THE HONG KONG POLYTECHNIC UNIVERSITY

DEPARTMENT OF COMPUTING

EXAMINATION

Course : MScIT/ST (61030/88004) / MScIS (61020) / MScEC (61030/61027/61028) / RS / CyberU (61801/61803)

Subject : COMP5222 Software Testing And Quality Assurance

Group : 101,1011 / 102,1021 / 1031 / 104,1041 / 1888 / --

Session : 2004 / 2005 Semester I

Date : 15 December 2004 Time : 18:30 - 20:30

Time Allowed : 2 Hours Subject Lecturer : Hareton Leung

This question paper has 4 pages (cover included).

Instructions to Candidates :

1) This is a CLOSED BOOK examination.
2) Answer **ALL** questions.

Do not turn this page until you are told to do so !

Question 1

(a) Describe four key deliverables of a testing project. (4 marks)

(b) Describe the contents of a weekly report on test progress. (3 marks)

(c) What is the purpose of SQA? (2 marks)

(d) Compare SQA and V&V. (5 marks)

Question 2

Given the following program,

```
     Procedure COMP
     X, Y, Z : integer;
1    read X, Y;
2    if X >= 3 then
3         Z := X + Y;
     else
4         Z := 0;
     endif;
5    if Y > 0 then
6         Y := Y + 5;
     endif;
7    if X - Y < 0 then
8         write Z;
     else
9         write Y;
     endif;
     end COMP;
```

(a) Identify the symbolic values of Y and Z, and the path condition for the path 1, 2, 3, 5, 6, 7, 9. (5 marks)

(b) Identify the basis paths. (6 marks)

(c) How many test cases are needed to achieve 100% path coverage? (2 marks)

Question 3

(a) Given a binary search routine that handles a special case list size of 13 elements. If the structure of the algorithm is used to identify equivalence classes, what is the minimum number of test cases required to test all equivalence classes and boundaries of this routine? (5 marks)

(b) Given the following specification of the Dental Insurance Claims Payment System:

Dentists with membership codes of 110 and 112 are member dentists.
For claims referencing a non-member dentist or for procedures not within the referenced dentist's record, a system table is used to calculate the amount paid. Otherwise, the amount submitted is paid. However, an override code of 111 allows the amount submitted to be paid for non-member dentists or for procedures not within the referenced dentist's record. When an override code is used an entry is made on the paid claims report.

Identify 3 causes and 5 effects from the above specification. (8 marks)

(c) Your new inventory control application will run on 4 different mobile devices, support 5 different communication protocols, and allows office staff, manager, and customer to check on the inventory status. Identify a suitable testing method for testing this application and describe the steps in using this testing method. (6 marks)

Question 4

(a) What type of errors may not be detected by

- boundary value testing, (3 marks)
- equivalence partitioning testing, (3 marks)
- decision table testing? (3 marks)

(b) Your boss wants to improve the effectiveness of testing and save testing cost. A tool vendor claims that buying his test tool will allow the boss to achieve his objective. Given the following data, do you agree with him?

Cost of tool: $200,000
Cost of training: $8000
Improvement of defect removal effectiveness: from 80% to 85%
Defects introduced during development: 20 defect/KLOC
Average output of the development team per year: 200KLOC
Cost to fix defect detected internally: $100/defect
Cost to fix defects reported by customer: $1000/defect. (6 marks)

Question 5

(a) Inspection follows a well-defined process and assigns a specific role to each team member. Describe in details the four key roles that must be included in an inspection team. (8 marks)

(b) A software team follows this process for software development: (5 marks)

- Develop requirements
- Develop system tests
- Design
- Develop integration tests
- Code
- Develop unit tests
- Execute unit tests
- Execute integration tests
- Execute system tests

Identify the inspections that can be added to this process.

