



## CD(UNIT -5) - Compiler design in jntuh helps in semester exams with neat explanation

Compiler Design (Jawaharlal Nehru Technological University, Hyderabad)



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## Unit-5

### Principal source of optimization

Refer to Unit-4

- optimization of Basic Block
  - peephole optimization
- } only contents i.e. inside topics

### Data flow Analysis :-

\* It is the analysis of flow of data in the control flow graph.

\* The analysis that determines the information regarding the definition and use of data in the program.

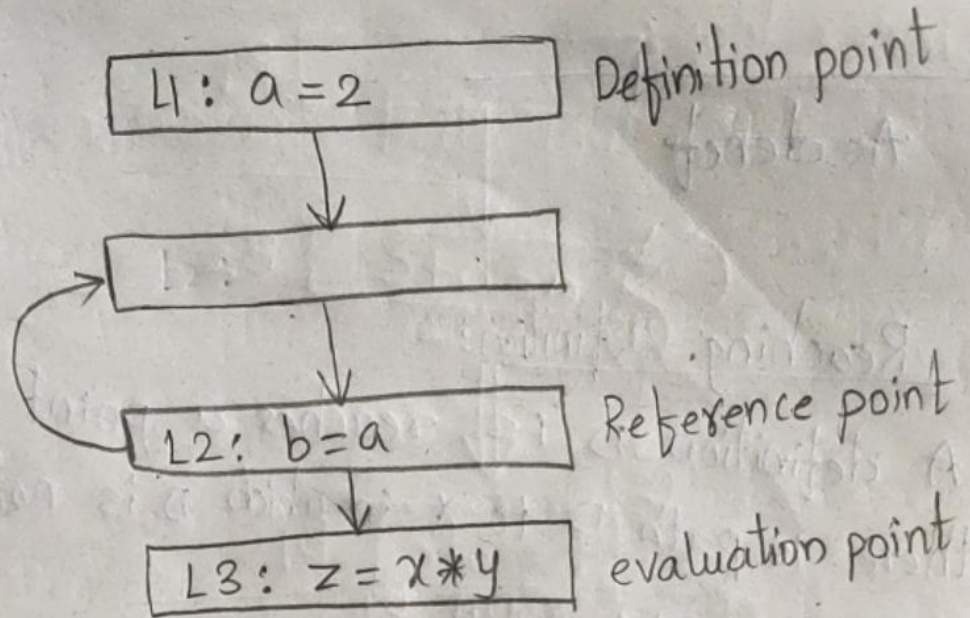
\* with the help of this analysis optimization can be done.

### Basic technologies :-

→ Definition point :- A point in a program containing some definition

→ Reference point :- A point in a program containing a reference to a data item

→ Evaluation point :- A point in a program containing evaluation of expression.

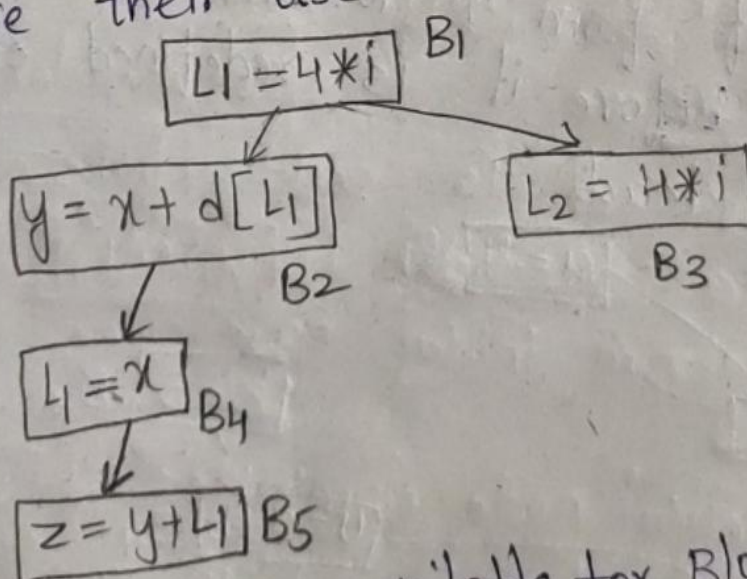


### Data flow properties:-

\* ~~An expr~~ Available expression

\* An expression is said to be available at a program point  $x$  if along path it is reaching to  $x$ .

\* An expression  $a+b$  is said to be available if none of the operands gets modified before their use.

