Försättsblad till skriftlig tentamen vid Linköpings Universitet

Datum för tentamen	2018-10-22
Sal	
Tid	
Kurskod	TDDD04
Provkod	
Kursnamn/benämning	Programvarutestning
Institution	IDA
Antal uppgifter som ingår i tentamen	
Antal sidor på tentamen (inkl. försättsbladet)	6
Jour/Kursansvarig	Lena Buffoni
Telefon under skrivtid	
Besöker salen ca kl.	
Kursadministratör (namn + tfnnr + mailadress)	Anna Grabska Eklund
Tillåtna hjälpmedel	Ordbok

LiTH, Linköpings tekniska högskola
IDA, Institutionen för datavetenskap
Lena Buffoni

Written exam

TDDD04 Software Testing

2018-10-22

Permissible aids
Dictionary (printed, NOT electronic)

Teacher on duty

Instructions and grading
You may answer in Swedish or English.

Your grade will depend on the total points you score on the exam. This is the grading scale:

Grade	3	4	5
Points required	50%	67%	83%

Important information: how your answers are assessed

Many questions indicate how your answers will be assessed. This is to provide some guidance on how to answer each question. Regardless of this it is important that you answer each question completely and correctly.

Several questions ask you to define test cases. In some cases you are asked to provide a minimal set of test cases. This means that you can’t remove a single test case from the ones you list and still meet the requirements of the question. Points will be deducted if your set of test cases is not minimal. (Note that “minimal” is not the same as “smallest number”; even when it would be possible to satisfy requirements with a single test case, a set of two or three could still be minimal.)

You may find it necessary to make assumptions in order to solve some problems. In fact, your ability to recognize and adequately handle situations where assumptions are necessary (e.g. requirements are incomplete or unclear) will be assessed as part of the exam. If you make assumptions, ensure that you satisfy the following requirements:

- You have documented your assumptions clearly.
- You have explained (briefly) why it was necessary to make the assumption.

Whenever you make an assumption, stay as true to the original problem as possible.

You don’t need to be verbose to get full points. A compact answer that hits all the important points is just as good – or better – than one that is long and wordy. Compact answers also happen to be quicker to write (and grade) than long ones.

Please double-check that you answer the entire question. In particular, if you don’t give a justification or example when asked for one, a significant number of points will always be deducted.

1. **Integration Testing (10p)**
    a. Explain the difference between decomposition based and call based integration and give an example of an integration strategy for each. (4p)
    Decomposition based – based on the hierarchical structure of the software (modules), uses the decomposition tree, eg:top-down, call based – based on the interactions (calls) between the modules, uses the call graph, pair-wise integration testing
    b. How many stubs need to be written for bottom up integration of software a module composed of three sub-modules? Justify your answer. (2p)
    0, no stubs in bottom up integration
    c. Explain what MM-path integration is and give two advantages and one disadvantage of this approach over bottom-up integration. (4p)
    Given a set of units, their **MM-Path graph** is the directed graph in which nodes are **module execution paths** and edges correspond to **messages** and **returns** from one unit to another. MM-path integration is integration of modules along this path.
    + no need for stubs
    + reflects better software behavior
    - paths can be difficult to identify

2. **State transition testing (12p)**
You are asked to test the following car sharing application: "Every time a driver set-up a trip, a listing is sent to the website for the trip details (date, time, starting point, destination) and number of available places in the car (3 passengers maximum). Users can book one or more places in the car in one booking. If the number of places requested is more than the number of places available, the booking is rejected. Once there are 0 places left in the car or the trip date has passed, the booking becomes unavailable"
    a. Draw a state-transition diagram for the application. If you make any assumptions about the model state them clearly (6p)
    b. Based on this generate a set of test cases providing transition coverage (4p)

    c. Is path coverage possible for this application? Justify your answer. (2p)
    No, because there can be an infinite number of rejected bookings
3. **Model Checking (6p)**
    a. Give the definitions of **sound** and **complete** algorithms for program verification. (2p)

An algorithm is **sound** in the case where each time it reports the program is safe wrt. some errors, then the original program is indeed safe wrt. those errors

