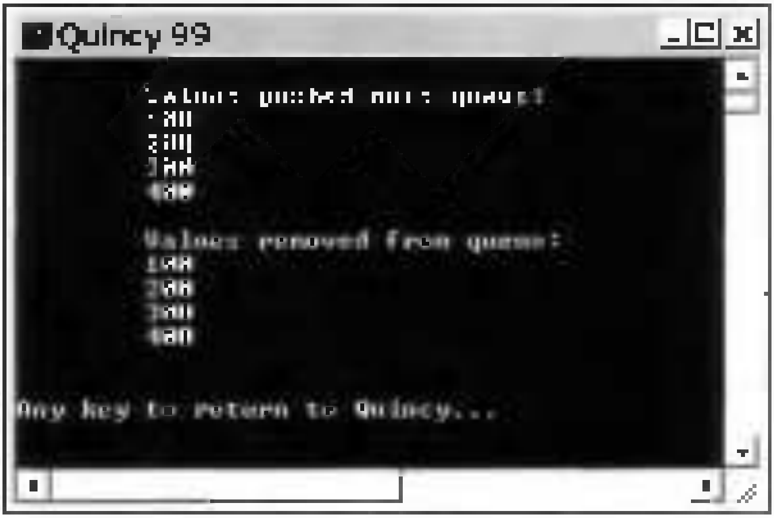
```
        How many integers? 12

        - - Pushing ---

      41    18467     6334    26500
   19169    15724    11478    29358
   26962    24464     5705    28145

        --- Popping ---

   28145     5705    24464    26962
   29358    11478    15724    19169
   26500     6334    18467       41

Any key to return to Quincy...
```

[illegible]

```
// Listing 14.22: Managing a que
#include <iostream>
#include <list>
#include <queue>

int main( )
{
	queue<int, list<int> > intQue;

	cout << "\n\nValues pushed onto queue:\n";
	for (int x=1; x<7; x++)
	{
		intQue.push(x*100);
		cout << '\t' << x*100 << endl;
	}

	cout << "\n\nValues removed from queue:\n";
	int size = intQue.size( );
```

```
        for (int x=0; x<size; ++x)
        {
                cout << "\t" << intQue.front( ) << endl;
                intQue.pop( );
        }
        cout << endl;
        return 0;
}
```

[illegible] Ex1422.cpp program [illegible] run [illegible]



```
        Values pushed onto queue:
        100
        200
        300
        400

        Values removed from queue:
        100
        200
        300
        400

Any key to return to Quincy...
```

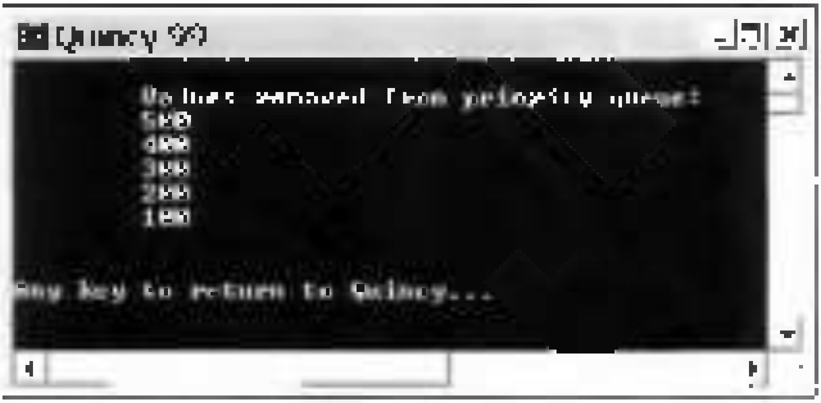
[illegible]

၁၄.၇ The priority_queue Container Adaptor

[illegible] Ex1423.cpp program [illegible] queue sequence [illegible] random add [illegible] remove [illegible] program [illegible]

```
// Listing 14.23: Managing a priority_queue
#include <iostream>
#include <list>
#include <queue>

int main( )
{
        priority_queue<int, vector<int> > intPQue;
        intPQue.push(400);
        intPQue.push(100);
        intPQue.push(500);
        intPQue.push(300);
        intPQue.push(200);
        cout << "\n\tValues removed from priority queue:\n";
        int  size = intPQue.size( );
        for (int  x=0; x<size; ++x)
        {
                cout << "\t" << intPQue.top( ) << endl;
                intPQue.pop();
        }
        cout << endl;
        return 0;
}
```

Output of the Ex1423.cpp program on run given below



```
        Values removed from priority queue:
        500
        400
        300
        200
        100


Any key to return to Quincy...
```

[illegible]

Chapter 15

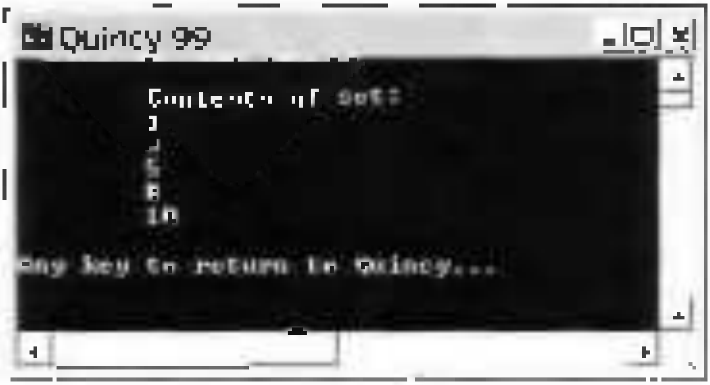
STL associative container [illegible] sequence [illegible] container [illegible] element [illegible] key [illegible] element [illegible] locate [illegible] associative container type [illegible] (၁) set (၂) multiset (၃) map (၄) multimap နဲ့ (၅) bitset type [illegible] set class template [illegible]

၁၅.၁ The set Class Template

[illegible] set class object [illegible] sorted order [illegible] program [illegible] set [illegible] ordered list [illegible] set element [illegible] stored data [illegible] data [illegible] key [illegible] Pr1501.cpp [illegible] set object [illegible] create [illegible] content [illegible] screen [illegible] display [illegible] program [illegible]

```
// Listing 15.1: Creating a simple set
#include <iostream>
#include <set>

int main( )
{
        // Create the set object.
        set<int> intSet;

        // Populate the set with values.
        intSet.insert(10);
        intSet.insert(5);
        intSet.insert(1);
        intSet.insert(3);
        intSet.insert(8);

        // Display the contents of the set.
        cout << "\n\nContents of set:\n";
        set<int>::iterator iter;
        for (iter=intSet.begin( ); iter!=intSet.end( ); iter++)
                cout << '\t' << *iter << endl;
        return 0;
}
```

Ex1501.cpp program [illegible] run [illegible] set object [illegible] insert [illegible] element [illegible]



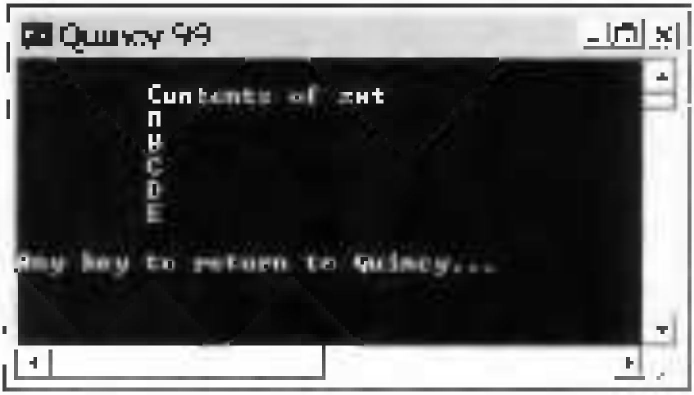
```
        Contents of set:
        1
        3
        5
        8
        10

any key to return to Quincy...
```

[illegible]

Adding Elements to a set

[illegible] char element [illegible] set [illegible] insert [illegible]

```
// Listing 15.2: Adding char elements to a set
#include <iostream>
#include <set>

int main( )
{
        set<char> charSet;
        charSet.insert('C');
        charSet.insert('E');
        charSet.insert('B');
        charSet.insert('D');
        charSet.insert('A');

        cout << "\n\tContents of set:\n";
        set<char>::iterator iter;
        for (iter = charSet.begin( ); iter != charSet.end( ); iter++)
                cout << '\t' << *iter << endl;
        return 0;
}
```



```
        Contents of set:
        A
        B
        C
        D
        E

Any key to return to Quincy...
```

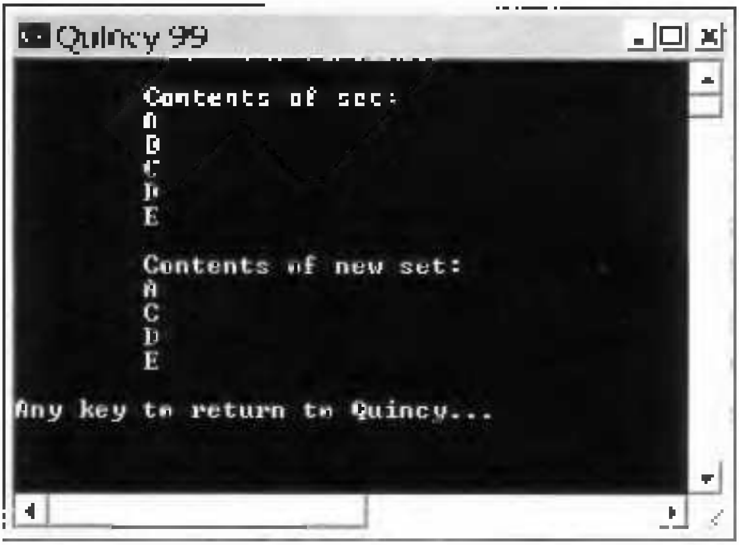
[illegible]

Removing Elements anywhere within a set

[illegible] Ex1503.cpp program [illegible] empty set object [illegible] create [illegible] new element [illegible] insert( ) function [illegible] charSet.erase(++iter); statement [illegible] second element [illegible] erase [illegible] new element [illegible] display [illegible]

```
// Listing 15.3: Removing elements anywhere within a set
#include <iostream>
#include <set>

int main( )
{
        set<char> charSet;

        charSet.insert('E');
        charSet.insert('D');
        charSet.insert('C');
        charSet.insert('B');
        charSet.insert('A');

        // Display the contents of the set.
        cout << "\n\tContents of set:\n";
        set<char>::iterator iter;
        for (iter = charSet.begin( ); iter != charSet.end( ); iter++)
                cout << "\t" << *iter << endl;

        iter = charSet.begin( );
        charSet.erase(++iter);

        cout << "\n\tContents of new set:\n";
        for (iter = charSet.begin( ); iter != charSet.end( ); iter++)
                cout << "\t" << *iter << endl;
        return 0;
}
```

၂။ Ex1503.cpp program မှာ run လိုက်မယ်ဆိုရင် ပထမ sorted set element တွေကို display လုပ်ပြီး second element ဖြစ်တဲ့ 'B' ကို erase လုပ်ပြီးနောက် new element တွေကို display လုပ်ပြလာတဲ့ အနေအထားကိုတွေ့ရမယ်။ ပုံ (၁၅-၃) ကိုကြည့်ပါ။



```
Contents of set:
A
B
C
D
E

Contents of new set:
A
C
D
E

Any key to return to Quincy...
```

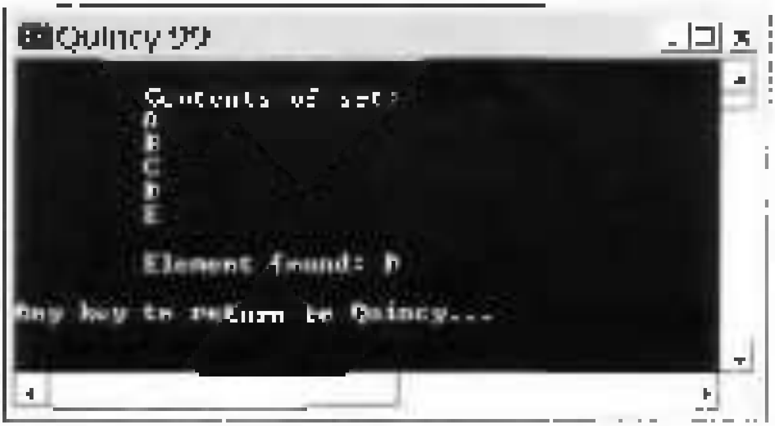
ပုံ (၁၅-၃)

Searching a set

၁။ အောက်မှာဖော်ပြထားတဲ့ Ex1504.cpp program ကတော့ set element တွေထဲက ကြိုက်တဲ့ element တစ်ခုကိုရှာတဲ့ program ဖြစ်ပါတယ်။ element တွေ့ခဲ့ရင် Element found. လို့ဖော်ပြပြီးတော့ မတွေ့ခဲ့ဘူးဆိုရင် Element not found. လို့ဖော်ပြပေးမှာပါ။

```
// Listing 15.4: Searching a set
#include <iostream>
#include <set>

int main( )
{
        set<char> charSet;
        charSet.insert('E');
        charSet.insert('D');
        charSet.insert('C');
        charSet.insert('B');
        charSet.insert('A');

        cout << "\n\tContents of set:\n";
        set<char>::iterator iter;
        for (iter= charSet.begin( ); iter != charSet.end( ); iter++)
                cout << "\t" << *iter << endl;

        // Find the D.
        iter = charSet.find('D');
        if (iter == charSet.end())
                cout << "\n\tElement not found.";
        else
                cout << "\n\tElement found: " << *iter;
        cout << endl;
        return 0;
}
```

Ex1504.cpp program ကို run [illegible] ABCDE ဆိုတဲ့ set ထဲက 'D' ကို [illegible] Element found: D ကို display [illegible] ပုံ (၁၅-၄) [illegible]



```
        Contents of set:
        A
        B
        C
        D
        E

        Element found: D

Any key to return to Quincy...
```

ပုံ (၁၅-၄)

