UNIVERSITI TUNKU ABDUL RAHMAN

ACADEMIC YEAR 2022/2023

SEPTEMBER EXAMINATION

UCCD3113 DISTRIBUTED COMPUTER SYSTEMS

MONDAY, 26 SEPTEMBER 2022 TIME : 2.00 PM – 4.00 PM (2 HOURS)

BACHELOR OF COMPUTER SCIENCE (HONOURS)
BACHELOR OF INFORMATION TECHNOLOGY (HONOURS)
COMMUNICATIONS AND NETWORKING
BACHELOR OF INFORMATION SYSTEMS (HONOURS)
INFORMATION SYSTEMS ENGINEERING

Instruction to Candidates:

This question paper consists of THREE (3) questions in Section A and TWO (2) questions in Section B.

Answer **ALL** questions in **Section A** and **ONLY ONE (1)** question in **Section B**.
Each question carrics 25 marks.

Candidates are allowed to use non-scientific calculator.

Answer questions only in the answer booklet provided.

UCCD3113 DISTRIBUTED COMPUTER SYSTEMS

SECTION A

Q1. (a) Docker containers and virtual machines have similar resource isolation benefit but with a different architectural approach. Illustrate with diagram how Docker containers are different from virtual machines. (7 marks)

(b) Propose an Amazon Web Services (AWS) architecture diagram in scaling your cloud infrastructure. Your design should consider:

- Choose an Amazon Machine Image (AMI) for your running web instance(s).
- Setup relational database(s) in storing web data.
- Perform application load balancing.
- Create an auto scaling group between availability zones.
- Automatically scale new instances within a private subnet.
- Allow your cloud resources in the private subnet in accessing internet.
- Create alarms and monitor performance of your infrastructure, and
- Integrating some relevant intelligent cloud services.

(12 marks)

(c) You hosted an application on AWS that lets users to render images and do some general computing. Which of the below listed services can be used to route the incoming user traffic? Justify your answer.

- Classic Load Balancer
- Application Load Balancer
- Network Load balancer (6 marks)

[Total : 25 marks]

Q2. (a) State **TWO (2)** reasons why should a startup company prefer public cloud over private cloud deployment model. (4 marks)

(b) Do you agree that the storage and processing of the data points collected by Internet of Things (IoT) devices will create more vulnerability? Provide **TWO (2)** reasons for your answer. (6 marks)

(c) Among Distributed Operating System (DOS), Network Operating System (NOS) and Middleware-based OS, which one is the best option that provides distribution transparency meanwhile resolving heterogeneity issues? Justify your answer. (4 marks)

(d) Show **FOUR (4)** differences between two-tier architecture and three-tier architecture. (8 marks)

Q2. (Continued)

(e) You are given a chance to design networking solution for a western restaurant. The restaurant has dynamic and unpredictable number of customers with majority having mobile devices. Which type of distributed system shall be chosen? Introduce and justify your selection. (3 marks)

[Total : 25 marks]

Q3. (a) Given a scenario of **4 Generals *AND* 1 Traitor**, find the traitor by using Byzantine Generals algorithm. Show all the steps and diagram necessary to your answer. (11 marks)

(b) Under which condition does the Byzantine Generals Problem cannot be solved? (3 marks)

(c) Processes W, X, Y, and Z are executing at 4 distributed sites. Suppose the timestamps assigned to them (at the time of their creation) are 23, 77, 45 and 66, respectively. Y acquires a shared resource. How to prevent a deadlock if the system implements Wait-Die (WD) scheme and Wound-Wait (WW) scheme, respectively for the following cases?

(i) Later, X requests the same resource (held by Z). (4 marks)

(ii) Later, W requests the same resource (held by Y). (4 marks)

(d) A clock, *X*, is reading 20:14:40.0 (hr:min:sec) when a clock synchronization request is sent to time server, *S*. After receiving the request from *X*, *S* prepares a response and appends the time 20:14:58.0 from its own clock. What will be the time set by *X* if the round-trip time (RTT) takes 8.0 seconds? Show your formula and calculation using Cristian's algorithm. (3 marks)

[Total : 25 marks]

SECTION B (Choose ONE question)

Q4. (a) Normally, we need to configure AD, DNS and DHCP servers during private cloud setup. What are the functionalities of each component?

(i) Active Directory (AD). (2 marks)

(ii) Domain Name System (DNS) server. (2 marks)

(iii) Dynamic Host Configuration Protocol (DHCP) server. (2 marks)

(b) A cloud application requires a database service. Do you think that web services such as Amazon Simple Storage Service (S3), Google Storage and Window Azure Storage are suitable for maintaining a database in the cloud? Justify your answer. (5 marks)

(c) Generate a smart car solution (architecture diagram) with AWS cloud platform. Your design should consider gathering of various data from the car and storing data into cloud storage and database for further analysis and visualization. (6 marks)

(d) Multi-Agent Systems (MAS) has shown significant impact in solving large scale distributed systems for the past few decades.

(i) How do you define non-player characters with Artificial Intelligence (AI) in the multiplayer online battle as a distributed system? (4 marks)

Field	Value
Purpose	INFORM
Sender	max@http://fanclub-beatrix.royalty-spotters.nl:7239
Receiver	elke@iiop://royalty-watcher.uk:5623
Language	Prolog
Ontology	genealogy
Content	female(beatrix),parent(beatrix,juliana,bernhard)

Figure 4.0

(ii) Figure 4.0 shows an example of agent communication message using FIPA ACL format. Interpret this message. (2 marks)

Q4. (d) (Continued)

(iii) Beside multiplayer online game, name **TWO (2)** more MAS applications in the real world. (2 marks)

[Total : 25 marks]

Q5. (a) Suppose there are four processes *W*, *X*, *Y* and *Z*. All clocks run at the same rate (1 unit of time) but initially *W*'s clock reads 12, *X*'s clock reads 0, *Y*'s clock reads 5 and *Z*'s clock reads 9. At time 12 by *W*'s clock, *W* sends a message to *X*, this message takes 4 units of time to reach *X*. *X* then waits one unit of time and then sends a message onto *Y* which takes 2 units of time to reach *Y*. Later, *Y* also waits one unit of time and then sends a message onto *Z*. The message reaches *Z* after 1 unit of time. After *Z* waits for 2 units of time, a message takes another 1 unit of time to reach *Y* again. If the system implements Lamport's timestamps, draw a picture to illustrate the timestamps for the messages and how the timestamps are obtained. (8 marks)

(b) Explain **TWO (2)** common intelligent resource scheduling policies which are applied in cloud computing to optimize the performance of virtual machines. (4 marks)

(c) Recommend **ONE (1)** type of distributed computer system which is suitable to support 8 classes of students (40 students per class), where different classes required different types of mathematic/computer applications. Suppose that UTAR can only hire one lab administrator to take care of the machines. Provide **TWO (2)** justifications for your selection of distributed computer system. (6 marks)

(d) Which type of persistence communication can be best applied in transferring a patient's record from his admitted hospital *A* to his physician's hospital *B*? Elaborate how to perform the selected communication service with the scenario above. *[Hints: Both hospitals are located in different cities, and aim to eliminate the traditional overhead associated with operating in-house communication infrastructures.]* (4 marks)

(e) Describe a traffic shaping algorithm that can ensure a good quality of service during video streaming. (3 marks)

[Total : 25 marks]
