ASSIGNMENT 2 - SYNTAX ANALYZER (PARSER)

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1 - LL(1) Grammar

```
<START> ::= <prog>
<prog> ::= <rept-prog0>

<rept-prog0> ::= <structOrImplOrFunc> <rept-prog0>
<rept-prog0> ::= EPSILON

<structOrImplOrFunc> ::= <structDecl>
<structOrImplOrFunc> ::= <implDef>
<structOrImplOrFunc> ::= <funcDef>

<structDecl> ::= 'struct' 'id' <opt-structDecl2> '{' <rept-structDecl4>
'}' ';'
<rept-structDecl4> ::= <visibility> <memberDecl> <rept-structDecl4>
<rept-structDecl4> ::= EPSILON
<opt-structDecl2> ::= 'inherits' 'id' <rept-opt-structDecl22>
<opt-structDecl2> ::= EPSILON
<rept-opt-structDecl22> ::= ',' 'id' <rept-opt-structDecl22>
<rept-opt-structDecl22> ::= EPSILON

<implDef> ::= 'impl' 'id' '{' <rept-implDef3> '}'
<rept-implDef3> ::= <funcDef> <rept-implDef3>
<rept-implDef3> ::= EPSILON

<funcDef> ::= <funcHead> <funcBody>
<funcBody> ::= '{' <rept-funcBody1> '}'

<visibility> ::= 'public'
<visibility> ::= 'private'

<memberDecl> ::= <funcDecl>
<memberDecl> ::= <varDecl>

<funcDecl> ::= <funcHead> ';'
<funcHead> ::= 'func' 'id' '(' <fParams> ')' '->' <returnType>
<rept-funcBody1> ::= <varDeclOrStat> <rept-funcBody1>
<rept-funcBody1> ::= EPSILON

<varDeclOrStat> ::= <varDecl>
<varDeclOrStat> ::= <statement>
```

```
<varDecl> ::= 'let' 'id' ':' <type> <rept-varDecl4> ';'
<rept-varDecl4> ::= <arraySize> <rept-varDecl4>
<rept-varDecl4> ::= EPSILON

<statement> ::= <assignStatOrFuncCall>
<statement> ::= 'if' '(' <relExpr> ')' 'then' <statBlock> 'else'
<statBlock> ';'
<statement> ::= 'while' '(' <relExpr> ')' <statBlock> ';'
<statement> ::= 'read' '(' <variable> ')' ';'
<statement> ::= 'write' '(' <expr> ')' ';'
<statement> ::= 'return' '(' <expr> ')' ';'

<assignStatOrFuncCall> ::= 'id' <assignStatOrFuncCall-disambiguate>

<assignStatOrFuncCall-disambiguate> ::= <indice> <more-indice> <more-
assign>
<assignStatOrFuncCall-disambiguate> ::= '(' <aParams> ')' <more-func>
<assignStatOrFuncCall-disambiguate> ::= <more-assign>

<more-assign> ::= '.' <assignStatOrFuncCall>
<more-assign> ::= <assignOp> <expr> ';'

<more-func> ::= '.' <assignStatOrFuncCall>
<more-func> ::= ';'

<indice> ::= '[' <arithExpr> ']'

<varOrFuncCall> ::= 'id' <varOrFuncCall-disambiguate>

<varOrFuncCall-disambiguate> ::= '(' <aParams> ')' <another>
<varOrFuncCall-disambiguate> ::= <indice> <more-indice> <another>
<varOrFuncCall-disambiguate> ::= <another>

<more-indice> ::= <indice> <more-indice>
<more-indice> ::= EPSILON

<another> ::= '.' <varOrFuncCall>
<another> ::= EPSILON

<variable> ::= 'id' <more-indice> <something>

<something> ::= '.' <varOrFuncCall> 'id' <more-indice>
<something> ::= EPSILON

<functionCall> ::= 'id' '(' <aParams> ')' <something-func>
<something-func> ::= '.' <varOrFuncCall> 'id' '(' <aParams> ')'
<something-func> ::= EPSILON

<factor> ::= <varOrFuncCall>
<factor> ::= 'intNum'
<factor> ::= 'floatNum'
```

```
<factor> ::= '(' <arithExpr> ')'
<factor> ::= 'not' <factor>
<factor> ::= <sign> <factor>

<assignStat> ::= <variable> <assignOp> <expr>

<statBlock> ::= '{' <rept-statBlock1> '}'
<statBlock> ::= <statement>
<statBlock> ::= EPSILON

<rept-statBlock1> ::= <statement> <rept-statBlock1>
<rept-statBlock1> ::= EPSILON

<expr> ::= <arithExpr> <arithOrRelExpr-disambiguate>

<arithOrRelExpr-disambiguate> ::= <relOp> <arithExpr>
<arithOrRelExpr-disambiguate> ::= EPSILON

<relExpr> ::= <arithExpr> <relOp> <arithExpr>
<arithExpr> ::= <term> <rightrec-arithExpr>

<rightrec-arithExpr> ::= <addOp> <term> <rightrec-arithExpr>
<rightrec-arithExpr> ::= EPSILON

<sign> ::= '+'
<sign> ::= '-'
<term> ::= <factor> <rightrec-term>

<rightrec-term> ::= <multOp> <factor> <rightrec-term>
<rightrec-term> ::= EPSILON

<arraySize> ::= '[' <arraySize-factorized>
<arraySize-factorized> ::= ']'
<arraySize-factorized> ::= 'intNum' ']'

<returnType> ::= <type>
<returnType> ::= 'void'

<fParams> ::= 'id' ':' <type> <rept-fParams3> <rept-fParams4>
<fParams> ::= EPSILON
<rept-fParams3> ::= <arraySize> <rept-fParams3>
<rept-fParams3> ::= EPSILON
<rept-fParams4> ::= <fParamsTail> <rept-fParams4>
<rept-fParams4> ::= EPSILON

<aParams> ::= <expr> <rept-aParams1>
<aParams> ::= EPSILON
<rept-aParams1> ::= <aParamsTail> <rept-aParams1>
<rept-aParams1> ::= EPSILON
<fParamsTail> ::= ',' 'id' ':' <type> <rept-fParamsTail4>
<rept-fParamsTail4> ::= <arraySize> <rept-fParamsTail4>
<rept-fParamsTail4> ::= EPSILON
```

```
<aParamsTail> ::= ',' <expr>

<assignOp> ::= '='

<relOp> ::= 'eq'
<relOp> ::= 'neq'
<relOp> ::= 'lt'
<relOp> ::= 'gt'
<relOp> ::= 'leq'
<relOp> ::= 'geq'

<addOp> ::= '+'
<addOp> ::= '-'
<addOp> ::= 'or'

<multOp> ::= '*'
<multOp> ::= '/'
<multOp> ::= 'and'

<type> ::= 'integer'
<type> ::= 'float'
<type> ::= 'id'
```

