```

Simple compiler:  Translate exprs to stack machine insns.

Syntax:     the ETF grammar
Lexical:    identifiers, numbers
Comments:   // and /**/ C-style
Directives: #-cpp style
Activity:   Build AST
Codegen:    Stack machine code

$Id: README,v 1.1 2015-07-08 13:29:32-07 - - $

```

```
/* $Id: lexer.l,v 1.9 2019-04-18 13:33:21-07 - - $ */

%{

#include "lyutils.h"

#define YY_USER_ACTION  { lexer::advance(); }

%}

%option 8bit
%option debug
%option nobackup
%option nodefault
%option noinput
%option nounput
%option noyywrap
%option warn
/*%option verbose*/

LETTER          [A-Za-z_]
DIGIT           [0-9]
MANTISSA        ({DIGIT}+\.?{DIGIT}*|\.{DIGIT}+)
EXPONENT        ([Ee][+-]?{DIGIT}+)
NUMBER          ({MANTISSA}{EXPONENT}?)
NOTNUMBER       ({MANTISSA}[Ee][+-]?)
IDENT           ({LETTER}({LETTER}|{DIGIT})*)

%%

"#".*           { lexer::include(); }
[ \t]+          { }
\n              { lexer::newline(); }

{NUMBER}        { return lexer::token (NUMBER); }
{IDENT}         { return lexer::token (IDENT); }
"="             { return lexer::token ('='); }
"+"             { return lexer::token ('+'); }
"-"             { return lexer::token ('-'); }
"*"             { return lexer::token ('*'); }
"/"             { return lexer::token ('/'); }
"^"             { return lexer::token ('^'); }
"("             { return lexer::token ('('); }
")"             { return lexer::token (')'); }
";"             { return lexer::token (';'); }

{NOTNUMBER}     { return lexer::badtoken (NUMBER); }
.               { lexer::badchar (*yytext); }

%%

```

```
// $Id: parser.y,v 1.14 2016-10-06 16:26:41-07 - - $

%{

#include <assert.h>
#include <stdlib.h>
#include <string.h>

#include "astree.h"
#include "lyutils.h"

%}

%debug
%defines
%error-verbose
%token-table
%verbose

%destructor { destroy ($$); } <>
%printer { astree::dump (yyoutput, $$); } <>

%initial-action {
   parser::root = new astree (ROOT, {0, 0, 0}, "<<ROOT>>");
}

%token  ROOT IDENT NUMBER

%right  '='
%left   '+' '-'
%left   '*' '/'
%right  '^'
%right  POS NEG

%start  program

```

```

%%

program : stmtseq               { $$ = $1 = nullptr; }
        ;

stmtseq : stmtseq expr ';'      { destroy ($3); $$ = $1->adopt ($2); }
        | stmtseq error ';'     { destroy ($3); $$ = $1; }
        | stmtseq ';'           { destroy ($2); $$ = $1; }
        |                       { $$ = parser::root; }
        ;

expr    : expr '=' expr         { $$ = $2->adopt ($1, $3); }
        | expr '+' expr         { $$ = $2->adopt ($1, $3); }
        | expr '-' expr         { $$ = $2->adopt ($1, $3); }
        | expr '*' expr         { $$ = $2->adopt ($1, $3); }
        | expr '/' expr         { $$ = $2->adopt ($1, $3); }
        | expr '^' expr         { $$ = $2->adopt ($1, $3); }
        | '+' expr %prec POS    { $$ = $1->adopt_sym ($2, POS); }
        | '-' expr %prec NEG    { $$ = $1->adopt_sym ($2, NEG); }
        | '(' expr ')'          { destroy ($1, $3); $$ = $2; }
        | IDENT                 { $$ = $1; }
        | NUMBER                { $$ = $1; }
        ;

%%

const char* parser::get_tname (int symbol) {
   return yytname [YYTRANSLATE (symbol)];
}

