

Final Review

PLT-4115

Q1. Consider the basic block:

$y := 3$

$x := y$

$z := 4 * x$

Now consider the local optimizations:

- constant propagation
 - copy propagation,
 - constant folding.
-
- For this example, what is the best order in which to apply the three optimizations, if each can be applied only once?

Ans: copy propagation, constant propagation, constant folding
correct

Q2. Consider the basic block:

$y := 3$

$x := y$

$z := 4 * x$

Now consider the local optimizations:

- constant propagation
 - copy propagation,
 - constant folding.
-
- For this example, What is the worst possible order (i.e., requires the most passes) for the basic block?

Ans: constant folding, constant propagation, copy propagation

Q3. Consider the following intermediate code:

```
1. x := 5
2. if y > 1 goto Label3
3. Label1:
4. w := w + 1
5. if y > 2 goto Label3
6. Label2:
7. q := 3
8. if z < 1 goto Label1
9. Label3:
10. w := 2
11. if z > 1 goto Label2
12. q := y + w
```

- a. Draw the CFG where each node is a BB.
- b. Which variables are live immediately before the execution of statement 7?
Assume only variable q is live after the statement in line 12.

Ans: y,z,w

Q3. Consider the following intermediate code:

```
1. x := 5
2. if y > 1 goto Label3
3. Label1:
4. w := w + 1
5. if y > 2 goto Label3
6. Label2:
7. q := 3
8. if z < 1 goto Label1
9. Label3:
10. w := 2
11. if z > 1 goto Label2
12. q := y + w
```

- c. Assume the constant propagation algorithm has completed. Which of the following statements is true?
- L_N is the statement at line N
 - $C(L, v, in) = C$ means that at the "in" of statement L variable v is some constant
 - $C(L, v, in) = \top$ means v is not a constant.

$C(L7,$	$w,$	$in)$	$=$	\top
$C(L2,$	$y,$	$out)$	$=$	C
$C(L5,$	$x,$	$out)$	$=$	C
$C(L4,$	$y,$	$in)$	$=$	\top
$C(L8,$	$z,$	$out)$	$=$	C

Q3. Consider the following intermediate code:

```
1. x := 5
2. if y > 1 goto Label3
3. Label1:
4. w := w + 1
5. if y > 2 goto Label3
6. Label2:
7. q := 3
8. if z < 1 goto Label1
9. Label3:
10. w := 2
11. if z > 1 goto Label2
12. q := y + w
```

- c. Assume the constant propagation algorithm has completed. Which of the following statements is true?
- L_N is the statement at line N
 - $C(L, v, in) = C$ means that at the "in" of statement L variable v is some constant
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$C(L7,$	$w,$	$in)$	$=$	\top
$C(L2,$	$y,$	$out)$	$=$	C
$C(L5,$	$x,$	$out)$	$=$	C
$C(L4,$	$y,$	$in)$	$=$	\top
$C(L8,$	$z,$	$out)$	$=$	C

Q4. Consider the following intermediate code:

```
1. x := 5, z := 2, y := 3
2. if y > 1 goto Label3
3. Label1:
4. w := w + 1
5. if y > 2 goto Label3
6. Label2:
7. q := 3
8. if z < 1 goto Label1
9. Label3:
10. w := 2
11. if z > 1 goto Label2
12.12: q := y + w
```

a. Which lines (using the numbering given above) are now unreachable?

**Do constant propagation
and dead code elimination**

```
1. x := 5, z := 2, y := 3
2. if y > 1 goto Label3
3. Label1:
4. w := w + 1
5. if y > 2 goto Label3
6. Label2:
7. q := 3
8. if z < 1 goto Label1
9. Label3:
10. w := 2
11. if z > 1 goto Label2
12. q := y + w
```

