

The National University of Lesotho

Department of Mathematics and Computer Science

Faculty of Science and technology



CS4430: Distributed Database Systems

Task: “System Design”

Due: “23 April 2023 ”

Team members(THE CLUSTER CRUSADERS):

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Entities

Loans

<u>L_ID</u>	B_ID	agent	amount	Loan term	date	status	Interest rate	balance	branch
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Borrowers

<u>B_ID</u>	names	contact	address	employed	Monthly income
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Agents

<u>A_ID</u>	Br_ID	names	Email	phone_number	Region
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Payments

<u>P_ID</u>	L_ID	amount	date	charge
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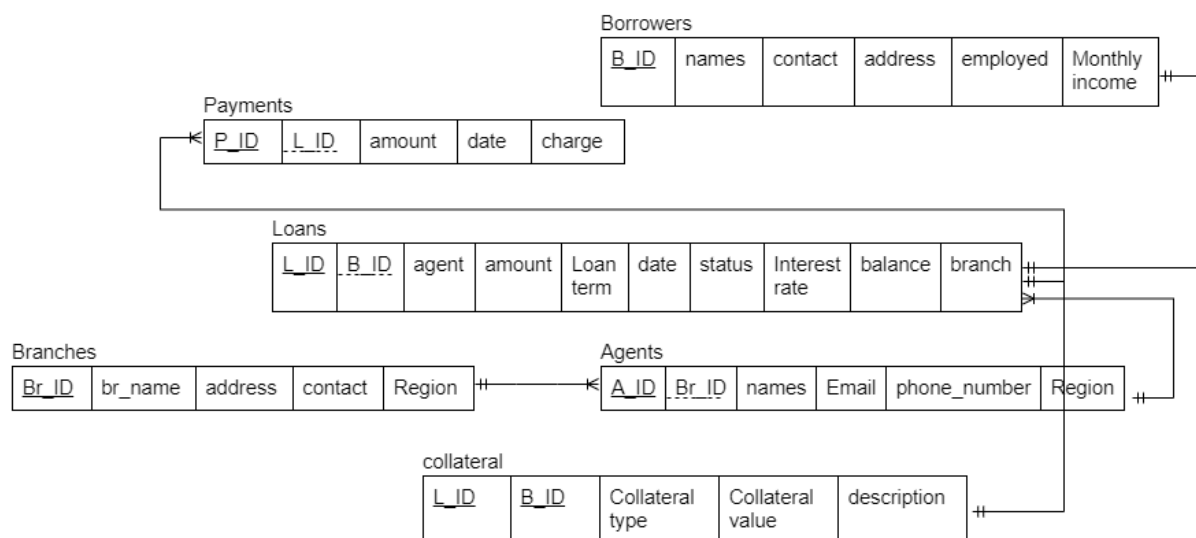
collateral

