

```
1: // $Id: xlist.h,v 1.6 2013-08-21 12:37:12-07 - - $
2:
3: #ifndef __XLIST_H__
4: #define __XLIST_H__
5:
6: template <typename T>
7: struct xlist {
8:     struct node;
9:     struct link {
10:         node* next;
11:         node* prev;
12:         explicit link (node* next = nullptr, node* prev = nullptr):
13:             next(next), prev(prev) {}
14:         node* operator&() { return static_cast<node*> (this); }
15:     };
16:     struct node: link {
17:         T item;
18:         explicit node (node* next = nullptr, node* prev = nullptr,
19:             const T& item = T()):
20:             link(next, prev), item(item) {}
21:     };
22:     link base;
23:
24:     xlist(): base (&base, &base) {}
25:     xlist (const xlist&) = delete;
26:     xlist& operator= (const xlist&) = delete;
27:     ~xlist() { while (not empty()) pop_back(); }
28:
29:     bool empty() { return base.next == &base; }
30:     void push_back (const T&);
31:     void pop_back();
32:     T& back() { return base.prev->item; }
33:
34:     class iterator;
35:     iterator begin() { return iterator (base.next); }
36:     iterator end() { return iterator (&base); }
37: };
38:
```

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39:
40: template <typename T>
41: struct xlist<T>::iterator {
42:     node* curr;
43:     explicit iterator (node* curr = nullptr): curr(curr) {}
44:     T& operator*() { return curr->item; }
45:     iterator& operator++() { curr = curr->next; return *this; }
46:     iterator& operator--() { curr = curr->prev; return *this; }
47:     bool operator== (const iterator &that) { return curr == that.curr; }
48:     bool operator!= (const iterator &that) { return curr != that.curr; }
49: };
50:
51: template <typename T>
52: void xlist<T>::push_back (const T& item) {
53:     node* tmp = new node (&base, base.prev, item);
54:     base.prev = tmp;
55:     tmp->prev->next = tmp;
56: }
57:
58: template <typename T>
59: void xlist<T>::pop_back() {
60:     node* tmp = base.prev;
61:     base.prev = tmp->prev;
62:     base.prev->next = &base;
63:     delete tmp;
64: }
65:
66: #endif
67:
```

```
1: // $Id: testxlist.cpp,v 1.3 2013-08-21 12:37:12-07 - - $
2:
3: #include <cxxabi.h>
4: #include <iostream>
5: #include <string>
6: #include <typeinfo>
7: using namespace std;
8:
9: #include "xlist.h"
10:
11: template <typename T>
12: ostream& show_node (typename xlist<T>::node* np) {
13:     cout << np << "->{next=" << np->next << ", prev=" << np->prev;
14:     return cout;
15: }
16:
17: template <typename T>
18: void show_list (const string &str, xlist<T>& thelist) {
19:     cout << str << ":" << endl;
20:     show_node<T> (&thelist.base) << "}" << endl;
21:     for (typename xlist<T>::iterator it = thelist.begin();
22:          it != thelist.end();
23:          ++it) {
24:         show_node<T> (it.curr) << ", item=" << *it << "}" << endl;
25:     }
26: }
27:
28: void test_int() {
29:     xlist<int> xli;
30:     cout << "sizeof (xlist) = " << sizeof (xli) << endl;
31:     cout << "sizeof (int) = " << sizeof (int) << endl;
32:     show_list ("After decl", xli);
33:     xli.push_back(3);
34:     xli.push_back(4);
35:     xli.push_back(5);
36:     xli.push_back(6);
37:     show_list ("After push_back", xli);
38:     cout << xli.back() << endl;
39:     xli.pop_back();
40:     cout << xli.back() << endl;
41:     xli.pop_back();
42:     show_list ("At end of test_int", xli);
43: }
44:
```

