

$ID(I, f) = ((w_{I11}, (n_{I11}, f)), (w_{I12}, (n_{I12}, f)), \dots (w_{I1m}, (n_{I1m}, f)))$
 $ID(S, f) = ((w_{SI1}, (n_{SI1}, f)), (w_{SI2}, (n_{SI1}, f)), \dots (w_{SIln}, (n_{SI1}, f)))$

f

$W^P = \text{prework}$	$W = \text{work}$
$M(I, f) = MI$	$M(S, f) = MS$
$e(W^P, f) = \text{prepeek}$	$e(W, f) = \text{peek}$
$o(W^P, f) = \text{popop}$	$o(W, f) = \text{pop}$
$u(W^P, f) = \text{prepush}$	$u(W, f) = \text{push}$
$C(f) = \text{copydown}$	

$OD(I, f) = ((w_{IO1}, d_{IO1}), (w_{IO2}, d_{IO2}), \dots (w_{IOlr}, d_{IOlr}))$
 $OD(S, f) = ((w_{SO1}, d_{SO1}), (w_{SO2}, d_{SO2}), \dots (w_{SOs}, d_{SOs}))$

Shorthand Variables:

$\text{dup} = \text{peek} - \text{pop}$

$\text{newpop} = MS / P \times \text{pop} + \text{dup}$

$\text{newpush} = MS / P \times \text{push}$

Fiss f by P



$ID(I, f) = ((w_{I11}, (n_{I11}, ID_I)), (w_{I12}, (n_{I12}, ID_I)), \dots (w_{I1m}, (n_{I1m}, ID_I)))$
 $ID(S, f) = ((w_{SI1}, (n_{SI1}, ID_I)), (w_{SI2}, (n_{SI1}, ID_I)), \dots (w_{SIln}, (n_{SI1}, ID_I)))$

ID_I

$OD(I) = ((1, ((ID_I, F_1)))$
 $OD(S) = ((\text{newpop} - C(f) - \text{dup}, ((ID_I, F_1))), (\text{dup}, ((ID_I, F_1), (ID_I, F_2))),$
 $(\text{newpop} - 2 \times \text{dup}, ((ID_I, F_2))), (\text{dup}, ((ID_I, F_2), (ID_I, F_3))),$
 $\dots,$
 $(\text{newpop} - 2 \times \text{dup}, ((ID_I, F_{p-1}))), (\text{dup}, ((ID_I, F_{p-1}), (ID_I, F_p))),$
 $(\text{newpop} - 2 \times \text{dup}, ((ID_I, F_p))), (\text{dup}, ((ID_I, F_p), (ID_I, F_1))),$
 $(C(f) - \text{dup}, ((ID_I, F_1)))$

$ID(I) = ((1, (ID_I, F_1)))$
 $ID(S) = ((1, (ID_I, F_1)))$

f_1

$M(I) = MI$
 $M(S) = MS / P$
 $e(W^P) = \max(\text{prepeek},$
 $\quad \text{prepop} + (MI - 1) \times \text{pop} + \text{dup})$
 $o(W^P) = \text{prepop} + (MI \times \text{pop})$
 $u(W^P) = \text{prepush} + (MI \times \text{push})$
 $e(W) = \text{newpop}$
 $o(W) = \text{newpop}$
 $u(W) = \text{newpush}$
 $C = C(f)$
 $W =$
 $\quad \text{for } (M(S, f) / P) \text{ work}$
 $\quad \text{for } (\text{dup}) \text{ pop}()$
 $W^P =$
 $\quad \text{prework}$
 $\quad \text{for } (MI - 1) \text{ work}$

$OD(I) = ((1, (F_1, ID_O)))$
 $OD(S) = ((1, (F_1, ID_O)))$

$ID(I) = (), ID(S) = ((1, (ID_I, F_2)))$

f_2

$M(I) = 0$
 $M(S) = MS / P$
 $e(W^P) = 0$
 $o(W^P) = 0$
 $u(W^P) = 0$
 $e(W) = \text{newpop}$
 $o(W) = \text{newpop}$
 $u(W) = \text{newpush}$
 $C = 0$
 $W =$
 $\quad \text{for } (M(S, f) / P) \text{ work}$
 $\quad \text{for } (\text{dup}) \text{ pop}()$
 $W^P = \emptyset$

$OD(I) = (), OD(S) = ((1, (F_2, ID_O)))$

...

$ID(I) = (), ID(S) = ((1, (ID_I, F_p)))$

f_P

$M(I) = 0$
 $M(S) = MS / P$
 $e(W^P) = 0$
 $o(W^P) = 0$
 $u(W^P) = 0$
 $e(W) = \text{newpop}$
 $o(W) = \text{newpop}$
 $u(W) = \text{newpush}$
 $C = 0$
 $W =$
 $\quad \text{for } (M(S, f) / P) \text{ work}$
 $\quad \text{for } (\text{dup}) \text{ pop}()$
 $W^P = \emptyset$

$OD(I) = (), OD(S) = ((1, (F_p, ID_O)))$

$ID(I) = ((1, (F_1, ID_O)))$
 $ID(S) = ((\text{newpush}, (F_1, ID_O), (\text{newpush}, (F_2, ID_O), \dots, (\text{newpush}, (F_p, ID_O)))$

ID_O

$OD(I, f) = ((w_{IO1}, d_{IO1}), (w_{IO2}, d_{IO2}), \dots (w_{IOlr}, d_{IOlr}))$ where ID_O replaces f in edges of d_{IOi}
 $OD(S, f) = ((w_{SO1}, d_{SO1}), (w_{SO2}, d_{SO2}), \dots (w_{SOs}, d_{SOs}))$ where ID_O replaces f in edges of d_{SOi}