

```
1: // $Id: bigint.h,v 1.29 2016-03-24 19:30:57-07 - - $
2:
3: #ifndef __BIGINT_H__
4: #define __BIGINT_H__
5:
6: #include <exception>
7: #include <iostream>
8: #include <limits>
9: #include <utility>
10: using namespace std;
11:
12: #include "debug.h"
13: #include "relops.h"
14: #include "ubigint.h"
15:
16: class bigint {
17:     friend ostream& operator<< (ostream&, const bigint&);
18:     private:
19:         ubigint uvalue;
20:         bool is_negative {false};
21:     public:
22:
23:         bigint() = default; // Needed or will be suppressed.
24:         bigint (long);
25:         bigint (const ubigint&, bool is_negative = false);
26:         explicit bigint (const string&);
27:
28:         bigint operator+() const;
29:         bigint operator-() const;
30:
31:         bigint operator+ (const bigint&) const;
32:         bigint operator- (const bigint&) const;
33:         bigint operator* (const bigint&) const;
34:         bigint operator/ (const bigint&) const;
35:         bigint operator% (const bigint&) const;
36:
37:         bool operator== (const bigint&) const;
38:         bool operator< (const bigint&) const;
39: };
40:
41: #endif
42:
```

```
1: // $Id: bigint.cpp,v 1.74 2016-03-24 19:30:57-07 - - $
2:
3: #include <cstdlib>
4: #include <exception>
5: #include <stack>
6: #include <stdexcept>
7: using namespace std;
8:
9: #include "bigint.h"
10: #include "debug.h"
11: #include "relops.h"
12:
13: bigint::bigint (long that): uvalue (that), is_negative (that < 0) {
14:     DEBUGF ('~', this << " -> " << uvalue)
15: }
16:
17: bigint::bigint (const ubigint& uvalue, bool is_negative):
18:     uvalue(uvalue), is_negative(is_negative) {
19: }
20:
21: bigint::bigint (const string& that) {
22:     is_negative = that.size() > 0 and that[0] == '-';
23:     uvalue = ubigint (that.substr (is_negative ? 1 : 0));
24: }
25:
26: bigint bigint::operator+ () const {
27:     return *this;
28: }
29:
30: bigint bigint::operator- () const {
31:     return {uvalue, not is_negative};
32: }
33:
34: bigint bigint::operator+ (const bigint& that) const {
35:     ubigint result = uvalue + that.uvalue;
36:     return result;
37: }
38:
39: bigint bigint::operator- (const bigint& that) const {
40:     ubigint result = uvalue - that.uvalue;
41:     return result;
42: }
43:
44: bigint bigint::operator* (const bigint& that) const {
45:     bigint result = uvalue * that.uvalue;
46:     return result;
47: }
48:
49: bigint bigint::operator/ (const bigint& that) const {
50:     bigint result = uvalue / that.uvalue;
51:     return result;
52: }
53:
54: bigint bigint::operator% (const bigint& that) const {
55:     bigint result = uvalue % that.uvalue;
56:     return result;
57: }
58:
```

```
59: bool bigint::operator==(const bigint& that) const {
60:     return is_negative == that.is_negative and uvalue == that.uvalue;
61: }
62:
63: bool bigint::operator< (const bigint& that) const {
64:     if (is_negative != that.is_negative) return is_negative;
65:     return is_negative ? uvalue > that.uvalue
66:         : uvalue < that.uvalue;
67: }
68:
69: ostream& operator<< (ostream& out, const bigint& that) {
70:     return out << "bigint(" << (that.is_negative ? "'-' " : "'+' ")
71:         << that.uvalue << ")";
72: }
73:
```

```
1: // $Id: ubigint.h,v 1.11 2016-03-24 19:43:57-07 - - $
2:
3: #ifndef __UBIGINT_H__
4: #define __UBIGINT_H__
5:
6: #include <exception>
7: #include <iostream>
8: #include <limits>
9: #include <utility>
10: using namespace std;
11:
12: #include "debug.h"
13: #include "relops.h"
14:
15: class ubigint {
16:     friend ostream& operator<< (ostream&, const ubigint&);
17:     private:
18:         using unumber = unsigned long;
19:         unumber uvalue {};
20:     public:
21:         void multiply_by_2();
22:         void divide_by_2();
23:
24:         ubigint() = default; // Need default ctor as well.