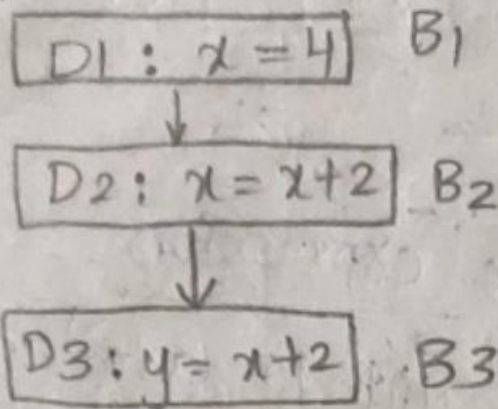


- \* Expression  $4*i$  is available for Block  $B_2, B_3$
- \* But at Block  $B_4$  it gets modified
- \* At Block  $B_5$  it is unavailable.

## Reaching Definition:-

A definition  $D$  reaches a point  $x$  if there is path  $D$  to  $x$  in which  $D$  is not killed

ex:-

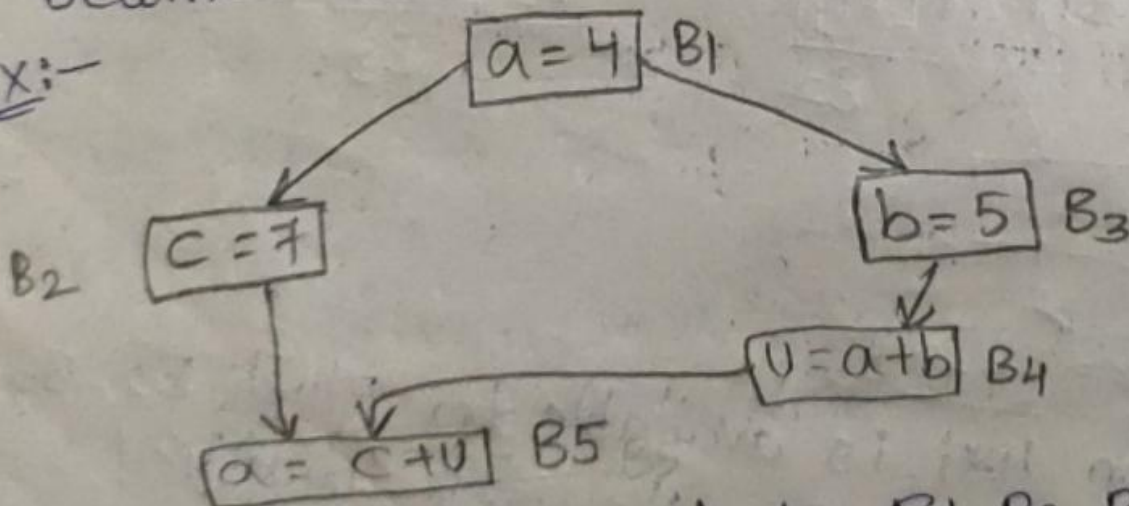


$D1$  is reaching definition for  $B_2$  but not for  $B_3$  (As  $x$  is modified / killed at  $D2$ )

## Live Variable:-

\* A variable is said to be live at some point  $p$  if from  $p$  to end of the variable is used before it is redefined else it becomes dead.

