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IMPLEMENTATION OF ARTIFICIAL NEURAL NETWORK IN CONCURRENCY CONTROL OF DISTRIBUTED DATABASE SYSTEM

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ABSTRACT

Current Database Management Systems (DBMSs) work in multiuser environment where users access the database concurrently. Therefore the DBMSs must have to control over the concurrent execution of user transactions, so that the overall correction of the database is maintained. A transaction is a user program accessing the database. To control over concurrent execution of transactions is becoming problematic thing in case of Distributed Database System (DDS). Although there are several techniques exists to control over Concurrent execution, some factors like time to lock and release objects, implementation complexity, memory space requirement, etc are not sufficient to avoid or control over concurrent execution of transaction appropriately in case of DDS. So in this paper we have proposed ANN model for Concurrency control of DDS, which may resolve the problems present in earlier techniques.

KEYWORDS

concurrent execution, DBMS, memory space.

1. INTRODUCTION

ABOUT DISTRIBUTED DATABASE

A distributed database is a database in which portions of the database are stored on multiple computers within a network. Users have access to the portion of the database at their location so that they can access the data relevant to their tasks without interfering with the work of others. A centralized distributed database management system (DDBMS) manages the database as if it were all stored on the same computer. The DDBMS synchronizes all the data periodically and, in cases where multiple users must access the same data, ensures that updates and deletes performed on the data at one location will be automatically reflected in the data stored elsewhere.

2. WHAT IS TRANSACTION?

Transaction is series of actions, carried out by user or application, which accesses or changes contents of database. It is a logical unit of work on the database. It transforms database from one consistent state to another, although consistency may be violated during transaction.

3. DISTRIBUTED CONCURRENCY CONTROL

In database systems and transaction processing (transaction management) distributed concurrency control refers primarily to the concurrency control of a distributed database. It also refers to the concurrency control in a multi-database (and other multi-transactional object) environment (e.g., federated database, grid computing, and cloud computing environments.

A major goal for distributed concurrency control is distributed serializability (or global serializability for multi-database systems). Distributed concurrency control poses special challenges beyond centralized one, primarily due to communication and computer latency. It often requires special techniques, like distributed lock manager over fast computer networks with low latency, is a general serializability technique that achieves distributed serializability (and global serializability in particular) effectively on a large scale, without concurrency control information distribution (e.g., local precedence relations, locks, timestamps, or tickets), and thus without performance penalties that are typical to other serializability techniques.

Executions of transactions guaranteed to ensure consistency is identified by the concept of serializability with those schedules of reads / write. There are two types of schedule Serial schedule and Non-Serial schedule. Serial schedule: is where operations of each transaction are executed consecutively without any interleaved operations from other transactions. Non serial Schedule: Schedule where operations from set of concurrent transactions are interleaved. Techniques used for concurrency Control are Locking and Timestamping. Both are conservative approaches when delay transactions in case they conflict with other transactions. These techniques are basically divided in two main categories Pessimistic and Optimistic. Optimistic methods assume conflict is rare and only check for conflicts at commit. Transaction uses locks to deny access to other transactions and so prevent incorrect updates. A transaction must claim a shared (read) or exclusive (write) lock on a data item before read or write. Lock prevents another transaction from modifying item or even reading it, in the case of a write lock. Rules of locking are, if transaction has shared lock on item, can read but not update item, and if transaction has exclusive lock on item, can both read and update item, Reads cannot conflict, so more than one transaction can hold shared locks simultaneously on same item, Exclusive lock gives transaction exclusive access to that item. The most common distributed concurrency control technique is strong strict two-phase locking

4. PROBLEM DEFINITION

There is inability to provide consistency in the database when long transactions are involved. It will not be able to identify if there is any violation of database consistency during the time of commitment. It is not possible to know, if the transaction is with undefined time limit.

