

left factoring

$sb \rightarrow \boxed{[]} \xleftarrow{t2} \text{fme id } (\langle P \rangle) \xrightarrow{\{ \}} \{ \xleftarrow{n} \text{MST} \} \}_{\leq sbs}$

$\boxed{[]} \xleftarrow{\text{cons}} \leq sbs \quad | \quad \text{fme id } (\langle P \rangle) \xrightarrow{\{ \}} \{ \xleftarrow{n} \text{MST} \}$

$\} \}_{\leq sbs} \quad | \quad \text{id } \xleftarrow{\text{init}} \leq \text{list } \leq sbs$

$sb \rightarrow [] \xleftarrow{\text{fme id } (\langle P \rangle)} \{ \xleftarrow{n} \text{MST} \} \quad |$

$[,] \xleftarrow{\text{fme id } (\langle P \rangle)} \{ \xleftarrow{n} \text{MST} \} \quad |$

$[] \text{id } \xleftarrow{\text{cons}} \leq sbs \quad | \quad [,] \text{id } \xleftarrow{\text{cons}} \leq sbs$

$\text{fme id } (\langle P \rangle) \xrightarrow{\{ \}} \{ \xleftarrow{n} \text{MST} \} \quad | \quad \text{id } \xleftarrow{\text{init}}$

$\leq \text{list } \leq sbs$

$sb \rightarrow [] \leq sb1 \quad | \quad [,] \leq sb1 \quad | \quad \text{fme -- } | \text{id -- }$

$sb1 \rightarrow \text{fme id } (\langle P \rangle) \xrightarrow{\{ \}} \{ \xleftarrow{n} \text{MST} \} \quad | \quad \text{id } \xleftarrow{\text{cons}} \leq sbs$

c-body' → abstract <C> | sealed <C> | void fun id
(<P>) { cn > c-MST } | id <C1> |
dt <C2> | dt <C2> "c-body'" | dt <C3>
 | cn >

c-body' → dt id <init> <list> | dt dt2 > fun id
(<P>) { cn > c-MST } | dt fun id (<P>) cn >
 { cn > c-MST } |
dt [cn > "c-body'"] |

dt [dt2 > fun id (<P>) { cn > c-MST }] |
dt fun id (<P>) { cn > c-MST } |
dt id <init> <list>

c-body' → dt ["c-body"] | dt "c-body2"

"c-body" → dt2 > fun id (<P>) { cn > c-MST } |
 cn > "c-body"

"c-body2" → id <init> <list> | fun id (<P>) { cn > c-MST }



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$S_2 \rightarrow$ static $\angle S_3 \rangle$ | id $\angle C_1 \rangle$ | $\boxed{dt} \angle C_2 \rangle$ | $\angle \text{sealed} \rangle$
 abstract $\angle C \rangle$ | $\boxed{dt} \angle C \rangle$ | $\boxed{dt} \angle C_3 \rangle$

$S_2 \rightarrow dt \angle \text{vars} \rangle$ | \boxed{dt} | id $\angle \text{ints} \rangle$ | lists |

$\boxed{dt} \angle t_2 \rangle$ free id ($\angle P \rangle$) $\angle n \rangle$ $\angle \text{MST} \rangle$ | \boxed{dt} | free id ($\angle P \rangle$)

| $dt \angle t_2 \rangle$ free id ($\angle P \rangle$) $\angle \text{MST} \rangle$ | dt free id ($\angle P \rangle$)

| dt id $\angle \text{ints} \rangle$ | lists

$S_2 \rightarrow dt \angle S_2-1 \rangle$ | $dt \angle S_2-2 \rangle$ | static ...

$\angle S_2-1 \rangle \rightarrow \angle \text{vars} \rangle$ | dt_2 free id ($\angle P \rangle$) $\angle n \rangle$ $\angle \text{MST} \rangle$ |
 $S_2-2 \rightarrow id \angle \text{ints} \rangle$ | lists | free id ($\angle P \rangle$) $\angle \text{MST} \rangle$

$\text{SST} \rightarrow$ $\rightarrow \text{while} \mid \text{do-while} \mid \text{for} \mid \text{if-else} \mid$
 $\text{return} \mid \text{break} \mid \text{continue} \mid$
 $\text{inc-dec} \rightarrow \boxed{\text{id}} \text{ SST1} \rightarrow \mid \text{dt SST2} \rightarrow$
 $\mid \text{void func id (P)} \rightarrow \left\{ \text{end SST2} \right\}$

$\text{SST2} \rightarrow$ $\boxed{\text{id}} \text{ init } \text{ lists} \mid \{ \text{ SST1} \} \mid \frac{\text{ SST}}{\downarrow}$
 $\left\{ \dots \mid \boxed{\text{id}} \text{ SST1} \mid \dots \right\}$

$\text{SST2} \rightarrow \text{id SST2-1} \mid \dots$

$\text{SST2-1} \rightarrow \text{init } \text{ lists} \mid \text{ SST1}$

$\langle \text{oe} \rangle \rightarrow \underline{\langle \text{ae} \rangle} \quad \langle \text{oe}' \rangle$
 $\rightarrow \underline{\langle \text{re} \rangle} \quad \langle \text{ae} \rangle, \langle \text{oe}' \rangle$
 $\rightarrow \underline{\langle \text{e} \rangle} \quad \underline{\langle \text{re}' \rangle}, \langle \text{ae}' \rangle \quad \langle \text{oe}' \rangle$
 $\rightarrow \underline{\langle \text{T} \rangle} \quad \underline{\langle \text{e}' \rangle}, \underline{\langle \text{re}' \rangle} \quad \langle \text{ae}' \rangle \quad \langle \text{oe}' \rangle$
 $\rightarrow \underline{\langle \text{F} \rangle} \quad \underline{\langle \text{T}' \rangle} \quad \langle \text{e}' \rangle \quad \langle \text{re}' \rangle \quad \langle \text{ae}' \rangle \quad \langle \text{oe}' \rangle$
* $\langle \text{oe} \rangle \rightarrow \underline{\langle \text{const} \rangle} \quad \langle \text{T}' \rangle \quad \langle \text{e}' \rangle \quad \langle \text{re}' \rangle \quad \langle \text{ae}' \rangle \quad \langle \text{oe}' \rangle_{\text{red}}$
(er) $\langle \text{T}' \rangle \quad \langle \text{e}' \rangle \quad \langle \text{re}' \rangle \quad \langle \text{ae}' \rangle \quad \langle \text{oe}' \rangle_{\text{red}}$
if $\langle \text{T}' \rangle \quad \langle \text{e}' \rangle \quad \langle \text{re}' \rangle \quad \langle \text{ae}' \rangle \quad \langle \text{oe}' \rangle_{\text{red}}$
in-dee $\langle \text{X} \rangle \quad \langle \text{T}' \rangle \quad \langle \text{e}' \rangle \quad \langle \text{re}' \rangle \quad \langle \text{ae}' \rangle \quad \langle \text{oe}' \rangle$
id $\langle \text{F}' \rangle \quad \langle \text{T} \rangle \quad \langle \text{e}' \rangle \quad \langle \text{re}' \rangle \quad \langle \text{ae}' \rangle \quad \langle \text{oe}' \rangle \quad \langle \text{oe}'' \rangle$

* $\langle \text{oe}'' \rangle \rightarrow \emptyset$

$\langle \text{oe} \rangle \rightarrow \text{OR } \langle \text{ae} \rangle \quad \langle \text{oe}' \rangle \mid \emptyset$
* $\langle \text{oe} \rangle \rightarrow \text{OR } \langle \text{oe} \rangle \quad \langle \text{oe}' \rangle \quad \langle \text{oe}'' \rangle \mid \langle \text{oe}' \rangle$
* $\langle \text{oe} \rangle \rightarrow \emptyset$

$\langle \text{ae} \rangle \rightarrow \underline{\langle \text{re} \rangle} \quad \langle \text{ae} \rangle$
 $\rightarrow \underline{\langle \text{er} \rangle} \quad \underline{\langle \text{re} \rangle} \quad \langle \text{ae}' \rangle$
 $\rightarrow \underline{\langle \text{T} \rangle} \quad \underline{\langle \text{e}' \rangle} \quad \langle \text{re}' \rangle \quad \langle \text{ae}' \rangle$
 $\rightarrow \underline{\langle \text{F} \rangle} \quad \underline{\langle \text{T}' \rangle} \quad \underline{\langle \text{T} \rangle} \quad \langle \text{e}' \rangle \quad \langle \text{re}' \rangle \quad \langle \text{ae}' \rangle$
* $\langle \text{ae} \rangle \rightarrow \underline{\langle \text{const} \rangle} \quad \underline{\langle \text{T}' \rangle} \quad \underline{\langle \text{T} \rangle} \quad \langle \text{e}' \rangle \quad \langle \text{re}' \rangle \quad \langle \text{ae}' \rangle \quad \langle \text{ae}' \rangle_{\text{red}}$
(er) $\langle \text{T}' \rangle \quad \underline{\langle \text{T} \rangle} \quad \langle \text{e}' \rangle \quad \langle \text{re}' \rangle \quad \langle \text{ae}' \rangle \quad \langle \text{ae}' \rangle_{\text{red}}$

<id <F' <T' <T> <e' <res> <ae's> <ae's>

* $ae'' \rightarrow \epsilon$

$ae' \rightarrow \text{AND } <\text{res}> <\text{ae's}> | \epsilon$

* $ae' \rightarrow \text{AND } <\text{res}> <\text{ae's}> <\text{ae's}> | <\text{ae's}>$

* $ae'' \rightarrow \epsilon$

$re \rightarrow <\text{e's}> <\text{re's}> | \epsilon$

$\rightarrow <\overline{T}> <\text{e's}> <\text{re's}> | \epsilon$

$\rightarrow <\overline{F'} <\overline{T}'> | \# <\text{e's}> <\text{res}> | \epsilon$