<u>L_ID</u>	<u>B_ID</u>	Collateral type	Collateral value	description
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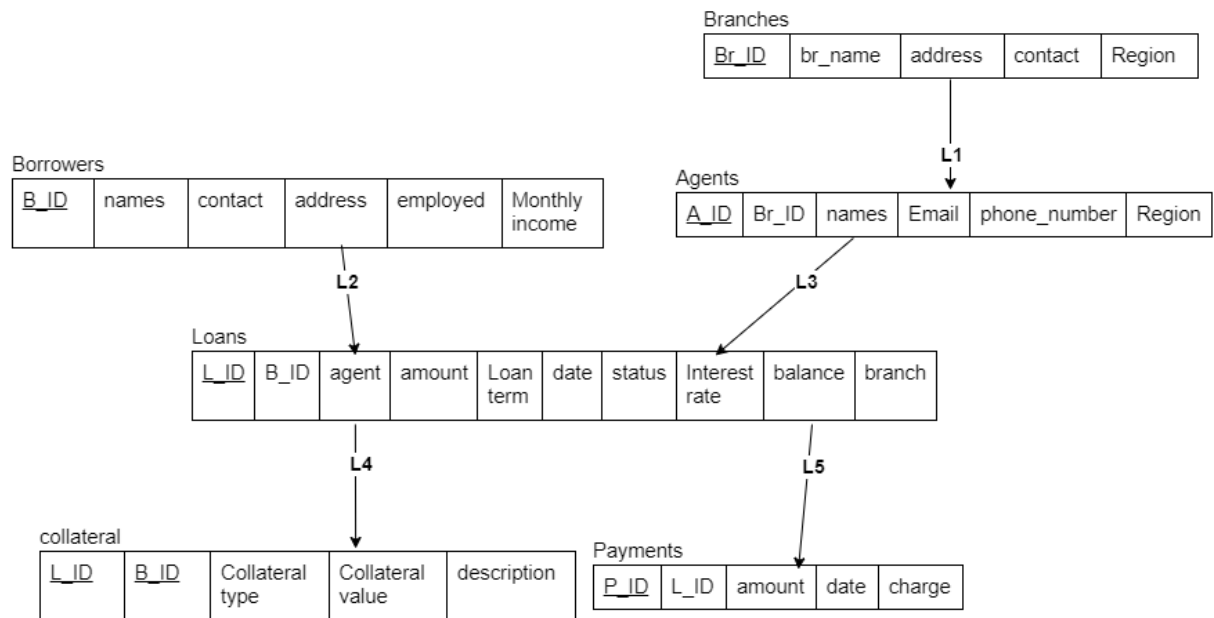
Branches

<u>Br_ID</u>	br_name	address	contact	Region
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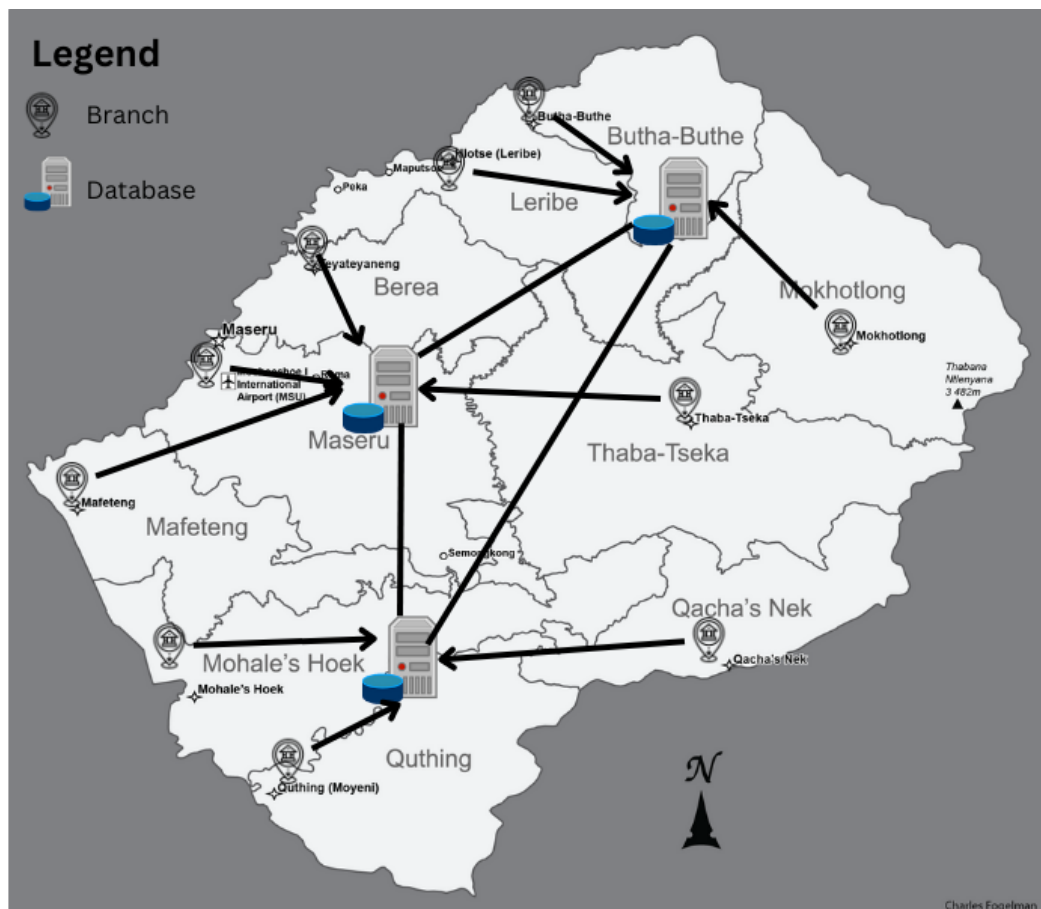
ER Diagram