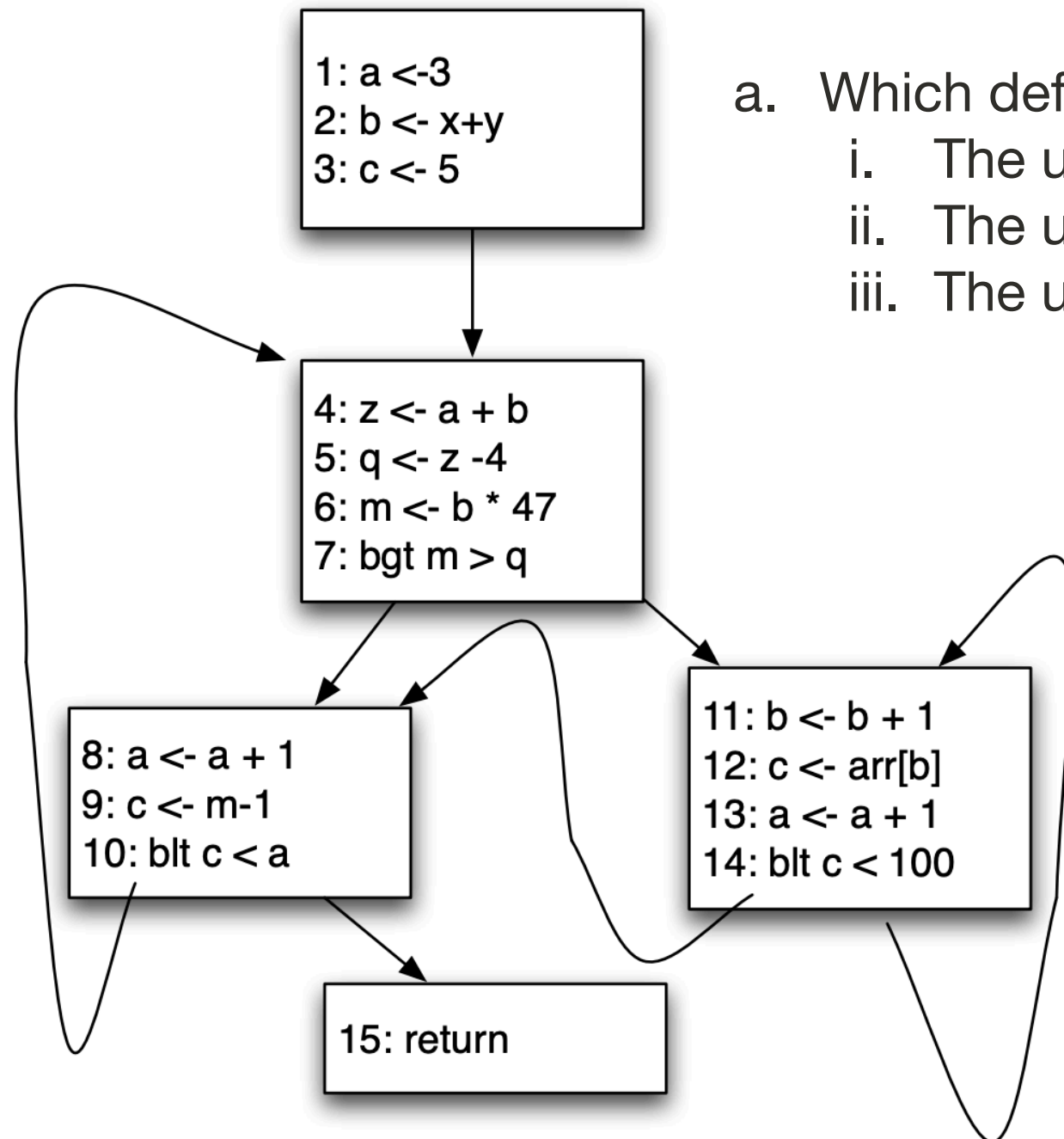
Q5. Optimize the following intermediate code:

```
1: z := 3
2: if b > 0 goto Label1
3: x := 1
4: y := 2
5: z := x + y
6: goto Label2
7: Label1:
8: w := x + 1
9: y := x + 1
10: Label2:
11: a := x + y
12: b := a * z
```

```
1: z := 3
2: if b > 0 goto Label1
3: x := 1
4: y := 2
5: z := x + y 3
6: goto Label2
7: Label1:
8: w := x + 1
9: y := x + 1 w
10: Label2:
11: a := x + y
12: b := a * z
```