* $re \rightarrow <\text{const}> <\overline{T}'> <\text{e's}> <\text{re's}> | \underline{\underline{(\text{e'})}} <\overline{T}'> <\text{e's}> <\text{res}> | ! <\overline{F'} <\overline{T}'> <\text{e's}> <\text{re's}> | \underline{\underline{\text{inc dec} <\overline{x}>}} <\overline{T}'> <\text{e's}> <\text{res}> | <\text{re's}> | \underline{\underline{id <F'> <\overline{T}'> <\text{e's}> <\text{re's}>}} <\text{res}> | \epsilon$

* $re'' \rightarrow \epsilon$

$re' \rightarrow \text{ROP} <\text{e's}> <\text{re's}> | \epsilon$

* $re' \rightarrow \text{ROP} <\text{e's}> <\text{re's}> <\text{re's}> | <\text{re's}>$

* $re'' \rightarrow \epsilon$

$e \rightarrow \underline{cT} \quad \underline{ce'}$

$\rightarrow \underline{cF} \quad \underline{cT'} \quad \underline{ce'}$

* $e \rightarrow \underline{\text{const}} \quad \underline{cT'} \quad \underline{ce'} \quad | \quad (\underline{ce}) \quad \underline{cT'} \quad \underline{ce'} \quad | \quad \underline{!cF} \quad \underline{cT'} \quad \underline{ce'} \quad | \quad \underline{ce'}$

| inc-dec $\underline{cX} \quad \underline{cT'} \quad \underline{ce'} \quad | \quad \underline{id} \quad \underline{cF'} \quad \underline{cT'} \quad \underline{ce'}$

* $e'' \rightarrow \epsilon$

$e' \rightarrow PM \quad \underline{cT} \quad \underline{ce'} \quad | \quad \epsilon$

* $e' \rightarrow PM \quad \underline{cT} \quad \underline{ce'} \quad \underline{ce} \quad | \quad \underline{ce'}$

* $e'' \rightarrow \epsilon$

$T \rightarrow \underline{cF} \quad \underline{cT'}$

* $T \rightarrow \underline{\text{const}} \quad \underline{cT'} \quad | \quad (\underline{ce}) \quad \underline{cT'} \quad | \quad \underline{!cF} \quad \underline{cT'} \quad |$
| inc-dec $\underline{cX} \quad \underline{cT'} \quad | \quad \underline{id} \quad \underline{cF'} \quad \underline{cT'} \quad \underline{cT''}$

* $T'' \rightarrow \epsilon$

$T' \rightarrow MDM \quad \underline{cF} \quad \underline{cT'} \quad | \quad \epsilon$

* $T' \rightarrow MDM \quad \underline{cF} \quad \underline{cT'} \quad \underline{cT''} \quad | \quad \underline{cT''}$

* $T'' \rightarrow \epsilon$

$\langle F \rangle \rightarrow \langle \text{const} \rangle \mid (\langle e \rangle) \mid !\langle F \rangle$ inc-dee $\langle x \rangle \mid \text{id}, \text{p.}$
 $* F \rightarrow \langle \text{const} \rangle \langle F' \rangle \mid ((\langle e \rangle) \langle F' \rangle) \mid !\langle F \rangle \langle F' \rangle$
 $\quad \quad \quad \text{inc-dee } \langle x \rangle \langle F' \rangle \mid \text{id } \langle F' \rangle$
 $* F' \rightarrow \epsilon$

$F' \rightarrow \underline{\langle Z \rangle} \mid \epsilon$
 $\rightarrow \cdot \text{id } \langle Z_2 \rangle \mid [\langle \text{oe} \rangle \langle W \rangle \langle Z \rangle] \mid \text{inc-dee}$
 $\quad \quad \quad (\langle \text{PL} \rangle) \langle Z_2 \rangle \mid \epsilon$
 $* F' \rightarrow \cdot \text{id } \langle Z_2 \rangle \langle F'' \rangle \mid [\langle \text{oe} \rangle \langle W \rangle \langle Z \rangle \langle Z' \rangle \langle F'' \rangle]$
 $\quad \quad \quad \text{inc-dee } \langle F'' \rangle \mid (\langle \text{PL} \rangle) \langle Z_2 \rangle \langle F'' \rangle \mid \langle F'' \rangle$
 $* F'' \rightarrow \epsilon$

$x \longrightarrow x$

$\langle Z \rangle \rightarrow \cdot \text{id } \langle Z_2 \rangle \mid [\langle \text{oe} \rangle \langle W \rangle \langle Z \rangle] \mid \text{inc-dee}$
 $\quad \quad \quad (\langle \text{PL} \rangle) \langle Z_2 \rangle$
 $* Z \rightarrow \cdot \text{id } \langle Z_2 \rangle \langle Z' \rangle \mid [\langle \text{oe} \rangle \langle W \rangle \langle Z \rangle \langle Z' \rangle] \mid \text{inc-dee}$
 $\quad \quad \quad (\langle \text{PL} \rangle) \langle Z_2 \rangle \langle Z' \rangle$
 $* Z' \rightarrow \epsilon$

~~Z'~~

$\langle Z_1 \rangle \rightarrow \cdot \text{id } \langle Z \rangle \mid \text{inc-dee}$
 $* Z_1 \rightarrow \cdot \text{id } \langle Z \rangle \mid \text{inc-dee } \langle Z_1 \rangle \quad * Z_1 \rightarrow \epsilon$
 $\langle Z_2 \rangle \rightarrow \cdot \text{id } \langle Z \rangle \mid \text{inc-dee } \langle Z_1 \rangle$
 $* Z_2 \rightarrow \cdot \text{id } \langle Z \rangle \langle Z_2 \rangle \mid \langle \text{oe} \rangle \langle W \rangle \langle Z \rangle \langle Z_1 \rangle \mid \epsilon$
 $* Z_2 \rightarrow \epsilon$



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- $\langle W \rangle \longrightarrow \cdot id \langle W \rangle \quad | \quad \{ coes \langle W_1 \rangle \langle W_2 \rangle \} \text{ inc-dec}$
 assign-ops coes | ($\langle PL \rangle$) $\langle W_3 \rangle$
- $* W \longrightarrow \cdot id \langle W \rangle \langle W \rangle \quad | \quad \{ coes \langle W_1 \rangle \langle W_2 \rangle \langle W' \rangle \}$
 inc-dec $\langle W' \rangle \quad | \quad \text{assign-ops coes} \langle W' \rangle$
 $(\langle PL \rangle) \langle W_3 \rangle \langle W' \rangle$
- $* W' \longrightarrow E$

- $W_1 \longrightarrow] \quad | \quad , coes]$
- $* W_1 \longrightarrow] \langle W_1' \rangle \quad | \quad , coes] \langle W_1' \rangle$
- $* W_1' \longrightarrow E$

- $W_2 \longrightarrow \cdot id \langle W \rangle \quad | \quad \text{inc-dec} \quad | \quad \text{Assg-Op} coes$
- $* W_2 \longrightarrow \cdot id \langle W \rangle \langle W_2' \rangle \quad | \quad \text{inc-dec} \langle W_2' \rangle \quad | \quad \text{Assg-Op} coes$
 $\langle W_2' \rangle$
- $* W_2' \longrightarrow E$

- $W_3 \longrightarrow \cdot id \langle W \rangle \quad | \quad \{ coes \langle W_1 \rangle \langle W_2 \rangle \} \quad | \quad E$
 $\{ coes \langle W_1 \rangle \langle W_2 \rangle \langle W_3 \rangle \} \quad | \quad \langle W_3 \rangle$
- $* W_3 \longrightarrow \cdot id \langle W \rangle \langle W_3' \rangle \quad | \quad \{ coes \langle W_1 \rangle \langle W_2 \rangle \langle W_3 \rangle \} \quad | \quad \langle W_3' \rangle$
- $* W_3' \longrightarrow E$

$x \longrightarrow x$

$\langle X_2 \rangle \rightarrow \text{id} \langle X_1 \rangle$

$\langle X_2 \rangle \rightarrow \text{id} \langle X_1 \rangle \langle X_2' \rangle$

$X' \rightarrow \epsilon$

$\langle X_1 \rangle \rightarrow \text{id} \langle X_2 \rangle \mid \underline{\langle X_3 \rangle} \mid \epsilon$

$\rightarrow \text{id} \langle X_2 \rangle \mid \epsilon \mid \text{coe}$

$\langle \text{Wb} \rangle \langle X_1 \rangle$

$\langle X_1 \rangle \rightarrow \text{id} \langle X_2 \rangle \langle X_1' \rangle \mid \langle X_1' \rangle$

$X_2 \rightarrow \underline{\langle X_4 \rangle} \mid \underline{\langle X_1 \rangle} \mid \epsilon$

$\rightarrow (\text{PL}) \langle X_4' \rangle \mid$

$\text{id} \langle X_2 \rangle \mid \text{coe} \langle W_1 \rangle \langle X_1 \rangle$

ϵ

$\text{[coe} \langle W_1 \rangle \langle X_1 \rangle \langle X_1' \rangle]$

$X_1' \rightarrow \epsilon$

$X_2 \rightarrow (\text{PL}) \langle X_4' \rangle \langle X_2' \rangle \mid \text{id} \langle X_2 \rangle \langle X_2' \rangle \mid \text{coe} \langle W_1 \rangle \text{dpl}$

$\langle X_2' \rangle \mid \langle X_2' \rangle$

$X_2' \rightarrow \epsilon$

$X_3 \rightarrow \text{[coe} \langle W_1 \rangle \langle X_1 \rangle$

$X_3 \rightarrow \text{[coe} \langle W_1 \rangle \langle X_1 \rangle \langle X_3' \rangle$

$X_3' \rightarrow \epsilon$

$X_4 \rightarrow (\text{PL}) \langle X_4' \rangle$

$X_4' \rightarrow \epsilon$

$X_4' \rightarrow \underline{\langle X_3 \rangle} \mid \langle X_3 \rangle$

$X_4'' \rightarrow \text{[coe} \langle W_1 \rangle \langle X_1 \rangle \langle X_4' \rangle \text{id} \langle X_1 \rangle \langle X_4' \rangle$

