NOI 2016 Reference Sheet

Compiled by Sun Yudong

March 19, 2016

Don't Panic

1 Sorts

1.1 Merge Sort

```
#include <iterator>
#include <algorithm> // for std::inplace_merge
#include <functional> // for std::less

template<typename RandomAccessIterator, typename Order>
void mergesort(RandomAccessIterator first, RandomAccessIterator last, Order order)
{
    if (last - first > 1)
    {
        RandomAccessIterator middle = first + (last - first) / 2;
        mergesort(first, middle, order);
        mergesort(middle, last, order);
        std::inplace_merge(first, middle, last, order);
    }
}

template<typename RandomAccessIterator>
void mergesort(RandomAccessIterator first, RandomAccessIterator last)
{
    mergesort(first, last, std::less<typename
        std::iterator_traits<RandomAccessIterator>::value_type>());
}
```

1.2 Sort using Algorithm Package

Using arrays:

```
// sort() Example using arrays.
// By Zereo 04/22/13
#include <iostream>
#include <algorithm>

using namespace std;

const int SIZE = 7;

int main()
{
    int intArray[SIZE] = {5, 3, 32, -1, 1, 104, 53};

    //Now we call the sort function
    sort(intArray, intArray + SIZE);
    //Alternatively in C++11
    sort(begin(intArray), end(intArray));

    cout << "Sorted Array looks like this." << endl;
    for (size_t i = 0; i != SIZE; ++i)
    cout << intArray[i] << " ";

    return 0;
}
```

And using vectors:

```
// Vector Sorting Example.
// By Zereo 04/22/13
#include <iostream>
#include <algorithm>
#include <vector>
#include <string>

using namespace std;

int main()
{
    // Warning this type of initialization requires a C++11 Compiler
    vector<int> intVec = {56, 32, -43, 23, 12, 93, 132, -154};
    vector<string> stringVec = {"John", "Bob", "Joe", "Zack", "Randy"};

    // Sorting the int vector
    sort(intVec.begin(), intVec.end());

    for (vector<int>::size_type i = 0; i != intVec.size(); ++i)
    cout << intVec[i] << " ";

    cout << endl;

    // Sorting the string vector
    sort(stringVec.begin(), stringVec.end());

    // Ranged Based loops. This requires a C++11 Compiler also
    // If you don't have a C++11 Compiler you can use a standard
    // for loop to print your vector.
    for (string &s : stringVec)
    cout << s << " ";

    return 0;
}
```

2 Greatest Common Divisor

```
unsigned int gcd(unsigned int u, unsigned int v)
{
    int shift;

    /* GCD(0,v) == v; GCD(u,0) == u, GCD(0,0) == 0 */
    if (u == 0) return v;
    if (v == 0) return u;

    /* Let shift := lg K, where K is the greatest power of 2 dividing both u and v. */
    for (shift = 0; ((u | v) & 1) == 0; ++shift) {
        u >>= 1;
        v >>= 1;
    }

    while ((u & 1) == 0) {
        u >>= 1;
    }

    /* From here on, u is always odd. */
    do {
        /* remove all factors of 2 in v -- they are not common */
        /*   note: v is not zero, so while will terminate */
        while ((v & 1) == 0) /* Loop X */ {
            v >>= 1;
        }

        /* Now u and v are both odd. Swap if necessary so u <= v,
        then set v = v - u (which is even). For bignums, the
        swapping is just pointer movement, and the subtraction
        can be done in-place. */

        if (u > v) {
            unsigned int t = v; v = u; u = t;} // Swap u and v.
            v = v - u;                       // Here v >= u.
    } while (v != 0);

    /* restore common factors of 2 */
    return u << shift;
}
```