```
45:
46: void test_string() {
47:     xlist<string> xli;
48:     cout << "sizeof (xlist) = " << sizeof (xli) << endl;
49:     cout << "sizeof (string) = " << sizeof (string) << endl;
50:     show_list ("After decl", xli);
51:     xli.push_back("Hello");
52:     xli.push_back("World");
53:     xli.push_back("foo");
54:     xli.push_back("bar");
55:     show_list ("After push_back", xli);
56:     cout << xli.back() << endl;
57:     xli.pop_back();
58:     cout << xli.back() << endl;
59:     xli.pop_back();
60:     show_list ("At end of test_string", xli);
61: }
62:
63: int main() {
64:     string line = "-----";
65:     cout << line << endl;
66:     test_int();
67:     cout << line << endl;
68:     test_string();
69:     cout << line << endl;
70:     return 0;
71: }
72:
```

```
1: # $Id: Makefile,v 1.4 2013-08-21 12:37:12-07 - - $
2:
3: GPP = g++ -g -O0 -Wall -Wextra -std=gnu++0x
4: GRIND = valgrind --leak-check=full --show-reachable=yes
5: SOURCES = xlist.h testxlist.cpp Makefile
6:
7: all : testxlist
8:
9: testxlist : ${SOURCES}
10:      tput init
11:      ${GPP} testxlist.cpp -o testxlist
12:
13: ci : ${SOURCES}
14:      cid ${SOURCES}
15:
16: out : testxlist
17:      ${GRIND} testxlist 2>&1 | tee testxlist.output
18:
19: clean :
20:      - rm testxlist testxlist.output
21:
22: lis : out
23:      mkpspdf testxlist.ps ${SOURCES} testxlist.output
24:
```

```
1: ==25218== Memcheck, a memory error detector
2: ==25218== Copyright (C) 2002-2013, and GNU GPL'd, by Julian Seward et al
.
3: ==25218== Using Valgrind-3.10.1 and LibVEX; rerun with -h for copyright
info
4: ==25218== Command: testxlist
5: ==25218==
6: -----
7: sizeof (xlist) = 16
8: sizeof (int) = 4
9: After decl:
10: 0xffefff480->{next=0xffefff480, prev=0xffefff480}
11: After push_back:
12: 0xffefff480->{next=0x5a16140, prev=0x5a16260}
13: 0x5a16140->{next=0x5a161a0, prev=0xffefff480, item=3}
14: 0x5a161a0->{next=0x5a16200, prev=0x5a16140, item=4}
15: 0x5a16200->{next=0x5a16260, prev=0x5a161a0, item=5}
16: 0x5a16260->{next=0xffefff480, prev=0x5a16200, item=6}
17: 6
18: 5
19: At end of test_int:
20: 0xffefff480->{next=0x5a16140, prev=0x5a161a0}
21: 0x5a16140->{next=0x5a161a0, prev=0xffefff480, item=3}
22: 0x5a161a0->{next=0xffefff480, prev=0x5a16140, item=4}
23: -----
24: sizeof (xlist) = 16
25: sizeof (string) = 8
26: After decl:
27: 0xffefff450->{next=0xffefff450, prev=0xffefff450}
28: After push_back:
29: 0xffefff450->{next=0x5a16470, prev=0x5a166b0}
30: 0x5a16470->{next=0x5a16530, prev=0xffefff450, item=Hello}
31: 0x5a16530->{next=0x5a165f0, prev=0x5a16470, item=World}
32: 0x5a165f0->{next=0x5a166b0, prev=0x5a16530, item=foo}
33: 0x5a166b0->{next=0xffefff450, prev=0x5a165f0, item=bar}
34: bar
35: foo
36: At end of test_string:
37: 0xffefff450->{next=0x5a16470, prev=0x5a16530}
38: 0x5a16470->{next=0x5a16530, prev=0xffefff450, item=Hello}
39: 0x5a16530->{next=0xffefff450, prev=0x5a16470, item=World}
40: -----
41: ==25218==
42: ==25218== HEAP SUMMARY:
43: ==25218==      in use at exit: 0 bytes in 0 blocks
44: ==25218==    total heap usage: 19 allocs, 19 frees, 622 bytes allocated
45: ==25218==
46: ==25218== All heap blocks were freed -- no leaks are possible
47: ==25218==
48: ==25218== For counts of detected and suppressed errors, rerun with: -v
49: ==25218== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 1 from 1)
```