NSD with right recursion

```
options
  start_node_filter = "x, u";
end
grammar NSD_right_rec
   terminal stmt(4), cond(4), while(6);
   nonterminal S(0), NSD(4), Stmt(4);
   start
               S;
   S()
                ::= NSD(x,y,u,v)
                                                               [init]
   NSD(x,y,u,v) ::= Stmt(x,y,r,s) NSD(r,s,u,v)
                                                               [seq1 ]
                  | Stmt(x,y,u,v)
                                                               [seq2]
   Stmt(x,y,u,v) ::= stmt(x,y,u,v)
                                                              [stmt]
                  cond(x,y,r,s) NSD(r,m,u,n) NSD(m,s,n,v)
                                                             [ cond ]
                   while(x,y,r,s,u,t) NSD(r,s,t,v)
                                                              [ while ]
end
```

NSD with left recursion

```
options
  start_node_filter = "x, u";
end
grammar NSD_left_rec
   terminal stmt(4), cond(4), while(6);
   nonterminal S(0), NSD(4), Stmt(4);
   start
               S;
   S()
                ::= NSD(x,y,u,v)
                                                              [init]
   NSD(x,y,u,v) := NSD(x,y,r,s) Stmt(r,s,u,v)
                                                              [seq1]
                  | Stmt(x,y,u,v)
                                                              [seq2]
   Stmt(x,y,u,v) ::= stmt(x,y,u,v)
                                                              [stmt]
                  cond(x,y,r,s) NSD(r,m,u,n) NSD(m,s,n,v)
                                                             [ cond ]
                   while(x,y,r,s,u,t) NSD(r,s,t,v)
                                                              [ while ]
end
```

NSD with right recursion

State	q_0	$(\boldsymbol{a},$	b)	
-------	-------	--------------------	------------	--

State $q_0(a, b)$	
$S() \longrightarrow NSD(\boldsymbol{a}, n_1, \boldsymbol{b}, n_2)$	
$NSD(\boldsymbol{a}, n_3, \boldsymbol{b}, n_4) \longrightarrow LStmt(\boldsymbol{a}, n_3, \boldsymbol{b}, n_4)$	
$NSD(\boldsymbol{a}, n_5, \boldsymbol{b}, n_6) \longrightarrow LStmt(\boldsymbol{a}, n_5, n_7, n_8) NSD(n_7, n_8, \boldsymbol{b}, n_6)$	
$Stmt(a, n_9, b, n_{10}) \rightarrow .cond(a, n_9, n_{11}, n_{12}) NSD(n_{11}, n_{13}, b, n_{14}) NSD(n_{13}, n_{12}, n_{14}, n_{10})$	
$Stmt(a, n_{15}, b, n_{16}) \to stmt(a, n_{15}, b, n_{16})$	
$Stmt(a, n_{17}, b, n_{18}) \to .while(a, n_{17}, n_{19}, n_{20}, b, n_{21}) NSD(n_{19}, n_{20}, n_{21}, n_{18})$	
$Stmt(a, n_{22}, n_{23}, n_{24}) \rightarrow cond(a, n_{22}, n_{25}, n_{26}) NSD(n_{25}, n_{27}, n_{23}, n_{28}) NSD(n_{27}, n_{26}, n_{28}, n_{28})$.)
	4)
$Stmt(a, n_{29}, n_{30}, n_{31}) \to stmt(a, n_{29}, n_{30}, n_{31})$	
$Stmt(a, n_{32}, n_{33}, n_{34}) \to Lwhile(a, n_{32}, n_{35}, n_{36}, n_{33}, n_{37}) NSD(n_{35}, n_{36}, n_{37}, n_{34})$	
$NSD(n_0, n_1, n_2, n_3)$	
$ \xrightarrow{\text{NSD}(n_0, n_1, n_2, n_3)} n_0 = \boldsymbol{a}, n_1 \uparrow, n_2 = \boldsymbol{b}, n_3 \uparrow \qquad $	
$ \underbrace{ Stmt(n_0, n_1, n_2, n_3)}_{n_0 = \mathbf{a}, n_1 \uparrow, n_2 = \mathbf{b}, n_3 \uparrow} \qquad $	
$ \underbrace{ \begin{array}{c} Stmt(n_0, n_1, n_2, n_3) \\ \hline n_0 = \boldsymbol{a}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow \end{array}}_{q_5(n_0, n_1, \boldsymbol{b}, n_2, n_3)} \rightarrow q_5(n_0, n_1, \boldsymbol{b}, n_2, n_3) $	
$- \underbrace{\operatorname{cond}(n_0, n_1, n_2, n_3)}_{m_1, m_2, m_3, m_2, m_3, m_2, m_3, m_3, m_2, m_3, m_3, m_3, m_3, m_3, m_3, m_3, m_3$	
$n_0 = \mathbf{a}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow \qquad $	
$ \begin{array}{c} \underbrace{stmt(n_0, n_1, n_2, n_3)}_{n_0 = \boldsymbol{a}, n_1 \uparrow, n_2 = \boldsymbol{b}, n_3 \uparrow} & \rightarrow q_1(n_0, n_1, n_2, n_3) \end{array} $	
$\xrightarrow{stmt(n_0, n_1, n_2, n_3)} q_1(n_0, n_1, n_2, n_3)$	
$n_0 = \boldsymbol{a}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow$	
$ \xrightarrow{\text{while}(n_0, n_1, n_2, n_3, n_4, n_5)} n_0 = \boldsymbol{a}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow, n_4 = \boldsymbol{b}, n_5 \uparrow \rightarrow q_2(n_0, n_1, n_4, n_2, n_3, n_5) $	
$ \xrightarrow{\text{while}(n_0, n_1, n_2, n_3, n_4, n_5)} p_0 = a, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow, n_4 \uparrow, n_5 \uparrow \qquad $	
$n_0 = \boldsymbol{a}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow, n_4 \uparrow, n_5 \uparrow$	
State $q_1(a, b, c, d)$	
$\frac{\operatorname{State} q_1(a, b, c, d)}{\operatorname{Stmt}(a, b, c, d) \to \operatorname{stmt}(a, b, c, d) \cdot [stmt]}$	
$\operatorname{Stint}(a, b, c, a) \to \operatorname{Stint}(a, b, c, a) \mapsto [\operatorname{Stint}]$	
State $q_2(a, b, c, d, e, f)$	
$Stmt(\boldsymbol{a},\boldsymbol{b},\boldsymbol{c},n_1) \longrightarrow while(\boldsymbol{a},\boldsymbol{b},\boldsymbol{d},\boldsymbol{e},\boldsymbol{c},\boldsymbol{f})$. $NSD(\boldsymbol{d},\boldsymbol{e},\boldsymbol{f},n_1)$]
$NSD(\boldsymbol{d}, \boldsymbol{e}, \boldsymbol{f}, n_2) \longrightarrow LStmt(\boldsymbol{d}, \boldsymbol{e}, \boldsymbol{f}, n_2)$	1
$NSD(d, e, f, n_3) \rightarrow LStmt(d, e, n_4, n_5) NSD(n_4, n_5, f, n_3)$	
$Stmt(d, e, f, n_6) \to cond(d, e, n_7, n_8) NSD(n_7, n_9, f, n_{10}) NSD(n_9, n_8, n_{10}, n_6)$	
$\operatorname{Stm}(d, e, f, n_{11}) \rightarrow \operatorname{stm}(d, e, f, n_{11})$	
$Stmt(d, e, f, n_{12}) \rightarrow while(d, e, n_{13}, n_{14}, f, n_{15}) NSD(n_{13}, n_{14}, n_{15}, n_{12})$	
$Stmt(d, e, n_{16}, n_{17}) \to cond(d, e, n_{18}, n_{19}) NSD(n_{18}, n_{20}, n_{16}, n_{21}) NSD(n_{20}, n_{19}, n_{21}, n_{17})$	
$Stmt(d, e, n_{22}, n_{23}) \rightarrow stmt(d, e, n_{22}, n_{23})$	
$Stmt(d, e, n_{24}, n_{25}) \rightarrow .while(d, e, n_{26}, n_{27}, n_{24}, n_{28}) NSD(n_{26}, n_{27}, n_{28}, n_{25})$	
$NSD(m_1, m_2, m_3, m_4)$	
$ \underbrace{ NSD(n_0, n_1, n_2, n_3)}_{n_0 = \mathbf{d}, n_1 = \mathbf{e}, n_2 = \mathbf{f}, n_3 \uparrow} \qquad $	
$n_0 = a, n_1 = e, n_2 = J, n_3$	
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· · · · · · · · · · · · · · · · · · ·	
$ \begin{array}{c} \underbrace{Stmt(n_0, n_1, n_2, n_3)}_{n_0 = d, n_1 = e, n_2 = f, n_3 \uparrow} & q_4(n_0, n_1, n_2, n_3) \end{array} $	
$ \begin{array}{c} \underbrace{Stmt(n_0, n_1, n_2, n_3)}_{n_0 = d, n_1 = e, n_2 = f, n_3 \uparrow} & q_4(n_0, n_1, n_2, n_3) \end{array} $	
$ \begin{array}{c} \underbrace{Stmt(n_0, n_1, n_2, n_3)}_{n_0 = d, n_1 = e, n_2 = f, n_3 \uparrow} & \qquad $	
$ \begin{array}{c} \underbrace{Stmt(n_0, n_1, n_2, n_3)}_{n_0 = d, n_1 = e, n_2 = f, n_3 \uparrow} & \qquad $	
$\begin{array}{c} \underbrace{Stmt(n_0, n_1, n_2, n_3)}_{n_0 = d, n_1 = e, n_2 = f, n_3 \uparrow} & \qquad $	
$\begin{array}{c} \underbrace{Stmt(n_0, n_1, n_2, n_3)}_{n_0 = d, n_1 = e, n_2 = f, n_3 \uparrow} & \to q_4(n_0, n_1, n_2, n_3) \\ \underbrace{Stmt(n_0, n_1, n_2, n_3)}_{n_0 = d, n_1 = e, n_2 \uparrow, n_3 \uparrow} & \to q_5(n_0, n_1, f, n_2, n_3) \\ \underbrace{cond(n_0, n_1, n_2, n_3)}_{n_0 = d, n_1 = e, n_2 \uparrow, n_3 \uparrow} & \to q_3(n_0, n_1, f, n_2, n_3) \\ \underbrace{stmt(n_0, n_1, n_2, n_3)}_{stmt(n_0, n_1, n_2, n_2)} & \to q_3(n_0, n_1, f, n_2, n_3) \\ \end{array}$	
$\begin{array}{c} \underbrace{\operatorname{Stmt}(n_0, n_1, n_2, n_3)}_{n_0 = d, n_1 = e, n_2 = f, n_3 \uparrow} \to q_4(n_0, n_1, n_2, n_3) \\ \underbrace{\operatorname{Stmt}(n_0, n_1, n_2, n_3)}_{n_0 = d, n_1 = e, n_2 \uparrow, n_3 \uparrow} \to q_5(n_0, n_1, f, n_2, n_3) \\ \underbrace{\operatorname{cond}(n_0, n_1, n_2, n_3)}_{n_0 = d, n_1 = e, n_2 \uparrow, n_3 \uparrow} \to q_3(n_0, n_1, f, n_2, n_3) \\ \underbrace{\operatorname{stmt}(n_0, n_1, n_2, n_3)}_{n_0 = d, n_1 = e, n_2 = f, n_3 \uparrow} \to q_1(n_0, n_1, n_2, n_3) \end{array}$	
$\begin{array}{c} \underbrace{\operatorname{Stmt}(n_{0},n_{1},n_{2},n_{3})}_{n_{0}=d,n_{1}=e,n_{2}=f,n_{3}\uparrow} \rightarrow q_{4}(n_{0},n_{1},n_{2},n_{3}) \\ \underbrace{\operatorname{Stmt}(n_{0},n_{1},n_{2},n_{3})}_{n_{0}=d,n_{1}=e,n_{2}\uparrow,n_{3}\uparrow} \rightarrow q_{5}(n_{0},n_{1},f,n_{2},n_{3}) \\ \underbrace{\operatorname{cond}(n_{0},n_{1},n_{2},n_{3})}_{n_{0}=d,n_{1}=e,n_{2}\uparrow,n_{3}\uparrow} \rightarrow q_{3}(n_{0},n_{1},f,n_{2},n_{3}) \\ \underbrace{\operatorname{stmt}(n_{0},n_{1},n_{2},n_{3})}_{n_{0}=d,n_{1}=e,n_{2}=f,n_{3}\uparrow} \rightarrow q_{1}(n_{0},n_{1},n_{2},n_{3}) \end{array}$	
$\begin{array}{c} \underbrace{\operatorname{Stmt}(n_{0}, n_{1}, n_{2}, n_{3})}_{n_{0} = d, n_{1} = e, n_{2} = f, n_{3}\uparrow} & \qquad $	
$\begin{array}{c} \underbrace{\operatorname{Stmt}(n_{0},n_{1},n_{2},n_{3})}{n_{0} = d,n_{1} = e,n_{2} = f,n_{3}\uparrow} & \qquad $	
$\begin{array}{c} \underbrace{\operatorname{Stmt}(n_{0},n_{1},n_{2},n_{3})}{n_{0} = d,n_{1} = e,n_{2} = f,n_{3}\uparrow} & q_{4}(n_{0},n_{1},n_{2},n_{3}) \\ \hline \underbrace{\operatorname{Stmt}(n_{0},n_{1},n_{2},n_{3})}{n_{0} = d,n_{1} = e,n_{2}\uparrow,n_{3}\uparrow} & q_{5}(n_{0},n_{1},f,n_{2},n_{3}) \\ \hline \underbrace{\operatorname{cond}(n_{0},n_{1},n_{2},n_{3})}{n_{0} = d,n_{1} = e,n_{2}\uparrow,n_{3}\uparrow} & q_{3}(n_{0},n_{1},f,n_{2},n_{3}) \\ \hline \underbrace{\operatorname{stmt}(n_{0},n_{1},n_{2},n_{3})}{n_{0} = d,n_{1} = e,n_{2} = f,n_{3}\uparrow} & q_{1}(n_{0},n_{1},n_{2},n_{3}) \\ \hline \underbrace{\operatorname{stmt}(n_{0},n_{1},n_{2},n_{3})}{n_{0} = d,n_{1} = e,n_{2}\uparrow,n_{3}\uparrow} & q_{1}(n_{0},n_{1},n_{2},n_{3}) \\ \hline \underbrace{\operatorname{stmt}(n_{0},n_{1},n_{2},n_{3})}{n_{0} = d,n_{1} = e,n_{2}\uparrow,n_{3}\uparrow} & q_{2}(n_{0},n_{1},n_{4},n_{2},n_{3},n_{5}) \\ \hline \end{array}$	
$\begin{array}{c} \underbrace{\operatorname{Stmt}(n_{0},n_{1},n_{2},n_{3})}{n_{0} = d,n_{1} = e,n_{2} = f,n_{3}\uparrow} & \qquad $	

