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MONASH University

Semester Two 2017
Examination Period

Faculty of Information Technology

EXAM CODES: **FIT2107**

TITLE OF PAPER: **Software Quality and testing - SAMPLE PAPER!**

EXAM DURATION: 2 hours writing time

READING TIME: 10 minutes

THIS PAPER IS FOR STUDENTS STUDYING AT: (tick where applicable)

☐ Berwick	☑ Clayton	☑ Malaysia	☐ Off Campus Learning	☐ Open Learning
☐ Caulfield	☐ Gippsland	☐ Peninsula	☐ Monash Extension	☐ Sth Africa
☐ Parkville	☐ Other (specify)			

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AUTHORISED MATERIALS

OPEN BOOK	**☑ YES**	**☐ NO**
CALCULATORS	**☐ YES**	**☑ NO**
SPECIFICALLY PERMITTED ITEMS	**☐ YES**	**☑NO**

if yes, items permitted are:

Candidates must complete this section if required to write answers within this paper

STUDENT ID: __ __ __ __ __ __ __ __ __ DESK NUMBER: __ __ __ __ __

INSTRUCTIONS TO STUDENTS

This sample exam is of a similar format and the questions are indicative of some of the types of questions you might see on the real exam. Some of them are directly from past exams in FIT4004; some have been modified, and some are completely new. I think, if anything, they are *slightly* harder than the real exam will be.

There are a total of 75 marks available in this exam. The number of marks allocated to a question is a *rough* guide to how long you should spend on it.

Question 1 – Quality (12 marks)

Programmable Logic Controllers (PLCs) are a specialized type of embedded computer system used by engineers to control industrial processes. They can be used to control motors, heating elements, valves (automated taps to control liquid or gas flow), and many other devices that are present in automated factories. They respond to a variety of sensors, including "on/off" sensors as well as analogue sensors that measure things like temperature, pressure, and speed.

Rather than conventional programming languages, PLCs are programmed using a specialized graphical language – the "programs" look like electrical circuit diagrams. They can often specify exact timing constraints – for instance, that a motor is to stop 50 milliseconds after a temperature sensor reads a certain value. Programs for a PLC are written on PCs and uploaded to PLCs via a USB or network connection, and interpreted by the PLC firmware.

The factories, and the hardware that these PLCs are used to control, often lasts for decades.

You are responsible for developing the firmware for a new PLC model. The firmware acts as the operating system for the PLC – it provides the environment for the programs written by the engineers for the specific factory installation to run. It includes the interpreter for the PLC programming language, and facilities to upload new or modified programs. It does not include the development environment that runs on the PCs, nor the programs written for a specific factory installation.

System quality attributes are defined in ISO/IEC9126 as:

- **Functionality**
- **Reliability**
- **Usability**
- **Efficiency**
- **Maintainability**
- **Portability**

For each quality attribute, give *two* examples of a specific, assessable requirement/property that *might plausibly* be applicable for the PLC firmware. If an attribute is of limited or no relevance in this application and therefore you can't give two such examples, explain why. If the attribute is relevant to the application, but it is difficult to describe assessable requirements relating to it, explain why.

Your understanding of the system quality attributes is much more important than your knowledge of the specifics of PLCs, so your answer does not have to go into great detail about the operational aspects of factories or other systems that PLCs are used to control.

(12 marks)

Question 2 – inspections (2 + 12 + 8 = 22 marks)

a) For a Fagan inspection of a source code artefact, should the programmer of that artefact attend the inspection? Explain why or why not in few sentences. (2 marks)

b) You are developing a new Fagan inspection checklist for source code written in Python.

Consider the following candidate items for the checklist and indicate whether they are suitable as-is for such a checklist, need to be modified (and propose a modified version), or are not suitable for a Fagan inspection checklist. In each case, state a rationale.

i) All variables must be initialized before use.
ii) Class and attribute names must be consistent with reviewed UML class diagram.
iii) All method names must reflect the purpose of the method.
iv) All methods must use the best algorithm available.
v) All methods that are not part of a class or module's public API should have names that begin with an underscore ('_') character.
vi) Attributes should be made part of a class or module's public API only when necessary.

