

## *SE 4367, HW #12, Coverage*

**For the following program P written in pseudo-code, given the test set T:**

$$T = \{t_1 = \langle 4, 2 \rangle, t_2 = \langle 9, 1 \rangle, t_3 = \langle 6, 1 \rangle\}$$

- 1) What is the domain for statement coverage of P?**
- 2) What is the statement coverage for T?**
- 3) What is the domain for block coverage of P?**
- 4) What is the block coverage for T?**
- 5) What is the domain for decision coverage of P?**
- 6) What is the decision coverage for T?**
- 7) What is the domain for condition coverage of P?**
- 8) What is the condition coverage for T?**

### Program P

```
1) integer X, Y, Z;
2) input (X, Y);
3) if (X<0 or X>8 or Y<1 or Y>3)
4) {
5)     output ("Boundary condition failure.");
6) } // end if invalid inputs
7) else
8) {
9)     Z = 0;
10)    if (X < 5)
11)    {
12)        Z = X + Y;
13)        if (Y == 1)
14)        {
15)            Z = X ^ 2;
16)        } // end if (Y==1)
17)    } // end if (X<5)
18)    else
19)    {
20)        Z = Z - X;
21)        if (Y == 0)
22)        {
23)            Z = Z * Z;
24)        } // end if (Y==2)
25)        else
26)        {
27)            Z = Z + X;
28)        } // end else !(Y==2)
29)        Z = Z + 1;
30)    } // end else !(X<5)
31)    output (X,Y,Z);
32) } // end else legal inputs
33) output ("Program ends.");
34) end;
```

# *Grading Rubric*

**Each part is worth 12 points**

**Each coverage part**

- 6 points for numerator and 6 for denominator if in ratio form (preferred)
- missing the infeasible element is worth 6 points on each coverage problem (denominator wrong)

**Answers can be either ratios (fractions), decimal numbers  $[0,1]$ , or percentages for coverage**

- if expressed as a decimal, two places is sufficient
- if expressed as a percentage, to the nearest percent is sufficient

# *Formatting Submissions*

**In the file name, include:**

- **class**
- **assignment identifier**
- **your name (or team's name)**
  - e.g., se4367a01jdoe

**In the file (or hardcopy) submitted, include the class, assignment, and name information at the top.**

***Minus 5 points per violation. Potentially 30 points off for formatting mistakes!***



### Program P

```
1) integer X, Y, Z;
2) input (X, Y);
3) if (X<0 or X>8 or Y<1 or Y>3)
4) {
5)     output ("Boundary condition failure.");
6) } // end if invalid inputs
7) else
8) {
9)     Z = 0;
10)    if (X < 5)
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12)        Z = X + Y;
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15)            Z = X ^ 2;
16) } // end if (Y==1)
17) } // end if (X<5)
18) else
19) {
20)        Z = Z - X;
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23)            Z = Z * Z;
24) } // end if (Y==2)
25) else
26) {
27)            Z = Z + X;
28) } // end else !(Y==2)
29)        Z = Z + 1;
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31)    output (X,Y,Z);
32) } // end else legal inputs
33) output ("Program ends.");
34) end;
```

## 12.1 Statement domain

- without syntactical markers

$D_S = \{1, 2, 3, 5, 9,$   
10, 12, 13, 15, 20,  
21, 23, 27, 29, 31,  
33}

$|D_S| = 16$

## 12.2 Statement Coverage

$T = \{t_1 = \langle 4, 2 \rangle, t_2 = \langle 9, 1 \rangle, t_3 = \langle 6, 1 \rangle\}$

- $t_1$  covers statements 1, 2, 3 (f)  $\rightarrow$  9, 10 (t)  $\rightarrow$  12, 13 (f)  $\rightarrow$  31, 33
- $t_2$  covers statements 1, 2, 3 (t)  $\rightarrow$  5  $\rightarrow$  33
- $t_3$  covers statements 1, 2, 3 (f)  $\rightarrow$  9, 10 (f)  $\rightarrow$  20, 21 (f)  $\rightarrow$  27, 29, 31, 33

### Infeasible elements and unreachable code

- Note that Y is in [1,3] according to the if at line 3, therefore the if (Y==0) at line 21 can never be true  $\rightarrow$  infeasible  $\rightarrow$  line 23 is unreachable
- the comments on lines 24 and 28 are clues that there was a mistake in writing the if at line 21