```

```
// $Id: astree.h,v 1.10 2016-10-06 16:42:35-07 - - $

#ifndef __ASTREE_H__
#define __ASTREE_H__

#include <string>
#include <vector>
using namespace std;

#include "auxlib.h"

struct location {
   size_t filenr;
   size_t linenr;
   size_t offset;
};

struct astree {

   // Fields.
   int symbol;               // token code
   location lloc;            // source location
   const string* lexinfo;    // pointer to lexical information
   vector<astree*> children; // children of this n-way node

   // Functions.
   astree (int symbol, const location&, const char* lexinfo);
   ~astree();
   astree* adopt (astree* child1, astree* child2 = nullptr);
   astree* adopt_sym (astree* child, int symbol);
   void dump_node (FILE*);
   void dump_tree (FILE*, int depth = 0);
   static void dump (FILE* outfile, astree* tree);
   static void print (FILE* outfile, astree* tree, int depth = 0);
};

void destroy (astree* tree1, astree* tree2 = nullptr);

void errllocprintf (const location&, const char* format, const char*);

#endif

```

```
// $Id: astree.cpp,v 1.17 2019-03-15 14:32:40-07 - - $

#include <assert.h>
#include <inttypes.h>
#include <stdarg.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include "astree.h"
#include "string_set.h"
#include "lyutils.h"

astree::astree (int symbol_, const location& lloc_, const char* info) {
   symbol = symbol_;
   lloc = lloc_;
   lexinfo = string_set::intern (info);
   // vector defaults to empty -- no children
}

astree::~astree() {
   while (not children.empty()) {
      astree* child = children.back();
      children.pop_back();
      delete child;
   }
   if (yydebug) {
      fprintf (stderr, "Deleting astree (");
      astree::dump (stderr, this);
      fprintf (stderr, ")\n");
   }
}

astree* astree::adopt (astree* child1, astree* child2) {
   if (child1 != nullptr) children.push_back (child1);
   if (child2 != nullptr) children.push_back (child2);
   return this;
}

astree* astree::adopt_sym (astree* child, int symbol_) {
   symbol = symbol_;
   return adopt (child);
}

```

```

void astree::dump_node (FILE* outfile) {
   fprintf (outfile, "%p->{%s %zd.%zd.%zd \"%s\":",
            static_cast<const void*> (this),
            parser::get_tname (symbol),
            lloc.filenr, lloc.linenr, lloc.offset,
            lexinfo->c_str());
   for (size_t child = 0; child < children.size(); ++child) {
      fprintf (outfile, " %p",
               static_cast<const void*> (children.at(child)));
   }
}

void astree::dump_tree (FILE* outfile, int depth) {
   fprintf (outfile, "%*s", depth * 3, "");
   dump_node (outfile);
   fprintf (outfile, "\n");
   for (astree* child: children) child->dump_tree (outfile, depth + 1);
   fflush (nullptr);
}

void astree::dump (FILE* outfile, astree* tree) {
   if (tree == nullptr) fprintf (outfile, "nullptr");
                   else tree->dump_node (outfile);
}

void astree::print (FILE* outfile, astree* tree, int depth) {
   fprintf (outfile, "; %*s", depth * 3, "");
   fprintf (outfile, "%s \"%s\" (%zd.%zd.%zd)\n",
            parser::get_tname (tree->symbol), tree->lexinfo->c_str(),
            tree->lloc.filenr, tree->lloc.linenr, tree->lloc.offset);
   for (astree* child: tree->children) {
      astree::print (outfile, child, depth + 1);
   }
}

void destroy (astree* tree1, astree* tree2) {
   if (tree1 != nullptr) delete tree1;
   if (tree2 != nullptr) delete tree2;
}

void errllocprintf (const location& lloc, const char* format,
                    const char* arg) {
   static char buffer[0x1000];
   assert (sizeof buffer > strlen (format) + strlen (arg));
   snprintf (buffer, sizeof buffer, format, arg);
   errprintf ("%s:%zd.%zd: %s",
              lexer::filename (lloc.filenr), lloc.linenr, lloc.offset,
              buffer);
}
```

```
// $Id: lyutils.h,v 1.7 2019-04-18 13:33:21-07 - - $

#ifndef __UTILS_H__
#define __UTILS_H__

// Lex and Yacc interface utility.

#include <string>
#include <vector>
using namespace std;

#include <stdio.h>

#include "astree.h"
#include "auxlib.h"

#define YYEOF 0

extern FILE* yyin;
extern char* yytext;
extern int yy_flex_debug;
extern int yydebug;
extern size_t yyleng;

int yylex();
int yylex_destroy();
int yyparse();
void yyerror (const char* message);

struct lexer {
   static bool interactive;
   static location lloc;
   static size_t last_yyleng;
   static vector<string> filenames;
   static const string* filename (int filenr);
   static void newfilename (const string& filename);
   static void advance();
   static void newline();
   static void badchar (unsigned char bad);
   static void include();
   static int token (int symbol);
   static int badtoken (int symbol);
};

struct parser {
   static astree* root;
   static const char* get_tname (int symbol);
};

#define YYSTYPE_IS_DECLARED
typedef astree* YYSTYPE;
#include "yyparse.h"

#endif

