

```
1: // $Id: ubigint.h,v 1.4 2020-01-06 13:39:55-08 - - $
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 1.8 2020-01-06 13:39:55-08 - - $
2:
3: #include <cctype>
4: #include <cstdlib>
5: #include <exception>
6: #include <stack>
7: #include <stdexcept>
8: using namespace std;
9:
10: #include "ubigint.h"
11: #include "debug.h"
12:
13: ubigint::ubigint (unsigned long that): uvalue (that) {
14:     DEBUGF ('~', this << " -> " << uvalue)
15: }
16:
17: ubigint::ubigint (const string& that): uvalue(0) {
18:     DEBUGF ('~', "that = \"" << that << "\"");
19:     for (char digit: that) {
20:         if (not isdigit (digit)) {
21:             throw invalid_argument ("ubigint::ubigint(" + that + ")");
22:         }
23:         uvalue = uvalue * 10 + digit - '0';
24:     }
25: }
26:
27: ubigint ubigint::operator+ (const ubigint& that) const {
28:     return ubigint (uvalue + that.uvalue);
29: }
30:
31: ubigint ubigint::operator- (const ubigint& that) const {
32:     if (*this < that) throw domain_error ("ubigint::operator-(a<b)");
33:     return ubigint (uvalue - that.uvalue);
34: }
35:
36: ubigint ubigint::operator* (const ubigint& that) const {
37:     return ubigint (uvalue * that.uvalue);
38: }
39:
40: void ubigint::multiply_by_2() {
41:     uvalue *= 2;
42: }
43:
44: void ubigint::divide_by_2() {
45:     uvalue /= 2;
46: }
47:
```

```
48:
49: struct quo_rem { ubigint quotient; ubigint remainder; };
50: quo_rem udivide (const ubigint& dividend, const ubigint& divisor_) {
51:     // NOTE: udivide is a non-member function.
52:     ubigint divisor {divisor_};
53:     ubigint zero {0};
54:     if (divisor == zero) throw domain_error ("udivide by zero");
55:     ubigint power_of_2 {1};
56:     ubigint quotient {0};
57:     ubigint remainder {dividend}; // left operand, dividend
58:     while (divisor < remainder) {
59:         divisor.multiply_by_2();
60:         power_of_2.multiply_by_2();
61:     }
62:     while (power_of_2 > zero) {
63:         if (divisor <= remainder) {
64:             remainder = remainder - divisor;
65:             quotient = quotient + power_of_2;
66:         }
67:         divisor.divide_by_2();
68:         power_of_2.divide_by_2();
69:     }
70:     return {.quotient = quotient, .remainder = remainder};
71: }
72:
73: ubigint ubigint::operator/ (const ubigint& that) const {
74:     return udivide (*this, that).quotient;
75: }
76:
77: ubigint ubigint::operator% (const ubigint& that) const {
78:     return udivide (*this, that).remainder;
79: }
80:
81: bool ubigint::operator== (const ubigint& that) const {
82:     return uvalue == that.uvalue;
83: }
84:
85: bool ubigint::operator< (const ubigint& that) const {
86:     return uvalue < that.uvalue;
87: }
88:
89: ostream& operator<< (ostream& out, const ubigint& that) {
90:     return out << "ubigint(" << that.uvalue << ")";
91: }
92:
```

```
1: // $Id: bigint.h,v 1.2 2020-01-06 13:39:55-08 - - $
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 1.2 2020-01-06 13:39:55-08 - - $
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:
45: bigint bigint::operator* (const bigint& that) const {
46:     bigint result = uvalue * that.uvalue;
47:     return result;
48: }
49:
50: bigint bigint::operator/ (const bigint& that) const {
51:     bigint result = uvalue / that.uvalue;
52:     return result;
53: }
54:
55: bigint bigint::operator% (const bigint& that) const {
56:     bigint result = uvalue % that.uvalue;
57:     return result;
58: }
59:
60: bool bigint::operator== (const bigint& that) const {
61:     return is_negative == that.is_negative and uvalue == that.uvalue;
62: }
63:
64: bool bigint::operator< (const bigint& that) const {
65:     if (is_negative != that.is_negative) return is_negative;
