THE UNIVERSITY
OF ADELAIDE
AUSTRALIA

Examination for
Bachelor of Arts, Bachelor of Science,
Bachelor of Computer Science, Bachelor of Computer Science (Advanced),
Bachelor of Mathematical and Computer Science, Bachelor of Computer Graphics, Bachelor of Engineering, Graduate Diploma in Computer Science,
Master of Computer Science, Master of Information Technology,
Master of Software Engineering, Master of Computing & Innovation

Semester 2, November 2013

Software Engineering and Project
COMPSCI 3006, 7015

Official Reading Time:	10 mins
Writing Time:	120 mins
Total Duration:	130 mins

Questions	Time	Marks
Answer all 7 questions	130 mins	120 marks 120 Total

Instructions

- Begin each answer on a new page
- Examination material must not be removed from the examination room
- Open book examination: text book, lecture notes, personal notes, foreign language dictionary (paper), English language dictionary (paper) allowed
- Write neatly to ensure readability

Materials

- 1 Blue book

DO NOT COMMENCE WRITING UNTIL INSTRUCTED TO DO SO

The questions in this exam paper relate to the following scenario.

The scenario

Following the successful deployment of the initial Road Closure Marking robot, a Japanese company has contracted your group to add additional features to the system so that it can be used in Japanese cities when disasters (e.g., earthquakes) strike.

In order to speed up the marking operation, the company has requested that your system controls not one, but multiple robots concurrently. The reason for this request is simple: the marking operation is time critical and by employing a dozen or so robots, road closures can be completed as quick as possible.

After exploring the safety ramifications of having multiple robots, the company has decided that the safest solution is to have multiple operators controlling a single robot each from their own computer. The information collected by each of the robots should be shared giving an overall picture of the state of exploration and in particular keeping track of the positions of all robots in the city.

Multiple robots introduce new safety concerns. In particular there is potential for robots to collide. The customer has therefore indicated that a collision avoidance system is a "must have" for the updated system. The company has requested a two stage collision avoidance system. It must include a **passive alert**, which warns the operator if there is another robot within a certain distance of the robot that they are controlling. This warning must be sufficiently early to allow corrective action to be taken by the human operator.

It must also include an **active emergency stop**, which will be used should the operator fail to take appropriate action. The system will stop the robot if there is another robot within a second predetermined distance.

Both the passive alert distance and active emergency stop distance should be configurable. To enable this, each robot will be fitted with a transmitter that periodically transmits its current position, facing and an identifier for the robot.

Regrettably, your group leader has had a good lunch with the CEO of the Japanese company and has promised to deliver the new robot system in 10 months.

Most of this exam will explore the software engineering issues that stem from this scenario. More specific details will be given in the relevant questions.

Software Engineering Process Models

Question 1

(a) Indicate the number of your project group in your exam booklet and give a description of the software engineering process model that your group followed in developing your initial product.

[4 marks]

The clients who are commissioning the new system require that your team demonstrates a prototype every two weeks. This requirement is not negotiable and should the client feel at any stage that the project is in significant danger of not delivering an adequate product on time, your contract will be terminated.

(b) Suggest an appropriate software engineering process model to adopt. Your answer must include a reasonable description of your chosen model.

[8 marks]

(c) Your software development manager has decided that the model you have just chosen might be a plausible model to adopt, but is not convinced of its suitability. You are required to write a report justifying your selected model. In the context of this:

- Provide four reasons for using this model for the new project.
- Suggest one risk in moving to this model.

[8 marks]

[Total for Question 1: 20 marks]

Tools

Question 2

(a) The stable trunk repository model is described in detail in the SVN book. Describe the purpose of each of the following features of the stable trunk repository model:

i. Trunk

[2 marks]

ii. Branch

[2 marks]

iii. Tag

[2 marks]

(b) Consider the following Ant script:

```
<project name="Robot" default="dist" basedir=".">
  <target name="init">
    <mkdir dir="classes"/>
    <mkdir dir="lib"/>
  </target>

  <target name="compile" depends="init">
     <javac srcdir="src" destdir="classes"/>
  </target>

  <target name="dist" depends="compile" >
    <jar jarfile="lib/Robot.jar" basedir="classes"/>
  </target>

  <target name="clean" >
    <delete dir="classes"/>
    <delete dir="lib"/>
  </target>
</project>
```

i. Explain precisely the operation of each target in this script.