2 - FIRST and FOLLOW sets

FIRST Set

```
FIRST(<funcHead>) = {'func'}
FIRST('then') = {'then'}
FIRST('+') = {'+'}
FIRST(<statement>) = {'id', 'if', 'while', 'read', 'write', 'return'}
FIRST(<varDecl>) = {'let'}
FIRST('void') = {'void'}
FIRST('inherits') = {'inherits'}
FIRST(<rept-implDef3>) = {'func', EPSILON}
FIRST(<relOp>) = {'geq', 'eq', 'neq', 'lt', 'gt', 'leq'}
FIRST(<more-assign>) = {'.', '='}
FIRST('/') = {'/'}
FIRST('if') = {'if'}
FIRST(<aParams>) = {'+', '-', EPSILON, 'id', 'intNum', 'floatNum', '(',
'not'}
FIRST(<assignOp>) = {'='}
FIRST(<prog>) = {'struct', 'impl', 'func', EPSILON}
FIRST(<rept-statBlock1>) = {'write', 'return', EPSILON, 'id', 'if',
'while', 'read'}
FIRST('lt') = {'lt'}
FIRST('write') = {'write'}
FIRST('public') = {'public'}
FIRST('struct') = {'struct'}
FIRST('not') = {'not'}
FIRST(<fParamsTail>) = {','}
FIRST('{') = {'{'}
FIRST(<statBlock>) = {'return', EPSILON, '{', 'id', 'if', 'while', 'read',
'write'}
FIRST('.') = {'.'}
FIRST(<something-func>) = {'.', EPSILON}
FIRST(<rightrec-arithExpr>) = {'-', 'or', EPSILON, '+'}
FIRST(<assignStatOrFuncCall>) = {'id'}
FIRST('geq') = {'geq'}
FIRST('id') = {'id'}
FIRST(<structOrImplOrFunc>) = {'struct', 'impl', 'func'}
FIRST('float') = {'float'}
FIRST(',') = {','}
FIRST('}') = {'}'}
FIRST('func') = {'func'}
FIRST(<funcDecl>) = {'func'}
FIRST(<rept-structDecl4>) = {'public', 'private', EPSILON}
FIRST('floatNum') = {'floatNum'}
FIRST('->') = {'->'}
FIRST(<rept-varDecl4>) = {'[', EPSILON}
FIRST(<rept-prog0>) = {'struct', 'impl', 'func', EPSILON}
FIRST(<varDeclOrStat>) = {'while', 'read', 'write', 'return', 'let', 'id',
'if'}
FIRST(<rept-fParamsTail4>) = {'[', EPSILON}
FIRST(<arraySize>) = {'['}
FIRST(';') = {';'}
FIRST(<relExpr>) = {'not', '+', '-', 'id', 'intNum', 'floatNum', '('}
FIRST(<rept-funcBody1>) = {EPSILON, 'let', 'id', 'if', 'while', 'read',
'write', 'return'}
FIRST('while') = {'while'}
FIRST(<opt-structDecl2>) = {'inherits', EPSILON}
FIRST(<visibility>) = {'public', 'private'}
FIRST(<variable>) = {'id'}
FIRST('neq') = {'neq'}
FIRST('integer') = {'integer'}
FIRST(<fParams>) = {'id', EPSILON}
FIRST(<funcDef>) = {'func'}
FIRST('return') = {'return'}
FIRST('impl') = {'impl'}
FIRST('let') = {'let'}
FIRST(<assignStat>) = {'id'}
FIRST(<more-indice>) = {'[', EPSILON}
FIRST(']') = {']'}
FIRST(<expr>) = {'id', 'intNum', 'floatNum', '(', 'not', '+', '-'}
FIRST(<START>) = {'struct', 'impl', 'func', EPSILON}
FIRST(<addOp>) = {'+', '-', 'or'}
FIRST(<arithExpr>) = {'floatNum', '(', 'not', '+', '-', 'id', 'intNum'}
FIRST(':') = {':'}
FIRST('leq') = {'leq'}
FIRST(<assignStatOrFuncCall-disambiguate>) = {'.', '=', '[', '('}
FIRST(<another>) = {'.', EPSILON}
FIRST(<rept-aParams1>) = {',', EPSILON}
FIRST(<indice>) = {'['}
FIRST(')') = {')'}
FIRST('gt') = {'gt'}
FIRST('private') = {'private'}
FIRST('eq') = {'eq'}
FIRST(<returnType>) = {'integer', 'float', 'id', 'void'}
FIRST(<varOrFuncCall>) = {'id'}
FIRST(<implDef>) = {'impl'}
FIRST(<rept-fParams3>) = {'[', EPSILON}
FIRST(<functionCall>) = {'id'}
FIRST(<structDecl>) = {'struct'}
FIRST(<aParamsTail>) = {','}
FIRST(<term>) = {'(', 'not', '+', '-', 'id', 'intNum', 'floatNum'}
FIRST(<sign>) = {'+', '-'}
FIRST(<rept-fParams4>) = {',', EPSILON}
FIRST(<something>) = {EPSILON, '.'}
FIRST(<rightrec-term>) = {'*', '/', 'and', EPSILON}
FIRST(<varOrFuncCall-disambiguate>) = {EPSILON, '(', '[', '.'}
FIRST('-') = {'-'}
FIRST(<type>) = {'integer', 'float', 'id'}
FIRST(<more-func>) = {'.', ';'}
FIRST('[') = {'['}
FIRST('intNum') = {'intNum'}
FIRST(<arraySize-factorized>) = {']', 'intNum'}
FIRST(<factor>) = {'id', 'intNum', 'floatNum', '(', 'not', '+', '-'}
FIRST('=') = {'='}
FIRST('and') = {'and'}
FIRST(<arithOrRelExpr-disambiguate>) = {'neq', 'lt', 'gt', 'leq', 'geq',
EPSILON, 'eq'}
FIRST(<multOp>) = {'and', '*', '/'}
FIRST('else') = {'else'}
FIRST('or') = {'or'}
FIRST(EPSILON) = {EPSILON}
FIRST(<memberDecl>) = {'let', 'func'}
FIRST(<funcBody>) = {'{'}
FIRST('*') = {'*'}
FIRST(<rept-opt-structDecl22>) = {',', EPSILON}
FIRST('read') = {'read'}
FIRST('(') = {'('}
```

