University of Westminster
Department of Computer Science

Concurrent and Distributed Systems 2022

Module leader	Mr. Rathesan Sivagananalingam
Unit	Coursework
Weighting:	50%
Qualifying mark	40%
Description	Report/Code
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:	15th August 2022
Due Date	6th September 2021
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. Oral feedback will also be offered upon appointment with the module leader. **All marks will remain provisional until formally agreed 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

Inventory control systems are used to manage an inventory of goods of a business and it's used to ensure a continued supply chain.

Consider the following scenarios for an inventory system used for a large organization with multiple warehouses and factories distributed geographically.

- An inventory system clerk from multiple regions update the new arrivals of goods. That's when a new stock of goods arrives, the clerk updates the system with the item details and the quantity
- Workshop managers from multiple factories place ***orders*** for different goods that are required to carry out the manufacturing of their factories.
- The system should allocate/block goods for orders based on a first-come-first-serve basis
- The system should be able to handle multiple orders made at the same time requiring the same item. So, the same item should not be assigned for two orders.

This inventory control system is expected to be highly available and scalable. Also, accuracy is critical to ensure orders placed by factories 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 and inventory updates. The inventory clerks' and factory managers' requests can be proceeded by any node in the system.
- **Accuracy**: 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 the 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 item 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 is not within this course's scope.

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 an inventory clerk adds items to the system *(explain how all nodes are informed about the new arrival of goods)*
- A match is made for an order that's already placed *(explain how the update of the inventory done across the system)*
- When two factory managers place order for the same item at the same time where the stock of item can only fulfill one order *(explain how system make sure only one order is processed and other is rejected)*
- One node exit the system *(explain how system continue 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 start providing the service)*

2. **Code (40%)**

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

Note: You can implement the above-explained system with technologies and tools covered in the class. However, you are free to use other tools/technologies with an explanation/justification of the usage

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: Identify how accuracy and consistency can be achieved and the system design	15%		
System Behavior : 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 Desing : How well the overall system design is architectured to achieve the system goals	10%		
Total	**100**		