

SOME DATABASE MANAGEMENT TOOLS FOR DATA MODELING AND REVERSE ENGINEERING

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ABSTRACT: *In this paper we tested the design of a database using database management tools. We compared some existing software products highlighting the platforms they can run on, the types of integrated databases, specific features, advantages and disadvantages. The implementation was done in PostgreSQL 15, and for the database schema we used Altova's DatabaseSPY utility.*

KEYWORDS: database management tool, data modeling, reverses engineering

1. Introduction

We tried to compare a few database management tools, focusing on the database modelling part. The choice of a particular design tool depends very much on the personal preferences of the database programmer and the specific features he wants from the chosen application figure 1 shows a comparisons table.

Feature	Altova DatabaseSpy	MySQL Workbench	dbForge Studio for MySQL	SQL Server Management Studio	TOAD for Oracle
Platforms	Windows, macOS, Linux	Windows, macOS, Linux	Windows, macOS, Linux	Windows, macOS, Linux	Windows, macOS, Linux
Databases supported	All major databases	MySQL, MariaDB, Amazon RDS for MySQL	MySQL, MariaDB, Amazon RDS for MySQL	Microsoft SQL Server, Azure SQL Database, Azure SQL Data Warehouse	Oracle, Oracle Cloud Database
Features	Data modeling, data editing, data visualization, SQL editor, data comparison, database migration, database backup and restore, reverse engineering	Data modeling, data editing, data visualization, SQL editor, data comparison, database migration, database backup and restore	Data modeling, data editing, data visualization, SQL editor, data comparison, database migration, database backup and restore	Data modeling, data editing, data visualization, SQL editor, data comparison, database migration, database backup and restore	Data modeling, data editing, data visualization, SQL editor, data comparison, database migration, database backup and restore, reverse engineering

Advantages	Free, cross-platform, powerful features	Free, cross-platform, powerful features	Free, cross-platform, powerful features	Free, cross-platform, powerful features	Free, cross-platform, powerful features
Disadvantages	Not as widely used as some other products	Not as widely used as some other products	Not as widely used as some other products	Not as widely used as some other products	Not as widely used as some other products
Price	Free (Community Edition)	Free (Community Edition)	Free (Express Edition)	Free (Express Edition)	Free (Personal Edition)

Fig.1. Comparison between Altova DatabaseSpy and 4 other similar software products[1]:

All of the products listed above offer the following common elements [2][3][4][5][6]:

- Data modeling: The ability to create and modify database schemas
- Data editing: The ability to add, edit, and delete data in tables
- Data visualization: The ability to create charts and graphs from data
- SQL editor: The ability to write and execute SQL queries
- Data comparison: The ability to compare two or more databases
- Database migration: The ability to move data from one database to another
- Database backup and restore: The ability to back up and restore databases

Differences:

- The products listed above differ in the following ways [2][3][4][5][6]:
- Price: The prices of the products range from free to \$499
- Platforms: The products are available on a variety of platforms, including Windows, macOS, and Linux
- Databases supported: The products support a variety of databases, including MySQL, MariaDB, Amazon RDS for MySQL, Microsoft SQL Server, Azure SQL Database, Azure SQL Data Warehouse, and Oracle

Features: The products offer a variety of features, some of which are more powerful than others

Advantages and disadvantages: The products have both advantages and disadvantages, which should be considered when choosing a product

2. Testing data modelling tools in a database

We tested two of the software products presented above, namely Altova DatabaseSpy and Toad for Oracle. Altova DatabaseSpy 2023 Enterprise Edition [9] is a Windows database client application that simplifies querying, visualizing, managing, and designing a wide range of relational databases. It allows database administrators, database developers, and other IT professionals interact with multiple database kinds consistently from the same graphical user interface. With DatabaseSpy, you can design or query databases visually or by means of SQL, generate SQL statements, generate scripts describing the structure of existing databases, perform data import (XML, CSV) or export (XML, CSV, Excel, HTML), and reuse resources defined globally across multiple Altova applications, such as files or database connections.