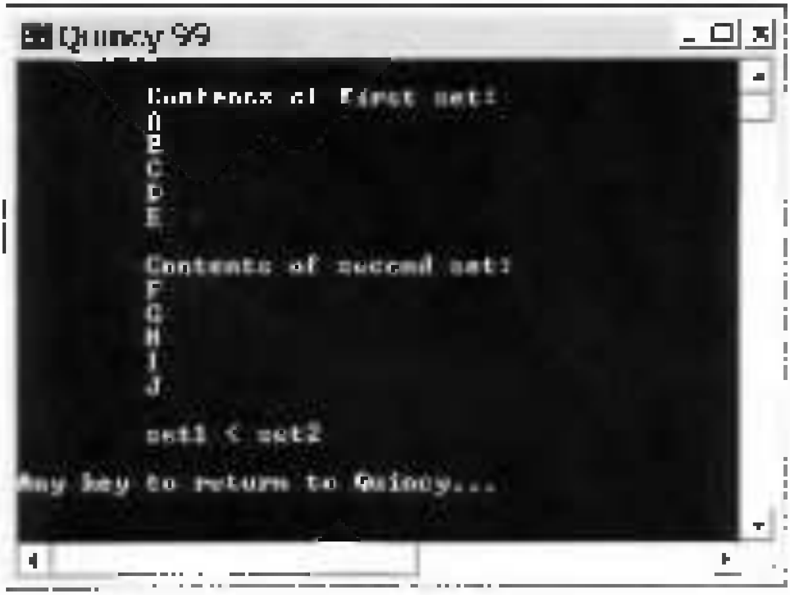
Comparing sets

[illegible] Ex15_5.cpp program [illegible] set object [illegible] program [illegible]

```
// Listing 15.5: Comparing sets
#include <iostream>
#include <set>

int  main( )
{
        // Create the first set object
        set<char> charSet1;

        charSet1.insert('E');
        charSet1.insert('D');
        charSet1.insert('C');
        charSet1.insert('B');
        charSet1.insert('A');

        cout << "\n\tContents of first set:\n";
        set<char>::iterator iter;
        for (iter= charSet1.begin( ); iter != charSet1.end( ); iter++)
                cout << "\t" << *iter << endl;

        // Create the second set object.
        set<char> charSet2;

        charSet2.insert('I');
        charSet2.insert('E');
        charSet2.insert('H');
        charSet2.insert('G');
        charSet2.insert('F');

        cout << "\n\tContents of second set:\n";
```

```
    for (iter= charSet2.begin( ); iter != charSet2.end( ); iter++)
        cout << '\t' << *iter << endl;
    cout << endl;

    // Compare the sets
    if (charSet1 == charSet2)
        cout << "\tset1 == set2";
    else if (charSet1 < charSet2)
        cout << "\tset1 < set2";
    else
        cout << "\tset1 > set2";
    cout << endl;
    return 0;
}
```

Ex1505.cpp program ကို run [illegible] ABCDE နဲ့ FGHIJ [illegible] set (2) [illegible] set1 < set2 [illegible] display [illegible] (ပုံ ၁၅-၅) [illegible]



```
        Contents of first set:
        A
        B
        C
        D
        E

        Contents of second set:
        F
        G
        H
        I
        J

        set1 < set2
Any key to return to Quincy...
```

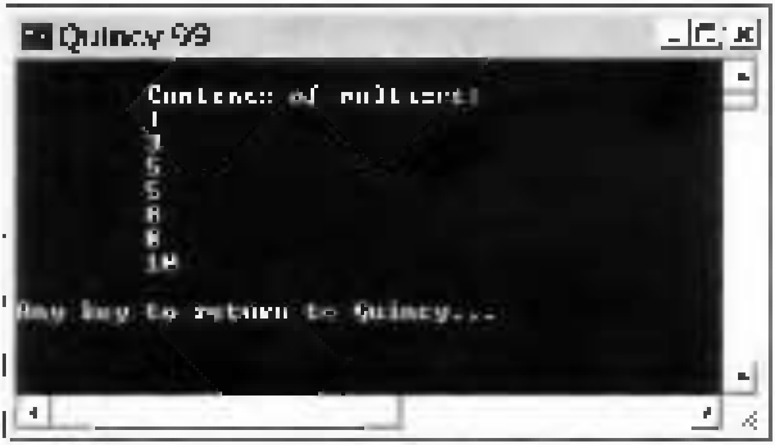
ပုံ (၁၅-၅)

၁၅၂ The multiset Class Template

[illegible] multiset object [illegible] sorted order [illegible] program [illegible] multiset [illegible] set [illegible] multiset element [illegible] duplicate [illegible] Ex1506.cpp [illegible] multiset object [illegible] create [illegible] content [illegible] display [illegible] program [illegible]

```
// Listing 15.6: Creating a simple multiset class template
#include <iostream>
#include <set>

int main( )
{
        // Create the multiset object.
        multiset<int> intMultiset;

        intMultiset.insert(10);
        intMultiset.insert(5);
        intMultiset.insert(1);
        intMultiset.insert(3);
        intMultiset.insert(8);
        intMultiset.insert(5);
        intMultiset.insert(8);

        // Display the contents of the multiset.
        cout << "\n\nContents of multiset:\n";
        multiset<int>::iterator iter;
        for (iter= intMultiset.begin( );iter != intMultiset.end( ); iter++)
                cout << " " << *iter << endl;
        return 0;
}
```

[illegible] Ex1506.cpp program [illegible] run [illegible] 1 3 5 5 8 8 10 [illegible] multiset [illegible] create [illegible] display [illegible]



```
        Contents of multiset:
        1
        3
        5
        5
        8
        8
        10

Any key to return to Quincy...
```

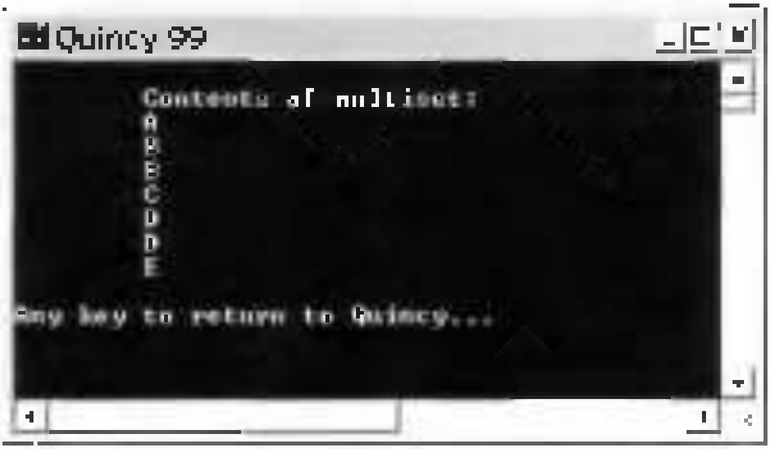
[illegible]

Inserting multiset Elements

[illegible] char element [illegible] multiset [illegible] insert [illegible]

[illegible]

```
// Listing 15.7: Adding elements to a multiset
#include <iostream>
#include <set>

int main( )
{
        multiset<char> charMultiset;

        charMultiset.insert('E');
        charMultiset.insert('D');
        charMultiset.insert('C');
        charMultiset.insert('B');
        charMultiset.insert('A');
        charMultiset.insert('B');
        charMultiset.insert('D');
        cout << "\n\nContents of multiset:\n";
        multiset<char>::iterator iter;
        for (iter = charMultiset.begin(); iter != charMultiset.end(); iter++)
                cout << '\t' << *iter << endl;
        return 0;
}
```



```
        Contents of multiset:
        A
        B
        B
        C
        D
        D
        E

Any key to return to Quincy...
```

([illegible])

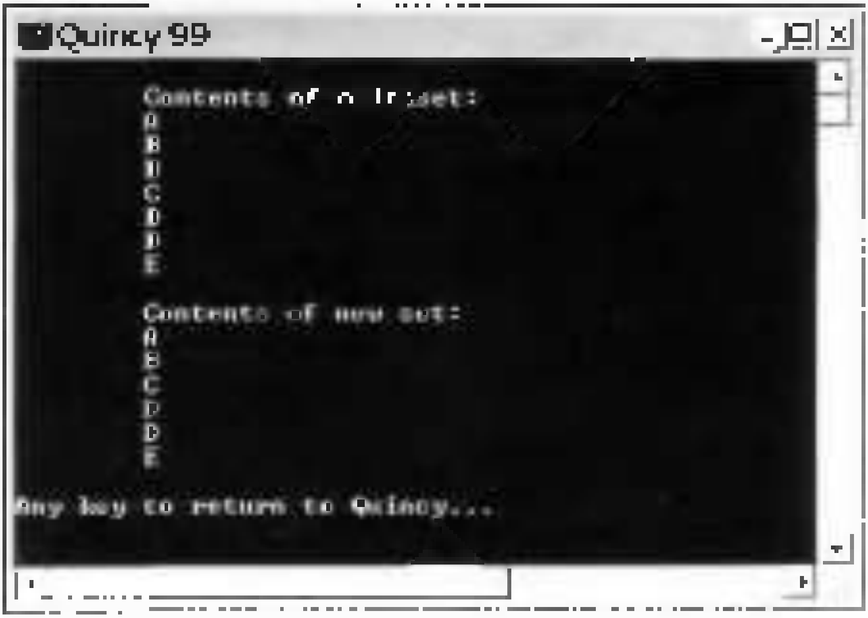
Removing multiset Elements

[illegible] Ex1508.cpp program [illegible] ABBCDDE [illegible] multiset [illegible] create [illegible] second element 'B' [illegible] erase [illegible] new set [illegible] ABCDDE [illegible] program [illegible]

```
// Listing 15.9. Removing multiset elements
#include <iostream>
#include <set>

int main( )
```

```
{
        // Create the set object.
        multiset<char> charMultiset;

        // Populate the multiset with values.
        charMultiset.insert('E');
        charMultiset.insert('D');
        charMultiset.insert('C');
        charMultiset.insert('B');
        charMultiset.insert('A');
        charMultiset.insert('B');
        charMultiset.insert('D');

        // Display the contents of the multiset.
        cout << "\n\tContents of multiset:\n";
        multiset<char>::iterator iter;
        for (iter= charMultiset.begin( ); iter != charMultiset.end( ); iter++)
                cout << "\t" << *iter << endl;

        // Erase the multiset's second element.
        iter = charMultiset.begin( );
        charMultiset.erase(++iter);

        // Display the new contents of the multiset.
        cout << "\n\tContents of new set:\n";
        for (iter= charMultiset.begin( ); iter != charMultiset.end( ); iter++)
                cout << "\t" << *iter << endl;
        return 0;
}
```

၂။ Ex150R.cpp program [illegible] run [illegible] sorted multiset element [illegible] display [illegible] second element [illegible] 'B' [illegible] erase [illegible] new element [illegible] display [illegible] (၅-၈) [illegible]



```
        Contents of multiset:
        A
        B
        B
        C
        D
        D
        E

        Contents of new set:
        A
        B
        C
        D
        D
        E

Any key to return to Quincy...
```

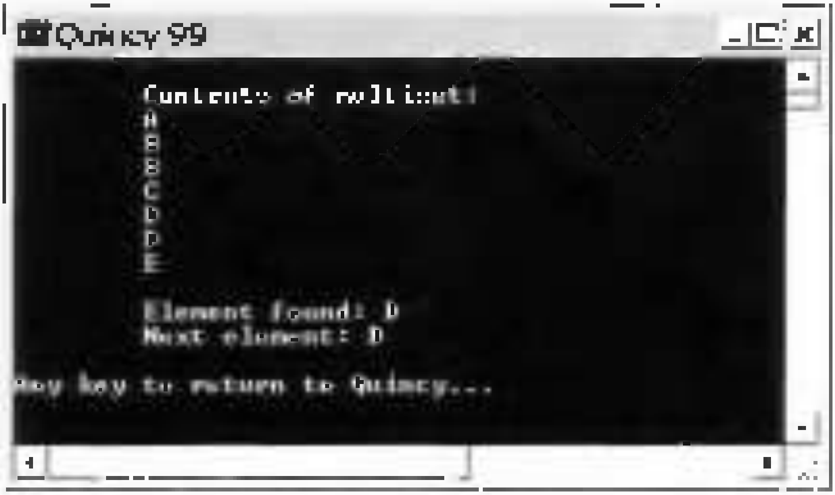
[illegible]

Searching a multiset

[illegible] Ex1509.cpp program [illegible] multiset element [illegible] element [illegible] program [illegible] element [illegible] Element found! [illegible] Next element! [illegible] element [illegible] Element not found! [illegible]

```
// Listing 15.9. Searching a multiset
#include <iostream>
#include <set>

int main()
{
        multiset<char> charMultiset;
        charMultiset.insert('E');
        charMultiset.insert('D');
        charMultiset.insert('C');
```

```
    charMultiset.insert('B');
    charMultiset.insert('A');
    charMultiset.insert('B');
    charMultiset.insert('D');

    cout << "\n\tContents of multiset:\n";
    multiset<char>::iterator iter;
    for (iter = charMultiset.begin(); iter != charMultiset.end(); iter++)
            cout << '\t' << *iter << endl;
    cout << endl;

    // Find the first D
    iter = charMultiset.find('D');
    if (iter == charMultiset.end())
            cout << "\n\tElement not found.";
    else
    {
            cout << "\tElement found: " << *iter++ << endl;
            cout << "\tNext element: " << *iter;
    }
    cout << endl;
    return 0;
}
```