$X_4'' \rightarrow \epsilon$

$\langle \text{fun_calls} \rangle \rightarrow \text{id} \triangleleft \triangleright$
 $\text{fun call} \rightarrow \text{id} \triangleleft \triangleright \langle \text{fun_calls} \rangle$
 $\langle \text{fun_calls} \rangle' \rightarrow \epsilon$

$\text{Assign_st} \rightarrow \underline{\langle X \rangle} \langle \text{Assign_ops} \rangle \text{ coes}$
 $\rightarrow \underline{\text{id}} \triangleleft \triangleright \langle \text{Assign_op} \rangle \text{ coes } \langle \text{Assign_st} \rangle$
 $\langle \text{Assign_st} \rangle' \rightarrow \epsilon$

$\langle \text{inc_dec_st} \rangle \rightarrow \underline{\langle X \rangle} \langle \text{inc_dec} \rangle \quad | \quad \langle \text{inc_dec} \rangle \triangleleft \triangleright$
 $\rightarrow \underline{\text{id}} \triangleleft \triangleright \langle \text{inc_dec} \rangle \quad | \quad \langle \text{inc_dec} \rangle \triangleleft \triangleright$
 $\langle \text{inc_dec_st} \rangle' \rightarrow \epsilon$

$X \longrightarrow X$

$Y \longrightarrow \cdot \text{id} \triangleleft \triangleright \quad | \quad (\triangleleft \triangleright) \triangleleft \triangleright \quad | \quad \underline{\text{coes}} \cdot \text{id} \triangleleft \triangleright$
 $Y \longrightarrow \cdot \text{id} \triangleleft \triangleright \triangleleft \triangleright \quad | \quad (\triangleleft \triangleright) \triangleleft \triangleright \triangleleft \triangleright \quad | \quad \{ \text{coes } \langle W \rangle \cdot \text{id} \triangleleft \triangleright \triangleleft \triangleright \}$

$Y' \longrightarrow \epsilon$

$Y_1 \longrightarrow \cdot \text{id} \triangleleft \triangleright \quad | \quad \underline{\text{coes}} \cdot \text{id} \triangleleft \triangleright \quad | \quad \epsilon$
 $Y_1 \longrightarrow \cdot \text{id} \triangleleft \triangleright \triangleleft \triangleright \quad | \quad \{ \text{coes } \langle W \rangle \cdot \text{id} \triangleleft \triangleright \triangleleft \triangleright \}$



$\langle \text{as} \rangle \rightarrow [\langle \text{coes} \rangle \langle \text{W1} \rangle \langle \text{as} \rangle]$

$\langle \text{as} \rangle \rightarrow E$

X → X

$\langle \text{dec} \rangle \rightarrow \underline{\text{dt}} \text{ id } \langle \text{int} \rangle \langle \text{list} \rangle \quad | \quad \underline{\text{id}} \text{ id } \langle \text{int} \rangle \langle \text{list} \rangle$

$\langle \text{dec} \rangle$

$\langle \text{dec} \rangle \rightarrow E$

$\text{list} \rightarrow , \text{id } \langle \text{int} \rangle \langle \text{list} \rangle \langle \text{list} \rangle | E \langle \text{list} \rangle$

$\text{list}' \rightarrow E$

$\text{init} \rightarrow = \langle \text{coes} \rangle \quad | \quad E \langle \text{init} \rangle$

$\text{init}' \rightarrow E$

X → X

$\text{func_def} \rightarrow \underline{\text{static}} \langle \text{types} \rangle \text{ func id } (\langle P \rangle) \langle \text{ns} \rangle$

$\{ \langle \text{ns} \rangle \langle \text{MST} \rangle \}$

$\rightarrow \text{static } \langle \text{types} \rangle \text{ func id } (\langle P \rangle) \langle \text{ns} \rangle \{ \langle \text{ns} \rangle \langle \text{MST} \rangle \}$

~~$\rightarrow \langle \text{types} \rangle \text{ func id } (\langle P \rangle) \langle \text{ns} \rangle \{ \langle \text{ns} \rangle \langle \text{MST} \rangle \}$~~

$\rightarrow \text{static } \langle \text{types} \rangle \text{ func id } (\langle P \rangle) \langle \text{ns} \rangle \{ \langle \text{ns} \rangle \langle \text{MST} \rangle \}$

$\text{dt } \langle \text{type} \rangle \text{ func id } (\langle R \rangle) \langle \text{ns} \rangle \{ \langle \text{ns} \rangle \langle \text{MST} \rangle \}$

$\text{dt } \langle \text{type} \rangle \text{ func id } (\langle R \rangle) \langle \text{ns} \rangle \{ \langle \text{ns} \rangle \langle \text{MST} \rangle \}$



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$\text{id_type}' \rightarrow \text{func_id} (\langle P \rangle) \rightsquigarrow \{ \text{cnr} \in \text{MST} \}$

$\text{func_def} \rightarrow \text{static } \langle \text{type} \rangle \text{ func_id} (\langle P \rangle) \rightsquigarrow \{$
 $\rightsquigarrow \{ \text{cnr} \in \text{MST} \} \quad \langle \text{func_def}' \rangle$
 $\text{dt_type}' \text{ func_id} (\langle P \rangle) \rightsquigarrow \{ \text{cnr} \in \text{MST} \}$
 $\langle \text{func_def}' \rangle \mid \text{void func_id} (\langle P \rangle) \rightsquigarrow \{ \text{cnr} \in \text{MST} \}$
 $\text{id_type}' \text{ func_id} (\langle P \rangle) \rightsquigarrow \{ \text{cnr} \in \text{MST} \}$
 $\langle \text{func_def}' \rangle$

$\langle \text{func_def}' \rangle \rightarrow \epsilon$

$\langle \text{static} \rangle \rightarrow \text{static} \mid \epsilon$

$\text{static} \rightarrow \text{static static}' \mid \text{static}'$
 $\langle \text{static}' \rangle \rightarrow \epsilon$

$\text{type} \rightarrow \text{dt_type}' \mid \text{void} \mid \text{id_type}'$
 $\text{type} \rightarrow \text{dt_type}' \text{ type}'' \mid \text{void type}'' \mid$
 $\text{id_type}' \text{ type}''$
 $\text{type}'' \rightarrow \epsilon$

$\text{type}' \rightarrow [\langle t_2 \rangle \mid \epsilon \text{ type}'']$
 $\text{type}'' \rightarrow \epsilon \quad \text{type}''$
 $t_2 \rightarrow] t_1] \quad ,] \langle t_2 \rangle$

$P \rightarrow dt < P1 > \text{id} < P1 > \frac{P''}{P'} \{ \epsilon \} < P1' >$

$P'' \rightarrow \epsilon$

$P1 \rightarrow \underline{id} < P1' > < P3 > < P1' >$

$P1'' \rightarrow \epsilon$

$P1' \rightarrow [< P2 > \underline{< P1' >}] \{ \epsilon \} < P1' >$

$P1'' \rightarrow \epsilon$

$P' \rightarrow \underline{id} < P1 > \underline{P''} | dt < P1 > < P'' >$

$P2 \rightarrow] < P3 > \underline{P2} | ,] < P3 > < P2' >$

$P23 \rightarrow \epsilon$

$P3 \rightarrow , < P3 > \underline{P3} | \{ \epsilon \} & < P3' >$

$\times \rightarrow \times$

$\{ \text{type/s} \} \rightarrow [< t2 > \text{type/s}] \{ \epsilon \} \text{ type/s}$

$< t2 > \rightarrow] \underline{t2} | ,] < t2' >$

$t2 \rightarrow \epsilon$

$\times \rightarrow \times$

$\langle \text{var-def} \rangle \rightarrow \text{id} \langle \text{var} \rangle \quad | \quad \text{dt} \langle \text{all} \rangle \quad \text{var-def}'$

$\langle \text{var-def}' \rangle \rightarrow \epsilon$

$\langle \text{var} \rangle \rightarrow [\langle \text{var}' \rangle \langle \text{var} \rangle]$

$\text{var}' \rightarrow \epsilon$

$\text{var}' \rightarrow] \text{id} \langle \text{var1} \rangle \quad | \quad , \text{id} \langle \text{var1} \rangle$

$\langle \text{var}'' \rangle$

$\langle \text{var}'' \rangle$

$\text{var}'' \rightarrow \epsilon$

$\text{var1} \rightarrow = \langle \text{var1}' \rangle \quad | \quad \& \quad \langle \text{var1}'' \rangle$

$\langle \text{var1}' \rangle$

$\text{var1}'' \rightarrow \epsilon$

$\text{var1}' \rightarrow \text{new } \langle \text{var2} \rangle \quad | \quad \{ \langle \text{values} \rangle \} \langle \text{var2} \rangle$

$\langle \text{var1}' \rangle$

$\langle \text{var1}'' \rangle \rightarrow \epsilon$

$\text{var2} \rightarrow \text{dt} \{ \langle \text{oes} \langle \text{var3} \rangle \rangle \langle \text{var2} \rangle \} \quad | \quad \text{id} \langle \text{oes} \langle \text{var3} \rangle \langle \text{var2} \rangle \rangle$

$\text{var2}' \rightarrow \epsilon$

$\text{var3} \rightarrow] \{ \langle \text{values} \rangle \langle \text{var2} \rangle \} \quad , \langle \text{oes} \rangle] \{ \langle \text{values} \rangle \langle \text{var3} \rangle \}$



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$\text{var3} \rightarrow \epsilon$

