

CD23 Programming Language LL(1) Grammar

NPROG <program> ::= CD23 <id> <global> <funcs> <mainbody>

NGLOB <globals> ::= <consts> <types> <arrays>

Special <consts> ::= constants <initlist> | ε

NILIST <initlist> ::= <init> <opt_initlist>

Special <opt_initlist> ::= , <initlist> | ε

We applied left factoring to this rule because it wasn't LL(1)

NINIT <init> ::= <id> is <expr>

Special <types> ::= types <typelist> | ε

Special <arrays> ::= arrays <arrdecls> | ε

NFUNCS <funcs> ::= <func> <funcs> | ε

NMAIN <mainbody> ::= main <slist> begin <stats> end CD23 <id>

NSDLST <slist> ::= <sdecl> <opt_slist>

Special <opt_slist> ::= , <slist> | ε

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NYPEL <typelist> ::= <type> <opt_typelist>

Special <opt_typelist> ::= <typelist> | ε

NRTYPE <type> ::= <structed> is <fields> end

NATYPE <type> ::= <typeid> is array [<expr>] of <structid> end

NFLIST <fields> ::= <sdecl> <opt_fields>

Special <opt_fields> ::= , <fields> | ε

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NSDECL <sdecl> ::= <id> : <stype>

NALIST <arrdecls> ::= <arrdecl> <opt_arrdecl>

Special <opt_arrdecl> ::= , <arrdecls> | ε

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NARRD <arrdecl> ::= <id> : <typeid>

NFUND <func> ::= func <id> (<plist>):<rtype> <funcbody>

Special <rtype> ::= <stype> | void

Special <plist> ::= <params> | ε

NPLIST <params> ::= <param> <opt_params>

Special <opt_params> ::= , <params> | ε

NSIMP <param> ::= <sdecl>

NARRP <param> ::= <arrdecl>

NARRC $\langle \text{param} \rangle ::= \text{const } \langle \text{arrdecl} \rangle$

Special $\langle \text{funcbody} \rangle ::= \langle \text{locals} \rangle \text{ begin } \langle \text{stats} \rangle \text{ end}$

Special $\langle \text{locals} \rangle ::= \langle \text{dlist} \rangle \mid \epsilon$

NDLIST $\langle \text{dlist} \rangle ::= \langle \text{decl} \rangle \langle \text{opt_dlist} \rangle$

Special $\langle \text{opt_dlist} \rangle ::= , \langle \text{dlist} \rangle \mid \epsilon$

Special $\langle \text{decl} \rangle ::= \langle \text{sdecl} \rangle \mid \langle \text{arrdecl} \rangle$

Special $\langle \text{stype} \rangle ::= \text{integer} \mid \text{real} \mid \text{Boolean}$

NSTATS $\langle \text{stats} \rangle ::= \langle \text{stat} \rangle ; \langle \text{opt_stats} \rangle \mid \langle \text{strstat} \rangle \langle \text{opt_stats} \rangle$

Special $\langle \text{opt_stats} \rangle ::= \langle \text{stats} \rangle \mid \epsilon$

Special $\langle \text{strstat} \rangle ::= \langle \text{forstat} \rangle \mid \langle \text{ifstat} \rangle$

Special $\langle \text{stat} \rangle ::= \langle \text{reptstat} \rangle \mid \langle \text{asgnstat} \rangle \mid \langle \text{iostat} \rangle$

Special $\langle \text{stat} \rangle ::= \langle \text{callstat} \rangle \mid \langle \text{returnstat} \rangle$

NFORL $\langle \text{forstat} \rangle ::= \text{for } (\langle \text{asgnlist} \rangle ; \langle \text{bool} \rangle) \langle \text{stats} \rangle \text{ end}$

NREPT $\langle \text{reptstat} \rangle ::= \text{repeat } (\langle \text{asgnlist} \rangle) \langle \text{stats} \rangle \text{ until } \langle \text{bool} \rangle$

Special $\langle \text{asgnlist} \rangle ::= \langle \text{alist} \rangle \mid \epsilon$

NASGNS $\langle \text{alist} \rangle ::= \langle \text{asgnstat} \rangle \langle \text{opt_alist} \rangle$

Special $\langle \text{opt_alist} \rangle ::= , \langle \text{alist} \rangle \mid \epsilon$

NIFTH $\langle \text{ifstat} \rangle ::= \text{if } (\langle \text{bool} \rangle) \langle \text{stats} \rangle \langle \text{opt_else} \rangle \text{ end}$

NIFTE $\langle \text{opt_else} \rangle ::= \text{else } \langle \text{stats} \rangle \mid \epsilon$

Special $\langle \text{asgnstat} \rangle ::= \langle \text{var} \rangle \langle \text{asgnop} \rangle \langle \text{bool} \rangle$