Statement coverage is  $14/(16-1) = 14/15 = 93\%$

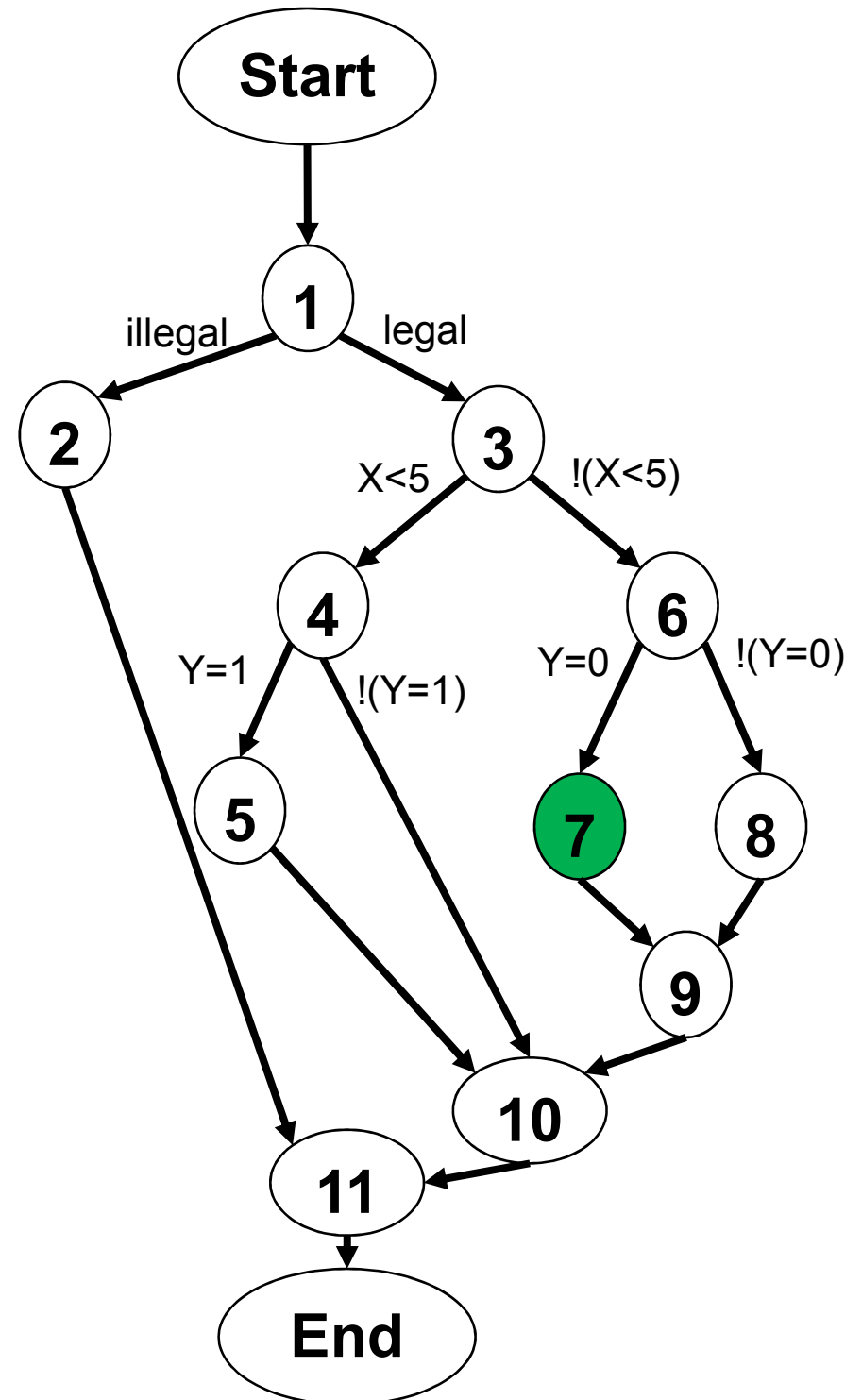
$D_S = \{1, 2, 3, 5, 9, 10, 12, 13, 15, 20, 21, 23, 27, 29, 31, 33\}$

