

YOUR NAME: _____

Program Analysis Quiz 2

Friday February 19, 2021

20 points

Recall the points-to analysis we defined in class (Lecture 7, slides 6-16). We assume preprocessing that yields 4 kinds of statements, each with the transfer function we defined in class. The analysis is solved with the Worklist algorithm. (Note that since the target language is typically C and C is type-unsafe, points-to analysis ignores declared types.)

- (1) `p = &a`
- (2) `p = q`
- (3) `p = *q`
- (4) `*p = q`

Several questions below refer to the following code:

```
1. a = &x;
2. p = &a;
3. if (...) {
4.     q = &b;
5.     *p = q;
6. }
7. else {
8.     q = &c;
9.     *p = q;
10. }
11. ...
```

Question 1. (2pts) At program point 8 the analysis reports that `q` points to

- (a) `b` only
- (b) `c` only
- (c) both `b` and `c`

Question 2. (2pts) At program point 8 the analysis reports that `p` points to

- (a) `a` only
- (b) `b` and `c`
- (c) all of `a`, `b` and `c`

Question 3. (2pts) At program point 8 the analysis reports that `a` points to

- (a) `x` only
- (b) `b` and `c`
- (c) all of `x`, `b` and `c`

Question 4. (2pts) Points-to analysis, as defined in class over the 4 kinds of statement is *distributive*.

- (a) true
- (b) false

Question 5. (2pts) Points-to analysis, as defined in class over the 4 kinds of statement is *monotone*.

- (a) true
- (b) false

Question 6. (2pts) Let $a = \langle x \rightarrow \top, y \rightarrow \perp, z \rightarrow 5 \rangle$ and $b = \langle x \rightarrow \top, y \rightarrow \perp, z \rightarrow 6 \rangle$ be elements of the product lattice we defined for Constant Propagation. Which of the following is true

- (a) $a \leq b$
- (b) $b \leq a$
- (c) neither, a and b are not ordered

Question 7. (2pts) Let $a = \langle x \rightarrow \top, y \rightarrow \perp, z \rightarrow 5 \rangle$ and $b = \langle x \rightarrow \top, y \rightarrow \perp, z \rightarrow 6 \rangle$ be elements of the product lattice we defined for Constant Propagation. What is $a \vee b$?

Question 8. (2pts) Let $a = \langle x \rightarrow \top, y \rightarrow \perp, z \rightarrow 5 \rangle$ and $b = \langle x \rightarrow \top, y \rightarrow \perp, z \rightarrow 6 \rangle$ be elements of the product lattice we defined for Constant Propagation. What is $a \wedge b$?

Questions 9 and 10 refer to the code below and the Constant Propagation analysis we defined in class.

```

1. int x = 0;
2. int y = 0;
3. int z = 0;
4. if (...) {
5.     x = 1;
6.     y = 2;
7. }
8. else {
9.     x = 2;
10.    y = 1;
11. }
12. z = x*y;
13. ...

```

Question 9. (2pts) What is the MFP solution at program point 9? Write your answer as the product lattice element $\langle l_x, l_y, l_z \rangle$.

Question 10. (2pts) What is the MOP solution at program point 9?