

Massachusetts Institute of Technology  
Department of Electrical Engineering and Computer Science

6.035, Fall 2006

Practice Quiz 2

Saturday, November 04

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1. For the basic block:

```
q = 3
r = 10
s = q + r
t = 2*r+s
t = q
u = q + r
v = q + t
w = 3 + x
```

State for each of the basic blocks on the following page which optimization was performed on the above:

- Constant Propagation/Folding
- Copy Propagation
- Common Subexpression Elimination
- Dead Code Elimination.

Name: \_\_\_\_\_

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(a)  $q = 3$   
 $r = 10$   
 $s = q + r$   
 $t1 = s$   
 $t = 2*r+s$   
 $t = q$   
 $u = t1$   
 $v = q + t$   
 $w = 3 + x$

(b)  $q = 3$   
 $r = 10$   
 $s = q + r$   
 $t = 2*r+s$   
 $t = q$   
 $u = q + r$   
 $v = q + q$   
 $w = 3 + x$

(c)  $q = 3$   
 $r = 10$   
 $s = 13$   
 $t = 33$   
 $t = 3$   
 $u = 13$   
 $v = 36$   
 $w = 3 + x$

(d)  $q = 3$   
 $r = 10$   
 $s = q + r$   
 $t = q$   
 $u = q + r$   
 $v = q + t$   
 $w = 3 + x$

Name: \_\_\_\_\_

2. In class we discussed *available expression* dataflow analysis. Recall that an expression  $e$  is available at point  $p$  if:

- Every path from the initial node to  $p$  evaluates  $e$  before reaching  $p$ , and
- There are no assignments to any operand of  $e$  after evaluation but before  $p$ .

In the table below, fill in the final values of **IN** obtained after performing available expression analysis on the CFG of Figure 1 (next page). A '1' should indicate the expression is available on entry to the block.

	a + b	c * d	e / f
B1	0	0	0
B2			
B3			
B4			
B5			
B6			
B7			

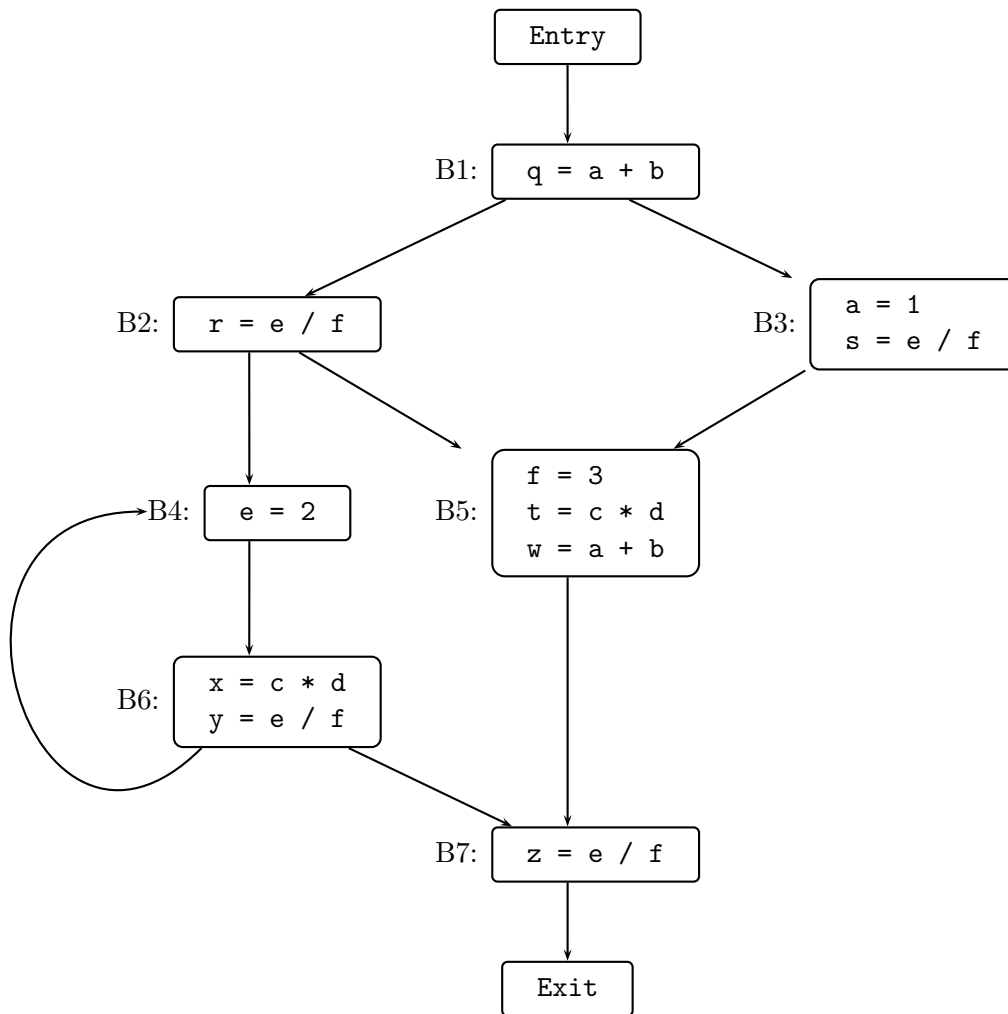


Figure 1: CFG for problem 2.