66:     return is_negative ? uvalue > that.uvalue
67:         : uvalue < that.uvalue;
68: }
69:
70: ostream& operator<< (ostream& out, const bigint& that) {
71:     return out << "bigint(" << (that.is_negative ? "-" : "+")
72:         << "," << that.uvalue << ")";
73: }
74:
```

```
1: // $Id: libfns.h,v 1.1 2019-12-12 18:19:23-08 - - $
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 1.1 2019-12-12 18:19:23-08 - - $
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 1.1 2019-12-12 18:19:23-08 - - $
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:
14: struct token {
15:     tsymbol symbol;
16:     string lexinfo;
17:     token (tsymbol sym, const string& lex = string()):
18:         symbol(sym), lexinfo(lex){
19:     }
20: };
21:
22: class scanner {
23:     private:
24:         istream& instream;
25:         int nextchar {instream.get()};
26:         bool good() { return nextchar != EOF; }
27:         char get();
28:     public:
29:         scanner (istream& instream_ = cin): instream(instream_) {}
30:         token scan();
31: };
32:
33: ostream& operator<< (ostream&, tsymbol);
34: ostream& operator<< (ostream&, const token&);
35:
36: #endif
37:
```

```
1: // $Id: scanner.cpp,v 1.1 2019-12-12 18:19:23-08 - - $
2:
3: #include <cassert>
4: #include <iostream>
5: #include <locale>
6: #include <stdexcept>
7: #include <type_traits>
8: #include <unordered_map>
9: using namespace std;
10:
11: #include "scanner.h"
12: #include "debug.h"
13:
14: char scanner::get() {
15:     if (not good()) throw runtime_error ("scanner::get() past EOF");
16:     char currchar = nextchar;
17:     nextchar = instream.get();
18:     return currchar;
19: }
20:
21: token scanner::scan() {
22:     while (good() and isspace (nextchar)) get();
23:     if (not good()) return {tsymbol::SCANEOF};
24:     if (nextchar == '_' or isdigit (nextchar)) {
25:         token result {tsymbol::NUMBER, {get()}};
26:         while (good() and isdigit (nextchar)) result.lexinfo += get();
27:         return result;
28:     }
29:     return {tsymbol::OPERATOR, {get()}};
30: }
31:
32: ostream& operator<< (ostream& out, tsymbol symbol) {
33:     struct hasher {
34:         auto operator() (tsymbol sym) const {
35:             return static_cast<underlying_type<tsymbol>::type> (sym);
36:         }
37:     };
38:     static const unordered_map<tsymbol,string,hasher> map {
39:         {tsymbol::NUMBER , "NUMBER" },
40:         {tsymbol::OPERATOR, "OPERATOR"},
41:         {tsymbol::SCANEOF , "SCANEOF" },
42:     };
43:     return out << map.at(symbol);
44: }
45:
46: ostream& operator<< (ostream& out, const token& token) {
47:     out << "{" << token.symbol << ", \"" << token.lexinfo << "\"}";
48:     return out;
49: }
50:
```

```
1: // $Id: debug.h,v 1.1 2019-12-12 18:19:23-08 - - $
2:
3: #ifndef __DEBUG_H__
4: #define __DEBUG_H__
5:
6: #include <bitset>
7: #include <climits>
8: #include <string>
9: using namespace std;
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:         using flagset = bitset<UCHAR_MAX + 1>;
23:         static flagset flags;
24:     public:
25:         static void setflags (const string& optflags);
26:         static bool getflag (char flag);
27:         static void where (char flag, const char* file, int line,
28:                             const char* pretty_function);
29: };
30:
```

```
31:
32: // DEBUGF -
33: //     Macro which expands into debug code.  First argument is a
34: //     debug flag char, second argument is output code that can
35: //     be sandwiched between <<.  Beware of operator precedence.
36: //     Example:
37: //         DEBUGF ('u', "foo = " << foo);
38: //     will print two words and a newline if flag 'u' is on.
39: //     Traces are preceded by filename, line number, and function.