```

```
// $Id: lyutils.cpp,v 1.6 2019-04-18 13:35:11-07 - - $

#include <assert.h>
#include <ctype.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include "auxlib.h"
#include "lyutils.h"

bool lexer::interactive = true;
location lexer::lloc = {0, 1, 0};
size_t lexer::last_yyleng = 0;
vector<string> lexer::filenames;

astree* parser::root = nullptr;

const string* lexer::filename (int filenr) {
   return &lexer::filenames.at(filenr);
}

void lexer::newfilename (const string& filename) {
   lexer::lloc.filenr = lexer::filenames.size();
   lexer::filenames.push_back (filename);
}

void lexer::advance() {
   if (not interactive) {
      if (lexer::lloc.offset == 0) {
         printf (";%2zd.%3zd: ",
                 lexer::lloc.filenr, lexer::lloc.linenr);
      }
      printf ("%s", yytext);
   }
   lexer::lloc.offset += last_yyleng;
   last_yyleng = yyleng;
}

void lexer::newline() {
   ++lexer::lloc.linenr;
   lexer::lloc.offset = 0;
}

void lexer::badchar (unsigned char bad) {
   char buffer[16];
   snprintf (buffer, sizeof buffer,
             isgraph (bad) ? "%c" : "\\%03o", bad);
   errllocprintf (lexer::lloc, "invalid source character (%s)\n",
                  buffer);
}

```

```

void lexer::include() {
   size_t linenr;
   static char filename[0x1000];
   assert (sizeof filename > strlen (yytext));
   int scan_rc = sscanf (yytext, "# %zu \"%[^\"]\"", &linenr, filename);
   if (scan_rc != 2) {
      errprintf ("%s: invalid directive, ignored\n", yytext);
   }else {
      if (yy_flex_debug) {
         fprintf (stderr, "--included # %zd \"%s\"\n",
                  linenr, filename);
      }
      lexer::lloc.linenr = linenr - 1;
      lexer::newfilename (filename);
   }
}

int lexer::token (int symbol) {
   yylval = new astree (symbol, lexer::lloc, yytext);
   return symbol;
}

int lexer::badtoken (int symbol) {
   errllocprintf (lexer::lloc, "invalid token (%s)\n", yytext);
   return lexer::token (symbol);
}

void yyerror (const char* message) {
   assert (not lexer::filenames.empty());
   errllocprintf (lexer::lloc, "%s\n", message);
}

```

```
// $Id: string_set.h,v 1.2 2016-08-18 15:12:57-07 - - $

#ifndef __STRING_SET__
#define __STRING_SET__

#include <string>
#include <unordered_set>
using namespace std;

#include <stdio.h>

struct string_set {
   string_set();
   static unordered_set<string> set;
   static const string* intern (const char*);
   static void dump (FILE*);
};

#endif