FOLLOW Set

```
FOLLOW('lt') = {'(', 'not', 'floatNum', 'id', '+', 'intNum', '-'}
FOLLOW('=') = {'not', 'id', '(', '+', '-', 'floatNum', 'intNum'}
FOLLOW('neq') = {'+', 'id', 'not', 'floatNum', '(', 'intNum', '-'}
FOLLOW('private') = {'let', 'func'}
FOLLOW(<memberDecl>) = {'private', 'public', '}'}
FOLLOW('id') = {'+', '-', 'let', 'id', 'if', 'neq', 'eq', ';', '}', 'lt',
']', 'geq', ',', '{', 'struct', '/', '*', '[', 'while', 'private', '(',
'.', '=', 'inherits', 'leq', 'or', 'gt', ':', 'read', 'write', 'public',
'return', 'and', ')', 'impl', 'func'}
FOLLOW('}') = {'struct', 'func', ';', 'impl', '}'}
FOLLOW('inherits') = {'id'}
FOLLOW(<funcHead>) = {';', '{'}
FOLLOW('write') = {'('}
FOLLOW(<rept-statBlock1>) = {'}'}
FOLLOW(<factor>) = {')', '*', 'neq', '+', ']', '/', 'lt', 'and', 'gt',
';', 'leq', 'geq', 'eq', '-', 'or', ','}
FOLLOW('func') = {'id'}
FOLLOW(')') = {'neq', 'read', 'or', '.', ']', 'geq', ',', 'write', 'if',
'}', '->', '+', '/', 'and', 'let', 'eq', 'lt', 'return', ';', 'leq', 'id',
')', 'then', 'while', '{', '-', 'gt', '*'}
FOLLOW(<funcBody>) = {'impl', 'struct', '}', 'func'}
FOLLOW(<returnType>) = {';', '{'}
FOLLOW(<functionCall>) = {}
FOLLOW(<funcDecl>) = {'public', 'private', '}'}
FOLLOW(<implDef>) = {'impl', 'struct', 'func'}
FOLLOW(<term>) = {',', 'neq', 'or', 'gt', ')', '+', 'geq', 'eq', 'leq',
'lt', ']', ';', '-'}
FOLLOW(<rept-structDecl4>) = {'}'}
FOLLOW('floatNum') = {'and', ',', 'neq', ';', '/', 'leq', 'or', '+', 'eq',
')', 'gt', 'geq', '-', '*', 'lt', ']'}
FOLLOW('geq') = {'(', '-', 'intNum', 'not', 'floatNum', '+', 'id'}
FOLLOW(<more-assign>) = {'}', 'if', 'write', 'return', 'id', 'while',
'let', ';', 'read'}
FOLLOW(<variable>) = {'=', ')'}
FOLLOW(<funcDef>) = {'}', 'struct', 'func', 'impl'}
FOLLOW('[') = {'floatNum', 'not', 'id', '(', ']', '+', '-', 'intNum'}
FOLLOW('intNum') = {'gt', ')', '+', ';', 'lt', 'or', '*', 'eq', 'leq',
'and', ',', 'neq', '/', ']', '-', 'geq'}
FOLLOW(<rept-funcBody1>) = {'}'}
FOLLOW(<varOrFuncCall>) = {'*', 'id', '+', 'lt', '-', ')', 'or', ']', ',',
'leq', 'neq', 'geq', 'eq', '/', 'gt', 'and', ';'}
FOLLOW(<rept-fParams3>) = {',', ')'}
FOLLOW('+') = {'(', 'id', 'not', 'floatNum', '-', '+', 'intNum'}
FOLLOW('and') = {'id', '+', 'floatNum', 'intNum', '-', '(', 'not'}
FOLLOW(<assignStatOrFuncCall-disambiguate>) = {'write', 'return', 'while',
';', 'let', '}', 'if', 'id', 'read'}
FOLLOW(<more-func>) = {'return', 'if', 'read', 'write', ';', 'while',
'let', '}', 'id'}
FOLLOW('.') = {'id'}
FOLLOW(<arithExpr>) = {';', 'gt', 'geq', 'eq', 'leq', ']', 'neq', ')',
',', 'lt'}
FOLLOW(<START>) = {}
FOLLOW(<rept-prog0>) = {}
FOLLOW(<statBlock>) = {';'}
FOLLOW(<fParamsTail>) = {')', ','}
FOLLOW('else') = {'}', 'read', 'id', ';', '{', 'while', 'if', 'return',
'let', 'write'}
FOLLOW('eq') = {'intNum', '-', '(', 'not', '+', 'floatNum', 'id'}
FOLLOW(<expr>) = {',', ';', ')'}
FOLLOW(<something-func>) = {}
FOLLOW(<addOp>) = {'intNum', '-', 'floatNum', 'id', '(', 'not', '+'}
FOLLOW('struct') = {'id'}
FOLLOW(<something>) = {')', '='}
FOLLOW(<another>) = {'and', 'gt', ',', 'lt', 'or', 'leq', 'neq', 'geq',
'/', '-', '*', ']', ';', ')', 'id', '+', 'eq'}
FOLLOW(<more-indice>) = {'or', '+', '/', 'id', ')', 'gt', 'neq', ';', '=',
'lt', 'eq', '-', '*', 'geq', 'leq', ']', 'and', '.', ','}
FOLLOW(<aParams>) = {')'}
FOLLOW(<structOrImplOrFunc>) = {'struct', 'impl', 'func'}
FOLLOW(']') = {'.', 'lt', 'write', '+', ';', '}', 'gt', ']', '[', ')',
'*', 'and', 'neq', 'or', 'if', 'let', 'read', 'eq', '/', 'id', '-',
'while', 'leq', 'geq', ',', '=', 'return'}
FOLLOW(<fParams>) = {')'}
FOLLOW('gt') = {'intNum', 'not', '-', 'id', '+', '(', 'floatNum'}