SQL syntax highlighting, autocompletion, conditional formatting, and text formatting capabilities are available for a wide range of SQL grammars. The Enterprise edition of DatabaseSpy provides the ability to automate repetitive tasks with the help of SQL Templates, and includes charting capabilities.

2.1. Altova databasespy [7] is a multi-database query, design, and database comparison tool from Altova, the creator of XMLSpy. DatabaseSpy connects to many major relational databases, facilitating SQL querying, database structure design, database content editing, and database comparison and conversion.

Altova DatabaseSpy offers a wide range of features, including: *Data modeling*: The ability to create and modify database schemas; *Data editing*: The ability to add, edit, and delete data in tables; *Data visualization*: The ability to create charts and graphs from data; *SQL editor*: The ability to write and execute SQL queries; *Data comparison*: The ability to compare two or more databases; *Database migration*: The ability to move data from one database to another; *Database backup and restore*: The ability to back up and restore databases. Altova DatabaseSpy offers a number of benefits, including: It is a powerful tool that can be used to manage databases of all sizes; It is easy to use, even for beginners; It is affordable, with a free community edition and a paid professional edition; It is compatible with all major databases; It is constantly being updated with new features and improvements.

Altova DatabaseSpy is a powerful and versatile database tool that offers a wide range of features and benefits. It is a good choice for database administrators, database developers, and anyone else who needs to manage databases. Altova DatabaseSpy can be used for a variety of tasks, including: Creating and modifying database schemas; Adding, editing, and deleting data in tables; Creating charts and graphs from data; Writing and executing SQL queries; Comparing two or more databases; Migrating data from one database to another; Backing up and restoring databases

2.2. Toad for oracle [8] is a popular integrated development environment (IDE) for Oracle databases. It is a powerful tool that can be used for a variety of tasks, including: Data manipulation; *Data analysis*; *SQL development*; *PL/SQL development*; *Database administration*; *Database development*. TOAD for Oracle offers a wide range of features, including: A graphical user interface (GUI) that makes it easy to interact with Oracle databases; A powerful SQL editor that supports syntax highlighting, code completion, and error checking; A PL/SQL editor that supports syntax highlighting, code completion, and error checking; A debugger that can be used to step through PL/SQL code; A data dictionary that provides information about the database schema; A data viewer that can be used to view and edit data in tables and views; A report generator that can be used to create reports from data in the database; A backup and restore tool that can be used to back up and restore databases.

TOAD for Oracle offers a number of benefits, including: It is a powerful tool that can be used for a variety of tasks; It is easy to use, even for beginners; It is affordable, with a free personal edition and a paid professional edition; It is compatible with all major Oracle versions; It is constantly being updated with new features and improvements.

TOAD for Oracle does have a few drawbacks, including: It can be a bit overwhelming for beginners; It is not as widely used as some other database tools. TOAD for Oracle can be used

for a variety of tasks, including: *Data manipulation*: TOAD for Oracle can be used to add, edit, and delete data in tables and views; *Data analysis*: TOAD for Oracle can be used to query data in tables

and views and to create reports from the data; *SQL development*: TOAD for Oracle can be used to develop and execute SQL queries. *PL/SQL development*: TOAD for Oracle can be used to develop and execute PL/SQL procedures and functions; *Database administration*: TOAD for Oracle can be used to perform a variety of database administration tasks, such as creating and managing users, creating and managing tables, and backing up and restoring databases; *Database development*: TOAD for Oracle can be used to develop and deploy Java applications that access Oracle databases.

3. Designing a database schema

The idea we started from was to generate a database schema for information management in a university. Thus we created a database containing information about faculties, departments, teachers, students and subjects taught. In addition, we added information about years of study, specializations, and student groups.

The database schema we have designed will manage information about the record of courses taught in a faculty. Such a record can contain the following information: subject, faculty (name, year of study, student group, calendar date (day, month, year), number of conventional hours (lecture or seminar or laboratory or project), hours of teaching (according to a timetable for the year of study in which the professor teaches), teaching mode (physical or online; if online, what communication platforms the professor uses), semester in which the subject is taught.