25:         ubigint (unsigned long);
26:         ubigint (const string&);
27:
28:         ubigint operator+ (const ubigint&) const;
29:         ubigint operator- (const ubigint&) const;
30:         ubigint operator* (const ubigint&) const;
31:         ubigint operator/ (const ubigint&) const;
32:         ubigint operator% (const ubigint&) const;
33:
34:         bool operator== (const ubigint&) const;
35:         bool operator< (const ubigint&) const;
36: };
37:
38: #endif
39:
```

```
1: // $Id: ubigint.cpp,v 1.11 2016-03-24 19:57:29-07 - - $
2:
3: #include <cstdlib>
4: #include <exception>
5: #include <stack>
6: #include <stdexcept>
7: using namespace std;
8:
9: #include "ubigint.h"
10: #include "debug.h"
11:
12: ubigint::ubigint (unsigned long that): uvalue (that) {
13:     DEBUGF ('~', this << " -> " << uvalue)
14: }
15:
16: ubigint::ubigint (const string& that): uvalue(0) {
17:     for (char digit: that) uvalue = uvalue * 10 + digit - '0';
18: }
19:
20: ubigint ubigint::operator+ (const ubigint& that) const {
21:     return ubigint (uvalue + that.uvalue);
22: }
23:
24: ubigint ubigint::operator- (const ubigint& that) const {
25:     if (*this < that) throw domain_error ("ubigint::operator-(a<b)");
26:     return ubigint (uvalue - that.uvalue);
27: }
28:
29: ubigint ubigint::operator* (const ubigint& that) const {
30:     return ubigint (uvalue * that.uvalue);
31: }
32:
33: void ubigint::multiply_by_2() {
34:     uvalue *= 2;
35: }
36:
37: void ubigint::divide_by_2() {
38:     uvalue /= 2;
39: }
40:
```

```
41:
42: struct quo_rem { ubigint quotient; ubigint remainder; };
43: quo_rem udivide (const ubigint& dividend, ubigint divisor) {
44:     // Note: divisor is modified so pass by value (copy).
45:     ubigint zero {0};
46:     if (divisor == zero) throw domain_error ("udivide by zero");
47:     ubigint power_of_2 {1};
48:     ubigint quotient {0};
49:     ubigint remainder {dividend}; // left operand, dividend
50:     while (divisor < remainder) {
51:         divisor.multiply_by_2();
52:         power_of_2.multiply_by_2();
53:     }
54:     while (power_of_2 > zero) {
55:         if (divisor <= remainder) {
56:             remainder = remainder - divisor;
57:             quotient = quotient + power_of_2;
58:         }
59:         divisor.divide_by_2();
60:         power_of_2.divide_by_2();
61:     }
62:     return {.quotient = quotient, .remainder = remainder};
63: }
64:
65: ubigint ubigint::operator/ (const ubigint& that) const {
66:     return udivide (*this, that).quotient;
67: }
68:
69: ubigint ubigint::operator% (const ubigint& that) const {
70:     return udivide (*this, that).remainder;
71: }
72:
73: bool ubigint::operator== (const ubigint& that) const {
74:     return uvalue == that.uvalue;
75: }
76:
77: bool ubigint::operator< (const ubigint& that) const {
78:     return uvalue < that.uvalue;
79: }
80:
81: ostream& operator<< (ostream& out, const ubigint& that) {
82:     return out << "ubigint(" << that.uvalue << ")";
83: }
84:
```

```
1: // $Id: libfns.h,v 1.2 2015-07-02 16:03:36-07 - - $
2:
3: // Library functions not members of any class.
4:
5: #include "bigint.h"
6:
7: bigint pow (const bigint& base, const bigint& exponent);
8:
```

```
1: // $Id: libfns.cpp,v 1.4 2015-07-03 14:46:41-07 - - $
2:
3: #include "libfns.h"
4:
5: //
6: // This algorithm would be more efficient with operators
7: // *=, /=2, and is_odd. But we leave it here.