FOLLOW(<assignStatOrFuncCall>) = {'}', ';', 'write', 'return', 'id',
'while', 'let', 'read', 'if'}
FOLLOW('/') = {'intNum', 'id', 'floatNum', '-', '+', '(', 'not'}
FOLLOW('or') = {'not', 'floatNum', '-', 'id', 'intNum', '+', '('}
FOLLOW('integer') = {'public', 'id', 'return', '}', 'private', 'let', ',',
'[', '{', 'write', ';', 'if', 'read', ')', 'while'}
FOLLOW(<rept-varDecl4>) = {';'}
FOLLOW('{') = {'if', 'private', ';', 'while', 'func', 'return', 'public',
'impl', 'id', 'read', '}', 'write', 'struct', 'let'}
FOLLOW(',') = {'id', '(', 'intNum', 'floatNum', '+', 'not', '-'}
FOLLOW('return') = {'('}
FOLLOW('void') = {'{', ';'}
FOLLOW('impl') = {'id'}
FOLLOW(<arithOrRelExpr-disambiguate>) = {')', ';', ','}
FOLLOW(';') = {'read', 'func', 'return', ';', 'private', '}', 'impl',
'let', 'write', 'struct', 'id', 'public', 'if', 'while'}
FOLLOW('leq') = {'(', '+', 'id', 'intNum', 'not', 'floatNum', '-'}
FOLLOW(EPSILON) = {'-', 'id', ')', '}', '/', '*', 'lt', ',', 'gt', 'eq',
'and', 'neq', 'leq', '{', ';', 'or', 'geq', ']', '+', '=', '.'}
FOLLOW(<prog>) = {}
FOLLOW(<visibility>) = {'let', 'func'}
FOLLOW(<statement>) = {'read', 'write', 'return', ';', 'while', '}', 'id',
'if', 'let'}
FOLLOW(<rightrec-arithExpr>) = {'leq', ']', ';', 'neq', ',', 'geq', 'lt',
')', 'eq', 'gt'}
FOLLOW(<multOp>) = {'-', 'floatNum', '+', 'intNum', '(', 'id', 'not'}
FOLLOW(<varOrFuncCall-disambiguate>) = {'eq', 'leq', '-', ',', 'neq',
'lt', ')', 'id', ';', 'or', ']', 'and', '*', 'gt', '+', '/', 'geq'}
FOLLOW(<assignOp>) = {'intNum', '-', 'id', 'floatNum', '(', '+', 'not'}
FOLLOW(':') = {'integer', 'float', 'id'}
FOLLOW(<rept-implDef3>) = {'}'}
FOLLOW(<varDeclOrStat>) = {'if', 'let', 'read', 'write', 'id', 'return',
'while', '}'}
FOLLOW(<indice>) = {'lt', 'read', 'return', 'eq', ',', 'neq', '+', '*',
'write', 'leq', '-', '/', '=', 'id', 'and', 'gt', 'if', ';', ']', 'geq',
'while', '[', ')', 'let', '.', 'or', '}'}
FOLLOW(<arraySize-factorized>) = {',', ';', '[', ')'}
FOLLOW('let') = {'id'}
FOLLOW('then') = {'if', '}', 'let', 'return', 'id', ';', 'write', '{',
'while', 'read'}
FOLLOW('if') = {'('}
FOLLOW(<relOp>) = {'(', 'intNum', 'not', 'floatNum', 'id', '-', '+'}
FOLLOW(<rept-aParams1>) = {')'}
FOLLOW(<rept-fParamsTail4>) = {')', ','}
FOLLOW(<rightrec-term>) = {',', '-', ')', '+', ';', 'neq', 'or', 'gt',
'geq', 'lt', 'leq', 'eq', ']'}
FOLLOW(<assignStat>) = {}
FOLLOW('read') = {'('}
FOLLOW('*') = {'id', 'not', '+', '(', '-', 'floatNum', 'intNum'}
FOLLOW('-') = {'-', 'intNum', 'id', 'not', '+', '(', 'floatNum'}
FOLLOW(<arraySize>) = {',', ';', '[', ')'}
FOLLOW(<sign>) = {'+', '-', 'intNum', 'id', '(', 'not', 'floatNum'}
FOLLOW('while') = {'('}
FOLLOW(<type>) = {'let', 'id', ';', '{', 'read', 'if', 'return', 'write',
'}', 'private', ',', '[', ')', 'while', 'public'}
FOLLOW(<varDecl>) = {'}', 'private', 'let', 'while', 'id', 'public',
'write', 'read', 'return', 'if'}
FOLLOW('public') = {'func', 'let'}
FOLLOW(<opt-structDecl2>) = {'{'}
FOLLOW(<structDecl>) = {'impl', 'func', 'struct'}
FOLLOW(<aParamsTail>) = {')', ','}
FOLLOW(<rept-fParams4>) = {')'}
FOLLOW('not') = {'floatNum', '(', 'not', 'id', 'intNum', '+', '-'}
FOLLOW(<rept-opt-structDecl22>) = {'{'}
FOLLOW(<relExpr>) = {')'}
FOLLOW('float') = {'write', ')', ',', 'id', '{', 'read', 'private', '}',
'public', 'return', 'let', ';', 'if', '[', 'while'}
FOLLOW('->') = {'integer', 'id', 'void', 'float'}
FOLLOW('(') = {'eq', 'while', 'write', '+', 'gt', 'leq', ',', 'not',
'geq', '{', '}', 'intNum', ']', 'neq', '-', 'floatNum', 'return', 'if',
'or', '/', '*', 'lt', '(', ';', 'let', 'read', 'and', ')', 'id'}
```

