Maynooth University
National University of Ireland Maynooth

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THE NATIONAL UNIVERSITY OF IRELAND MAYNOOTH

JANUARY 2019 EXAMINATION

CS608

Software Testing

Dr. R. Bond, Dr. J. Timoney, Dr. S. Brown

Time allowed: 3 hours

Answer at least three questions

Your mark will be based on your best ***three*** answers

All questions carry equal marks

[25 marks]

1 (a) Describe (a) the goals, and (b) how to derive test cases, for the following three types of black-box testing: [6 marks]

(i) Equivalence partitioning (EP)
(ii) Boundary value analysis (BVA)
(iii) Combinations (using truth tables)

(b) Develop equivalence partition (EP) tests for the method `Car.getMotion()` as defined below. Make sure to include your analysis, test cases, and test data in your answer. Use value lines to assist in the analysis. Clearly indicate which test covers each test case, and the test cases covered by each test. Do not include a test implementation in your answer. [15 marks]

```
public class Car {

   public enum Motion {STOPPED, FORWARDS, REVERSE, INVALID};

   /**
    * Determine the motion of a car.
    *
    * @param speed - the speed of the car
    * @return INVALID if the absolute value of the speed is
    *                 greater than 300
    *         STOPPED if the speed is 0
    *         FORWARDS if the speed is valid and greater than 0
    *         REVERSE if the speed is valid and less than 0
    */
   public static Motion getMotion(int speed);

}
```

(c) Explain why the tests developed in part (b) of this question may not have found all the faults in the code. Refer to exhaustive testing and errors of commission in your answer. [4 marks]

[25 marks]

2 (a) Describe how a code coverage tool (such as EclEmma in Eclipse) can be used to identify statements that have not been executed during black-box testing. [2 marks]

(b) Explain the process of developing statement coverage (SC) tests. In your answer, explain what must be done in the analysis, where the test cases are derived from, and how the test data is developed. [5 marks]

(c) Develop statement coverage (SC) tests for the method shown below, using the line numbers provided on the left. No black-box test coverage results are available, so you must develop tests to cover every statement. You may if you wish develop a control flow graph (CFG) as part of your answer, but it is not necessary. Include analysis, test cases, and test data in your answer. Do not include an implementation in your answer. [15 marks]

```
   /**
    * Determine whether to warn a driver to brake
    * @param speedDifference - the difference between this cars
    *        speed and that of the car ahead
    * @param stopSignAhead - whether the camera has identified a
    *        stop sign ahead
    * @return true if the speed difference is greater than 25 or
    *              there is a stop sign ahead
    *         otherwise return false
    */
 1   public static boolean brake( int speedDifference,
 2         boolean stopSignAhead ) {
 3      boolean result=false;
 4      if (stopSignAhead)
 5         if (speedDifference>25)
 6            result=true;
 7         else
 8            result=true;
 9      else
10         if (speedDifference>25)
11            result=true;
12         else
13            result=false;
14    return result;
15    }
```

(d) Explain why a white-box test, such as statement coverage, is unlikely to find an error of omission. Provide an example in your answer, based on the code in part (c) of this question. [3 marks]

[25 marks]

3 (a) Describe how each of the following aspects of object-orientation making testing both easier and harder: [4 marks]
(a) Encapsulation
(b) Inheritance
(c) Polymorphism
(d) Message Sequence and State

(b) Describe what setter and getter methods are, and how these are used to unit test methods in class-context. [3 marks]

(c) A cloud file server allows files to be uploaded if the user has enough free space, or has special permission to exceed this. Develop equivalence partition (EP) tests for method `CloudFile.allow(int)` defined below. In your analysis show the model attributes, and getters, setters, and use methods for each attribute. Include value lines for natural ranges and partitions. There are no error cases. Show whether use methods read and/or write the attributes. Include tables for the test cases and test data. The test data must show the methods to call, the order of calling, and the data values. Do not include an implementation in your answer. [18 marks]

```
public class CloudFile {
   private int free; // disk free space
   private boolean specialPermission; // to exceed limit
   public void setFree(int newFree) {
      free = newFree;
   }
   public void setSpecial (boolean newValue) {
      specialPermission = newValue;
   }
   public int getFree() {
      return free;
   }
   /**
    * Determine whether a file may be saved to the file server
    * And if so, update the free space
    * @param bytes - the size of the file to be saved
    * @return true if specialPermission or bytes<=free
    *         otherwise false
    */
   public boolean allowed(int bytes) {
      boolean allowed;
      if (specialPermission) allowed = true;
      else if (bytes<=free) allowed = true;
      if (allowed) free -= bytes;
      return allowed;
   }
}
```

[25 marks]

4 (a) Give three reasons why test automation is important. [3 marks]

(b) Show the general outline of an automated test for a web-based application using Selenium. You may use pseudo-code in your answer. Clearly indicate how: [10 marks]

(i) The web browser is opened before the tests run
(ii) HTML elements are found using their unique IDs
(iii) Data is entered into input fields
(iv) Buttons and Anchors are clicked
(v) Output text may be retrieved from text elements

(c) Show the outline of an automated random test for the method `Rectangle.isSquare()` defined below. Include a method that generates rectangles at random, using the technique of a decision tree to select an output at random, and then selecting random values that match. You can assume a class Rectangle exists, with constructor `Rectangle(x,y)` and public attributes `int x` and `int y`. Explain how this approach resolves the test oracle problem. [12 marks]

```
/**
 * Determine whether a rectangle is square
 * @param x – the width
 * @param y – the length
 * @return true if x==y && x>0 && y>0
 *         false otherwise
 */
public static void isSquare(int x, int y) {
}
```