8: //
9:
10: bigint pow (const bigint& base_arg, const bigint& exponent_arg) {
11:     bigint base (base_arg);
12:     bigint exponent (exponent_arg);
13:     static const bigint ZERO (0);
14:     static const bigint ONE (1);
15:     static const bigint TWO (2);
16:     DEBUGF ('^', "base = " << base << ", exponent = " << exponent);
17:     if (base == ZERO) return ZERO;
18:     bigint result = ONE;
19:     if (exponent < ZERO) {
20:         base = ONE / base;
21:         exponent = - exponent;
22:     }
23:     while (exponent > ZERO) {
24:         if (exponent % TWO == ONE) {
25:             result = result * base;
26:             exponent = exponent - 1;
27:         }else {
28:             base = base * base;
29:             exponent = exponent / 2;
30:         }
31:     }
32:     DEBUGF ('^', "result = " << result);
33:     return result;
34: }
35:
```



```
1: // $Id: scanner.h,v 1.3 2015-07-02 16:48:18-07 - - $
2:
3: #ifndef __SCANNER_H__
4: #define __SCANNER_H__
5:
6: #include <iostream>
7: #include <utility>
8: using namespace std;
9:
10: #include "debug.h"
11:
12: enum class tsymbol {SCANEOF, NUMBER, OPERATOR};
13: struct token_t {
14:     tsymbol symbol;
15:     string lexinfo;
16: };
17:
18: class scanner {
19:     private:
20:         bool seen_eof;
21:         char lookahead;
22:         void advance();
23:     public:
24:         scanner();
25:         token_t scan();
26: };
27:
28: ostream& operator<< (ostream&, const tsymbol&);
29: ostream& operator<< (ostream&, const token_t&);
30:
31: #endif
32:
```

```
1: // $Id: scanner.cpp,v 1.8 2015-07-02 16:48:18-07 - - $
2:
3: #include <iostream>
4: #include <locale>
5: using namespace std;
6:
7: #include "scanner.h"
8: #include "debug.h"
9:
10: scanner::scanner() {
11:     seen_eof = false;
12:     advance();
13: }
14:
15: void scanner::advance() {
16:     if (not seen_eof) {
17:         cin.get (lookahead);
18:         if (cin.eof()) seen_eof = true;
19:     }
20: }
21:
22: token_t scanner::scan() {
23:     token_t result;
24:     while (not seen_eof and isspace (lookahead)) advance();
25:     if (seen_eof) {
26:         result.symbol = tsymbol::SCANEOF;
27:     } else if (lookahead == '_' or isdigit (lookahead)) {
28:         result.symbol = tsymbol::NUMBER;
29:         do {
30:             result.lexinfo += lookahead;
31:             advance();
32:         } while (not seen_eof and isdigit (lookahead));
33:     } else {
34:         result.symbol = tsymbol::OPERATOR;
35:         result.lexinfo += lookahead;
36:         advance();
37:     }
38:     DEBUGF ('S', result);
39:     return result;
40: }
41:
42: ostream& operator<< (ostream& out, const tsymbol& symbol) {
43:     switch (symbol) {
44:         case tsymbol::NUMBER : out << "NUMBER" ; break;
45:         case tsymbol::OPERATOR: out << "OPERATOR"; break;
46:         case tsymbol::SCANEOF : out << "SCANEOF" ; break;
47:     }
48:     return out;
49: }
50:
51: ostream& operator<< (ostream& out, const token_t& token) {
52:     out << token.symbol << ": \"\" << token.lexinfo << "\"\"";
53:     return out;
54: }
55:
```

```
1: // $Id: debug.h,v 1.3 2015-07-01 18:52:26-07 - - $
2:
3: #ifndef __DEBUG_H__
4: #define __DEBUG_H__
5:
6: #include <string>
7: #include <vector>
8: using namespace std;
9:
10: //
11: // debug -
12: //     static class for maintaining global debug flags.
13: // setflags -
14: //     Takes a string argument, and sets a flag for each char in the
15: //     string. As a special case, '@', sets all flags.
16: // getflag -
17: //     Used by the DEBUGF macro to check to see if a flag has been set.