An algorithm is **complete** in the case where each time it is given a program that is safe wrt. some errors, then it does report it to be safe wrt. those errors

    b. Is it possible to build an algorithm for program verification that is both sound and complete? Justify your answer. (2p)
    Yes, but it will not be a terminating algorithm

c. Give two examples of correctness properties that can be verified by a model checking algorithm (2p)
   Absence of dead-locks, violation of constraints, …

4. **Control flow testing (14p)**
   a. For the code below, determine a set of basis paths (6p)
      4 basis paths
   b. From the given set of basis baths deduce a set of test cases that provide decision coverage (4p)
   c. How does this set need to be modified to provide condition coverage? (2p)
      A test for each separate condition to be true and false
   d. Is this set of basis paths unique? Justify your answer. (2p)
      No, if you start with a different basis path, you end up with a different set

```
        public int rollDice(int dice1, int dice2, int bonusDice){
                int winPoints;

                if(dice1 == dice2)
                        winPoints = dice1*4;
                else if(dice1==6||dice2==6)
                        winPoints = 12;
                else
                        winPoints = dice1 + dice2;

                if(winPoints > 10 || bonusDice==6)
                        winPoints += bonusDice;

                return winPoints;
        }
}
```

5. **Defect classification (10p)**
   a. You are asked to classify the following report using the table below (copy it out on paper first). (6p)

"To conform with the General Data Protection Regulation the specification of the HR management tool has been updated to add a requirement that all personnel data stored needs to be encrypted, however during a code review Sam noticed that the interface for this functionality was not implemented in the database module"

   b. Give two ways defect taxonomies can be helpful in testing (2p)
      - help with identification and classification of faults
      - used to help with test case generation
   c. Is defect severity directly related to priority? Justify your answer. (2p)
      Not necessarily, a severe defect eg: locking out of the system for no reason, can be low priority if it only happens once in a billion logins

Fault/Defect	Attribute	Value
Defect	Asset	HR management tool
Defect	Artefact	Database Module

Fault/Defect	**Attribute**	**Value**
Defect	Effect	Security
Defect	Mode	Missing
Defect	Severity	High

6. **Test Planning 8p**
   a. Explain what data-based coverage criteria mean. Give an example of a testing method for achieving data coverage. (2p)
   Data-based coverage criteria means criteria on covering types of possible inputs and outputs in the software (EC-testing for example)
   b. You are hired as a test team leader in a team that is developing a social application connected to a fitness watch that allows users to interact with each other. The application is being produced for the watch manufacturer in a team that uses continuous delivery and top-down development. Outline the criteria you would use to stop testing for this project and the test strategy to achieve this. To get full points for this question you must motivate your answer. (4p)
   Mentioning any of these strategies + explanation, or any other reasonable strategy -> 2 points
   - Top-down development means top down integration testing is probably also best suited, we also should integrate consistently with the client application
   - Continuous delivery means we need to automate the testing process, and run tests on each new commit or complete testing each iteration or…
   - Since we have a client with an assumed requirement specification we can generate test cases based on the requirement specification or on the user stories that the client provides us with

   Mentioning any of these criteria or any other reasonable criteria + justification – 2p
   - Since we will have a requirement specification we can use requirement coverage as our test criteria
   - Since this is not a highly critical application (social networking) we do not need very stringent test criteria, so we can focus on black box testing and for each iteration when our test suite covers 100% the current iteration requirements and the software passes 80% of the tests
   - We should probably have a budget for security testing, to ensure all the data is stored in conformance with the latest regulations, since this might cause a problem
   - …

c. Give two scenarios when exploratory testing is preferable over scripted testing (2p)
   i. Quick feedback on a finished product
   ii. To further investigate a specific fault more interactively

7. **Software Test Automation (8p)**

a. What is meant by **sensitive** tests and **robust** tests? Illustrate your answer with an example. (3p)
   i. Sensitive – compares test results more in detail, more thorough but is more affected by changes to software
   ii. Robust – compares test results more superficially but is more stable wrt to changes
   Example, gui testing: robust = test the message displayed, sensitive = test message, fonts, box size and location

b. What are reference tests and when are they useful? (2p)
   Reference results are results of manually executed tests verified to be correct, they are used to test against in automated testing

c. Give one disadvantage of test automation (1p)
   Can give the wrong perception of having things under control, but does not remove the need for human intervention