We designed the University_DB database using pgAdmin4 from PostgreSQL 15 [8].

The database contains 10 tables (faculties, departments, disciplines, groups, years_studies, teachers, teaching_degrees, specializations, semester and teaching_activity_type). Figure 2 shows the table structure of the University_DB database:

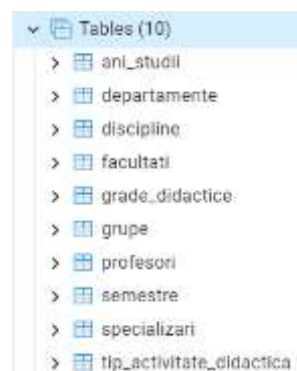


Figure 2. Table structure of the University_DB database (in pgAdmin4)

We have entered information in each table. We can exemplify, in figure 3, the contents of the tables using the following SQL script:

```

Query Query History
1 select s.ume_semestru, p.ume_profesor, p.prenume_profesor, g.ume_grad_didactic, p.specializare,
2 t.ume_activitate_didactica, t.numar_ore_activitate_didactica, d.ume_disciplina
3 from semestre s, profesori p, tip_activitate_didactica t, discipline d, grade_didactice g
4 where p.id_profesor=s.id_profesor
5 and t.id_activitate_didactica=s.id_tip_activitate
6 and d.id_disciplina=s.id_disciplina
7 and p.id_grad_didactic=g.id_grad_didactic;

```

nume_semestru	nume_profesor	prenume_profesor	nume_grad_didactc	specializare	nume_activitate_didactica	numar_ore_activitate_didactica	nume_disciplina
Semestrul I	Vasilescu	Vasile	Profesor universitar doctor	Automatica	Curs		2 Programarea calculatoarelor si limbaje de programare
Semestrul I	Vasilescu	Vasile	Profesor universitar doctor	Automatica	Laborator		2 Programarea calculatoarelor si limbaje de programare
Semestrul I	Bedes	Grigore	Conferețiar universitar doctor	Informatica	Curs		3 Programare orientata pe obiecte
Semestrul I	Bedes	Grigore	Conferețiar universitar doctor	Informatica	Laborator		3 Programare orientata pe obiecte

Figure 3. Example of SQL script in pgAdmin4

To generate the schema of the University_DB database (figure 4) we used the DatabaseSpy application from Altova.