18: //     Not to be called by user code.
19: //
20: class debugflags {
21:     private:
22:         static vector<bool> flags;
23:     public:
24:         static void setflags (const string& optflags);
25:         static bool getflag (char flag);
26:         static void where (char flag, const char* file, int line,
27:                             const char* func);
28: };
29:
30: //
31: // DEBUGF -
32: //     Macro which expands into trace code. First argument is a
33: //     trace flag char, second argument is output code that can
34: //     be sandwiched between <<. Beware of operator precedence.
35: //     Example:
36: //         DEBUGF ('u', "foo = " << foo);
37: //     will print two words and a newline if flag 'u' is on.
38: //     Traces are preceded by filename, line number, and function.
39: //
40: #define DEBUGF(FLAG, CODE) { \
41:     if (debugflags::getflag (FLAG)) { \
42:         debugflags::where (FLAG, __FILE__, __LINE__, __func__); \
43:         cerr << CODE << endl; \
44:     } \
45: }
46: #define DEBUGS(FLAG, STMT) { \
47:     if (debugflags::getflag (FLAG)) { \
48:         debugflags::where (FLAG, __FILE__, __LINE__, __func__); \
49:         STMT; \
50:     } \
51: }
52: #endif
53:
```

```
1: // $Id: debug.cpp,v 1.6 2015-07-02 16:48:18-07 - - $
2:
3: #include <climits>
4: #include <iostream>
5: #include <vector>
6: using namespace std;
7:
8: #include "debug.h"
9: #include "general.h"
10:
11: vector<bool> debugflags::flags (UCHAR_MAX + 1, false);
12:
13: void debugflags::setflags (const string& initflags) {
14:     for (const unsigned char flag: initflags) {
15:         if (flag == '@') flags.assign (flags.size(), true);
16:         else flags[flag] = true;
17:     }
18:     // Note that DEBUGF can trace setflags.
19:     if (getflag ('x')) {
20:         string flag_chars;
21:         for (size_t index = 0; index < flags.size(); ++index) {
22:             if (getflag (index)) flag_chars += static_cast<char> (index);
23:         }
24:         DEBUGF ('x', "debugflags::flags = " << flag_chars);
25:     }
26: }
27:
28: //
29: // getflag -
30: //     Check to see if a certain flag is on.
31: //
32:
33: bool debugflags::getflag (char flag) {
34:     return flags[static_cast<unsigned char> (flag)];
35: }
36:
37: void debugflags::where (char flag, const char* file, int line,
38:                        const char* func) {
39:     note() << "DEBUG(" << flag << ") " << file << "[" << line << "]" "
40:         << func << "()" << endl;
41: }
42:
```

```
1: // $Id: general.h,v 1.5 2015-07-08 12:32:13-07 - - $
2:
3: //
4: // general -
5: //     A general utility class to provide various services
6: //     not conveniently included in other modules.
7: //
8:
9: #ifndef __UTIL_H__
10: #define __UTIL_H__
11:
12: #include <iomanip>
13: #include <iostream>
14: #include <sstream>
15: #include <stdexcept>
16: #include <vector>
17: using namespace std;
18:
19: #include "debug.h"
20:
21: //
22: // ydc_exn -
23: //     Indicate a problem where processing should be abandoned and
24: //     the main function should take control.
25: //
26:
27: class ydc_exn: public runtime_error {
28:     public:
29:         explicit ydc_exn (const string& what);
30: };
31:
32: //
33: // octal -
34: //     Convert integer to octal string.
35: //
36:
37: template <typename numeric>
38: const string octal (numeric number) {
39:     ostringstream stream;
40:     stream << showbase << oct << number;
41:     return stream.str();
42: }
43:
```

```
44:
45: //
46: // main -
47: //     Keep track of execname and exit status.  Must be initialized
48: //     as the first thing done inside main.  Main should call:
49: //         main::execname (argv[0]);
50: //     before anything else.