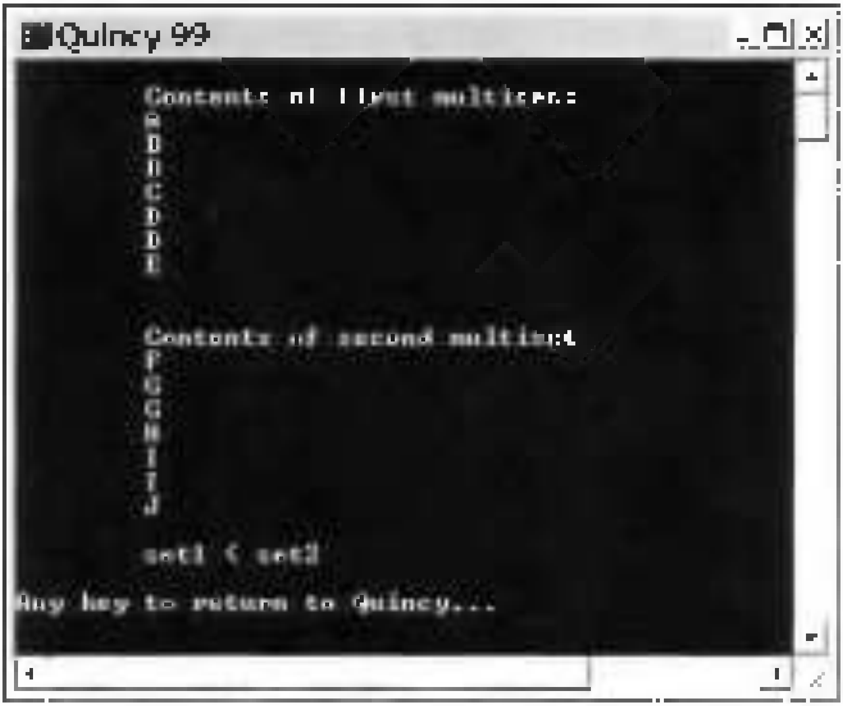
```
        Contents of multiset:
        A
        B
        B
        C
        D
        D
        E

        Element found: D
        Next element: D

Any key to return to Quincy...
```

Comparing multisets

[illegible] Ex1510.cpp program [illegible] multiset object [illegible] program output [illegible]

```
// Listing 15.10: Comparing multisets
#include <iostream>
#include <set>

int main( )
{
        multiset<char> charMultiset1;
        charMultiset1.insert('E');
        charMultiset1.insert('D');
        charMultiset1.insert('C');
        charMultiset1.insert('B');
        charMultiset1.insert('A');
        charMultiset1.insert('B');
        charMultiset1.insert('D');

        cout << "\n\tContents of first multiset:\n";
        multiset<char>::iterator iter;
        for (iter= charMultiset1.begin( ); iter != charMultiset1.end( ); iter++)
                cout << '\t' << *iter << endl;
        cout << endl;

        multiset<char> charMultiset2;
        charMultiset2.insert("J");
        charMultiset2.insert("I");
        charMultiset2.insert("H");
        charMultiset2.insert("G");
        charMultiset2.insert("F");
        charMultiset2.insert("G");
        charMultiset2.insert("I");
        cout << "\n\tContents of second multiset:\n";
        for (iter= charMultiset2.begin( ); iter != charMultiset2.end( ); iter++)
                cout << '\t' << *iter << endl;
        cout << endl;

        // Compare the sets
         if (charMultiset1 == charMultiset2)
                cout << "\tset1 == set2";
        else if (charMultiset1 < charMultiset2)
                cout << "\tset1 < set2";
        else
                cout << "\tset1 > set2";
        cout << endl;
        return 0;
}
```

Ex1510.cpp program ကို run [illegible] ABBCDDE နှင့် FGGHIJJ [illegible] multiset [illegible] set1 [illegible] set2 [illegible] display [illegible] ပုံ (၅-၁၀) [illegible]



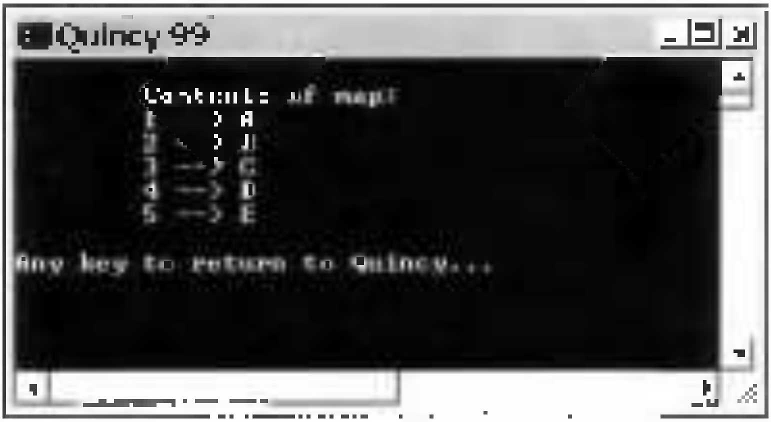
```
        Contents of first multiset:
        A
        B
        B
        C
        D
        D
        E

        Contents of second multiset:
        F
        G
        G
        H
        I
        J
        J

        set1 < set2
Any key to return to Quincy...
```

ပုံ (၅-၁၀)

၁၅.၃ The map Class Template

၁။ map class object တစ်ခုသည် အချိန်အတော်တစ်ခုကို sorted order ဖြင့်ထားသော program မှာသည့်သွင်း အသုံးပြုနိုင်ရှိပါသည်။ map element များသည် stored data အနေနှင့်ပါဝင်သော data များအတွက် search key များကိုဖြင့် အသုံးပြုနိုင်စေသည်ဖြစ်သည်။ Ex1511.cpp တွင်ရှိ simple map object တစ်ခုကို create လုပ်ပြီး content များကို display လုပ်ပြသည့် program တစ်ခုဖြစ်ပါသည်။ ပုံ (၁၅.၁၁) တွင်ဖော်ပြထားပါ

```
// Listing 15.11: Creating a simple map
#include <iostream>
#include <map>

int main( )
{
        // Create the map object.
        map<int, char> charMap;

        // Populate the map with values.
        charMap.insert(std::map<int, char>::value_type(1,'A'));
        charMap.insert(std::map<int, char>::value_type(3,'C'));
        charMap.insert(std::map<int, char>::value_type(2,'B'));
        charMap.insert(std::map<int, char>::value_type(5,'E'));
        charMap.insert(std::map<int, char>::value_type(4,'D'));

        // Display the contents of the map.
        cout << "\n\tContents of map:\n";
        map<int, char>::iterator iter;
        for (iter= charMap.begin( ); iter != charMap.end( ); iter++)
        {
                cout << '\t' << (*iter).first << " --> ";
                cout << (*iter).second << endl;
        }
        return 0;
}
```



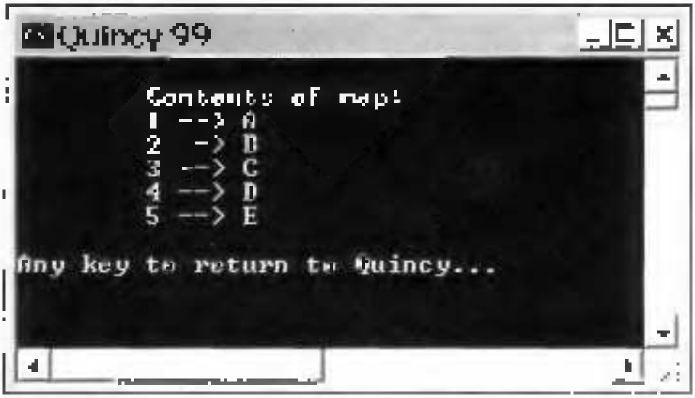
```
Contents of map:
1 --> A
2 --> B
3 --> C
4 --> D
5 --> E

Any key to return to Quincy...
```

[illegible]

Adding Elements to a map

[illegible] char element [illegible] map [illegible] add [illegible] Ex1512.cpp program [illegible] run [illegible]

```
// Listing 15.12 Adding elements to a map
#include <iostream>
#include <map>

typedef map<int, char> MYMAP;

int main()
{
        // Create the map object.
        MYMAP charMap;

        // Populate the map with values
        charMap.insert(MYMAP::value_type(1,'A'));
        charMap.insert(MYMAP::value_type(3,'C'));
        charMap.insert(MYMAP::value_type(2,'B'));
        charMap.insert(MYMAP::value_type(5,'E'));
        charMap.insert(MYMAP::value_type(4,'D'));

        // Display the contents of the map.
        cout << "\n\tContents of map:\n";
        MYMAP::iterator iter;
        for (iter= charMap.begin( );iter != charMap.end( ); iter++)
        {
                cout << '\t' << (*iter).first << " --> ";
                cout << (*iter).second << endl;
        }
        return 0;
}
```



```
        Contents of map:
        1 --> A
        2 --> B
        3 --> C
        4 --> D
        5 --> E

Any key to return to Quincy...
```

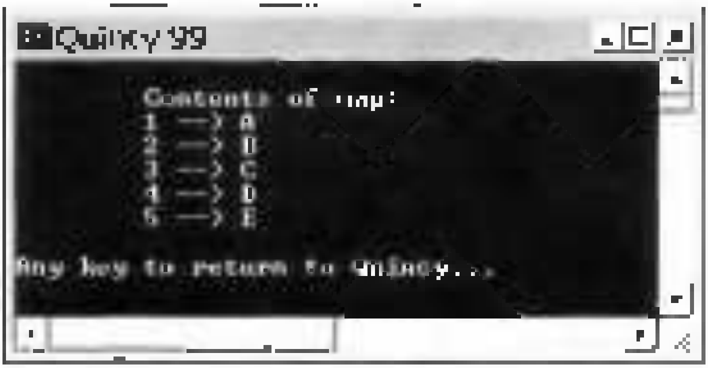
ပုံ (၁၅-၆)

Adding Elements to a map Using the [ ] Operator

။ map class template မှာပါဝင်တဲ့ [ ] operator ကို အသုံးပြုခြင်းအားဖြင့် insert( ) function ကို အသုံးမပြုဘဲ element တွေကို map object ထဲမှာ insert လုပ်ပေးနိုင်ပါတယ်။ အောက်မှာဖော်ပြထားတဲ့ Ex1513.cpp ပရိုဂရမ်ကလေးကို လေ့လာကြည့်ရင် နားလည်နိုင်ပါလိမ့်မယ်။

```
// Listing 15.13: Adding elements to a map using the [ ] operator
#include <iostream>
#include <map>
typedef map<int, char> MYMAP;

int main( )
{
        MYMAP charMap;
        charMap[1] = 'A';
        charMap[4] = 'D';
        charMap[2] = 'B';
        charMap[5] = 'E';
        charMap[3] = 'C';

        cout << "\n\tContents of map:\n";
        MYMAP::iterator iter;
        for (iter = charMap.begin( ); iter != charMap.end( ); iter++)
        {
                cout << "\t" << (*iter).first << " --> ";
                cout << (*iter).second << endl;
        }
        return 0;
}
```

Ex1513.cpp program ကို run [illegible]



```
        Contents of map:
        1 --> A
        2 --> B
        3 --> C
        4 --> D
        5 --> E

Any key to return to Quincy...
```

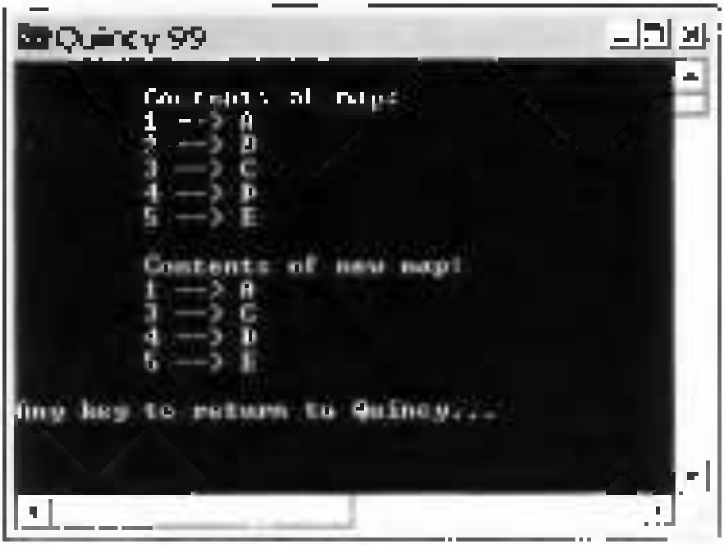
[illegible]

Removing map Elements

[illegible] Ex1514.cpp program [illegible] empty map object [illegible] create [illegible] new element [illegible] [ ] operator [illegible] charMap.erase(++iter); statement [illegible] second element [illegible] erase [illegible] new element [illegible] display [illegible] program [illegible] run [illegible] sorted set element [illegible] display [illegible] second element [illegible] erase [illegible] new element [illegible] display [illegible]

```
// Listing 15.14: Removing map elements
#include <iostream>
#include <map>

typedef map<int, char> MYMAP;

int main( )
{
        MYMAP charMap;
        charMap[1] = 'A';
        charMap[4] = 'D';
        charMap[2] = 'B';
        charMap[5] = 'E';
        charMap[3] = 'C';

        cout << "\n\nContents of map:\n";
        MYMAP::iterator iter;
        for (iter= charMap.begin( );iter != charMap.end( ); iter++)
        {
                cout << '\t' << (*iter).first << " --> ";
                cout << (*iter).second << endl;
        }

        iter = charMap.begin( );
        charMap.erase(++iter);
```

```
	// Display the new contents of the map.
	cout << "\n\tContents of new map:\n";
	for (iter= charMap.begin( ); iter != charMap.end( ); iter++)
	{
		cout << "\t" << (*iter).first << " --> ";
		cout << (*iter).second << endl;
	}
	return 0;
}
```



```
	Contents of map:
	1 --> A
	2 --> B
	3 --> C
	4 --> D
	5 --> E

	Contents of new map:
	1 --> A
	3 --> C
	4 --> D
	5 --> E

Any key to return to Quincy...
```

[illegible]