[6 marks]

ii. Which target will be called when the following command is issued and why?

```
ant
```

[2 marks]

[Total for Question 2: 14 marks]

Project Management

Question 3

Based on the software process model that you have chosen in Question 1(b), your task in this question is to create a project time line that reflects this chosen process. For this question, you should assume that a central "map-server" is used to facilitate communication between each client machine.

(a) Identify a series of milestones (at least 4) for the new project (You need to give proper explanation for each milestone).

[8 marks]

(b) Draw a project time-line for the updated robot system, assuming that the starting point for the project is the Road Closure Marking Robot system which fully implements all the features mentioned in the project specification distributed at the beginning of the semester.

The project time-line should include the milestones identified above and should show the important aspects of the development model chosen in Question 1(b).

Note that you do not need to provide any time estimates for any work unit.

[8 marks]

(c) Configuration management is an important part of the Software Engineering process.

i. List four (4) aspects of Configuration Management that should be addressed in the CM plan.

[4 marks]

ii. What is the difference between a codeline and a baseline?

[2 marks]

[Total for Question 3: 22 marks]

Risks and Hazards

Question 4

(a) State and briefly describe a **significant risk** which is applicable to the new robot project. The chosen risk must have been insignificant or completely absent from the original Road Closure Marking robot.

[4 marks]

(b) For the risk you identified above in part(a), briefly outline the following:

- An avoidance strategy
- A mimimisation strategy
- Contingency plan.

[4 marks]

(c) A collision between two robots is a definite hazard associated with the new system. This question requires you to classify this hazard according to the IEC 61508 hazard classification as discussed in the SafetyCritialSE lecture.

i. What is the severity of this hazard? Briefly justify your answer.

[2 marks]

ii. What is the likelihood of the hazard occurring, assuming that no control measures (including the passive and active avoidance systems) have been implemented? Briefly justify your answer.

[2 marks]

iii. Given the severity and likelihood of the hazard, classify the risk associated with the hazard. Indicate whether or not you believe this risk is at an acceptable level; justify your answer.

[2 marks]

iv. Assuming that the risk is not acceptable, describe one control measure that you would put into place to reduce the risk.

[2 marks]

[Total for Question 4: 16 marks]

Software Architectures

Question 5

(a) The updated system will involve multiple operators sharing map and robot position data. Two possible architecture organisational styles are the shared repository model and the client-server model.

i. Describe how the shared repository model may be used for the new system.

[3 marks]

ii. Describe how the client-server model could be used for the new system.

[3 marks]

iii. Give one advantage that the repository model has in comparison to the client-server model.

[2 marks]

iv. Give one advantage that the client-server model has in comparison to the repository model.

[2 marks]

(b) The following questions relate to software architecture control styles.

i. Briefly describe the broadcast control model. Give an example of how this could be applied for part of the Road Closure Marking system.

[3 marks]

ii. Briefly describe the interrupt driven control model. Describe one feature of the system for which this control model would be most appropriate.

[3 marks]

[Total for Question 5: 16 marks]

Requirements and Testing

Question 6

(a) What are the major factors which need to be considered when determining the threshold distance at which the **Passive alert** system is activated?

[5 marks]

(b) What are the major factors to be considered when determining the threshold distance for the **Active emergency stop** system?

[3 marks]

(c) Using the proforma, below, write a functional user requirement relating to the **active emergency stop** system described in the scenario description.

- Title
- Description
- Rationale
- Acceptance criteria

[6 marks]

(d) For the requirement given above, describe an acceptance test suite that can be used to determine whether or not the acceptance criteria are satisfied.

[6 marks]

(e) As a project manager which of the following is preferable:

- The test suite covers 100% of the critical code, but currently a large number of these tests fail.
- The test suite covers less than 50% of the critical code, but all tests pass.

Justify your answer.

[2 marks]

[Total for Question 6: 22 marks]

Quality Management

Question 7

(a) The following questions relate to software quality. Name 4 quality assurance practices used in your group project, and briefly explain the reasons that you used each of the practices.

[6 marks]

(b) Your code reviews have revealed a substantial portion of code that is non-compliant with the coding standard. Describe two (2) process improvements that could be put into place in order to improve compliance against the standard. Justify your answers. (Alternatively you may describe two processes that you already have in place that you feel they improved the code quality).

[4 marks]

[Total for Question 7: 10 marks]

End of exam