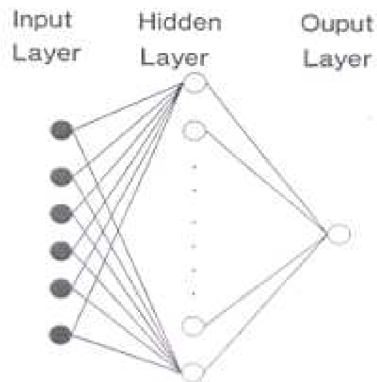
There is no serializability when many users work on shared objects. During long transactions, optimistic transactions and two phase locking will result in deadlock. Two phase locking forces to lock resources for long time even after they have finished using them. Other transactions that need to access the same resources are blocked. The problem in optimistic mechanism with Time Stamping is that it causes repeated rollback of transactions when the rate of conflicts increases significantly.

5. ABOUT ANN

An artificial neuron network (ANN) is a computational model based on the structure and functions of biological neural networks. Information that flows through the network affects the structure of the ANN because a neural network changes - or learns, in a sense - based on that input and output. ANNs are considered nonlinear statistical data modeling tools where the complex relationships between inputs and outputs are modeled or patterns are found. ANN is also known as a neural network.

An ANN has several advantages but one of the most recognized of these is the fact that it can actually learn from observing data sets. In this way, ANN is used as a random function approximation tool. These types of tools help estimate the most cost-effective and ideal methods for arriving at solutions while defining computing functions or distributions. ANN takes data samples rather than entire data sets to arrive at solutions, which saves both time and money. ANNs are considered fairly simple mathematical models to enhance existing data analysis technologies. ANNs have three layers that are interconnected. The first layer consists of input neurons. Those neurons send data on to the second layer, which in turn sends the output neurons to the third layer.

FIG. 1: MULTILAYER PERCEPTION



6. IMPLEMNTING BACKPROPAGATION ALGORITHM OF ANN IN CONCURENCY CONTROL

6.1 BACKPROPAGATION ALGORITHM (BPA)

The BPA uses the steepest-descent method to reach a global minimum. The number of layers and number of nodes in the hidden layers are decided. The connections between nodes are
initialized with random weights. As shown in following steps a pattern from the training set is presented in the input layer of the network and the error at the output layer is calculated. The error is propagated backwards towards the input layer and the weights are updated. This procedure is
repeated for all the training patterns. At the end of each iteration, test patterns are presented to
ANN, and the classification performance of ANN is evaluated. Further training of ANN is continued till the desired classification performance is reached.

6.2 STEPS INVOLVED

FORWARD PROPAGATION

- The weights and thresholds of the network are initialized.
- The inputs and outputs of a pattern are presented to the network.
- The output of each node in the successive layers is calculated.

o(output of a node) = 1/(1+exp(_wij xi + Θ))

- The error of a pattern is calculated

E(p) = (1/2) _(d(p) – o(p))2

REVERSE PROPAGATION

- The error for the nodes in the output layer is calculated

δ(output layer) = o(1-o)(d-o)

- The weights between output layer and hidden layer are updated

W(n+1) = W(n) + ηδ(output layer) o(hidden layer)

- The error for the nodes in the hidden layer is calculated

δ(hidden layer) = o(1-o) _δ(output layer) W(updated weights between hidden and output layer)

- The weights between hidden and input layer are updated.

W(n+1) = W(n) + ηδ(hidden layer) o(input layer)

The above steps complete one weight updation.
Second pattern is presented and the above steps are followed for the second weight updation. When all the training patterns are presented, a cycle of iteration or epoch is completed. The errors of all the training patterns are calculated and displayed on the monitor as the mean squared error(MSE).
E(MSE) = _ E(p)