Question 6

(a) Your team performs unit test, integration test, and system test prior to releasing your product. Assume the defect removal effectiveness of unit, integration and system test are 50%, 40% and 70% respectively. What is the defect density of your released product if we assume your team introduces 20 defects per KLOC during development? (5 marks)

(b) One of your friends knows that you are an expert in software testing and asks for your advice on code coverage tool. Identify the key functions that a good code coverage tool should provide. (5 marks)

Explain why the total cost of using a test tool may be several times the purchase price of the tool. (4 marks)

(c) Your friend also likes to determine the effectiveness of his test team. Suggest three metrics that can be used for this purpose. (6 marks)

(d) Usability testing should be included as part of e-commerce application testing. Describe the three categories of metric that are commonly used for measuring usability. (6 marks)

- END -

THE HONG KONG POLYTECHNIC UNIVERSITY

DEPARTMENT OF COMPUTING

EXAMINATION

Course : MScIT (61030/88004) / MScST (61030/88004) / MScIS (61030/61020) / MScEC (61030/61027/61028) / MSc CyberU (61801/61802/61803) / Research Student

Subject : COMP5222 Software Testing and Quality Assurance

Group : 101,1011 / 102,1021 / 103,1031 / 104,1041 / 181/ 1888 / 1889

Session : 2005 / 2006 Semester I

Date : 15 December 2005 Time : 18:30-20:30

Time Allowed : 2 Hours Subject Lecturer : Hareton Leung

This question paper has __4__ pages (cover included).

Instructions to Candidates :

1. This is a CLOSED BOOK examination.
2. Answer **ALL** questions.
3. Write ALL answers in the answer book provided. Begin each question on a new page.
4. Answer the question I asked, not the question you think I asked. Ask at once if any question is unclear.

Do not turn this page until you are told to do so !

Question 1

(a) Why is it important to thoroughly retest a defect after it has been reported fixed? Give 5 reasons. (5 marks)

(b) Explain the relationship between V&V, testing and inspection. (6 marks)

(c) Software testing is usually performed in one of four test levels, which occur at different times within the software development process. Name the four levels and discuss whether black box and/or white box testing is useful at each of them. (8 marks)

Question 2

(a) Identify four types of information required to be reported to upper management on a testing project. (8 marks)

(b) What data we need to collect during operational use of our software if we want to improve the test process? Give 4 data. (8 marks)

(c) Identify 5 key process factors that influence the effort required for doing testing. (5 marks)

Question 3

(a) You have been testing a certain software application for two months. How would you know when to recommend that the software be released to the customer? Describe 3 possible ways. (6 marks)

(b) Random testing is not recommended even for relatively small programs. Give 3 reasons. (3 marks)

(c) Describe six key functions/features of a Problem Management Tool (or Defect Tracking Tool). (6 marks)

(d) Studies have indicated that writing automated test can take up to 10 times more effort compare to running the test manually. Give 4 key reasons why this is the case. (4 marks)

Question 4

(a) Two inspectors inspected a source code and found the following defects. Estimate the remaining defects in the source code. (5 marks)

Product size	2 KLOC
Total defect found by inspector A	15
Total defect found by inspector B	24
Total defects found by both	14

(b) Draw a flow diagram showing the relationship between the following activities during system testing: (10 marks)

- Test case execution
- Fault identification
- Rework
- Regression testing

And the following entities of testing:

- Test cases
- Failures
- Identified faults
- Software
- Bad fixes

Question 5

Given the following functional requirement for a door security system (an embedded system):

- The status of 4 entry doors is monitored.
- Four electric door locks, one for each door, be controlled.
- The normal hours of business when the doors will be unlocked are from 8am to 6pm on Monday to Friday.
- No entry is permitted on Saturday or Sunday.
- No entry is permitted on company-specified holidays.

(a) Apply decision table testing technique to identify suitable test cases. (5 marks)

(b) Apply equivalence partitioning testing to identify suitable test cases. (5 marks)

Question 6

We are going to do some configuration testing on the Word Processor. We want to test it on

- Windows 98, 2000, XP home, and XP Pro
- Printing to an HP inkjet, a LexMark inkjet, an HP laser printer and a Xerox laser printer
- Connected to the web with a dial-up modem (28k), a DSL modem, a cable modem, and a wireless card (802.11b)
- With a 640X480 display, an 800 X 600 display, a 1024 X 768 display and a 1152 X 720 display

(a) How many combinations are there of these variables? (2 marks)

(b) Identify a suitable testing method that can reduce the number of test cases. Describe the steps to use this test method. (6 marks)

