

**NANYANG TECHNOLOGICAL UNIVERSITY****SEMESTER 1 EXAMINATION 2023-2024****SC2006/CE2006/CZ2006 – SOFTWARE ENGINEERING**

Nov/Dec 2023

Time Allowed: 2 hours

**INSTRUCTIONS**

1. This paper contains 4 questions and comprises 4 pages.
  2. Answer **ALL** questions.
  3. This is an open-book examination.
  4. All questions carry equal marks.
  5. Refer to Appendix A on page 4 for the project description which is needed to answer some of the questions.
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1. Based on the project description given in Appendix A,
    - (a) Identify the actors and use cases of the project and draw the use case diagram. Use <<include>> and <<extend>> relationships where appropriate. (17 marks)
    - (b) Write the use case description(s) for the functionality of security check of a project code. Your use case description must include the following elements: Actors, Pre-conditions, Flow of events and Alternative flows, if any. (8 marks)
  2. (a) For the functionality of security check, identify the main classes and their associations and draw a conceptual class diagram. Your conceptual class diagram should clearly depict the stereotypes of each class. You do not need to identify any attribute or operation within the classes. (8 marks)

Note: Question No. 2 continues on Page 2

- (b) Draw an activity diagram with swimlanes that shows the activities of each actor for the security check process. (8 marks)
- (c) Explain the statement “Incremental development can be plan-driven or agile”. (4 marks)
- (d) Explain why agile methods may not work well in a team with a wide range of skills and abilities. (5 marks)
3. (a) Based on the project description given in Appendix A,
- (i) Identify the most important non-functional requirements for the DevSecOps platform. (6 marks)
  - (ii) Propose an appropriate architecture for the DevSecOps platform, and draw a detailed Class diagram with key attributes and methods in each class to reflect the architecture design. (Note: your solution should address the non-functional requirements identified in question above) (8 marks)
- (b) Answer the following questions related to software design:
- (i) Propose a scenario in the DevSecOps platform where more than one design patterns can be applied together, and draw the class diagram to explain the scenario. (6 marks)
  - (ii) AI (like ChatGPT) has been widely adopted in software development, like code completion and code summarization. Discuss whether AI can be used to design software architectures and explain the reason. (5 marks)

4. (a) When a software project is added into the DevSecOps platform, the following information is required:
1. Project ID: the product identity information, which must be in ASCII format.
  2. Scan Time Limit (minutes): a 6-digit integer value.
  3. Last Commit Date: a date between 2000 and 2023.
  4. Scan Engines: one of “SAST”, “SCA”, “DAST”, “IAST” and “All Engines”.
- (i) Determine the equivalence classes for the above FOUR inputs. (4 marks)
- (ii) Determine the boundaries of the equivalence classes identified in your answers to Q4(a)(i). For each boundary, identify a value on the boundary, a value just below the boundary, and a value just above the boundary. (4 marks)
- (iii) You intend to perform **defensive testing** of the order information. Design a set of test cases to test the FOUR inputs based on the equivalence classes and boundary values identified in your answers to Q4(a)(i) and Q4(a)(ii). (5 marks)
- (b) To systematically test the DevSecOps platform, suggest how to apply Unit Testing, Integration Testing, System Testing and Acceptance Testing in the development process to improve the quality of the platform. (8 marks)
- (c) To test the capability of the different engines (“SAST”, “SCA”, “DAST” and “IAST”), please suggest how to design the test cases of the software project to be uploaded into the system to achieve good confidence in the platform. (4 marks)

## Appendix A

### DevSecOps Platform

A DevSecOps platform is a system designed to streamline the process of development for engineers and developers and help them to build higher quality and secure software applications. This platform does this by centralizing several complex operations into a single, user-friendly interface. You are requested to develop this platform.

With this platform, developers can specify a project locally or, through a GitHub link, and the DevSecOps platform automatically begins analyzing the provided project. Upon analysis, the system generates a detailed report for the developer, informing them of potential security and quality issues within the project. Beyond identifying issues, the system can also provide actionable recommendations to mitigate these problems.

The DevSecOps platform integrates at least four main external toolsets. These are SCA (Software Component Analysis), SAST (Static Application Security Testing), DAST (Dynamic Application Security Testing), and IAST (Interactive Application Security Testing). Each of these toolsets performs a specific set of operations designed to analyze the project in different ways. For example, SCA finds potential security or quality issues by looking at the project's component structure, while SAST and DAST test the application's security in both stable and dynamic states, respectively. The IAST allows for deeper, more interactive security testing.

A developer begins by specifying a project on the UI interface, after which the DevSecOps platform will then scan using the four types of analysis toolsets. A help screen for project selection for this function will be an extra feature for some developers. The platform then generates a comprehensive report outlining both the security and quality measures of the project. The platform should allow the developer to do the security check using any of the toolsets to verify fixes. The platform also allows the developer to generate reports as needed. The security analysis includes checks for potential vulnerabilities in the software. Meanwhile, the quality measurement looks at coding practices among other things. Upon reviewing this report, the developer can ask the DevSecOps platform for mitigation solutions. These may range from fixing recommendations for the detected code vulnerabilities to updating vulnerable third-party libraries present within the project.

END OF PAPER







**CE2006 SOFTWARE ENGINEERING**

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Please read the following instructions carefully:

- 1. Please do not turn over the question paper until you are told to do so. Disciplinary action may be taken against you if you do so.**
2. You are not allowed to leave the examination hall unless accompanied by an invigilator. You may raise your hand if you need to communicate with the invigilator.
3. Please write your Matriculation Number on the front of the answer book.
4. Please indicate clearly in the answer book (at the appropriate place) if you are continuing the answer to a question elsewhere in the book.