TABLE 1: LOCK MANAGEMENT VARIABLES

User	Object	Mode

Where,
User represents the client
Object represents the database/ file/ record
Mode represents type of lock assigned to an object.
exclusive (X) mode: Data item can be both read as well as written.
shared (S) mode: Data item can only be read..
intention-shared (IS): Indicates explicit locking at a lower level of the tree but only with shared locks.
Intention-exclusive (IX): Indicates explicit locking at a lower level with exclusive or shared locks.
shared and intention-exclusive (SIX): The sub tree rooted by that node is locked explicitly in shared mode and explicit locking is being done at a lower level with exclusive-mode locks.
A intention locks allow a higher level node to be locked in S or X mode without having to check all descendent nodes.
In Table 2, column 1 represents the lock type. Column 2 represents the value to be used in the input layer of the ANN in module 1 and module 3. Column 3 gives binary representation of Lock type to be used in the output layer of module 1 and module 3. The values are used as target outputs in the module 1 and module 3 during lock release on a data item.
Table 3 shows two transactions T1 and T2 in the first column. Each transaction requests object a or b with a lock mode S or X. The fourth column indicates if any one of the lock is assigned for the object and otherwise '0' if no lock is assigned to the object.

TABLE 2: LOCK TYPE AND THEIR BINARY REPRESENTATION

Lock type	(Input layer representation numerical value).	Binary representation in target layer of the ANN
S	1	001
X	2	010
IS	3	011
IX	4	100
Object Not locked	0	000

TABLE 3: SEQUENCE OF OBJECT ACCESS BY TWO USERS

User / Intermediate transaction	Object (a)	Object (b)	Mode S,X ,IS,IX	Lock Enabled – (1) Otherwise (0)
T1	a	-	S	1
T2	a	-	S	1
T1	a	-	X	1
T1	-	B	S	1
T2	a	-	X	1
T1	-	B	X	1

This work uses for modules of algorithm which work using BPA given in Table 1. The modules given in Table 4 gives their usage for learning and finding the lock states. OML(Object, Mode, Lock) and OL (Object Mode).

TABLE 4: MODULES AND LOCK STATUS OF AN OBJECT

Module	Name	Testing / Testing	ANN Topology
1	OML	Training(Figure 1)	2{user number and mode} x {no. of nodes in hidden layer} x 3{Lock value}
2	OML	Testing (Figure 2)	2{user number and mode} x (no. of nodes in hidden layer) x 3(Lock value)
3	OL	Training(Figure 3)	1{user} x 2 {no. of nodes in hidden layer} x 3{lock value}
4	OL	Testing (Figure 4)	1{user} x 2 {no. of nodes in hidden layer} x 3{lock value}