Question 7

Consider the following code fragment:

```
1   input x;
2   if x > 0 then
3      output x+1;
4   else  output x-1;
5   end if;
6   while x > 5 then
7      if x = 10 then
8         output "blah"
9      else  output "ugh"
10     end if;
11     x = x – 1
12  end while;
```

(a) What is the cyclomatic number for this code? (2 marks)

(b) Identify the basis paths. (4 marks)

(c) What is the minimal number of test cases to achieve 100% branch coverage? (2 marks)

END

THE HONG KONG POLYTECHNIC UNIVERSITY

DEPARTMENT OF COMPUTING

EXAMINATION

Course : MScIT (61030/88004), MScST (61030/88004), MScIS (61030/61020), MScEC (61030/61027), RS, MSc Programme (CyberU)

Subject : COMP5222 Software Testing and Quality Assurance

Group : 101, 102, 103, 104, 1888, CyberU

Session : 2006 / 2007 Semester I

Date : 21 December 2006 Time : 18:30-20:30

Time Allowed : 2 Hours Subject Lecturer : Hareton Leung

This question paper has ___4___ pages (cover included).

Instructions to Candidates:

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Question 1

(a) Why is it impossible to guarantee that an arbitrary software application is error free? Give 3 reasons. (9 marks)

(b) List 5 characteristics of a test case that is "better" than another test. (10 marks)

(c) Myers proposed the following principle in software testing: the more defects found during testing, the more that remain to be found later. Explain why this is the case. (6 marks)

Question 2

(a) Identify the focus of SQA: (4 marks)

i. when projects consistently use software metrics
ii. when projects not employing metrics

(b) Give 5 common deliverables of testing and briefly describe the content of these deliverables/documents. (10 marks)

(c) A small IT company with 20 development staff comes to you for advice on improving their testing. They list the following problems:

- many defects are detected late and by the customer
- testing often takes a long time to complete, thus delaying the delivery of their product
- the project manager finds it difficult to know the status of testing.
- most testers quit the job after working for a few months.

Suggest 5 ways that can help this company to improve their testing. (10 marks)

(d) Both code inspection and white-box testing focus on finding faults. Identify 3 advantages of doing code inspection over white-box testing. (6 marks)

(e) You have been testing a new system for 3 weeks and collected defect data daily. Your manager now asks you to estimate the remaining defects in the system. You look for some historical data from previous projects but find none available. Suggest a method to estimate the remaining defects. (7 marks)

Question 3

Given the following `Prime number` program:

```
main () {
(1) int number;
(2)    bool prime = true;
(3)    cin >> number;
(4) int I = 2;
(5)    while (I <= number/2 && prime) {
(6)    if (number/I*I == number)
(7)       prime = false;
(8)    I = I + 1:
(9) }
(10)   if (prime)
(11)      cout << "yes";
(12)   else
(13)      cout << "no";
(14)   }
```

(a) Draw its control flow graph. (5 marks)

(b) Compute the cyclomatic complexity of the `prime number` program. (3 marks)

(c) List the du-pairs for variable I. (4 marks)

Question 4

(a) A typical copy and paste function works like the following:

1. Goto the source document (can be a WORD file, Powerpoint file, MS Paint, or Excel file)
2. Mark the item to be copied
3. Copy (can be control-C or click COPY)
4. Move to the destination document (can be a WORD file, Powerpoint file, MS Paint, or Excel file)
5. Indicate where to do the paste action
6. Paste (can be control-P or click PASTE)

Explain how you would test this function. (6 marks)

How can you reduce the number of test cases? (5 marks)

(b) Given the following business rules:

Customer:

If the customer is a new customer, offer 20% discount on next order
If the customer is a repeat customer, offer free shipping

Risk level of goods:

If the risk level of goods is high, then
    If the customer is a new customer, check their credit record
    If the customer is a repeat customer, then:
        If the past orders total > 500, no checking needed
        Otherwise check their credit record.