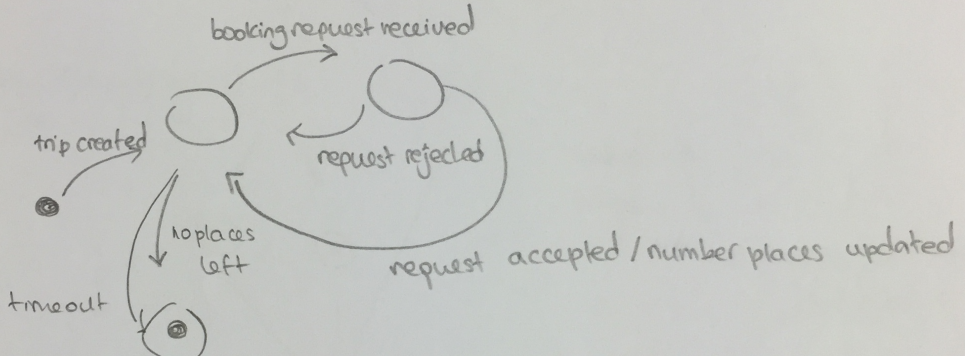
d. Give two strategies for automated test generation (2p)
   - Based on behaviour – model based testing
   - Based on structure – model checking with invariants
   - Based on interfaces – covering possible inputs/outputs

8. **Easy Points – True or False (8p)**

You get 1p for each correct answer, 0p for no answer, and -1p for each incorrect answer. However, you cannot get negative points for this question.

a. Equivalence Class testing is a kind of Boundary Value testing **F**
b. A risk identification taxonomy is helpful in classifying faults **F**
c. Test automation does not remove the need for human analysis of the test results **T**
d. The defect detection percentage of a test suite keeps increasing after the software is released **F**
e. Automated pairwise testing algorithms generate the minimal number of test cases testing all combinations of two variables **F**
f. Using line coverage as a coverage criteria is better than using nothing at all **T**
g. In model based test case generation, concretizing test cases means organizing them into feature sets **F**
h. Test driven development requires regular refactoring of the code **T**

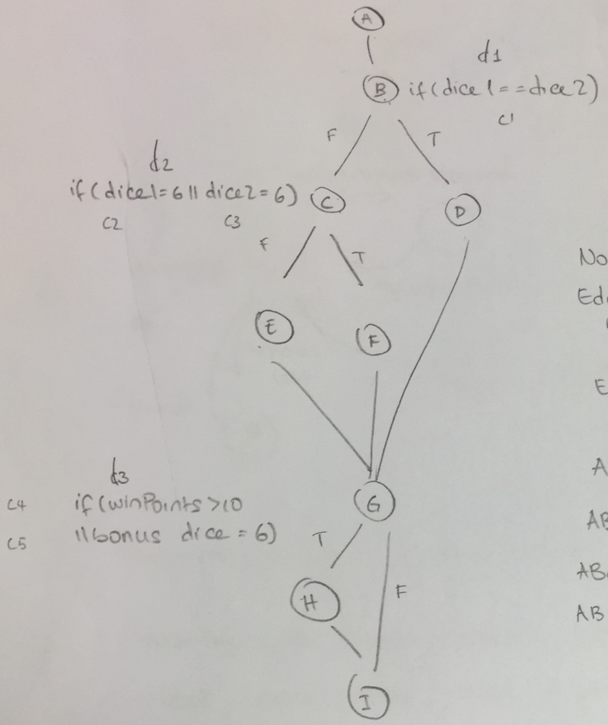
Registration system



transition coverage = arrows covered

T1: create trip with 3 empty places, book 2 places, book 2 more places, book 1 place

T2: create trip with 1 empty place, let it time out



Nodes = 9

Edges = 11

$E - N + 2P = \underline{\underline{4}}$ basis paths

ABCEGHI

ABDGHI

ABCFGHI

ABCEGI

	d1	d2	d3	input d1	d2	bonus	expected output
T1	F	F	T	5	4	6	15
T2	T	–	T	6	6	4	28
T3	F	T	T	5	6	6	17
T4	F	F	F	1	2	4	3

	C1	C2	C3	C4	C5
T1	F	F	F	F	T
T2	T	T		T	F
T3			T		
T4					

there is a test case for each test condition where it is F and T

no additional test cases needed