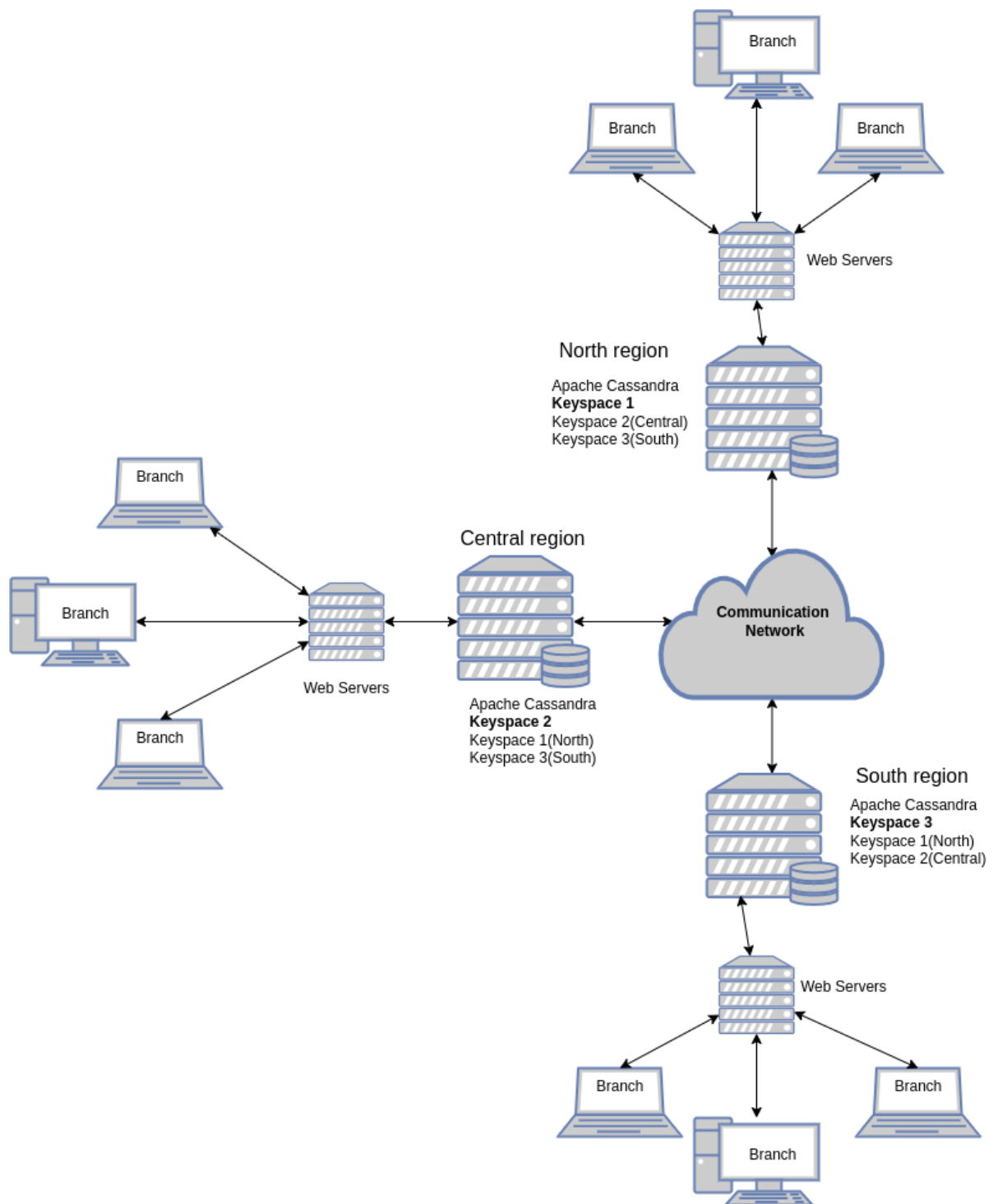


Join Graph



Real-World Scenario system Architecture Diagram





Architecture

We are going to adopt cloud architecture for the following reasons:

1. Cloud providers offer security measures such as encryption, firewalls, and monitoring, which can help to keep data secure. Additionally, cloud architecture often offers disaster recovery options and automatic backups, which can help to protect against data loss.
2. Cloud architecture allows for easy integration with other cloud services and tools, which can help to streamline workflows and improve overall efficiency

We are going to use Shared Nothing architecture for hardware because:

1. In a shared nothing architecture, each node has its own set of resources, including storage, memory, and processing power. This allows the system to scale horizontally by simply adding more nodes to the cluster as demand increases.
