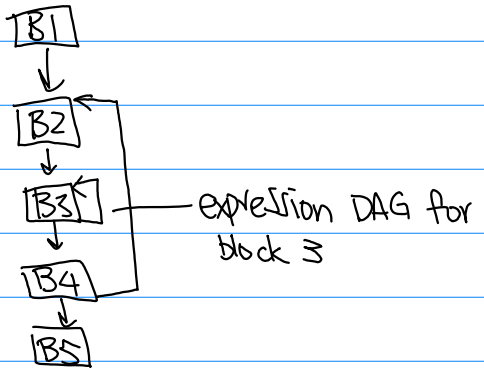
value numbering:

common subexpression, elimination

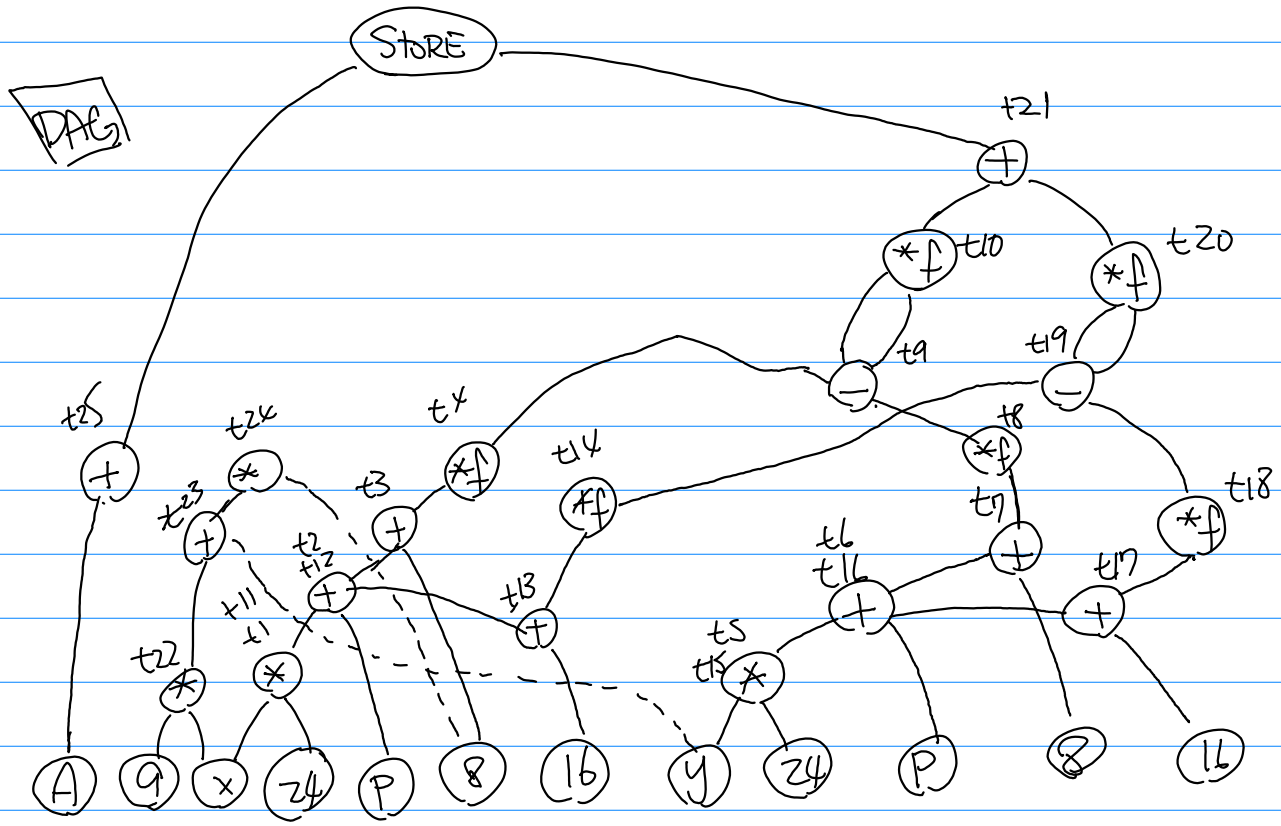
loop optimization:



expression DAG for block 3

x=0

y=0



definitions of all variables

t1 = x + 24

loop invariant → t2 = t1; *p

⋮

t3 = t2 + 8

t4 = x + t3 (f) ← loads and thus not invariant

t5 = y * 24

↑ not invariant, but an index for a loop

t10 = t9 * t8

t13 = t2 + 16

t14 = *t13 (f)

t17 = t6 + t16

t18 = *t17 (f)

⋮

loop optimizations:

↳ reaching definitions (reachable)

code motion for loop invariants (move loop preloader)

those in the code that can be defined

defined internally ↓

[B1, 1, x] [A] [B4, 1, x] local (externally to the y loop) (does not change as y changes)

[B2, 1 y]

[B3, 1, t1]

[B3, 2, t2]

t14 is not loop invariant

loop invariant ↓

instruction [t53 = opA * opB]

[y=0]

↓

t1, t2, t3, t13 : [B3'] ← loop preheader

↓

[B3]

All outside of loop predecessor of B3 now predecessor of B3'.

loop induction variables

- have one offsetting assignment in loop.

$y = y + 1$

$z = z + 2$ $\quad z_0 + 2 * \#$ of loop iterations

$\downarrow$

$z_0 + 2 * (y - y_0)$

$z_0 + 2y - 2y_0$

$\underbrace{(z_0 - 2y_0)}_{z'} + 2y$ $\quad \| \; y = z_0 + z_0'$, $z = z_0' + y'$

[t5 = t5 + 24]

strength reduction

never used

[t6 = t6 + 24] if initialized properly

then t5 instruction will be removed as it is not used.

[t7 = t7 + 24]

[t17 = t17 + 24]