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ADVANCED PEDAGOGICAL TECHNOLOGIES IN EDUCATION

ANALYSIS OF THE MOST UP-TO-DATE SERVER DATABASE MANAGEMENT SYSTEMS

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Abstract:

Objective. The purpose of this article is to conduct an overview and comparative analysis of the most up-to-date server database management systems, including Informix Dynamic Server, Microsoft SQL Server, Db2 Universal Database and Oracle 9i. we strive to identify the main characteristics and distinctive features of each of these DBMS, as well as to evaluate their advantages and limitations.

Methods. For the analysis, we relied on available sources of information, including official documents, technical documentation, scientific articles and publications, as well as experienced users and database experts.

Results. the analysis showed that each of the considered DBMS has its own advantages and disadvantages. Informix Dynamic Server stands out for a wide range of architectural features that provide high performance and scalability, but require a higher level of professionalism in administration. Microsoft SQL Server is attractive for the Windows operating system, has a developed dialect of the SQL language and a rich set of development tools, but is mainly focused on integration with other Microsoft products. Db2 Universal Database provides high performance, scalability and multiplatform, but has a complex interface and functionality. Oracle 9i is focused on use in the Internet environment, supports various hardware and software platforms, but requires highly qualified developers and administrators.

Conclusion. In this paper, we considered the signs by which it is possible to analyze the advantages and disadvantages of database management systems (DBMS). During the performance analysis, the indicators of query execution speed, transaction processing and scalability of the system with an increase in data volume were considered. Data availability has also been studied, including the possibility of replication and fault tolerance of the system, special attention is paid to the functionality of the DBMS server.

Keywords: database management systems, performance, scalability, data availability, server functionality, DBMS openness, development tools, administration tools, DB2, Oracle, Microsoft SQL Server, Informix, advantages, disadvantages.

Introduction. Server database management systems (DBMS) plays an important role in modern information systems, providing efficient storage, access, and processing of data. With the rapid development of information technology and the growth of data volumes, choosing the right DBMS becomes a key aspect for organizations. This article will analyze the most current server database management systems, such as Informix Dynamic Server, Microsoft SQL Server, Db2 Universal Database, and Oracle 9i.

Methods. To conduct our analysis, we relied on available sources of information, including white papers, technical papers, scientific articles, and publications, as well as experienced users and database experts. We reviewed the main characteristics of each of the considered DBMS, including performance, scalability, functionality, compatibility with various platforms and operating systems, as well as development and administration tools.

Results. The analysis showed that each considered DBMS has its advantages and disadvantages. Informix Dynamic Server is distinguished by a wide range of architectural features that provide high performance and scalability but require a higher level of professionalism in administration. Microsoft SQL Server is attractive for the Windows operating system, has a developed dialect of the SQL language and a rich set of development

tools, but is mainly focused on integration with other Microsoft products. Db2 Universal Database provides high performance, scalability, and multiplatform functionality, but has a complex interface and functionality. Oracle 9i is focused on use in the Internet environment, and supports various hardware and software platforms, but requires highly skilled developers and administrators.

Discussions. There are currently many server-side database management systems (DBMS) on the market - this is software designed to create, manage, organize, and process data in a database. By analyzing criteria such as scalability, performance, data availability, server functionality, openness, and development tools, we can compare the efficiency and functionality of different DBMS and determine their advantages and disadvantages in different use cases:

1. Scalability refers to the ability of a system to run on various types of hardware, including laptops and massively parallel (MPP) servers. The higher the level of scalability, the more opportunities to expand the system as requirements grow [1]. By improving system scalability, including hardware expansion, you can achieve a significant increase in performance and processing efficiency.

Informix DBMS is scalable with multithreading architecture, multiprocessing, and PDQ technology. The multi-threaded architecture evenly distributes the load between resources, and PDQ technology speeds up the processing of large tables. Informix also allows you to dynamically change the size and configuration of resources such as virtual processors and disk space. This allows you to flexibly adjust parallel processing and change the rules for table fragmentation. To improve performance, Informix provides the ability to distribute data and processing across multiple servers. This load balancing and efficient use of resources contribute to improved system performance. All these scalability options make Informix a flexible and efficient DBMS for processing large amounts of data and optimizing system performance according to requirements and available resources [8].

Db2 Universal Database runs flexibly on portable computers and powerful machines with massive parallelism, serving mobile users and processing terabytes of data for thousands of users. It is highly scalable and runs in a variety of symmetric multiprocessor (SMP) and SMP cluster configurations.

DB2 UDB provides cross-version compatibility by allowing object-relational features in both older and newer versions. This makes it an attractive choice for small and medium-sized organizations, as well as large enterprises that need to scale applications at different architecture levels. DB2 UDB is also popular with ISPs and business partners.

