

**CMPSCI 521/621**  
**Homework #2**  
**September 25, 2006**  
**Due: October 23, 2006**

1) For the **Wensley** procedure given below:

```
Procedure Wensley (P: input, Q: input, E: input, Y:
output);
1  declare P, Q, E, Y, A, B, D real;
2  A :=0.0; B :=Q / 2.0; D :=1.0; Y := 0.0;
3  while (D>=E) do
4      if ~(P - A - B < 0.0) then
5          Y := Y + (D / 2.0);
6          A := A + B;
7      endif;
8      B :=B / 2.0;
9      D := D / 2.0;
10 endwhile;
11 end Wensley;
```

- a) Draw a control flow graph (CFG) for the fragment (node=statement. Include def-use notations for each node for the variables P, Q, E, Y, A, B, and D. (15 pts)
- b) For the following paths:

- 1,2,3,10,11
- 1,2,3,4,5,6,7,8,9,3,10,11
- 1,2,3,4,5,6,7,8,9,3,4,7,8,9,3,10,11

find a (minimum) combination of paths would be included in each coverage criterion below and **discuss**. If no such combination exists, **discuss why not**. (5 pts each)

- i) All-Nodes [statements]
- ii) All-Edges
- iii) All-Paths
- iv) Rapp's and Weyuker's All-Uses criterion [for B]
- v) Rapp's and Weyuker's All-P-Uses criterion [for B]
- vi) Rapp's and Weyuker's All-DU-Paths criterion [for Y]
- vii) Ntafos' 2-DR criterion [for B]
- viii) Ntafos' 3-DR criterion [for B,A]
- ix) Laski's and Korel's Context Coverage criterion [for Q,B,A]

- 2) Explain why it may not be possible to achieve 100% data flow coverage for many of the data flow criteria. Give an example using a CFG for a well-formed program fragment that illustrates your explanation. (20 points)
- 3) In Zhu, et al, the authors describe a subsumption hierarchy [Figure 7] that describes relationships among the coverage criteria: (10 points each)
- i) What does it mean when one criterion subsumes another?
  - ii) If testing criterion A subsumes testing criterion B, will A always reveal more faults than B when applied to the same program? Explain your answer.
- 4) **[621 only]** consider the following program fragment:

```

1   input a,b,c,d
2   v:=a
3   x:= a+(b*d);
4   y:=x*v;
5   z:=x*b;
6   w:=x*z;
7   output w;

```

For perturbation testing, consider the computation error that results from

$$f_7 \circ f_{4 \rightarrow 6} \circ f_3 \circ f_{1 \rightarrow 2}(v) \neq f_7 \circ f_{4 \rightarrow 6} \circ f'_3 \circ f_{1 \rightarrow 2}(v).$$

- What is the "blindness space"? (5 points)
- Describe how you would calculate it. (5 points)
- Is the error caused when  $x := a + (b + d)$ , instead of the correct assignment, in the blindness space? (5 points)
- Discuss domain errors and distinguish from computation errors. (5 points)

**Submitting Homework, you may:**

- Email your homework to Anna Grishkan ([agrishka@cs.umass.edu](mailto:agrishka@cs.umass.edu)) or me ([adrion@cs.umass.edu](mailto:adrion@cs.umass.edu)) in text, MSWord, PDF or some other format that we can print. Homework submitted via email must have a postmark before 4 pm on the date the homework is due.
- Turn in written/printed solutions to the CMPSCI front office on or before 4 pm on the due date to Pauline Hollister
- FAX your homework (**definitely not recommended**) to 413-545-3729 before 4 pm on the due date.
- **Do not drop off homework** in my or Anna Grishkan's mailbox nor at our or Wendy Cooper's offices. **We cannot guarantee receipt if you do not email the solutions or drop them off with Pauline.**
- **Unless you have obtained prior approval for an extension, 5 pts/day (or part thereof) will be deducted from your score.**
- I expect you to do **independent work** unless specifically indicated. **Failure to do this will result in penalties.**