

SQL in Programming Languages

Slides derived from those by Jeffrey D. Ullman

SQL and Programming Languages

- The user does not want to execute SQL statements
- She wants to interact with an application targeted to her domain
 - Limited set of choices
 - Simple execution of complex operations
 - Graphical interface:
 - Simple data input
 - Nice data output (presentation)

Applications

- They are written in traditional programming languages:
 - C, C++, Java, Fortran, C#, F#, Visual Basic, Cobol
- Host languages

Approaches

- Embedded SQL
 - Older approach (since the 70s)
- Call Level Interface (CLI)
 - Most recent
 - SQL/CLI, ODBC, JDBC

Embedded SQL

- In the embedded SQL approach the programmer inserts SQL statements directly in the source code of the host programming language
- A precompiler is used to translate the code so that SQL statements are translated into function/procedure calls of the specific DBMS API
- From a file containing embedded SQL to a file in the same language containing function calls

Concrete Examples

- In DB2 you can develop embedded SQL applications in the following host programming languages: C, C++, COBOL, FORTRAN, and REXX
- The DB2 precompiler is invoked with PREP (PRECOMPILE)
- In Postgres the preprocessor for C is called ECPG

Call Level Interface

- Sending commands to DBMS by means of function calls of an API
 - standard **SQL/CLI** ('95 and then part of SQL:1999)
 - **ODBC**: proprietary (Microsoft) implementation of SQL/CLI
 - OLE DB: high level API
 - ADO: higher level API
 - **JDBC**: CLI for Java

SQL/CLI

- SQL/CLI is the library for C
- ODBC differs from SQL/CLI in minor details

OLE DB

- ODBC is complicated, so Microsoft proposed OLE DB and ADO
- OLE DB: is a library that provides applications with uniform access to data stored in diverse information sources
 - Not only relational
- OLE DB is based on the Microsoft object model: Component Object Model (COM)

ADO and ADO.NET

- ADO: Activex Data Object
- High level interface for OLE DB
- ADO.NET: ADO for the .NET framework
- ADO.NET is independent from OLE DB: there does not exist OLE DB.NET

.NET Framework

- The .NET Framework is Microsoft's replacement for COM technology.
- You can code .NET applications in over forty different programming languages. The most popular languages for .NET development are C# and Visual Basic .NET.
- The .NET Framework class library provides the building blocks with which you build .NET applications. This class library is language agnostic and provides interfaces to operating system and application services.

.NET Framework

- .NET applications (regardless of language) compile into Intermediate Language (IL), a type of bytecode.
- The Common Language Runtime (CLR) is the heart of the .NET Framework, compiling the IL code on the fly, and then running it.
- In running the compiled IL code, the CLR activates objects, verifies their security clearance, allocates their memory, executes them, and cleans up their memory once execution is finished.