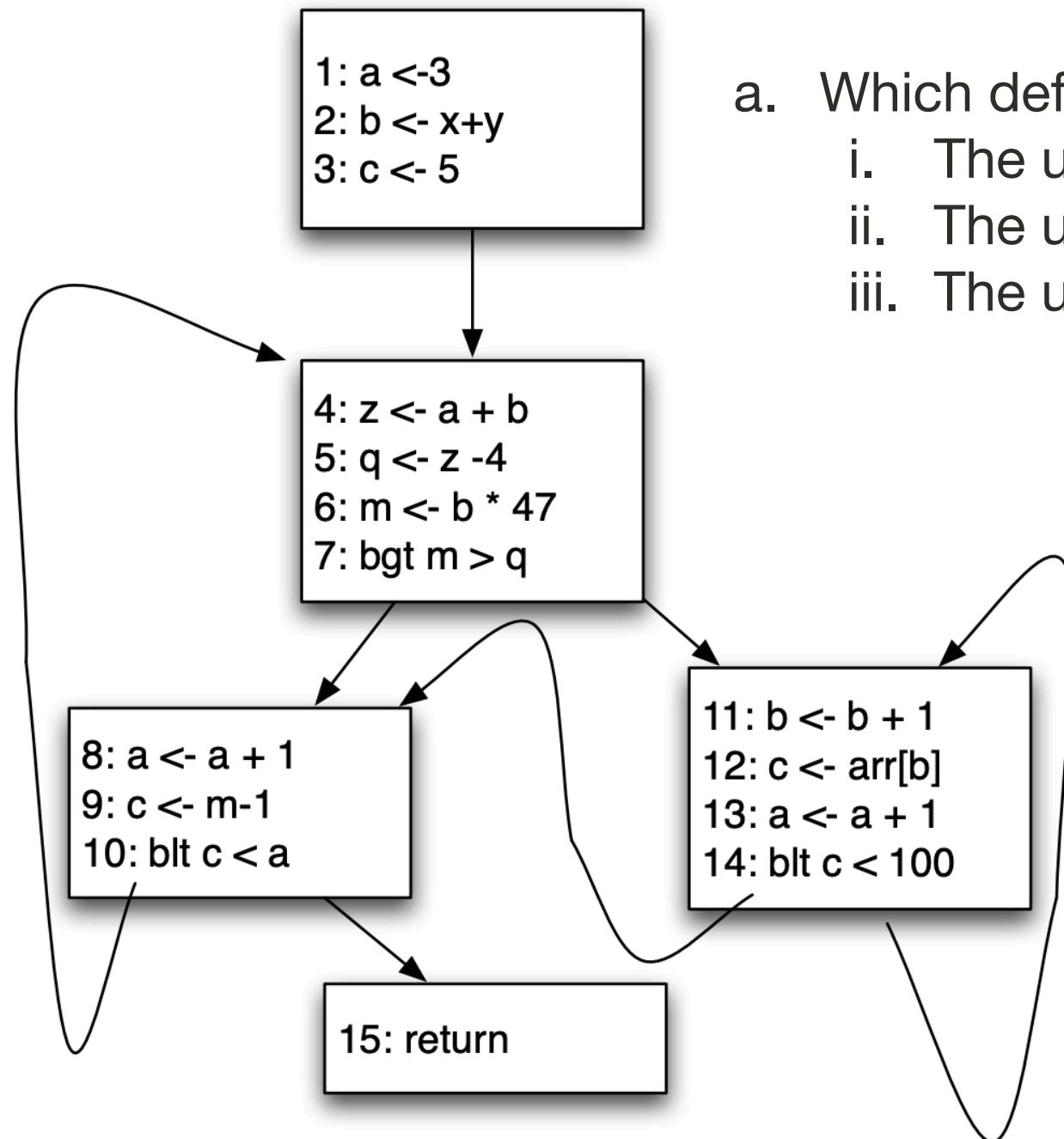
Line 8 can also be removed if you
assume w will not be used after line 12