51: //
52:
53: class exec {
54:     private:
55:         static string execname_;
56:         static int status_;
57:         static void execname (const string& argv0);
58:         friend int main (int, char**);
59:     public:
60:         static void status (int status);
61:         static const string& execname() {return execname_; }
62:         static int status() {return status_; }
63: };
64:
65: //
66: // complain -
67: //     Used for starting error messages.  Sets the exit status to
68: //     EXIT_FAILURE, writes the program name to cerr, and then
69: //     returns the cerr ostream.  Example:
70: //         complain() << filename << ": some problem" << endl;
71: //
72:
73: ostream& note();
74: ostream& error();
75:
76: #endif
77:
```

```
1: // $Id: general.cpp,v 1.5 2015-07-08 12:32:13-07 - - $
2:
3: #include <cstring>
4: using namespace std;
5:
6: #include "general.h"
7:
8: ydc_exn::ydc_exn (const string& what): runtime_error (what) {
9: }
10:
11: string exec::execname_; // Must be initialized from main().
12: int exec::status_ = EXIT_SUCCESS;
13:
14: void exec::execname (const string& argv0) {
15:     execname_ = basename (argv0.c_str());
16:     cout << boolalpha;
17:     cerr << boolalpha;
18:     DEBUGF ('Y', "execname = " << execname_);
19: }
20:
21: void exec::status (int new_status) {
22:     new_status &= 0xFF;
23:     if (status_ < new_status) status_ = new_status;
24: }
25:
26: ostream& note() {
27:     return cerr << exec::execname() << ": ";
28: }
29:
30: ostream& error() {
31:     exec::status (EXIT_FAILURE);
32:     return note();
33: }
34:
```

```
1: // $Id: iterstack.h,v 1.13 2014-06-26 17:21:55-07 - - $
2:
3: //
4: // The class std::stack does not provide an iterator, which is
5: // needed for this class. So, like std::stack, class iterstack
6: // is implemented on top of a container.
7: //
8: // We use private inheritance because we want to restrict
9: // operations only to those few that are approved. All functions
10: // are merely inherited from the container, with only ones needed
11: // being exported as public.
12: //
13: // No implementation file is needed because all functions are
14: // inherited, and the convenience functions that are added are
15: // trivial, and so can be inline.
16: //
17: // Any underlying container which supports the necessary operations
18: // could be used, such as vector, list, or deque.
19: //
20:
21: #ifndef __ITERSTACK_H__
22: #define __ITERSTACK_H__
23:
24: #include <vector>
25: using namespace std;
26:
27: template <typename value_type>
28: class iterstack: private vector<value_type> {
29:     private:
30:         using stack_t = vector<value_type>;
31:         using stack_t::crbegin;
32:         using stack_t::crend;
33:         using stack_t::push_back;
34:         using stack_t::pop_back;
35:         using stack_t::back;
36:         using const_iterator = typename stack_t::const_reverse_iterator;
37:     public:
38:         using stack_t::clear;
39:         using stack_t::empty;
40:         using stack_t::size;
41:         inline const_iterator begin() {return crbegin();}
42:         inline const_iterator end() {return crend();}
43:         inline void push (const value_type& value) {push_back (value);}
44:         inline void pop() {pop_back();}
45:         inline const value_type& top() const {return back();}
46: };
47:
48: #endif
49:
```



```
1: // $Id: relops.h,v 1.1 2015-07-02 15:52:45-07 - - $
2:
3: //
4: // Assuming that for any given type T, there are operators
5: // bool operator< (const T&, const T&);
6: // bool operator== (const T&, const T&);
7: // as fundamental comparisons for type T, define the other
8: // six operators in terms of the basic ones.
