

```
1: // $Id: commands.h,v 1.11 2016-01-14 14:45:21-08 - - $
2:
3: #ifndef __COMMANDS_H__
4: #define __COMMANDS_H__
5:
6: #include <unordered_map>
7: using namespace std;
8:
9: #include "file_sys.h"
10: #include "util.h"
11:
12: // A couple of convenient usings to avoid verbosity.
13:
14: using command_fn = void (*)(inode_state& state, const wordvec& words);
15: using command_hash = unordered_map<string, command_fn>;
16:
17: // command_error -
18: //     Extend runtime_error for throwing exceptions related to this
19: //     program.
20:
21: class command_error: public runtime_error {
22: public:
23:     explicit command_error (const string& what);
24: };
25:
26: // execution functions -
27:
28: void fn_cat      (inode_state& state, const wordvec& words);
29: void fn_cd      (inode_state& state, const wordvec& words);
30: void fn_echo    (inode_state& state, const wordvec& words);
31: void fn_exit    (inode_state& state, const wordvec& words);
32: void fn_ls      (inode_state& state, const wordvec& words);
33: void fn_lsr     (inode_state& state, const wordvec& words);
34: void fn_make    (inode_state& state, const wordvec& words);
35: void fn_mkdir   (inode_state& state, const wordvec& words);
36: void fn_prompt  (inode_state& state, const wordvec& words);
37: void fn_pwd     (inode_state& state, const wordvec& words);
38: void fn_rm      (inode_state& state, const wordvec& words);
39: void fn_rmr     (inode_state& state, const wordvec& words);
40:
41: command_fn find_command_fn (const string& command);
42:
43: // exit_status_message -
44: //     Prints an exit message and returns the exit status, as recorded
45: //     by any of the functions.
46:
47: int exit_status_message();
48: class ysh_exit: public exception {};
49:
50: #endif
51:
```

```
1: // $Id: commands.cpp,v 1.16 2016-01-14 16:10:40-08 - - $
2:
3: #include "commands.h"
4: #include "debug.h"
5:
6: command_hash cmd_hash {
7:     {"cat"      , fn_cat    },
8:     {"cd"       , fn_cd     },
9:     {"echo"     , fn_echo   },
10:    {"exit"      , fn_exit   },
11:    {"ls"        , fn_ls     },
12:    {"lsr"       , fn_lsr    },
13:    {"make"      , fn_make   },
14:    {"mkdir"     , fn_mkdir  },
15:    {"prompt"    , fn_prompt },
16:    {"pwd"       , fn_pwd    },
17:    {"rm"        , fn_rm     },
18: };
19:
20: command_fn find_command_fn (const string& cmd) {
21:     // Note: value_type is pair<const key_type, mapped_type>
22:     // So: iterator->first is key_type (string)
23:     // So: iterator->second is mapped_type (command_fn)
24:     const auto result = cmd_hash.find (cmd);
25:     if (result == cmd_hash.end()) {
26:         throw command_error (cmd + ": no such function");
27:     }
28:     return result->second;
29: }
30:
31: command_error::command_error (const string& what):
32:     runtime_error (what) {
33: }
34:
35: int exit_status_message() {
36:     int exit_status = exit_status::get();
37:     cout << execname() << ": exit(" << exit_status << ")" << endl;
38:     return exit_status;
39: }
40:
41: void fn_cat (inode_state& state, const wordvec& words){
42:     DEBUGF ('c', state);
43:     DEBUGF ('c', words);
44: }
45:
46: void fn_cd (inode_state& state, const wordvec& words){
47:     DEBUGF ('c', state);
48:     DEBUGF ('c', words);
49: }
50:
51: void fn_echo (inode_state& state, const wordvec& words){
52:     DEBUGF ('c', state);
53:     DEBUGF ('c', words);
54:     cout << word_range (words.cbegin() + 1, words.cend()) << endl;
55: }
56:
```

```
57:
58: void fn_exit (inode_state& state, const wordvec& words){
59:     DEBUGF ('c', state);
60:     DEBUGF ('c', words);
61:     throw ysh_exit();