ex:-



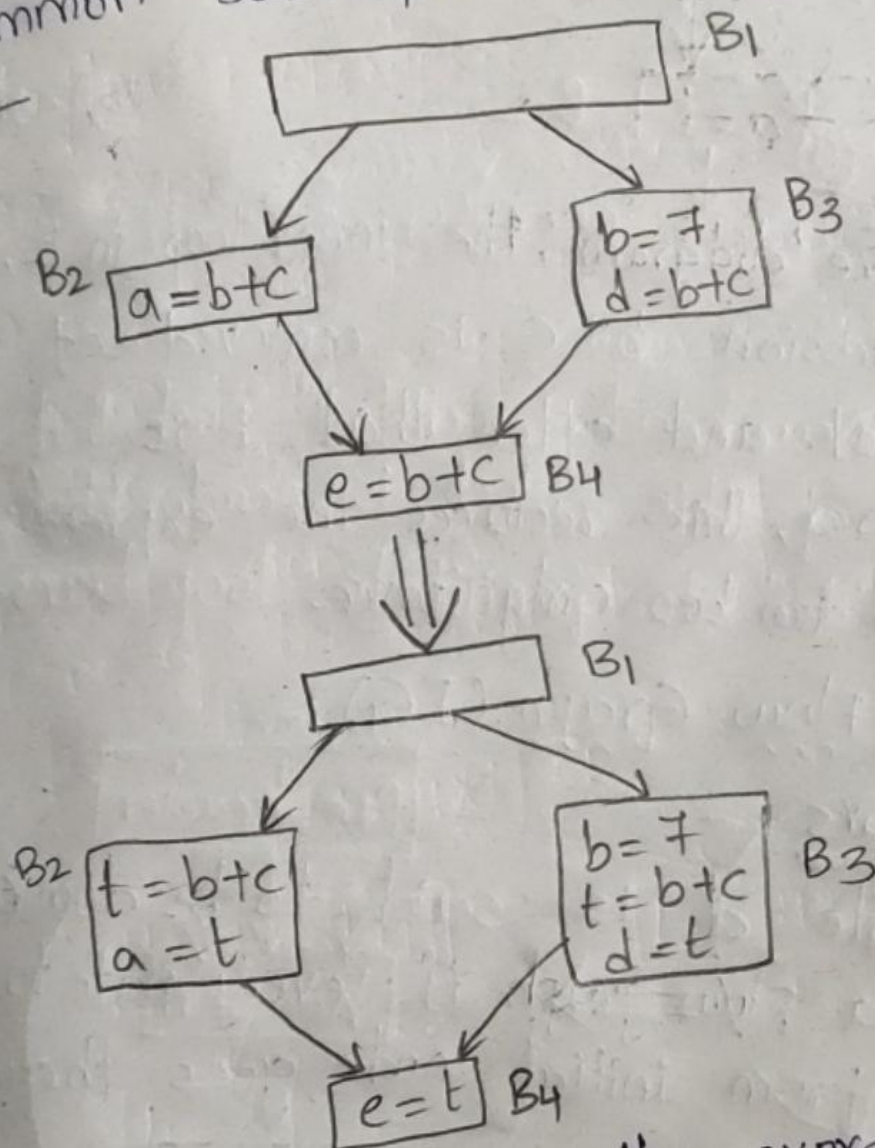
Here  $a$  is live at Block  $B_1, B_2, B_3, B_4$

but killed at

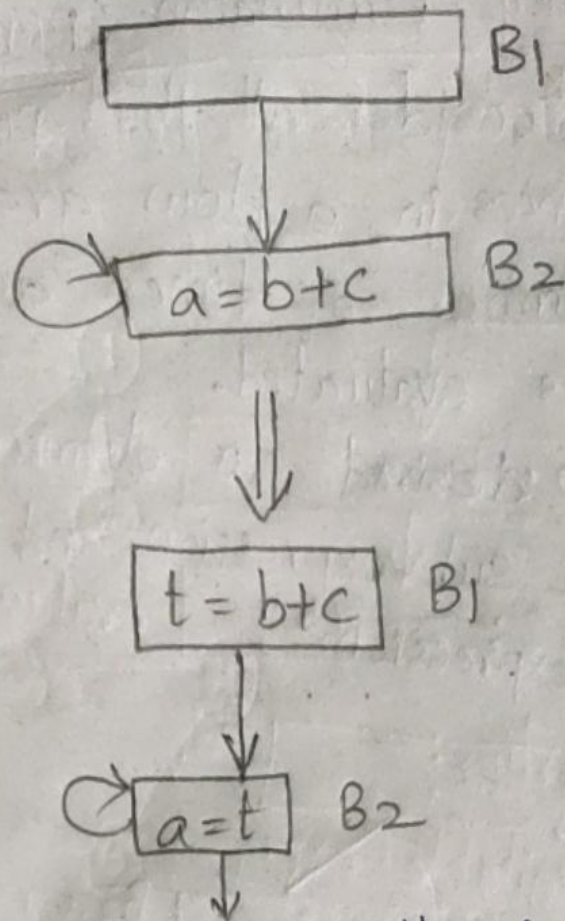
## Partial Redundancy Elimination (PRE):-

- \* In PRE, we consider all the possible execution sequences in a flow graph, and look at the number of times an expression such as  $x, y$  is evaluated.
- \* PRE can be desired to eliminate both global common sub expression and local common sub expression.

ex:-



In the above diagram, the expression  $b + c$  computed in block  $B_4$  is redundant, So in block  $B_2$  and  $B_3$ ,  $t = b + c$  is added and in block  $B_4$ ,  $t$  is assigned to  $e = t$ .