Use a decision table to identify test cases. (10 marks)

(c) Given a software module that controls a temperature sensor that drives a warning light on an airplane to notify the pilot of potential icing problems. The specification says that this light is to glow red whenever the temperature is strictly less than –20 degrees Celsius, yellow between –20 and 10 degrees Celsius (inclusive), and green for all temperatures strictly greater than 10 degrees Celsius.

What is the minimum number of test cases needed to achieve statement coverage? (5 marks)

END

THE HONG KONG POLYTECHNIC UNIVERSITY

DEPARTMENT OF COMPUTING

EXAMINATION

Course : MSc Scheme-61030, CyberU

Subject : COMP5222 Software Testing and Quality Assurance

Group : 101, 102, 104, 1222, 1888, 181

Session : 2007 / 2008 Semester I

Date : 19 December 2007 Time : 18:30-20:30

Time Allowed : 2 Hours Subject Lecturer : Hareton Leung

This question paper has ___3___ pages (cover included).

Instructions to Candidates:

1. This is a **CLOSED BOOK** examination.
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3. Write **ALL** answers in the answer book provided. Begin each question on a new page.
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Question 1

A telecom system consisting of a telephone switch with 2 terminal telephones need to be tested. Both telephones can be provided by 3 vendors each producing 3 models. The switch, which manages between the two telephones, can also be provided by three vendors, each having 3 models of switch. The connection between the telephones and the switch can be of 8 different types: fiber optics, analog, ISDN, DSL, satellite, GSM, UMTS, and GPRS. *Telephone 1 --- switch --- Telephone 2*

(a) To fully test this telecom system, how many test cases are needed? (4 marks)

(b) For this telecom system, how can you reduce the number of test cases? Explain in detail your testing approach. (9 marks)

Question 2

(a) In XP, the customer and developers work cooperatively to specify the acceptance tests. Identify 3 advantages and 3 disadvantages if the customer and developers work together on acceptance tests? (9 marks)

(b) Your customer does not have experience in writing Acceptance Test Plan. Identify the major contents of Acceptance Test Plan. What should be the objective of doing Acceptance Testing? (9 marks)

(c) The roles of QA and Tester are very different. Identify 5 differences. (10 marks)

(d) What 3 tools would you purchase for your company for use in testing? Give the reasons why you propose these tools? (12 marks)

Question 3

(a) Your boss has learned about the benefits of Inspection and wants to implement it across all projects. Explain the steps you will take to introduce inspection to the project teams and have it used in the V&V process. (10 marks)

(b) We performed inspection on a document. The result is 16 defects detected in 36 pages. Assume the fix-fail-rate is 20% and the defect removal effectiveness of inspection is 60%,

(i) Estimate the remaining defect. (5 marks)

(ii) Estimate the defect density. (5 marks)

Question 4

(a) The high level requirement for an antilock braking system (ABS) of a car are listed below:

1. The ABS system should guarantee near-optimum braking performance irrespective of vehicle speed when braking
2. The ABS system should control the vehicle speed in the interval between vmin=2km/h and vmax=250km/h
3. The ABS system should work for different ground conditions, such as dry, wet, snow, and ice.
4. It should also work on straight or curve roads.

Draw a classification tree for the ABS. (9 marks)

Given the following functional requirement for a door security system (an embedded system):

- The status of 4 entry doors is monitored.
- Four electric door locks, one for each door, be controlled.
- The normal hours of business when the doors will be unlocked are from 8am to 6pm on Monday to Friday.
- No entry is permitted on Saturday or Sunday.
- No entry is permitted on company-specified holidays.

(b) Apply FSM testing (9 marks)

(c) Apply cause effect graph testing (9 marks)

END

THE HONG KONG POLYTECHNIC UNIVERSITY

DEPARTMENT OF COMPUTING

EXAMINATION

Course : MSc Scheme - 61030

Subject : COMP5222 Software Testing and Quality Assurance

Group : 101, 102, 103, 104, 105, 1888

Session : 2008 / 2009 Semester I

Date : 12 December 2008 Time : 18:30-20:30

Time Allowed: 2 Hours Subject Lecturer: Hareton Leung

This question paper has ___4___ pages (cover included).

Instructions to Candidates:

1. This is a CLOSED BOOK examination.
2. Answer ALL questions.
3. Write ALL answers in the answer book provided. Begin each question on a new page.
4. Answer the question I asked, not the question you think I asked. Ask at once if any question is unclear.