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values → $\langle \text{loes} \rangle \text{ } \langle \text{Vs} \rangle$
→ $\langle \text{ae} \rangle \langle \text{oe} \rangle \text{ } \langle \text{Vs} \rangle$
→ $\langle \text{res} \rangle \langle \text{ae} \rangle \langle \text{oe} \rangle \text{ } \langle \text{Vs} \rangle$
→ $\langle \text{es} \rangle \langle \text{re} \rangle \langle \text{res} \rangle \langle \text{ae} \rangle \langle \text{oe} \rangle \text{ } \langle \text{Vs} \rangle$
→ $\langle \overline{\text{T}} \rangle \langle \text{e} \rangle \rightarrow \langle \text{res} \rangle \langle \text{re} \rangle \langle \text{ae} \rangle \langle \text{oe} \rangle \text{ } \langle \text{Vs} \rangle$
→ $\langle \text{F} \rangle \langle \overline{\text{T}} \rangle \langle \text{es} \rangle \langle \text{re} \rangle \langle \text{res} \rangle \langle \text{ae} \rangle \langle \text{oe} \rangle \text{ } \langle \text{Vs} \rangle$
Values → $\langle \text{consts} \rangle \langle \overline{\text{T}} \rangle \langle \text{e} \rangle \langle \text{res} \rangle \langle \text{re} \rangle \langle \text{ae} \rangle \langle \text{oe} \rangle \text{ } \langle \text{Vs} \rangle$
 $\langle \text{es} \rangle \langle \overline{\text{T}} \rangle \langle \text{e} \rangle \langle \text{res} \rangle \langle \text{re} \rangle \langle \text{ae} \rangle \langle \text{oe} \rangle \text{ } \langle \text{Vs} \rangle$
 $\underline{!} \langle \text{F} \rangle \langle \overline{\text{T}} \rangle \langle \text{e} \rangle \langle \text{res} \rangle \langle \text{re} \rangle \langle \text{ae} \rangle \langle \text{oe} \rangle \text{ } \langle \text{Vs} \rangle$
 $\underline{\text{inc-dec}} \langle \text{X} \rangle \langle \overline{\text{T}} \rangle \langle \text{e} \rangle \langle \text{res} \rangle \langle \text{re} \rangle \langle \text{ae} \rangle \langle \text{oe} \rangle \text{ } \langle \text{Vs} \rangle$
 $\underline{\text{Id}} \langle \text{F} \rangle \langle \overline{\text{T}} \rangle \langle \text{es} \rangle \langle \text{re} \rangle \langle \text{res} \rangle \langle \text{ae} \rangle \langle \text{oe} \rangle \text{ } \langle \text{Vs} \rangle$
 $\langle \text{values} \rangle$

$\langle \text{values} \rangle \rightarrow \text{E}$

* $\langle \text{values} \rangle \rightarrow \{ \langle \text{values} \rangle \} \text{ } \langle \text{Vs} \# \text{ values} \rangle$
 $\langle \text{values} \rangle \rightarrow \text{g}$

* $\text{V} \rightarrow , \langle \text{oe} \rangle \text{ } \langle \text{Vs} \rangle \text{ } \langle \text{Vs} \# \text{ values} \rangle \& \text{ } \langle \text{Vs} \rangle$
 $\text{Vs} \rightarrow \text{g}$

* <break_st> → break | E <break_st>

<break_st> → E

* <continue_st> → continue | E <continue_st>

<continue_st> → E

* <return_st> → return <r'> β

<return_st> → return α' <return_st>

<return_st> → E

* <r's'> → <loes> = | E

→ <loes> <oer'> | E

→ <res><aer'> <oer'> | E

→ <es> <res> <aer'> <oer'> | E

→ <T> <es> <res> <aer'> <oer'> | E

→ <F> <T> <es> <res> <aer'> <oer'> | E

<res> → <const> <T> <es> <res> <aer'> <oer'> | (<es>) <T>

<es> <res> <aer'> <oer'> | ! <F> <T> <es> <res>

<aer'> <oer'> <res> | inc-dec <T> <es> <res>

<aer'> <oer'> | id <F> <T> <es> <res> <aer'> <oer'> |

E <res>



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* $\langle n \rangle \rightarrow \ln \langle n \rangle \langle n \rangle$

$\langle n \rangle \rightarrow \epsilon$

* $\langle n' \rangle \rightarrow \langle n \rangle \langle n' \rangle | \epsilon \langle n' \rangle$

$\langle n' \rangle \rightarrow \epsilon$

* $\langle MST \rangle \rightarrow \epsilon_{\langle MST \rangle} | \langle SSt \rangle \langle n \rangle \langle MST \rangle \langle MST \rangle'$

$\langle MST \rangle \rightarrow \epsilon$

* $\langle \text{if-else} \rangle \rightarrow \text{if } \langle \text{exp} \rangle : \langle n \rangle \langle \text{body} \rangle \langle \text{op-else} \rangle \langle \text{if-else} \rangle$

$\langle \text{if-else} \rangle \rightarrow \epsilon$

* $\langle \text{body} \rangle \rightarrow \epsilon_{\langle \text{body} \rangle} | \langle SSt \rangle \langle n \rangle \langle \text{body} \rangle \{ \langle n \rangle \langle MST \rangle \} \langle n \rangle \langle \text{body} \rangle$

$\langle \text{body} \rangle \rightarrow \cancel{\text{body}} \epsilon$

* $\langle \text{op-else} \rangle \rightarrow \text{else} : \langle n \rangle \langle \text{body} \rangle \langle \text{op-else} \rangle | \epsilon \langle \text{op-else} \rangle$

$\langle \text{op-else} \rangle \rightarrow \epsilon$

* $\langle \text{while-st} \rangle \rightarrow \text{while } \langle \text{exp} \rangle : \langle n \rangle \langle \text{body} \rangle \langle \text{while-st} \rangle$

$\langle \text{while-st} \rangle \rightarrow \epsilon$

* $\langle \text{do-white} \rangle \rightarrow \text{do } \langle n \rangle \{ \langle n \rangle \langle MST \rangle \} \langle n \rangle$

$\text{while } \langle \text{exp} \rangle : \langle n \rangle \langle \text{do-white} \rangle$

$\langle \text{do-white} \rangle \rightarrow \epsilon$

$\langle \text{fors} \rangle \rightarrow \underline{\langle e1 \rangle : \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle}$
 $\rightarrow \underline{\langle \text{decs} \rangle : \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle} \mid$
 $\underline{\langle \text{Assign_op} \rangle : \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle} \mid$
 $\in \langle e2 \rangle \in \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle \quad \text{for}$
 $\langle \text{fors} \rangle \rightarrow \underline{\text{dt} \ \text{id} \ \text{units} \ \text{lists}} : \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle$
 $\underline{\text{id} \ \text{id} \ \text{units} \ \text{lists}} : \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle \quad \text{for}$
 $: \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle \ \text{fors} \quad \text{for}$
 ~~$\langle \text{fors} \rangle \rightarrow \underline{\epsilon} \ \underline{\langle X \rangle \ \langle \text{Assign_op} \rangle \ \text{coes}} : \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle$~~
 $[\underline{\text{id}} \ \underline{\langle X_1 \rangle}] \ \langle \text{Assign_op} \rangle \ \text{coes} : \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle$
 $\langle e1 \rangle \rightarrow \underline{\langle \text{decs} \rangle} \mid \underline{\langle \text{Assign_op} \rangle \ \text{coes}}$

$\langle \text{fors} \rangle \rightarrow \underline{\text{dt} \ \text{id} \ \text{units} \ \text{lists}} : \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle \ \text{fors} \quad \boxed{\text{id}} \ \text{id} \ \text{units} \ \text{lists} : \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle$
 $: \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle \ \text{fors} \quad \boxed{\text{id}} \ \underline{\langle X_1 \rangle \ \langle \text{Assign_op} \rangle \ \text{coes}} : \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle$
 $\in \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle \ \text{fors}$

$\langle \text{fors} \rangle \rightarrow \underline{\epsilon}$

~~*Left factor*~~
~~for~~ $\rightarrow \text{id} \ \underline{\langle \text{for} \rangle 1} \mid \text{dt} \ - \ - \ \mid : \langle e2 \rangle \ - \ -$
 $\langle \text{for} \rangle 1 \rightarrow \text{id} \ \text{units} \ \text{lists} : \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle \ \text{fors} \mid$



Shot on Y11 $\langle \text{Ass_op} \rangle \ \text{coes} : \langle e2 \rangle : \langle e3 \rangle \in \text{ns} \langle \text{body} \rangle \ \text{fors}$
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left feature

e1 → id <e1> | dt --- | <e2>

e11 → id units dist <e1> | <X> <AssignOp>

<e1> → dees | AssignOp | E

→ dt id units dist | id id units dist
 | <AssignOp> <e1> { [id <X>] dt }

e1 → dt id units dists | id id units dists
 | [id] | <X> <AssignOp> <e1> | E <e2>

<e1> → E
left feature
 |

<e2> → caes | E

→ caes caes | E

→ caes caes caes | E

→ caes caes caes caes | E

→ caes caes caes caes caes | E

e2 → cons | T' | <e1> <res> <res> <res> <res> | E

T' | <res> <res> <res> <res> | (<e1>)

<res> <res> <res> <res> | <F> T' | <F> T' | <res> <res>

<res> <res> | <mc-dee> X | T' | <res> <res> <res> <res>

<res> <res> | id <F> T' | <res> <res> <res> <res> | E

<res> <res>



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2021.08.1

left factor

SST → id <SST1> | dt <SST12> | --

SST11 → <SST1> | id <init> <lists> | if <SST12> <es>

SST12 → <SST2> | id <init> <lists>

e3 → id <e3> <e3> | inc-dec <x> <e3> | ε <e3>
<e3> → ε

e3' → assign_ops <e3> | inc-dec <e3>
<e3> → ε

x → x

2SSTs → <while_st> | <do_while> | <if_elses> | <for>
<return_st> | <break_st> | <continue_st>
inc-dec <x> | id <SST1> | dt <SST2>
void func id (<P>) <n> { cns <MST> }

