

## Question 1

### Framework for Strong Liveness Analysis

#### Direction of the analysis

Backward

#### Lattice and Meet

Lattice for two variables:

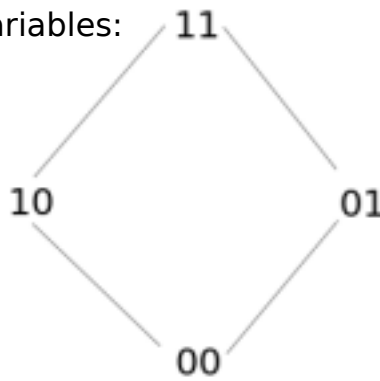


Figure 1: lattice

Meet operation for this frame work will be similar as live variables( $\cup$ )  
Note: In strong liveness analysis lattice is non-seperable.

#### Gen and Kill Computation:

- $\text{if}(e)$  or  $\text{print}(e)$ 
  - $\text{Gen} = \{v \mid v \in \text{operand}(e)\}$ ,  $e$  is an expression.
  - $\text{Kill} = \phi$
- $y = e$ 
  - $\text{Gen} = \text{if } y \in \text{Out}(S)$   
then  $\{v \mid v \in \text{operand}(e)\}$   
else  $\phi$ , where  $e$  is an expression
  - $\text{Kill} = \text{if } y \in \text{operand}(e)$   
then  $\phi$   
else  $y$

## Question 2

No, the result of strong liveness analysis is not similar as iterative liveness analysis. Figure 2 represents a counter example. Live variable analysis will mark  $x$  as live at  $\text{Out}(\text{Stmt})$  and hence no dead code elimination where as Strong liveness analysis will mark  $x$  as dead variable at  $\text{Out}(\text{Stmt})$  and statement will be eliminated during dead code elimination.

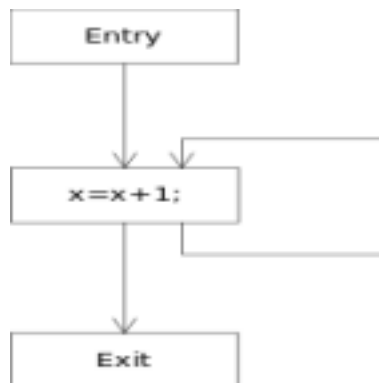


Figure 2: Counter Example