ECE 322
SOFTWARE TESTING AND MAINTENANCE
Fall 2021

Assignment #3

<u>**Due date**: Monday, October 18, 2021 by 11:00 PM</u>

Total: 40 points

Value 5 points

1.Explain a concept of coincidental correctness using a function cos(2x) as an example.

Solution

Consider $x = \pi/8$. The function was incorrectly realized as cos(x); for this particular input, the result is correct.

Consider $x = n*2\pi$ (n=0, 1, 2, …). The function was incorrectly realized as cos(x); for this particular input, the result is correct.

Consider $x = \pi/8$. The function was incorrectly realized as sin(2x); for this particular input, the result is correct.

Value 10 points

2. A credit union is planning to offer new financial products and considers clients being characterized by gender, city dwelling (yes or no), and age group (under 25, between 25 and 65, and over 65). There are four new products: A, B, C, and D. Product A will appeal to male city dwellers. Product B will appeal to young (under 25) males. Product C will appeal to female in-between 25 and 65 who do not live in cities. Product D will appeal to all but males over 65. Construct a decision table for this problem. Answer the following:

(a) what is the maximal number of rules,

(b) simplify the table and show a collection of resulting test cases.

Solution

We identify attributes (input variables) and their values

Gender: M, F (2)

City dwelling: Y, N (2)

Age group: a- under 25, b –between 25 and 65, c – over 65 (3)

Maximal number of rules = 12

Rule#	1	2	3	4	5	6	7	8	9	10	11	12
gender	m	f	m	f	m	f	m	f	m	f	m	f
city	y	y	n	n	y	y	n	n	y	y	n	n
Age group	a	a	a	a	b	b	b	b	c	c	c	c
A	x				x				x			

B	x		x									
C								x				
D	x	x	x	x	x	x	x	x		x		x

Reduced table: rules 2, 6, 10 – two of the three conditions (gender and city dweller) are identical and all three values of age groups are present. The action part is the same. The rules are collapsed to a single rule (rule #2).

Rule#	1	2	3	4	5	6	7	8	9	10
gender	m	f	m	f	m	m	f	m	f	m
city	y	y	n	n	y	n	n	y	y	n
Age group	a	-	a	a	b	b	b	c	c	c
A	x				x			x		
B	x		x							
C							x			
D	x	x	x	x	x	x	x		x	

Further reduced rules are:

male & city dweller -> A
male & under 25 -> B
female & not city dweller & over 65 -> C
not (male & over 65) -> D

Value 10 points

3. (a) Propose test cases using the EPC testing strategy and a weak n x 1 testing strategy for the subdomain described as follows

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

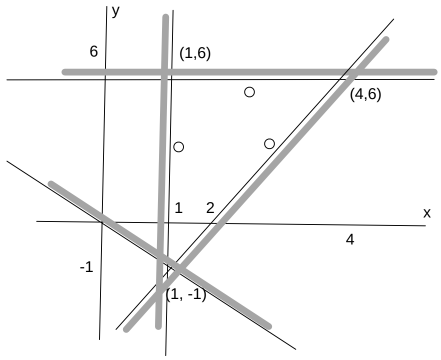
(b) How many test cases is required to carry out EPC testing strategy for the following subdomain

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

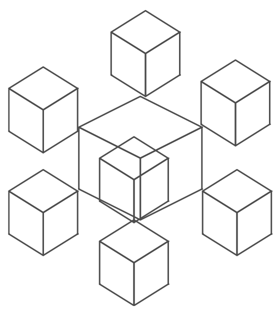
$w>-1$
$w<20$

Solution

The subdomain is presented below in the *x*-*y* coordinates; a *z*-coordinate 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 there are 8 test cases.



The weak *n*x1 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 have to be linearly independent so that they uniquely determine the corresponding plane.

