Faculty of Science

Academy of Computer Science and Software Engineering

Final Summative Assessment
First Opportunity

Module	**IFM03A3 / IFM3A10** Informatics 3A – Introduction to Software Engineering
Campus	APK
Month	June 2021

Date	4 June 2021	**Reading Time** download and read assessment paper	10 minutes (08:00)
Assessor	Mr T Moodley	**Writing Time**	180 minutes (11:10)
External Moderator	Prof A van der Merwe (UP)	**Submission Time** export diagrams, compile & save document, and upload	50 minutes (12:00)
		Submission Closes	12:05
Marks	150		

Instructions

- Answers may be typed, or hand-written and photographed.
- Ensure that all diagrams are neatly drawn, either by hand or using a drawing tool.
- Unless otherwise stated, diagrams do not constitute complete answers.
- Where possible, provide answers in the form of a list.
- Where possible, upload your submission as a single **PDF document**.
- Please **DO NOT** compress (ZIP, RAR, etc.) your submission.
- Please upload your submission before the closing time at **12:05**

This question paper consists of 5 pages

AntExterminators

Teamwork makes the dream work.

Mr Jerry approaches you in a huff and a puff, looking frightened and bewildered.

"Thank you!" Mr Jerry yells, "You have done an excellent job with our Ant Tracker. The AntTracker was used in Aspen Autos community center to track the movement of all the ants and we managed to successfully identify the queen. But with all great things, the end has come, it is time to get rid of these overpopulated ants! An idea came to me in my sleep, why not start my own ant extermination business, and we can finally rid them from this planet?"

"I want to be able to, along with my assistant, manage my team of ant exterminators. We keep a strict record of exactly when each of our ant exterminators was recruited and how many ants they have exterminated. Each ant exterminator has a speciality, which only I want to know. Some deal with flying ants, while others deal with ants that like to hide and build massive anthills."

"The stock manager – Ms Doom – needs to know exactly what and how many cans of insecticide are currently in storage and how many are currently being used. Depending on how many call-outs we get per week, she adjusts her restock order accordingly."

"Then there is the swatter manager – Mr Swats – and he must know exactly which swatter is being used. Swatters need to be serviced regularly. Otherwise, they will fall apart. Each swat needs to be registered when returning from assignment, and a service should be booked when the swatter has swatted 100 times."

"Ant exterminators are assigned based on their speciality. When there is an assignment, I must know which ant exterminator is currently on that assignment. I also need to know the status of the assignment, as provided by the ant exterminator. We cannot have too many idle ant exterminators! Before the exterminators go out they must ensure they log the vehicle out, and in some cases they should be able to request for backup, when they need to dig hard for those ants."

"An ant exterminator returning from assignment, must log a report, but they also need to return all insecticide cans (full or empty) and swatters to their respective departments. Finally, during the reporting, the ant exterminators need to log the ants that were killed, if any. A record is kept, according to be used later."

"I want to see exactly which ants can be found in which areas around our service area. If I see an increase, we might need to hire more ant exterminators."

"Do you think you can help out?"

QUESTION 1

1.1. Provide a definition for Software Engineering. (3)

The application of a **systematic, disciplined, quantifiable approach [1]** to the **development, operation, and maintenance [1]** of software; that is, the application of engineering to software. [1] And the s**tudy of approaches [1]** of such. take last part out

1.2. As a software engineer, you architect and compose software. But what is software? (3)

Instructions [1] that when executed provide desired features, function, and performance;
Data structures [1] that enable the programs to adequately manipulate information;
And **description information [1]** in both hard copy and virtual forms that describes the operation and use of the programs.

1.3. Compare the nature of software versus the work of other engineering disciplines. (4)

- Software is logical not physical
- Not affected by the environment
- Does not "wear out", but can deteriorate
- Can easily be reengineered

[10]

QUESTION 2

One of the most difficult tasks software engineer faces, is understanding the requirements. The seven tasks of requirements engineering can be defined as follows:

1. Inception
2. Elicitation
3. Elaboration
4. Negotiation
5. Specification
6. Validation
7. Management

2.1. Which **requirements analysis model** would be the best for the project described by Mr Jerry? Motivate your answer by referring to the steps described above.