40:
41: #ifdef NDEBUG
42: #define DEBUGF(FLAG, CODE) ;
43: #define DEBUGS(FLAG, STMT) ;
44: #else
45: #define DEBUGF(FLAG, CODE) { \
46:     if (debugflags::getflag (FLAG)) { \
47:         debugflags::where (FLAG, __FILE__, __LINE__, \
48:             __PRETTY_FUNCTION__); \
49:         cerr << CODE << endl; \
50:     } \
51: }
52: #define DEBUGS(FLAG, STMT) { \
53:     if (debugflags::getflag (FLAG)) { \
54:         debugflags::where (FLAG, __FILE__, __LINE__, \
55:             __PRETTY_FUNCTION__); \
56:         STMT; \
57:     } \
58: }
59: #endif
60:
61: #endif
62:
```

```
1: // $Id: debug.cpp,v 1.1 2019-12-12 18:19:23-08 - - $
2:
3: #include <climits>
4: #include <iostream>
5: #include <vector>
6:
7: using namespace std;
8:
9: #include "debug.h"
10: #include "util.h"
11:
12: debugflags::flagset debugflags::flags {};
13:
14: void debugflags::setflags (const string& initflags) {
15:     for (const unsigned char flag: initflags) {
16:         if (flag == '@') flags.set();
17:         else flags.set (flag, true);
18:     }
19: }
20:
21: // getflag -
22: //     Check to see if a certain flag is on.
23:
24: bool debugflags::getflag (char flag) {
25:     // WARNING: Don't TRACE this function or the stack will blow up.
26:     return flags.test (static_cast<unsigned char> (flag));
27: }
28:
29: void debugflags::where (char flag, const char* file, int line,
30:                        const char* pretty_function) {
31:     cout << exec::execname() << ": DEBUG(" << flag << ") "
32:          << file << "[" << line << "]" " << endl
33:          << "    " << pretty_function << endl;
34: }
35:
```

```
1: // $Id: util.h,v 1.2 2019-12-12 19:22:40-08 - - $
2:
3: //
4: // util -
5: //      A 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_error -
23: //      Indicate a problem where processing should be abandoned and
24: //      the main function should take control.
25: //
26:
27: class ydc_error: public runtime_error {
28:     public:
29:         explicit ydc_error (const string& what): runtime_error (what) {
30:             }
31: };
32:
33: //
34: // octal -
35: //      Convert integer to octal string.
36: //
37:
38: template <typename numeric>
39: const string octal (numeric number) {
40:     ostringstream stream;
41:     stream << showbase << oct << (number + 0);
42:     return stream.str();
43: }
44:
```

```
45:
46: //
47: // main -
48: //     Keep track of execname and exit status.  Must be initialized
49: //     as the first thing done inside main.  Main should call:
50: //         main::execname (argv[0]);
51: //     before anything else.
52: //
53:
54: class exec {
55:     private:
56:         static string execname_;
57:         static int status_;
58:         static void execname (const string& argv0);
59:         friend int main (int, char**);
60:     public:
61:         static void status (int status);
62:         static const string& execname() {return execname_; }
63:         static int status() {return status_; }
64: };
65:
66: //
67: // complain -
68: //     Used for starting error messages.  Sets the exit status to
69: //     EXIT_FAILURE, writes the program name to cerr, and then
70: //     returns the cerr ostream.  Example:
71: //         complain() << filename << ": some problem" << endl;
72: //
73:
74: ostream& note();
75: ostream& error();
76:
77: #endif
78:
```

```
1: // $Id: util.cpp,v 1.2 2019-12-12 19:22:40-08 - - $
2:
3: #include <cstring>
4: using namespace std;
5:
6: #include "util.h"
7:
8: string exec::execname_; // Must be initialized from main().
