Finals Review

CS406: Compilers

Spring 2021

Practice Exercise: CFGs and low-level loop optimizations

1. Draw CFG for the code shown. Identify loops if any. For each loop identified, mark entry node and all basic blocks.

(refer to slides 10, 36, and 48 of week12)

2. Identify loop invariant statements. Can they be moved outside their enclosing loop?

(refer to slides 59, 65-67, week12)

3. Identify induction variables. Show the code that results after performing possible strength reduction

(refer to slides 59, 65-69, week12)

```
1. X = 2;
2. Y = 10;
3. if (X < Y) goto 14
4. A = Y * X;
5. B = X * 2 + Y;
6. Z = 10;
7. if (B < Z) goto 12
8. D = Y + Z * -3;
9. Q = Y - 8;
10. Z = Z - Q;
11. goto 7;
12. X = X + 2;
13. goto 3;
14. Y = D;
15. halt;
```

Practice Exercise: Peephole Optimizations - CSE

1. Show the results of performing CSE on the code shown. Write 3AC after performing CSE.

(refer to slides 14-20, week10)

2. Suppose A and F are aliased. How would that change the results of CSE

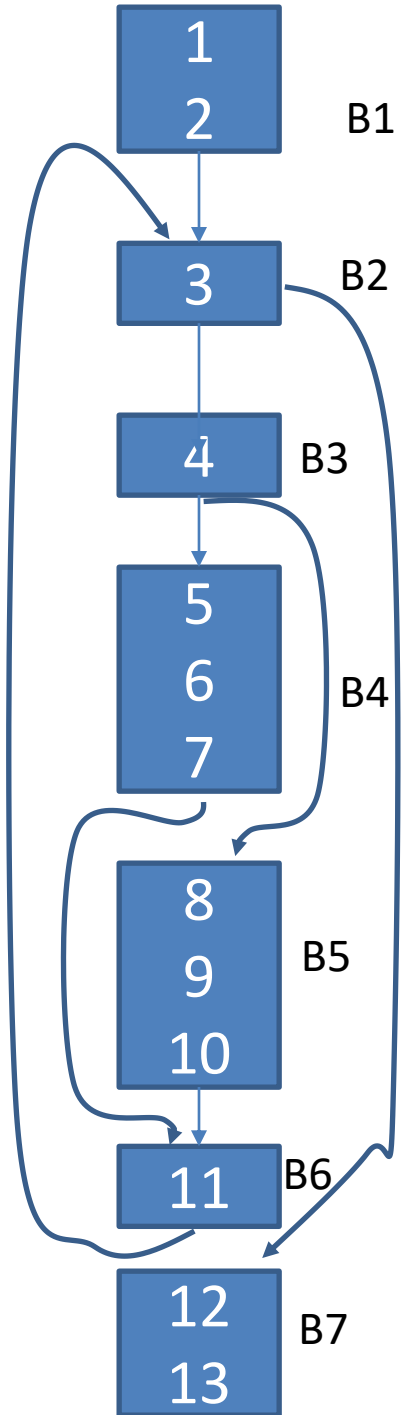
```
1. READ(A)
2. READ(B)
3. C = A + B
4. A = A + B
5. B = C * D
6. T1 = C * D
7. T2 = T1 + C
8. F = A + B
9. C = F + B
10. G = A + B
11. T3 = F + B
12. WRITE(T3)
```

Practice Exercise: Dataflow analysis (available expressions)

1. Show the results of running an "available expressions" analysis on the code shown. For each line of code, show which expressions are available in that line of code.

(refer to slide 8, week 14. Section 9.2.6 in Dragon book)

```
1: x = 4;
2: y = 7;
3: if (x > c) goto 12
4: if (y > 3) goto 8
5: c = x + 1;
6: b = a + x;
7: goto 10
8: a = a + x;
9: b = x + 1;
10: y = a + x;
11: goto 3;
12: c = a + x
13: halt
```




```
1: x = 4;
2: y = 7;
3: if (x > c) goto 12
4: if (y > 3) goto 8
5: c = x + 1;
6: b = a + x;
7: goto 10
8: a = a + x;
9: b = x + 1;
10: y = a + x;
11: goto 3;
12: c = a + x
13: halt
```

Basic Block	Pred.	Succ.	Gen	Kill
B1	Entry	B2	4,7	x+1, a+x, x>c, y>3
B2	B6,B1	B3,B7	x>c	-
B3	B2	B4,B5	y>3	-
B4	B3	B6	x+1,a+x	x>c
B5	B3	B6	a+x, x+1	y>3
B6	B4,B5	B2	-	-
B7	B2	Exit	a+x	x>c

Basic Block	IN	OUT
B1	-	4, 7
B2	4, 7	4, 7, x>c
B3	4, 7, x>c	4, 7, x>c, y>3
B4	4, 7, x > c, y > 3	4, 7, y > 3, x + 1, a + x
B5	4, 7, x > c, y > 3	4, 7, x + 1, a + x
B6	4, 7, x + 1, a + x	4, 7, x + 1, a + x
B7	4, 7, x > c	4, 7, a+x