ECE 322
SOFTWARE TESTING AND MAINTENANCE
Fall 2025

Assignment #3
Solutions

Due date: Tuesday, October 14, 2025 by 3:00 PM

Total: 40 points

Value 10 points

1.One chooses randomly a single test case coming from each equivalence class. All tests have passed. Is the system under testing free of faults? Justify your answer.

Solution

No, because of possible coincidental correctness.

Value 10 points

2. (i) Propose test cases using the EPC and a weak n x 1 testing strategy, and determine the number of test cases using the EPC testing for the subdomain described as follows

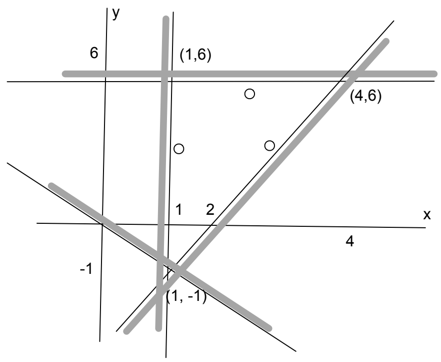
$$
\begin{aligned}
&x+y \geq 0\\
&y<6\\
&x-y-2 \leq 0\\
&x>1\\
&z>0\\
&z<6
\end{aligned}
$$

(ii) How many test cases is required to carry out EPC testing strategy for the following subdomain

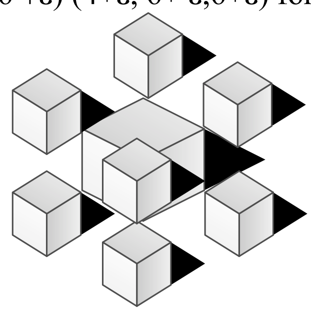
$$
\begin{aligned}
&x+y \geq 0\\
&y<6\\
&x-y-2 \leq 0\\
&x>7\\
&z>0\\
&z<8\\
&w>-1\\
&w<15
\end{aligned}
$$

Solution

The subdomain is presented below in the x-y coordinates; z- and w- coordinates not shown here.



EPC strategy. We require 4^n+1 test cases (n =3) so in total there are 64+1 =65 test cases. A part of the test cases for one of the vertices of the subdomain is listed below
(4,6,6) (4+ε, 6,6) (4, 6+ ε,6) (4+ε, 6+ ε,6)
(4,6,6+ ε) (4+ε, 6,6 +ε) (4, 6+ ε,6 +ε) (4+ε, 6+ ε,6+ε) for each corner of the cube.



The weak nx1 strategy produces the following test cases:

3 points on the plane (x, y, z) for which y =6 and one point in the interior of the subdomain, y<6
3 points on the plane (x, y, z) for which x =1 and one point in the interior of the subdomain, x>1
3 points on the plane (x, y, z) for which y> x-2 and one point in the interior of the subdomain, y>x-2

3 points on the plane (x, y, z) for which z =0 and one point in the interior of the subdomain, z < 0

3 points on the plane (x, y, z) for which z =6 and one point in the interior of the subdomain, z > 6

Note that the triples of points must be linearly independent so that they uniquely determine the corresponding plane.

For the subdomain

$$x+y\geq 0$$
$$y<6$$
$$x-y-2\leq 0$$
$$x>1$$

$$z>0$$
$$z<6$$
$$w>-1$$
$$w<20$$

and the EPC strategy, we require $4^4+1 = 257$ test cases.

Value 10 points

3. Which of the two collections of tests
Case-1

$$\left(\begin{bmatrix}1\\2\\3\\4\end{bmatrix}, \begin{bmatrix}5\\6\\1\\1\end{bmatrix}, \begin{bmatrix}0\\-2\\-6\\2\end{bmatrix}, \begin{bmatrix}11\\14\\5\\6\end{bmatrix}\right)$$

or
Case-2

$$\left(\begin{bmatrix}1\\2\\3\\4\end{bmatrix}, \begin{bmatrix}1\\9\\8\\7\end{bmatrix}, \begin{bmatrix}0\\-2\\-6\\2\end{bmatrix}, \begin{bmatrix}5\\6\\1\\1\end{bmatrix}\right)$$

would you use in a weak *n* x1 strategy assuming that all boundaries are linear and the subdomains are in the 4-dimensional space of real numbers. Justify your choice.

Solution
Case-2 can be used; the points are linearly independent, det(case-2) $\boxed{\neq 0}$. Case-1 consists of linearly dependent points, det(case-1)=0, so these points do not determine a position of the hyperplane (boundary) in a unique way.

Value 10 points

4. What is the minimal set of tests that covers all faults; see the for the matrix presented below.
hint: you may also view this problem as an example of integer linear programming (ILP) and use a Python package to solve it.

	T1	T2	T3	T4	T5	T6	T7	T8	T9
F1	1					1	1		
F2			1				1		1
F3					1		1	1	
F4		1							
F5			1	1				1	1
F6					1			1	
F7			1				1		1
F8		1		1			1		
F9						1			
F10				1	1	1			1
F11					1			1	1

Solution

T2 is a must because only T2 covers F4. The same applies to T6 as it is the only test that covers F9. After selecting T2 and T6, 6 faults remain uncovered: {F2, F3, F5, F6, F7, F11}. One selects T8 as it covers 4 remaining faults: {F3, F5, F6, F11}. T3 covers 2 remaining faults: {F2, F7}. The collection of test cases is composed of
{T2, T3, T6, T8}.

By solving the ILP problem, the set of test cases consists of T2, T3, T5, and T6.