State $q_3(a, b, c, d, e)$

$Stmt(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, n_1)$	$ ightarrow cond(oldsymbol{a},oldsymbol{b},oldsymbol{d},oldsymbol{e})$. $NSD(oldsymbol{d},n_2,oldsymbol{c},n_3)NSD(n_2,oldsymbol{e},n_3,n_1)$
$Stmt(\boldsymbol{a}, \boldsymbol{b}, n_4, n_5)$	$ ightarrow cond(oldsymbol{a},oldsymbol{b},oldsymbol{d},oldsymbol{e})$. $NSD(oldsymbol{d},n_6,n_4,n_7)NSD(n_6,oldsymbol{e},n_7,n_5)$
$NSD(d, n_8, n_9, n_{10})$	$ ightarrow$. Stmt $(oldsymbol{d}, n_8, n_{11}, n_{12})$ NSD $(n_{11}, n_{12}, n_9, n_{10})$
	$rac{} ightarrow$ - Stmt $(oldsymbol{d}, n_{13}, n_{14}, n_{15})$
NSD (d, n_{16}, c, n_{17})	$ ightarrow$. Stmt $(oldsymbol{d}, n_{16}, n_{18}, n_{19})$ NSD $(n_{18}, n_{19}, oldsymbol{c}, n_{17})$
$NSD(d, n_{20}, c, n_{21})$	$ ightarrow$. $Stmt(oldsymbol{d}, n_{20}, oldsymbol{c}, n_{21})$
Stmt $(d, n_{22}, n_{23}, n_{24})$) $\rightarrow Lcond(d, n_{22}, n_{25}, n_{26}) \operatorname{NSD}(n_{25}, n_{27}, n_{23}, n_{28}) \operatorname{NSD}(n_{27}, n_{26}, n_{28}, n_{24})$
Stmt $(d, n_{29}, n_{30}, n_{31})$	$) ightarrow extsf{stmt}(oldsymbol{d}, n_{29}, n_{30}, n_{31})$
) $ ightarrow$. while $(m{d}, n_{32}, n_{35}, n_{36}, n_{33}, n_{37})$ NSD $(n_{35}, n_{36}, n_{37}, n_{34})$
Stmt (d, n_{38}, c, n_{39})	$ ightarrow$. cond $({\it d}, n_{38}, n_{40}, n_{41}){\sf NSD}(n_{40}, n_{42}, {\it c}, n_{43}){\sf NSD}(n_{42}, n_{41}, n_{43}, n_{39})$
	$ ightarrow$. stmt $(oldsymbol{d}, n_{44}, oldsymbol{c}, n_{45})$
$Stmt(\boldsymbol{d}, n_{46}, \boldsymbol{c}, n_{47})$	$ ightarrow$. while $({m d}, n_{46}, n_{48}, n_{49}, {m c}, n_{50})$ NSD $(n_{48}, n_{49}, n_{50}, n_{47})$

