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TE Comps B - Batch B

DC LAB

DISTRIBUTED COMPUTING EXPERIMENT 10

Aim:

Implement a load balancing algorithm.

Theory:

Load balancing is the method of distributing network traffic equally across a pool of resources that support an application. Modern applications must process millions of users simultaneously and return the correct text, videos, images, and other data to each user quickly and reliably.

What are load balancing algorithms?

A] Static load balancing: Static load balancing algorithms follow fixed rules and are independent of the current server state. The following are examples of static load balancing.

1) Round-robin method:

Servers have IP addresses that tell the client where to send requests. The IP address is a long number that is difficult to remember. To make it easy, a Domain Name System maps website names to servers. When you enter aws.amazon.com into your browser, the request first goes to our name server, which returns our IP address to your browser. In the round-robin method, an authoritative name server does the load balancing instead of specialized hardware or software. The name server returns the IP addresses of different servers in the server farm turn by turn or in a round-robin fashion.

2) Weighted round-robin method:
In weighted round-robin load balancing, you can assign different weights to each server based on their priority or capacity. Servers with higher weights will receive more incoming application traffic from the name server.

3) IP hash method:
In the IP hash method, the load balancer performs a mathematical computation, called hashing, on the client IP address. It converts the client IP address to a number, which is then mapped to individual servers.

B] Dynamic load balancing:
Dynamic load balancing algorithms examine the current state of the servers before distributing traffic. The following are some examples of dynamic load balancing algorithms.

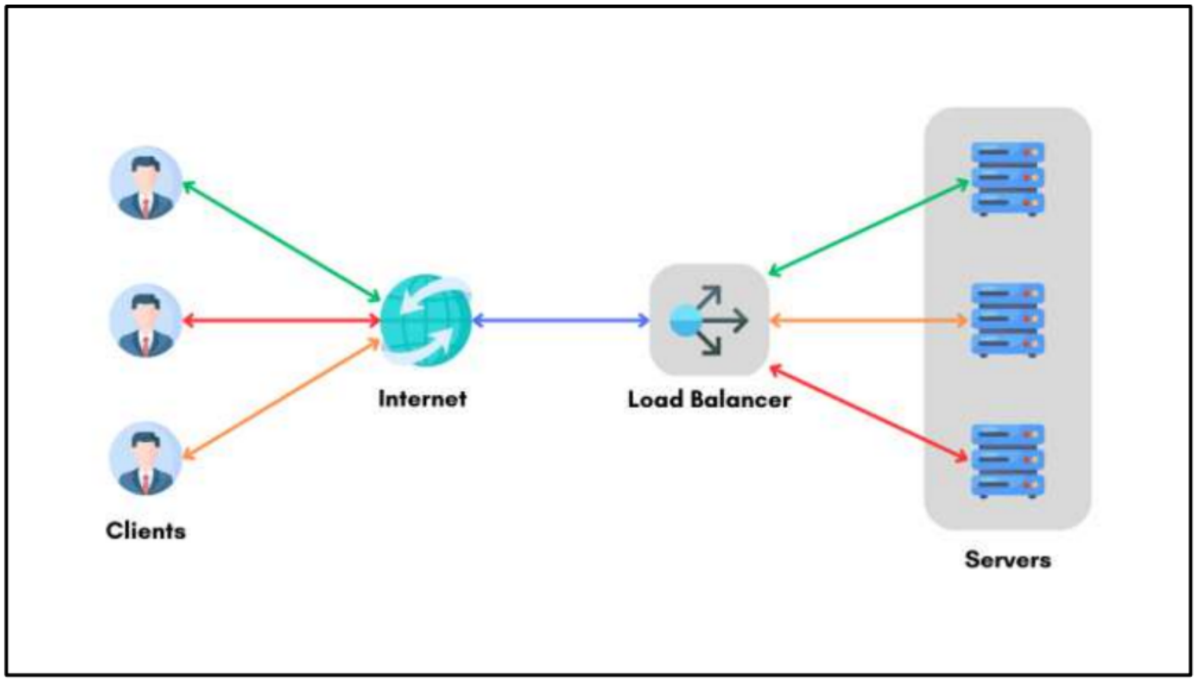
1) Least connection method:
A connection is an open communication channel between a client and a server. When the client sends the first request to the server, they authenticate and establish an active connection between each other. In the least connection method, the load balancer checks which servers have the fewest active connections and sends traffic to those servers. This method assumes that all connections require equal processing power for all servers.

2) Weighted least connection method:
Weighted least connection algorithms assume that some servers can handle more active connections than others. Therefore, you can assign different weights or capacities to each server, and the load balancer sends the new client requests to the server with the least connections by capacity.