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Question 1

(a) Quality control activities focus on identifying defects in the actual products produced; however your boss wants you to identify and define processes that would prevent defects. Explain to your boss the difference between QA and QC responsibilities. (6 marks)

(b) You have been promoted to be the test team leader. Describe your responsibilities from the project start to end. (6 marks)

(c) In testing, the tester needs access to many information sources. Identify what documents/information sources a tester needs when doing (6 marks)

- Unit testing
- Integration testing
- System testing

(b) Give an example for each of the following defects: (8 marks)

1. High Priority and high severity defect
2. High Priority and low severity defect
3. High severity and low priority defect
4. Low severity and low priority defect

Question 2

(a) Given the following program statement: (9 marks)

```
if (a or b or c)
        x=0;
```

a, b and c are Boolean variables.

Give the test cases required to achieve

- statement coverage
- decision coverage
- MCDC coverage

(b) Imagine testing a date field. The field is of the form MM/DD/YYYY (two digit month, two digit day, 4 digit year). Do an equivalence class analysis and identify the boundary tests that you would run in order to test this field. No need to consider non-numeric values for these fields. (9 marks)

(c) Given the following specification:

A mailing is to be sent out to customers. The content of the letter is different for different types of customers. The content is about the current level of discounting and offer of another level of discounting.

Customer Types A, B and C get a normal letter except Customer Type C, who get a special letter. Any customer with 2 or more current lines or with a credit rating of 'X' gets a special paragraph added in the letter with an offer to subscribe to another level of discounting.

Apply decision table testing and determine how many test cases are needed to test this specification. (9 marks)

(d) Consider the following description of a function:

A start value and a length define a range of values. The function will determine if a given input value is within the defined range or not. The function will only consider integer input. Example: (5, 10) defines a range from 5 to 15.

Create a classification tree for this function that can be used to generate useful test cases. (10 marks)

Question 3

(a) Your manager would like to monitor the progress of fixing defects. Describe two metrics that can be used to monitor this. (6 marks)

(b) Given the following defect detection and defect removal data, (10 marks)

Stage Detected	Stage Originated							
	Requirements	Design	Code and Unit Test	SW Integration	SW Quality Test	System Integration and test	SW Maintenance	Total
Requirements	1,515							1,515
Design	1,181	1,555						2,736
Code and Unit Test	402	912	2,421					3,735
SW Integration	200	420	1,525	37				2,182
SW Quality Test	191	223	370	7	1			792
System Integration and Test	89	114	114	5	0	10		332
SW Maintenance	0	0	0	0	0	0	0	0
Total	3,578	3,224	4,430	49	1	10	0	11,292

calculate

- The percentage of defects originated in design and were detected in the design process
- Defect containment % (that is, total number of defects caught in-stage/total defects)

Question 4

(a) Your boss likes to implement a code inspection process. Your team wants to have some tools to reduce the work required for inspection. Identify and describe 3 tools that you will recommend to your team. (12 marks)

(b) Identify 3 major challenges in doing code inspection and explain how you can overcome these challenges. (9 marks)

END

THE HONG KONG POLYTECHNIC UNIVERSITY

DEPARTMENT OF COMPUTING

EXAMINATION

Course : MSc Scheme - 61030, CyberU

Subject : COMP5222 Software Testing and Quality Assurance

Group : 281, CyberU

Session : 2008 / 2009 Semester II

Date : 15 May 2009 Time : 18:30-20:30

Time Allowed: 2 Hours Subject Lecturer: Hareton Leung

This question paper has ___3___ pages (cover included).

Instructions to Candidates:

1. This is a CLOSED BOOK examination.
2. Answer **ALL** questions.
3. Write **ALL** answers in the answer book provided. Begin each question on a new page.

Do not turn this page until you are told to do so!

Question 1

(a) Given 2 examples for each of Prevention cost, Appraisal cost, Internal Failure cost and External Failure cost. (4 marks)

(b) Ad-hoc testing is not recommended even for relatively small programs. Give 3 reasons. (6 marks)

(c) What type of defects may not be detected by each of the following techniques?