$\xrightarrow{NSD(n_0, n_1, n_2, n_3)} q_{10}(\boldsymbol{a}, \boldsymbol{b}, n_2, n_0, \boldsymbol{e}, n_1, n_3)$
$n_0 = \boldsymbol{d}, n_1 \uparrow, n_2 = \boldsymbol{c}, n_3 \uparrow \qquad $
$\xrightarrow{NSD(n_0, n_1, n_2, n_3)} q_{10}(\boldsymbol{a}, \boldsymbol{b}, n_2, n_0, \boldsymbol{e}, n_1, n_3)$
$n_0 = \boldsymbol{d}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow \qquad \qquad \forall q_{10}(\boldsymbol{a}, \boldsymbol{b}, n_2, n_0, \boldsymbol{c}, n_1, n_3)$
$-\underbrace{Stmt(n_0, n_1, n_2, n_3)}_{n_1 \dots n_2 \dots n_3 \dots \dots n_1 \dots \dots n_2 \dots \dots \dots n_2 \dots \dots$
$n_0 = u, n_1 , n_2 = c, n_3 $
$\xrightarrow{Stmt(n_0, n_1, n_2, n_3)} q_6(n_0, n_1, \boldsymbol{c}, n_2, n_3)$
$n_0 = u, n_1 , n_2 , n_3 $
$\xrightarrow{cond(n_0, n_1, n_2, n_3)} q_3(n_0, n_1, \boldsymbol{c}, n_2, n_3)$
$n_0 = u, n_1 , n_2 , n_3 $
$\xrightarrow{stmt(n_0, n_1, n_2, n_3)} q_1(n_0, n_1, n_2, n_3)$
$n_0 = a, n_1 , n_2 = c, n_3 $
$\xrightarrow{stmt(n_0, n_1, n_2, n_3)} q_1(n_0, n_1, n_2, n_3)$
$n_0 = a, n_1 , n_2 , n_3 $
$-\frac{while(n_0, n_1, n_2, n_3, n_4, n_5)}{n_1 - d_1 n_2 + n_2 + n_3 + n_4 + n_5 + n_4 + n_5 + n_4 + n_4 + n_5} q_2(n_0, n_1, n_4, n_2, n_3, n_5)$
$n_0 = d, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow, n_4 = c, n_5 \uparrow^{-7} q_2(n_0, n_1, n_4, n_2, n_3, n_5)$
$\xrightarrow{\text{while}(n_0, n_1, n_2, n_3, n_4, n_5)} q_2(n_0, n_1, n_4, n_2, n_3, n_5)$
$\overline{n_0 = \boldsymbol{d}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow, n_4 \uparrow, n_5 \uparrow} q_2(n_0, n_1, n_4, n_2, n_3, n_5)$

 $\begin{array}{c} \textbf{State} \ \boldsymbol{q_4}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, \boldsymbol{d}) \\ \hline \left[\ \textbf{NSD}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, \boldsymbol{d}) \rightarrow \textbf{Stmt}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, \boldsymbol{d}) \boldsymbol{.} \quad [seq2] \right] \end{array}$

State $q_5(a, b, c, d, e)$

$NSD(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, n_1)$	$ ightarrow Stmt(oldsymbol{a},oldsymbol{b},oldsymbol{d},oldsymbol{e},oldsymbol{c},n_1)$
$NSD(\boldsymbol{d}, \boldsymbol{e}, \boldsymbol{c}, n_2)$	$ ightarrow$. Stmt $(oldsymbol{d},oldsymbol{e},n_3,n_4)$ NSD $(n_3,n_4,oldsymbol{c},n_2)$
$NSD(\boldsymbol{d}, \boldsymbol{e}, \boldsymbol{c}, n_5)$	$ ightarrow$. Stmt $(oldsymbol{d},oldsymbol{e},oldsymbol{c},n_5)$
$Stmt(\boldsymbol{d}, \boldsymbol{e}, n_6, n_7)$	$\rightarrow .cond(d, e, n_8, n_9) NSD(n_8, n_{10}, n_6, n_{11}) NSD(n_{10}, n_9, n_{11}, n_7)$
Stmt(d, e, n_{12}, n_{13}	$) ightarrow extsf{stmt}(oldsymbol{d},oldsymbol{e},n_{12},n_{13})$
Stmt(d, e, n_{14}, n_{15}) \rightarrow . while $(d, e, n_{16}, n_{17}, n_{14}, n_{18})$ NSD $(n_{16}, n_{17}, n_{18}, n_{15})$
$Stmt(\boldsymbol{d}, \boldsymbol{e}, \boldsymbol{c}, n_{19})$	$\rightarrow .cond(\boldsymbol{d}, \boldsymbol{e}, n_{20}, n_{21}) NSD(n_{20}, n_{22}, \boldsymbol{c}, n_{23}) NSD(n_{22}, n_{21}, n_{23}, n_{19})$
$Stmt(\boldsymbol{d}, \boldsymbol{e}, \boldsymbol{c}, n_{24})$	$ ightarrow$. stmt $(oldsymbol{d},oldsymbol{e},oldsymbol{c},n_{24})$
$Stmt(\boldsymbol{d}, \boldsymbol{e}, \boldsymbol{c}, n_{25})$	$ ightarrow$ while $(\boldsymbol{d}, \boldsymbol{e}, n_{26}, n_{27}, \boldsymbol{c}, n_{28})$ NSD $(n_{26}, n_{27}, n_{28}, n_{25})$

$NSD(n_0, n_1, n_2, n_3)$	
$\frac{-n_{3} \mathbf{b}(n_{0}, n_{1}, n_{2}, n_{3})}{n_{0} = \mathbf{d}, n_{1} = \mathbf{e}, n_{2} = \mathbf{c}, n_{3} \uparrow$	$\rightarrow q_7(oldsymbol{a},oldsymbol{b},n_2,n_3,n_0,n_1)$
$Stmt(n_0, n_1, n_2, n_3)$	
$n_0 = d, n_1 = e, n_2 = c, n_3 \uparrow$	$\rightarrow q_4(n_0, n_1, n_2, n_3)$
$Stmt(n_0, n_1, n_2, n_3)$	$\rightarrow q_5(n_0, n_1, \boldsymbol{c}, n_2, n_3)$
$n_0=oldsymbol{d}, n_1=oldsymbol{e}, n_2\!\!\uparrow, n_3\!\!\uparrow$	$\neq q_5(n_0, n_1, c, n_2, n_3)$
$cond(n_0, n_1, n_2, n_3)$	$\rightarrow q_3(n_0, n_1, \boldsymbol{c}, n_2, n_3)$
$n_0=oldsymbol{d}, n_1=oldsymbol{e}, n_2\!\!\uparrow, n_3\!\!\uparrow$	$(q_3(n_0, n_1, c, n_2, n_3))$
$stmt(n_0, n_1, n_2, n_3)$	$\rightarrow q_1(n_0, n_1, n_2, n_3)$
$n_0=oldsymbol{d}, n_1=oldsymbol{e}, n_2=oldsymbol{c}, n_3\!\!\uparrow$	$(q_1(n_0, n_1, n_2, n_3))$
$stmt(n_0,n_1,n_2,n_3)$	$\rightarrow q_1(n_0, n_1, n_2, n_3)$
$n_0=oldsymbol{d}, n_1=oldsymbol{e}, n_2\!\!\uparrow, n_3\!\!\uparrow$	$(q_1(n_0, n_1, n_2, n_3))$
while $(n_0, n_1, n_2, n_3, n_4, n_5)$	$\rightarrow q_2(n_0, n_1, n_4, n_2, n_3, n_5)$
$n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow, n_4 = \boldsymbol{c}, n_5 \uparrow$	$\gamma q_2(n_0, n_1, n_4, n_2, n_3, n_5)$
while $(n_0, n_1, n_2, n_3, n_4, n_5)$	$\rightarrow q_2(n_0, n_1, n_4, n_2, n_3, n_5)$
$n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow, n_4 \uparrow, n_5 \uparrow$	42(10), 101, 104, 102, 103, 105)

State $q_6(a, b, c, d, e)$

$NSD(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, n_1)$	$ ightarrow Stmt(oldsymbol{a},oldsymbol{b},oldsymbol{d},oldsymbol{e},oldsymbol{c},n_1)$	
$NSD(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{d}, \boldsymbol{e})$	$ ightarrow Stmt(oldsymbol{a},oldsymbol{b},oldsymbol{d},oldsymbol{e})$.	[seq2]
$NSD(\boldsymbol{a},\boldsymbol{b},n_2,n_3)$	$ ightarrow Stmt(oldsymbol{a},oldsymbol{b},oldsymbol{d},oldsymbol{e},n_2,n_3)$. NSD $(oldsymbol{d},oldsymbol{e},n_2,n_3)$	
$NSD(\boldsymbol{d}, \boldsymbol{e}, n_4, n_5)$	$ ightarrow$. Stmt $(oldsymbol{d},oldsymbol{e},n_6,n_7)NSD(n_6,n_7,n_4,n_5)$	
$NSD(\boldsymbol{d}, \boldsymbol{e}, n_8, n_9)$	$ ightarrow$. $Stmt(oldsymbol{d},oldsymbol{e},n_8,n_9)$	
$NSD(\boldsymbol{d}, \boldsymbol{e}, \boldsymbol{c}, n_{10})$	$ ightarrow$. Stmt $(oldsymbol{d},oldsymbol{e},n_{11},n_{12})$ NSD $(n_{11},n_{12},oldsymbol{c},n_{10})$	
$NSD(\boldsymbol{d}, \boldsymbol{e}, \boldsymbol{c}, n_{13})$	$ ightarrow$. Stmt $(oldsymbol{d},oldsymbol{e},oldsymbol{c},n_{13})$	
Stmt (d, e, n_{14}, n_{15})	$) \rightarrow Lcond(d, e, n_{16}, n_{17}) \operatorname{NSD}(n_{16}, n_{18}, n_{14}, n_{19}) \operatorname{NSD}(n_{18}, n_{17}, n_{19}, n_{15})$	
$Stmt(d, e, n_{20}, n_{21})$	$) ightarrow extsf{i} stmt(oldsymbol{d},oldsymbol{e},n_{20},n_{21})$	
$Stmt(d, e, n_{22}, n_{23})$) $ ightarrow$. while $(m{d},m{e},n_{24},n_{25},n_{22},n_{26})$ NSD $(n_{24},n_{25},n_{26},n_{23})$	
$Stmt(\boldsymbol{d}, \boldsymbol{e}, \boldsymbol{c}, n_{27})$	$ ightarrow$. cond $(m{d},m{e},n_{28},n_{29})NSD(n_{28},n_{30},m{c},n_{31})NSD(n_{30},n_{29},n_{31},n_{27})$	
$Stmt(\boldsymbol{d}, \boldsymbol{e}, \boldsymbol{c}, n_{32})$	$ ightarrow$. stmt $(oldsymbol{d},oldsymbol{e},oldsymbol{c},n_{32})$	
$Stmt(\boldsymbol{d}, \boldsymbol{e}, \boldsymbol{c}, n_{33})$	$ ightarrow$. while $(m{d},m{e},n_{34},n_{35},m{c},n_{36})$ NSD $(n_{34},n_{35},n_{36},n_{33})$	

