

LOCAL OPTIMIZATIONS

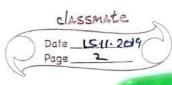
| | LOCAL OPTIMIZATION |
|--------|--|
| | oworks on single basic black |
| | & TIBERTHANKS |
| | REGIONAL TECHNIQUES |
| | · consider multiple blocks, but less than whole procedure |
| | · single loop, loop nest, dominator region |
| | INTRAPROCEDURAL OR GLOBAL TECHNIQUES |
| | · Operate on entire procedure |
| | · common unit of compilation |
| | INTERPROCEDURAL OR WHOLE PROGRAM TECHNIQUES |
| | o operate on >1 procedure, upto whole program |
| | · logistical issues related to accessing the coole Clink time? |
| | LINK TIME OPTIMIZATIONS |
| APTIA | MZATION |
| Of III | |
| | LOCAL TECHNIQUES |

· dependence graph (instruction schooluling)

· control-blow graph (natural loops)

REGIONAL TECHNIQUES

· dominator tree



| = | INTRAPROCEPORAL OR GLOBAL TECHNIQUES |
|---|---|
| | · control flow graph |
| | · def-use chains, sparse evaluation graphs, SSA as graph. |
| | INTERPROCEDURAL OR WHOLE PROGRAM TECHNIQUES |
| | · call (multi) graph |
| | |
| | ANALYSIS: |
| | reasons about the code's behaviour |
| | TRANSFORMATION: |
| | rewrites the code to change its behaviour |
| | |
| | VALUE NUMBERING |
| | a2 or b0 + c' map: var -> value n. |
| | b" ← a2 - d3 map: valuen. → var |
| | · |
| | $c^5 \leftarrow b^4 + c^4$ $d^4 \leftarrow a^2 - d^2$ $4^2 - 3^4 \rightarrow 4$ |
| | $d^{4} \leftarrow q^{2} - d^{2} \qquad \qquad$ |
| | (4) -, 0 |
| | $"au" \rightarrow (2)$ |
| | 014 - 7(7) |

→ ''a"

CSE VALUE N. ORIGINAL a3 = x' + y2 $a^3 = x' + y^2$ a = x + y b3 = x1 + y2 b3 = x1 + g2 6 = x + y a" = 17 a4 = 1714 a = 17 C3 = P3 c3 = x' + y2 C = x+g var -> vn? vn -> var exp -> vn

(q) → q. (3) → c

a = x + y $a^3 = x' + y^2$ a = 17 $a^4 = 17^4$

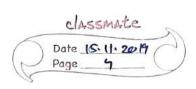
VALUE NUMBERING

 $c = x + y, \qquad c^3 = x' + y^2$ issue: Olthornh C- when is read-order to the China

issue: although C= x+y is redundant, its value. (VN-3)
is not available in any variable.

possible solution:

(introduce temporary variables.) $a^3 = x' + y^2$ $t^3 = a^3$ $a^4 = 17^7$ $c^3 = t^3$



SINGLE STATIC ASSIGNMENT FORM (SSA)

$$a = 17$$
 $a_1 = 17$
 $c = x + y$ $c_0 = x + y$

how to reconcile with the rest of the namespace in other BBs?

$$a_1 = 17$$
 $c_2 = c_0$
 $c_3 = \chi + \gamma$

ORIGINAL CODE SSA FORM SSA WITH VN

$$a = x + y$$
 $a_0 = x + y$ $a_0^3 = x' + y^2$

$$Q = 17$$
 $Q_1 = 17$ $Q_1^9 = 17^9$

OPTIMIZED CODE

| | nº 2x nxn-1 classmate |
|-------------------|--|
| | duv) = duv + vdv |
| · · | SSA FORM day + 2.dx |
| Contract Contract | SSA FORM day, x + x.dx |
| | a program is in SSA form when it meets two |
| | constraints: |
| | - each definition has a distinct name |
| | - each use refers to a single definition |
| | |
| | TRAINSLATING TO SSA FORM |
| | how to translate IR into SSA form? |
| - | - easy for straight line sequence code |
| | - each assignment to variable is given unique are |
| | - all of the uses reached by theat assignment renamed, |
| | 1: a = x + y 1: a, = x + y |
| - | 2: a = a + 3 2: a2 = a1 + 3 |
| - | 3: b = x + y 3: b, = 20 + yo |
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