3 - Design

This design is a table-driven parser.

The parser is implemented in Golang and the main module is called: `github.com/obonobo/esac`.

The design is very similar to how the scanner was written in assignment 1. I begun the implementation by designing a set of small but powerful interfaces and data types for my components:

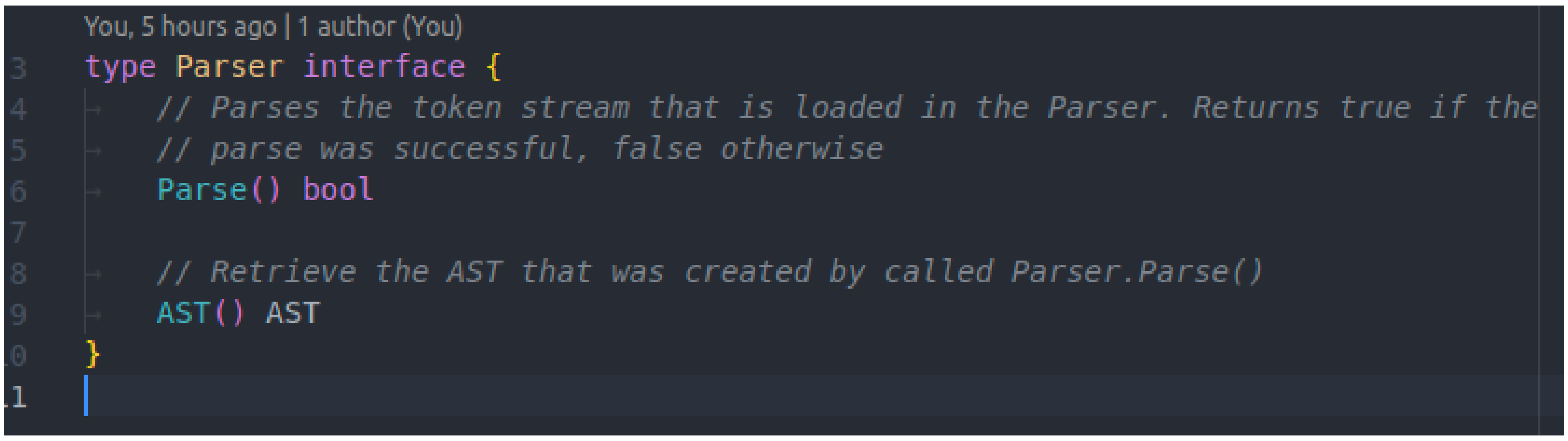
- PACKAGE: `github.com/obonobo/esac/core/parser`