 $NSD(n_0, n_1, n_2, n_3)$ $\rightarrow q_7(\boldsymbol{a}, \boldsymbol{b}, n_2, n_3, n_0, n_1)$ $n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 = \boldsymbol{c}, n_3 \uparrow$ $NSD(n_0, n_1, n_2, n_3)$ $\rightarrow q_7(\boldsymbol{a}, \boldsymbol{b}, n_2, n_3, n_0, n_1)$ $n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow$ $Stmt(n_0, n_1, n_2, n_3)$ $\rightarrow q_4(n_0, n_1, n_2, n_3)$ $n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 = \boldsymbol{c}, n_3 \uparrow$ $Stmt(n_0, n_1, n_2, n_3)$ $\rightarrow q_6(n_0, n_1, \boldsymbol{c}, n_2, n_3)$ $n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow$ $cond(n_0, n_1, n_2, n_3)$ $\rightarrow q_3(n_0, n_1, \boldsymbol{c}, n_2, n_3)$ $n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow$ $stmt(n_0, n_1, n_2, n_3)$ $\rightarrow q_1(n_0, n_1, n_2, n_3)$ $n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 = \boldsymbol{c}, n_3 \uparrow$ $\mathsf{stmt}(n_0,n_1,n_2,n_3)$ $\rightarrow q_1(n_0, n_1, n_2, n_3)$ $n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow$ while $(n_0, n_1, n_2, n_3, n_4, n_5)$ $\rightarrow q_2(n_0, n_1, n_4, n_2, n_3, n_5)$ $n_0 = d, n_1 = e, n_2 \uparrow, n_3 \uparrow, n_4 = c, n_5 \uparrow$ $\mathsf{while}(n_0,n_1,n_2,n_3,n_4,n_5)$ $\rightarrow q_2(n_0, n_1, n_4, n_2, n_3, n_5)$ $n_0 = d, n_1 = e, n_2 \uparrow, n_3 \uparrow, n_4 \uparrow, n_5 \uparrow$

 $\begin{array}{c} \textbf{State } \boldsymbol{q_7}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, \boldsymbol{d}, \boldsymbol{e}, \boldsymbol{f}) \\ \hline \textbf{NSD}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, \boldsymbol{d}) \rightarrow \textbf{Stmt}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{e}, \boldsymbol{f}) \, \textbf{NSD}(\boldsymbol{e}, \boldsymbol{f}, \boldsymbol{c}, \boldsymbol{d}) \boldsymbol{.} \quad [seq1] \end{array}$

 $\begin{array}{c} \textbf{State } \boldsymbol{q_8}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, \boldsymbol{d}) \\ \hline \textbf{S}() \rightarrow \textbf{NSD}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, \boldsymbol{d}) \textbf{.} \quad [init] \end{array}$

 $\begin{array}{l} \textbf{State } q_9(a, b, c, d, e, f, g) \\ \hline \textbf{Stmt}(a, b, c, d) \rightarrow \textsf{while}(a, b, e, f, c, g) \, \textsf{NSD}(e, f, g, d) \textbf{.} \quad [while] \end{array}$

 $\begin{array}{l} \label{eq:state q10} {\rm State } q_{10}(a,b,c,d,e,f,g) \\ \hline \\ \hline {\rm Stmt}(a,b,c,n_1) & \to {\rm cond}(a,b,d,e) \, {\rm NSD}(d,f,c,g) \, \cdot \, {\rm NSD}(f,e,g,n_1) \\ \hline {\rm NSD}(f,e,g,n_2) & \to {\rm Stmt}(f,e,g,n_2) \\ \hline {\rm NSD}(f,e,g,n_3) & \to {\rm Stmt}(f,e,n_4,n_5) \, {\rm NSD}(n_4,n_5,g,n_3) \\ \hline {\rm Stmt}(f,e,g,n_6) & \to {\rm cond}(f,e,n_7,n_8) \, {\rm NSD}(n_7,n_9,g,n_{10}) \, {\rm NSD}(n_9,n_8,n_{10},n_6) \\ \hline {\rm Stmt}(f,e,g,n_{11}) & \to {\rm stmt}(f,e,g,n_{11}) \\ \hline {\rm Stmt}(f,e,g,n_{12}) & \to {\rm while}(f,e,n_{13},n_{14},g,n_{15}) \, {\rm NSD}(n_{13},n_{14},n_{15},n_{12}) \\ \hline {\rm Stmt}(f,e,n_{16},n_{17}) & \to {\rm cond}(f,e,n_{18},n_{19}) \, {\rm NSD}(n_{18},n_{20},n_{16},n_{21}) \, {\rm NSD}(n_{20},n_{19},n_{21},n_{17}) \\ \hline {\rm Stmt}(f,e,n_{22},n_{23}) & \to {\rm stmt}(f,e,n_{22},n_{23}) \\ \hline {\rm Stmt}(f,e,n_{24},n_{25}) & \to {\rm while}(f,e,n_{26},n_{27},n_{24},n_{28}) \, {\rm NSD}(n_{26},n_{27},n_{28},n_{25}) \\ \hline \end{array}$

$\xrightarrow{NSD(n_0, n_1, n_2, n_3)} q_{11}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, n_3, \boldsymbol{d}, n_1, n_0, n_2)$
$n_0 = f, n_1 = e, n_2 = g, n_3 \uparrow$ $q_{11}(a, b, c, n_3, a, n_1, n_0, n_2)$
$\underbrace{Stmt(n_0, n_1, n_2, n_3)}_{n_2 = \mathbf{f}, n_1 = \mathbf{g}, n_2 = \mathbf{g}, n_2 \uparrow} \qquad $
$n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 = \boldsymbol{g}, n_3 \uparrow \qquad $
$\xrightarrow{Stmt(n_0, n_1, n_2, n_3)} q_5(n_0, n_1, \boldsymbol{g}, n_2, n_3)$
$n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow \qquad $
$\xrightarrow{\text{cond}(n_0, n_1, n_2, n_3)} q_3(n_0, n_1, \boldsymbol{g}, n_2, n_3)$
$n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow \qquad $
$stmt(n_0, n_1, n_2, n_3)$
$ \begin{array}{c} \xrightarrow{\mathbf{Gint}(n_0,n_1,n_2,n_3)} \\ \hline n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 = \boldsymbol{g}, n_3 \uparrow \end{array} \rightarrow q_1(n_0,n_1,n_2,n_3) $
$stmt(n_0, n_1, n_2, n_3)$
$ \begin{array}{c} \xrightarrow{\operatorname{Stitt}(n_0, n_1, n_2, n_3)} \\ \hline n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow \end{array} \rightarrow q_1(n_0, n_1, n_2, n_3) $
while $(n_0, n_1, n_2, n_3, n_4, n_5)$
$ \xrightarrow{\mathbf{winc}(n_0, n_1, n_2, n_3, n_4, n_5)} n_0 = \mathbf{f}, n_1 = \mathbf{e}, n_2 \uparrow, n_3 \uparrow, n_4 = \mathbf{g}, n_5 \uparrow \qquad q_2(n_0, n_1, n_4, n_2, n_3, n_5) $
while $(n_0, n_1, n_2, n_3, n_4, n_5)$
$\frac{-\mathbf{w}_{111}(n_0, n_1, n_2, n_3, n_4, n_5)}{n_0 = \mathbf{f}, n_1 = \mathbf{e}, n_2 \uparrow, n_3 \uparrow, n_4 \uparrow, n_5 \uparrow} \to q_2(n_0, n_1, n_4, n_2, n_3, n_5)$

 $\begin{array}{l} \textbf{State } q_{11}(a, b, c, d, e, f, g, h) \\ \hline \begin{bmatrix} \texttt{Stmt}(a, b, c, d) \rightarrow \texttt{cond}(a, b, e, f) \ \texttt{NSD}(e, g, c, h) \ \texttt{NSD}(g, f, h, d) \textbf{.} & [cond] \end{bmatrix} \end{array}$