9: //
10:
11: #ifndef __REL_OPS_H__
12: #define __REL_OPS_H__
13:
14: template <typename value>
15: inline bool operator!= (const value &left, const value &right) {
16:     return not (left == right);
17: }
18:
19: template <typename value>
20: inline bool operator> (const value &left, const value &right) {
21:     return right < left;
22: }
23:
24: template <typename value>
25: inline bool operator<= (const value &left, const value &right) {
26:     return not (right < left);
27: }
28:
29: template <typename value>
30: inline bool operator>= (const value &left, const value &right) {
31:     return not (left < right);
32: }
33:
34: #endif
35:
```

```
1: // $Id: main.cpp,v 1.49 2016-01-13 13:35:41-08 - - $
2:
3: #include <cassert>
4: #include <deque>
5: #include <iostream>
6: #include <stdexcept>
7: #include <unordered_map>
8: #include <utility>
9: using namespace std;
10:
11: #include <unistd.h>
12:
13: #include "bigint.h"
14: #include "debug.h"
15: #include "general.h"
16: #include "iterstack.h"
17: #include "libfns.h"
18: #include "scanner.h"
19:
20: using bigint_stack = iterstack<bigint>;
21:
22: void do_arith (bigint_stack& stack, const char oper) {
23:     if (stack.size() < 2) throw ydc_exn ("stack empty");
24:     bigint right = stack.top();
25:     stack.pop();
26:     DEBUGF ('d', "right = " << right);
27:     bigint left = stack.top();
28:     stack.pop();
29:     DEBUGF ('d', "left = " << left);
30:     bigint result;
31:     switch (oper) {
32:         case '+': result = left + right; break;
33:         case '-': result = left - right; break;
34:         case '*': result = left * right; break;
35:         case '/': result = left / right; break;
36:         case '%': result = left % right; break;
37:         case '^': result = pow (left, right); break;
38:         default: throw invalid_argument (
39:             string ("do_arith operator is ") + oper);
40:     }
41:     DEBUGF ('d', "result = " << result);
42:     stack.push (result);
43: }
44:
45: void do_clear (bigint_stack& stack, const char) {
46:     DEBUGF ('d', "");
47:     stack.clear();
48: }
49:
```

```
50:
51: void do_dup (bigint_stack& stack, const char) {
52:     bigint top = stack.top();
53:     DEBUGF ('d', top);
54:     stack.push (top);
55: }
56:
57: void do_printall (bigint_stack& stack, const char) {
58:     for (const auto &elem: stack) cout << elem << endl;
59: }
60:
61: void do_print (bigint_stack& stack, const char) {
62:     cout << stack.top() << endl;
63: }
64:
65: void do_debug (bigint_stack& stack, const char) {
66:     (void) stack; // SUPPRESS: warning: unused parameter 'stack'
67:     cout << "Y not implemented" << endl;
68: }
69:
70: class ydc_quit: public exception {};
71: void do_quit (bigint_stack&, const char) {
72:     throw ydc_quit();
73: }
74:
75: using function_t = void (*)(bigint_stack&, const char);
76: using fn_hash = unordered_map<string,function_t>;
77: fn_hash do_functions = {
78:     {"+", do_arith},
79:     {"-", do_arith},
80:     {"*", do_arith},
81:     {"/", do_arith},
82:     {"%", do_arith},
83:     {"^", do_arith},
84:     {"Y", do_debug},
85:     {"c", do_clear},
86:     {"d", do_dup},
87:     {"f", do_printall},
88:     {"p", do_print},
89:     {"q", do_quit},
90: };
91:
```

```
92:
93: //
94: // scan_options
95: //   Options analysis:  The only option is -Dflags.
96: //
97: void scan_options (int argc, char** argv) {
98:     opterr = 0;
99:     for (;;) {
100:         int option = getopt (argc, argv, "@:");
101:         if (option == EOF) break;
102:         switch (option) {
103:             case '@':
104:                 debugflags::setflags (optarg);
105:                 break;
106:             default:
107:                 error() << "-" << static_cast<char> (optopt)
108:                     << ": invalid option" << endl;
109:                 break;
110:         }
111:     }
112:     if (optind < argc) {
113:         error() << "operand not permitted" << endl;
114:     }
115: }
116:
```

```
117:
118: //
119: // Main function.