3) Least response time method:
The response time is the total time that the server takes to process the incoming requests and send a response. The least response time method combines the server response time and the active connections to determine the best server. Load balancers use this algorithm to ensure faster service for all users.

4) Resource-based method:
In the resource-based method, load balancers distribute traffic by analyzing the current server load. Specialized software called an agent runs on each server and calculates usage of server resources, such as its computing capacity and memory. Then, the load balancer checks the agent for sufficient free resources before distributing traffic to that server.

Diagram:



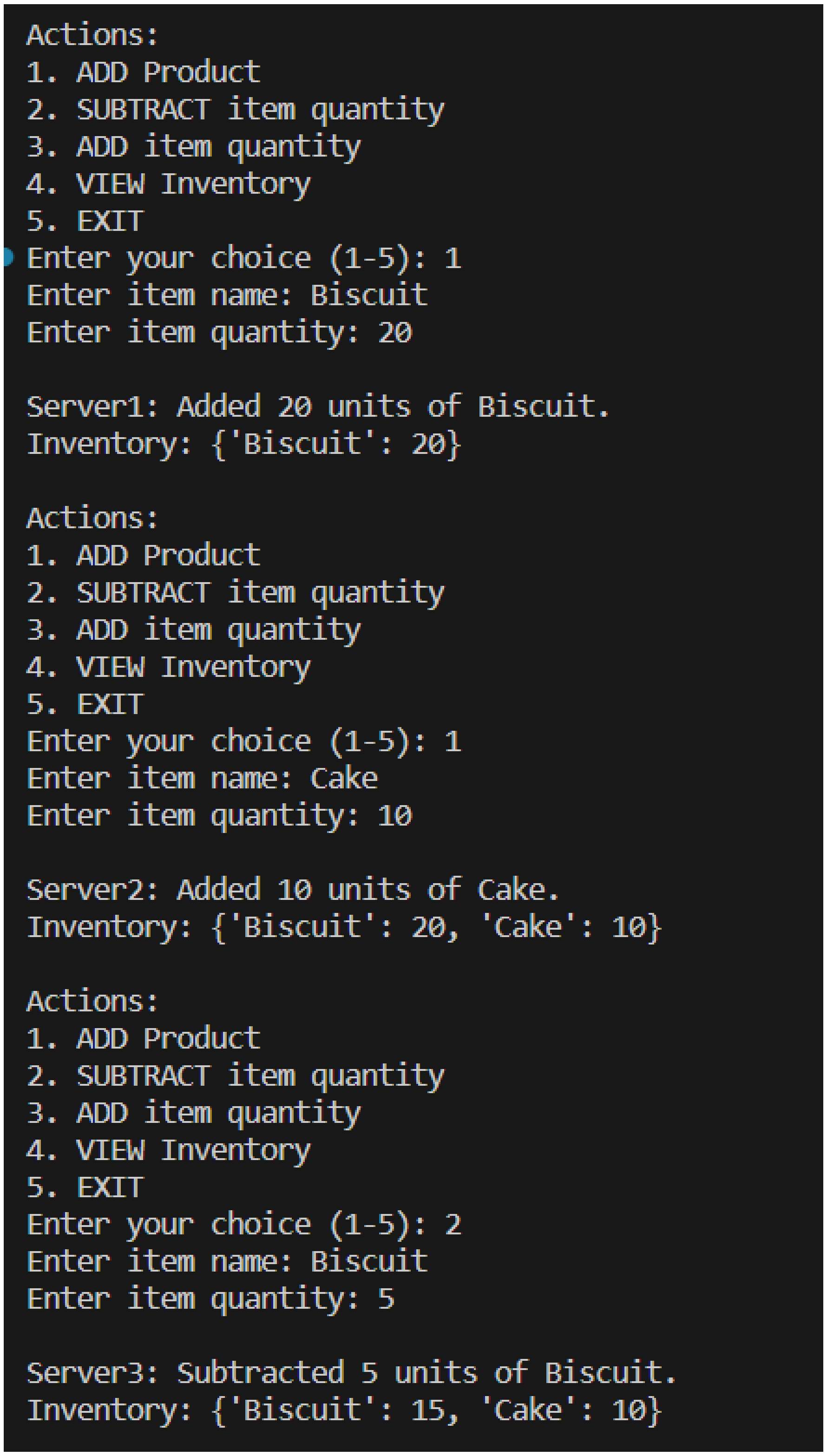
Code:

```
class InventoryServer:
    inventory = {}
    def __init__(self, server_name):
        self.server_name = server_name
        self.inventory = InventoryServer.inventory


    def process_request(self, action, item, quantity):
        if action == 1:
            self.add_product(item, quantity)
        elif action == 2:
            self.subtract_quantity(item, quantity)
        elif action == 3:
            self.add_quantity(item, quantity)
        elif action == 4:
            self.view_inventory()
        else:
            print("Invalid action: {}".format(action))
    def add_product(self, item, quantity):
        if item in self.inventory:
            self.inventory[item] += quantity
        else:
            self.inventory[item] = quantity
        print("\n{}: Added {} units of {}.\nInventory: {}".format(
            self.server_name, quantity, item, self.inventory))

    def subtract_quantity(self, item, quantity):
        if item in self.inventory:
            if self.inventory[item] >= quantity:
                self.inventory[item] -= quantity
                print("\n{}: Subtracted {} units of {}.\nInventory:
{}".format(
                    self.server_name, quantity, item, self.inventory))
            else:
                print("\n{}: Not enough units of {} to subtract.".format(
                    self.server_name, item))
        else:
            print("\n{}: Item {} not found in inventory.".format(
                self.server_name, item))

    def add_quantity(self, item, quantity):
        if item in self.inventory:
            self.inventory[item] += quantity
            print("\n{}: Updated {} to {} units.\nInventory:
{}".format(self.server_name, item, quantity, self.inventory))
        else:
            print("\nProduct not found")

    def view_inventory(self):
        print("\n{}: Inventory :".format(self.server_name))
        print("-------------------------")
        if self.inventory.__len__() > 0:
            for item in self.inventory:
                print(f"Name : {item}")
                print(f"Quantity : {self.inventory[item]}")
                print("-------------------------")
        else:
            print("\nInventory in Empty.")
```