NSD with left recursion

State	$q_0(a,$	b)
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State $q_0(a, b)$
$S() \rightarrow INSD(\boldsymbol{a}, n_1, \boldsymbol{b}, n_2)$
$NSD(\boldsymbol{a}, n_3, \boldsymbol{b}, n_4) \longrightarrow LNSD(\boldsymbol{a}, n_3, n_5, n_6) \operatorname{Stmt}(n_5, n_6, \boldsymbol{b}, n_4)$
$NSD(\boldsymbol{a}, n_7, \boldsymbol{b}, n_8) \longrightarrow LStmt(\boldsymbol{a}, n_7, \boldsymbol{b}, n_8)$
$NSD(a, n_9, n_{10}, n_{11}) \rightarrow LNSD(a, n_9, n_{12}, n_{13}) \operatorname{Stmt}(n_{12}, n_{13}, n_{10}, n_{11})$
$NSD(\boldsymbol{a}, n_{14}, n_{15}, n_{16}) ightarrow LStmt(\boldsymbol{a}, n_{14}, n_{15}, n_{16})$
$Stmt(a, n_{17}, b, n_{18}) \rightarrow .cond(a, n_{17}, n_{19}, n_{20}) NSD(n_{19}, n_{21}, b, n_{22}) NSD(n_{21}, n_{20}, n_{22}, n_{18})$
$Stmt(oldsymbol{a}, n_{23}, oldsymbol{b}, n_{24}) o .stmt(oldsymbol{a}, n_{23}, oldsymbol{b}, n_{24})$
$Stmt(a, n_{25}, b, n_{26}) \rightarrow .while(a, n_{25}, n_{27}, n_{28}, b, n_{29}) NSD(n_{27}, n_{28}, n_{29}, n_{26})$
$Stmt(a, n_{30}, n_{31}, n_{32}) \rightarrow .cond(a, n_{30}, n_{33}, n_{34}) NSD(n_{33}, n_{35}, n_{31}, n_{36}) NSD(n_{35}, n_{34}, n_{36}, n_{32})$
$Stmt(a, n_{37}, n_{38}, n_{39}) ightarrow stmt(a, n_{37}, n_{38}, n_{39})$
$Stmt(a, n_{40}, n_{41}, n_{42}) \rightarrow L while(a, n_{40}, n_{43}, n_{44}, n_{41}, n_{45}) NSD(n_{43}, n_{44}, n_{45}, n_{42})$
$\xrightarrow{NSD(n_0, n_1, n_2, n_3)} q_6(n_0, n_1, n_2, n_3)$
$n_0 = \boldsymbol{a}, n_1$ $, n_2 = \boldsymbol{b}, n_3$
$\xrightarrow{NSD(n_0, n_1, n_2, n_3)} q_5(n_0, n_1, n_2, n_3, \boldsymbol{b})$
$n_0 = a, n_1, n_2, n_3$
$ \begin{array}{c} \underbrace{Stmt(n_0, n_1, n_2, n_3)}_{n_0 = \mathbf{a}, n_1 \uparrow, n_2 = \mathbf{b}, n_3 \uparrow} \to q_4(n_0, n_1, n_2, n_3) \end{array} $
$\frac{Stmt(n_0, n_1, n_2, n_3)}{n_0 = a, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow} \to q_4(n_0, n_1, n_2, n_3)$
$\operatorname{cond}(n_0, n_1, n_2, n_3)$
$ \xrightarrow{\text{cond}(n_0, n_1, n_2, n_3)} q_3(n_0, n_1, \boldsymbol{b}, n_2, n_3) $
$\operatorname{stmt}(n_0, n_1, n_0, n_0)$
$ \xrightarrow{\mathbf{a}_{1}, n_{1}, n_{2}, n_{3}} n_{0} = \mathbf{a}, n_{1} \uparrow, n_{2} = \mathbf{b}, n_{3} \uparrow \qquad $
$stmt(n_0, n_1, n_2, n_2)$
$ \begin{array}{c} \xrightarrow{\operatorname{Stim}(n_0, n_1, n_2, n_3)} \\ \hline n_0 = \boldsymbol{a}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow \end{array} \rightarrow q_1(n_0, n_1, n_2, n_3) $
while $(n_0, n_1, n_2, n_3, n_4, n_5)$
$\xrightarrow{\text{while}(n_0, n_1, n_2, n_3, n_4, n_5)}{n_0 = \boldsymbol{a}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow, n_4 = \boldsymbol{b}, n_5 \uparrow} q_2(n_0, n_1, n_4, n_2, n_3, n_5)$
$\xrightarrow{\text{while}(n_0, n_1, n_2, n_3, n_4, n_5)} q_2(n_0, n_1, n_4, n_2, n_3, n_5)$
$ \xrightarrow{n_0 = a, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow, n_4 \uparrow, n_5 \uparrow} q_2(n_0, n_1, n_4, n_2, n_3, n_5) $
State $q_1(a, b, c, d)$
$Stmt({m a},{m b},{m c},{m d}) o stmt({m a},{m b},{m c},{m d})$. $[stmt]$

 $\begin{array}{l} \label{eq:state q2} \mathbf{State q2}(a, b, c, d, e, f) \\ \hline \mathbf{Stmt}(a, b, c, n_1) & \rightarrow \mathsf{while}(a, b, d, e, c, f) \cdot \mathsf{NSD}(d, e, f, n_1) \\ \hline \mathsf{NSD}(d, e, f, n_2) & \rightarrow \cdot \mathsf{NSD}(d, e, n_3, n_4) \, \mathsf{Stmt}(n_3, n_4, f, n_2) \\ \mathsf{NSD}(d, e, f, n_5) & \rightarrow \cdot \mathsf{Stmt}(d, e, f, n_5) \\ \mathsf{NSD}(d, e, n_6, n_7) & \rightarrow \cdot \mathsf{NSD}(d, e, n_8, n_9) \, \mathsf{Stmt}(n_8, n_9, n_6, n_7) \\ \mathsf{NSD}(d, e, n_{10}, n_{11}) & \rightarrow \cdot \mathsf{Stmt}(d, e, n_{10}, n_{11}) \\ \mathsf{Stmt}(d, e, f, n_{12}) & \rightarrow \cdot \mathsf{cond}(d, e, n_{13}, n_{14}) \, \mathsf{NSD}(n_{13}, n_{15}, f, n_{16}) \, \mathsf{NSD}(n_{15}, n_{14}, n_{16}, n_{12}) \\ \mathsf{Stmt}(d, e, f, n_{12}) & \rightarrow \cdot \mathsf{cond}(d, e, n_{13}, n_{14}) \, \mathsf{NSD}(n_{19}, n_{20}, n_{21}, n_{18}) \\ \mathsf{Stmt}(d, e, f, n_{18}) & \rightarrow \cdot \mathsf{while}(d, e, n_{19}, n_{20}, f, n_{21}) \, \mathsf{NSD}(n_{19}, n_{20}, n_{21}, n_{18}) \\ \mathsf{Stmt}(d, e, n_{22}, n_{23}) & \rightarrow \cdot \mathsf{cond}(d, e, n_{24}, n_{25}) \, \mathsf{NSD}(n_{24}, n_{26}, n_{22}, n_{27}) \, \mathsf{NSD}(n_{26}, n_{25}, n_{27}, n_{23}) \\ \mathsf{Stmt}(d, e, n_{28}, n_{29}) & \rightarrow \cdot \mathsf{stmt}(d, e, n_{28}, n_{29}) \\ \mathsf{Stmt}(d, e, n_{30}, n_{31}) & \rightarrow \cdot \mathsf{while}(d, e, n_{32}, n_{33}, n_{30}, n_{34}) \, \mathsf{NSD}(n_{32}, n_{33}, n_{34}, n_{31}) \end{array}$

$\xrightarrow{NSD(n_0, n_1, n_2, n_3)} q_7(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, n_3, n_0, n_1, n_2)$
$n_0 = d, n_1 = e, n_2 = f, n_3 \uparrow$
$\xrightarrow{NSD(n_0, n_1, n_2, n_3)} q_5(n_0, n_1, n_2, n_3, \boldsymbol{f})$
$n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow$ $q_5(n_0, n_1, n_2, n_3, \boldsymbol{J})$
$\underbrace{Stmt(n_0, n_1, n_2, n_3)}_{n_1 = d} \xrightarrow{q_1, n_2 = d} q_4(n_0, n_1, n_2, n_3)$
$n_0 = d, n_1 = e, n_2 = f, n_3 \uparrow \qquad (q_4(n_0, n_1, n_2, n_3))$
$\underbrace{Stmt(n_0, n_1, n_2, n_3)}_{n_1 = d, n_1 = d, n_2 \to n_1 \to n_2 \to n_$
$n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow$
$ \xrightarrow{\text{cond}(n_0, n_1, n_2, n_3)} q_3(n_0, n_1, \boldsymbol{f}, n_2, n_3) $
$n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow$ $q_3(n_0, n_1, \boldsymbol{J}, n_2, n_3)$
$stmt(n_0, n_1, n_2, n_3)$
$ \xrightarrow{\text{Stift}(n_0, n_1, n_2, n_3)} n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 = \boldsymbol{f}, n_3 \uparrow \qquad $
$\operatorname{stmt}(n_0, n_1, n_2, n_3)$
$ \begin{array}{c} -\underbrace{\operatorname{stim}(n_0, n_1, n_2, n_3)} \\ n_0 = \boldsymbol{d}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow \end{array} \rightarrow q_1(n_0, n_1, n_2, n_3) $
while $(n_0, n_1, n_2, n_3, n_4, n_5)$
$\frac{-\mathbf{m}(n_0, n_1, n_2, n_3, n_4, n_5)}{n_0 = \mathbf{d}, n_1 = \mathbf{e}, n_2 \uparrow, n_3 \uparrow, n_4 = \mathbf{f}, n_5 \uparrow} q_2(n_0, n_1, n_4, n_2, n_3, n_5)$
while $(n_0, n_1, n_2, n_3, n_4, n_5)$
$\xrightarrow{n_0=d, n_1=e, n_2\uparrow, n_3\uparrow, n_4\uparrow, n_5\uparrow} q_2(n_0, n_1, n_4, n_2, n_3, n_5)$