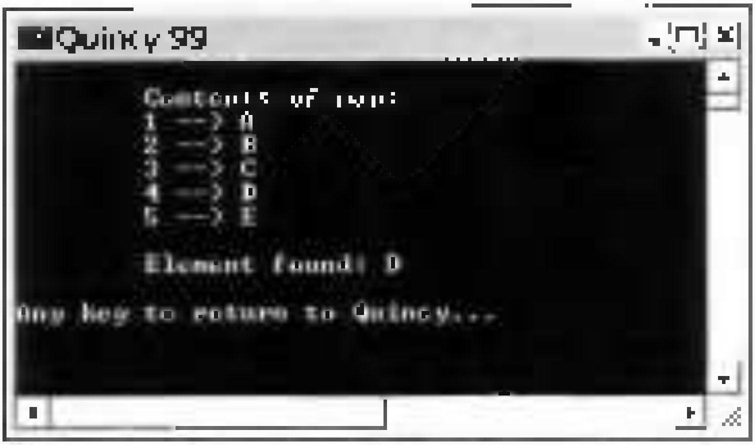
Searching a map

[illegible] Ex1515.cpp program [illegible] map object [illegible] element [illegible] program [illegible] element [illegible] Element found" [illegible] Element not found" [illegible]

```
// Listing 15.15 Searching a map
#include <iostream>
```

```
#include <map>

typedef map<int, char> MYMAP;

int main( )
{
        MYMAP charMap;

        // Populate the map with values.
        charMap[1] = 'A';
        charMap[4] = 'D';
        charMap[2] = 'B';
        charMap[5] = 'E';
        charMap[3] = 'C';

        cout << "\n\tContents of map:\n";
        MYMAP::iterator iter;
        for (iter= charMap.begin( ); iter != charMap.end( ); iter++)
        {
                cout << "\t" << (*iter).first << " --> ";
                cout << (*iter).second << endl;
        }

        // Find the D.
        MYMAP::iterator pos = charMap.find(4);

        if (pos == charMap.end())
                cout << "\n\tElement not found.";
        else
                cout << "\n\tElement found: " << (*pos).second;

        cout << endl;
        return 0;
}
```

Ex1515.cpp program [illegible] run [illegible] ABCDE [illegible] map object [illegible] 'D' [illegible] Element found: D [illegible] display [illegible]



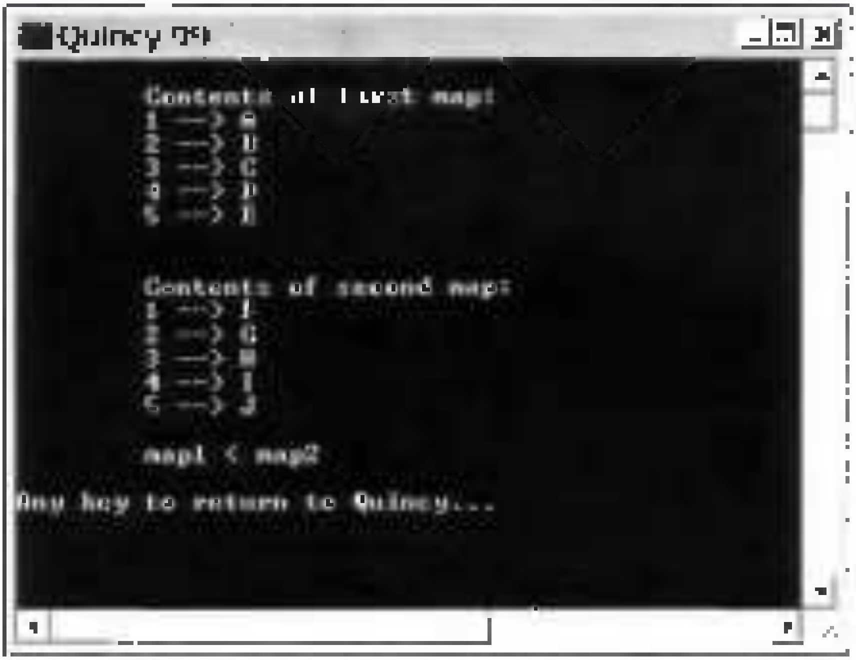
```
        Contents of map:
        1 --> A
        2 --> B
        3 --> C
        4 --> D
        5 --> E

        Element found: D

Any key to return to Quincy...
```

ပုံ (၁၅-၁၅)

Comparing maps

Ex15_16.cpp program [illegible] set object (2) [illegible] program [illegible] program [illegible] run [illegible] ABCDE နဲ့ FG [illegible] map object (2) [illegible] map1 က map2 [illegible] display [illegible] ပုံ (၁၅-၁၆) [illegible]

```
// Listing 15.16: Comparing maps
#include <iostream>
#include <map>

typedef map<int, char> MYMAP;
int main( )
{
        // Create the first map object
        MYMAP charMap1;
        charMap1[1] = 'A';
        charMap1[4] = 'D';
        charMap1[2] = 'B';
        charMap1[5] = 'E';
        charMap1[3] = 'C';
        cout << "\n\tContents of first map:\n";
        MYMAP::iterator iter;
        for  (iter= charMap1.begin( ); iter != charMap1.end( ); iter++)
        {
                cout << "\t" << (*iter).first << " --> ";
                cout << (*iter).second << endl;
        }
        cout << endl;

        // Create the second map object.
        MYMAP charMap2;
        charMap2[1] = 'F';
        charMap2[4] = 'I';
        charMap2[2] = 'G';
        charMap2[5] = 'J';
        charMap2[3] = 'H';

        cout << "\n\tContents of second map:\n";
        for  (iter= charMap2.begin( );iter != charMap2.end( ); iter++)
        {
                cout << "\t" << (*iter).first << " --> ";
                cout << (*iter).second << endl;
        }
        cout << endl;

        // Compare the maps
        if (charMap1 == charMap2)
                cout << "\tmap1 == map2";
        else if (charMap1 < charMap2)
                cout << "\tmap1 < map2";
        else
                cout << "\tmap1 > map2";

        cout << endl;
        return 0;
}
```



```
        Contents of first map:
        1 --> A
        2 --> B
        3 --> C
        4 --> D
        5 --> E

        Contents of second map:
        1 --> F
        2 --> G
        3 --> H
        4 --> I
        5 --> J

        map1 < map2

Any key to return to Quincy...
```

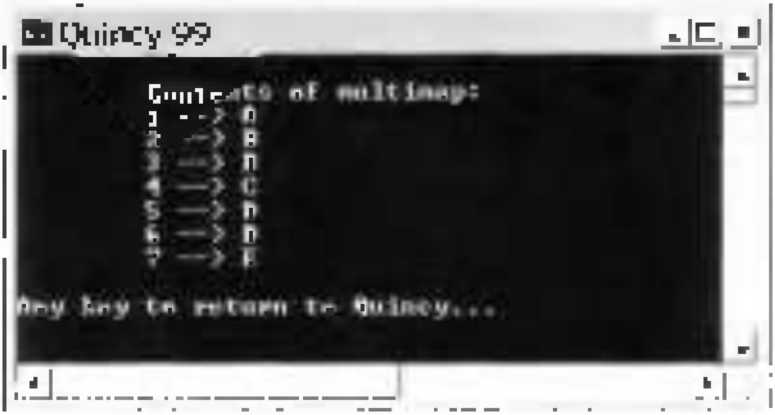
[illegible]

၁၅.၄ The multimap Class Template

multimap object [illegible] sorted order [illegible] program [illegible] multimap [illegible] map [illegible] multimap element [illegible] duplicate [illegible] Ex1517.cpp program [illegible] A B B C D D E [illegible] multimap [illegible] create [illegible] display [illegible]

```
// Listing 15.17: A simple multimap
#include <iostream>
#include <map>

typedef multimap<int, char> MYMAP;
```

```
int main( )
{
	// Create the multimap object.
	MYMAP charMultimap;

	// Populate the multimap with values.
	charMultimap.insert(MYMAP::value_type(1,'A'));
	charMultimap.insert(MYMAP::value_type(4,'C'));
	charMultimap.insert(MYMAP::value_type(2,'B'));
	charMultimap.insert(MYMAP::value_type(7,'E'));
	charMultimap.insert(MYMAP::value_type(5,'D'));
	charMultimap.insert(MYMAP::value_type(3,'B'));
	charMultimap.insert(MYMAP::value_type(6,'D'));

	// Display the contents of the multimap.
	cout << "\n\nContents of multimap:\n";
	MYMAP::iterator iter;
	for (iter = charMultimap.begin( ); iter != charMultimap.end( ); iter++)
	{
		cout << '\t' << (*iter).first << " --> ";
		cout << (*iter).second << endl;
	}
	return 0;
}
```

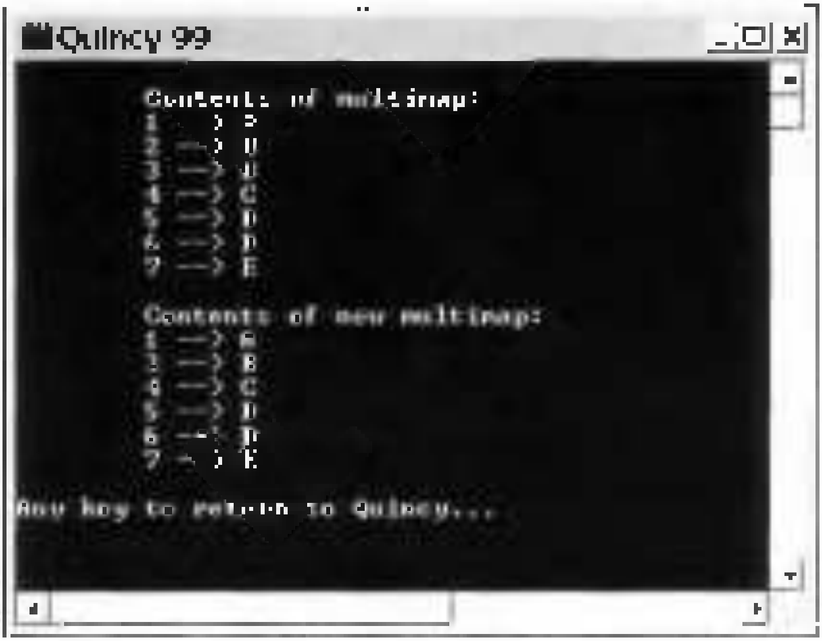


```
        Contents of multimap:
        1 --> A
        2 --> B
        3 --> B
        4 --> C
        5 --> D
        6 --> D
        7 --> E

Any key to return to Quincy...
```

Removing multimap Elements

၁။ အောက်မှာဖော်ပြထားတဲ့ Ex1518.cpp program ထဲမှာတော့ ABBCDDE ဆိုတဲ့ multimap တစ်ခုကို create လုပ်ပြီး second element 'B' ကို erase လုပ်ခြင်းအားဖြင့် new set ဟာ ABCDDE ဖြစ်သွားအောင် လုပ်ပေးတဲ့ program ဖြစ်ပါတယ်။ လေ့လာကြည့်ပါ။

```
// Listing 15.18: Removing multimap elements
#include <iostream>
#induce <map>

typedef multimap<int, char> MYMAP;

int main( )
{
        MYMAP charMultimap;

        charMultimap.insert(MYMAP::value_type(1,'A'));
        charMultimap.insert(MYMAP::value_type(4,'C'));
        charMultimap.insert(MYMAP::value_type(2,'B'));
        charMultimap.insert(MYMAP::value_type(7,'E'));
        charMultimap.insert(MYMAP::value_type(5,'D'));
        charMultimap.insert(MYMAP::value_type(3,'B'));
        charMultimap.insert(MYMAP::value_type(6,'D'));

        // Display the contents of the multimap.
        cout << "\n\tContents of multimap:\n";
        MYMAP::iterator iter;
        for (iter= charMultimap.begin( ); iter != charMultimap.end( ); iter++)
        {
                cout << "\t" << (*iter).first << " --> ";
                cout << (*iter).second << endl;
        }

         // Erase the multimap's second element.
        iter = charMultimap.begin( );
        charMultimap.erase(++iter);
        // Display the new contents of the multimap.
        cout << "\n\tContents of new multimap: " << endl;
        for (iter = charMultimap.begin( ); iter != charMultimap.end( ); iter++)
        {
                cout << "\t" << (*iter).first << " --> ";
                cout << (*iter).second << endl;
        }
        return 0;
}
```



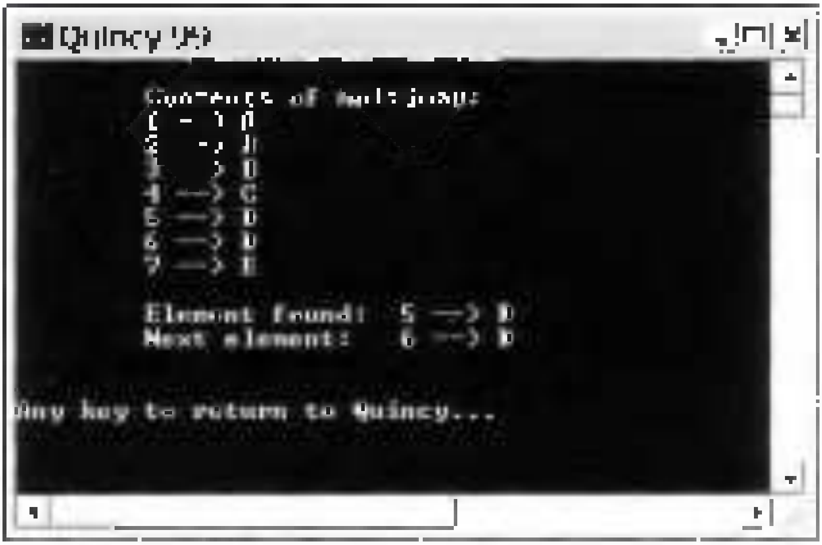
```
        Contents of multimap:
        1 --> A
        2 --> B
        3 --> B
        4 --> C
        5 --> D
        6 --> D
        7 --> E

        Contents of new multimap:
        1 --> A
        3 --> B
        4 --> C
        5 --> D
        6 --> D
        7 --> E

Any key to return to Quincy...
```

[illegible]

Searching a multimap

[illegible] Ex1515.cpp program [illegible] multimap object [illegible] element [illegible] program [illegible] element [illegible] Element found: [illegible] first element: [illegible] element [illegible] Element not found: [illegible]

```
// Listing 15.19 Searching a multimap
#include <iostream>
#include <map>

typedef multimap<int, char> MYMAP;

int main( )
{
	MYMAP charMultimap;

	charMultimap.insert(MYMAP::value_type(1,'A'));
	charMultimap.insert(MYMAP::value_type(4,'C'));
	charMultimap.insert(MYMAP::value_type(2,'B'));
	charMultimap.insert(MYMAP::value_type(7,'E'));
	charMultimap.insert(MYMAP::value_type(5,'D'));
	charMultimap.insert(MYMAP::value_type(3,'B'));
	charMultimap.insert(MYMAP::value_type(6,'D'));

	cout << "\n\tContents of multimap:\n";
	MYMAP::iterator iter;
	for (iter = charMultimap.begin( ); iter != charMultimap.end( ); iter++)
	{
		cout << "\t" << (*iter).first << " --> ";
		cout << (*iter).second << endl;
	}
	cout << endl;

	// Find the first D.
	iter = charMultimap.find(5);
	if (iter == charMultimap.end( ))
		cout << "\tElement not found.";
	else
	{
        cout << "\tElement found: ";
        cout << "\t" << (*iter).first << " --> ";
        cout << (*iter).second << endl;
        cout << "\tNext element: ";
        cout << "\t" << (*iter).first << " --> ";
        cout << (*iter).second << endl;
    }
    cout << endl;
    return 0;
}
```