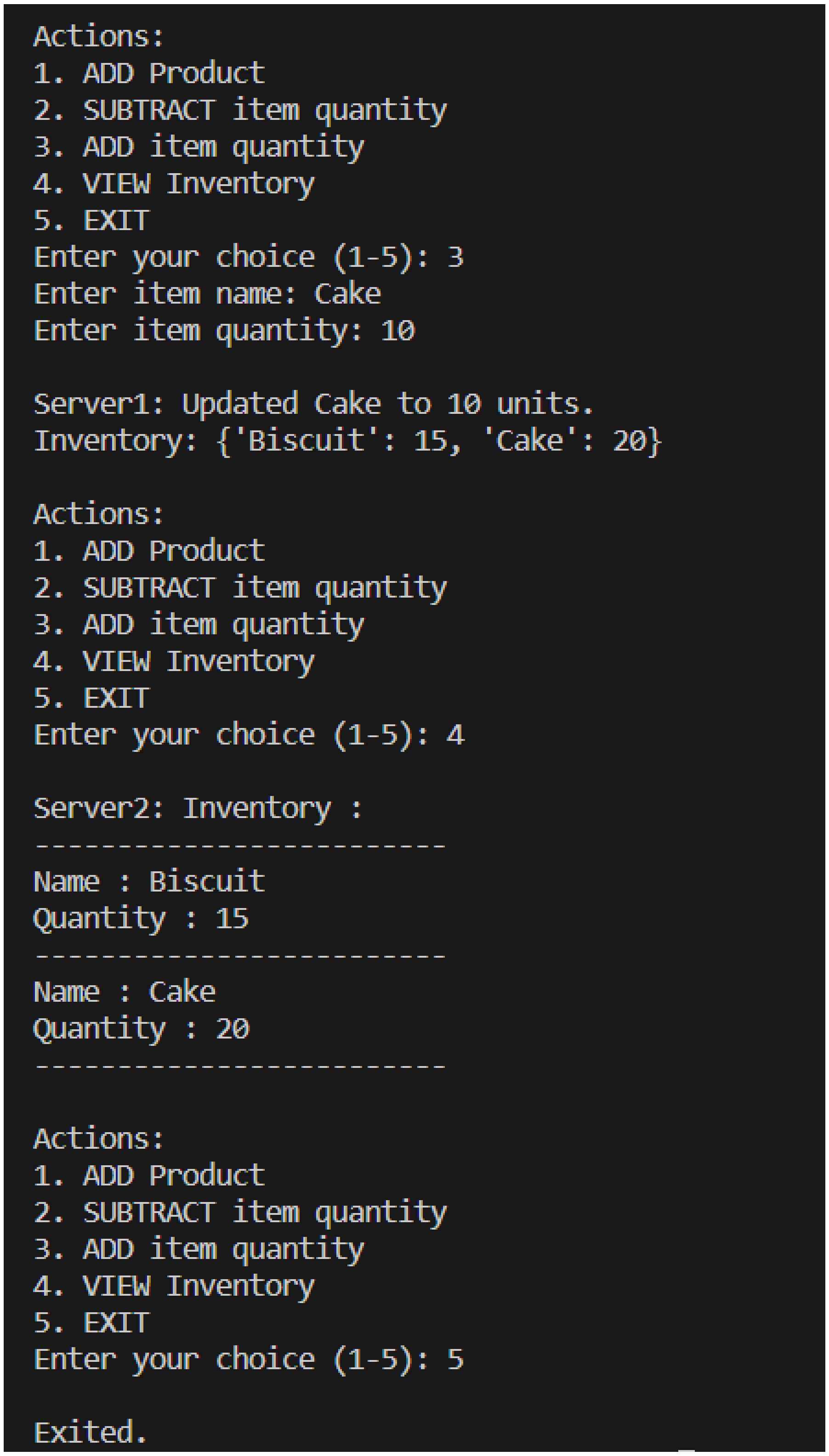
```
class RoundRobinLoadBalancer:
    def __init__(self, servers):
        self.servers = servers
        self.current_server_index = 0

    def get_next_server(self):
        next_server = self.servers[self.current_server_index]
        self.current_server_index = (self.current_server_index + 1) %
len(self.servers)
        return next_server

class InventoryManagementSystem:
    def __init__(self, servers):
        self.load_balancer = RoundRobinLoadBalancer(servers)

    def process_inventory_request(self, action, item, quantity):
        server = self.load_balancer.get_next_server()
        server.process_request(action, item, quantity)

# Example usage
server_names = ["Server1", "Server2", "Server3"]
inventory_servers = [InventoryServer(name) for name in server_names]
inventory_system = InventoryManagementSystem(inventory_servers)

while True:
    print("\nActions:")
    print("1. ADD Product")
    print("2. SUBTRACT item quantity")
    print("3. ADD item quantity")
    print("4. VIEW Inventory")
    print("5. EXIT")

    choice = int(input("Enter your choice (1-5): "))
    if choice == 4:
        inventory_system.process_inventory_request(choice, 0, 0)
    elif choice >= 1 and choice < 5:
        item = input("Enter item name: ")
        quantity = int(input("Enter item quantity: "))
        inventory_system.process_inventory_request(choice, item, quantity)
```

```python
    elif choice == 5:
        print("\nExited.")
        break
    else:
        print("Invalid input. Try again!")
```