2. Because each node in a shared nothing architecture is independent, a failure in one node does not affect the operation of the entire system. This means that if one node goes down, the others can continue to function normally, ensuring high availability and fault tolerance.
3. By partitioning the data and processing across multiple nodes, shared nothing architecture can provide high performance and low latency for distributed database systems, particularly for read-heavy workloads.

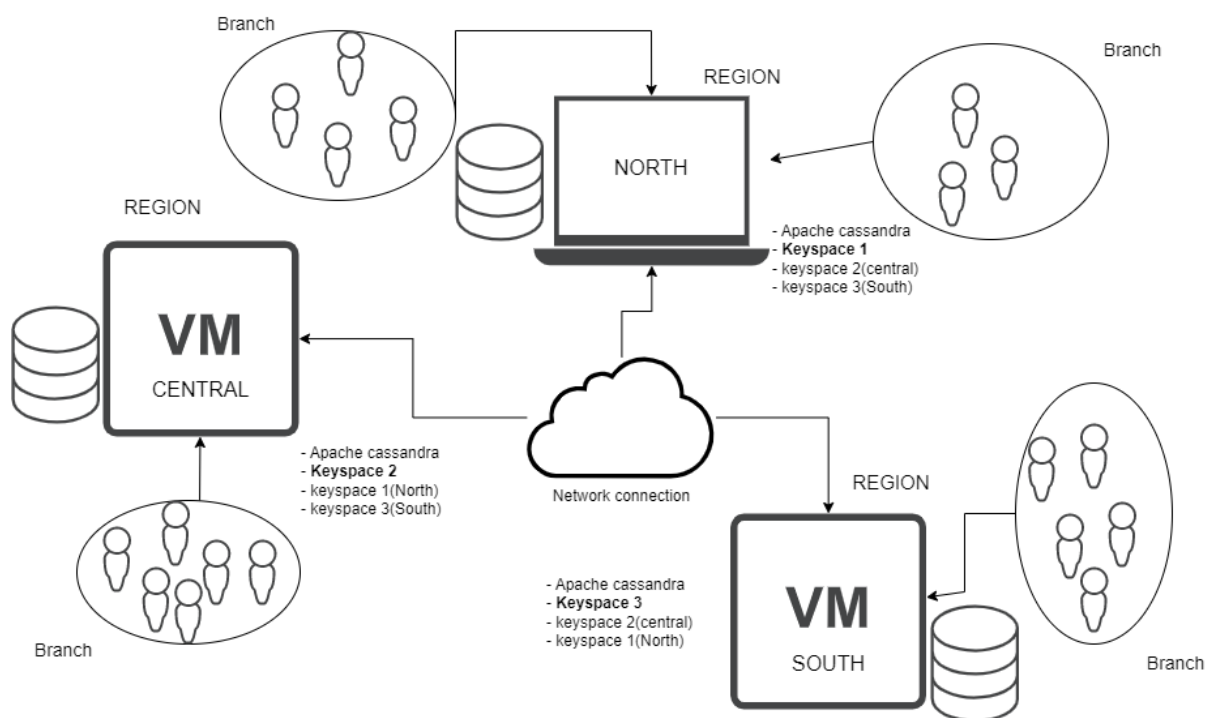
For networking, a client-server architecture is suitable for our system because any update is done straight into the server ensuring real time data access by managers at different branches of that region hence cuts overhead that would result from peer-to-peer updates of the databases.