DB2 UDB offers symmetric multiprocessor (SMP) parallel processing and support for clusters and massively parallel (MPP) systems for scalability. These capabilities improve performance and scalability when working with large amounts of data.

By using these scalability tools, DB2 UDB provides flexibility and efficiency to work with different enterprise sizes and data volumes [4].

One of the widely recognized advantages of the Oracle server is its high degree of scalability, which includes both "horizontal" and "vertical" scalability. This means that the Oracle server can effectively scale both horizontally (by adding additional servers and nodes) and vertically (by increasing the resources and capacity of a single server). Regardless of the configuration, Oracle Server supports parallelism in operations due to its architecture. Parallel execution of individual queries in an SMP architecture may require installing the Parallel Query Option. For clusters and MPP systems,

Oracle offers an architecture that allows all nodes of these systems to access the same database in parallel, and this requires the installation of the Parallel Server Option [7].

Microsoft SQL Server also provides a high level of scalability and availability. However, unlike Oracle, the scalability of SQL Server is not "pure", since the performance of SQL Server depends not only on the hardware but also on the operating environment on which the DBMS is running [10].

2. Performance is an important consideration when choosing a database management system (DBMS), and every software company usually claims that their product has high performance. However, specific optimization mechanisms that affect performance may differ for each DBMS. Key architectural features of the Informix DS DBMS that affect performance include:

–multithreading, parallel processing, and fragmentation of tables that increase performance and efficiency in data processing;

–optimization of query execution, selection of efficient execution plans, and use of shared memory to speed up data access;

–caching of data dictionaries and stored procedures, which speeds up access to metadata and reuse of compiled procedures;

–disk management, asynchronous I/O, and pre-reading that optimizes data read and write operations.

As a result of these features, Informix DS provides high performance and efficiency in data processing and query execution [6].

Db2 Universal Database supports the following key object-relational features that comply with SQL3 standards and have an open approach:

–user-defined data types (UDTs), which allow you to create new data types based on built-in types;

–special functions (UDFs) that allow you to use powerful computational and search predicates in queries to filter data directly from the source;

–large objects (LOBs), which provide the ability to store very large binary or text objects in the database, several gigabytes in size;

–user-defined table functions (Table UDF), which allow accessing data that is not stored in a relational format and fully use the query capabilities of a relational database;

–Special Ole Functions (OLE UDFs) that allow you to interact with OLE server data through DB2 using UDFs. This makes it possible to transfer data from OLE servers through DB2 to SQL queries [4].

In turn, Oracle offers a wide range of features, including the powerful PL/SQL programming language and various engines. Tools such as triggers, stored procedures, functions, and others allow developers to flexibly manage and process data in the database [4].

Microsoft SQL Server also provides a powerful data language known as Transact-SQL. This language, which is an extension of standard SQL, has great potential. While not fully compliant with the ANSI/ISO SQL-92 standard, Transact-SQL is considered one of the most prominent dialects of SQL. It supports database objects, including stored procedures, triggers, integrity support, and other features. However, there are no mechanisms for cascading deletion and automatic data recovery based on foreign keys [3].

5. Openness is a broad term covering various aspects and assessments. It defines the integration of databases and products based on them in various environments, including hardware, software, administrative and national environments. This is important both for the current development of information systems and for their future development.

Here are some characteristics that define the openness of Informix systems:

–support for various platforms, including Sequent, HP, Sun, IBM, Siemens Nixdorf, NCR;

–support for Windows NT and NetWare operating systems, except for UNIX;

–the ability to integrate Informix databases into a variety of distributed information systems built on various hardware and software platforms and databases from different manufacturers;

–Informix integration with centralized management and administration systems such as Tivoli Management Environment (TME), HP OpenView, and IBM NetView.

–support for multilingualism [8].

Db2 Universal Database provides flexible access to databases from virtually any client using various types of networks. It offers support for many industry standards, allowing users to interact with the system using pre-existing tools and applications. Thanks to this, integration with existing infrastructure becomes easier and more convenient.

Db2 Universal Database servers and Db2 Connect gateways provide the ability to run on a variety of platforms, including AIX, Linux, HP-UX, OS/2, Solaris, Windows NT, and Windows 2000. This provides system flexibility and adaptability, allowing it to run in different environments and with different operating systems.

The openness of Microsoft SQL Server, like its scalability, is relative. SQL Server interacts with other Microsoft products such as MS Office, MS Visual Studio, MS Internet Information Server, etc. The developers claim that the interaction between these software systems is more efficient since they are developed by one company than with similar products from other companies [3].

The Informix development and access toolkit, including the Informix NewEra GUI, has been praised by industry experts as mature and up-to-date tools that meet the demands of today's application development. These tools provide a convenient way for team development to keep developers productive and make it easy to create applications.