In the above diagram, the inner loop in B2, the expression  $b+c$  is removed and placed in B1 and after that  $t$  is assigned to  $a$ , this reduces the expression evaluated to be only once.

Loops in Flow Graph (FG) :-

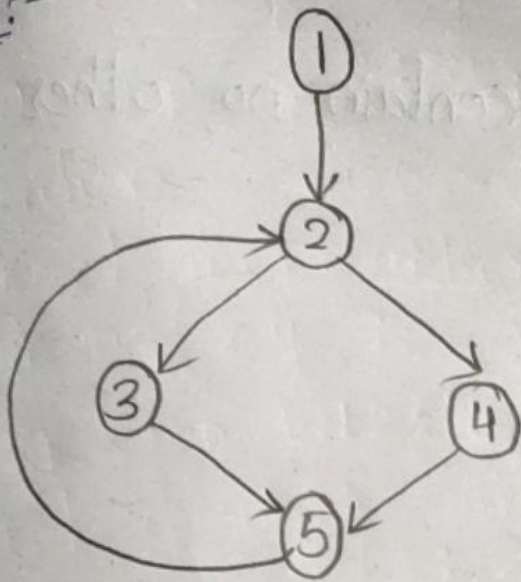
1) Dominators :-

A node  $d$  is said to be dominant node in a Flow graph if every path to node  $n$  from initial node goes through  $d$  only.

\* Every initial node dominates all the remaining nodes in a Flow Graph.

\* Every node dominates itself.

ex:-

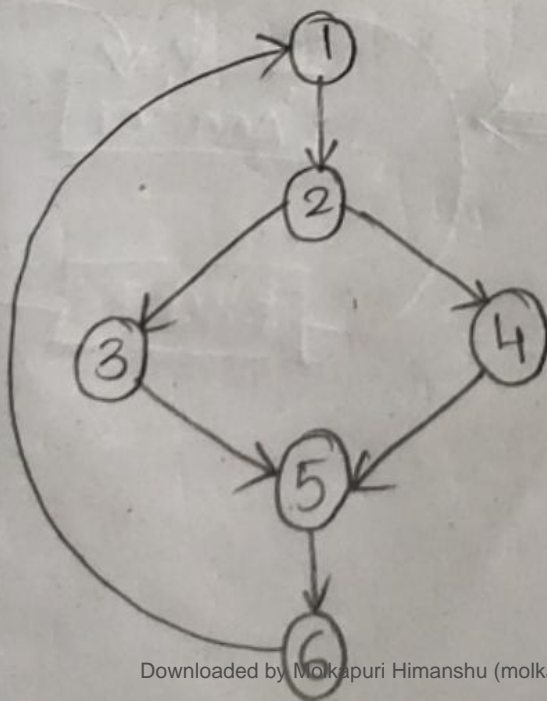


Node	1	dominates	2, 3, 4 and 5
Node	2	dominates	3, 4, 5
Node	3	dominates	only itself
Node	4	dominates	only itself
Node	5	dominates	only itself.

## 2) Natural Loop:-

A Natural loop can be defined by a back edge  $n \rightarrow d$  such that there exists a collection of all the nodes that can reach to  $n$  without going through  $d$ .

ex:-



Natural loop:-

$6 \rightarrow 1$

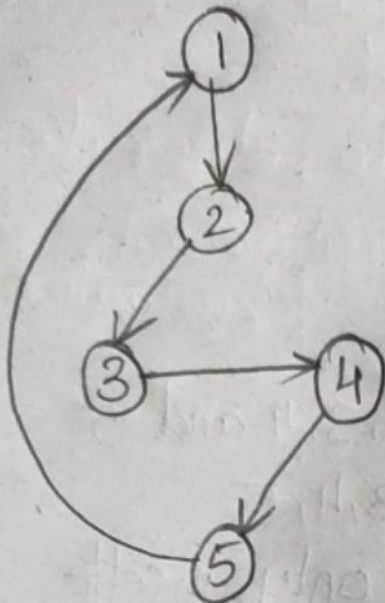
$n \rightarrow d$

$\{2, 3, 4, 5, 6, 1\}$

## Inner loop:-

It is a loop that contain no other loop.

ex:-



Here 2 to 4 is inner loop {2,3,4}

## Pre header:-

It is a new header related such that successor of this block is header block.

\* It is added to facilitate loop transformations.