62: }
63:
64: void fn_ls (inode_state& state, const wordvec& words){
65:     DEBUGF ('c', state);
66:     DEBUGF ('c', words);
67: }
68:
69: void fn_lsr (inode_state& state, const wordvec& words){
70:     DEBUGF ('c', state);
71:     DEBUGF ('c', words);
72: }
73:
74: void fn_make (inode_state& state, const wordvec& words){
75:     DEBUGF ('c', state);
76:     DEBUGF ('c', words);
77: }
78:
79: void fn_mkdir (inode_state& state, const wordvec& words){
80:     DEBUGF ('c', state);
81:     DEBUGF ('c', words);
82: }
83:
84: void fn_prompt (inode_state& state, const wordvec& words){
85:     DEBUGF ('c', state);
86:     DEBUGF ('c', words);
87: }
88:
89: void fn_pwd (inode_state& state, const wordvec& words){
90:     DEBUGF ('c', state);
91:     DEBUGF ('c', words);
92: }
93:
94: void fn_rm (inode_state& state, const wordvec& words){
95:     DEBUGF ('c', state);
96:     DEBUGF ('c', words);
97: }
98:
99: void fn_rmr (inode_state& state, const wordvec& words){
100:     DEBUGF ('c', state);
101:     DEBUGF ('c', words);
102: }
103:
```



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

```
1: // $Id: debug.cpp,v 1.9 2016-01-14 16:16:52-08 - - $
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* func) {
31:     cout << execname() << ": DEBUG(" << flag << ") "
32:          << file << "[" << line << "]" " << func << "()" << endl;
33: }
34:
```

```
1: // $Id: file_sys.h,v 1.5 2016-04-07 13:36:11-07 - - $
2:
3: #ifndef __INODE_H__
4: #define __INODE_H__
5:
6: #include <exception>
7: #include <iostream>
8: #include <memory>
9: #include <map>
10: #include <vector>
11: using namespace std;
12:
13: #include "util.h"
14:
15: // inode_t -
16: //      An inode is either a directory or a plain file.
17:
18: enum class file_type {PLAIN_TYPE, DIRECTORY_TYPE};
19: class inode;
20: class base_file;
21: class plain_file;
22: class directory;
23: using inode_ptr = shared_ptr<inode>;
24: using base_file_ptr = shared_ptr<base_file>;
25: ostream& operator<< (ostream&, file_type);
26:
```

```
27:
28: // inode_state -
29: //   A small convenient class to maintain the state of the simulated
30: //   process: the root (/), the current directory (.), and the
31: //   prompt.
32:
33: class inode_state {
34:     friend class inode;
35:     friend ostream& operator<< (ostream& out, const inode_state&);
36:     private:
37:         inode_ptr root {nullptr};
38:         inode_ptr cwd {nullptr};
39:         string prompt_ {"% "};
40:     public:
41:         inode_state (const inode_state&) = delete; // copy ctor
42:         inode_state& operator= (const inode_state&) = delete; // op=
43:         inode_state();
44:         const string& prompt();
45: };
46:
47: // class inode -
48: // inode ctor -
49: //   Create a new inode of the given type.
50: // get_inode_nr -
51: //   Retrieves the serial number of the inode. Inode numbers are
52: //   allocated in sequence by small integer.
53: // size -
54: //   Returns the size of an inode. For a directory, this is the
55: //   number of dirents. For a text file, the number of characters
56: //   when printed (the sum of the lengths of each word, plus the
57: //   number of words.
58: //
59:
60: class inode {
61:     friend class inode_state;
62:     private:
63:         static int next_inode_nr;
64:         int inode_nr;
65:         base_file_ptr contents;
66:     public:
67:         inode (file_type);
68:         int get_inode_nr() const;
69: };
70:
```



```
71:
72: // class base_file -
73: // Just a base class at which an inode can point. No data or
74: // functions. Makes the synthesized members useable only from
75: // the derived classes.