  - `Parser` interface
  - `AST` struct

- PACKAGE: `github.com/obonobo/esac/core/tabledrivenparser`
  - This package contains an implementation of the `Parser` interface from the previous package.
  - `Table` interface

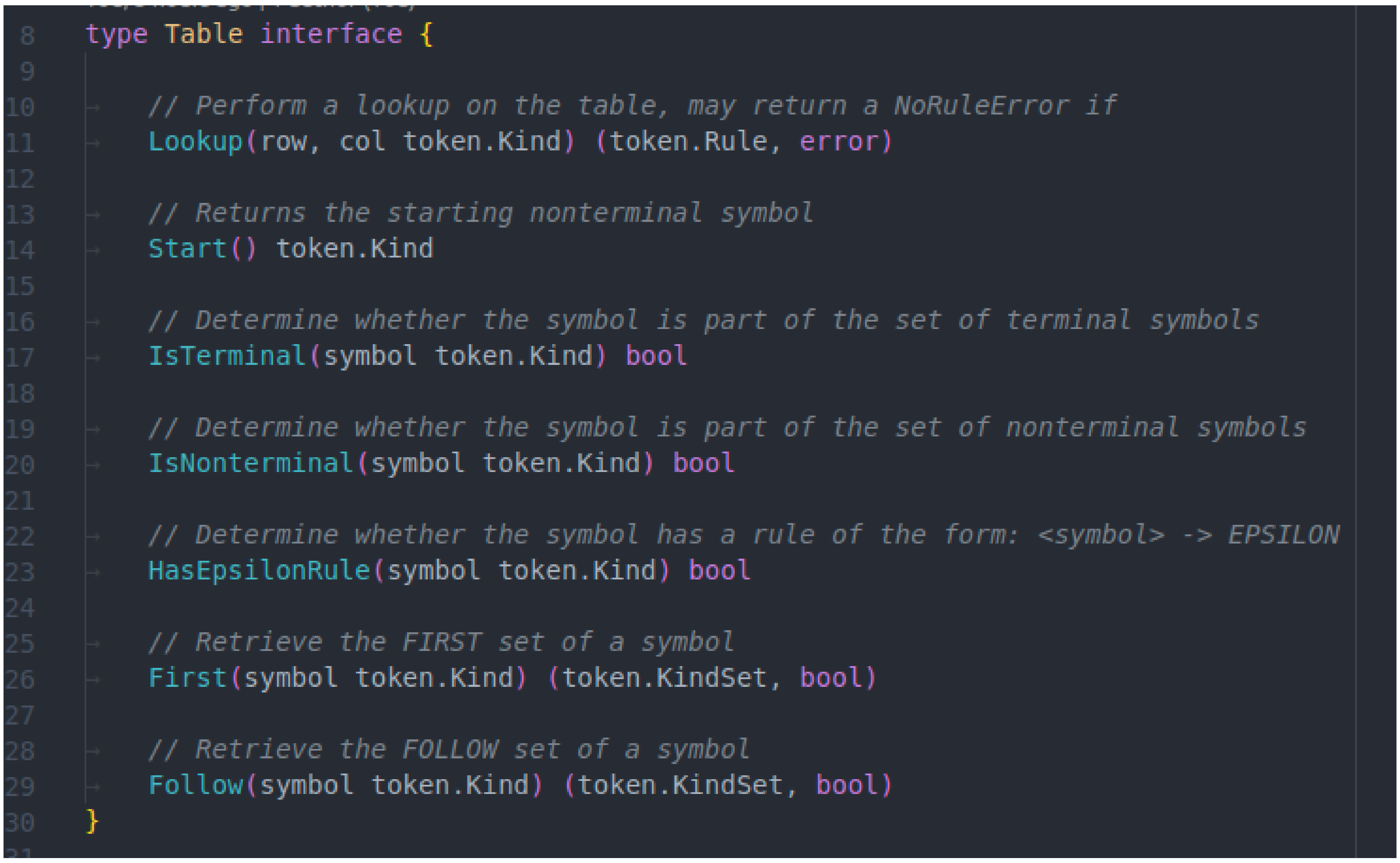
- PACKAGE: `github.com/obonobo/esac/core/tabledrivenparser/compositetable`
  - This package contains an implementation of the `Table` interface from the previous package.