→ while coes: <n> <bodys> | do <n> { <n> <MST> }
<n> while coes: <n> | if coes: <n> <bodys>
<op_elses> | <e3> <e3> = <e3> <n> <bodys>
return <r's> | break | continue | ε |
inc-dec <x> | id <SST1> | dt <SST2>
void func id (<P>) <n> { <n> <MST> }

→ while coes: <n> <bodys> | do <n> { <n> <MST> }
<n> while coes: <n> | if coes: <n> <bodys>
<op_elses> | return <n> | break | continue | ε |
inc-dec <x> | id <SST1> | dt <SST2>
void func id (<P>) <n> { <n> <MST> }



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Vivo Alkameter & <es>

2021.6

Left factorization

$SST_1 \rightarrow [\langle SST_{11} \rangle] \dots$

$SST_{11} \rightarrow \text{coes} \langle W_1 \rangle \langle W_2 \rangle \langle SST_1' \rangle \langle SST_1' \rangle$

$SST_1' \rightarrow \epsilon$

\swarrow

$SST_1 \rightarrow \frac{\langle W_1 \rangle}{\text{id} \langle W_1 \rangle} \mid \frac{\langle SST_1' \rangle}{\text{coes} \langle W_1 \rangle \langle W_2 \rangle} \mid \frac{\text{id} \langle SST_3 \rangle}{\text{we-dec}}$

$\rightarrow \frac{\text{id} \langle W_1 \rangle}{\text{classif-ops} \langle SST_1' \rangle \text{coes} \langle W_2 \rangle} \mid \frac{\langle P_L \rangle \langle W_2 \rangle}{\text{id} \langle SST_3 \rangle \text{func id} \langle P_R \rangle \text{ens} \{ \text{cons} \}}$

$\langle MST_1 \rangle \in \langle SST_1' \rangle$

$SST_1' \rightarrow \epsilon$

$SST_1' \rightarrow [\langle SST_4 \rangle \langle SST_1'' \rangle] \cup [\langle SST_4 \rangle \langle SST_1'' \rangle]$

$SST_1'' \rightarrow \epsilon$

$\swarrow SST_2 \rightarrow \frac{\text{id} \langle \text{init} \rangle \langle \text{lists} \rangle}{\text{id} \langle \text{init} \rangle \langle \text{lists} \rangle \langle SST_2' \rangle} \mid \frac{\langle SST_1' \rangle}{\langle SST_1' \rangle \langle SST_2' \rangle}$

$SST_2 \rightarrow \frac{\text{id} \langle \text{init} \rangle \langle \text{lists} \rangle \langle SST_2' \rangle}{\text{while} \langle \text{coes} \rangle = \langle \text{ns} \rangle \langle \text{body} \rangle \langle SST_2' \rangle} \mid \frac{\langle do \rangle}{\text{do} \langle \text{body} \rangle \langle \text{ns} \rangle}$

$\langle \text{ns} \rangle \text{ while} \langle \text{coes} \rangle = \langle \text{ns} \rangle \langle SST_2' \rangle \mid \text{if} \langle \text{coes} \rangle$

$\langle \text{ns} \rangle \langle \text{body} \rangle \langle \text{op-else} \rangle \langle SST_2' \rangle \mid \text{break} \langle SST_2' \rangle$

$\text{continue} \langle SST_2' \rangle \mid \text{EqST}_2' \mid$

$\text{we-dec} \langle X \rangle \langle SST_2' \rangle \mid \frac{\text{id} \langle SST_1 \rangle \langle SST_2' \rangle}{\text{dt} \langle SST_2 \rangle \langle SST_2' \rangle \mid \text{void func id} \langle P \rangle}$

$\langle \text{ns} \rangle \{ \langle \text{ns} \rangle \langle MST_1 \rangle \} \mid \frac{\text{dt} \text{id} \langle \text{init} \rangle \langle \text{lists} \rangle}{\langle SST_2' \rangle \mid \text{id} \text{id} \langle \text{init} \rangle \langle \text{lists} \rangle \langle SST_2' \rangle}$

$\frac{\text{id} \langle X \rangle \langle \text{sh-ops} \rangle \langle \text{coes} \rangle}{\langle SST_2' \rangle}$

$SST_2' \rightarrow \epsilon$

$\text{SSTB} \rightarrow \text{SSTB}' \text{ SSTB}''$

$\text{SSTB}'' \rightarrow \epsilon$

$\text{SSTB}' \rightarrow \underline{\text{new id}} \vee \underline{\text{const}} \vee \underline{\text{ λ -exp}}$

$\underline{\text{ λ -exp}} \underline{\text{ λ -exp}} \underline{\text{ λ -exp}}$

$\underline{\text{let}} \underline{\text{in}} \underline{\text{let}} \underline{\text{in}}$

$\underline{\text{let}} \underline{\text{in}} \underline{\text{let}} \underline{\text{in}}$

$\underline{\text{let}} \underline{\text{in}} \underline{\text{let}} \underline{\text{in}}$

$\text{SSTB}' \rightarrow \underline{\text{new id}} \vee \underline{\text{const}} \vee \underline{\text{ λ -exp}} \vee \underline{\text{ λ -exp}}$

$\underline{\text{ λ -exp}} \underline{\text{ λ -exp}} \vee \underline{\text{(exp)}}$

$\underline{\text{SSTB}''}} \vee \underline{\text{! F T' let in let in const}}$

$\underline{\text{let in let in let in const}}$

$\underline{\text{id ! F T' let in let in let in const}}$

$\underline{\text{id ! F T' let in let in let in const}}$

$\text{SSTB}'' \rightarrow \epsilon$

$\text{SST4} \rightarrow \underline{\text{id const}} \vee \underline{\text{SST5}}$

$\rightarrow \underline{\text{id const}} \vee \underline{\text{SST4'}} \vee \underline{\text{fun id (op) const}}$

$\underline{\text{MSL}} \underline{\text{SST4'}}$

$\text{SST4'} \rightarrow \epsilon$

$\text{SST5} \rightarrow \underline{\text{fun id (op)}} \underline{\text{in MSL}} \underline{\text{SST5'}}$

$\text{SST5'} \rightarrow \epsilon$

$\langle \text{defs} \rangle \longrightarrow \underline{\text{Public}} \; \langle \text{def} \rangle^* \mid \underline{\text{cdefs}}^* \mid \underline{\epsilon}$

$\left\{ \begin{array}{l} \underline{\text{class_def}}^* \; \langle \text{ns} \rangle \; \langle \text{def} \rangle^* \mid \underline{\text{struct_def}}^* \\ \langle \text{ns} \rangle \; \langle \text{def} \rangle^* \end{array} \right.$

$\text{cdefs} \longrightarrow \underline{\text{Public}} \; \langle \text{def} \rangle^* \mid \underline{\epsilon}^* \mid \underline{\text{abs_sealed}}$

$\underline{\text{abstract}} \; \langle \text{static} \rangle \; \text{class id} \; \langle \text{cbody} \rangle^* \; \langle \text{cbody} \rangle$

$\langle \text{cbody} \rangle^* \; \langle \text{ns} \rangle \; \text{cdefs} \; \langle \text{def} \rangle^* \mid$

$\underline{\text{sealed}} \; \langle \text{static} \rangle \; \text{class id} \; \langle \text{cbody} \rangle^* \; \langle \text{ns} \rangle$

$\langle \text{cbody} \rangle^* \; \langle \text{ns} \rangle \; \langle \text{def} \rangle^* \; \langle \text{def} \rangle^* \mid$

$\underline{\text{static}} \; \text{class id} \; \langle \text{cbody} \rangle^* \; \langle \text{ns} \rangle \; \langle \text{cbody} \rangle$

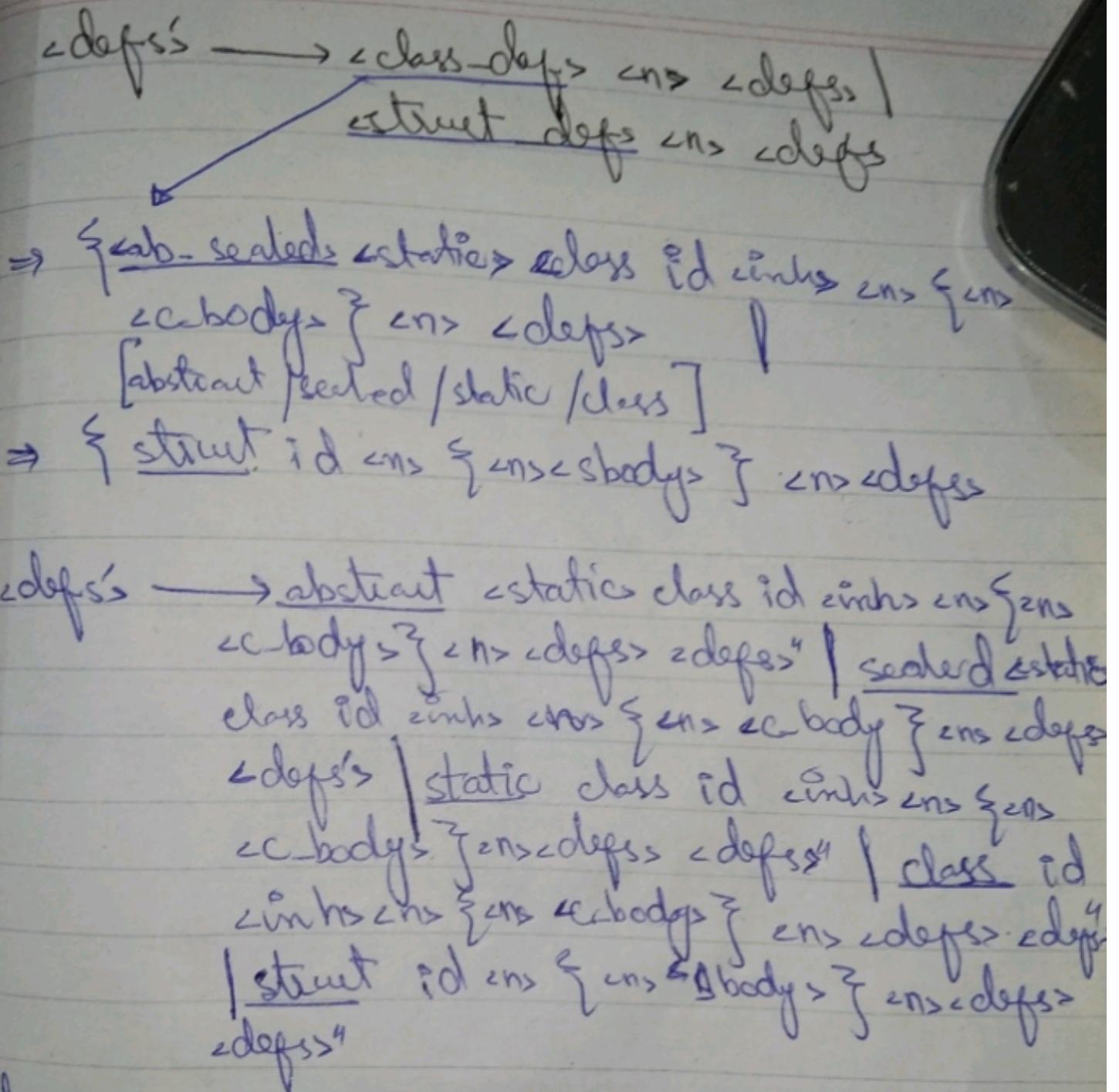
$\langle \text{cbody} \rangle^* \; \langle \text{ns} \rangle \; \langle \text{def} \rangle^* \mid \underline{\text{class id}}$