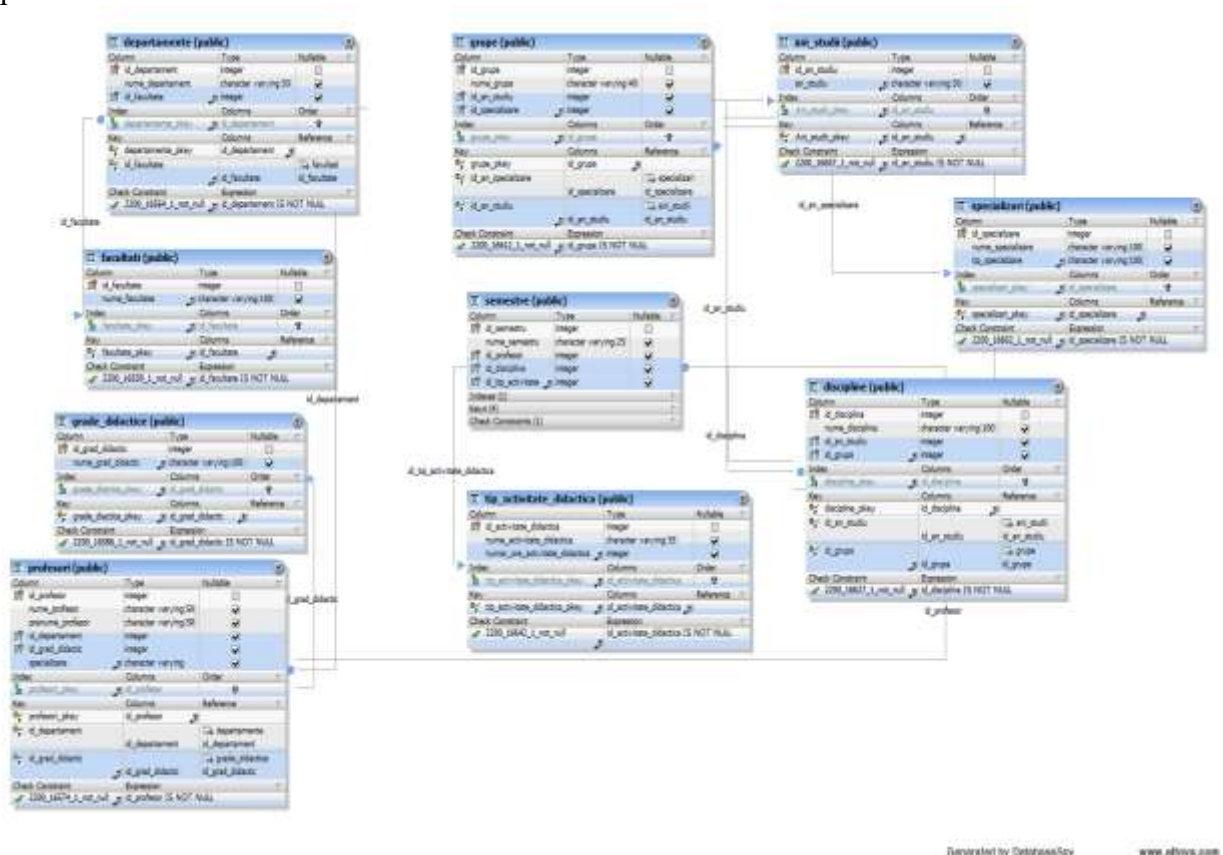


Figure 4. University_DB database schema

The following information can be seen for each table: table name, contained fields along with data types, primary keys and foreign keys. This information (Figure 5) is very useful in the subsequent construction of any application that manages data.

Column	Type	Nullable
id_profesor	integer	<input type="checkbox"/>
nume_profesor	character varying(50)	<input checked="" type="checkbox"/>
prenume_profesor	character varying(50)	<input checked="" type="checkbox"/>
id_departament	integer	<input checked="" type="checkbox"/>
id_grad_didactic	integer	<input checked="" type="checkbox"/>
specializare	character varying	<input checked="" type="checkbox"/>

Index	Columns	Order
profesori_pkey	id_profesor	↑

Key	Columns	Reference
profesori_pkey	id_profesor	
id_departament	id_departament	departamente id_departament
id_grad_didactic	id_grad_didactic	grade_didac... id_grad_didactic

Check Constraint	Expression
2200_16574_1_not...	id_profesor IS NOT NULL

Figure 5. Teachers table from the University_DB database, in the Design Editor of Altova DatabaseSpy

4. Conclusions

Altova DatabaseSpy [7] is a powerful and versatile database tool that offers a wide range of features and benefits. It is a good choice for database administrators, database developers, and anyone else who needs to manage databases. TOAD for Oracle [6] is a powerful and versatile database tool that offers a wide range of features and benefits. It is a good choice for database administrators, database developers, and anyone else who needs to manage Oracle databases.

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References

- [1] https://en.wikipedia.org/wiki/Comparison_of_database_administration_tools
- [2] <https://www.altova.com/manual/DatabaseSpy/databasespyenterprise/>
- [3] <https://dev.mysql.com/doc/workbench/en/>
- [4] <https://docs.devart.com/studio-for-mysql/>
- [5] <https://www.sqlshack.com/sql-server-management-studio-step-step-installation-guide/>
- [6] <https://www.quest.com/products/toad-for-oracle/>
- [7] <https://en.wikipedia.org/wiki/DatabaseSpy>
- [8] <https://www.pgadmin.org/docs/pgadmin4/latest/>
- [9] <https://www.altova.com/documentation#databasespy>