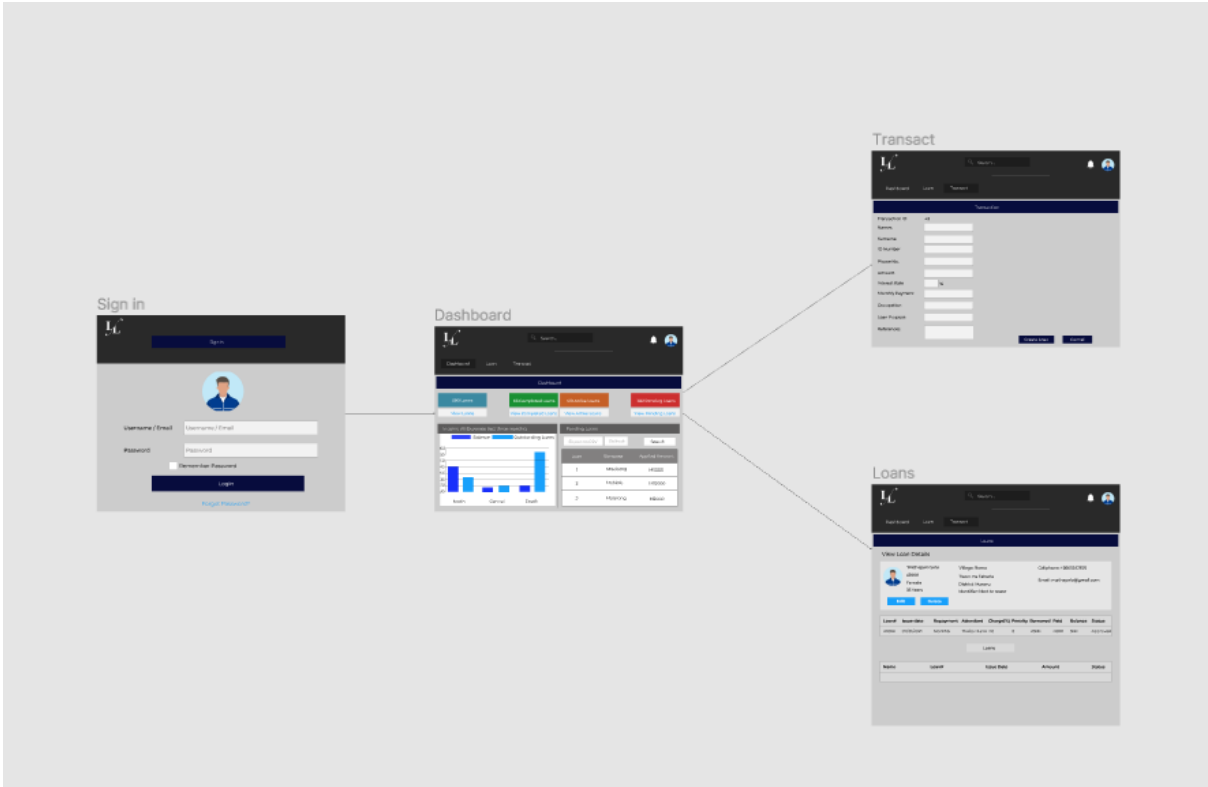
Software architecture

Peer to peer because all the nodes are equal and perform the same replication of data. On top of this, all the nodes communicate.

For our platform, we will use apache cassandra.