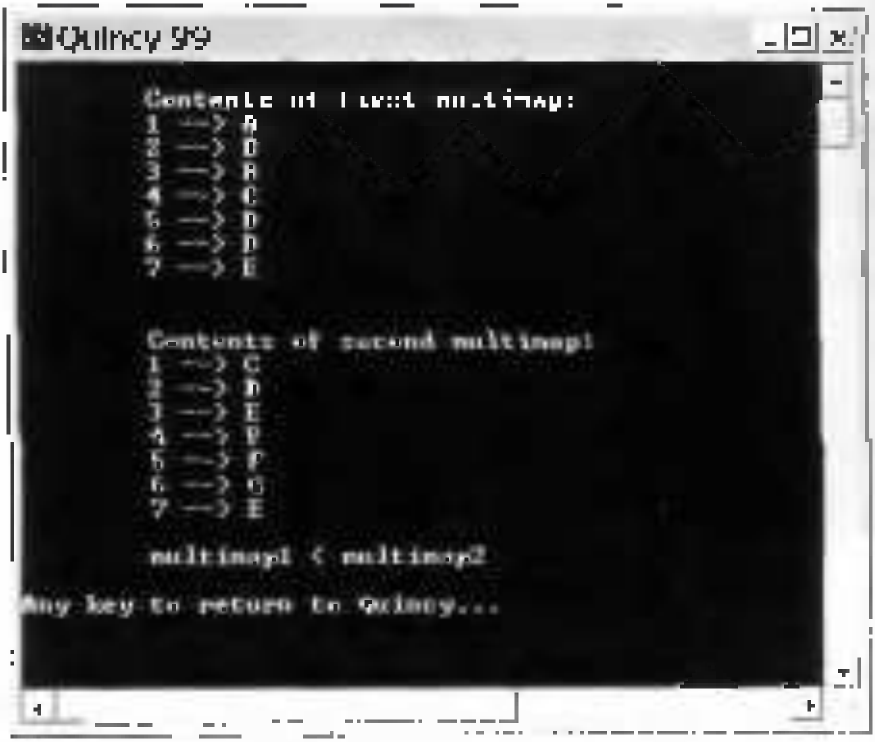
```
        Contents of multimap:
        1 --> A
        2 --> B
        3 --> B
        4 --> C
        5 --> D
        6 --> D
        7 --> E

        Element found:  5 --> D
        Next element:   6 --> D


Any key to return to Quincy...
```

[illegible]

Comparing multimaps

Ex6??.cpp program [illegible] set object (2) [illegible] program [illegible] program [illegible] ABBCDDE & CDEFFGE [illegible] multimap object (2) [illegible] multimap1 & multimap2 [illegible] display [illegible]

```
// Listing 15.20: Comparing multimaps
#include <iostream>
#include <map>

typedef multimap<int, char> MYMAP;

int main( )
{
        // Create the first multimap object.
        MYMAP charMultimap;

        charMultimap.insert(MYMAP::value_type(1,'A'));
        charMultimap.insert(MYMAP::value_type(4,'C'));
        charMultimap.insert(MYMAP::value_type(2,'B'));
        charMultimap.insert(MYMAP::value_type(7,'E'));
        charMultimap.insert(MYMAP::value_type(5,'D'));
        charMultimap.insert(MYMAP::value_type(3,'B'));
        charMultimap.insert(MYMAP::value_type(6,'D'));

        cout << "\nContents of first multimap:\n";
        MYMAP::iterator iter;
        for (iter= charMultimap.begin( ); iter != charMultimap.end( ); iter++)
        {
                cout << '\t' << (*iter).first << " --> ";
                cout << (*iter).second << endl;
        }
        cout << endl;

        // Create the second multimap object.
        MYMAP charMultimap2;

        charMultimap2.insert(MYMAP::value_type(1,'C'));
        charMultimap2.insert(MYMAP::value_type(4,'F'));
        charMultimap2.insert(MYMAP::value_type(2,'D'));
        charMultimap2.insert(MYMAP::value_type(7,'E'));
        charMultimap2.insert(MYMAP::value_type(5,'F'));
        charMultimap2.insert(MYMAP::value_type(3,'E'));
```



```
        Contents of first multimap:
        1 --> A
        2 --> B
        3 --> B
        4 --> C
        5 --> D
        6 --> D
        7 --> E


        Contents of second multimap:
        1 --> C
        2 --> D
        3 --> E
        4 --> F
        5 --> F
        6 --> G
        7 --> E

        multimap1 < multimap2

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```

(Output)

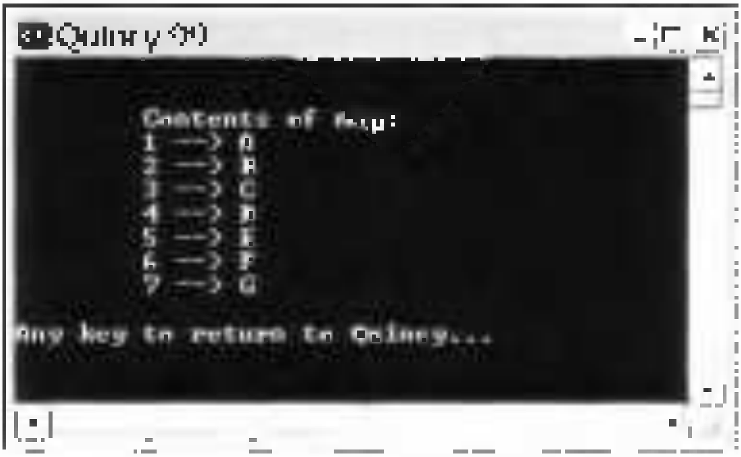
```
charMultimap2.insert(MYMAP::value_type(6,'G'));

cout << "\n\nContents of second multimap:\n";

for (iter = charMultimap2.begin( ); iter != charMultimap2.end( ); iter++)
{
        cout << '\t' << (*iter).first << " --> ";
        cout << (*iter).second << endl;
}
cout << endl;

// Compare the multimaps
if (charMultimap == charMultimap2)
        cout << "\tmultimap1 == multimap2";
else if (charMultimap < charMultimap2)
```

```
                cout << "\nmultimap1 < multimap2";
        else
                cout << "\nmultimap1 > multimap2";

        cout << endl;
        return 0;
}
```

၁၅.၅ User-Defined Predicates

Ex15-21.cpp program [illegible] compare [illegible] predicate [illegible] define [illegible] map object [illegible] element [illegible] compare_and_sort [illegible] program [illegible] predicate [illegible] class [illegible] predicate name [illegible] compare [illegible] overloaded ( ) operator [illegible] program [illegible] run [illegible] (၁၅.၂၁) [illegible]

```
// Listing 15.21 User-defined predicates
#include <iostream>
#include <map>

class  compare
{
    public:
        bool  operator( )(const  int  c1, const  int  c2) const
        {
                return  c1 < c2;
        }
};


int  main( )
{
        // Create the map object.
        map<int, char, compare>  charMap;
        // Populate the map with values.
        charMap.insert(map<int, char>::value_type(6,'F'));
        charMap.insert(map<int, char>::value_type(2,'B'));
        charMap.insert(map<int, char>::value_type(7,'G'));
        charMap.insert(map<int, char>::value_type(4,'D'));
        charMap.insert(map<int, char>::value_type(3,'C'));
        charMap.insert(map<int, char>::value_type(5,'E'));
        charMap.insert(map<int, char>::value_type(1,'A'));

        // Display the contents of the map.
        cout << endl << "\t\tContents of map:\n";
        map<int, char>::iterator iter;
        for (iter= charMap.begin(); iter != charMap.end(); iter++)
        {
                cout << "\t\t" << (*iter).first << " --> ";
                cout << (*iter).second << endl;
        }
        return 0;
}
```



```
                Contents of map:
                1 --> A
                2 --> B
                3 --> C
                4 --> D
                5 --> E
                6 --> F
                7 --> G

Any key to return to Quincy...
```

Output

Chapter 16

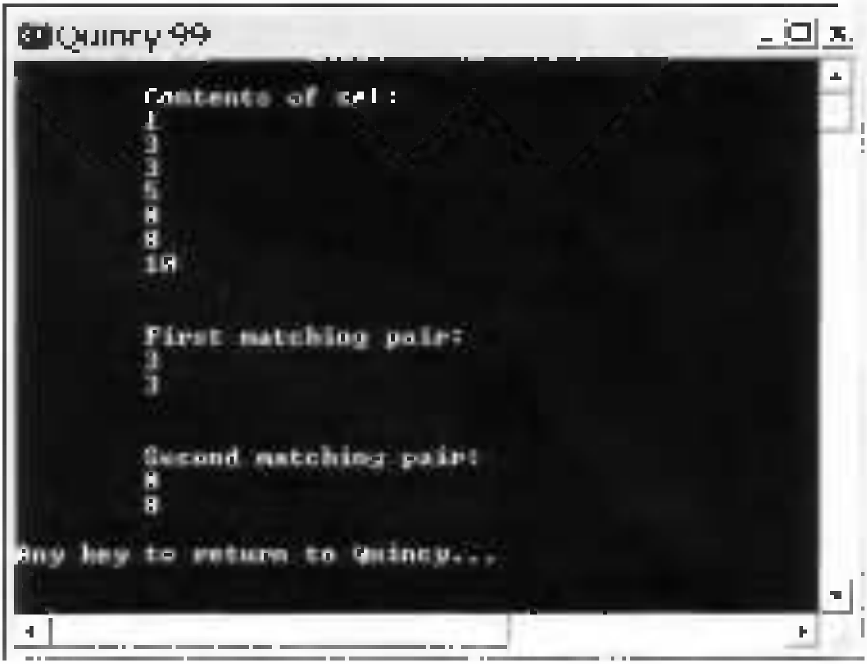
Standard Template Library [illegible] container [illegible] type [illegible] generic algorithm [illegible] STL [illegible] generic algorithm [illegible] (4) [illegible] ( ) Non-modifying sequence algorithms (၂) Mutating sequence algorithms (၃) Sorting algorithms နှင့် (၄) Numeric algorithm [illegible] non-modifying sequence algorithms [illegible] sequence [illegible] modify [illegible] function apply [illegible] count( ) function [illegible] sequence [illegible] element [illegible] sequence [illegible] STL [illegible] non-modifying sequence algorithm (9) [illegible] adjacent_find( ), find( ), find_end( ), find_first( ), count( ), mismatch( ), equal( ), for_each( ) နှင့် search( ) algorithm [illegible]

၁၆.၁ Using the adjacent_find( ) Function

[illegible] Ex1601.cpp program [illegible] set object [illegible] value [illegible] adjacent_find( ) generic algorithm [illegible] program [illegible] algorithm [illegible] set object element [illegible] modify [illegible]

```
// Listing 16.1: Using adjacent_find( ) function
#include <iostream>
#include <set>
#include <algorithm>

int main( )
{
        // Create the set object.
        multiset<int, less<int> > intSet;
        intSet.insert(10);
        intSet.insert(3);
        intSet.insert(1);
        intSet.insert(5);
        intSet.insert(8);
        intSet.insert(8);
        intSet.insert(5);

        // Display the contents of the set.
        cout << "\n\tContents of set:\n";
        multiset<int, less<int> >::iterator it = intSet.begin( );
        for (int x=0; x < intSet.size( ); ++x)
                cout << "\t" << *it++ << endl;
        cout << endl;

        // Find the first pair of equal values.
        cout << "\n\tFirst matching pair:\n";
        it = adjacent_find (intSet.begin( ), intSet.end( ));
        cout << '\t' << *it++ << endl;
        cout << '\t' << *it << endl << endl;

        // Find the second pair of equal values.
        cout << "\n\tSecond matching pair:\n";
        it = adjacent_find (it, intSet.end());
        cout << '\t' << *it++ << endl;
        cout << '\t' << *it << endl;
        return 0;
}
```

Ex160.cpp program [illegible] run [illegible] set element (7) [illegible] create [illegible] 3 [illegible] 8 [illegible] (2) [illegible] adjacent_find( ) algorithm [illegible]



```
        Contents of set:
        1
        3
        3
        5
        8
        8
        10


        First matching pair:
        3
        3


        Second matching pair:
        8
        8

Any key to return to Quincy...
```

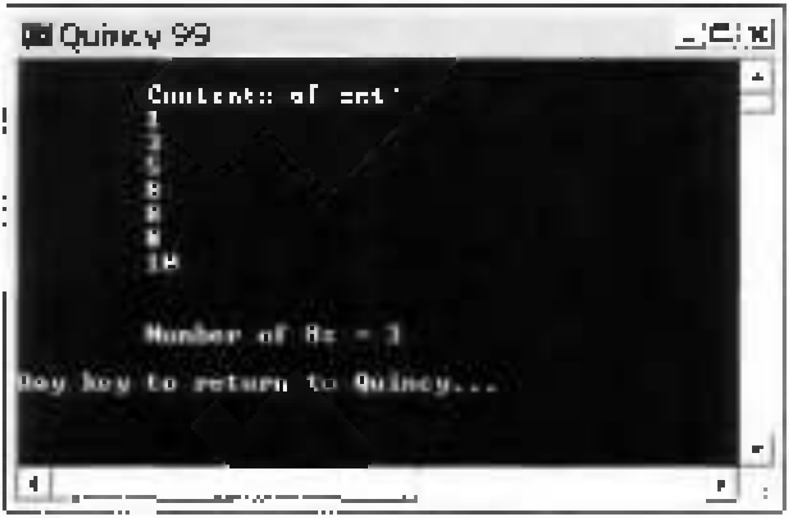
[illegible]

၁၆.၂ Using the count( ) Function

[illegible] [illegible] Ex1602.cpp program [illegible] set object [illegible] [illegible] element [illegible] [illegible] program [illegible] count( ) algorithm [illegible] [illegible]