76:
77: class file_error: public runtime_error {
78:     public:
79:         explicit file_error (const string& what);
80: };
81:
82: class base_file {
83:     protected:
84:         base_file() = default;
85:     public:
86:         virtual ~base_file() = default;
87:         base_file (const base_file&) = delete;
88:         base_file& operator= (const base_file&) = delete;
89:         virtual size_t size() const = 0;
90:         virtual const wordvec& readfile() const = 0;
91:         virtual void writefile (const wordvec& newdata) = 0;
92:         virtual void remove (const string& filename) = 0;
93:         virtual inode_ptr mkdir (const string& dirname) = 0;
94:         virtual inode_ptr mkfile (const string& filename) = 0;
95: };
```

```
96:
97: // class plain_file -
98: // Used to hold data.
99: // synthesized default ctor -
100: //     Default vector<string> is a an empty vector.
101: // readfile -
102: //     Returns a copy of the contents of the wordvec in the file.
103: // writefile -
104: //     Replaces the contents of a file with new contents.
105:
106: class plain_file: public base_file {
107:     private:
108:         wordvec data;
109:     public:
110:         virtual size_t size() const override;
111:         virtual const wordvec& readfile() const override;
112:         virtual void writefile (const wordvec& newdata) override;
113:         virtual void remove (const string& filename) override;
114:         virtual inode_ptr mkdir (const string& dirname) override;
115:         virtual inode_ptr mkfile (const string& filename) override;
116: };
117:
118: // class directory -
119: // Used to map filenames onto inode pointers.
120: // default ctor -
121: //     Creates a new map with keys "." and "..".
122: // remove -
123: //     Removes the file or subdirectory from the current inode.
124: //     Throws an file_error if this is not a directory, the file
125: //     does not exist, or the subdirectory is not empty.
126: //     Here empty means the only entries are dot (.) and dotdot (..).
127: // mkdir -
128: //     Creates a new directory under the current directory and
129: //     immediately adds the directories dot (.) and dotdot (..) to it.
130: //     Note that the parent (..) of / is / itself. It is an error
131: //     if the entry already exists.
132: // mkfile -
133: //     Create a new empty text file with the given name. Error if
134: //     a dirent with that name exists.
135:
136: class directory: public base_file {
137:     private:
138:         // Must be a map, not unordered_map, so printing is lexicographic
139:         map<string,inode_ptr> dirents;
140:     public:
141:         virtual size_t size() const override;
142:         virtual const wordvec& readfile() const override;
143:         virtual void writefile (const wordvec& newdata) override;
144:         virtual void remove (const string& filename) override;
145:         virtual inode_ptr mkdir (const string& dirname) override;
146:         virtual inode_ptr mkfile (const string& filename) override;
147: };
148:
149: #endif
150:
```

```
1: // $Id: file_sys.cpp,v 1.5 2016-01-14 16:16:52-08 - - $
2:
3: #include <iostream>
4: #include <stdexcept>
5: #include <unordered_map>
6:
7: using namespace std;
8:
9: #include "debug.h"
10: #include "file_sys.h"
11:
12: int inode::next_inode_nr {1};
13:
14: struct file_type_hash {
15:     size_t operator() (file_type type) const {
16:         return static_cast<size_t> (type);
17:     }
18: };
19:
20: ostream& operator<< (ostream& out, file_type type) {
21:     static unordered_map<file_type, string, file_type_hash> hash {
22:         {file_type::PLAIN_TYPE, "PLAIN_TYPE"},
23:         {file_type::DIRECTORY_TYPE, "DIRECTORY_TYPE"},
24:     };
25:     return out << hash[type];
26: }
27:
28: inode_state::inode_state() {
29:     DEBUGF ('i', "root = " << root << ", cwd = " << cwd
30:         << ", prompt = \" " << prompt() << "\"");
31: }
32:
33: const string& inode_state::prompt() { return prompt_; }
34:
35: ostream& operator<< (ostream& out, const inode_state& state) {
36:     out << "inode_state: root = " << state.root
37:         << ", cwd = " << state.cwd;
38:     return out;
39: }
40:
41: inode::inode(file_type type): inode_nr (next_inode_nr++) {
42:     switch (type) {
43:         case file_type::PLAIN_TYPE:
44:             contents = make_shared<plain_file>();
45:             break;
46:         case file_type::DIRECTORY_TYPE:
47:             contents = make_shared<directory>();
48:             break;
49:     }
50:     DEBUGF ('i', "inode " << inode_nr << ", type = " << type);
51: }
52:
53: int inode::get_inode_nr() const {
54:     DEBUGF ('i', "inode = " << inode_nr);
55:     return inode_nr;
56: }
57:
```

```
58:
59: file_error::file_error (const string& what):
60:     runtime_error (what) {
61: }
62:
63: size_t plain_file::size() const {
64:     size_t size {0};
65:     DEBUGF ('i', "size = " << size);
66:     return size;
67: }
68:
69: const wordvec& plain_file::readfile() const {
70:     DEBUGF ('i', data);
71:     return data;
72: }
73:
74: void plain_file::writefile (const wordvec& words) {
75:     DEBUGF ('i', words);
76: }
77:
78: void plain_file::remove (const string&) {
79:     throw file_error ("is a plain file");
80: }
81:
82: inode_ptr plain_file::mkdir (const string&) {
83:     throw file_error ("is a plain file");
84: }
85:
86: inode_ptr plain_file::mkfile (const string&) {
87:     throw file_error ("is a plain file");
88: }
89:
```

```
90:
91: size_t directory::size() const {
92:     size_t size {0};
93:     DEBUGF ('i', "size = " << size);
94:     return size;
95: }
96:
97: const wordvec& directory::readfile() const {
98:     throw file_error ("is a directory");
99: }
100:
101: void directory::writefile (const wordvec&) {
102:     throw file_error ("is a directory");
103: }
104:
105: void directory::remove (const string& filename) {
106:     DEBUGF ('i', filename);
107: }
108:
109: inode_ptr directory::mkdir (const string& dirname) {
110:     DEBUGF ('i', dirname);
111:     return nullptr;
112: }
113:
114: inode_ptr directory::mkfile (const string& filename) {
115:     DEBUGF ('i', filename);
116:     return nullptr;
117: }
118:
```

```
1: // $Id: util.h,v 1.12 2016-01-14 16:16:52-08 - - $
2:
3: // util -
4: //     A utility class to provide various services not conveniently
5: //     included in other modules.
6:
7: #ifndef __UTIL_H__
8: #define __UTIL_H__
9:
10: #include <iostream>
11: #include <stdexcept>
12: #include <string>
13: #include <vector>
14: using namespace std;
15:
16: // Convenient type using to allow brevity of code elsewhere.
17:
18: template <typename iterator>
19: using range_type = pair<iterator,iterator>;
20:
21: using wordvec = vector<string>;
22: using word_range = range_type<decltype(declval<wordvec>().cbegin())>;
23:
24: // setexecname -
25: //     Sets the static string to be used as an execname.
26: // execname -
27: //     Returns the basename of the executable image, which is used in
28: //     printing error messages.
29:
30: void execname (const string&);
31: string& execname();
32:
33: // want_echo -
34: //     We want to echo all of cin to cout if either cin or cout
35: //     is not a tty. This helps make batch processing easier by
36: //     making cout look like a terminal session trace.
37:
38: bool want_echo();
39:
40: // exit_status -
41: //     A static class for maintaining the exit status. The default
42: //     status is EXIT_SUCCESS (0), but can be set to another value,
43: //     such as EXIT_FAILURE (1) to indicate that error messages have
44: //     been printed.
45:
46: class exit_status {
47:     private:
48:         static int status;
49:     public:
50:         static void set (int);
51:         static int get();
52: };
53:
```

```
54:
55: // split -
56: //     Split a string into a wordvec (as defined above). Any sequence
57: //     of chars in the delimiter string is used as a separator. To
58: //     Split a pathname, use "/". To split a shell command, use " ".
59:
60: wordvec split (const string& line, const string& delimiter);
61:
62: // complain -
63: //     Used for starting error messages. Sets the exit status to
64: //     EXIT_FAILURE, writes the program name to cerr, and then
65: //     returns the cerr ostream. Example:
66: //     complain() << filename << ": some problem" << endl;
67:
68: ostream& complain();
69:
70: // operator<< (vector) -
71: //     An overloaded template operator which allows vectors to be
72: //     printed out as a single operator, each element separated from
73: //     the next with spaces. The item_t must have an output operator
74: //     defined for it.