Scenario-based models
Class-oriented models
Behavioural and Pattern-based models
Data Models
Flow-oriented Models
MOTIVATION SHOULD MATCH PROCESS [3]
MOTIVATION SHOULD INCLUDE CASE STUDY [4] (7)

- Inception
  - o Understand where the problem originated
- Elicitation
  - o Problems of scope, problems of understanding, problems of volatility
- Elaboration
  - o Expand and refine the problem defined by the customer
- Negotiation
  - o Conflicts between engineer and customer's requirements reconciled
- Specification

- o Set the written requirements for use by engineer
- Validation
  - o Is each requirement consistent with the overall objective?
  - o Have all requirements been specified proper abstraction?
- Management
  - o Changes can be made as progress is made

2.2. Provide a concise **problem statement** for the AntExterminators. (4)
- Relevance to Case Study [2] – management of exterminators to errdicate the ants
- Description of source Problem, not solution [2] – must be problem specific, do not relate to the solution

2.3. Provide a brief **proposed solution** for the AntExterminators. (4)
- Relevance to Case Study [2]
- Brevity/Cohesiveness of solution [2]

[15]

QUESTION 3

3.1. Name one **non-functional requirement** that specifically applies the AntExterminators. Explain how you believe it can be applied and how it can then be measured.
NOTE: Do not use general non-functional requirements such as: security, reliability, availability, etc. (5)
- Relevance to Case Study [1] - must relate: The cans being full or not
- Application to Solution/Functional Requirements [2]
- Applicable Measurement [2]

3.2. List *all* the **functional requirements** that you can extract from Mr Jerry's description of AntExterminators. *NOTE: The mark allocation does not indicate the number of functional requirements.* (6)
- Phrased as Functional Requirements (Stories) and NOT Use Cases
- Each use case should be relevant from the case study.

3.3. Draw a **use case diagram** illustrating the use cases derived from the requirements identified in **Question 3.2**. (20)

