

**SE 4367, Software Testing**  
**Homework #5, ASTs and CFGs**

1. Draw the abstract syntax trees for the following predicates,  $AST(p_r)$ , where  $a$ ,  $b$ ,  $c$ , and  $d$  are Boolean variables:

*a)  $a + cd$*

*b)  $abc$*

*c)  $a + !(bc) + d$*

*d)  $a!bc + ab!d$*

*e)  $a + !b(!a!c + d)$*

2. Program P1 CFG.

f) Identify the basic blocks for the following program P1 written in pseudo-code.

g) Draw the control flow graph.

Program P1

```
1)  integer A, B;  
2)  input (A);  
3)  if (A == 0)  
4)  {  
5)      B = A + 1;  
6)  }  
7)  else  
8)  {  
9)      B = A - 2;  
10) }  
11) output (A,B);  
12) end;
```

3. Program P2 CFG.

- a) Identify the basic blocks for the following program P2 written in pseudo-code.
- b) Draw the control flow graph.

Program P2

```
1)  integer A, B;
2)  input  (A);
3)  B = 1;
4)  while (int i=1; i<=A; i++)
5)  {
6)      B = B * i;
7)  }
8)  output (A,B);
9)  end;
```

4. Program P3 CFG.

- a) Identify the basic blocks for the following program P3 written in pseudo-code.
- b) Draw the control flow graph.

Program P3

```
1)  integer A, B;
2)  input (A);
3)  if (A > 7)
4)      B = 1;
5)  else
6)      {
7)          B = 2;
8)          if (A < 2)
9)              B = 3;
10) } // end else A>7
11) while (int i=1; i<=A; i++)
12) {
13)     if (B<0)
14)         B = B + 4;
15)     else
16)         B = B - 5;
17) } // end for loop
18) output (A,B);
19) end;
```

5. Program P4 CFG.

- a) Identify the basic blocks for the following program P4 written in pseudo-code. Note the post-test loop at line 7!
- b) Draw the control flow graph.

Program P4

```
1)  integer A, B;  
2)  input (A);  
3)  B = 1;  
4)  do {  
5)      B = B * A;  
6)      A = A - 1;  
7)  } while (A<=0);  
8)  output (A,B);  
9)  end;
```

## Grading Rubric

Each of the five problems is worth 20 points.

For #1, each AST is worth 4 points.

For #2-5, each of the eight (4\*a,b) parts above is worth 10 points each.

Each basic block and each node & edge is worth a proportional part of its 10 points. For example,

- if there are 5 basic blocks for part a, correctly defining each is worth 2 points apiece
- if there are 5 nodes and 5 edges in the CFG for part b, each node and edge correctly drawn is worth 1 point