ECE 322
SOFTWARE TESTING AND MAINTENANCE

Mid-term Examination
October 25, 2019
10:00 – 10:50 AM

SOLUTIONS

Total 60 points ***GOOD LUCK***

Student Name & ID _____

1	2	3	4	5	Σ
/20	/10	/10	/10	/10	/60

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1. **[20 points=5*4]** Answer the following questions – please be concise.

(i)Are there any similarities between random testing and operational profiles?

Both use randomness (probability) to choose test cases.

(iii)Is the black box testing aimed at software validation or software verification? Justify your answer.

Validation; driven by specifications formulated by the user

(iii)The module supposed to compute the value of the expression $sin(x)+ cos(x)$. The test case was completed for $x= \pi/4$ and the returned result is $\sqrt{2}$. Is the module free of faults?

Cannot say this; one might have encountered an effect of coincidental correctness

(iv)Identify valid and invalid equivalence classes for the system having two inputs namely, a name and a phone area code of customer located in North America.
Develop a suite of test cases.

name – string of letters of length >1 and lower than 60

phone area code of customer located in North America

equivalence classes for name – if we consider only letters

valid equivalence class
only letters -length of string – integer in (1, 60)
invalid equivalence classes – length of string 0, 1
length of string greater or equal to 60

one can also consider strings composed of other symbols than letters; there could be other equivalence classes letters vs mixture of letters/other symbols

equivalence classes for phone area see also
valid equivalence classes
integer numbers in [200, 999]
invalid equivalence classes integers outside this range
Note that even in the range [200, 999] you have some special cases (currently not used).
Also there could be invalid equivalence classes formed by strings including letters, special symbols, etc.

(v) Complete the array below (fill in missing entries) so that it becomes an orthogonal array

a	*b*	*c*	*d*
1	1	1	1
1	2	2	2
1	3	3	3
2	1	2	3
2	2	3	1
2	3	1	2
3	1	3	2
3	2	1	3
3	3	2	1

2. [10 points] The university computer system allows students an allocation of disc space depending on their projects. If they have used allotted space, they have only allowed limited access, i.e., to delete files, not to create them. This is assuming they have logged in with a valid username and password.
Construct a reduced decision table and list a collection of tests.

Solution

Rules

Input conditions				
Valid username	F	T	T	T
Valid password	-	F	T	T
Account in credit	-	-	F	T
Output condition				
Login accepted	F	F	T	T
Restricted access			T	F

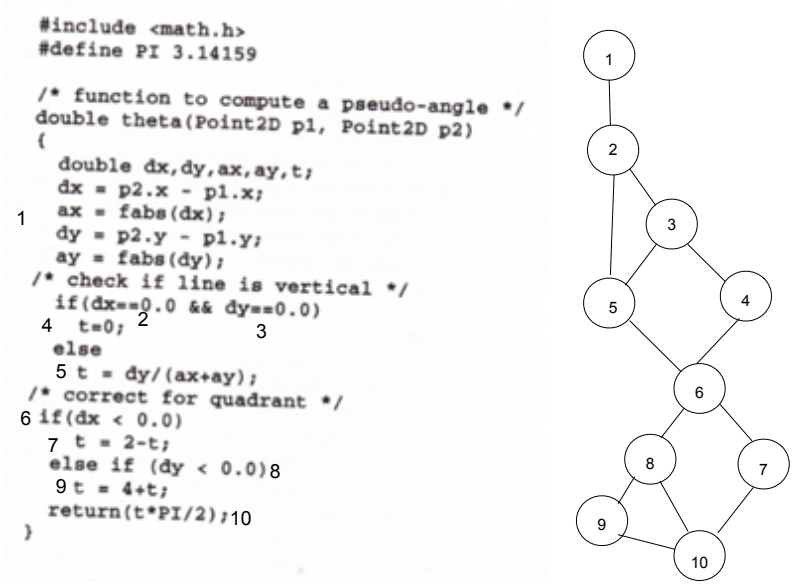
3. **[10 points]** Given is the following code

```
#include <math.h>
#define PI 3.14159

/* function to compute a pseudo-angle */
double theta(Point2D p1, Point2D p2)
{
  double dx,dy,ax,ay,t;
  dx = p2.x - p1.x;
  ax = fabs(dx);
  dy = p2.y - p1.y;
  ay = fabs(dy);
/* check if line is vertical */
  if(dx==0.0 && dy==0.0)
    t=0;
  else
    t = dy/(ax+ay);
/* correct for quadrant */
 if(dx < 0.0)
    t = 2-t;
  else if (dy < 0.0)
    t = 4+t;
  return(t*PI/2);
}
```

Draw a control flow graph and determine its cyclomatic complexity.

Solution



The number of binary decision boxes is 4, so the cyclomatic complexity is 5. One can also count the number of regions (the graph is planar) and here we obtain 5.

If (2 and 3) are treated as a single decision box, then the cyclomatic complexity is 4 (one binary decision box less).

4. [10 points] Consider a program that solves 2nd order differential equation

$$y''+ay'+cy=0$$

Identify valid equivalence classes. Develop test cases.

Solution

We consider a characteristic polynomial
$k^2+ak+c=0$
and determine $D = a^2-4c$
There are three cases implying a certain type of solution to this equation
$D>0$ – two real roots
$D=0$ roots are real and equal
$D<0$ there are two complex conjugate roots

Thus we have three equivalence classes W_1, W_2, W_3 formed in the (a, c) input domain:
$W_1 = \{ (a, c) \mid D>0\}$ $W_2 = \{ (a, c) \mid D=0\}$ $W_3 = \{ (a, c) \mid D<0\}$

5. [10 points] The subdomain is described by the following relationships

$$|x_1|+|x_2|>4$$

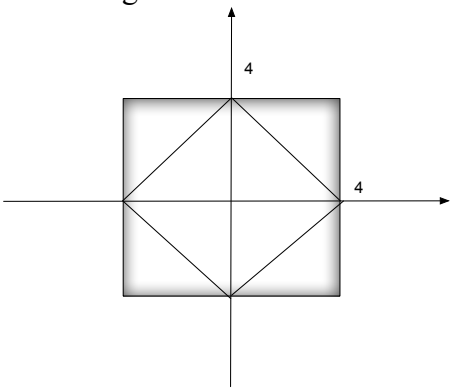
$$\text{Max}(|x_1|, |x_2|)\leq 4$$

(i)Plot this subdomain; is it open or closed?

(ii)Use the EPC strategy -list a set of test cases.

(iii)Show test cases produced by the weak *n* x1 strategy.

Solution
The subdomain is illustrated in the figure below



(i)it is neither open nor closed
(ii)the EPC strategy positions the test cases at the corners of the square

(iii)the weak *n* x1 strategy is realized by test cases indicated by black dots