75:
76: template <typename item_t>
77: ostream& operator<< (ostream& out, const vector<item_t>& vec) {
78:     string space = "";
79:     for (const auto& item: vec) {
80:         out << space << item;
81:         space = " ";
82:     }
83:     return out;
84: }
85:
86: template <typename iterator>
87: ostream& operator<< (ostream& out, range_type<iterator> range) {
88:     for (auto itor = range.first; itor != range.second; ++itor) {
89:         if (itor != range.first) out << " ";
90:         out << *itor;
91:     }
92:     return out;
93: }
94:
95: #endif
96:
```

```
1: // $Id: util.cpp,v 1.11 2016-01-13 16:21:53-08 - - $
2:
3: #include <cstdlib>
4: #include <unistd.h>
5:
6: using namespace std;
7:
8: #include "util.h"
9: #include "debug.h"
10:
11: int exit_status::status = EXIT_SUCCESS;
12: static string execname_string;
13:
14: void exit_status::set (int new_status) {
15:     status = new_status;
16: }
17:
18: int exit_status::get() {
19:     return status;
20: }
21:
22: void execname (const string& name) {
23:     execname_string = name.substr (name.rfind ('/') + 1);
24:     DEBUGF ('u', execname_string);
25: }
26:
27: string& execname() {
28:     return execname_string;
29: }
30:
31: bool want_echo() {
32:     constexpr int CIN_FD {0};
33:     constexpr int COUT_FD {1};
34:     bool cin_is_not_a_tty = not isatty (CIN_FD);
35:     bool cout_is_not_a_tty = not isatty (COUT_FD);
36:     DEBUGF ('u', "cin_is_not_a_tty = " << cin_is_not_a_tty
37:           << ", cout_is_not_a_tty = " << cout_is_not_a_tty);
38:     return cin_is_not_a_tty or cout_is_not_a_tty;
39: }
40:
```



```
41:
42: wordvec split (const string& line, const string& delimiters) {
43:     wordvec words;
44:     size_t end = 0;
45:
46:     // Loop over the string, splitting out words, and for each word
47:     // thus found, append it to the output wordvec.
48:     for (;;) {
49:         size_t start = line.find_first_not_of (delimiters, end);
50:         if (start == string::npos) break;
51:         end = line.find_first_of (delimiters, start);
52:         words.push_back (line.substr (start, end - start));
53:     }
54:     DEBUGF ('u', words);
55:     return words;
56: }
57:
58: ostream& complain() {
59:     exit_status::set (EXIT_FAILURE);
60:     cerr << execname() << ": ";
61:     return cerr;
62: }
63:
```

```
1: // $Id: main.cpp,v 1.9 2016-01-14 16:16:52-08 - - $
2:
3: #include <cstdlib>
4: #include <iostream>
5: #include <string>
6: #include <utility>
7: #include <unistd.h>
8:
9: using namespace std;
10:
11: #include "commands.h"
12: #include "debug.h"
13: #include "file_sys.h"
14: #include "util.h"
15:
16: // scan_options
17: // Options analysis: The only option is -Dflags.
18:
19: void scan_options (int argc, char** argv) {
20:     opterr = 0;
21:     for (;;) {
22:         int option = getopt (argc, argv, "@:");
23:         if (option == EOF) break;
24:         switch (option) {
25:             case '@':
26:                 debugflags::setflags (optarg);
27:                 break;
28:             default:
29:                 complain() << "-" << static_cast<char> (option)
30:                     << ": invalid option" << endl;
31:                 break;
32:         }
33:     }
34:     if (optind < argc) {
35:         complain() << "operands not permitted" << endl;
36:     }
37: }
38:
```

```
39:
40: // main -
41: //      Main program which loops reading commands until end of file.
42:
43: int main (int argc, char** argv) {
44:     execname (argv[0]);
45:     cout << boolalpha;    // Print false or true instead of 0 or 1.
