Department of Computer Science
Graduate Comprehensive Exam
in
Software Engineering
Spring 2020

- **Answer the questions on the paper supplied.**
- **Answer question 1, and answer question 2, and answer question 3. You should answer a total of three questions.**
- **Start each question on a new page. Write on only one side of the paper.**
- **Write your SIX-DIGIT Texas State ID in the top right corner of each page of your answer. Do NOT put your name anywhere on the answers.**
- **Put the number of the question being answered in the top left corner of each answer page.**
- **If the answer to a question is written on more than one page, number the pages consecutively.**

1. CS5391 Survey of Software Engineering
   {*from Dr. Chen*}

   Explain the following software process models and point out their pros and cons:

   (a) Formal method development model

   (b) Agile development model

2. CS5392 Formal Methods in Software Engineering
   {*from Dr. Yang*}
   1). Consider the following system M.

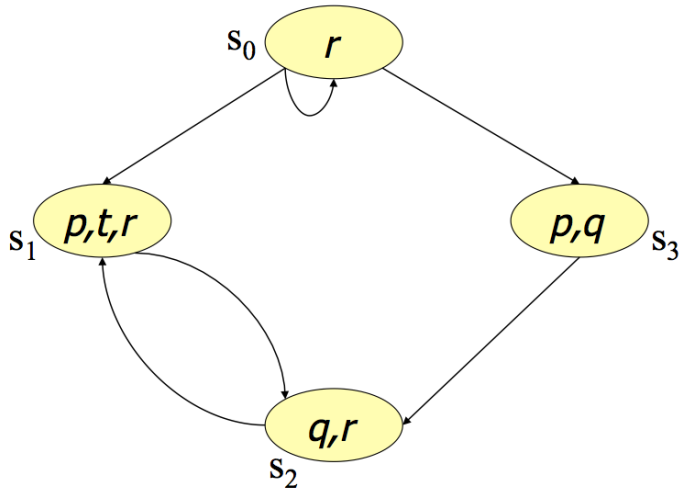


Figure 1: A model with four states.

(a) Beginning from state s_0, unwind this system into an infinite tree, and draw all computation paths up to length 4 (= the first four layers of that tree.)

(b) Determine whether $M, s_0 \models \phi$ and $M, s_3 \models \phi$ hold and justify your answer, where ϕ is the LTL or CTL formula:

(a) F t
(b) E (t U q)
(c) G ($r \vee q$)

2). Conduct symbolic evaluation of path 1,2,4,5,7,8 for the code fragment below. Explain if this path is feasible. Provide the intermediate and final results for path condition, domain and computation.

```
1)  input x,z;
2)  if x > z then
3)    y := 3;
    else
4)    x := z + 2;
    end if;
5)  if x > z + 1 then
6)    w := 3;
    else
7)    w := 2
    end if;
8)  write w;
```

3. CS5393 Software Quality
{*from Dr. Yang*}

1). For the following annotated control flow graph.

(a) List the test requirements (using nodes, edges, or paths in the graph) for node coverage, edge coverage, edge pair coverage on the graph.

(b) Give a set of test paths that would be needed to achieve node Coverage but not Edge Coverage.

(c) Give a set of test paths that would be needed to achieve Edge Coverage but not Edge Pair Coverage.

(d) Give a set of test paths that would be needed to achieve Edge Pair Coverage.

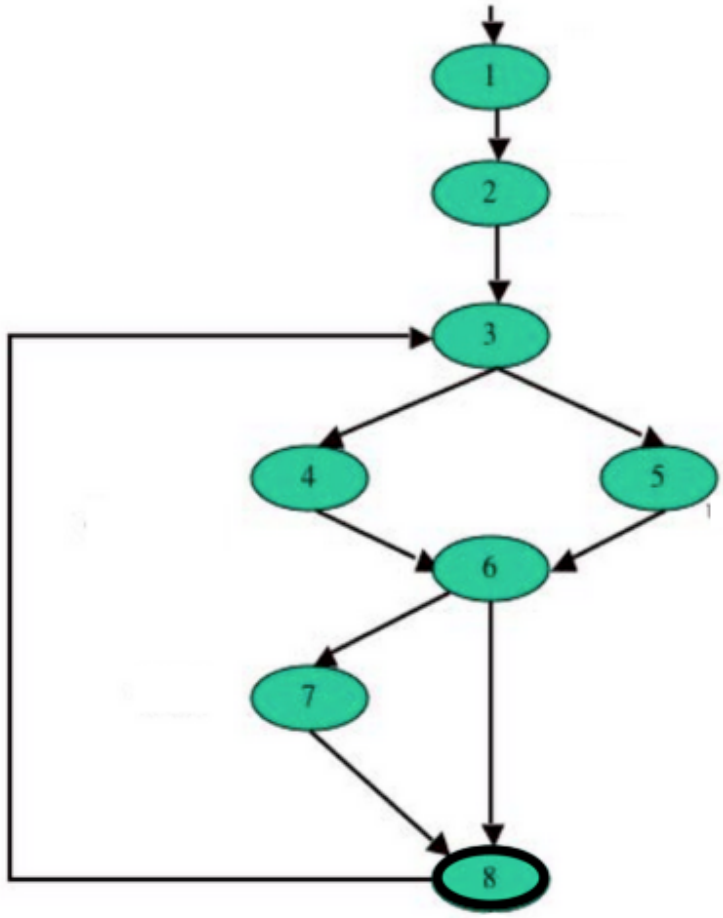
2). Recall a *du-path* with respect to a variable v is a simple path that is *def-clear* with respect to v from node n_i for which v is in *def(n_i)* to a node n_j for which v is in *use(n_j)*.

Consider the following code fragment and answer the questions that follow using the node numbers given as comments:

(a) Provide a control flow graph representation for the code fragment, assuming that node 1 is a initial node and node 8 is a final node.

(b) Which nodes have defs for variable w? Which nodes have uses for variable w?

(c) Give a set of paths that would be needed to achieve *All-du-paths Coverage* with respect to variable y. Show the def-use relations and indicate which paths cover which relationships.


1
2
3
4
5
6
7
8

```
y = m;              // node 1
if(x>0){            // node 2
      w++;          // node 3
}
else{
      w = 2*w;      // node 4
}
while(y<10){        // node 5
      x++;          // node 6
      y++;          // node 7
}
z = w + x;          // node 8
```