```

```
// $Id: string_set.cpp,v 1.5 2019-03-15 14:32:40-07 - - $

#include <string>
#include <unordered_set>
using namespace std;

#include "auxlib.h"
#include "string_set.h"

unordered_set<string> string_set::set;

string_set::string_set() {
   set.max_load_factor (0.5);
}

const string* string_set::intern (const char* string) {
   auto handle = set.insert (string);
   DEBUGF ('s', "inserted \"%s\" %s\n", handle.first->c_str(),
           handle.second ? "newly inserted" : "already there");
   return &*handle.first;
}

void string_set::dump (FILE* out) {
   static unordered_set<string>::hasher hash_fn
               = string_set::set.hash_function();
   size_t max_bucket_size = 0;
   for (size_t bucket = 0; bucket < set.bucket_count(); ++bucket) {
      bool need_index = true;
      size_t curr_size = set.bucket_size (bucket);
      if (max_bucket_size < curr_size) max_bucket_size = curr_size;
      for (auto itor = set.cbegin (bucket);
           itor != set.cend (bucket); ++itor) {
         if (need_index) fprintf (out, "string_set[%4zu]: ", bucket);
                    else fprintf (out, "          %4s   ", "");
         need_index = false;
         const string* str = &*itor;
         fprintf (out, "%22zu %p->\"%s\"\n", hash_fn(*str),
                  reinterpret_cast<const void*> (str), str->c_str());
      }
   }
   fprintf (out, "load_factor = %.3f\n", set.load_factor());
   fprintf (out, "bucket_count = %zu\n", set.bucket_count());
   fprintf (out, "max_bucket_size = %zu\n", max_bucket_size);
}
```

```
// $Id: emitter.h,v 1.1 2015-07-09 14:08:38-07 - - $

#ifndef __EMIT_H__
#define __EMIT_H__

#include "astree.h"

void emit_sm_code (astree*);

#endif

```

```
// $Id: emitter.cpp,v 1.5 2017-10-05 16:39:39-07 - - $

#include <assert.h>
#include <stdio.h>

#include "astree.h"
#include "emitter.h"
#include "auxlib.h"
#include "lyutils.h"

void emit (astree* root);

void emit_insn (const char* opcode, const char* operand, astree* tree) {
   printf ("%-10s%-10s%-20s; %s %zd.%zd\n", "",
            opcode, operand,
            lexer::filename (tree->lloc.filenr)->c_str(),
            tree->lloc.linenr, tree->lloc.offset);
}

void postorder (astree* tree) {
   assert (tree != nullptr);
   for (size_t child = 0; child < tree->children.size(); ++child) {
      emit (tree->children.at(child));
   }
}

void postorder_emit_stmts (astree* tree) {
   postorder (tree);
}

void postorder_emit_oper (astree* tree, const char* opcode) {
   postorder (tree);
   emit_insn (opcode, "", tree);
}

void postorder_emit_semi (astree* tree) {
   postorder (tree);
   emit_insn ("", "", tree);
}

void emit_push (astree* tree, const char* opcode) {
   emit_insn (opcode, tree->lexinfo->c_str(), tree);
}

void emit_assign (astree* tree) {
   assert (tree->children.size() == 2);
   astree* left = tree->children.at(0);
   emit (tree->children.at(1));
   if (left->symbol != IDENT) {
      errllocprintf (left->lloc, "%s\n",
                     "left operand of ’=’ not an identifier");
   }else{
      emit_insn ("popvar", left->lexinfo->c_str(), left);
   }
}

```

```

void emit (astree* tree) {
   switch (tree->symbol) {
      case ROOT  : postorder_emit_stmts (tree);       break;
      case ';'   : postorder_emit_semi (tree);        break;
      case '='   : emit_assign (tree);                break;
      case '+'   : postorder_emit_oper (tree, "add"); break;
      case '-'   : postorder_emit_oper (tree, "sub"); break;
      case '*'   : postorder_emit_oper (tree, "mul"); break;
      case '/'   : postorder_emit_oper (tree, "div"); break;
      case '^'   : postorder_emit_oper (tree, "pow"); break;
      case POS   : postorder_emit_oper (tree, "pos"); break;
      case NEG   : postorder_emit_oper (tree, "neg"); break;
      case IDENT : emit_push (tree, "pushvar");       break;
      case NUMBER: emit_push (tree, "pushnum");       break;
      default    : assert (false);                    break;
   }
}

void emit_sm_code (astree* tree) {
   printf ("\n");
   if (tree) emit (tree);
}