Name: \_\_\_\_\_

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3. Recall from lecture that a variable  $v$  is live at point  $p$  if:

- $v$  is used along some path starting at  $p$ , and
- There is no definition of  $v$  along  $p$  before its use.

In the table below, fill in the final values of **OUT** obtained after performing liveness analysis on the CFG of Figure 2 (next page). A '1' should indicate the variable is live on exit from the block. Assume all variables are visible outside the procedure.

	a	b	c
B1			
B2			
B3			
B4			
B5			
B6			
B7	1	1	1

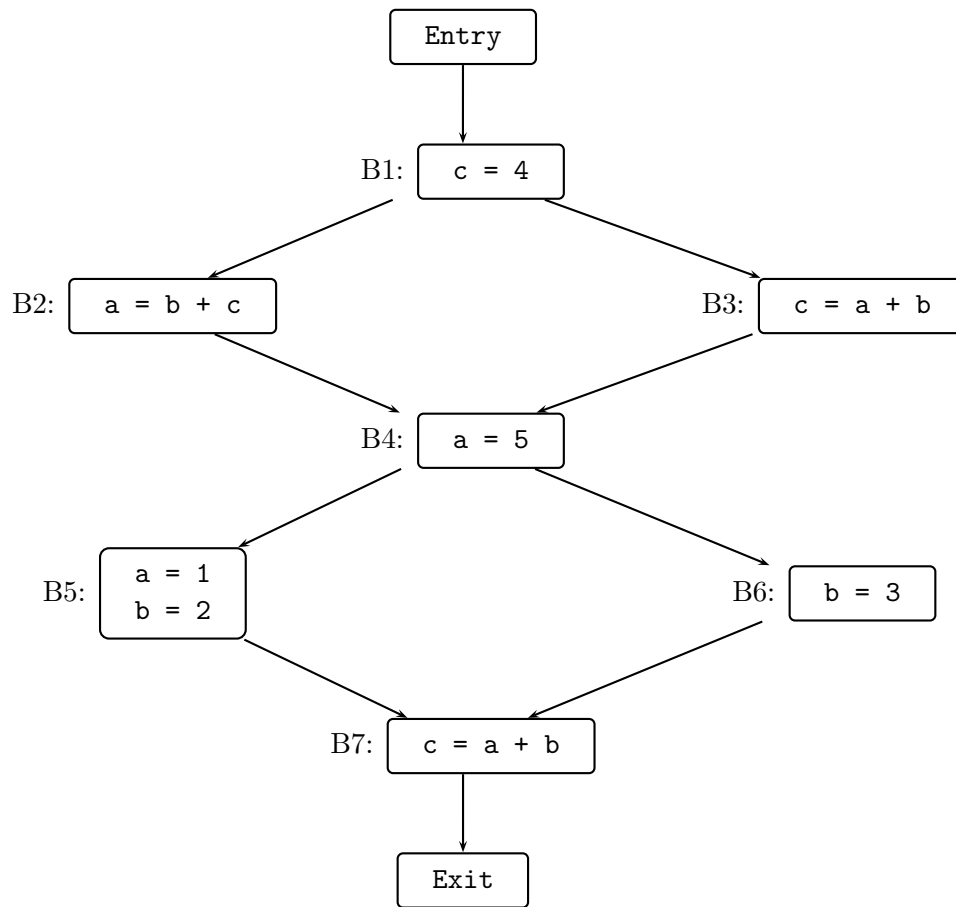


Figure 2: CFG for problem 3.

Name: \_\_\_\_\_

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4. A compiler hacker writes an analysis to compute values of integer variables in a program. The hacker's analysis maintains a set for each variable at each program point, the set contains the possible values for that variable. The hacker uses set union to combine values at the control-flow join points.

The hacker tests the analysis on several acyclic control flow graphs and it is shipped in the compiler. One of the customers tries to compile a program that contains a loop, and the analysis fails to terminate. What is the problem?

Describe the changes that the compiler hacker must make to fix the analysis.