For the subdomain

$$
\begin{aligned}
&x+y \geq 0\\
&y<6\\
&x-y-2 \leq 0\\
&x>1\\
&z>0\\
&z<6\\
&w>-1\\
&w<20
\end{aligned}
$$

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

Value 10 points

4. Discuss the EPC and the weak n x 1 strategies for testing a system that solves the following quadratic equation

$$ax^2+bx+c=0$$

How useful are these strategies in dealing with this testing problem.
Hint: Is the boundary linear?

Solution

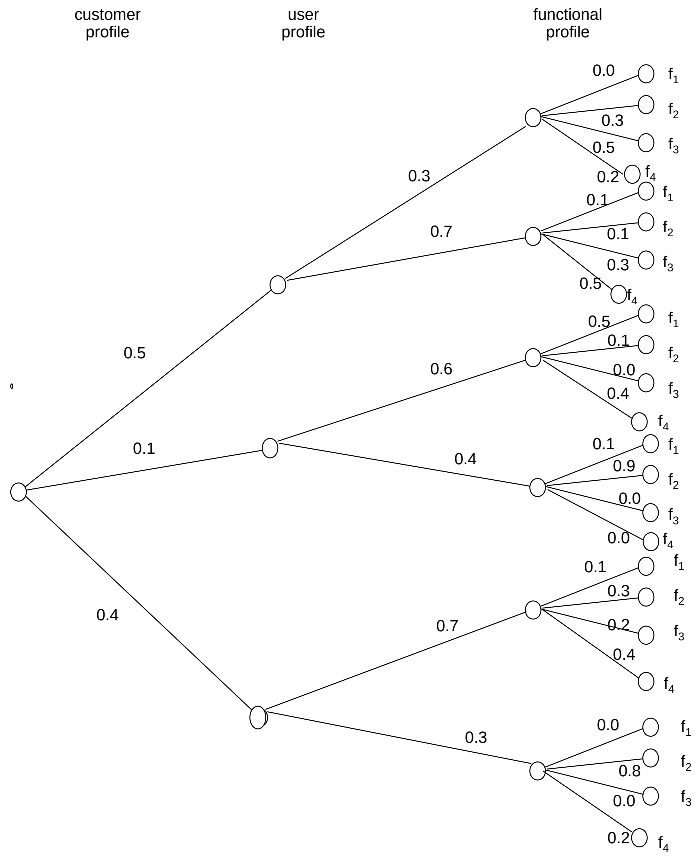
There are three situation depending on the value of the expression

$$b^2-4ac$$

This expression produces two subdomains $b^2-4ac>0$ and $b^2-4ac<0$.
The boundary is nonlinear; to use weak nx1 strategy one has to consider a linear approximation.
The EPC strategy involves the range of values of a, b, c depending on the range of floating point numbers expressed in a given precision used to represent the parameters of the equation. Say, in a single precision for 64 bits, one has the range -10^{-308} and 10^{308}. Given the location of the extreme points, the use of EPC strategy is very low.

Value 5 points

5.The relationships in operational profile can be conveniently presented in the following graph format where the numbers next to the edges of the graph stand for corresponding probabilities. Given the structure where we consider customer, user, and system model profiles, determine an order in which testing should be realized for each of the system model profiles f_1, f_2, f_3, and f_4.



Solution

We compute probabilities of f_i's. For instance, for f_1 we have

0.5*0.3*0.0+ 0.5*0.7*0.1+ 0.1*0.6*0.5+ 0.1*0.4*0.1+0.4*0.7*0.1+0.4*0.3*0.0 = 0.097

0.5*0.3*0.3+ 0.5*0.7*0.1+ 0.1*0.6*0.1+ 0.1*0.4*0.9+0.4*0.7*0.3+0.4*0.3*0.8 = 0.302

0.5*0.3*0.5+ 0.5*0.7*0.3+ 0.1*0.6*0.0+ 0.1*0.4*0.0+0.4*0.7*0.2+0.4*0.3*0.0 = 0.236

0.5*0.3*0.2+ 0.5*0.7*0.5+ 0.1*0.6*0.4+ 0.1*0.4*0.0+0.4*0.7*0.4+0.4*0.3*0.2 = 0.365

f4, f2, f3, f1