```

```
// $Id: auxlib.h,v 1.5 2017-10-11 14:33:45-07 - - $

#ifndef __AUXLIB_H__
#define __AUXLIB_H__

#include <string>
using namespace std;

#include <stdarg.h>

//
// DESCRIPTION
//    Auxiliary library containing miscellaneous useful things.
//

//
// Error message and exit status utility.
//

struct exec {
   static string execname;
   static int exit_status;
};

void veprintf (const char* format, va_list args);
// Prints a message to stderr using the vector form of
// argument list.

void eprintf (const char* format, ...);
// Print a message to stderr according to the printf format
// specified.  Usually called for debug output.
// Precedes the message by the program name if the format
// begins with the characters ‘%:’.

void errprintf (const char* format, ...);
// Print an error message according to the printf format
// specified, using eprintf.
// Sets the exitstatus to EXIT_FAILURE.

void syserrprintf (const char* object);
// Print a message resulting from a bad system call.  The
// object is the name of the object causing the problem and
// the reason is taken from the external variable errno.
// Sets the exit status to EXIT_FAILURE.

void eprint_status (const char* command, int status);
// Print the status returned by wait(2) from a subprocess.

```

```

//
// Support for stub messages.
//
#define STUBPRINTF(...) \
        __stubprintf (__FILE__, __LINE__, __PRETTY_FUNCTION__, \
                      __VA_ARGS__)
void __stubprintf (const char* file, int line, const char* func,
                   const char* format, ...);

//
// Debugging utility.
//

void set_debugflags (const char* flags);
// Sets a string of debug flags to be used by DEBUGF statements.
// Uses the address of the string, and does not copy it, so
// it must not be dangling.  If a particular debug flag has
// been set, messages are printed.  The format is identical to
// printf format.  The flag "@" turns on all flags.

bool is_debugflag (char flag);
// Checks to see if a debugflag is set.

#ifdef NDEBUG
// Do not generate any code.
#define DEBUGF(FLAG,...)   /**/
#define DEBUGSTMT(FLAG,STMTS) /**/
#else
// Generate debugging code.
void __debugprintf (char flag, const char* file, int line,
                    const char* func, const char* format, ...);
#define DEBUGF(FLAG,...) \
        __debugprintf (FLAG, __FILE__, __LINE__, __PRETTY_FUNCTION__, \
                       __VA_ARGS__)
#define DEBUGSTMT(FLAG,STMTS) \
        if (is_debugflag (FLAG)) { DEBUGF (FLAG, "\n"); STMTS }
#endif

#endif

```

```
// $Id: auxlib.cpp,v 1.4 2019-04-10 15:50:29-07 - - $

#include <assert.h>
#include <errno.h>
#include <libgen.h>
#include <limits.h>
#include <stdarg.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <wait.h>

#include "auxlib.h"

string exec::execname;
int exec::exit_status = EXIT_SUCCESS;

const char* debugflags = "";
bool alldebugflags = false;

static void eprint_signal (const char* kind, int signal) {
   eprintf (", %s %d", kind, signal);
   const char* sigstr = strsignal (signal);
   if (sigstr != nullptr) fprintf (stderr, " %s", sigstr);
}

void eprint_status (const char* command, int status) {
   if (status == 0) return;
   eprintf ("%s: status 0x%04X", command, status);
   if (WIFEXITED (status)) {
      eprintf (", exit %d", WEXITSTATUS (status));
   }
   if (WIFSIGNALED (status)) {
      eprint_signal ("Terminated", WTERMSIG (status));
      #ifdef WCOREDUMP
      if (WCOREDUMP (status)) eprintf (", core dumped");
      #endif
   }
   if (WIFSTOPPED (status)) {
      eprint_signal ("Stopped", WSTOPSIG (status));
   }
   if (WIFCONTINUED (status)) {
      eprintf (", Continued");
   }
   eprintf ("\n");
}

