

Spring, 2016

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

(Please *don't* write your id number!)

COP 5021 — Program Analysis

## Midterm Exam

This test has 8 questions and pages numbered 1 through 3.

This test is open book and notes, but no electronics.

If you need more space, use the back of a page. Note when you do that on the front.

Before you begin, please take a moment to look over the entire test so that you can budget your time.

Clarity is important; if your answers are sloppy and hard to read, you may lose some points.

### For Grading

Question:	1	2	3	4	5	6	7	8	Total
Points:	10	30	10	10	5	5	10	20	100
Score:									

1. (10 points) [Concepts] What is the overall goal of your semester project (i.e., that of your group, if you are in a group)?

2. (30 points) [Concepts] Describe, in English, one or two analysis questions that your semester project needs to answer in order to achieve its goal.

3. (10 points) [Concepts] Pick one of the program analyses we have studied this semester, and explain for that analysis what makes an analysis result “more precise.”

## Dependency Analysis

The following questions concern checking a WHILE language program to find what other variables may have influenced that variable’s value, at each program point. We call this analysis the “Depends On” (DO) analysis.

We say that a variable  $y$  may have influenced the value of a variable  $x$  if changing the value of  $y$  might change the value of  $x$  in some execution. In this case we say that  $x$  *depends on*  $y$ . (This dependency information could, outside of this problem, be used to for computer security, e.g., checking for flows from high security variables to low security ones, or for taint checking, or in program verification.)

Consider the following example.

```
[i := n]1;
[j := i]2;
if [i > 0]3 then [m := j+1]4 else [m := j-1]5;
[j := m-i]6;
[k := j]7
```

In this example, at the exit to block 1,  $i$  depends on  $n$ . At the exit from block 2,  $j$  depends on both  $i$  and  $n$ , and  $i$  still depends on  $n$ . At exit from block 3, the same dependencies hold as on exit from block 2. At exit from block 4, in addition to the dependencies that hold on exit from block 3,  $m$  depends on  $j$ ,  $i$ , and  $n$ , and the same holds on exit from block 5. At exit from block 6, all the dependencies that hold on exits from blocks 4 and 5 hold, except that  $j$  depends on  $m$ ,  $i$ ,  $j$ , and  $n$ . At exit from block 7, all the dependencies that hold on exits from block 6, and in addition,  $k$  depends on  $j$ ,  $m$ ,  $i$ , and  $n$ .

4. (10 points) [Concepts] Could the Depends On analysis be formulated using abstract interpretation? Answer “yes” or “no” and briefly justify your answer. (Note: you do not have to describe an implementation technique.)

5. (5 points) [Concepts] As a dataflow analysis, would the Depends On analysis be best thought of as a forward or backward analysis? Answer “forward” or “backward” and briefly justify your answer.
  
  
  
  
  
  
  
  
  
  
6. (5 points) [Concepts] As a dataflow analysis, would the Depends On analysis be best thought of as a “may” or a “must” analysis? Answer “may” or “must” and briefly justify your answer.
  
  
  
  
  
  
  
  
  
  
7. (10 points) [Concepts] Give a definition of a property space that would be good for the Depends On analysis.
  
  
  
  
  
  
  
  
  
  
8. (20 points) Using the property space in your answer above, write dataflow equations to formalize the Depends On analysis.