$\langle \text{cbody} \rangle^* \; \langle \text{ns} \rangle \; \langle \text{cbody} \rangle^* \; \langle \text{ns} \rangle \; \langle \text{def} \rangle^*$

$\langle \text{def} \rangle^* \mid \underline{\text{struct id}} \; \langle \text{ns} \rangle \; \langle \text{cbody} \rangle^* \; \langle \text{ns} \rangle \; \langle \text{def} \rangle^*$

$\langle \text{def} \rangle^* \mid \langle \text{def} \rangle^* \; \langle \text{def} \rangle^* \mid$

$\text{def}^* \longrightarrow \epsilon$



defⁿ → ε

$S \rightarrow$ public class id \in init $\{ \text{cns} \leftarrow S_1 \leftarrow S \}$
class id \in init $\{ \text{cns} \leftarrow S_1 \leftarrow S \}$

$S' \rightarrow E$

$S_1 \rightarrow$ Public $\leftarrow S_2$

| Private \leftarrow statics \leftarrow bodies
 \leftarrow ns \leftarrow c_bodies |

| Private Protected

statics \leftarrow c_bodies \leftarrow ns \leftarrow c_bodies

| statics \leftarrow c_bodies \leftarrow ns \leftarrow c_bodies

\rightarrow Public $\leftarrow S_2 \leftarrow S_1$ | Private statics \leftarrow c_bodies \leftarrow ns

\leftarrow c_bodies $\leftarrow S_1$ | Protected statics \leftarrow c_bodies \leftarrow ns

\leftarrow c_bodies $\leftarrow S_1$ | static \leftarrow c_bodies \leftarrow ns \leftarrow c_body $\leftarrow S_1$

| c_bodies \leftarrow ns, c_bodies $\leftarrow S_1$

| abstract / sealed / E / !ns !ns

$S_1 \rightarrow$ Public $\leftarrow S_2 \leftarrow S_1$ | Private statics \leftarrow c_bodies \leftarrow ns

\leftarrow c_bodies $\leftarrow S_1$ | Protected statics \leftarrow c_bodies \leftarrow ns

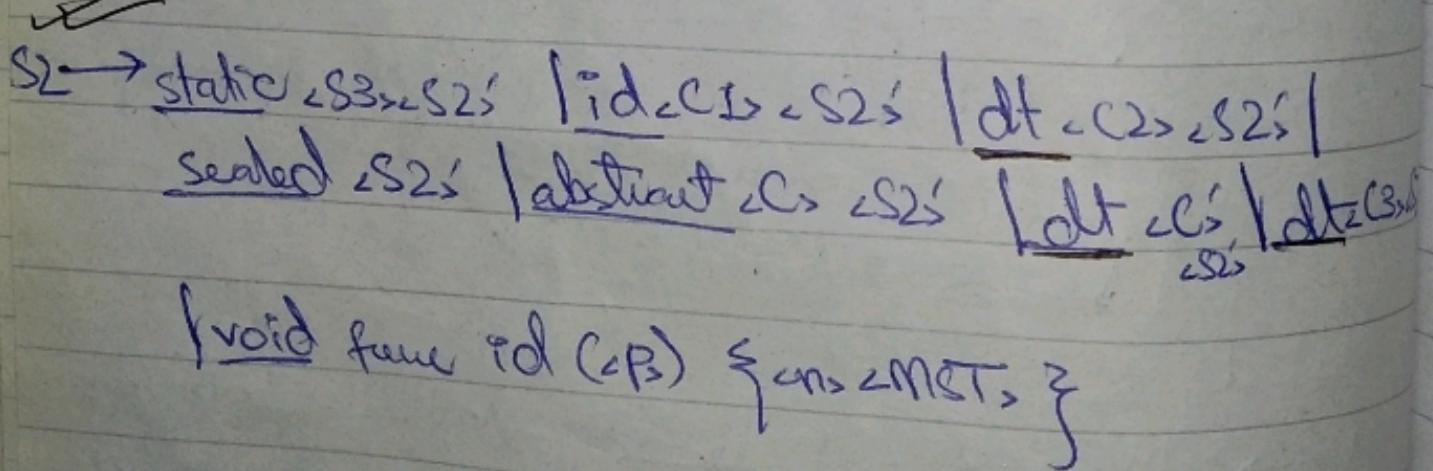
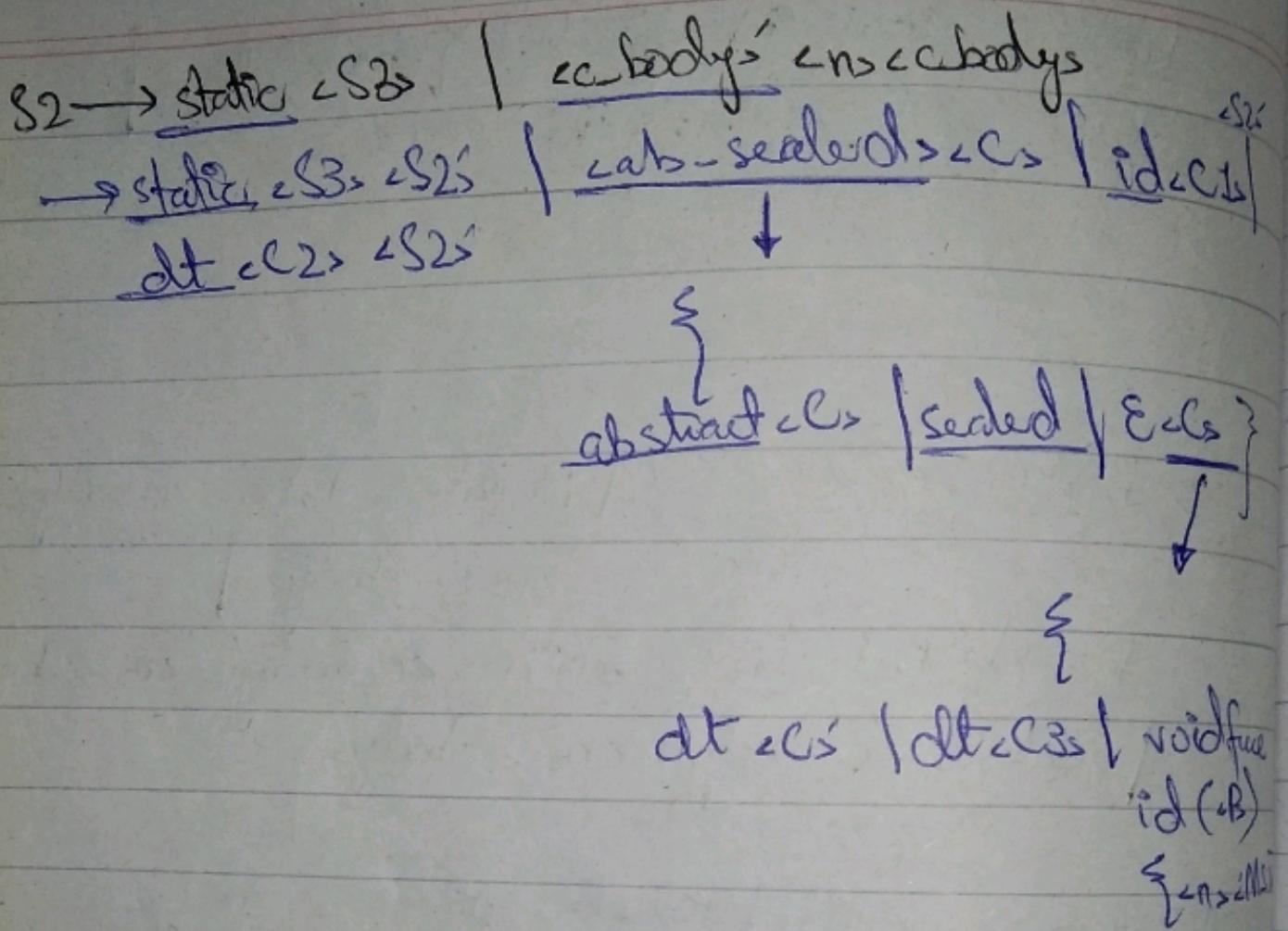
\leftarrow c_bodies $\leftarrow S_1$ | static \leftarrow c_body \leftarrow ns \leftarrow c_body

$\leftarrow S_1$ | abstract \leftarrow ns \leftarrow c_body $\leftarrow S_1$ | sealed \leftarrow ns