# HW 12.3

## Block Domain

<u>Block</u>	<u>LOC</u>
1	1,2,3
2	5
3	9,10
4	12,13
5	15
6	20,21
7	23 (infeasible)
8	27
9	29
10	31
11	33

$$|D_B| = 11$$





## *HW 12.4 Block Coverage*

$T = \{t_1 = \langle 4, 2 \rangle, t_2 = \langle 9, 1 \rangle, t_3 = \langle 6, 1 \rangle\}$

$t_1$  covers statements 1, 2, 3 (f)  $\rightarrow$  9, 10 (t)  $\rightarrow$  12, 13 (f)  $\rightarrow$  31, 33  
 $\rightarrow t_1$  covers blocks 1, 3, 4, 10, 11

$t_2$  covers statements 1, 2, 3 (t)  $\rightarrow$  5  $\rightarrow$  33  
 $\rightarrow t_2$  covers blocks 1, 2, 11

$t_3$  covers statements 1, 2, 3 (f)  $\rightarrow$  9, 10 (f)  $\rightarrow$  20, 21 (f)  $\rightarrow$  27, 29, 31, 33  
 $\rightarrow t_3$  covers blocks 1, 3, 6, 8, 9, 10, 11

Block coverage is  $9/(11-1) = 9/10 = 90\%$

• {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11}

## 12.5 Decision domain

$D_D = \{\text{line 3, line 10, line 13, line 21}\}$

$|D_D| = 4$

Decision at line 21 is infeasible

### Program P

```
1) integer X, Y, Z;
2) input (X, Y);
3) if (X<0 or X>8 or Y<1 or Y>3)
4) {
5)     output ("Boundary condition failure.");
6) } // end if invalid inputs
7) else
8) {
9)     Z = 0;
10)    if (X < 5)
11)    {
12)        Z = X + Y;
13)        if (Y == 1)
14)        {
15)            Z = X ^ 2;
16)        } // end if (Y==1)
17)    } // end if (X<5)
18) else
19) {
20)     Z = Z - X;
21)     if (Y == 0)
22)     {
23)         Z = Z * Z;
24)     } // end if (Y==2)
25)     else
26)     {
27)         Z = Z + X;
28)     } // end else !(Y==2)
29)     Z = Z + 1;
30) } // end else !(X<5)
31) output (X,Y,Z);
32) } // end else legal inputs
33) output ("Program ends.");
34) end;
```

## HW 12.6 Decision Coverage

$T = \{t_1 = \langle 4, 2 \rangle, t_2 = \langle 9, 1 \rangle, t_3 = \langle 6, 1 \rangle\}$

line 3: if (X<0 or X>8 or  
Y<1 or Y>3)

$t_1 \rightarrow 3$  is **false**  
 $\rightarrow 10$  is **true**  
 $\rightarrow 13$  is **false**

line 10: if (X < 5)

$t_2 \rightarrow 3$  is **true**

line 13: if (Y == 1)

$t_3 \rightarrow 3$  is **false**  
 $\rightarrow 10$  is **false**  
 $\rightarrow 21$  is **false**

line 21: if (Y == 0)

- infeasible since Y==0  
cannot be covered –  
always false

Decisions at 3, 10

Decisions at 13, 21 are only touched once

Decision at 21 is infeasible

**4 decisions**

**1 infeasible decision**

Decision coverage is  $2/(4-1) = 2/3$   
**= 67%**

## *HW 12.7 Condition Domain*

3)  $X < 0$

3)  $X > 8$

3)  $Y < 1$

3)  $Y > 3$

**7 conditions**

**1 infeasible condition**

- 21)  $Y == 0$

10)  $X < 5$

13)  $Y == 1$

21)  $Y == 0$

## HW 12.8 Condition Coverage

$T = \{t_1 = \langle 4, 2 \rangle, t_2 = \langle 9, 1 \rangle, t_3 = \langle 6, 1 \rangle\}$

	$t_1$	$t_2$	$t_3$	
3) $X < 0$	false	false	false	7 conditions
3) $X > 8$	false	true	false	
3) $Y < 1$	false	false	false	
3) $Y > 3$	false	false	false	
				2 conditions covered
				• 3) $X > 8$
				• 10) $X < 5$
10) $X < 5$	true	--	false	1 infeasible condition
13) $Y == 1$	false	--	--	
				• 21) $Y == 0$
21) $Y == 0$	--	--	false	Condition coverage is
				$2/(7-1) = 2/6 = 33\%$