State $q_3(a, b, c, d, e)$

 $\mathsf{Stmt}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, n_1)$ $\rightarrow \operatorname{cond}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{d}, \boldsymbol{e}) \cdot \operatorname{NSD}(\boldsymbol{d}, n_2, \boldsymbol{c}, n_3) \operatorname{NSD}(n_2, \boldsymbol{e}, n_3, n_1)$ $\rightarrow \mathsf{cond}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{d}, \boldsymbol{e})$. $\mathsf{NSD}(\boldsymbol{d}, n_6, n_4, n_7) \, \mathsf{NSD}(n_6, \boldsymbol{e}, n_7, n_5)$ $\mathsf{Stmt}(\boldsymbol{a}, \boldsymbol{b}, n_4, n_5)$ $\overline{\mathsf{NSD}}(d, n_8, n_9, n_{10})$ \rightarrow . NSD(d, n_8 , n_{11} , n_{12}) Stmt(n_{11} , n_{12} , n_9 , n_{10}) $NSD(d, n_{13}, n_{14}, n_{15}) \rightarrow IStmt(d, n_{13}, n_{14}, n_{15})$ $NSD(d, n_{16}, c, n_{17})$ \rightarrow . NSD(d, n_{16} , n_{18} , n_{19}) Stmt(n_{18} , n_{19} , c, n_{17}) $\mathsf{NSD}(\boldsymbol{d}, n_{20}, \boldsymbol{c}, n_{21})$ \rightarrow . Stmt($\boldsymbol{d}, n_{20}, \boldsymbol{c}, n_{21}$) $\text{Stmt}(d, n_{22}, n_{23}, n_{24}) \rightarrow \text{.cond}(d, n_{22}, n_{25}, n_{26}) \text{NSD}(n_{25}, n_{27}, n_{23}, n_{28}) \text{NSD}(n_{27}, n_{26}, n_{28}, n_{24})$ $\mathsf{Stmt}(d, n_{29}, n_{30}, n_{31}) \rightarrow \mathsf{stmt}(d, n_{29}, n_{30}, n_{31})$ $\mathsf{Stmt}(d, n_{32}, n_{33}, n_{34}) \rightarrow \mathsf{I} while(d, n_{32}, n_{35}, n_{36}, n_{33}, n_{37}) \mathsf{NSD}(n_{35}, n_{36}, n_{37}, n_{34})$ $\mathsf{Stmt}(d, n_{38}, c, n_{39})$ \rightarrow . cond(d, n_{38} , n_{40} , n_{41}) NSD(n_{40} , n_{42} , c, n_{43}) NSD(n_{42} , n_{41} , n_{43} , n_{39}) $\mathsf{Stmt}(d, n_{44}, c, n_{45})$ \rightarrow . stmt $(\boldsymbol{d}, n_{44}, \boldsymbol{c}, n_{45})$ $Stmt(d, n_{46}, c, n_{47})$ \rightarrow while $(d, n_{46}, n_{48}, n_{49}, c, n_{50})$ NSD $(n_{48}, n_{49}, n_{50}, n_{47})$

 $NSD(n_0, n_1, n_2, n_3)$ $\rightarrow q_8(\boldsymbol{a}, \boldsymbol{b}, n_2, n_0, \boldsymbol{e}, n_1, n_3)$ $n_0 = \boldsymbol{d}, n_1 \uparrow, n_2 = \boldsymbol{c}, n_3 \uparrow$ $NSD(n_0, n_1, n_2, n_3)$ $\rightarrow q_9(n_0, n_1, n_2, n_3, \boldsymbol{c}, \boldsymbol{a}, \boldsymbol{b}, \boldsymbol{e})$ $\overline{n_0 = \boldsymbol{d}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow}$ $\mathsf{Stmt}(n_0, n_1, \underline{n_2}, n_3)$ $\rightarrow q_4(n_0, n_1, n_2, n_3)$ $n_0 = \boldsymbol{d}, n_1 \uparrow, n_2 = \boldsymbol{c}, n_3 \uparrow$ $\mathsf{Stmt}(n_0, n_1, n_2, n_3)$ $\rightarrow q_4(n_0, n_1, n_2, n_3)$ $\overline{n_0 = \boldsymbol{d}, n_1 \uparrow, n_2 \uparrow, n_3} \uparrow$ $cond(n_0, n_1, n_2, n_3)$ $\rightarrow q_3(n_0, n_1, \boldsymbol{c}, n_2, n_3)$ $n_0 = d, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow$ $\mathsf{stmt}(n_0, n_1, n_2, n_3)$ $\rightarrow q_1(n_0, n_1, n_2, n_3)$ $n_0 = \boldsymbol{d}, n_1 \uparrow, n_2 = \boldsymbol{c}, n_3 \uparrow$ $\mathsf{stmt}(n_0, n_1, n_2, n_3)$ $\rightarrow q_1(n_0, n_1, n_2, n_3)$ $n_0 = \boldsymbol{d}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow$ while $(n_0, n_1, n_2, n_3, n_4, n_5)$ $\rightarrow q_2(n_0, n_1, n_4, n_2, n_3, n_5)$ $n_0 = \boldsymbol{d}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow, n_4 = \boldsymbol{c}, n_5 \uparrow$ while $(n_0, n_1, n_2, n_3, n_4, n_5)$ $\rightarrow q_2(n_0, n_1, n_4, n_2, n_3, n_5)$ $n_0 = \boldsymbol{d}, n_1 \uparrow, n_2 \uparrow, n_3 \uparrow, n_4 \uparrow, n_5 \uparrow$

State $q_4(a, b, c, d)$

 $\mathsf{NSD}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, \boldsymbol{d}) o \mathsf{Stmt}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, \boldsymbol{d})$. [seq2]

State $q_5(a, b, c, d, e)$

$NSD(\boldsymbol{a}, \boldsymbol{b}, n_1, n_2) \to NSD(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, \boldsymbol{d})$. $Stmt(\boldsymbol{c}, \boldsymbol{d}, n_1, n_2)$
$NSD(m{a},m{b},m{e},n_3) \longrightarrow NSD(m{a},m{b},m{c},m{d})$. $Stmt(m{c},m{d},m{e},n_3)$
$ \texttt{Stmt}(\boldsymbol{c}, \boldsymbol{d}, n_4, n_5) \rightarrow \texttt{.cond}(\boldsymbol{c}, \boldsymbol{d}, n_6, n_7) NSD(n_6, n_8, n_4, n_9) NSD(n_8, n_7, n_9, n_5) $
$Stmt(\boldsymbol{c}, \boldsymbol{d}, n_{10}, n_{11}) \rightarrow stmt(\boldsymbol{c}, \boldsymbol{d}, n_{10}, n_{11})$
Stmt $(c, d, n_{12}, n_{13}) \rightarrow \text{.while}(c, d, n_{14}, n_{15}, n_{12}, n_{16}) \text{NSD}(n_{14}, n_{15}, n_{16}, n_{13})$
$ \left Stmt(\boldsymbol{c}, \boldsymbol{d}, \boldsymbol{e}, n_{17}) \rightarrow .cond(\boldsymbol{c}, \boldsymbol{d}, n_{18}, n_{19}) NSD(n_{18}, n_{20}, \boldsymbol{e}, n_{21}) NSD(n_{20}, n_{19}, n_{21}, n_{17}) \right $
$Stmt(\boldsymbol{c}, \boldsymbol{d}, \boldsymbol{e}, n_{22}) \rightarrow stmt(\boldsymbol{c}, \boldsymbol{d}, \boldsymbol{e}, n_{22})$
Stmt $(c, d, e, n_{23}) \rightarrow \text{.while}(c, d, n_{24}, n_{25}, e, n_{26}) \text{NSD}(n_{24}, n_{25}, n_{26}, n_{23})$