\leftarrow c_bodies $\leftarrow S_1$ | !ns !ns \leftarrow c_bodies $\leftarrow S_1$

$S_1 \rightarrow E$

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$S_2 \rightarrow E$

S3 → void < S4 > $\{ \text{dt} < C_5' \}_{S3'} \mid id < C_3 > \}_{S3}$
 abstract < S5 >
S3' → e

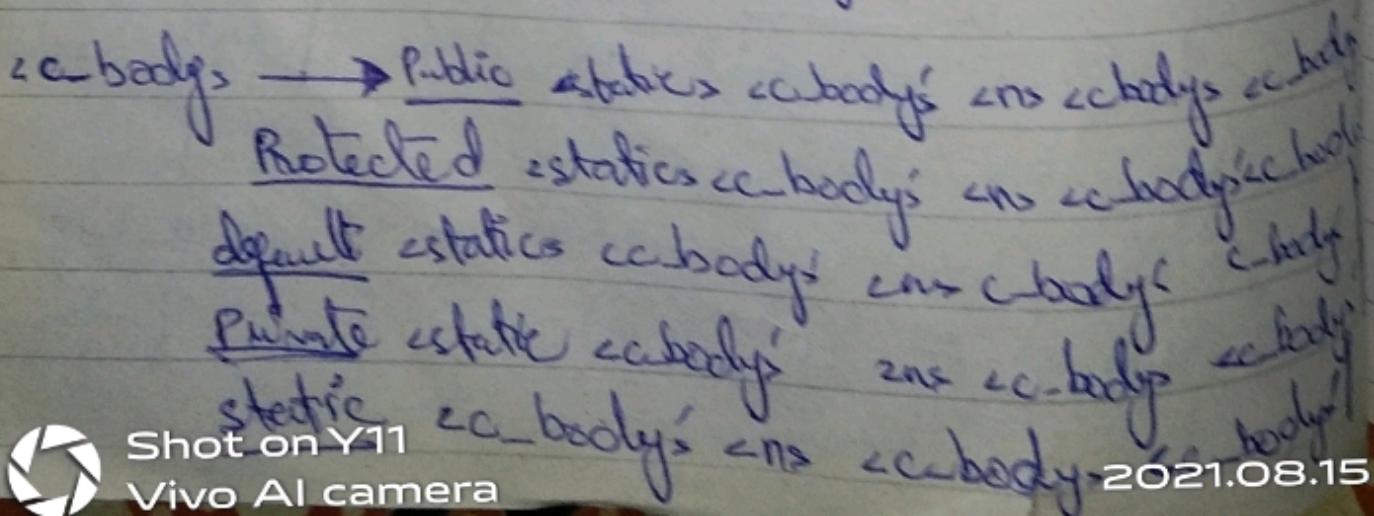
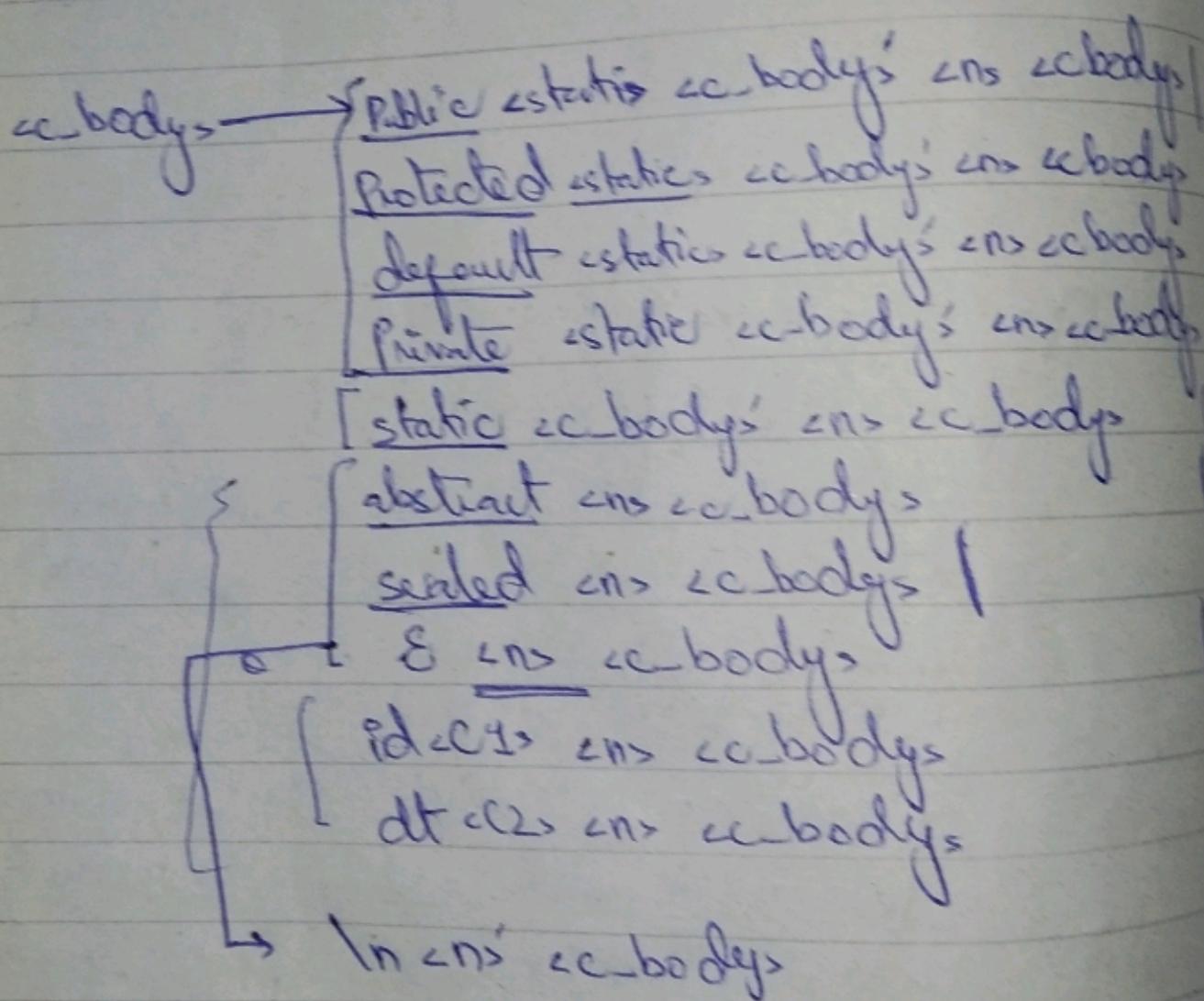
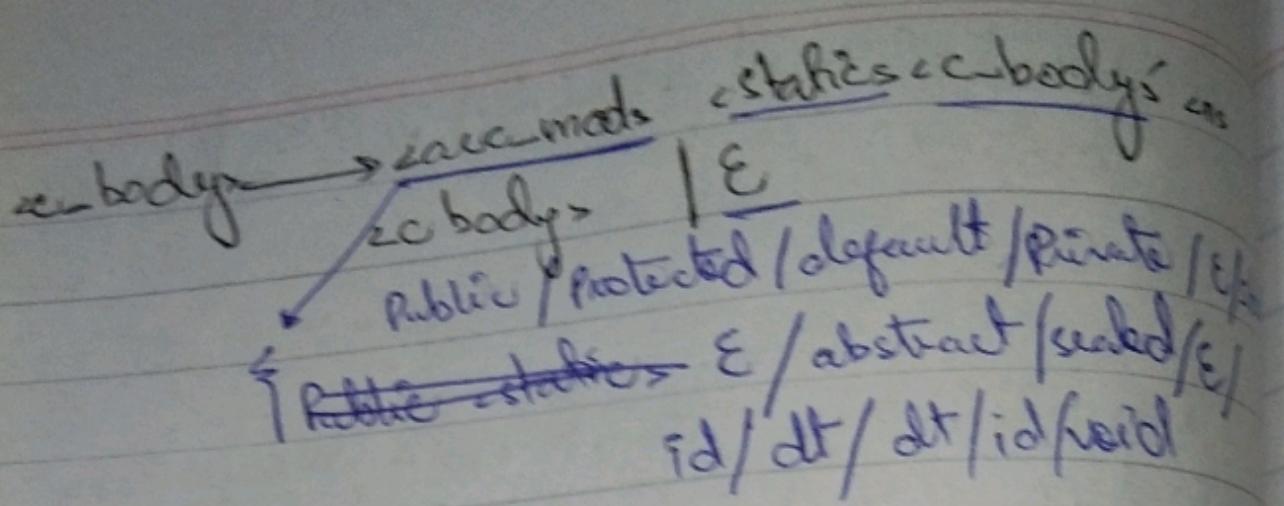
$S^4 \rightarrow \underline{main}() \{ \dots \} \in \text{cons} \times \text{MSB} \} \in \text{w-Body} \} \in \text{ns}$
 $\text{2defns } \langle S^4 \rangle \mid \underline{\text{fun}} \text{ id } (\text{cP}) \{ \dots \} \in \text{cons} \times \text{MSB} \} \in \langle S^4 \rangle$

~~✓~~ X

<class-def> → cab_sealed <static> class id \in int hs
 ↘
 {
 cns { cns cc-body }
 abstract / sealed /
 } abstract <static> class id \in int hs cns
 cc-body }
 sealed "
 <static> [static] {

 static class id \in int hs > cns { unscbody }
 class id \in int hs cns { cns cc-body }

 <class-def> → abstract <static> class id \in int hs cns
 { cns cc-body } <class-def> | sealed <static>
 class id \in int hs cns { cns cc-body } |
 static class id \in int hs cns { unscbody }
 <class-def> / class id \in int hs cns { cns
 <class-def> } <class-def>