Q6. Consider the following CFG



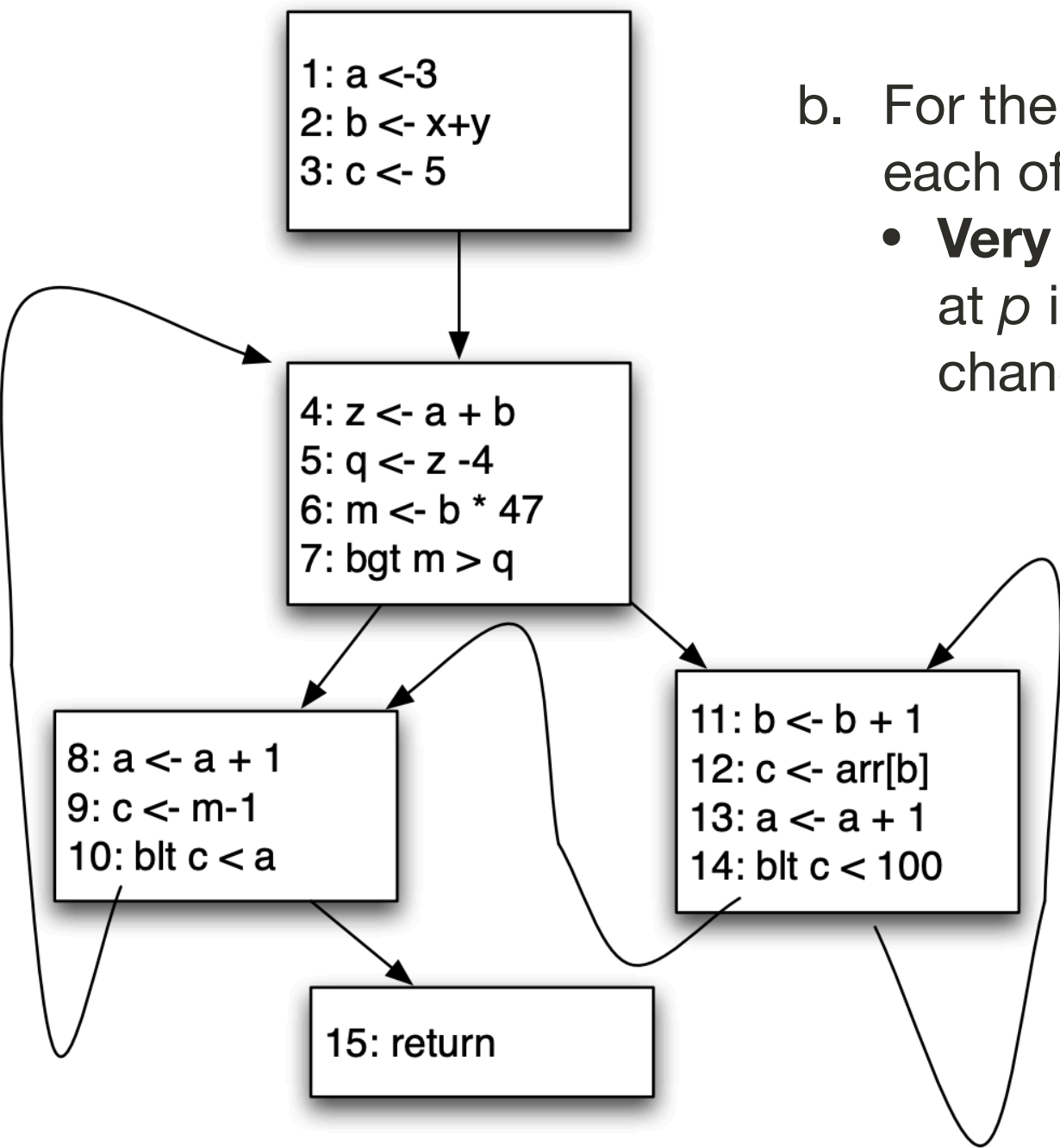
- a. Which definitions reach the following uses:
- The use of a in instruction 4.
 - The use of a in instruction 8.
 - The use of b in instruction 6.

Q6. Consider the following CFG



- a. Which definitions reach the following uses:
- i. The use of a in instruction 4. **1,8**
 - ii. The use of a in instruction 8. **1,8,13**
 - iii. The use of b in instruction 6. **2,11**

Q6. Consider the following CFG



- b. For the same program fragment, indicate whether each of the following expressions is “very busy”
- **Very Busy Expressions:** An expression is very busy at p if it is evaluated on *every* path *from* p before it changes in value. (**Backward Must**)

	a + 1	m - 1	a + b	b * 47	x + y	b+1	arr[b]
3	Y	N	Y	Y	N	N	N
7	Y	Y	N	N	N	N	N
10	N	N	N	N	N	N	N
14	Y	Y	N	N	N	N	N
15	N	N	N	N	N	N	N