`Parser` interface



```
You, 5 hours ago | 1 author (You)
type Parser interface {
	// Parses the token stream that is loaded in the Parser. Returns true if the
	// parse was successful, false otherwise
	Parse() bool

	// Retrieve the AST that was created by called Parser.Parse()
	AST() AST
}
```

`Table` interface

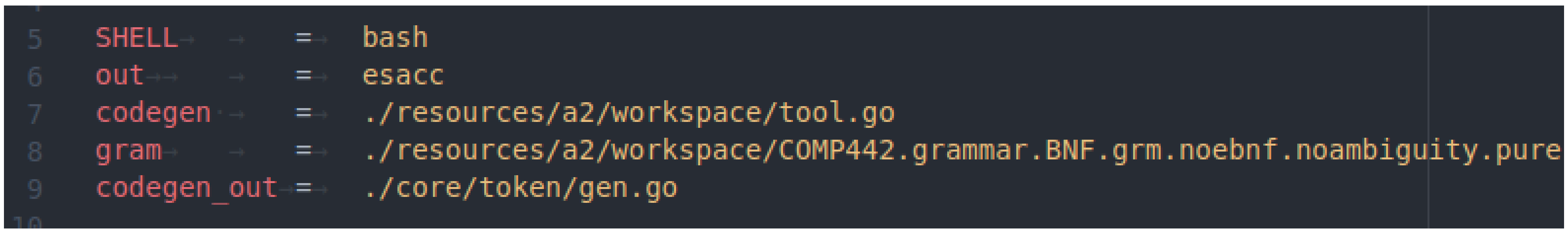


```
type Table interface {

	// Perform a lookup on the table, may return a NoRuleError if
	Lookup(row, col token.Kind) (token.Rule, error)

	// Returns the starting nonterminal symbol
	Start() token.Kind

	// Determine whether the symbol is part of the set of terminal symbols
	IsTerminal(symbol token.Kind) bool

	// Determine whether the symbol is part of the set of nonterminal symbols
	IsNonterminal(symbol token.Kind) bool

	// Determine whether the symbol has a rule of the form: <symbol> -> EPSILON
	HasEpsilonRule(symbol token.Kind) bool

	// Retrieve the FIRST set of a symbol
	First(symbol token.Kind) (token.KindSet, bool)

	// Retrieve the FOLLOW set of a symbol
	Follow(symbol token.Kind) (token.KindSet, bool)
}
```

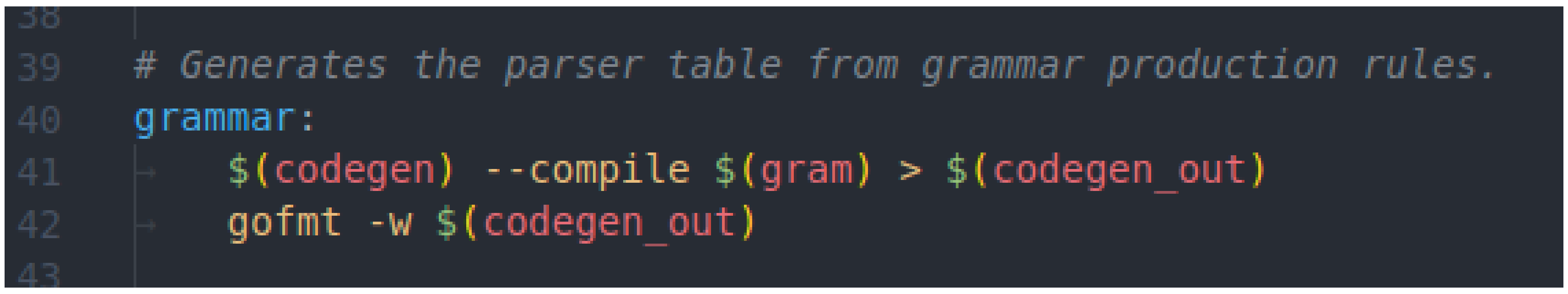
The Parser accepts any object that implements the `Table` interface shown above. This makes it modular - it is possible to replace the table entirely and reuse the same parser algorithm.

Another important component is the table generator tool: `tool.go`. This is a script that I wrote to generate the parser table (in Go code) from the grammar production rules. It implements the algorithms for determining the FIRST and FOLLOW sets. Using those sets, it constructs the parser table.

In my `Makefile`, I wrote a target that runs the tool:



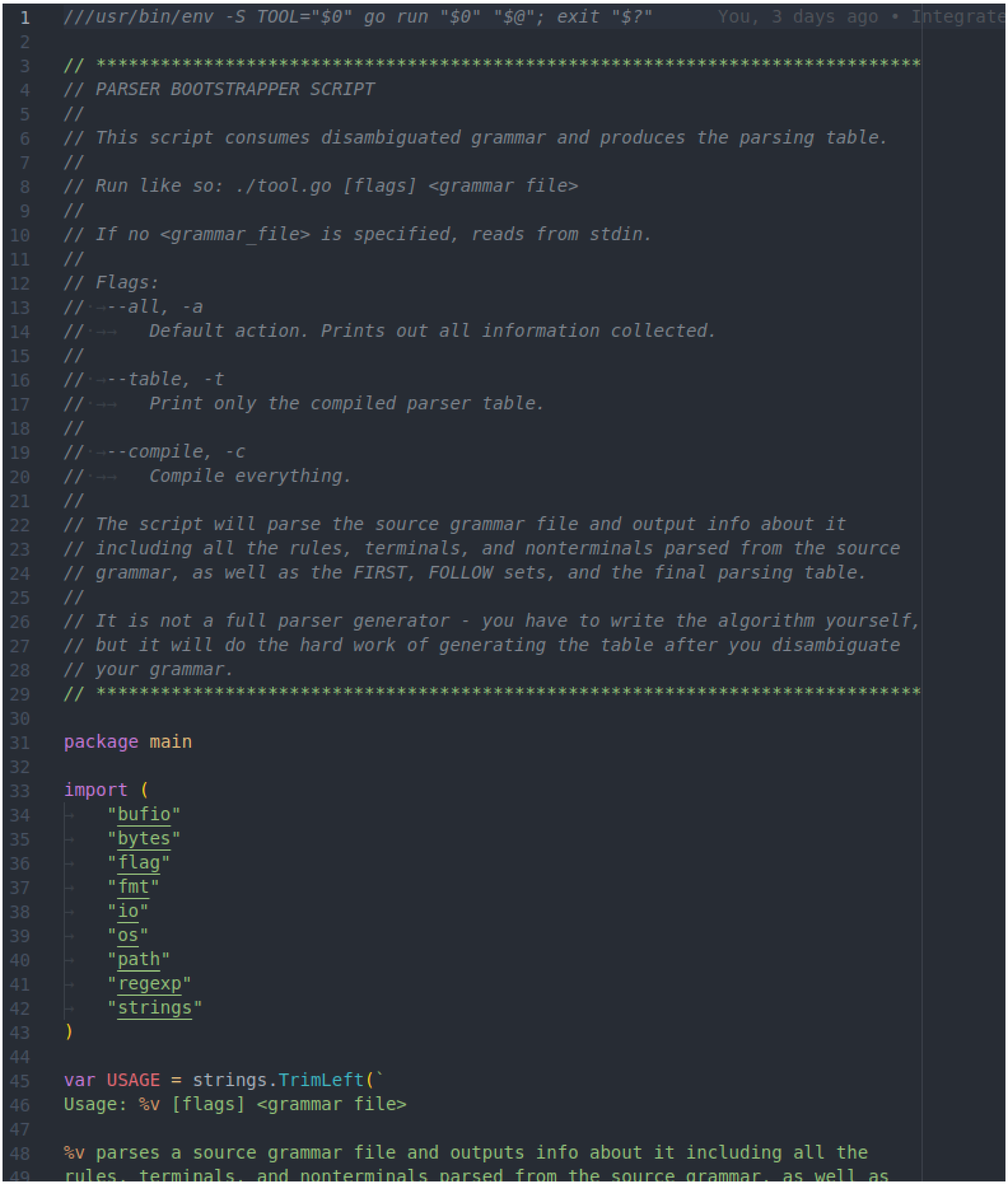
```
SHELL       =   bash
out         =   esacc
codegen     =   ./resources/a2/workspace/tool.go
gram        =   ./resources/a2/workspace/COMP442.grammar.BNF.grm.noebnf.noambiguity.pure
codegen_out =   ./core/token/gen.go
```



```

# Generates the parser table from grammar production rules.
grammar:
	$(codegen) --compile $(gram) > $(codegen_out)
	gofmt -w $(codegen_out)

```

It spits out a `gen.go` in the `github.com/obonobo/esac/core/token` package. The constants produced by `tool.go` are then used in the `compositetable` package.

`tool.go` Sample:



```go
///usr/bin/env -S TOOL="$0" go run "$0" "$@"; exit "$?"      You, 3 days ago • Integrate

// ******************************************************************************
// PARSER BOOTSTRAPPER SCRIPT
//
// This script consumes disambiguated grammar and produces the parsing table.
//
// Run like so: ./tool.go [flags] <grammar file>
//
// If no <grammar_file> is specified, reads from stdin.
//
// Flags:
//	--all, -a
//		Default action. Prints out all information collected.
//
//	--table, -t
//		Print only the compiled parser table.
//
//	--compile, -c
//		Compile everything.
//
// The script will parse the source grammar file and output info about it
// including all the rules, terminals, and nonterminals parsed from the source
// grammar, as well as the FIRST, FOLLOW sets, and the final parsing table.
//
// It is not a full parser generator - you have to write the algorithm yourself,
// but it will do the hard work of generating the table after you disambiguate
// your grammar.
// ******************************************************************************

package main

import (
	"bufio"
	"bytes"
	"flag"
	"fmt"
	"io"
	"os"
	"path"
	"regexp"
	"strings"
)

var USAGE = strings.TrimLeft(`
Usage: %v [flags] <grammar file>

%v parses a source grammar file and outputs info about it including all the
rules, terminals, and nonterminals parsed from the source grammar, as well as
```

Using `tool.go` really saved me a lot of time iterating.

4 - Use of Tools

- `tool.go` : written by me for this project
- GitHub Actions for running my CI while I develop
- `grammartool.jar` : I used this at the beginning to verify that my I was producing the LL(1) grammar correctly - but I did the transformations by hand.