The University of Newcastle

School of Electrical Engineering and Computing

COMP3290 Compiler Design

Semester 2, 2018

The CD18 Programming Language
Version 1.0 – 2018-08-01

CD18 Language Syntax – Version 1.0 – with Syntax Tree Node Values

NPROG	<program>	::= CD18 <id> <globals> <funcs> <mainbody>
NGLOB	<globals>	::= <consts> <types> <arrays>
Special	<consts>	::= constants <initlist> | ε
NILIST	<initlist>	::= <init> , <initlist>
Special	<initlist>	::= <init>
NINIT	<init>	::= <id> = <expr>
Special	<types>	::= types <typelist> | ε
Special	<arrays>	::= arrays <arrdecls>
Special	<arrays>	::= ε
NFUNCS	<funcs>	::= <func> <funcs>
Special	<funcs>	::= ε
NMAIN	<mainbody>	::= main <slist> begin <stats> end CD18 <id>
NSDLST	<slist>	::= <sdecl> , <slist>
Special	<slist>	::= <sdecl>
NTYPEL	<typelist>	::= <type> <typelist>
Special	<typelist>	::= <type>
NRTYPE	<type>	::= <structid> is <fields> end
NATYPE	<type>	::= <typeid> is array [<expr>] of <structid>
NFLIST	<fields>	::= <sdecl> , <fields>
Special	<fields>	::= <sdecl>
NSDECL	<sdecl>	::= <id> : <stype>
NALIST	<arrdecls>	::= <arrdecl> , <arrdecls>
Special	<arrdecls>	::= <arrdecl>
NARRD	<arrdecl>	::= <id> : <typeid>
NFUND	<func>	::= func <id> (<plist>) : <rtype> <funcbody>
Special	<rtype>	::= <stype> | void
Special	<plist>	::= <params> | ε
NPLIST	<params>	::= <param> , <params>
Special	<params>	::= <param>
NSIMP	<param>	::= <sdecl>
NARRP	<param>	::= <arrdecl>
NARRC	<param>	::= const <arrdecl>
Special	<funcbody>	::= <locals> begin <stats> end
Special	<locals>	::= <dlist> | ε