```

```

void veprintf (const char* format, va_list args) {
   assert (exec::execname.size() != 0);
   assert (format != nullptr);
   fflush (nullptr);
   if (strstr (format, "%:") == format) {
      fprintf (stderr, "%s: ", exec::execname.c_str());
      format += 2;
   }
   vfprintf (stderr, format, args);
   fflush (nullptr);
}

void eprintf (const char* format, ...) {
   va_list args;
   va_start (args, format);
   veprintf (format, args);
   va_end (args);
}

void errprintf (const char* format, ...) {
   va_list args;
   va_start (args, format);
   veprintf (format, args);
   va_end (args);
   exec::exit_status = EXIT_FAILURE;
}

void syserrprintf (const char* object) {
   errprintf ("%:%s: %s\n", object, strerror (errno));
}

void __stubprintf (const char* file, int line, const char* func,
                   const char* format, ...) {
   va_list args;
   fflush (nullptr);
   printf ("%s: %s[%d] %s: ", exec::execname.c_str(), file, line, func);
   va_start (args, format);
   vprintf (format, args);
   va_end (args);
   fflush (nullptr);
}

```

```

void set_debugflags (const char* flags) {
   debugflags = flags;
   assert (debugflags != nullptr);
   if (strchr (debugflags, '@') != nullptr) alldebugflags = true;
   DEBUGF ('x', "Debugflags = \"%s\", all = %d\n",
           debugflags, alldebugflags);
}

bool is_debugflag (char flag) {
   return alldebugflags or strchr (debugflags, flag) != nullptr;
}

void __debugprintf (char flag, const char* file, int line,
                    const char* func, const char* format, ...) {
   va_list args;
   if (not is_debugflag (flag)) return;
   fflush (nullptr);
   va_start (args, format);
   fprintf (stderr, "DEBUGF(%c): %s[%d] %s():\n",
             flag, file, line, func);
   vfprintf (stderr, format, args);
   va_end (args);
   fflush (nullptr);
}

```

```
// $Id: main.cpp,v 1.18 2017-10-19 16:02:14-07 - - $

#include <string>
#include <vector>
using namespace std;

#include <assert.h>
#include <errno.h>
#include <libgen.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>

#include "astree.h"
#include "auxlib.h"
#include "emitter.h"
#include "lyutils.h"
#include "string_set.h"

const string cpp_name = "/usr/bin/cpp";
string cpp_command;

// Open a pipe from the C preprocessor.
// Exit failure if can’t.
// Assigns opened pipe to FILE* yyin.
void cpp_popen (const char* filename) {
   cpp_command = cpp_name + " " + filename;
   yyin = popen (cpp_command.c_str(), "r");
   if (yyin == nullptr) {
      syserrprintf (cpp_command.c_str());
      exit (exec::exit_status);
   }else {
      if (yy_flex_debug) {
         fprintf (stderr, "-- popen (%s), fileno(yyin) = %d\n",
                  cpp_command.c_str(), fileno (yyin));
      }
      lexer::newfilename (cpp_command);
   }
}

void cpp_pclose() {
   int pclose_rc = pclose (yyin);
   eprint_status (cpp_command.c_str(), pclose_rc);
   if (pclose_rc != 0) exec::exit_status = EXIT_FAILURE;
}

```

```

void scan_opts (int argc, char** argv) {
   opterr = 0;
   yy_flex_debug = 0;
   yydebug = 0;
   lexer::interactive = isatty (fileno (stdin))
                    and isatty (fileno (stdout));
   for(;;) {
      int opt = getopt (argc, argv, "@:ly");
      if (opt == EOF) break;
      switch (opt) {
         case '@': set_debugflags (optarg);   break;
         case 'l': yy_flex_debug = 1;         break;
         case 'y': yydebug = 1;               break;
         default:  errprintf ("bad option (%c)\n", optopt); break;
      }
   }
   if (optind > argc) {
      errprintf ("Usage: %s [-ly] [filename]\n",
                 exec::execname.c_str());
      exit (exec::exit_status);
   }
   const char* filename = optind == argc ? "-" : argv[optind];
   cpp_popen (filename);
}

int main (int argc, char** argv) {
   exec::execname = basename (argv[0]);
   if (yydebug or yy_flex_debug) {
      fprintf (stderr, "Command:");
      for (char** arg = &argv[0]; arg < &argv[argc]; ++arg) {
            fprintf (stderr, " %s", *arg);
      }
      fprintf (stderr, "\n");
   }
   scan_opts (argc, argv);
   int parse_rc = yyparse();
   cpp_pclose();
   yylex_destroy();
   if (yydebug or yy_flex_debug) {
      fprintf (stderr, "Dumping parser::root:\n");
      if (parser::root != nullptr) parser::root->dump_tree (stderr);
      fprintf (stderr, "Dumping string_set:\n");
      string_set::dump (stderr);
   }
   if (parse_rc) {
      errprintf ("parse failed (%d)\n", parse_rc);
   }else {
      astree::print (stdout, parser::root);
      emit_sm_code (parser::root);
      delete parser::root;
   }
   return exec::exit_status;
}