```
// Listing 16.2: Using the count( ) function
#include <iostream>
#include <set>
#include <algorithm>

int main( )
{
        // Create the set object.
        multiset<int, less<int> > intSet;
        intSet.insert(10);
        intSet.insert(8);
        intSet.insert(1);
        intSet.insert(3);
        intSet.insert(8);
        intSet.insert(8);
        intSet.insert(5);

        cout << "\n\tContents of set:\n";
        multiset<int, less<int> >::iterator it = intSet.begin( );
        for  (int x=0; x < intSet.size( ); ++x)
                cout << "\t" << *it++ << endl;
        cout << endl;

        // Count the number of 8s in the set.
        int  cnt = count (intSet.begin( ), intSet.end( ), 8);
        cout << "\n\tNumber of 8s = " << cnt << endl;

        return  0;
}
```

[illegible] Ex1502.cpp program [illegible] run [illegible] create [illegible] sequence [illegible] (8) [illegible]



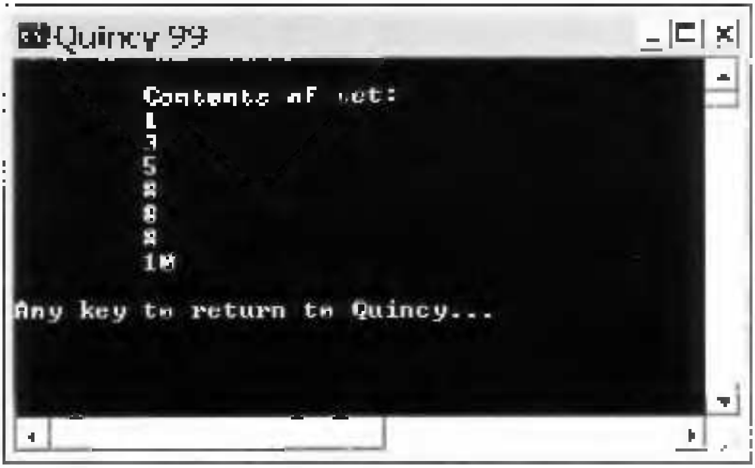
```
Contents of set:
1
2
5
8
8
8
10

Number of 8s = 3

Any key to return to Quincy...
```

(ပုံ ၁၆.၂)

၁၆.၃ Using the for_each( ) Function

Ex1603.cpp program [illegible] for_each (start, end, func_call) format [illegible] sequence [illegible] element [illegible] sorted order [illegible] display [illegible] program [illegible] count( ) algorithm [illegible]

```
// Listing 16.3: Using the for_each( ) function
#include <iostream>
#include <set>
#include <algorithm>

void showVal(int val)
{
        cout << '\t' << val << endl;
}

int main( )
{
        // Create the set object.
        multiset<int, less<int> > intSet;

        // Populate the set with values.
        intSet.insert(10);
        intSet.insert(8);
        intSet.insert(1);
        intSet.insert(3);
        intSet.insert(8);
        intSet.insert(8);
        intSet.insert(5);

        // Display the contents of the set.
        cout << "\n\tContents of set:\n";
        for_each(intSet.begin( ), intSet.end( ), showVal);

        return 0;
}
```



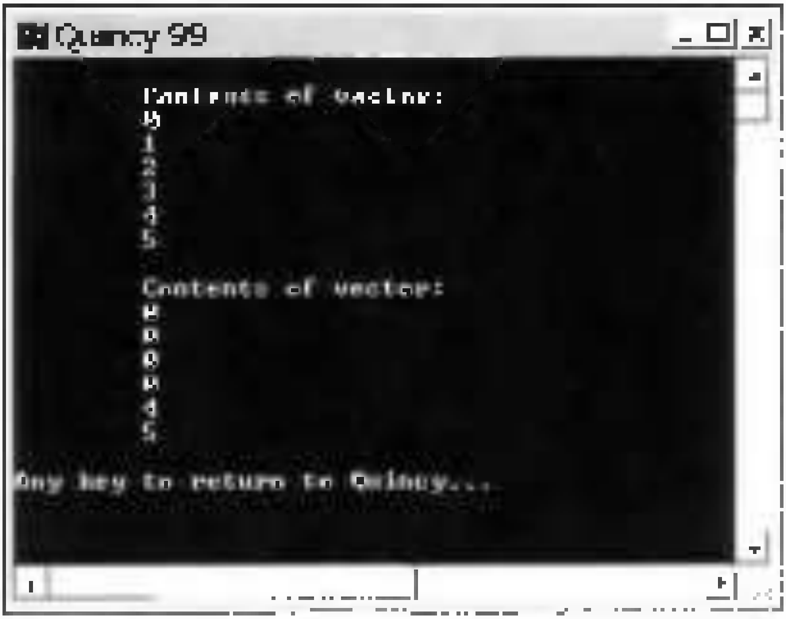
```
        Contents of set:
        1
        3
        5
        8
        8
        8
        10

Any key to return to Quincy...
```

၁၆.၄ Using the fill( ) Function

[illegible] sequence operation [illegible] container [illegible] modify [illegible] algorithm [illegible] Mutating sequence algorithm [illegible] sequence [illegible] same sequence [illegible] copy [illegible] sequence operation [illegible] container content [illegible] Mutating sequence algorithm [illegible] copy( ), copy_backward( ), fill( ), generate( ), partition( ), random_shuffle( ), swap( ), swap_ranges( ), remove( ), replace( ), rotate( ), reverse( ), transform( ), unique( ) [illegible] Ex16f4.cpp program [illegible] fill( ) algorithm [illegible]

```
// Listing 16.4: Using the fill( ) function
#include <iostream>
#include <vector>
#include <algorithm>

void showVal(int val)
{
        cout << "\t" << val << endl;
}

int main( )
{
        vector<int> intVector;          // Create the vector object

        for (int x=0; x<6; ++x)
                intVector.push_back(x);
        cout << "\n\tContents of vector:\n";
        for_each (intVector.begin( ), intVector.end( ), showVal);

        // Fill vector with zeroes.
        fill (intVector.begin( ), intVector.begin( ) + 4, 0);

        // Display the contents of the new vector.
        cout << "\n\tContents of vector:\n";
        for_each (intVector.begin( ), intVector.end( ), show);
        return 0;
}
```

[illegible] Ex1604.cpp program [illegible] run [illegible] create [illegible] sequence [illegible] fill [illegible]



```
        Contents of vector:
        0
        1
        2
        3
        4
        5

        Contents of vector:
        0
        0
        0
        0
        4
        5

Any key to return to Quincy...
```

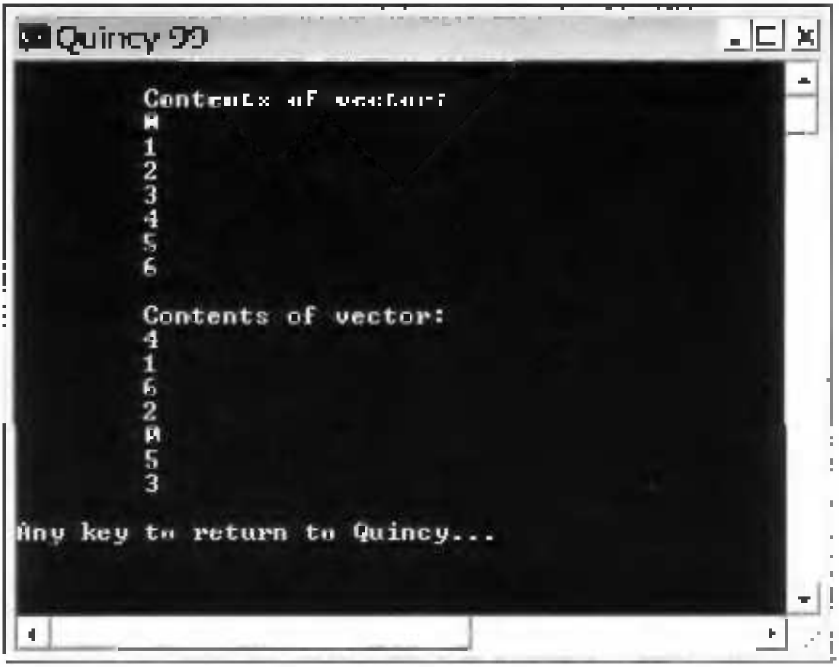
[illegible]

၁၆.၅ Using the random_shuffle( ) Function

[illegible] Ex1605.cpp program [illegible] sequence [illegible] value [illegible] random_shuffle( ) generic algorithm [illegible] program [illegible] algorithm [illegible] sequence element [illegible] modify [illegible]

```
// Listing 16.5: Using the random_shuffle( ) function
#include <iostream>
#include <vector>
#include <algorithm>

void  showVal(int val)
{
        cout << '\t' << val << endl;
}

int main( )
{
        // Create the vector object
        vector<int> intVector;

        // Populate the vector with values.
        for (int x=0; x<7; ++x)
                intVector.push_back(x);

        // Display the contents of the vector.
        cout << "\n\nContents of vector:\n";
        for_each (intVector.begin( ), intVector.end( ), showVal);

        // Shuffle the vector
        random_shuffle (intVector.begin( ), intVector.end( ));

        // Display the contents of the new vector.
        cout << "\n\nContents of vector:\n";
        for_each (intVector.begin( ), intVector.end( ), showVal);

        return 0;
}
```

Ex16_05.cpp program [illegible] run [illegible] sequence [illegible] modify [illegible] (2) [illegible]



```
Contents of vector:
0
1
2
3
4
5
6

Contents of vector:
4
1
6
2
0
5
3

Any key to return to Quincy...
```

ပုံ (၁၆-၅)

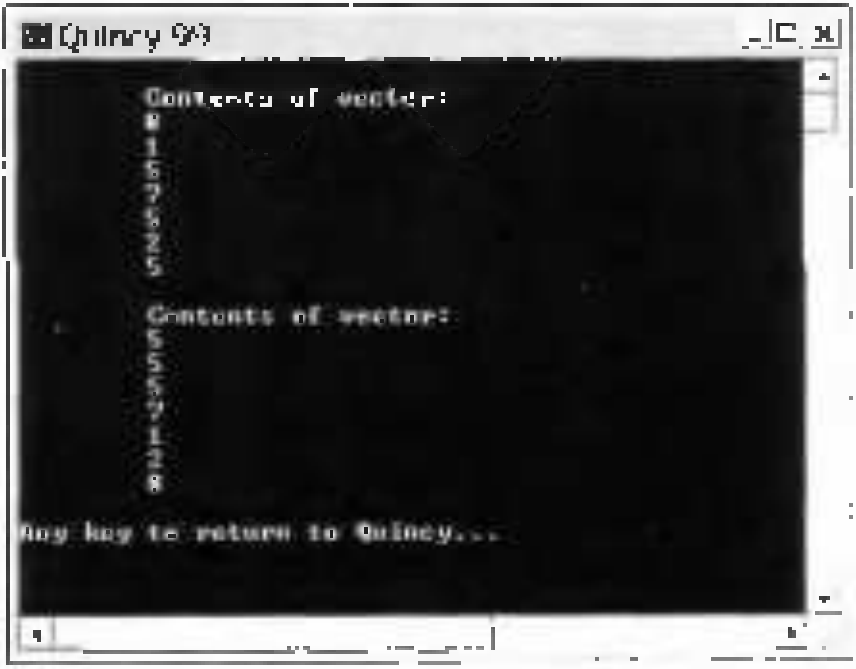
၁၆.၆ Using the partition( ) Function

။ Ex1606.cpp program [illegible] sequence [illegible] element [illegible] element [illegible] sequence [illegible] program [illegible] partition( ) algorithm [illegible] program [illegible]။

```
// Listing 16.6: Using the partition( ) function
#include <iostream>
#include <vector>
#include <algorithm>

void  showVal(int  val)
{       cout << '\t' << val << endl;        }
```

```
bool  equals5 (int val)
{
        return (val == 5);
}


int main( )
{
        // Create the vector object
        vector <int> intVector;

        //  Populate the vector with values.intVector.push_back(6);
        intVector.push_back(5);
        intVector.push_back(1);
        intVector.push_back(7);
        intVector.push_back(5);
        intVector.push_back(7);
        intVector.push_back(5);

        cout << "\n\nContents of vector:\n";
        for_each (intVector.begin( ), intVector.end( ), showVal);

        // Partition the vector.
        partition (intVector.begin( ), intVector.end( ), equals5);

        // Display the contents of the new vector
        cout << "\n\nContents of vector:\n";
        for_each (intVector.begin( ), intVector.end( ), showVal);

        return 0;
}
```

Ex16-06.cpp program [illegible] create [illegible] sequence element [illegible] (5) [illegible] sequence [illegible] partition [illegible] (5) [illegible] (7) [illegible] (7) [illegible] sorted [illegible]



```
        Contents of vector:
        8
        1
        5
        7
        5
        2
        5

        Contents of vector:
        5
        5
        5
        7
        1
        2
        8

Any key to return to Quincy...
```

ပုံ (၁၆.၆)

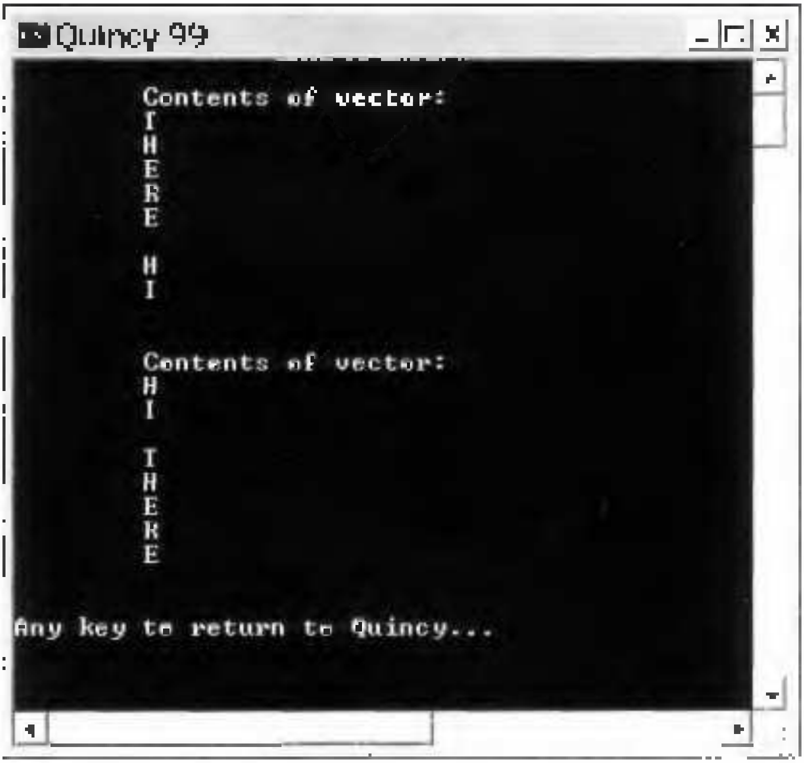
၁၆.၇ Using the rotate( ) Function

Ex1607.cpp program [illegible] sequence [illegible] element [illegible] program [illegible] rotate( ) algorithm [illegible] program [illegible]