Use Cases MUST match Functional Requirements from previous question

	Weak	Fair	Accomplished
Applicable Actors	0-1	2-3	4
Applicable Subsystems	0	1	2-3
Applicable Use Cases	0-3	4-6	7-9
Diagram Correctness	0-1	2-3	4
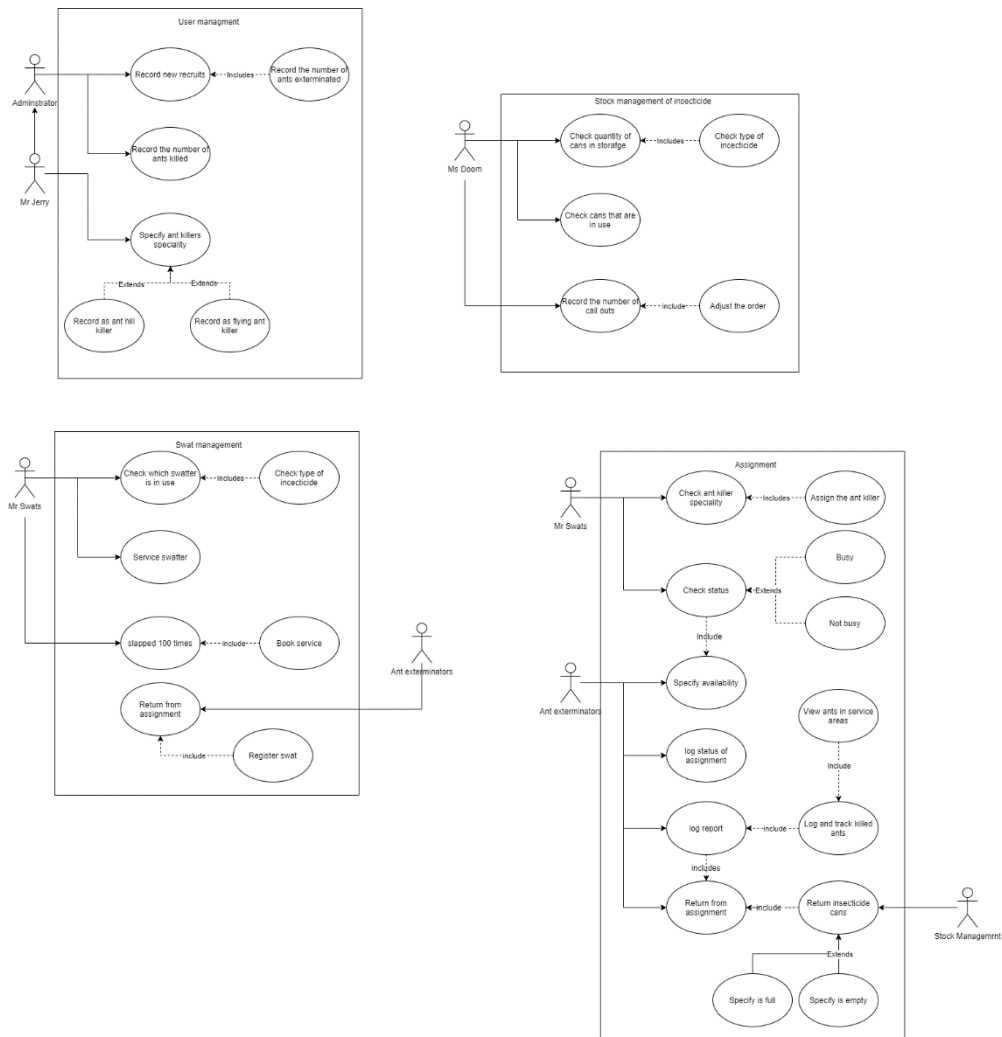
3.4. If you could **alter** the functional requirements for *AntExterminators*, what would you
add or change, and why? Please ensure you motivate each change. (4)
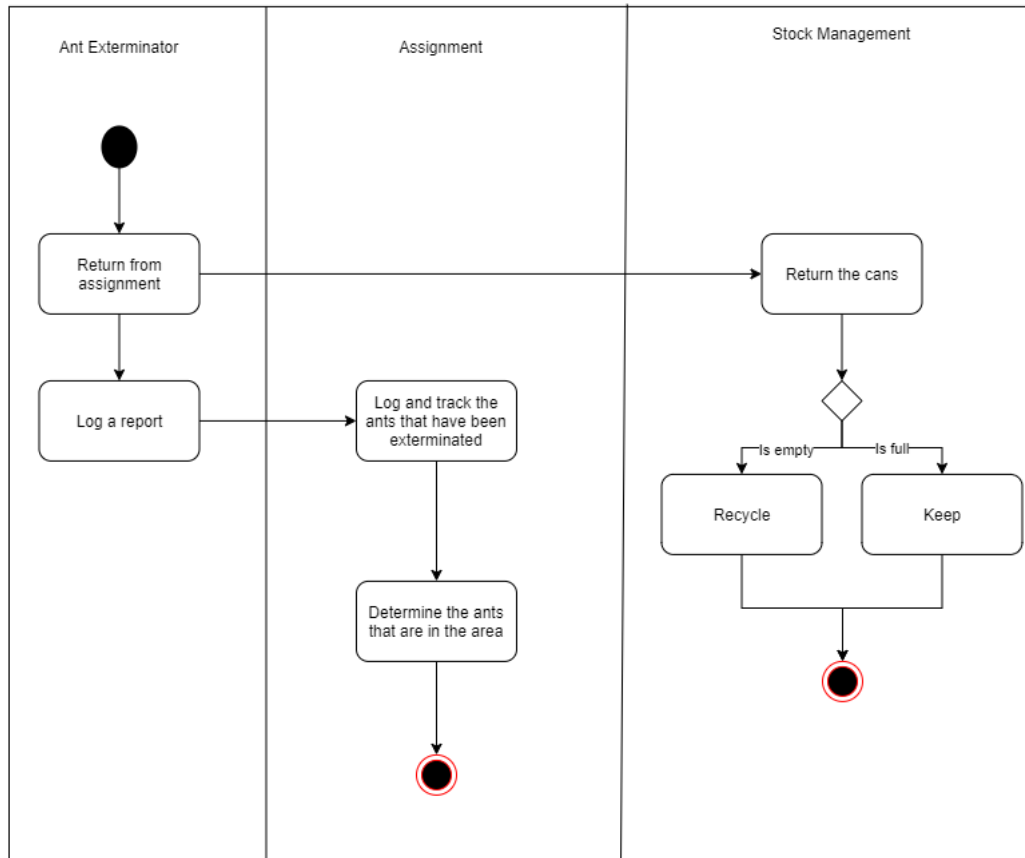
Student's Answer. Should NOT changes business processes!

[35]

QUESTION 4

Draw an **activity diagram** for a use case entitled: "*Return from assignment*".

If it does not contain INFORMATION SYSTEM subsystems/swimlanes **= 0**

	Weak	Fair	Accomplished
Basic Activity Elements (Start, End, Arrows)	0	1	2
Swimlanes	0	1	2-3
Appropriate Actions	0-1	2	3-5
Logical Flow	0-1	2	3-5
No swimlanes = 0			

[15]