```

```
# $Id: Makefile,v 1.40 2019-04-18 13:38:03-07 - - $

DEPSFILE  = Makefile.deps
NOINCLUDE = ci clean spotless
NEEDINCL  = ${filter ${NOINCLUDE}, ${MAKECMDGOALS}}
WARNING   = -Wall -Wextra -Wpedantic -Wshadow -Wold-style-cast
GPP       = g++ -std=gnu++17 -g -O0
GPPWARN   = ${GPP} ${WARNING} -fdiagnostics-color=never
GPPYY     = ${GPP} -Wno-sign-compare -Wno-register
MKDEPS    = g++ -std=gnu++17 -MM
GRIND     = valgrind --leak-check=full --show-reachable=yes
UTILBIN   = /afs/cats.ucsc.edu/courses/cmps104a-wm/bin/

MODULES   = astree lyutils string_set emitter auxlib
HDRSRC    = ${MODULES:=.h}
CPPSRC    = ${MODULES:=.cpp} main.cpp
FLEXSRC   = lexer.l
BISONSRC  = parser.y
PARSEHDR  = yyparse.h
LEXCPP    = yylex.cpp
PARSECPP  = yyparse.cpp
CGENS     = ${LEXCPP} ${PARSECPP}
ALLGENS   = ${PARSEHDR} ${CGENS}
EXECBIN   = zexprsm
ALLCSRC   = ${CPPSRC} ${CGENS}
OBJECTS   = ${ALLCSRC:.cpp=.o}
LEXOUT    = yylex.output
PARSEOUT  = yyparse.output
REPORTS   = ${LEXOUT} ${PARSEOUT}
MODSRC    = ${foreach MOD, ${MODULES}, ${MOD}.h ${MOD}.cpp}
MISCSRC   = ${filter-out ${MODSRC}, ${HDRSRC} ${CPPSRC}}
ALLSRC    = README ${FLEXSRC} ${BISONSRC} ${MODSRC} ${MISCSRC} Makefile
TESTINS   = ${wildcard test*.in}
EXECTEST  = ${EXECBIN} -ly
LISTSRC   = ${ALLSRC} ${DEPSFILE} ${PARSEHDR}

all : ${EXECBIN}

${EXECBIN} : ${OBJECTS}
        ${GPPWARN} -o${EXECBIN} ${OBJECTS}

yylex.o : yylex.cpp
        ${GPPYY} -c $<

yyparse.o : yyparse.cpp
        ${GPPYY} -c $<

%.o : %.cpp
        - ${UTILBIN}/cpplint.py.perl $<
        - ${UTILBIN}/checksource $<
        ${GPPWARN} -c $<