3 deque

```
deque();                                    //default constructor
deque<int> dq1;                             //produces empty deque of ints

deque(const deque& d );                     //copy constructor
deque<int> dq2(dq1);                        //creates a copy of dq1 in dq2
deque<int> dq2(dq1.begin(), dq1.end());
deque<int> dq2(dq1.rbegin(), dq1.rend());   //create a new deque, reversing dq1 by using
    reverse iterators

deque(size_type number, const T& value=T() ); //initialization construction
deque<double> dq3(10);                      //deque of doubles with 10 elements set to default
    (0.0)
deque<double> dq4(5, 8.1);                  //deque of doubles with 5 elements set to 8.1

deque(iterator start, iterator end );       //interator constructor
double array1[]={0.0,1.0,2.0,3.0,4.0,5.0,6.0,7.0,8.0,9.0};
deque<double> dq5(array1,array1+4);         //constructs deque with elements 0-3 from array1

/*----------*/

#include <stdexcept>  //required for defining and catching standard exceptions

deque<double> dq(5, 8.1);

for (int i=0; i<=5; ++i) {
    cout << "Element "<< i << " accessed with [] : "<< dq[i] << endl;
}
```

```
try {
    cout << "Element " << i << " accessed with at(i) :" << dq.at(i) << endl;
} catch (out_of_range&) {
    cout << "**out of range exception accessing element " << i << " with at() **" << endl;
}

/*---------*/

dq.at(2)=9.5                /* to change the element */
dq.size()                   /* Size of deque */
(dq.empty())                /* Is deque empty? Return true if it is*/
dq.max_size()               /* Maximum size of deque */
dq.push_back(i)             /* Add elements to the back */
dq.push_front(i)            /* Add elements to the front */
dq.pop_front()              /* Remove first element */
dq.pop_back()               /* Remove last element */

/* display to screen */
for (int i=0; i<(signed)dq.size(); ++i) cout << dq.at(i);

/* insert array into deque */
int array[]= { 0, 1, 2, 3, 4 };
dq.insert(dq.begin()+2, array, array+5);

dq.insert(dq.begin()+4, 3, 0);   /* insert 3 copies of 0s */
dq.erase(dq.end()-2);            /* erase the next-to-last element */
    /* note: end() returns and iterator to the point just past the end of the queue. */
dq.erase(dq.begin(),dq.begin()+3); /* erase the first three elements */

/* ----- */

//  declare two deques and intialize the second to contain 10 zeros
deque<int> dq1;
deque<int> dq2(10,0);

dq1.assign(10,5);  /* assign 10 copies of the int 5 to deque 1 */
dq1.resize(15,10);  /* resize deque 1, trailing elems truncated, new elems initialized to 10 */
dq1.swap(dq2);    /* swap contents of the deques */
dq1.clear();      /* clears and empties dq1, size will return 0 */

/* iterate through a deque */
for (deque<int>::iterator itr = dq.begin(); itr != dq.end(); ++itr)
```

4 Vectors

```
/* initializing a vector */
    vector<int> v { 34,23 };
    vector<int> v[1000005];

    vector<int> v(2);
    v = { 34,23 };

    vector<char> array;
    array.reserve(10) // If the vector already has room for the required number of elements,
        reserve() does nothing. In other words, reserve() will grow the allocated storage of
        the vector, if necessary, but will never shrink it.

/* using a vector */
v.push_back(1)        //adds the element 1 to the end of the vector
v.capacity()          //vector capacity
```

