CSC410 A5

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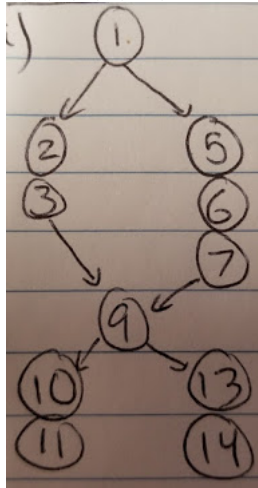
1. (a) **All Paths:**
   1,2,3,9,10,11
   1,2,3,9,13,14
   1,5,6,7,9,10,11
   1,5,6,7,9,13,14

   (b)

Infeasible Path		
Line No.	Assignment	Path Conditions
1,2,3	$x \leftarrow X - 5$ $y \leftarrow Y + 5$	$X + Y > 10$
9,10,11	$x \leftarrow -(X - 5)$ $y \leftarrow -(Y + 5)$	$X + Y > 10$ AND $(X - 5) + (Y + 5) < 0$

This path is infeasible because of the conflicting path conditions.
$10 < (X + Y) = (X - 5) + (Y + 5) \not< 0$.

(c)

Assertion Violation Path		
Line No.	Assignment	Path Conditions
1,5,6,7	$x \leftarrow Y$ $y \leftarrow X$	$X + Y \leq 10$
9,13,14	$x \leftarrow Y - 1$ $y \leftarrow X - 1$	$X + Y \leq 10$ AND $X + Y \geq 0$

This path will cause an assertion violation in the case that $X + Y \leq 2$ since the assignments from 9,13,14 subtract 2 from the sum, $(X - 1) + (Y - 1) = X + Y - 2$

Why the other 2 paths never cause an assertion violation:

Assertion Violation Path		
Line No.	Assignment	Path Conditions
1,5,6,7	$x \leftarrow Y$ $y \leftarrow X$	$X + Y \leq 10$
9,10,11	$x \leftarrow -Y$ $y \leftarrow -X$	$X + Y \leq 10$ AND $X + Y < 0$

Since $x \leftarrow -Y$ and $y \leftarrow -X$ and $X + Y < 0$ then $(X - 1) + (Y - 1) = -(X + Y) > 0$

Assertion Violation Path		
Line No.	Assignment	Path Conditions
1,2,3	$x \leftarrow X - 5$ $y \leftarrow Y + 5$	$X + Y > 10$
9,13,14	$x \leftarrow (X - 5) - 1 = X - 6$ $y \leftarrow (Y + 5) - 1 = Y + 4$	$X + Y > 10$ AND $X + Y \geq 0$

Since $X + Y > 10$ then $(X - 6) + (Y + 4) = X + Y - 2 > 10 - 2 = 8$ therefore $x + y > 0$

2. (a) $\Box b \rightarrow b \cup o$

   (b) $\Box \neg o \rightarrow ((r \rightarrow \bigcirc w) \land (w \rightarrow \bigcirc r)$

   (c) $\Box \neg o \rightarrow r \cup (b \cup (w \cup r))$

   (d) $\Box (r \land b \land g) \rightarrow \bigcirc w$

   (e) $\Box r \rightarrow r \cup \neg r$

3.

4.

5.

6.

7.