University of Westminster
Department of Computer Science

7SENG007C Concurrent and Distributed Systems 2023	
Module leader	Mr. Guhanathan Poravi. CW Prepared by Mr.Sajith Ravindra
Unit	Coursework
Weighting:	50%
Qualifying mark	40%
Description	Report
Learning Outcomes Covered in this Assignment:	LO3 Demonstrate the skills to design and use appropriate technology to build a distributed system to critically solve a common goal. LO4 Demonstrates a comprehensive understanding of distributed computing concepts and is able to critically make use of such concepts in the development of large-scale systems.
Handed Out:	25th April 2023
Due Date	20th May 2023
Expected deliverables	One electronic file containing the report as specified below.
Method of Submission:	Online via Blackboard
Type of Feedback and Due Date:	Written feedback and marks 15 working days (3 weeks) after the submission deadline, the week starting Monday 1st of June 2023. Oral feedback will also be offered upon appointment with the module leader. **All marks will remain provisional until formally agreed upon by an Assessment Board.**

Copying and plagiarism

Any external sources utilized should be correctly referenced using a common referencing technique (e.g., the Harvard technique). For more details on referencing please visit **https://www.westminster.ac.uk/current-students/studies/study-skills-and-training/research-skills/referencing-your-work** .

Copying and plagiarism carry severe penalties. Please note that the University offers an online learning tutorial designed to help students understand and avoid plagiarism. This can be accessed by any student under My Organisation on Blackboard. The tab is labelled 'Avoiding Plagiarism'.

Penalty for Late Submission

If you submit your coursework late but within 24 hours or one working day of the specified deadline, 10 marks will be deducted from the final mark, to minimum of the pass mark (50%), as a penalty for late submission,. If you submit your coursework more than 24 hours or more than one working day after the specified deadline you will be given a mark of zero for the work in question unless a claim of Mitigating Circumstances has been submitted and accepted as valid.

It is recognised that on occasion, illness or a personal crisis can mean that you fail to submit a piece of work on time. In such cases you must inform the Faculty Registry Office in writing on a mitigating circumstances form, giving the reason for your late or non-submission. You must provide relevant documentary evidence with the form. This information will be reported to the relevant Assessment Board that will decide whether the mark of zero shall stand. For more detailed information regarding University Assessment Regulations, please refer to the following website: http://www.westminster.ac.uk/study/current-students/resources/academic-regulations.

Coursework Description

Introduction

Online retail shops allow users to do online shopping by browsing through catalogues of goods, adding them to a virtual shopping cart, and finally buying the goods by checking out the items in the shopping cart.

Consider the following scenarios for a distributed system platform that powers globally distributed online retail with a large number of users

- The system administrator updates the quantities of the goods when a new shipment arrives.
- Shoppers from different locations log into the system and place different items in the shopping carts that they wish to purchase
- Multiple shoppers try to check out the shopping carts which has the same item with limited quantity, and the system should allocate/block items based on the first-come-first-serve basis
- The system should be able to handle multiple checkouts made at the same time requiring the same item. So, the same item should not be assigned for two purchases.

This online retail shopping platform is expected to be highly available and scalable. Also, accuracy is critical to ensure orders placed by shoppers are processed correctly. In this assignment, you are expected to design and build this mini-distributed inventory system.

Systems Requirements

- **The system should be highly available**: Your system should consist of more than one process which is ready to accept orders. The traders can place orders to any node in the system.
- **Accuracy**: The system must always produce consistent results regardless of which node receives the order. *(Hint: Consider having only designated one node as the processing node in your system always)*
- **Fault Tolerance**: In event of a failure of a node, other nodes must continue to process the orders without losing accuracy.

Assumptions

You can make the following assumptions. In case you make any other assumptions please indicate them clearly in the report

- There are only three nodes in your system and their IP addresses are known to each other in advance
- Consider only one good type
- Orders are only processed if the number of items requested <= the number of items available
- Ignore the case where all nodes can crash. This has to be handled with disaster recovery and it's not within the scope of this course.

Deliverables

1. **Report (60%)**

   A report (PDF) explains the design of your system and how you achieve each of the system requirements mentioned above with distributed computing techniques.

And explain the system behavior for the following scenarios,

- When a system admin adds items to the system (explain how all nodes are informed about the new arrival of goods)
- A shopping cart is checked out (explain how the update of the inventory update is done across the system)
- When shoppers try to check out the same item at the same time where the stock of item can only fulfill one order (explain how the system makes sure only one order is processed and the other is rejected)
- One node exits the system (explain how the system continues to function without losing its accuracy and availability)
- One node joins the system or restarts (explain how the new node catches up with the system state and starts providing the service)

2. **Code (40%)**

   Code of the Implementation of the designed system using internode communication technologies and consumers/coordination technologies covered in the class.

Coursework Marking scheme

The Coursework will be marked based on the following marking criteria:

Question	Mark per component	Mark provided	Comments
Report			
High Availability: Identifying how high availability can be achieved and design to achieve high availability in the system	15%		
Fault Tolerance: Identifying how fault tolerance can be achieved and design to achieve fault tolerance in a transparent manner in the system	15%		
Accuracy and Consistency: Identity how accuracy and consistency can be achieved and the system design	15%		
System Behaviour: Explanation on how the system will behave and ensure above mentioned qualities in each request flow students are asked to	15%		
Implementation			
Implementing internode communication – Using RPC for internode communication	15%		
Consensus and Coordination: Using distributed consensus and coordination in the system implementation to achieve design goals	15%		
Overall System Design: How well the overall system design is architectured to achieve the system goals	10%		
Total	**100**		