(12 marks)

c) Some software engineering experts have proposed, based on the fact that more defects are found by inspections than unit testing, to eliminate unit testing entirely and rely exclusively on inspections and system testing.

In two or three paragraphs, analyse the strengths and weaknesses of such a proposal. Do you think it is likely to be an improvement on current practice? Justify your answer.

(8 marks)

Question 3 – Mocking (6 marks)

In your assignment 3, you were asked to "mock" calls to the Tweepy library when unit testing your program. The Tweepy library provides the ability to access information from the Twitter social network from within a Python program.

Describe and clearly explain two advantages of using mocking to test this particular program. Take a few sentences to explain each advantage – including providing specific scenarios where mocking is helpful
(6 marks)

Question 4 – unit testing (4 + 4 + 2 + 6 + 3 = 19 marks)

The questions relate to the following Python source code:

```
class Student:
    def __init__(self, firstName, familyName, grade):
        self.givenName = firstName
        self.familyName = familyName
        self.grade = grade

    def letter_grade(self):
        '''Return the letter grade from the numerical mark
        for this student
        according to the standard Monash scale'''
        if self.grade >= 80:
            return "HD"
        elif self.grade >=70:
            return "D"
        elif self.grade >=60:
            return "C"
        elif self.grade >=50:
            return "P"
        else:
            return "N"

    def pass_subject(self):
        '''Return true if the student has received a passing grade for
        this subject'''
        return self.letter_grade() is not "N"

    def result_summary(self):
        return self.firstName + " " + self.familyName + " " +
str(self.grade) + " " + self.letter_grade()

class Unit:
    def __init__(self, students):
        self.students = students

    def fail_report(self):
        for student in students:
            if not student.pass_subject():
                print(student.result_summary())
```

(question on next page)

a) Give the smallest possible set of *test inputs* (that is, values for `self.grade`) that would achieve 100% *statement coverage* for the method `letter_grade()`. (4 marks)

b) Give the smallest possible set of *test inputs* for `Unit.fail_report()` (where a test input involves calling the constructor to create a `Unit` object and calling `fail_report()` on it) to achieve 100% *branch* coverage for `fail_report()` (not including methods invoked by it). (4 marks)

c) Do you think it would be a good idea to test `fail_report()` just using your answer to part b)? Explain why or why not and if not, provide an alternative approach in about a paragraph. (2 marks)

d) Suggest an appropriate *black-box* testing strategy for `letter_grade()`. Explain why it is appropriate for this method, and use it to come up with a set of *test cases* for `letter_grade()`. (6 marks)

e) Write Python code using the `unittest` module that implements the *first* of your tests in part d). (3 marks)

Question 5- metrics (3 + 3 + 4 + 4 = 14 marks)

One of the Chidamber and Kemerer metrics is Coupling Between Objects.

It is defined as:
CBO for a class is a count of the number of other class to which it is coupled…ie methods of one use methods or instance variables of another. (Chidamber and Kemerer (1994))

a) In general, do you think a system with many classes with a high CBO metric would be easier or harder to *unit test* well than an equivalent system with lower CBO values? Explain your answer in about a paragraph. (3 marks)

b) Is it likely to be easy to reuse classes with a very high CBO score? Justify your answer. (3 marks)

c) Are there aspects of good design related to coupling that CBO *does not* measure adequately? Explain your answer – if there are such aspects, include examples to illustrate. (4 marks)

d) Chidamber and Kemerer's Response for a Class metric (RFC) is defined as the size of the set of the following methods:
   - The methods defined in the class.
   - Any method called directly by a method defined in the class.

   If RFC is high, does that tell us anything about the likely value of the CBO score? What about the other way around – if CBO is high, is RFC likely to be high? Explain your answers. (4 marks)