NASGN $\langle \text{asgnop} \rangle ::= =$

NPSEQ $\langle \text{asgnop} \rangle ::= +=$

NMNEQ $\langle \text{asgnop} \rangle ::= -=$

NSTEQ $\langle \text{asgnop} \rangle ::= *=$

NDVEQ $\langle \text{asgnop} \rangle ::= /=$

NINPUT $\langle \text{iostat} \rangle ::= \text{In } \langle \text{vlist} \rangle$

NOUTP $\langle \text{iostat} \rangle ::= \text{Out } \langle \langle \text{prlist} \rangle \langle \text{opt_line} \rangle$

Special $\langle \text{opt_line} \rangle ::= \epsilon$

NOUTL $\langle \text{opt_line} \rangle ::= \langle \text{Line} \rangle$

NOUTL $\langle \text{iostat} \rangle ::= \text{Out } \langle \text{Line} \rangle$

NCALL $\langle \text{callstat} \rangle ::= \langle \text{id} \rangle (\langle \text{elist} \rangle) \mid \langle \text{id} \rangle ()$

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Note that if $\langle \text{opt_line} \rangle$ is $\langle \text{Line} \rangle$, the node is NOUTL, not NOUTP

NRETN <returnstat> ::= return void | return <expr>

NVLIST <vlist> ::= <var> <opt_vlist>

Special <opt_vlist> ::= , <vlist> | ε

We applied left factoring to NVLIST because it wasn't LL(1)

Special <var> ::= <id> <opt_expr>

NSIMV <opt_expr> ::= ε

Special <opt_expr> ::= [<expr>] <opt_id>

NAELT <opt_id> ::= ε

NARRV <opt_id> ::= . <id>

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Note that if <opt_line> is <<Line, the node is NOUTL, not NOUTP

NEXPL <elist> ::= <bool> <opt_elist>

Special <opt_elist> ::= , <elist> | ε

NBOOL <bool> ::= <rel> <bool'>

Special <bool'> ::= <logop> <rel> <bool'> | ε

We applied left factoring to NEXPL because it wasn't LL(1)

We changed NBOOL because it was left recursive

NNOT <rel> ::= ! <expr> <relop> <expr>

Special <rel> ::= <expr> <opt_rel>

Special <opt_rel> ::= <relop> <expr> | ε

We applied left factoring to this rule because it wasn't LL(1)

NAND <logop> ::= &&

NOR <logop> ::= ||

NXOR <logop> ::= &|

NEQL <relop> ::= ==

NNEQ <relop> ::= !=

NGRT <relop> ::= >

NLSS <relop> ::= <

NLEQ <relop> ::= <=

NGEQ <relop> ::= >=

Special <expr> ::= <term> <expr'>

NADD <expr'> ::= +<term> <expr'>

NSUB <expr'> ::= - <term> <expr'>

Special <expr'> ::= ε

Special <term> ::= <fact> <term'>

NMUL <term'> ::= * <fact> <term'>

NDIV <term'> ::= / <fact> <term'>

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NMOD $\langle \text{term}' \rangle ::= \% \langle \text{fact} \rangle \langle \text{term}' \rangle$

Special $\langle \text{term}' \rangle ::= \epsilon$

Special $\langle \text{fact} \rangle ::= \langle \text{exponent} \rangle \langle \text{fact}' \rangle$

NPOW $\langle \text{fact}' \rangle ::= ^ \langle \text{exponent} \rangle \langle \text{fact}' \rangle \mid \epsilon$

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Special $\langle \text{exponent} \rangle ::= \langle \text{var} \rangle$

NILIT $\langle \text{exponent} \rangle ::= \langle \text{intlitt} \rangle$

NFLIT $\langle \text{exponent} \rangle ::= \langle \text{reallitt} \rangle$

Special $\langle \text{exponent} \rangle ::= \langle \text{fncall} \rangle$

NTRUE $\langle \text{exponent} \rangle ::= \text{true}$

NFALS $\langle \text{exponent} \rangle ::= \text{false}$

Special $\langle \text{exponent} \rangle ::= (\langle \text{bool} \rangle)$

NFCALL $\langle \text{fncall} \rangle ::= \langle \text{id} \rangle (\langle \text{elist} \rangle) \mid \langle \text{id} \rangle ()$

NPRLST $\langle \text{prlist} \rangle ::= \langle \text{printitem} \rangle \langle \text{opt_prlist} \rangle$

Special $\langle \text{opt_prlist} \rangle ::= , \langle \text{prlist} \rangle \mid \epsilon$

We applied left
factoring to this rule
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Special $\langle \text{printitem} \rangle ::= \langle \text{expr} \rangle$

NSTRG $\langle \text{printitem} \rangle ::= \langle \text{string} \rangle$