 $\mathsf{Stmt}(n_0, n_1, n_2, n_3)$ $\rightarrow q_{10}(\boldsymbol{a}, \boldsymbol{b}, n_2, n_3, n_0, n_1)$ $n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d}, n_2 = \boldsymbol{e}, n_3 \uparrow$ $Stmt(n_0, n_1, n_2, n_3)$ $\rightarrow q_{10}(\boldsymbol{a}, \boldsymbol{b}, n_2, n_3, n_0, n_1)$ $n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d}, n_2 \uparrow, n_3 \uparrow$ $cond(n_0, n_1, n_2, n_3)$ $\rightarrow q_3(n_0, n_1, \boldsymbol{e}, n_2, n_3)$ $n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d}, n_2 \uparrow, n_3 \uparrow$ $stmt(n_0, n_1, n_2, n_3)$ $\rightarrow q_1(n_0, n_1, n_2, n_3)$ $n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d}, n_2 = \boldsymbol{e}, n_3 \uparrow$ $stmt(n_0, n_1, n_2, n_3)$ $\rightarrow q_1(n_0, n_1, n_2, n_3)$ $n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d}, n_2 \uparrow, n_3 \uparrow$ while $(n_0, n_1, n_2, n_3, n_4, n_5)$ $\rightarrow q_2(n_0, n_1, n_4, n_2, n_3, n_5)$ $n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d}, n_2 \uparrow, n_3 \uparrow, n_4 = \boldsymbol{e}, n_5 \uparrow$ while $(n_0, n_1, n_2, n_3, n_4, n_5)$ $\rightarrow q_2(n_0, n_1, n_4, n_2, n_3, n_5)$ $n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d}, n_2 \uparrow, n_3 \uparrow, n_4 \uparrow, n_5 \uparrow$ State $q_6(a, b, c, d)$ $\mathsf{S}()
ightarrow \mathsf{NSD}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, \boldsymbol{d})$. [init]State $q_7(a, b, c, d, e, f, g)$ $\mathsf{Stmt}(a, b, c, d) \rightarrow \mathsf{while}(a, b, e, f, c, g) \mathsf{NSD}(e, f, g, d)$. [while] State $q_8(a, b, c, d, e, f, g)$ $\mathsf{Stmt}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, n_1) \longrightarrow \mathsf{cond}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{d}, \boldsymbol{e}) \mathsf{NSD}(\boldsymbol{d}, \boldsymbol{f}, \boldsymbol{c}, \boldsymbol{g}) \cdot \mathsf{NSD}(\boldsymbol{f}, \boldsymbol{e}, \boldsymbol{g}, n_1)$ $\mathsf{NSD}(\boldsymbol{f}, \boldsymbol{e}, \boldsymbol{g}, n_2)$ \rightarrow $\mathsf{NSD}(\boldsymbol{f}, \boldsymbol{e}, n_3, n_4) \operatorname{Stmt}(n_3, n_4, \boldsymbol{g}, n_2)$ $\mathsf{NSD}(\boldsymbol{f}, \boldsymbol{e}, \boldsymbol{g}, n_5)$ \rightarrow . Stmt $(\boldsymbol{f}, \boldsymbol{e}, \boldsymbol{g}, n_5)$ $\mathsf{NSD}(\boldsymbol{f}, \boldsymbol{e}, n_6, n_7) \rightarrow \mathsf{LNSD}(\boldsymbol{f}, \boldsymbol{e}, n_8, n_9) \operatorname{Stmt}(n_8, n_9, n_6, n_7)$ $\mathsf{NSD}(\boldsymbol{f}, \boldsymbol{e}, n_{10}, n_{11}) \rightarrow \mathsf{LStmt}(\boldsymbol{f}, \boldsymbol{e}, n_{10}, n_{11})$ $\mathsf{Stmt}(\boldsymbol{f}, \boldsymbol{e}, \boldsymbol{g}, n_{12}) \quad \rightarrow \mathsf{.cond}(\boldsymbol{f}, \boldsymbol{e}, n_{13}, n_{14}) \, \mathsf{NSD}(n_{13}, n_{15}, \boldsymbol{g}, n_{16}) \, \mathsf{NSD}(n_{15}, n_{14}, n_{16}, n_{12})$ $\mathsf{Stmt}(\boldsymbol{f}, \boldsymbol{e}, \boldsymbol{g}, n_{17})$ ightarrow . stmt $(oldsymbol{f},oldsymbol{e},oldsymbol{g},n_{17})$ $\mathsf{Stmt}(\boldsymbol{f}, \boldsymbol{e}, \boldsymbol{g}, n_{18}) \rightarrow \mathsf{while}(\boldsymbol{f}, \boldsymbol{e}, n_{19}, n_{20}, \boldsymbol{g}, n_{21}) \mathsf{NSD}(n_{19}, n_{20}, n_{21}, n_{18})$ $Stmt(f, e, n_{22}, n_{23}) \rightarrow cond(f, e, n_{24}, n_{25}) NSD(n_{24}, n_{26}, n_{22}, n_{27}) NSD(n_{26}, n_{25}, n_{27}, n_{23})$ $\mathsf{Stmt}(\boldsymbol{f}, \boldsymbol{e}, n_{28}, n_{29}) \rightarrow \mathsf{.stmt}(\boldsymbol{f}, \boldsymbol{e}, n_{28}, n_{29})$ $\mathsf{Stmt}(f, e, n_{30}, n_{31}) \rightarrow \mathsf{.while}(f, e, n_{32}, n_{33}, n_{30}, n_{34}) \mathsf{NSD}(n_{32}, n_{33}, n_{34}, n_{31})$ $NSD(n_0, n_1, n_2, n_3)$ $\longrightarrow q_{11}(\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}, n_3, \boldsymbol{d}, n_1, n_0, n_2)$ $n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 = \boldsymbol{g}, n_3 \uparrow$ $NSD(n_0, n_1, n_2, n_3)$ $\rightarrow q_5(n_0, n_1, n_2, n_3, \boldsymbol{g})$ $n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow$ $Stmt(n_0, n_1, n_2, n_3)$ $\rightarrow q_4(n_0, n_1, n_2, n_3)$ $n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 = \boldsymbol{g}, n_3 \uparrow$ $Stmt(n_0, n_1, n_2, n_3)$ $\longrightarrow q_4(n_0, n_1, n_2, n_3)$ $n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow$ $cond(n_0, n_1, n_2, n_3)$ $\rightarrow q_3(n_0, n_1, \boldsymbol{g}, n_2, n_3)$ $n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow$ $stmt(n_0, n_1, n_2, n_3)$ $\rightarrow q_1(n_0, n_1, n_2, n_3)$ $n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 = \boldsymbol{g}, n_3 \uparrow$ $stmt(n_0, n_1, n_2, n_3)$ $\rightarrow q_1(n_0, n_1, n_2, n_3)$ $n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow$ while $(n_0, n_1, n_2, n_3, n_4, n_5)$ $\xrightarrow{n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow, n_4 = \boldsymbol{g}, n_5 \uparrow} q_2(n_0, n_1, n_4, n_2, n_3, n_5)$ while $(n_0, n_1, n_2, n_3, n_4, n_5)$ $\rightarrow q_2(n_0, n_1, n_4, n_2, n_3, n_5)$ $n_0 = \boldsymbol{f}, n_1 = \boldsymbol{e}, n_2 \uparrow, n_3 \uparrow, n_4 \uparrow, n_5 \uparrow$