Demonstration System Architecture Diagram





Entities

Loans									
L_ID	B_ID	Agent	Amount	Loan term	Date	Status	Interest rate	Balance	Branch
L1	B1	Ntsoaki	2500	3 years	2022-02-15	Active	12%	2200	Maseru
L2	B2	Lebohang	5000	5 years	2021-09-10	Active	8%	4600	Mafeteng
L3	B1	Thabo	1500	2 years	2022-04-01	Active	15%	1300	Maseru
L4	B3	Kefuoe	8000	7 years	2021-08-25	Default	10%	8000	Quthing
L5	B2	Tsebo	4000	4 years	2021-11-12	Active	9%	3600	Mafeteng
L6	B1	Moshe	3500	3 years	2022-03-	Active	14%	3050	Maseru

					20				
L7	B3	Naledi	6500	6 years	2021-10-05	Active	11%	5850	Quthing
L8	B1	Relebohile	2000	2 years	2022-05-02	Active	13%	1740	Maseru
L9	B2	Rethabile	4500	5 years	2021-12-07	Active	8.50%	4132.5	Mafeteng
L10	B1	Mpho	1800	2 years	2022-02-18	Active	12.50%	1575	Maseru

Borrowers					
B_ID	Names	Contact	Address	Employed	Monthly income
B1	Thabo Mohale	62876543	12 Main Road, Maseru, Lesotho	Yes	8000
B2	Mamello Tsekoa	68123456	5 High Street, Mafeteng, Lesotho	Yes	10000
B3	Tsebo Mokhali	67894561	28 Hilltop, Quthing, Lesotho	No	0
B4	Rethabile Motaung	67987654	15 Riverside, Mohale's Hoek, Lesotho	Yes	12000
B5	Mpho Lekhooa	62897543	10A Kingsway, Maseru, Lesotho	Yes	9000
B6	Neo Mahao	67823456	3B Tlokoeng Road, Mohale's Hoek, Lesotho	Yes	11000
B7	Tumelo Tšoaeli	67984561	29 Mabote Street, Qacha's Nek, Lesotho	Yes	9500
B8	Nthabiseng Mohapi	62867543	8 Mpilo Road, Maseru, Lesotho	No	0
B9	Kefuoe Kholoana	68123457	2A Ntja Road, Butha-Buthe, Lesotho	Yes	7000

B10	Mohau Motloung	67804561	6 Phakalane Street, Qacha's Nek, Lesotho	Yes	8500
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Agents				
A_ID	Br_ID	names	Email	phone_number
A1	2	Mpho Mokoena	mphomokoena@example.com	555-12340
A2	1	Tumelo Moholo	tumelomoholo@example.com	555-12341
A3	3	Khotso Ntuli	khotso.ntuli@example.com	555-12342
A4	2	Mosiuoa Mohapi	mosiuoa.mohapi@example.com	555-12343
A5	1	Neo Masenya	neo.masenya@example.com	555-12344
A6	3	Masechaba Sebatane	masechaba.sebatane@example.com	555-12345
A7	2	Tsebo Mofokeng	tsebo.mofokeng@example.com	555-12346
A8	1	Tlali Mosebi	tlali.mosebi@example.com	555-12347
A9	3	Lehlohonolo Ramafole	lehlohonolo.ramafole@example.com	555-12348
A10	2	Itumeleng Molefe	itumeleng.molefe@example.com	555-12349

Payments				
P_ID	L_ID	amount	date	charge
P1	L1	500	04-03-23	100
P2	L2	750	11-03-23	150
P3	L3	12000	11-03-23	2400
P4	L4	3400	19-03-23	680

P5	L5	4350	20-03-23	870
P6	L6	1110	21-03-23	222
P7	L7	100	21-03-23	20
P8	L8	320	24-03-23	64

Branches				
<u>Br_ID</u>	<u>br_name</u>	<u>Address</u>	<u>contact</u>	<u>Region</u>
Br1	Mokhotlong Branch	Mapholaneng	53405800	North
Br2	Butha-Buthe Branch	Teba	53405801	North
Br3	Leribe Branch	Hlotse	53405802	North
Br4	Berea Branch	Kolonyama	53405803	Central
Br5	Maseru Branch	Sefika Complex	53405804	Central
Br6	Mafeteng Branch	Teba	53405805	Central
Br7	Mohale's Hoek Branch	Qalakheng	53405806	South
Br8	Quthing Branch	Upper Moyeni	53405807	South
Br9	Qacha's Nek Branch	Letloepe	53405808	South
Br10	Thaba-Tseka Branch	Bokong	53405809	Central

