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Explaining the Fundamental Concepts of TRANSACTION PROCESSING MECHANISM WITHIN A DBMS

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Abstract:

Imagine you've just transferred $900 to your mom via PayPal/Venmo, or perhaps you've found an item you love on Amazon and purchased it with your credit card. Maybe you're a store manager who has received a payment that automatically triggers the dispatch of products to your customers. These are just a few examples of how a system can perform such tasks. This is made possible by a Transaction Processing System (TPS). This article provides a concise overview of how this system operates.

Concept:

The term **"transaction processing"** refers to a database **mechanism concept** that specifies the logical steps in database processing that must be followed to guarantee that a database management system is operating as intended (Elmasri & Navathe, 2016).

A **transaction processing** system is a digital system that can handle massive amounts of data and manage enormous databases with hundreds of concurrent users. It is a **multi-user system** capable of handling hundreds or thousands of **simultaneous interactions and resource requests without significant downtime**. These systems are also **capable of processing and manipulating large amounts of data** if configured appropriately. This mechanism concept is applied to various DBMS in use by banks, stock exchanges, reservation systems, supermarkets, law enforcement agencies, and other organizations. Additionally, this concept can be used to **clarify concurrency control techniques and recovery concepts** in Database Management Systems (Elmasri & Navathe, 2016).

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Mechanism:

A **high-level query language like SQL** can be used to specify database operations interactively or they can be embedded within an application program to form a transaction. To add **transaction boundaries** to an application program, we can define certain criteria within its source code that indicate when transactions should **begin** and **end**. Transactions within a database management system (DBMS) typically involve operations such as inserting, deleting, modifying, and retrieving data. For example, suppose John wants to transfer $800 to his mother using PayPal/Venmo. We know that such applications use cloud server DBMS to store information and TPS to process transactions. So, firstly, as John begins the process of the transaction, the transaction boundaries specified in PayPal/Venmo's source code kicks in. The transaction will only proceed if John has at least $800 or more in his account. Otherwise, data transfer protection within the processing mechanism will kick in and block that specific transaction from moving forward (Elmasri & Navathe, 2016; Pavlo, 2022).

When a database management system is being used by a large number of users **simultaneously**, such as 100 or more people at the same time, it is necessary to implement **concurrency control mechanisms** to **prevent data corruption, inconsistency, and redundancy** caused by the **actions of end-users**. Without proper **concurrency control and backup & recovery mechanisms**, a multi-user concurrent DBMS is likely to encounter many issues related to these problems (Elmasri & Navathe, 2016).

Real-Time and Batch Processing Mechanism:

A transaction processing system (TPS) can process the data and information of a system in either **"real-time"** or queuing it up in a batch and processing it at a specified time or at configured intervals. The latter is known as **"batch processing".** Real-time processing is a mechanism within a transaction processing system (TPS) that allows transactions or activities to be processed as soon as an input is made, or an action or command is executed, reducing the occurrence rate of unnecessary delays. It is worth noting that both real-time and batch processing methods of a TPS require one or more input information in order to proceed (Antonenko, 2023). This concept will be illustrated below through the example of a financial institution:

Let's consider a bank called Cassandra & Co., which operates two branches: one in New Orleans, Louisiana, and the other in Norfolk, Virginia, which serves as their headquarters. Throughout the business day, customers in New Orleans conduct transactions smoothly and instantly. This is made possible by the branch's system, which uses a Transaction Processing System (TPS) to process each transaction in real-time and stores the transaction data in a database.

At the end of the day, Cassandra & Co. New Orleans needs to consolidate this data into meaningful information that can provide valuable insights. Additionally, this data needs to be replicated to their central server. The system accomplishes this through the batch processing feature of the TPS, which compiles all the data according to their settings and transfers this information to the central server, provided the configuration is set up correctly.

As the month comes to a close, the Norfolk headquarters of Cassandra & Co. needs to evaluate the performance of their New Orleans branch to balance their financial records. To gather the necessary transaction information about the New Orleans branch's operations, the headquarters in Virginia can run a monthly batch processing operation on their central servers. This process will collect and organize the relevant data as required.

OLTP and OLAP:

OLTP, or Online Transaction Processing, is a conventional method of managing databases. It involves adding, removing, updating, and changing data while also enabling users to perform information queries. Although traditional relational database management systems (RDBMSs) are designed to handle these functions efficiently, they cannot be optimized for data mining or **online analytical processing (OLAP)** as they process a limited number of relations per tuple (Sinha, 2021).

OLAP refers to the analysis of intricate data from a data warehouse. **Data warehouses** are known for collecting data by digital systems that are subject-oriented, integrated, non-volatile, and time-variant. These warehouses allow for accessing data for complex analysis, decision-making, and the discovery of knowledge (Sinha, 2021).

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References

Antonenko, D., 2023. *Transaction Processing Systems: An Introduction to TPS | BusinessTech Weekly.* [Online]
Available at: https://www.businesstechweekly.com/online-sales-and-growth/payment-systems/transaction-processing-systems-tps/

Elmasri, R. & Navathe, S. B., 2016. *Fundamentals of Database Systems.* 7th ed. Hoboken, New Jersey, USA: Pearson Higher Education.

Pavlo, A., 2022. *Lecture #15: Concurrency Control Theory - Database Systems,* Pennsylvania: Carnegie Mellon University.

Sinha, T., 2021. *OLAP vs. OLTP: What's the Difference?.* [Online]
Available at: https://www.ibm.com/blog/olap-vs-oltp/