9: int exec::status_ = EXIT_SUCCESS;
10:
11: void exec::execname (const string& argv0) {
12:     execname_ = basename (argv0.c_str());
13:     cout << boolalpha;
14:     cerr << boolalpha;
15:     DEBUGF ('Y', "execname = " << execname_);
16: }
17:
18: void exec::status (int new_status) {
19:     new_status &= 0xFF;
20:     if (status_ < new_status) status_ = new_status;
21: }
22:
23: ostream& note() {
24:     return cerr << exec::execname() << ": ";
25: }
26:
27: ostream& error() {
28:     exec::status (EXIT_FAILURE);
29:     return note();
30: }
31:
```



```
1: // $Id: iterstack.h,v 1.1 2019-12-12 18:19:23-08 - - $
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_t, typename container = vector<value_t>>
28: class iterstack {
29:     public:
30:         using value_type = value_t;
31:         using const_iterator = typename container::const_reverse_iterator;
32:         using size_type = typename container::size_type;
33:     private:
34:         container stack;
35:     public:
36:         void clear() { stack.clear(); }
37:         bool empty() const { return stack.empty(); }
38:         size_type size() const { return stack.size(); }
39:         const_iterator begin() { return stack.crbegin(); }
40:         const_iterator end() { return stack.crend(); }
41:         void push (const value_type& value) { stack.push_back (value); }
42:         void pop() { stack.pop_back(); }
43:         const value_type& top() const { return stack.back(); }
44: };
45:
46: #endif
47:
```

```
1: // $Id: relops.h,v 1.1 2019-12-12 18:19:23-08 - - $
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 1.2 2019-12-12 19:22:40-08 - - $
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 "iterstack.h"
16: #include "libfns.h"
17: #include "scanner.h"
18: #include "util.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_error ("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 ("do_arith operator "s + oper);
39:     }
40:     DEBUGF ('d', "result = " << result);
41:     stack.push (result);
42: }
43:
44: void do_clear (bigint_stack& stack, const char) {
45:     DEBUGF ('d', "");
46:     stack.clear();
47: }
48:
```

```
49:
50: void do_dup (bigint_stack& stack, const char) {
51:     bigint top = stack.top();
52:     DEBUGF ('d', top);
53:     stack.push (top);
54: }
55:
56: void do_printall (bigint_stack& stack, const char) {
57:     for (const auto& elem: stack) cout << elem << endl;
58: }
59:
60: void do_print (bigint_stack& stack, const char) {
61:     if (stack.size() < 1) throw ydc_error ("stack empty");
62:     cout << stack.top() << endl;
63: }
64:
65: void do_debug (bigint_stack&, const char) {
66:     cout << "Y not implemented" << endl;
67: }
68:
69: class ydc_quit: public exception {};
70: void do_quit (bigint_stack&, const char) {
71:     throw ydc_quit();
72: }
73:
74: string unimplemented (char oper) {
75:     if (isgraph (oper)) {
76:         return "'"s + oper + "'" ("s + octal (oper) + ") unimplemented";
77:     }else {
78:         return octal (oper) + " unimplemented"s;
79:     }
80: }
81:
82: void do_function (bigint_stack& stack, const char oper) {
83:     switch (oper) {
84:         case '+': do_arith      (stack, oper); break;
85:         case '-': do_arith      (stack, oper); break;
86:         case '*': do_arith      (stack, oper); break;
87:         case '/': do_arith      (stack, oper); break;
88:         case '%': do_arith      (stack, oper); break;
89:         case '^': do_arith      (stack, oper); break;
90:         case 'Y': do_debug      (stack, oper); break;
91:         case 'c': do_clear      (stack, oper); break;
92:         case 'd': do_dup        (stack, oper); break;
93:         case 'f': do_printall   (stack, oper); break;
94:         case 'p': do_print      (stack, oper); break;
95:         case 'q': do_quit       (stack, oper); break;
96:         default : throw ydc_error (unimplemented (oper));
97:     }
98: }
99:
```

```
100:
101: //
102: // scan_options
103: //   Options analysis:  The only option is -Dflags.
104: //
105: void scan_options (int argc, char** argv) {
106:     opterr = 0;
107:     for (;;) {
108:         int option = getopt (argc, argv, "@:");
109:         if (option == EOF) break;
110:         switch (option) {
111:             case '@':
112:                 debugflags::setflags (optarg);
113:                 break;
114:             default:
115:                 error() << "-" << static_cast<char> (optopt)
116:                     << ": invalid option" << endl;
117:                 break;
118:         }
119:     }
120:     if (optind < argc) {
121:         error() << "operand not permitted" << endl;
122:     }
123: }
124:
```

```
125:
126: //
127: // Main function.