- boundary value testing (4 marks)
- equivalence partitioning testing (4 marks)
- decision table testing (4 marks)

(d) System testing includes many types of non-functional testing. Identify 3 of them and briefly describe their objectives and key success factors. (12 marks)

Question 2

Given the following program:

```
main () {
(1)    int number;
(2)    bool discount = true;
(3)    while (not end of file) {
(4)    Read (age)
(5)    if (age >65)
(6)       discount = false;
(7)    else  discount = true
(8)     }
(9)    if (discount)
(10)      Write "yes";
(11)   else Write "no";
(12)   }
```

(a) Draw its control flow graph. (5 marks)

(b) Compute the cyclomatic number of this program. (3 marks)

(c) Identify the basis paths. (4 marks)

(d) List the du-pairs for variable `discount`. (3 marks)

(e) How many test cases are needed to achieve 100% path coverage? (4 marks)

Question 3

(a) Inspection has been found to be more effective than testing. Give 3 advantages of code inspection over white-box testing. (6 marks)

(b) Your boss likes to introduce inspection into the organization and asks you for an implementation plan. Present the steps for introducing inspection to your project team. (10 marks)

(c) Problem Management Tool (such as QuickBugs and Test Director) is a common tool used by larger organizations. Briefly describe six key features of this kind of tool. Also indicate when to use this tool in the development life cycle. (9 marks)

(d) Some people say automated testing is not worth-while if you plan to repeat the testing only two or three times. Give 4 key reasons why this is the case. (8 marks)

Question 4

You have been testing the software application for three months.

(a) Your boss asked you when the software will be ready for the customer. Describe 3 possible ways that you can use to make the release decision. (6 marks)

(b) Your boss also asked you to estimate the remaining defects in the system. You looked for some historical data from previous projects but found none available. Suggest a method to estimate the remaining defects. (8 marks)

END

THE HONG KONG POLYTECHNIC UNIVERSITY

DEPARTMENT OF COMPUTING

EXAMINATION

Course : MSc Scheme - 61030

Subject : COMP5222 Software Testing and Quality Assurance

Group : 102, 103, 104, 105, 1888

Session : 2009 / 2010 Semester I

Date : 21 December 2009 Time : 18:30-20:30

Time Allowed: 2 Hours Subject Lecturer: Lui Wing Cheung

This question paper has 15 pages (cover included).

Instructions to Candidates:

Answer **ALL** questions in the space provided.

Do not turn this page until you are told to do so!

Name:
Student ID:
Mark:

Question 1 (20 marks)

a) [2 marks] What is the difference between regression and confirmation testing?

b) [4 marks] Explain why we should start testing early and how to perform early testing.

c) [6 marks] Can static and dynamic testing detect/prevent error, fault and failure? Explain your answer.

d) [4 marks] What is a test stub and test driver? Describe the use of stubs and drivers in the different phases of the system development life cycle.

e) [4 marks] Describe one tool for automating the test execution and one tool for coverage measurement.

Question 2 (30 marks)

The 12-hour clock is a time representation in which the 24 hours of the day are divided into two periods called ante meridiem (a.m) and post meridiem (p.m). The period a.m. starts from 00:00 (midnight) and ends at 11:59am. The period p.m. starts from 12:00pm (noon) and ends at 11:59pm.

Consider a program which increments the current time by 1 minute. The user inputs the current date (in day-month-year format) and current time (minute:hour in 12-hour clock). The program outputs the date and time after one minute. For instance, suppose the user input March 15, 11:59am, the program should output should output March 15, 12:00pm. If the user inputs an invalid date (e.g. March 25, 0:15pm), the program should reject the input.

a) [8 marks] Identify the input variables and the associated equivalence classes using equivalence partitioning.

b) [4 marks] Give two examples of simple faults (1-way) for the program. What type of combination testing strategy do you suggest for testing this kind of fault?

c) [6 marks] Construct an extended decision table for the program. You only need to show 5 examples rules in the decision table.

d) [12 marks] Suppose pair-wise testing is used to generate test cases to test combinations of variables in part a).

i) Compare the use of Orthogonal Array and Covering array in test case generation. Which one is more preferred for pairwise testing?

ii) State two examples of pairwise faults for the program which can be revealed by pairwise testing.

iii) State two examples of faults in the program which may not be revealed by pairwise testing.