$\text{abstract} \leftarrow \text{ns} \leftarrow \text{c_body} \leftarrow \text{cc_body}$
 $\text{sealed} \leftarrow \text{ns} \leftarrow \text{c_body} \leftarrow \text{cc_body}$
 $\backslash n \leftarrow \text{ns} \leftarrow \text{c_body} \leftarrow \text{cc_body}$ | $\text{id}_{\text{C1}} \leftarrow \text{ns} \leftarrow \text{c_body}$
 cc_body | $\underline{\text{dt}}$ $\leftarrow \text{C2} \leftarrow \text{ns} \leftarrow \text{c_body} \leftarrow \text{cc_body}$

$c_body \rightarrow \epsilon$

$c_body \rightarrow \underline{\text{abstract}} \leftarrow \text{C1}$ | $\underline{\text{id}}_{\text{C2}}$ | $\underline{\text{dt}}_{\text{C3}}$

{ $\text{abstract} \leftarrow \text{ns}$ | $\text{sealed} \leftarrow \text{ns}$ | $\epsilon \leftarrow \text{ns}$

{ $\underline{\text{dt}}_{\text{C4}}$ | $\underline{\text{dt}}_{\text{C5}}$ | $\underline{\text{void}}$
 $\text{fun } \text{id}(\text{P}) \leftarrow \text{ns}$ | MST }

~~$c_body \rightarrow \underline{\text{abstract}} \leftarrow \text{ns} \leftarrow \text{c_body} \leftarrow \text{cc_body}$~~

$c_body \rightarrow \epsilon$

$C \rightarrow \underline{\text{dt}}_{\text{C1}} \leftarrow \text{C2} \leftarrow \text{C3}$ | $\underline{\text{id}}_{\text{C4}} \leftarrow \text{C5}$ | $\underline{\text{void}} \text{ fun } \text{id}(\text{P})$
 $\left\{ \text{ns} \leftarrow \text{MST} \right\} \left\{ \text{C6} \right\}$

$C' \rightarrow \epsilon$

$C \rightarrow id \leftarrow \text{init} > \text{list},$ | types free id(α_P)
 $\left\{ \begin{array}{l} \text{cons} \\ \text{MST} \end{array} \right\}$ | $\left\{ \begin{array}{l} \vdash t_2 \\ \vdash \varepsilon \end{array} \right\}$

$C \rightarrow id \leftarrow \text{init} > \text{list} > C'' \left\{ \begin{array}{l} \vdash t_2 \text{ free id}(\alpha_P) \\ \left\{ \begin{array}{l} \text{cons} \\ \text{MST} \end{array} \right\} \quad C_3 \quad | \text{ free id}(\alpha_P) \end{array} \right\}_{C''}$
 $\left\{ \begin{array}{l} \text{MST} \end{array} \right\} \quad C''$

$C'' \rightarrow \varepsilon$

$C_1 \rightarrow \text{cons} \mid (\underline{\alpha_P}) \left\{ \begin{array}{l} \text{cons_body} \end{array} \right\} \mid$
 \downarrow
 $\left\{ \begin{array}{l} \text{id} = \text{new id} \wedge \\ \text{cons} \end{array} \right\}$

$C_1 \rightarrow \vdash \text{cons} \leftarrow C_1 \left(\underline{\alpha_P} \right) \left\{ \begin{array}{l} \text{cons_body} \end{array} \right\} C_1'$
 \downarrow
 $\left\{ \begin{array}{l} \text{id} = \text{new id} \wedge \\ C_1' \end{array} \right\}$

$C_1' \rightarrow \varepsilon$

$C_2 \rightarrow \text{cons}$

\downarrow
 $\rightarrow \vdash \text{cons} \leftarrow C_2'$

$C_2' \rightarrow \varepsilon$

$C_3 \rightarrow$ types func id ($\in P$) $\{ \in ns \in MST \}$
 |
 | $t_2 \in E$
 |
 | id \in units lists

$C_3 \rightarrow$ func func id ($\in P$) $\{ \in ns \in MST \}$ $C_3' |$
 |
 | func id ($\in P$) $\{ \in ns \in MST \}$ $C_3' |$ id \in units
 |
 | lists C_3'

$C_3' \rightarrow E$

inh \rightarrow id $| E$ units
 |
 | inh

inh \rightarrow ab-sealed \rightarrow abstract ab-seals | sealed ab-seals | ab-seals

ab-sealed \rightarrow E

static \rightarrow static statics $| E$ statics
statics \rightarrow E

X \rightarrow X

$\langle\text{struct_def}\rangle \rightarrow \frac{\text{street id} \rightsquigarrow \{ \text{ens} \text{ } \langle\text{sbody}\rangle \}}{\text{street_def}}$

$\langle\text{struct_def}\rangle \rightarrow \epsilon$

$\langle\text{sbody}\rangle \rightarrow \frac{\langle\text{ens} \text{ } \langle\text{sbody}\rangle \rangle}{[\text{Public} / \text{Private} / \epsilon]} \rightsquigarrow \{ \langle\text{struct_def}\rangle | \langle\text{static_sbody}\rangle \text{ } \langle\text{ens} \text{ } \langle\text{sbody}\rangle \rangle$

$\langle\text{sbody}\rangle \rightarrow \frac{\text{Public } \langle\text{sbody}\rangle \text{ } \langle\text{s_body}\rangle}{\langle\text{s_body}\rangle | \langle\text{struct_def}\rangle}$ $\frac{\text{Private } \langle\text{sbody}\rangle}{\langle\text{statics}\rangle \langle\text{sbody}\rangle}$

$\langle\text{struct_def}\rangle \rightarrow \frac{\{ \text{street id} \rightsquigarrow \langle\text{ens} \text{ } \langle\text{sbody}\rangle \}}{\langle\text{sbody}\rangle}$

$\langle\text{ens} \text{ } \langle\text{sbody}\rangle \rangle \rightarrow \frac{\langle\text{static}\rangle \langle\text{sbody}\rangle \text{ } \langle\text{ens} \text{ } \langle\text{sbody}\rangle \rangle}{\langle\text{static}\rangle \langle\text{sbody}\rangle \text{ } \langle\text{ens} \text{ } \langle\text{sbody}\rangle \rangle}$

$\langle\text{static}\rangle \langle\text{sbody}\rangle \text{ } \langle\text{ens} \text{ } \langle\text{sbody}\rangle \rangle \rightarrow \frac{\text{void fun id} (\langle\text{P}\rangle) \rightsquigarrow \{ \}}{\text{dt } \langle\text{sbs}\rangle | \langle\text{bs}\rangle}$

$\langle\text{sbody}\rangle \rightarrow \frac{\text{Public } \langle\text{sbody}\rangle \text{ } \langle\text{s_body}\rangle}{\langle\text{s_body}\rangle | \langle\text{static}\rangle \langle\text{sbody}\rangle}$ $\frac{\text{Private } \langle\text{sbody}\rangle}{\langle\text{statics}\rangle \langle\text{sbody}\rangle}$

$\langle\text{static}\rangle \langle\text{sbody}\rangle \rightarrow \frac{\text{street id} \rightsquigarrow \langle\text{ens} \text{ } \langle\text{sbody}\rangle \rangle}{\langle\text{sbody}\rangle}$

$\langle\text{ens} \text{ } \langle\text{sbody}\rangle \rangle \rightarrow \frac{\{ \text{cns} \text{ } \langle\text{MST}\rangle \}}{\langle\text{sbody}\rangle}$

$\langle\text{cns} \text{ } \langle\text{MST}\rangle \rangle \rightarrow \frac{\langle\text{id} \text{ } \langle\text{sby}\rangle \rangle \text{ } \langle\text{sbody}\rangle}{\langle\text{id} \text{ } \langle\text{sby}\rangle \rangle}$

$\langle\text{id} \text{ } \langle\text{sby}\rangle \rangle \rightarrow \frac{\langle\text{dt}\rangle \langle\text{sbs}\rangle}{\langle\text{dt}\rangle \langle\text{sbs}\rangle}$



* $s_body_1 \rightarrow \underbrace{stmt_def}_{\in s_body_1} \quad | \quad static \in s_body_1 \in s_1$

$\rightarrow \underbrace{stmt \ id \ \in \ \{ \text{fun} \} \in s_body_1}_{|} \quad | \quad \underbrace{\underbrace{static \ \in \ s_body_1 \in s_body_1}_{|} \quad | \quad \underbrace{\underbrace{\underbrace{void \ fun \ id \ (\epsilon_P) \ \in \ \{ \ \} \in MST}_{|} \quad | \quad \underbrace{\underbrace{s_body_1}_{|} \ dt \ \in \ s_1 \in s_body_1}_{|}}$

$s_body_1' \rightarrow \epsilon$

* $s_body' \rightarrow \underbrace{void \ fun \ id \ (\epsilon_P) \ \in \ \{ \ \} \in MST}_{|} \quad | \quad \underbrace{\underbrace{dt \ \in \ s_1 \in s_body_1}_{|} \ id \ \in \ s_1 \in s_body_1}_{|}$

$s_body'' \rightarrow \epsilon$

* $s_b \rightarrow \underbrace{types \ fun \ id \ (\epsilon_P) \ \in \ \{ \ \} \in MST}_{|} \quad |$

$\underbrace{[t_2] \ \in \ calls}_{|} \quad | \quad \underbrace{id \ \in \ units \ \in \ lists}_{|}$

\downarrow
 $[t_2]$

$\rightarrow \underbrace{[t_2] \ fun \ id \ (\epsilon_P) \ \in \ \{ \ \} \in MST}_{|} \quad | \quad \underbrace{s_b'}_{|}$

$\underbrace{fun \ id \ (\epsilon_P) \ \in \ \{ \ \} \in MST}_{|} \quad | \quad \underbrace{s_b'}_{|}$

$\underbrace{[t_2] \ \in \ calls}_{|} \quad | \quad \underbrace{id \ \in \ units \ \in \ \{ \ \} \in s_b'}_{|}$

$s_b' \rightarrow \epsilon$

* ~~s_b~~ ac \rightarrow Public calls | Private calls | E calls



Shot on Y11

Vivo AI camera

2021.08.15