Precise Shape Analysis using Field Sensitivity

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1 Termination Criteria

The termination of computation of boolean functions for Cycle and Dag can be proved using the associativity and distributivity of the bollean operators ($\vee$ and $\wedge$). Consider Fig. 1(a) which shows a basic block b with its in and out sets, IN(b) and OUT(b) respectively. The boolean formulas Ψ and γ respectively denote the gen and kill sets corresponding to basic bloack b. Let f denotes the boolean formula at a program poin before executing b. Figure 1(b) shows the in and out sets generated in each iteration of the data flow analysis. As depicted in Fig. 1(b), the boolean functions reeached fixed-point after the second iteration.
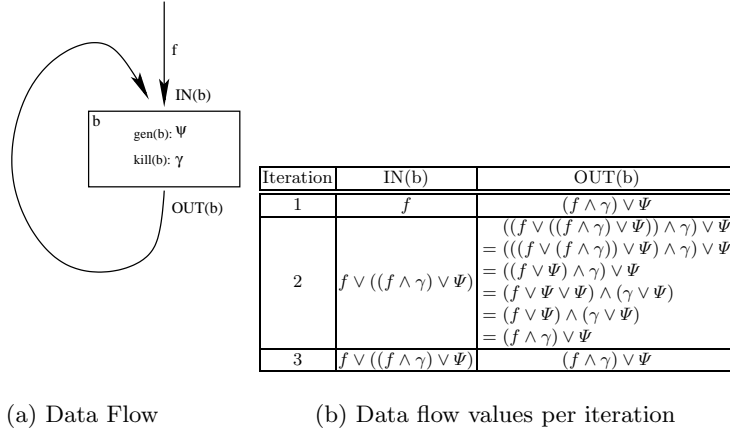

Iteration	IN(b)	OUT(b)
1	f	$(f \wedge \gamma) \vee \Psi$
2	$f \vee ((f \wedge \gamma) \vee \Psi)$	$((f \vee ((f \wedge \gamma) \vee \Psi)) \wedge \gamma) \vee \Psi$ $= (((f \vee (f \wedge \gamma)) \vee \Psi) \wedge \gamma) \vee \Psi$ $= ((f \vee \Psi) \wedge \gamma) \vee \Psi$ $= (f \vee \Psi \vee \Psi) \wedge (\gamma \vee \Psi)$ $= (f \vee \Psi) \wedge (\gamma \vee \Psi)$ $= (f \wedge \gamma) \vee \Psi$
3	$f \vee ((f \wedge \gamma) \vee \Psi)$	$(f \wedge \gamma) \vee \Psi$

(a) Data Flow   (b) Data flow values per iteration

Fig. 1. The termination of computation of boolean functions