Question 3(30 marks)

a) [4 marks] Describe, with an example, the difference between condition and multiple condition coverage.

b) [4 marks] Define modified condition/decision coverage (MC/DC). What is the relationship between MC/DC and decision coverage?

c) [4 marks] Consider the following program which accepts 3 integers x, y and z as the length of a triangle and classify the type of the triangle.

```
1   public static void testTriangle(int a, int b, int c){
2      if(a<b+c && b<a+c && c<a+b){
3         if(a==b && b==c)
4            System.out.println("Equilateral");
5         else if (a==b || b==c || a==c)
6            System.out.println("Isosceles");
7         else
8             System.out.println("Scalene");
9      }
10     else{
11        System.out.println("Not a triangle");
12     }
13  }
```

Propose an MC/DC adequate test set.

d) [8 marks] Consider the following function which accepts 3 integers x, y and z as input and output whether x, y, or z is the biggest.

```
1   public static void greaterThan(int x,int y,int z) {
2       if (x>y){
3           if (x>z){
4               System.out.println("x is the greatest");
5           }
6           else {
7             System.out.println("z is the greatest");
8           }
9       }
10      else{
11          if (y>z){
12              System.out.println("y is the greatest");
13          }
14      }
15  }
```

i) What is the fault?

ii) Identify one test case which will result in a failure.

iii) Which white box coverage criterion will you adopt to reveal the fault? You should define the criterion and explain your choice. (note: you should choose a criterion which can always detect the fault but requires the fewest number of test cases)

e) [10 marks] Consider the following program function for checking if a number is prime or non-prime.

```
1   public static void isPrime(int n){
2         int count=2; /* the factor used to test if n is a prime*/
3         int numOfFactor=0;
4
5         if (n<0) {
6               System.out.println("Error: Negative number\n");
7         }
8         else if (n==0 || n==1){
9               System.out.println("non-prime\n"); /*by definition*/
10        }
11        else  {
12              while( count<n ){
13                    if (n%count==0){
14                          numOfFactor++;
15                    }
16                    count++;
17              }
18
19              if (numOfFactor==0)
20                    System.out.println("prime\n");
21              else
22                    System.out.println("non-prime\n");
23        }
24      }
25
```

Consider the test set T = {n=3, n=4}. Complete the following table for all the covered and uncovered c-use and p-use of the variable `numOfFactor` (in terms of the line number the variable is defined or used).

Defined at	Covered c-used	Uncovered c-used	Covered p-use	Uncovered p-use

Question 4: (20 marks)

a) [4 marks] For each of the following type of quality cost, list two quality related activities which contribute to the cost.

- Prevention cost
- Failure Cost

b) [4 marks] Describe the purpose of SQA audit. Distinguish between external and internal audit.

c) [8 marks] Consider the following tables which shows the scale of phase age and the defects which are injected and removed in the various phases in the system development life cycle.

	Phase Discovered							
Phase Injected	Requirements	High-Level Design	Detailed Design	Coding	Unit Testing	Integration Testing	System Testing	Acceptance Testing
Requiremants	0	1	2	3	4	5	6	7
High-level design		0	1	2	3	4	5	6
Detailed design			0	1	2	3	4	5
Coding				0	1	2	3	4

Figure 1: Scale of phase age

	Phase Discovered								
Phase Injected	Requirements	High-Level Design	Detailed Design	Coding	Unit Testing	Integration Testing	System Testing	Acceptance Testing	Total Defects
Requiremants	0	7	3	1	0	0	2	4	17
High-level design		0	8	4	1	2	6	1	22
Detailed design			0	13	3	4	5	0	25
Coding				0	63	24	37	12	136
Summary	0	7	11	18	67	30	50	17	200

Figure 2: Defect Injection versus Discovery

i) Compute the spoilage metric for the defects injected in the requirement, high-level design, detailed design and coding phase.

ii) [4 marks] Compute the defect removal efficiency (DRE) for the detailed design and unit testing phase.