46:     cerr << boolalpha;
47:     cout << argv[0] << " build " << __DATE__ << " " << __TIME__ << endl;
48:     scan_options (argc, argv);
49:     bool need_echo = want_echo();
50:     inode_state state;
51:     try {
52:         for (;;) {
53:             try {
54:                 // Read a line, break at EOF, and echo print the prompt
55:                 // if one is needed.
56:                 cout << state.prompt();
57:                 string line;
58:                 getline (cin, line);
59:                 if (cin.eof()) {
60:                     if (need_echo) cout << "^D";
61:                     cout << endl;
62:                     DEBUGF ('y', "EOF");
63:                     break;
64:                 }
65:                 if (need_echo) cout << line << endl;
66:
67:                 // Split the line into words and lookup the appropriate
68:                 // function.  Complain or call it.
69:                 wordvec words = split (line, " \t");
70:                 DEBUGF ('y', "words = " << words);
71:                 command_fn fn = find_command_fn (words.at(0));
72:                 fn (state, words);
73:             } catch (command_error& error) {
74:                 // If there is a problem discovered in any function, an
75:                 // exn is thrown and printed here.
76:                 complain() << error.what() << endl;
77:             }
78:         }
79:     } catch (ysh_exit&) {
80:         // This catch intentionally left blank.
81:     }
82:
83:     return exit_status_message();
84: }
85:
```

```
1: # $Id: Makefile,v 1.20 2016-01-13 16:24:32-08 - - $
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:
9: COMPILECPP  = g++ -std=gnu++14 -g -O0 -Wall -Wextra
10: MAKEDEPCPP = g++ -std=gnu++14 -MM
11:
12: MODULES     = commands debug file_sys util
13: CPPHEADER   = ${MODULES:=.h}
14: CPPSOURCE   = ${MODULES:=.cpp} main.cpp
15: EXECBIN     = yshell
16: OBJECTS     = ${CPPSOURCE:.cpp=.o}
17: MODULESRC   = ${foreach MOD, ${MODULES}, ${MOD}.h ${MOD}.cpp}
18: OTHERSRC    = ${filter-out ${MODULESRC}, ${CPPHEADER} ${CPPSOURCE}}
19: ALLSOURCES  = ${MODULESRC} ${OTHERSRC} ${MKFILE}
20: LISTING     = Listing.ps
21:
22: all : ${EXECBIN}
23:
24: ${EXECBIN} : ${OBJECTS}
25:             ${COMPILECPP} -o $@ ${OBJECTS}
26:
27: %.o : %.cpp
28:             ${COMPILECPP} -c $<
29:
30: ci : ${ALLSOURCES}
31:     cid + ${ALLSOURCES}
32:     - checksource ${ALLSOURCES}
33:     - cpplint.py.perl ${CPPSOURCE}
34:
35: lis : ${ALLSOURCES}
36:     mkpspdf ${LISTING} ${ALLSOURCES} ${DEPFILE}
37:
38: clean :
39:     - rm ${OBJECTS} ${DEPFILE} core ${EXECBIN}.errs
40:
41: spotless : clean
42:     - rm ${EXECBIN} ${LISTING} ${LISTING:.ps=.pdf}
43:
44: dep : ${CPPSOURCE} ${CPPHEADER}
45:     @ echo "# ${DEPFILE} created `LC_TIME=C date`" >${DEPFILE}
46:     ${MAKEDEPCPP} ${CPPSOURCE} >>${DEPFILE}
47:
48: ${DEPFILE} : ${MKFILE}
49:     @ touch ${DEPFILE}
50:     ${GMAKE} dep
51:
52: again :
53:     ${GMAKE} spotless dep ci all lis
54:
55: ifeq (${NEEDINCL}, )
56: include ${DEPFILE}
57: endif
58:
```

```
1: # Makefile.dep created Thu Apr  7 13:36:11 PDT 2016
2: commands.o: commands.cpp commands.h file_sys.h util.h debug.h
3: debug.o: debug.cpp debug.h util.h
4: file_sys.o: file_sys.cpp debug.h file_sys.h util.h
5: util.o: util.cpp util.h debug.h
6: main.o: main.cpp commands.h file_sys.h util.h debug.h
```