ECE 322
SOFTWARE TESTING AND MAINTENANCE
Fall 2021

Assignment #2
SOLUTIONS

Due date: Monday, October 4, 2021 by 3:00 PM

Total: 45 points

Value 5 points

1.Find on the Internet an application next_date (having the same functionality as the one discussed in class). Complete its testing for the input dates of October 4, 1582 and September 2, 1752. Comment on the obtained results. Include also a link to the application you have tested.

Solution
There are different solutions depending on the application being tested.

Value 10 points

2.Suggest a collection of test cases to test a procedure finding a maximum of five integer numbers

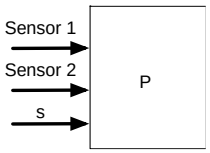
```
maxofFiveNumbers(int n1, int n2, int n3, int n4, int n5)
```

Integer numbers are represented using a 128 bit representation. Consider (i) exhaustive testing and (ii) error guessing.

Solution
Consider that integers are represented using n bits. Then exhaustive testing requires $2^n * 2^n * 2^n * 2^n * 2^n = 2^{5n} = 2^{5*128} = 2^{640}$ test cases.
In error guessing, one can suggest a number of test cases:
positive and negative integer numbers,
all integer numbers are the same,
some of the integer numbers out of the range
symbols,
etc.

Value 15 points

3.(i) Suppose that an application has n inputs (variables) and each variable partitions its input space in m equivalence classes. Determine the number of equivalence classes. How many tests do you require? Could you make the number of tests lower? Do detailed calculations for n =20 and m =10.
(ii) Some procedure P has three inputs



This procedure is invoked under the following input readings:

Sensor 1: (10, 25) or [15, 50]. The sensor generates positive readings with values in [0, range1], range1>50.
Sensor 2: [-1,1] or [4, 5]. The sensor generates both positive and negative readings from some range [-range2, range2], range2 >5
Control variable *s*: {1, 2}. The control variable assumes positive integer values {1, 2,... s_{max}}
Identify equivalence classes in this problem. Consider weak normal equivalence testing and strong normal equivalence testing. List test cases.

Solution
(i)The number of equivalence classes is m^n. In particular, one has 10^{20}. The number of test cases could be reduced by considering a certain testing strategy, for instance each choice coverage criterion. Unfortunately, the effectiveness of this testing is limited and the choice of test cases is arbitrary.

(ii) Equivalency classes are listed below (invalid classes are shown in red)
Sensor 1: [0,10]1 (10,50]2 (50,range1]3
Sensor 2: [-5,-1)**4** [-1,1]**5** (1,4)**6** [4, 5]**7** (5, range2]**8**
Control variable:
{1,2}**9** {3, 4,...,s_{max}}**10**
Using the weak normal equivalence class strategy, the tests are:
(1,5,9)(3,7,9)(2,4,9)(2,6,9)(2,8,9)(2,5,10)
There could be some other options depending which combinations of valid and invalid equivalence classes have been selected.

Using the strong normal equivalence class strategy, we end up with 5*5*2 = 50 tests.

Value 15 points

4. Consider a two-dimensional input domain described as

$$W = [0, 10] \quad [0, 20]$$

(viz. there are two input variables assuming values in the corresponding intervals). In this domain, there are four equivalence classes given as

$$W_1 = \{(x, y) \mid x^2+y^2 \leq e^2\}$$

$$W_2 = \{(x, y) \mid (x-1)^2+ (y-2)^2 \leq e^2\}$$

$$W_3 = \{(x, y) \mid (x-0.5)^2+ (y-2.5)^2 \leq e^2\}$$

$$W_4 = W-W_1-W_2-W_3$$

where *e* is a certain positive number. What should be the maximal value of *e* so that these equivalence classes form a partition?

Solution

The distance between the centers of any two circles has to be greater than 2*e*. We have the following inequalities

$$\sqrt{1+4} \geq 2e$$

$$\sqrt{(0.5)^2+(2.5)^2} \geq 2e$$

$$\sqrt{(0.5)^2+(0.5)^2} \geq 2e$$

so *e* assumes values smaller or equal to min(1.118, 1.274, 0.354)=0.354.