--End of Paper--

THE HONG KONG POLYTECHNIC UNIVERSITY

DEPARTMENT OF COMPUTING

EXAMINATION

Course : MSc Scheme - 61030, CyberU

Subject : COMP5222 Software Testing & Quality Assurance

Group : 281

Session : 2009 / 2010 Semester II

Date : 4 May 2010 Time : 18:30-20:30

Time Allowed: 2 Hours Subject Lecturer: Hareton Leung

This question paper has ___3___ pages (cover included).

Instructions to Candidates:

1. This is a CLOSED BOOK examination.
2. Answer ALL questions.
3. Write ALL answers in the answer book provided. Begin each question on a new page.

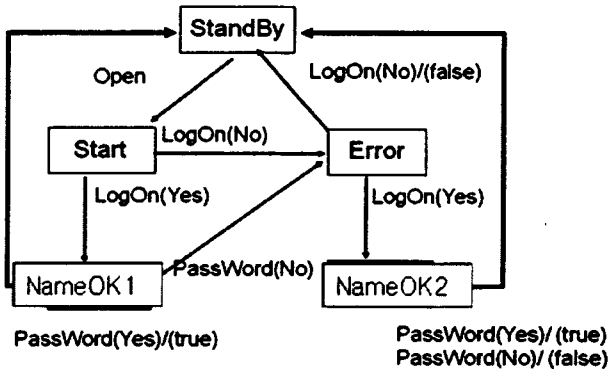
Do not turn this page until you are told to do so!

Question 1

The SignOn object (for managing user sign on to the system) has the following methods:

- Open - initiates a sign-on procedure
- LogOn - requests a name
- if the name is correct, PassWord requests the password
- if the password is correct, SignOn terminates with the value **true**
- if there is any error, the program starts again at LogOn
- for any 2 errors, SignOn terminates with the value **false**

The SignOn object returns either **true** or **false**. Then, other objects will take the return value and continue processing.



(a) Draw the transition table of SignOn. (5 marks)

(b) Give the test cases that can test all the transitions. (6 marks)

(c) Some testers like to use OA to reduce the number of test cases. Explain the OA testing method. Will you use OA to test SignOn and explain your answer? (6 marks)

Question 2

Given the following program:

```
1     input x;
2     if x > 0 then
3        output x+1;
4     else  output x-1;
5     end if;
6     while x > 5 then
7        if x = 10 then
8           output "yes"
9        else  output "no"
10     end if;
11     x = x - 1
12    end while;
```

(a) Compute its cyclomatic number. (3 marks)

(b) Identify the basis paths of this program. (4 marks)

(c) Give the minimal number of test cases to achieve 100% branch coverage for this program? (3 marks)

(d) Give all du pairs. (5 marks)

(e) Suppose you just finished testing 50% of the system and detected 100 defects. Estimate the remaining defects in the system. State all your key assumptions. (6 marks)

Question 3

(a) The capture/playback tool is one of the many popular testing tools. Identify 5 key functions of this type of tools. (10 marks)

(b) Explain how this tool can help with performance testing. (4 marks)

(c) Before we capture the test cases, which 3 key conditions (related to the system under test) must be satisfied? (6 marks)

(d) Your testing manager has proposed to buy a test automation tool for $40000 and the cost to implement automation is expected to be around $10000. He has further estimated that the cost for test execution will be reduced from the current $5000 per testing cycle to $1000 per testing cycle after test automation. If the project requires 5 testing cycles each year for the coming two years, should the company support test automation? Explain. (9 marks)

Question 4

Your friend is in charge of testing an e-commerce application. He asks you for advice.

(a) Recommend three key system testing types that your friend should include in his test plan. Briefly describe these three types of testing in the context of e-commerce application. (12 marks)

(b) Your friend also wants to know how to monitor the effectiveness of testing. Identify and describe three metrics that can be used for measuring test effectiveness in the context of e-commerce application. (9 marks)

(c) Your friend likes to use inspection to detect defects as early as possible. Each member of the inspection team is often assigned one or more specific roles. Identify four key roles in a typical inspection team and describe their responsibilities. (12 marks)

END