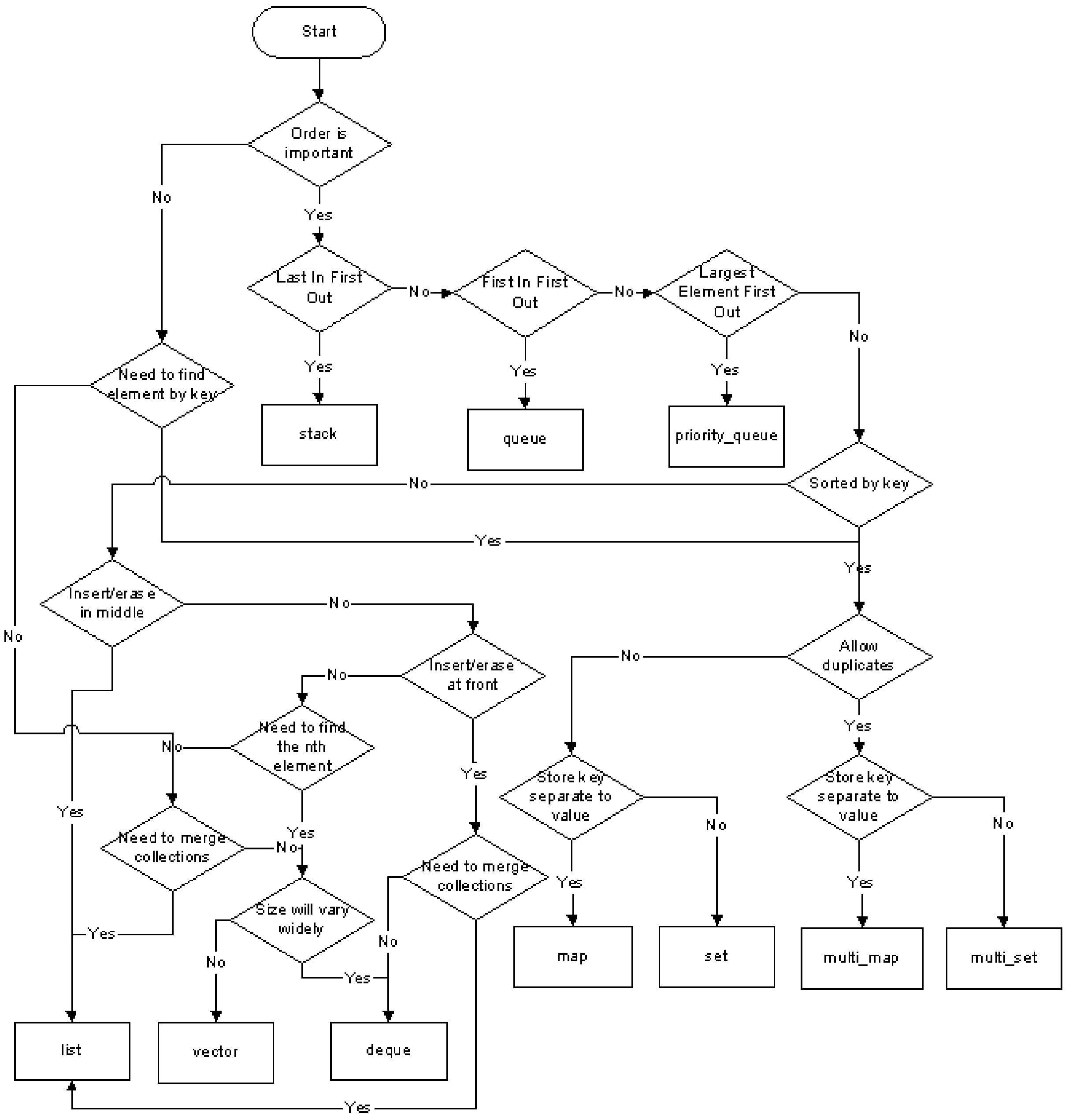
```
v.size()              //actually how many elements there are
v.resize(6, 1);       //similar to deque

double a[] = {1, 2, 3, 4, 5};
mean(a, 5)
/* is equal to */
vector<double> a; //and you push the necessary elements
mean(&a[0], 5)

/* inserting array into vector */
double p[] = {1, 2, 3, 4, 5};
vector<double> a(p, p+5);

/* interating */
vector<double>::const_iterator i;
   for(i=a.begin(); i!=a.end(); ++i){
   std::cout<<(*i)<<std::endl;
}
```

5 AARGHHHH

```
/* always begin with the right bits */
#include <bits/stdc++.h>

/* reading/writing from/to standard input */
scanf("%d", &n);
printf("%d\n", n);

/* reading/writing to filestreams */
ifstream fin("file1.txt");
ofstream fout("output.txt");
!stream1.eof()               //check if end of file

/* initializing an array */
long long int x[1000] = {x1, x2, ....};

/* getting the whole line */
string name;
cin.getline (name, [chars], [delim]); /* or */
getline(cin, name);
```

Here marks the end... Good luck! :D

Don't Panic


Start
Order is important
No
Yes
Last In First Out
No
First In First Out
No
Largest Element First Out
No
Yes
stack
Yes
queue
Yes
priority_queue
Need to find element by key
Sorted by key
No
Yes
Yes
Insert/erase in middle
No
Allow duplicates
No
Insert/erase at front
No
No
Need to find the nth element
No
Yes
Yes
Yes
Store key separate to value
No
Yes
Store key separate to value
No
Yes
Need to merge collections
No
Yes
Need to merge collections
No
Size will vary widely
No
Yes
Yes
map
set
multi_map
multi_set
list
vector
deque
Yes