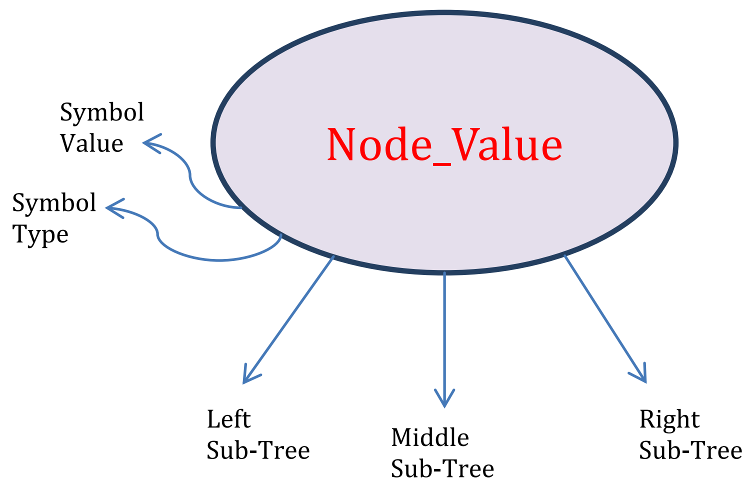
NDLIST	<dlist>	::= <decl> , <dlist>
Special	<dlist>	::= <decl>
Special	<decl>	::= <sdecl> | <arrdecl>
Special	<stype>	::= integer | real | boolean
NSTATS	<stats>	::= <stat> ; <stats> | <strstat> <stats>
Special	<stats>	::= <stat>; | <strstat>
Special	<strstat>	::= <forstat> | <ifstat>
Special	<stat>	::= <reptstat> | <asgnstat> | <iostat> | <callstat> | <returnstat>
NFOR	<forstat>	::= for (<asgnlist> ; <bool>) <stats> end
NREPT	<repstat>	::= repeat (<asgnlist>) <stats> until <bool>
Special	<asgnlist>	::= <alist> | ε
NASGNS	<alist>	::= <asgnstat> , <alist>
Special	<alist>	::= <asgnstat>
NIFTH	<ifstat>	::= if (<bool>) <stats> end
NIFTE	<ifstat>	::= if (<bool>) <stats> else <stats> end
Special	<asgnstat>	::= <var> <asgnop> <bool>
Various	<asgnop>	::= = | += | -= | *= | /=
		NASGN, NPLEQ, NMNEQ, NSTEQ, NDVEQ
NINPUT	<iostat>	::= input <vlist>
NPRINT	<iostat>	::= print <prlist>
NPRLN	<iostat>	::= printline <prlist>
NCALL	<callstat>	::= <id> (<elist>) | <id> ( )
NRETN	<returnstat>	::= return | return <expr>
NVLIST	<vlist>	::= <var> , <vlist>
Special	<vlist>	::= <var>
NSIMV	<var>	::= <id>
NARRV	<var>	::= <id>[<expr>] . <id>
NEXPL	<elist>	::= <bool> , <elist>
Special	<elist>	::= <bool>
NBOOL	<bool>	::= <bool><logop> <rel>
Special	<bool>	::= <rel>
NNOT	<rel>	::= not <expr> <relop> <expr>
Special	<rel>	::= <expr> <relop><expr>
Special	<rel>	::= <expr>
Various	<logop>	::= and | or | xor
		NAND, NOR, NXOR
Various	<relop>	::= == | != | > | <= | < | >=
		NEQL, NNEQ, NGRT, NLEQ, NLSS, NGEQ
NADD	<expr>	::= <expr> + <term>
NSUB	<expr>	::= <expr> - <term>
Special	<expr>	::= <term>
NMUL	<term>	::= <term> * <fact>
NDIV	<term>	::= <term> / <fact>
NMOD	<term>	::= <term> % <fact>
Special	<term>	::= <fact>
NPOW	<fact>	::= <fact> ^ <exponent>
Special	<fact>	::= <exponent>
Special	<exponent>	::= <var>
NILIT	<exponent>	::= <intlit>
NFLIT	<exponent>	::= <reallit>

Special	<exponent>	::= <fncall>
NTRUE	<exponent>	::= true
NFALS	<exponent>	::= false
Special	<exponent>	::= (<bool>)
NFCALL	<fncall>	::= <id> (<elist>) | <id> ( )
NPRLST	<prlist>	::= <printitem> , <prlist>
Special	<prlist>	::= <printitem>
Special	<printitem>	::= <expr>
NSTRG	<printitem>	::= <string>

<id>, <structid>, <typeid> are all simply identifier tokens returned by the scanner.
<intlit>, <reallit> and <string> are also special tokens returned by the scanner.

The Syntax Tree

The basic design of a Syntax Tree Node is to have a node that holds a node value (Nxxxx), and that this will also contain references to other (child) nodes in the syntax tree (say 3 of these) and a couple of references to Symbol Table records as follows:



It is possible to design polymorphic variants for each of the different Node values that can occur in the syntax tree. However, it can be just as easy to use a single Node type and leave references as null if they are not needed for a particular case. There will be significant discussion in class on many issues pertinent to the syntax tree.

Child Node assignments will be in the order as presented in the previously listed rules. If a rule contains *three children*, then work left to right; if a rule contains *two children*, use left and right, if a rule contains *one child*, use the left.

For example:

NTRAF	<trafficlight> ::= <id><red><yellow><green>
NTROG	<trogdor> ::= he was a <dragon><man>;
NSCHM	<schmoo> ::= <value> schmoo

```
   NTRAF(id)         NTROG            NSCHM
  /  |  \           /     \          /
 /   |   \         /       \        /
r    y    g     dragon     man    value
```

The Parser

Version 1.0 of the grammar, as it stands, is not sufficient to write a Recursive Descent Parser for CD18, and it is certainly not LL(1). There are a number of places where rules need left-factoring and other places where left-recursion needs to be eliminated.

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