```

```

${LEXCPP} : ${FLEXSRC}
	flex --outfile=${LEXCPP} ${FLEXSRC}

${PARSECPP} ${PARSEHDR} : ${BISONSRC}
	bison --defines=${PARSEHDR} --output=${PARSECPP} ${BISONSRC}

ci : ${ALLSRC} ${TESTINS}
	- ${UTILBIN}/checksource ${ALLSRC}
	${UTILBIN}/cid + ${ALLSRC} ${TESTINS} test?.inh

lis : ${LISTSRC} tests
	${UTILBIN}/mkpspdf List.source.ps ${LISTSRC}
	${UTILBIN}/mkpspdf List.output.ps ${REPORTS} \
	      ${foreach test, ${TESTINS:.in=}, \
	      ${patsubst %, ${test}.%, in out err log}}

clean :
	- rm ${OBJECTS} ${ALLGENS} ${REPORTS} ${DEPSFILE} core
	- rm ${foreach test, ${TESTINS:.in=}, \
	      ${patsubst %, ${test}.%, out err log}}

spotless : clean
	- rm ${EXECBIN} List.*.ps List.*.pdf

deps : ${ALLCSRC}
	@ echo "# ${DEPSFILE} created ‘date‘ by ${MAKE}" >${DEPSFILE}
	${MKDEPS} ${ALLCSRC} >>${DEPSFILE}

${DEPSFILE} :
	@ touch ${DEPSFILE}
	${MAKE} --no-print-directory deps

tests : ${EXECBIN}
	touch ${TESTINS}
	gmake --no-print-directory ${TESTINS:.in=.out}

%.out %.err : %.in
	${GRIND} --log-file=$*.log ${EXECTEST} $< 1>$*.out 2>$*.err; \
	echo EXIT STATUS = $$? >>$*.log

again :
	gmake --no-print-directory spotless deps ci all lis

ifeq "${NEEDINCL}" ""
include ${DEPSFILE}
endif

```

```
# Makefile.deps created Thu Apr 18 13:38:02 PDT 2019 by gmake
astree.o: astree.cpp astree.h auxlib.h string_set.h lyutils.h yyparse.h
lyutils.o: lyutils.cpp auxlib.h lyutils.h astree.h yyparse.h
string_set.o: string_set.cpp auxlib.h string_set.h
emitter.o: emitter.cpp astree.h auxlib.h emitter.h lyutils.h yyparse.h
auxlib.o: auxlib.cpp auxlib.h
main.o: main.cpp astree.h auxlib.h emitter.h lyutils.h yyparse.h \
 string_set.h
yylex.o: yylex.cpp lyutils.h astree.h auxlib.h yyparse.h
yyparse.o: yyparse.cpp astree.h auxlib.h lyutils.h yyparse.h
```

```
/* A Bison parser, made by GNU Bison 3.0.4.  */

/* Bison interface for Yacc-like parsers in C

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   the Free Software Foundation, either version 3 of the License, or
   (at your option) any later version.

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   but WITHOUT ANY WARRANTY; without even the implied warranty of
   MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
   GNU General Public License for more details.

   You should have received a copy of the GNU General Public License
   along with this program.  If not, see <http://www.gnu.org/licenses/>.  */

/* As a special exception, you may create a larger work that contains
   part or all of the Bison parser skeleton and distribute that work
   under terms of your choice, so long as that work isn't itself a
   parser generator using the skeleton or a modified version thereof
   as a parser skeleton.  Alternatively, if you modify or redistribute
   the parser skeleton itself, you may (at your option) remove this
   special exception, which will cause the skeleton and the resulting
   Bison output files to be licensed under the GNU General Public
   License without this special exception.

   This special exception was added by the Free Software Foundation in
   version 2.2 of Bison.  */

#ifndef YY_YY_YYPARSE_H_INCLUDED
# define YY_YY_YYPARSE_H_INCLUDED
/* Debug traces.  */
#ifndef YYDEBUG
# define YYDEBUG 1
#endif
#if YYDEBUG
extern int yydebug;
#endif

/* Token type.  */
#ifndef YYTOKENTYPE
# define YYTOKENTYPE
  enum yytokentype
  {
    ROOT = 258,
    IDENT = 259,
    NUMBER = 260,
    POS = 261,
    NEG = 262
  };
#endif

/* Value type.  */
```

```
#if ! defined YYSTYPE && ! defined YYSTYPE_IS_DECLARED
typedef int YYSTYPE;
# define YYSTYPE_IS_TRIVIAL 1
# define YYSTYPE_IS_DECLARED 1
#endif


extern YYSTYPE yylval;

int yyparse (void);

#endif /* !YY_YY_YYPARSE_H_INCLUDED  */
```