120: //
121: int main (int argc, char** argv) {
122:     exec::execname (argv[0]);
123:     scan_options (argc, argv);
124:     bigint_stack operand_stack;
125:     scanner input;
126:     try {
127:         for (;;) {
128:             try {
129:                 token_t token = input.scan();
130:                 if (token.symbol == tsymbol::SCANEOF) break;
131:                 switch (token.symbol) {
132:                     case tsymbol::NUMBER:
133:                         operand_stack.push (bigint (token.lexinfo));
134:                         break;
135:                     case tsymbol::OPERATOR: {
136:                         fn_hash::const_iterator fn
137:                             = do_functions.find (token.lexinfo);
138:                         if (fn == do_functions.end()) {
139:                             throw ydc_exn (octal (token.lexinfo[0])
140:                                             + " is unimplemented");
141:                         }
142:                         fn->second (operand_stack, token.lexinfo.at(0));
143:                         break;
144:                     }
145:                     default:
146:                         assert (false);
147:                 }
148:             } catch (ydc_exn& exn) {
149:                 cout << exn.what() << endl;
150:             }
151:         }
152:     } catch (ydc_quit&) {
153:         // Intentionally left empty.
154:     }
155:     return exec::status();
156: }
157:
```

```
1: # $Id: Makefile,v 1.18 2016-03-24 19:30:57-07 - - $
2:
3: MKFILE      = Makefile
4: DEPFILE     = ${MKFILE}.dep
5: NOINCL      = ci clean spotless
6: NEEDINCL    = ${filter ${NOINCL}, ${MAKECMDGOALS}}
7: GMAKE       = ${MAKE} --no-print-directory
8: COMPILECPP  = g++ -std=gnu++14 -g -O0 -Wall -Wextra
9: MAKEDEPCPP  = g++ -std=gnu++14 -MM
10:
11: MODULES     = bigint ubigint libfns scanner debug general
12: CPPHEADER   = ${MODULES:=.h} iterstack.h relops.h
13: CPPSOURCE   = ${MODULES:=.cpp} main.cpp
14: EXECBIN     = ydc
15: OBJECTS     = ${CPPSOURCE:.cpp=.o}
16: MODULESRC   = ${foreach MOD, ${MODULES}, ${MOD}.h ${MOD}.cpp}
17: OTHERSRC    = ${filter-out ${MODULESRC}, ${CPPHEADER} ${CPPSOURCE}}
18: ALLSOURCES  = ${MODULESRC} ${OTHERSRC} ${MKFILE}
19: LISTING     = Listing.ps
20:
21: all : ${EXECBIN}
22:
23: ${EXECBIN} : ${OBJECTS}
24:             ${COMPILECPP} -o $@ ${OBJECTS}
25:
26: %.o : %.cpp
27:             ${COMPILECPP} -c $<
28:
29: ci : ${ALLSOURCES}
30:     - checksource ${ALLSOURCES}
31:     - cpplint.py.perl ${CPPSOURCE}
32:     cid + ${ALLSOURCES}
33:
34: lis : ${ALLSOURCES}
35:     mkpspdf ${LISTING} ${ALLSOURCES} ${DEPFILE}
36:
37: clean :
38:     - rm ${OBJECTS} ${DEPFILE} core ${EXECBIN}.errs
39:
40: spotless : clean
41:     - rm ${EXECBIN} ${LISTING} ${LISTING:.ps=.pdf}
42:
43: dep : ${CPPSOURCE} ${CPPHEADER}
44:     @ echo "# ${DEPFILE} created `LC_TIME=C date`" >${DEPFILE}
45:     ${MAKEDEPCPP} ${CPPSOURCE} >>${DEPFILE}
46:
47: ${DEPFILE} :
48:     @ touch ${DEPFILE}
49:     ${GMAKE} dep
50:
51: again :
52:     ${GMAKE} spotless dep ci all lis
53:
54: ifeq (${NEEDINCL}, )
55: include ${DEPFILE}
56: endif
57:
```

```
1: # Makefile.dep created Thu Mar 24 19:57:27 PDT 2016
2: bigint.o: bigint.cpp bigint.h debug.h relops.h ubigint.h
3: ubigint.o: ubigint.cpp ubigint.h debug.h relops.h
4: libfns.o: libfns.cpp libfns.h bigint.h debug.h relops.h ubigint.h
5: scanner.o: scanner.cpp scanner.h debug.h
6: debug.o: debug.cpp debug.h general.h
7: general.o: general.cpp general.h debug.h
8: main.o: main.cpp bigint.h debug.h relops.h ubigint.h general.h \
9:  iterstack.h libfns.h scanner.h
```