Db2 Personal Developer's Edition and DB2 Universal Developer's Edition provide a development environment that allows programmers to create data applications in IBM relational database systems. These versions of DB2 include developer tools, documentation, and sample application source code for supported Db2 Universal Database platforms. Db2 Personal Developer's Edition provides all the tools you need to develop applications on Linux, OS/2, and Windows, including the Software Developer's Kit (SDK). This allows developers to create applications with a convenient and familiar set of tools, as well as take advantage of all the features and functionality of the Db2 Universal Database. DB2 Universal Database is one of the easiest database management systems in its class to use and manage. It has a complete set of graphical tools that satisfy the needs of database administrators and application developers [4].

Oracle development tools include [5]:

–Oracle Developer, which allows you to develop applications, forms, and reports for various databases, as well as their localization and migration to web applications;

–Oracle Express, which provides multidimensional database technology for analytical tasks, including a multidimensional database server, development tools, and ready-made analytical applications;

–Oracle Express Server, a multidimensional database management system that supports a multidimensional data model and access to relational databases through various data storage schemes;

–Oracle Express Analyzer, a tool for creating reports, analyzing multidimensional data, and publishing results on the Internet;

–Oracle Express Objects, development environment for object-oriented OLAP applications for Oracle Express databases.

These tools allow developers to build applications, analyze data, and work with multidimensional databases in Oracle.

Microsoft SQL Server also offers extensive database development options. It includes the following development tools:

–SQL Server Query Analyzer, used to develop and optimize queries. It allows you to view detailed query execution plans graphically using icons and text tooltips. Query Analyzer also provides index-building recommendations to optimize query execution;

–Visual Database Tools, which is a set of graphical tools for creating entity-relationship diagrams and developing complex queries. With Microsoft Visual Database Tools, you can connect to databases, create, and modify them using diagrams, design and run complex queries, modify data in tables, and design objects such as tables, triggers, and stored procedures for Microsoft SQL Server and Oracle databases.

However, it should be noted that SQL Server lags behind other DBMSs under consideration in two important areas: programmability and development tools.

Based on the analysis of the DBMS evaluation criteria, it is possible to compile a table of effectiveness, highlighting the advantages and disadvantages of each of them.

Table 1

Efficiency of the DBMS highlighting the advantages and disadvantages

DBMS	Advantages	Disadvantages
Informix Dynamic Server	A wide range of architectural features that provide high performance, internal mechanisms to support scalability, rich features of the built-in data manipulation language, support for multiple hardware platforms and operating systems	The more features, the more subtleties in setting up the server for a particular task. System administration requires a high level of professionalism. The functionality and work itself is much more complicated in Informix DS than in MS SQL Server
MS SQL Server	Ideal for the Windows operating system. In addition to a rich set of software tools for development and administration, the attractiveness of the server is due to the presence of a highly intelligent query processor and a well-developed dialect of the SQL language (Transact-SQL)	Such important DBMS parameters as performance and scalability depend on the operating environment - Windows. The server is focused primarily on integration with other Microsoft products; there are much fewer opportunities for integration with software from other manufacturers. The DBMS is based on the fundamental refusal to support operating systems that do not belong to the Windows family
DB2 Universal Database	High performance, rich scalability, developer and database administrator GUI, multi-platform; support for object-relational paradigm and SQL3 standard	Unlike MS SQL Server, very complex and inconvenient interface, and functionality
Oracle 9i	Orientation to the Internet, support for a large number of hardware and software platforms; rich opportunities for developers (object-relational DB, PL/SQL, etc.)	Relatively high price, heavy administration; broad server capabilities require highly qualified developers and administrators

Conclusion. From the analysis carried out, the following conclusions can be drawn about each of the considered DBMS:

MS SQL Server is an ideal choice for the Windows operating system due to its highly intelligent query processor and well-developed dialect of the SQL language (Transact-SQL). These features provide efficient and fast query processing and allow developers to easily work with the database.

Oracle 9i is focused on the Internet environment and supports a wide range of hardware and software platforms. This DBMS offers developers many features, including object-relational databases and the PL/SQL programming language. This makes Oracle 9i a powerful tool for building modern applications, especially in the context of Internet technologies.

Informix DBMS can efficiently serve concurrent online transaction processing and decision support applications for local and distributed databases with large numbers of users. This makes it an attractive choice for companies that need a reliable and scalable database for various types of applications.

Db2 Universal Database combines high-performance online transaction processing, object-relational extensions, advanced optimizations, and data parallel processing capabilities. With these features, Db2 Universal Database can efficiently manage very large databases and deliver high performance in a variety of usage scenarios.

Thus, the existing capabilities of server DBMS reflect modern trends in the development of information systems, such as the use of multiprocessor systems and distributed data processing, the creation of distributed systems using Internet technologies, rapid application development, decision support systems with analytical data processing, as well as increased requirements for reliability of information systems.

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