

mini-language
 code for machine (algorithm)
 code for mathematics (ZFL)
 code for human-being (Dijkstra)

Formal language Theory
 syntax
 semantic

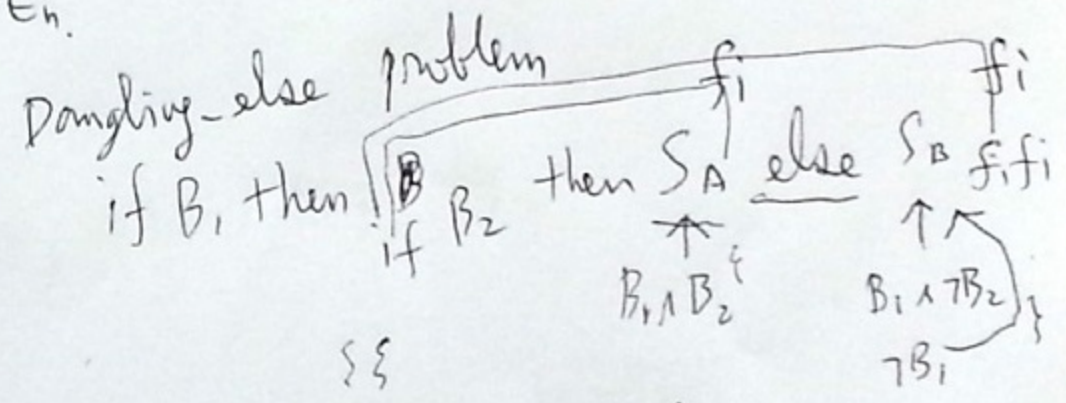
concurrent statement
 [GOTO statement considered harmful E. Dijkstra
 Assignment " " " " " " ZFL]

$$x_1, x_2, \dots, x_n := E_1, E_2, \dots, E_n$$

IF (alternative) statement
 if $x \geq y \rightarrow m := x$
 or $y \geq x \rightarrow m := y$

good!

VS
 if $(x > y)$ then $m := x$ else $m := y$ — bad!
 if $(x >= y)$ " " " " " "



guard
 ↑
 guarded statement (command)

if $B_1 \rightarrow SL_1$
 or $B_2 \rightarrow SL_2$
 ⋮
 or $B_n \rightarrow SL_n$

$$\exists i, j \text{ s.t. } 1 \leq i < j \leq n$$

$$B_i \wedge B_j$$

$$\rightarrow SL_i \vee SL_j$$

~~(or $B_{n+1} \rightarrow SL_{n+1}$)~~
 fi

$$\text{if } 1 \leq i \leq n: \neg B_i \triangleq \neg BB$$

$$BB = \bigwedge_{1 \leq i \leq n} B_i$$

{ SL₁ }
 if B_1 then
 else if B_2 then { SL₂ }
 else if B_3 then { SL₃ }
 ⋮
 else if B_n then { SL_n }
 else { SL_{n+1} }

if $fi \equiv$ 'abort'

Repetative statement
(while)

$g_1, g_2, g_3, g_4 := Q_1, Q_2, Q_3, Q_4;$
do $g_1 > g_2 \rightarrow g_1, g_2 := g_2, g_1$
 \square $g_2 > g_3 \rightarrow g_2, g_3 := g_3, g_2$
 \square $g_3 > g_4 \rightarrow g_3, g_4 := g_4, g_3$
od

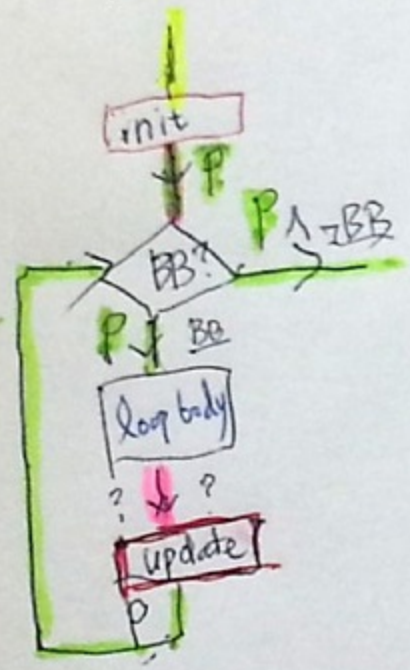
① Nondeterminancy.

② Terminates?
loop if $f_i \equiv \text{abort}$
do od $\equiv \text{skip}$.

③ Loop invariance

$\neg BB$

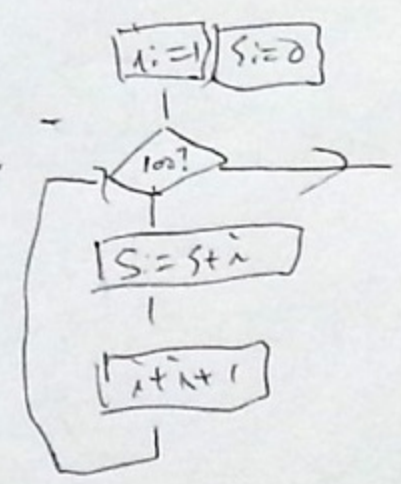
P



for (init; test; update) loop-body

in C

$s := 0$
for $i = 1$ to 100 do loop-body.



$x, y := X, Y;$

do $x > y \rightarrow x := x - y$
 \square $y > x \rightarrow y := y - x$
od

0, 1, 2, 3
} 2, 1, 0
3, 9, 1, 9 \rightarrow 1399
5, 100, 2821, 4899
2821, 4899, 1, 100

$g_1 \leq g_2 \leq g_3 \leq g_4$

Terminating ~~at~~ numeric f_n
positive

which is monotonically decreasing