FIGURE 2: OML TRAINING

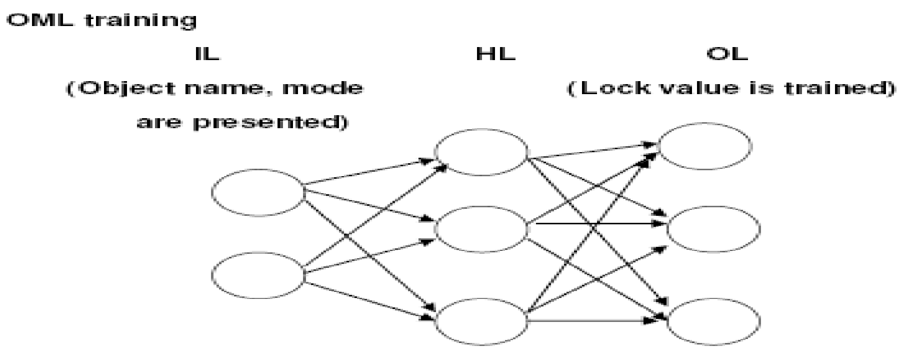


FIGURE 3: OML TESTING

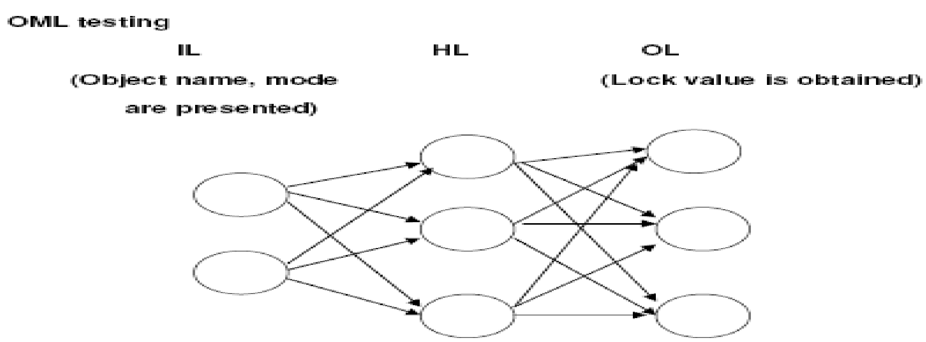


FIGURE 4: OL TRAINING

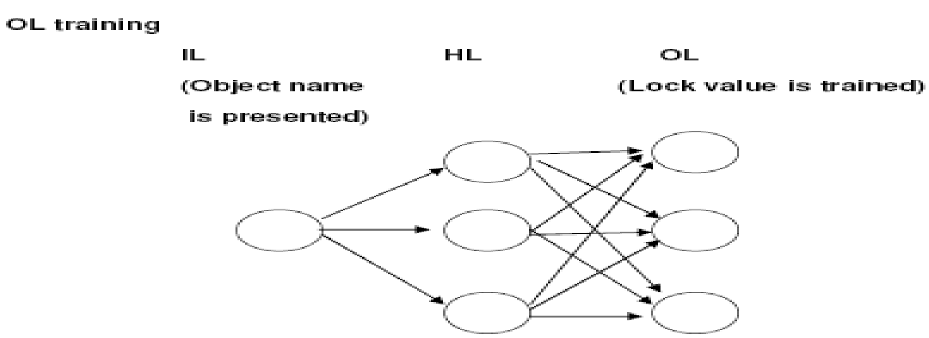
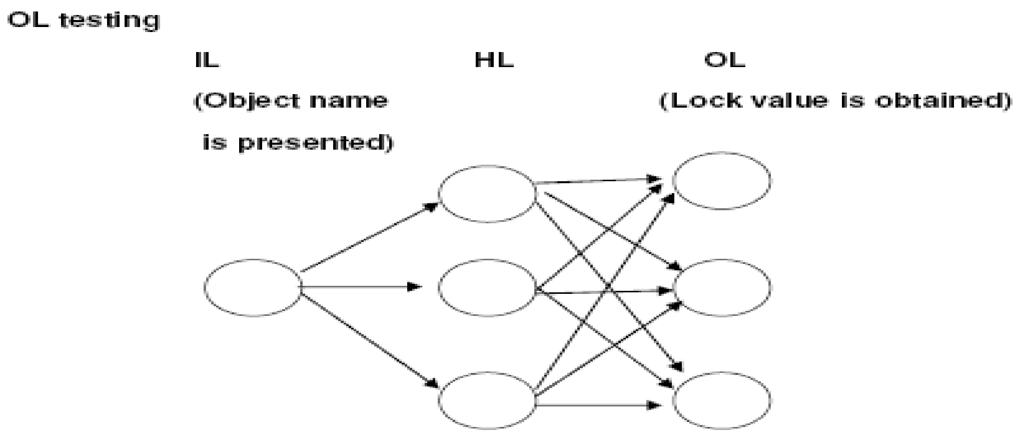


FIGURE 5: OL TESTING



7. SEQUENCE OF MODULES EXECUTED WHEN A TRANSACTION REQUESTS LOCK OR RELEASES LOCK

1. Initialize randomly the weights of module 1 and module 3
2. A transaction Ti requests lock on an object (a ,b,)
3. Module 4 is tested with object (a, b,…) requested in step 2 to obtain binary value. If '000' is output in the output layer of module 4, then the object is free to be accessed. If (001, 010, 011, 100 is output then the object is under use. If the output value is 001, then the transaction in step is given access to the requested object
4. In any case , if Ti is given transaction to requested object, then module 1 and module 3 are weight updated using the back propagation algorithm (forward and backward steps)
5. In any case , if the object is under any lock mode other than shared or no lock, then the transactions are kept under queue.

8. CONCLUSION

An approach has been attempted to implement ANN in concurrency control. The approach has to be verified with different types of files operated by many users in a distributed environment. ANN algorithms can be attempted to achieve concurrency control in distributed database applications which are more beneficial than conventional techniques like two phase locking, timestamp ordering, etc.

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