Question 5

Consider the following C# code. Draw an **Interaction Sequence Diagram** to model the code. You may assume that **Main** is automatically executed.

```csharp
01: class Program
02: {
03:     static void Main()
04:     {
05:         bool ground = // value from GUI
06:         AntExterminator me = new AntExterminator();
07:         Assignment myAssignment = new Assignment(me);
08:         myAssignment.GetTransport(ground);
09:         myAssignment.Execute();
10:     }
11: }
12:
13: class Assignment
14: {
15:     private Exterminator _mainExterminator;
16:     private Vehicle missionTransport;
17:     public Assignment (Exterminator mainExterminator)
18:     {
19:         _mainExterminator = mainExterminator;
20:     }
21:
22:     public void GetTransport(bool groundMission)
23:     {
24:         missionTransport = new Vehicle(groundMission);
25:     }
26:
27:     public void Execute() {
28:         mainExterminator.Dispatch(missionTransport);
29:     }
30: }
31:
32: class Exterminator
33: {
34:     public void Dispatch(Vehicle myTransport) {
35:         // Off on an assignment
36:         myTransport.Go();
37:     }
38: }
39:
40: class Vehicle
41: {
42:     private bool _needsDigger;
43:     public Vehicle(bool groundMission) {
44:         _needsDigger = groundMission;
45:     }
46:     public void Go() {
47:         if (_needsDigger)
48:             System.Console.WriteLine( "Dig dig dig." );
49:         else
50:             System.Console.WriteLine( "Swat swat swat." );
51:     }
52: }
```

[20]

	Weak	Fair	Accomplished
Classes from Code	0-1	2	3-4
Appropriate Messages/ Method Calls	0-1	2-4	5-6
Logical Flow	0-2	3-5	5-8
Diagram Correctness	0	1	2

QUESTION 6

6.1. Which **software development process** do you think will be best for the development of AntExterminators? Motivate your decision based on AntExterminators. (3)

Waterfall
Evolutionary
Iterative
Any Agile-based process
MOTIVATION SHOULD MATCH PROCESS [3]

6.2. Provide a brief description of the **operation** of the software development process. you selected in Question 6.1. You may use a diagram to aid you. (7)

	Weak	Fair	Accomplished
Diagram	0	1	2-3
Description	0-1	2-3	3-4
Description*	0-1	2-4	5-7

* If no diagram, full [7] marks can be awarded to description

[10]

QUESTION 7

7.1. What is a **software architecture**? (3)

The software architecture of a program or computing system is the structure or structures of the system [1], which comprise software components [1], the externally visible properties of those components [1], and the relationships [1] among them

7.2. During the architectural design process, where should security be considered? Motivate your answer. (3)

- Security should be considered throughout the entire development process.
- Security should be a non-functional requirement in any system, no matter the functional requirements.
- Security should be kept in mind during the initial design phases as it will impact the design of the entire system
- Test cases for security should be developed
- Security should never be an "add-on", but deeply rooted in the entire

7.3. Data is at the base of the design model and it is usually considered before all other aspects. Why is this? (2)

Data is the main reason for the software. No data, No software.
Associations needs to be determined.
Inputs, transformations and outputs considered

7.4. Considering AntExterminators, which **generic architectural style** will you base your design on? Motivate your decision. (2)

Layered
Data Centred
Object Oriented
NOT: Data flow, Main/Subsystem
Motivation must make sense in terms of the Case Study

7.5. Use a diagram to describe the architectural style you selected in **Question 7.4** while referring to AntExterminators in the diagram.

(10)

	Weak	Fair	Accomplished
Diagram*	0-1	2	3-4
Description*	0-1	2-3	3-6

* If diagram does not contain components from case study, WEAK only, full ACCOMPLISHED can still be awarded to description

[20]

QUESTION 8

8.1. Choose any one (1) **design pattern** *(creational, structural, or behavioral)* that could be applied to AntExterminators. Motivate why you chose this pattern, then briefly describe it. (5)

	Weak	Fair	Accomplished
Description	0	1	2
Motivation	0	1	2-3

8.2. When starting an architectural design, you are faced with many architectural styles. What are some factors you need to consider when choosing an appropriate style? (5)

	Weak	Fair	Accomplished
Design pattern outline	0-2	3-4	5-6
Applicable to Case Study	0	3-4	5-6

8.3. Draw a conceptual class diagram for AntExterminators demonstrating the design pattern that you chose in **Question 8.1**. (10)

At least 3 classes [3-4]
Appropriate relationships [3-4]
Appropriate Attributes / Methods [3-4]

[20]

QUESTION 9

Considering that AntExterminators deals with highly sensitive data, discuss measures you will put in place to ensure the integrity of data.

	None	Definition	Application
Identification	0	1	2
Authentication	0	1	2
Authorisation	0	1	2
Confidentiality	0	1	2
Integrity	0	1	2
(Other relevant disucssion)			2

[5]

» End of Exam «