Collateral				
<u>L_ID</u>	<u>B_ID</u>	<u>Collateral type</u>	<u>Collateral value</u>	<u>Description</u>
L1	B1	Car	180 000	Fair conditions
L2	B2	Phone	25 000	good conditions
L3	B3	Laptop	13 000	Fair conditions
L4	B4	Phone	5 000	goof conditions
L5	B5	Car	17 000	Fair conditions
L6	B6	Watch	340 000	Fair conditions
L7	B7	Ring	500 000	good conditions
L8	B8	House	230 000	Fair conditions

Test Plan

Test	Explanation	How	Expected result
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Functional testing	<p>This test is aimed at ensuring that the distributed database implementation works as intended, performs the necessary operations and meets the functional requirements of the loan management system</p>	<p>Develop test cases that cover all the possible scenarios:</p> <ol style="list-style-type: none"> 1. creation of a new loan application, updating an existing loan application, or deleting a loan application. 2. create test cases to cover scenarios such as successful and unsuccessful logins, testing different user roles, and ensuring that unauthorised users are not able to access the system. 	<p>1.Loan application should be created, updated, or deleted successfully without any errors or issues AND should be saved/stored correctly.</p> <p>2. users should be able to log in successfully and access appropriate features based on their user role. They should not be able to log in with invalid credentials. users should not be able to access data that they are not authorised to access (appropriate error message displays if access is denied).</p>
Security Testing	<p>This test is aimed at verifying the security features of the system and ensuring that confidential information is protected from unauthorised access.</p>	<ol style="list-style-type: none"> 1. Attempt to log in with incorrect credentials or with a user who does not have access to specific resources. 2. Attempt to access data that the user does not have permission to view or modify. 	<ol style="list-style-type: none"> 1. The system verifies user identity and prevents unauthorised access. 2. The system restricts user access to data based on their privileges and roles.

Efficiency (performance) Testing	This test is aimed at evaluating the performance of a system under different levels of load and data complexity, and to identify any performance issues that could affect the system's overall efficiency.	<ol style="list-style-type: none"> 1. log in or submit a loan application to test the system's response time. 2. Test the system performance for complex queries, such as generating reports or analysing data. 3. Test the system performance under different levels of data volume. 	<ol style="list-style-type: none"> 1. Fast response times for common user actions. 2. Perform complex queries and analyse within acceptable time limits. 3. The system should maintain acceptable performance levels even with large amounts of data.
Disaster Recovery Testing	This type of testing is aimed at evaluating the system's ability to recover from a disaster, such as a power outage or hardware failure.	<ol style="list-style-type: none"> 1. Simulate a power outage by shutting down the system's servers and bring the servers back up to attempt restoration. 2. Remove one of the system's hardware components and attempt to restore information using the remaining hardware. 	<ol style="list-style-type: none"> 1. Recover from the power outage and restore all data within a reasonable amount of time. 2. Recover from the hardware failure and restore all data within a reasonable amount of time.

Usability Testing	<p>This test is aimed at evaluating how user-friendly and easy the system is, by gathering feedback from users about their overall experience using the system.</p>	<p>1. Observe how user-friendly the input forms are: Enter data into the loan management system using the input forms and check whether any confusing or unclear input fields are encountered.</p> <p>2. Check how quickly users can find the features they need and how easily users can move between pages and sections of the system.</p>	<p>1. Users should be able to enter data into the system quickly and accurately, without making mistakes or encountering confusing input fields.</p> <p>2. Users should be able to navigate the system easily and efficiently, without getting lost or confused.</p>
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