```
// Listing 16.7. Using the rotate( ) function
#include <iostream>
#include <vector>
#include <algorithm>

void  showVal(char  val)
{        cout << "\t" << val << endl;          }
```

```
int main( )
{
        // Create the vector object
        vector<char> charVector;

        // Populate the vector with values
        charVector.push_back('T');
        charVector.push_back('H');
        charVector.push_back('E');
        charVector.push_back('R');
        charVector.push_back('E');
        charVector.push_back(' ');
        charVector.push_back('H');
        charVector.push_back('I');
        charVector.push_back(' ');

        // Display the contents of the vector
        cout << "\n\nContents of vector:\n";
        for_each (charVector.begin( ), charVector.end( ), showVal);

        // Rotate the vector.
        rotate (charVector.begin( ),charVector.begin( )+6, charVector.end( ));

        // Display the contents of the new vector.
        cout << "\n\nContents of vector:\n";
        for_each (charVector.begin( ), charVector.end( ), showVal);

        return 0;
}
```

Ex1607.cpp program [illegible] run [illegible] create [illegible] THERE HI sequence [illegible] (6) [illegible] element [illegible] HI THERE sequence [illegible] rotate [illegible]



```
        Contents of vector:
        T
        H
        E
        R
        E

        H
        I


        Contents of vector:
        H
        I

        T
        H
        E
        R
        E

Any key to return to Quincy...
```

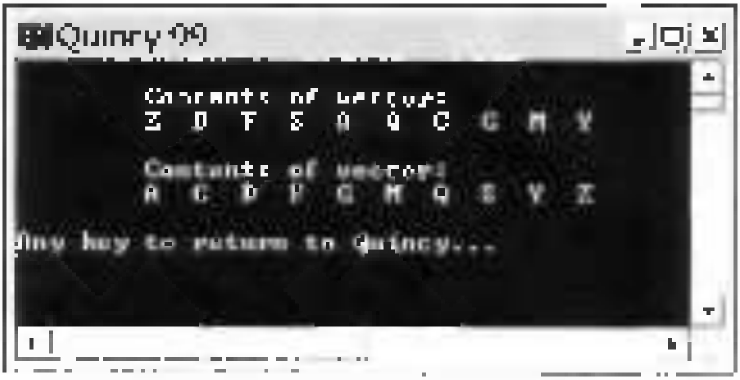
ပုံ (၁၆.၇)

၁၆.၈ Using the sort( ) Function

[illegible] Sorting algorithm [illegible] sort( ), partial_sort( ) merge( ) [illegible] algorithm [illegible] Ex1608.cpp program [illegible] sequence [illegible] char element [illegible] sort( ) algorithm program [illegible] A to Z [illegible] ပုံ (၁၆.၈) [illegible] Ex1608.cpp program [illegible] run [illegible]

```
// Listing 16.8  Using the sort( ) function
#include <iostream>
#include <vector>
#include <algorithm>
```

```
void showVal(char val)
{         cout << val << " ";       }
int main( )
{
        // Create and populate the vector object
        vector<char> charVector;
        charVector.push_back('Z');
        charVector.push_back('D');
        charVector.push_back('F');
        charVector.push_back('S');
        charVector.push_back('A');
        charVector.push_back('Q');
        charVector.push_back('C');
        charVector.push_back('G');
        charVector.push_back('M');
        charVector.push_back('Y');
        cout << "\n\tContents of vector:\n\t";
        for_each (charVector.begin( ), charVector.end( ), showVal);

        sort (charVector.begin( ), charVector.end( ));

        // Display the contents of the new vector.
        cout << "\n\n\tContents of vector:\n\t";
        for_each (charVector.begin( ), charVector.end( ), showVal);
        cout << endl;
        return 0;
}
```



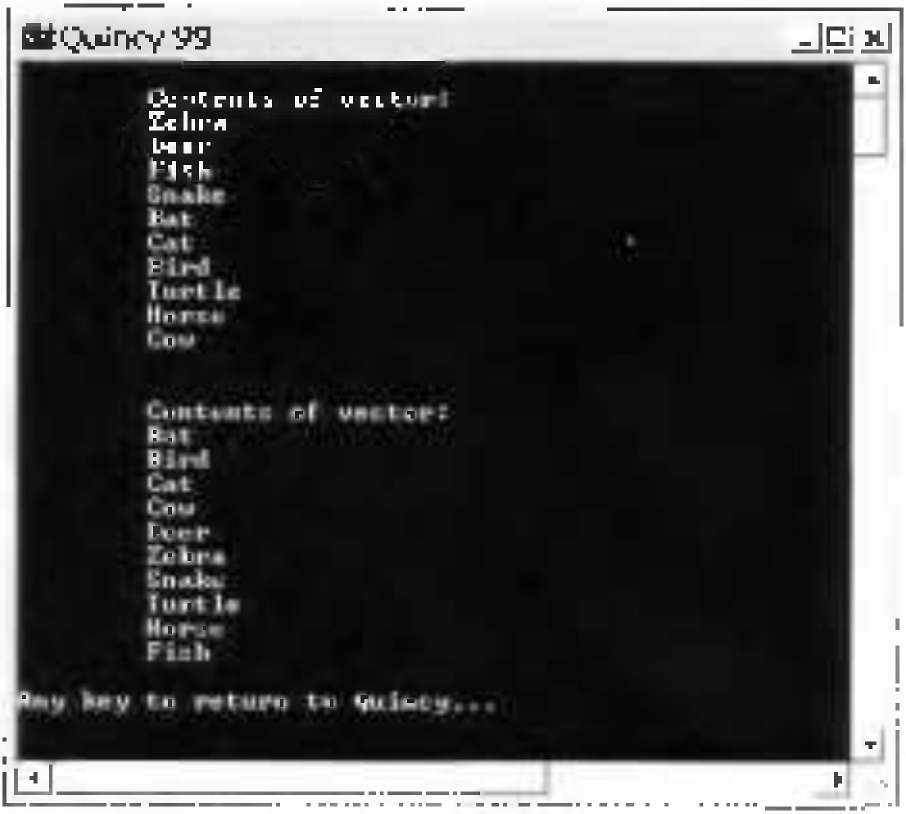
```
        Contents of vector:
        Z  D  F  S  A  Q  C  G  M  Y

        Contents of vector:
        A  C  D  F  G  M  Q  S  Y  Z
Any key to return to Quincy...
```

၁၆.၉ Using the partial_sort( ) Function

Ex1609.cpp program [illegible] (10) char element [illegible] sequence [illegible] char (5) [illegible] sort [illegible] program [illegible] partial_sort( ) algorithm [illegible] program [illegible] run [illegible]

```
// Listing 16.9 Using the partial_sort( ) function
#include <iostream>
#include <vector>
#include <algorithm>
#include <string>

void  showval(string  val)
{        cout << "\t" << val << endl;          }

int  main( )
{
        // Create the vector object
        vector<string> strVector;

        // Populate the vector with values
        strVector.push_back("Zebra");
        strVector.push_back("Deer");
        strVector.push_back("Fish");
        strVector.push_back("Snake");
        strVector.push_back("Bat");
        strVector.push_back("Cat");
        strVector.push_back("Bird");
        strVector.push_back("Turtle");
        strVector.push_back("Horse");
        strVector.push_back("Cow");
```

```
    // Display the contents of the vector
    cout << "\n\tContents of vector:\n";
    for_each (strVector.begin( ), strVector.end( ), showVal);
    cout << endl;

    // Sort the vector.
    partial_sort (strVector.begin( ),strVector.begin() + 5, strVector.end( ));

    // Display the contents of the new vector.
    cout << "\n\tContents of vector:\n";
    for_each (strVector.begin( ), strVector.end( ), showVal);
    return 0;
}
```



```
        Contents of vector:
        Zebra
        Deer
        Fish
        Snake
        Bat
        Cat
        Bird
        Turtle
        Horse
        Cow


        Contents of vector:
        Bat
        Bird
        Cat
        Cow
        Deer
        Zebra
        Snake
        Turtle
        Horse
        Fish

Any key to return to Quincy...
```

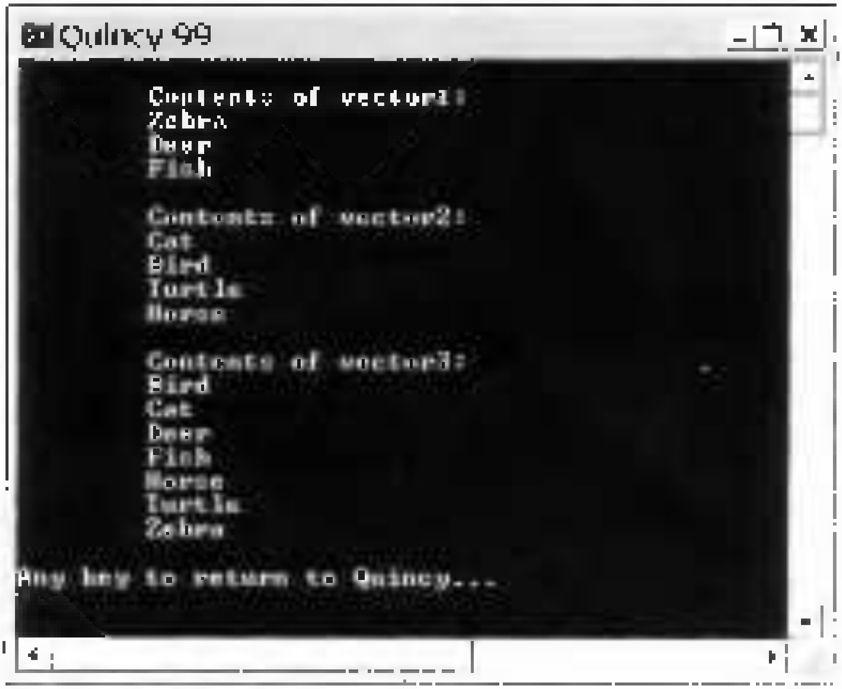
(15.2)

၁၆.၁၀ Using the merge( ) Function

Ex1610.cpp program [illegible] vector object (2) [illegible] program [illegible] merge [illegible] element [illegible] program [illegible] run [illegible]

```
// Listing 16.10: Using the merge( ) function
#include <iostream>
#include <vector>
#include <algorithm>
#include <string>

void  showVal(string  val)
{
        cout << "\t" << val << endl;
}

int  main( )
{
        // Create the vector objects.
        vector<string>  strVector1;
        vector<string>  strVector2;
        vector<string>  strVector3(7);

        // Populate two vectors with values.
        strVector1.push_back("Zebra");
        strVector1.push_back("Deer");
        strVector1.push_back("Fish");

        strVector2.push_back("Cat");
        strVector2.push_back("Bird");
        strVector2.push_back("Turtle");
        strVector2.push_back("Horse");

        // Display the contents of the vectors.
        cout << "\n\tContents of vector1:\n";
```

```
    for_each (strVector1.begin( ), strVector1.end( ), showVal);
    cout << "\n\tContents of vector2:\n";
    for_each (strVector2.begin( ), strVector2.end( ), showVal);

    // Sort the vectors.
    sort (strVector1.begin( ), strVector1.end( ));
    sort (strVector2.begin( ), strVector2.end( ));

    // Merge the sorted vectors.
    merge (strVector1.begin( ), strVector1.end( ),
    strVector2.begin( ), strVector2.end( ),
    strVector3.begin( ));

    // Display the contents of the new vector.
    cout << "\n\tContents of vector3:\n";
    for_each(strVector3.begin( ), strVector3.end( ), showVal);
    return 0;
}
```



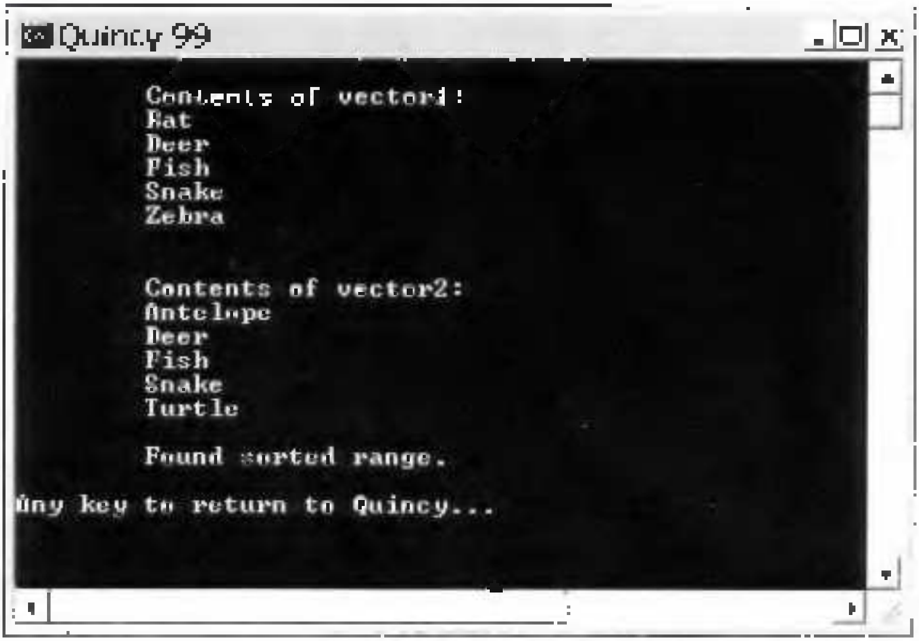
```
        Contents of vector1:
        Zebra
        Deer
        Fish