Output:



```
Actions:
1. ADD Product
2. SUBTRACT item quantity
3. ADD item quantity
4. VIEW Inventory
5. EXIT
Enter your choice (1-5): 1
Enter item name: Biscuit
Enter item quantity: 20

Server1: Added 20 units of Biscuit.
Inventory: {'Biscuit': 20}

Actions:
1. ADD Product
2. SUBTRACT item quantity
3. ADD item quantity
4. VIEW Inventory
5. EXIT
Enter your choice (1-5): 1
Enter item name: Cake
Enter item quantity: 10

Server2: Added 10 units of Cake.
Inventory: {'Biscuit': 20, 'Cake': 10}

Actions:
1. ADD Product
2. SUBTRACT item quantity
3. ADD item quantity
4. VIEW Inventory
5. EXIT
Enter your choice (1-5): 2
Enter item name: Biscuit
Enter item quantity: 5

Server3: Subtracted 5 units of Biscuit.
Inventory: {'Biscuit': 15, 'Cake': 10}
```



```
Actions:
1. ADD Product
2. SUBTRACT item quantity
3. ADD item quantity
4. VIEW Inventory
5. EXIT
Enter your choice (1-5): 3
Enter item name: Cake
Enter item quantity: 10

Server1: Updated Cake to 10 units.
Inventory: {'Biscuit': 15, 'Cake': 20}

Actions:
1. ADD Product
2. SUBTRACT item quantity
3. ADD item quantity
4. VIEW Inventory
5. EXIT
Enter your choice (1-5): 4

Server2: Inventory :
-------------------------
Name : Biscuit
Quantity : 15
-------------------------
Name : Cake
Quantity : 20
-------------------------

Actions:
1. ADD Product
2. SUBTRACT item quantity
3. ADD item quantity
4. VIEW Inventory
5. EXIT
Enter your choice (1-5): 5

Exited.
```

Conclusion:

From this experiment, we learned about load balancing algorithms. We saw how load balancing works and also how to implement it in python. We saw how it is important and also how it plays a pivotal role in distributed systems. We saw how it increases the efficiency by accurately sending the requests to the appropriate server. Thus, load balancing proves to be an essential part of distributed systems and builds the backbone of any efficient system and improves all the user’s experience across the website.