128: //
129: int main (int argc, char** argv) {
130:     exec::execname (argv[0]);
131:     scan_options (argc, argv);
132:     bigint_stack operand_stack;
133:     scanner input;
134:     try {
135:         for (;;) {
136:             try {
137:                 token lexeme = input.scan();
138:                 switch (lexeme.symbol) {
139:                     case tsymbol::SCANEOF:
140:                         throw ydc_quit();
141:                         break;
142:                     case tsymbol::NUMBER:
143:                         operand_stack.push (bigint (lexeme.lexinfo));
144:                         break;
145:                     case tsymbol::OPERATOR: {
146:                         char oper = lexeme.lexinfo[0];
147:                         do_function (operand_stack, oper);
148:                         break;
149:                     }
150:                     default:
151:                         assert (false);
152:                 }
153:             } catch (ydc_error& error) {
154:                 cout << exec::execname() << ": " << error.what() << endl;
155:             }
156:         }
157:     } catch (ydc_quit&) {
158:         // Intentionally left empty.
159:     }
160:     return exec::status();
161: }
162:
```

```
1: # $Id: Makefile,v 1.1 2019-12-12 18:19:23-08 - - $
2:
3: MKFILE      = Makefile
4: DEPSFILE    = ${MKFILE}.deps
5: NOINCL      = ci clean spotless
6: NEEDINCL    = ${filter ${NOINCL}, ${MAKECMDGOALS}}
7: GMAKE       = ${MAKE} --no-print-directory
8: GPPWARN     = -Wall -Wextra -Wpedantic -Wshadow -Wold-style-cast
9: GPPOPTS     = ${GPPWARN} -fdiagnostics-color=never
10: COMPILECPP  = g++ -std=gnu++2a -g -O0 ${GPPOPTS}
11: MAKEDEPSCPP = g++ -std=gnu++2a -MM ${GPPOPTS}
12: UTILBIN     = /afs/cats.ucsc.edu/courses/cse111-wm/bin
13:
14: MODULES     = ubigint bigint libfns scanner debug util
15: CPPHEADER   = ${MODULES:=.h} iterstack.h relops.h
16: CPPSOURCE   = ${MODULES:=.cpp} main.cpp
17: EXECBIN     = ydc
18: OBJECTS     = ${CPPSOURCE:.cpp=.o}
19: MODULESRC   = ${foreach MOD, ${MODULES}, ${MOD}.h ${MOD}.cpp}
20: OTHERSRC    = ${filter-out ${MODULESRC}, ${CPPHEADER} ${CPPSOURCE}}
21: ALLSOURCES  = ${MODULESRC} ${OTHERSRC} ${MKFILE}
22: LISTING     = Listing.ps
23:
24: all : ${EXECBIN}
25:
26: ${EXECBIN} : ${OBJECTS}
27:     ${COMPILECPP} -o $@ ${OBJECTS}
28:
29: %.o : %.cpp
30:     - ${UTILBIN}/checksource $<
31:     - ${UTILBIN}/cpplint.py.perl $<
32:     ${COMPILECPP} -c $<
33:
34: ci : ${ALLSOURCES}
35:     ${UTILBIN}/cid + ${ALLSOURCES}
36:     - ${UTILBIN}/checksource ${ALLSOURCES}
37:
38: lis : ${ALLSOURCES}
39:     mkpspdf ${LISTING} ${ALLSOURCES} ${DEPSFILE}
40:
41: clean :
42:     - rm ${OBJECTS} ${DEPSFILE} core ${EXECBIN}.errs
43:
44: spotless : clean
45:     - rm ${EXECBIN} ${LISTING} ${LISTING:.ps=.pdf}
46:
```

```
47:
48: deps : ${CPPSOURCE} ${CPPHEADER}
49:         @ echo "# ${DEPSFILE} created `LC_TIME=C date`" >${DEPSFILE}
50:         ${MAKEDEPSCPP} ${CPPSOURCE} >>${DEPSFILE}
51:
52: ${DEPSFILE} :
53:         @ touch ${DEPSFILE}
54:         ${GMAKE} deps
55:
56: again :
57:         ${GMAKE} spotless deps ci all lis
58:
59: ifeq (${NEEDINCL}, )
60: include ${DEPSFILE}
61: endif
62:
```



```
1: # Makefile.deps created Mon Jan  6 16:06:08 PST 2020
2: ubigint.o: ubigint.cpp ubigint.h debug.h relops.h
3: bigint.o: bigint.cpp bigint.h debug.h relops.h ubigint.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 util.h
7: util.o: util.cpp util.h debug.h
8: main.o: main.cpp bigint.h debug.h relops.h ubigint.h iterstack.h libfns.
h \
9:  scanner.h util.h
```