        Contents of vector2:
        Cat
        Bird
        Turtle
        Horse

        Contents of vector3:
        Bird
        Cat
        Deer
        Fish
        Horse
        Turtle
        Zebra

Any key to return to Quincy...
```

[illegible]

More on Using the merge( ) Function

```
// Listing 16.11: More on using the merge( ) function
#include <iostream>
#include <vector>
#include <algorithm>
#include <string>

void  showval(string  val)
{
        cout << "\t" << val << endl;
}

int  main( )
{
        // Create the vector objects.
        vector<string>  strVector1;
        vector<string>  strVector2;

        // Populate two vectors with values
        strVector1.push_back("Zebra");
        strVector1.push_back("Deer");
        strVector1.push_back("Fish");
        strVector1.push_back("Snake");
        strVector1.push_back("Bat");

        strVector2.push_back("Tiger");
        strVector2.push_back("Antelope");
        strVector2.push_back("Turtle");
        strVector2.push_back("Snake");
        strVector2.push_back("Fish");

        // Sort the vectors.
        sort (strVector1.begin( ), strVector1.end( ));
        sort (strVector2.begin( ), strVector2.end( ));
```

```
    // Display the contents of the vectors.
    cout << "\n\tContents of vector1:\n";
    for_each (strVector1.begin( ), strVector1.end( ), showVal);
    cout << endl;
    cout << "\n\tContents of vector2:\n";
    for_each (strVector2.begin( ), strVector2.end( ), showVal);
    cout << endl;

    // Search for the sorted range Deer, Fish, Snake.
    bool result = includes(strVector1.begin( ), strVector1.end( ),
            strVector2.begin( )+1, strVector2.begin()+3);
    if (result)
            cout << "\tFound sorted range.\n";
    else
            cout << "\tDid not find sorted range.\n";
    return 0;
}
```



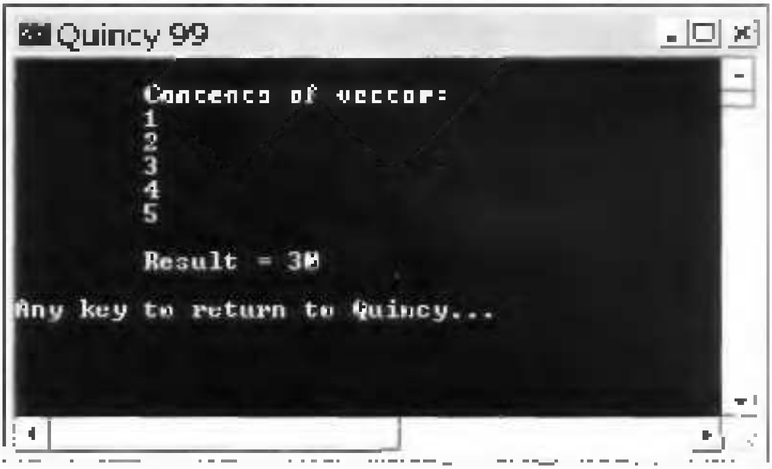
```
        Contents of vector1:
        Rat
        Deer
        Fish
        Snake
        Zebra


        Contents of vector2:
        Antelope
        Deer
        Fish
        Snake
        Turtle

        Found sorted range.

Any key to return to Quincy...
```

[illegible] (05- 22)

၁၆.၁၁ Using the accumulate( ) Function

[illegible] accumulate( ) inner_product( ) partial_sum( ) adjacent_difference( ) [illegible] Numeric algorithm [illegible] Ex1612.cpp program [illegible] accumulate( ) algorithm [illegible] vector object [illegible] program [illegible] program [illegible] run [illegible]

```
// Listing 16.12: Using the accumulate( ) function
#include <iostream>
#include <vector>
#include <algorithm>
#include <numeric>

void  showVal(int  val)
{         cout << " " << val << endl;          }

int  main( )
{
        // Create and populate the vector object
        vector<int>  intVec;
        for  (int  x=1; x<6; x++)
                intVec.push_back(x);

        // Display the contents of the vector
        cout << "\nContents of vector:\n";
        for_each (intVec.begin( ),intVec.end( ), showVal);
        cout << endl;

        // Calculate and display sum
        int  result = accumulate(intvec.begin( ),intvec.end( ), 15);
        cout << "\tResult = " << result << endl;

        return  0;
}
```



```
        Contents of vector:
        1
        2
        3
        4
        5

        Result = 30

Any key to return to Quincy...
```

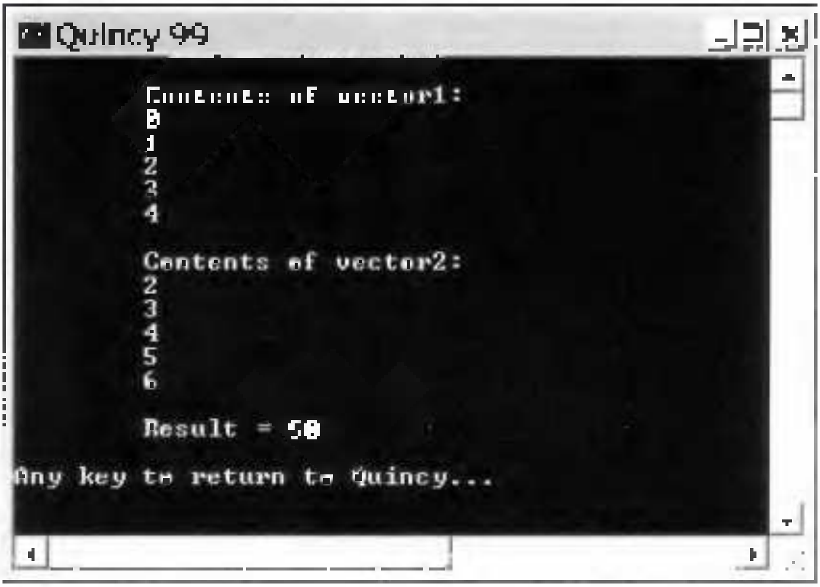
ပုံ (၁၆.၁၂)

၁၆.၁၂ Using the inner_product( ) Function

[illegible] vector object (2) ခု [illegible] {0,1,2,3,4} နဲ့ {2,3,4,5,6} တို့ရဲ့ inner product [illegible] (0*2+1*3+2*4+3*5+4*6) [illegible] Ex1613.cpp program [illegible] ပုံ (၁၆.၁၃) မှာ run [illegible]

```
// Listing 16.13: Using the inner_product( ) function
#include <iostream>
#include <vector>
#include <algorithm>
#include <numeric>

void  showval (int  val)
{
        cout << "\t" << val << endl;
}
```

```
int main( )
{
        // Create and populate the two vector objects.
        vector<int> intVector1;
        vector<int> intVector2;
        for (int x=0; x<5; ++x)    intVector1.push_back(x);
        for (int x=2; x<7; ++x)    intVector2.push_back(x);

        // Display the contents of the vectors.
        cout << "\n\tContents of vector1:\n";
        for_each (intVector1.begin( ), intVector1.end( ), showVal);
        cout << "\n\tContents of vector2:\n";
        for_each (intVector2.begin( ),intVector2.end( ), showVal);
        cout << endl;

        // Calculate the inner product.
        int result = inner_product(intVector1.begin( ),
                        intVector1.end( ), intVector2.begin( ), 0);
        cout << "\tResult = " << result << endl;
        return 0;
}
```



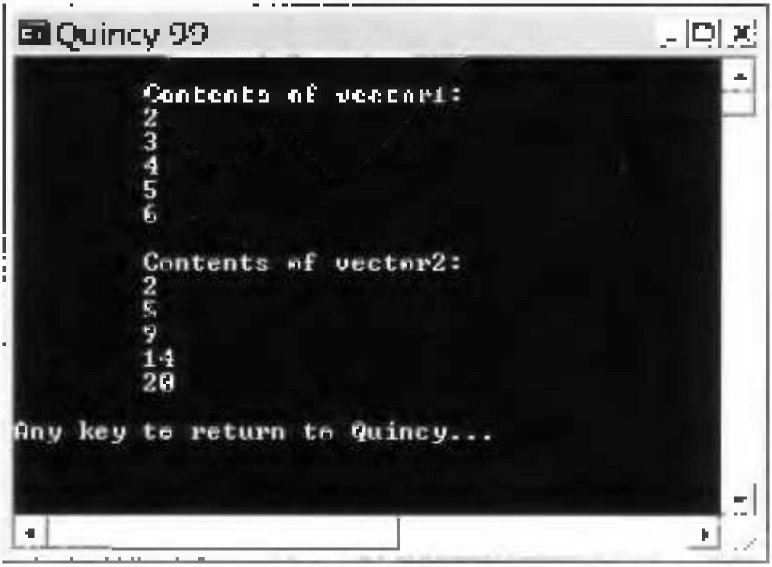
```
        Contents of vector1:
        0
        1
        2
        3
        4

        Contents of vector2:
        2
        3
        4
        5
        6

        Result = 50

Any key to return to Quincy...
```

၁၆.၁၄ Using the partial_sum( ) Function

Ex1614.cpp program [illegible] vector object [illegible] {2,3,4,5,6} [illegible] second vector [illegible] partial_sum( ) algorithm [illegible] (2, 3+2, 4+(3+2), 5+(4+3+2), 6+(5+4+3+2)) create [illegible] program [illegible] program [illegible]

```
// Listing 16.14  Using the partial_sum( ) function
#include <iostream>
#include <vector>
#include <algorithm>
#include <numeric>

void  showVal(int  val)
{
	cout << "\t" << val << endl;
}

int  main( )
{
	// Create the vector objects.
	vector<int> intVector1;
	vector<int> intVector2(4);

	// Populate the vector.
	for  (int  x=2; x<7; ++x)  intVector1.push_back(x);

	// Display the contents of the vector.
	cout << "\n\tContents of vector1:\n";
	for_each (intVector1.begin( ), intVector1.end( ), showVal);

	// Calculate the partial sum.
	partial_sum(intVector1.begin( ), intVector1.end( ), intVector2.begin( ));
```

```
        // Display the contents of the resultant vector.
        cout << "\n\tContents of vector2:\n";
        for_each (intVector2.begin( ), intVector2.end( ), showVal);

        return 0;
}
```



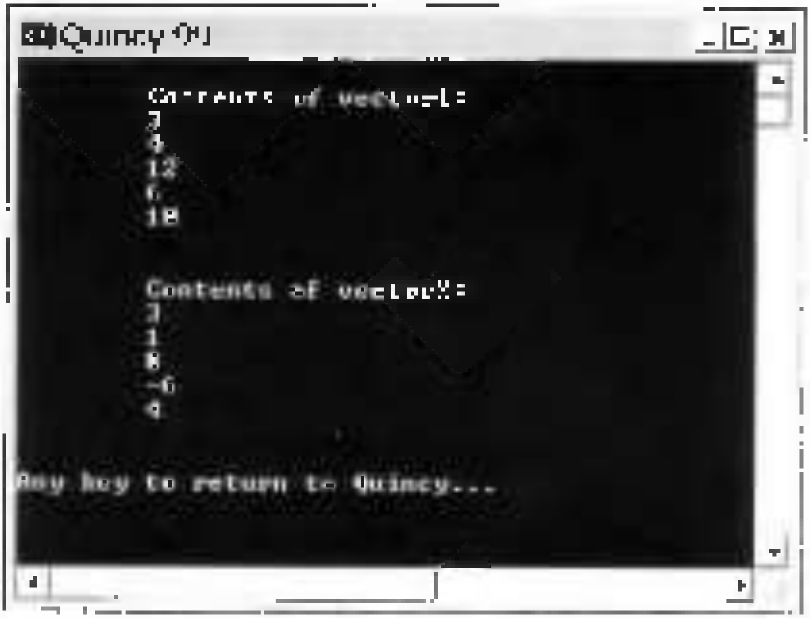
```
        Contents of vector1:
        2
        3
        4
        5
        6

        Contents of vector2:
        2
        5
        9
        14
        20

Any key to return to Quincy...
```

ပုံ (၁၆.၁၄)

၁၆.၁၄ Using the adjacent_difference( ) Function

အောက်မှာဖော်ပြထားတဲ့ Ex1615.cpp program ဟာ vector object တစ်ခု ဖြစ်တဲ့ {3, 4, 12,6,10} ထဲမှ second vector တစ်ခုကို partial difference( ) algorithm အသုံးပြုပြီး အစဉ် {3, 4-3,12-4, 6-12, 10-6} create လုပ်ပေးမှာဖြစ်တဲ့ program ဖြစ်ပါတယ်။ Ex1615.cpp program ကို ပုံ (၁၆.၁၅) မှာ run ပြထားပါတယ်။ လေ့လာကြည့်ပါ။

```
// Listing 16.15: Using the adjacent_difference( ) function
#include <iostream>
#include <vector>
#include <algorithm>
#include <numeric>


void  showVal (int  val)
{
        cout << "\t" << val << endl;
}


int  main( )
{
        // Create the vector objects
        vector<int> intVector1;
        vector<int> intVector2(5);

        // Populate the vector.
        intVector1.push_back(3);
        intVector1.push_back(4);
        intVector1.push_back(12);
        intVector1.push_back(6);
        intVector1.push_back(10);

        // Display the contents of the vector
        cout << "\n\tContents of vector1:\n";
        for_each (intVector1.begin( ),intVector1.end( ), showVal);
        cout << endl;

        // Calculate the partial sum.
        adjacent_difference(intVector1.begin( ),
                intVector1.end( ), intVector2.begin( ));

        // Display the contents of the resultant vector.
        cout << "\n\tContents of vector2:\n";
        for_each (myVector2.begin( ), myVector2.end( ), showVal);
        cout << endl;

        return 0;
}
```



```
        Contents of vector1:
        3
        4
        12
        6
        18

        Contents of vector2:
        3
        1
        8
        -6
        4

Any key to return to Quincy...
```

[illegible]