

BITS ID:

Birla Institute of Technology & Science, Pilani
AY2016-2017 Semester 2, Software Architectures (SS G653)
Comprehensive Examination, May 2017 (Partially Open Book)

Max Marks: 35M

Duration: 180 Minutes

INSTRUCTIONS:

- All questions are compulsory. The paper has total EIGHT (8) questions on THREE (3) printed pages.
 - Answer all parts of a question together. Attempt questions in the same order as given in the question paper. Follow this instruction strictly.
 - Comprehensive Examination contributes 35% toward final grade of the course.
 - Despite the correctness of an answer, the quality of the answer is an important evaluation criterion. Always justify your answers. Vague and overwritten answers will not be entertained. Mention your assumptions with your answers as and when considered/assumed by you.
 - The exam is partially open book. One-page single-sided handwritten A4 (black/blue ball point pen) size cheat sheet is allowed. Use of calculator is allowed.
 - Write your BITS ID on the top corner of the paper.
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1. [6M] Consider the following information:

Consider the recent WannaCry ransomware attack controversy, one of the source of the attack can be email service. Hence, in order to have some measures to save from the attack, Information Processing Center (IPC) at BITS Pilani updated its BITS email system. The system divides incoming emails into three groups: A “whitelist” which contains emails from senders which are whitelisted by IPC, such emails come in the “Inbox” folder. A “blacklist” which contains email from senders which are blacklisted by IPC, such emails are automatically deleted and come in the “Trash” folder. The third list “spamlist” contains emails that do not pass the above two criterion, such emails are marked as “Spam”. The recipient can mark the spammed email as legitimate and move them in “Inbox”, otherwise they remain in the “Spam” folder. Also, the system is running on a multi-core server to handle the high load.

- (a) [1M] Which architectural pattern you use to implement the system?
- (b) [3M] Given the above mentioned requirements, draw a diagram describing your architecture. Clearly name the components of the system, interaction among them, and the services offered by them. The diagram should be complete, clear and information must be consistent with the requirements given to you. Briefly explain in words step-by-step how your system is working.
- (c) [2M] Identify two most important advantages of your architecture. Justify them.

2. **[9M]** Answer the following questions:
- (a) **[3M]** Suppose that you have created a BITS Library management system for its Pilani campus that crashed 50 times in a year 2016. Further, for each crash, it takes 8 minutes to restart. Calculate availability in percentage in the year. Mention the expressions used for calculations.
 - (b) **[1M]** Identify two availability tactics that are suitable for the BITS Library management system. Mention your reasoning for choosing each tactic.
 - (c) **[1M]** Given that usability plays a major role in the BITS Library management system. Identify two usability tactics that are suitable for the BITS Library system. Mention your reasoning for choosing each tactic.
 - (d) **[4M]** Suppose that BITS Pilani plans to deploy its BITS Library management system to all of its four campuses. In order to generate revenue, the variants of the system can also be sold to other institutions. In such cases, each of the variants of the system differ slightly from each other, resulting into different members of a software product line.

As an architect of BITS Library management system:

- (i) **[1M]** How will you identify the variation points? Mention the general approach used to identify variation points in a product line.
 - (ii) **[2M]** Identify four variation mechanisms you would use to achieve the variability.
 - (iii) **[1M]** Give an example of describing concrete scenario for variability in the context of the Library system.
3. **[2M*4=8M]** Answer the following questions
- (a) Consider a redundant system S consisting of five modules where it is sufficient to have one module working. Given that the probability of any module working without failure is 0.4. What is the probability that the system S will work without failure? Mention the expressions used for calculations.
 - (b) As an architect, you are asked to design a application that executes in the cloud. The application is utilizing a virtual machine on a physical computer that is hosting multiple virtual machines. If one of the other tenants on your machine is malicious, list and identify four major attacks they can do to your application.
 - (c) Is it possible for a system to achieve all the three properties—Consistency, Partitioning and Availability—simultaneously without compromising each other? Justify your answer.
 - (d) Does availability ensure reliability of a system? Justify your answer with an example.
4. **[1M*2=2M]** A software architect often needs to balance tradeoffs among different quality attributes. In order to satisfy one of the quality attribute (QA) requirements, the system needs

to compromise with another QA requirements. Considering the following concrete scenario, identify which quality attribute is compromised in each case.

- a) One way to increase the scalability of a service is to replicate the servers. But, ensuring consistency among all the servers (i.e., each server has the same logically consistent data) will incur some overhead. Which quality attribute is compromised here to ensure scalability? Justify your answer.
 - b) One way to ensure system availability is using ping/echo mechanism. Which quality attribute is compromised here to ensure ping/echo mechanism? Justify your answer.
5. [1M*3=3M] Answer the following questions:
- (a) Suppose you are asked to design a security check-in system for APOGEE that provides face, fingerprint, voice recognition means. Which architectural pattern you will use to implement the system? Justify your answer.
 - (b) Which architectural pattern you will choose while designing compilers? Justify your answer.
 - (c) How the allocation patterns differ from module patterns? Mention the name of one allocation pattern and one module pattern.
6. [1M*3=3M] Differentiate the following terms:
- (a) Variant vs Version
 - (b) Architectural Patterns vs Idioms
 - (c) Layered Architecture vs Tiered Architecture
7. [1M*2=2M] Mark the following as either True (T) or False (F). Justify your answer. Zero marks will be awarded with no/incomplete justification of the answer.
- (a) Functional requirements must be satisfied by software quality attributes.
 - (b) In the blackboard architecture, the hypotheses are placed in the knowledge-source component of the system.
8. [1M*2 = 2M] Choose the best option. Justify your answer. Zero marks will be given without justification.
- (a) You want to create a family of related objects to be used interchangeably to configure the application. The most appropriate pattern to use is:
 - (i) Bridge
 - (ii) Composite
 - (iii) Factory Method
 - (iv) Command
 - (b) Which of the following is a typical design domain for the Model-View-Controller architecture?
 - (i) Hierarchical Structures
 - (ii) Web server site application
 - (iii) Multiple agents in a distributed system
 - (iv) None of these

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