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State q_9(a, b, c, d, e, f, g, h)
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State $q_9(a, b, c, d, e, f, g, h)$
$igsqrmathinspace{-1.5} NSD(m{a},m{b},n_1,n_2) o NSD(m{a},m{b},m{c},m{d})$. $Stmt(m{c},m{d},n_1,n_2)$
$NSD(oldsymbol{a},oldsymbol{b},oldsymbol{e},n_3) o NSD(oldsymbol{a},oldsymbol{b},oldsymbol{c},oldsymbol{d})$. $Stmt(oldsymbol{c},oldsymbol{a},oldsymbol{e},n_3)$
$Stmt(m{f},m{g},m{c},n_4) o cond(m{f},m{g},m{a},m{h}) NSD(m{a},m{b},m{c},m{d})$. $NSD(m{b},m{h},m{d},n_4)$
$NSD(\boldsymbol{b}, \boldsymbol{h}, \boldsymbol{d}, n_5) \longrightarrow NSD(\boldsymbol{b}, \boldsymbol{h}, n_6, n_7) \operatorname{Stmt}(n_6, n_7, \boldsymbol{d}, n_5)$
$NSD(\boldsymbol{b}, \boldsymbol{h}, \boldsymbol{d}, n_8) \rightarrow .Stmt(\boldsymbol{b}, \boldsymbol{h}, \boldsymbol{d}, n_8)$
$NSD(\boldsymbol{b},\boldsymbol{h},n_9,n_{10}) \rightarrow NSD(\boldsymbol{b},\boldsymbol{h},n_{11},n_{12}) \operatorname{Stmt}(n_{11},n_{12},n_9,n_{10})$
$NSD(\boldsymbol{b},\boldsymbol{h},n_{13},n_{14}) \rightarrow .Stmt(\boldsymbol{b},\boldsymbol{h},n_{13},n_{14})$
$\left Stmt(\boldsymbol{b}, \boldsymbol{h}, \boldsymbol{d}, n_{15}) \rightarrow .cond(\boldsymbol{b}, \boldsymbol{h}, n_{16}, n_{17}) NSD(n_{16}, n_{18}, \boldsymbol{d}, n_{19}) NSD(n_{18}, n_{17}, n_{19}, n_{15}) \right $
$Stmt(\boldsymbol{b},\boldsymbol{h},\boldsymbol{d},n_{20}) \to .stmt(\boldsymbol{b},\boldsymbol{h},\boldsymbol{d},n_{20})$
$Stmt(\boldsymbol{b}, \boldsymbol{h}, \boldsymbol{d}, n_{21}) \rightarrow .while(\boldsymbol{b}, \boldsymbol{h}, n_{22}, n_{23}, \boldsymbol{d}, n_{24}) NSD(n_{22}, n_{23}, n_{24}, n_{21})$
$Stmt(\boldsymbol{b}, \boldsymbol{h}, n_{25}, n_{26}) \to cond(\boldsymbol{b}, \boldsymbol{h}, n_{27}, n_{28}) NSD(n_{27}, n_{29}, n_{25}, n_{30}) NSD(n_{29}, n_{28}, n_{30}, n_{26})$
$ \begin{array}{c} Stmt(\mathbf{b}, \mathbf{h}, n_{31}, n_{32}) \rightarrow stmt(\mathbf{b}, \mathbf{h}, n_{31}, n_{32}) \end{array} \\ (N_{24}, N_{23}, \mathsf$
$Stmt(\boldsymbol{b}, \boldsymbol{h}, n_{33}, n_{34}) \rightarrow .while(\boldsymbol{b}, \boldsymbol{h}, n_{35}, n_{36}, n_{33}, n_{37}) NSD(n_{35}, n_{36}, n_{37}, n_{34})$
$Stmt(\boldsymbol{c}, \boldsymbol{d}, n_{38}, n_{39}) \rightarrow .cond(\boldsymbol{c}, \boldsymbol{d}, n_{40}, n_{41}) NSD(n_{40}, n_{42}, n_{38}, n_{43}) NSD(n_{42}, n_{41}, n_{43}, n_{39})$
$Stmt(\boldsymbol{c}, \boldsymbol{d}, n_{44}, n_{45}) \to stmt(\boldsymbol{c}, \boldsymbol{d}, n_{44}, n_{45})$
$Stmt(c, d, n_{46}, n_{47}) \to while(c, d, n_{48}, n_{49}, n_{46}, n_{50}) NSD(n_{48}, n_{49}, n_{50}, n_{47})$
$\begin{array}{c} Stmt(c, d, e_1, n_{40}, n_{41}) \rightarrow Lound(c, d, n_{52}, n_{53}) NSD(n_{52}, n_{54}, e_1, n_{55}) NSD(n_{54}, n_{53}, n_{55}, n_{51}) \\ \\ Stmt(c, d, e_1, n_{51}) \rightarrow Lound(c, d, n_{52}, n_{53}) NSD(n_{52}, n_{54}, e_1, n_{55}) NSD(n_{54}, n_{53}, n_{55}, n_{51}) \end{array}$
$\begin{array}{c} Stmt(c, d, e, n_{51}) & \to Iccn(c, d, n_{52}, n_{53}) NSD(n_{52}, n_{53}, n_{55}) NSD(n_{54}, n_{53}, n_{53}, n_{51}) \\ Stmt(c, d, e, n_{56}) & \to Istmt(c, d, e, n_{56}) \end{array}$
$\begin{array}{c} Stmt(c, d, e, n_{56}) & \to Istm(c, d, e, n_{56}) \\ Stmt(c, d, e, n_{57}) & \to Istm(c, d, n_{58}, n_{59}, e, n_{60}) NSD(n_{58}, n_{59}, n_{60}, n_{57}) \end{array}$
$(c, u, c, n_{57}) = 7 \text{ while}(c, u, n_{58}, n_{59}, c, n_{60}) \text{ wide}(n_{58}, n_{59}, n_{60}, n_{57})$
$NSD(n_0, n_1, n_2, n_3) \qquad \qquad$
$ \xrightarrow{(n_0,n_1,n_2,n_3)} q_{11}(\boldsymbol{f},\boldsymbol{g},\boldsymbol{c},n_3,\boldsymbol{a},n_1,n_0,n_2) $
$\xrightarrow{NSD(n_0, n_1, n_2, n_3)} q_5(n_0, n_1, n_2, n_3, \boldsymbol{d})$
$n_0 = \boldsymbol{b}, n_1 = \boldsymbol{h}, n_2 \uparrow, n_3 \uparrow \qquad $
$\xrightarrow{Stmt(n_0, n_1, n_2, n_3)} q_4(n_0, n_1, n_2, n_3)$
$n_0 = b, n_1 = h, n_2 = a, n_3$
$\xrightarrow{Stmt(n_0, n_1, n_2, n_3)} q_4(n_0, n_1, n_2, n_3)$
$n_0 = 0, n_1 = n, n_2, n_3$
$\xrightarrow{Stmt(n_0, n_1, n_2, n_3)} q_{10}(\boldsymbol{a}, \boldsymbol{b}, n_2, n_3, n_0, n_1)$
$n_0 = c, n_1 = a, n_2 = c, n_3$
$\xrightarrow{Stmt(n_0, n_1, n_2, n_3)} q_{10}(\boldsymbol{a}, \boldsymbol{b}, n_2, n_3, n_0, n_1)$
$n_0 = c, n_1 = a, n_2 , n_3 $
$\frac{\operatorname{cond}(n_0, n_1, n_2, n_3)}{n_1 - h_2 - h_2 - h_2 - h_2} \to q_3(n_0, n_1, d, n_2, n_3)$
$n_0 = 0, n_1 = n, n_2$, n_3
$\frac{\operatorname{cond}(n_0, n_1, n_2, n_3)}{n_0 = \mathbf{c}, n_1 = \mathbf{d}, n_2 \uparrow, n_3 \uparrow} \to q_3(n_0, n_1, \mathbf{e}, n_2, n_3)$
$\frac{stmt(n_0, n_1, n_2, n_3)}{n_0 = \boldsymbol{b}, n_1 = \boldsymbol{h}, n_2 = \boldsymbol{d}, n_3 \uparrow \qquad $
$ \xrightarrow{stmt(n_0, n_1, n_2, n_3)} n_0 = \boldsymbol{b}, n_1 = \boldsymbol{h}, n_2 \uparrow, n_3 \uparrow \qquad $
$ \xrightarrow{\text{Stiff}(n_0, n_1, n_2, n_3)} n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d}, n_2 = \boldsymbol{e}, n_3 \uparrow \qquad $
$ \begin{array}{c} \underbrace{stmt(n_0, n_1, n_2, n_3)}_{n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d}, n_2 \uparrow, n_3 \uparrow} & \to q_1(n_0, n_1, n_2, n_3) \end{array} $
$ \begin{array}{c} \begin{array}{c} \text{while}(n_0, n_1, n_2, n_3, n_4, n_5) \\ \hline n_0 = \boldsymbol{b}, n_1 = \boldsymbol{h}, n_2 \uparrow, n_3 \uparrow, n_4 = \boldsymbol{d}, n_5 \uparrow \end{array} \\ \end{array} \qquad \qquad$
$ \begin{array}{c} \underset{n_0 = \boldsymbol{b}, n_1 = \boldsymbol{h}, n_2\uparrow, n_3\uparrow, n_4\uparrow, n_5\uparrow}{\text{while}(n_0, n_1 = \boldsymbol{h}, n_2\uparrow, n_3\uparrow, n_4\uparrow, n_5\uparrow)} & q_2(n_0, n_1, n_4, n_2, n_3, n_5) \end{array} $
$ \xrightarrow{ \text{while}(n_0, n_1, n_2, n_3, n_4, n_5) } n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d}, n_2 \uparrow, n_3 \uparrow, n_4 = \boldsymbol{e}, n_5 \uparrow \rightarrow q_2(n_0, n_1, n_4, n_2, n_3, n_5) $
$\overline{n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d}, n_2 \uparrow, n_3 \uparrow, n_4 = \boldsymbol{e}, n_5 \uparrow} q_2(n_0, n_1, n_4, n_2, n_3, n_5)$
while $(n_0, n_1, n_2, n_3, n_4, n_5)$
$ \begin{array}{c} \underset{n_0 = \boldsymbol{c}, n_1 = \boldsymbol{d}, n_2 \uparrow, n_3 \uparrow, n_4 \uparrow, n_5 \uparrow}{\text{while}(n_0, n_1 = \boldsymbol{d}, n_2 \uparrow, n_3 \uparrow, n_4 \uparrow, n_5 \uparrow} & \rightarrow q_2(n_0, n_1, n_4, n_2, n_3, n_5) \end{array} $
State $q_{10}(a, b, c, d, e, f)$
$\boxed{NSD(\boldsymbol{a},\boldsymbol{b},\boldsymbol{c},\boldsymbol{d}) \to NSD(\boldsymbol{a},\boldsymbol{b},\boldsymbol{e},\boldsymbol{f})Stmt(\boldsymbol{e},\boldsymbol{f},\boldsymbol{c},\boldsymbol{d})\boldsymbol{\cdot} [seq1]}$
State $q_{11}(a, b, c, d, e, f, g, h)$
$\boxed{Stmt(a, b, c, d) \to cond(a, b, e, f) NSD(e, g, c, h) NSD(g, f, h, d) \cdot [cond]}$