

Introduction to SQL

CS 152 -- Programming Paradigms
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Domain-Specific Languages (DSLs)

- Until now, we have been learning general-purpose programming languages.
- Domain-specific languages (DSLs) are targeted to specific environments as opposed to general use.
- Examples of DSLs:
 - Markup languages for describing documents (e.g., HTML, XML, TeX, LaTeX).
 - Query languages (e.g., SQL, Datalog, XPath, GraphQL, Cypher)
 - Macro languages (e.g., C preprocessor, Microsoft Excel macros)
- Advantage of DSLs:
 - Easier to express certain problems (it's helpful to think of languages as *interfaces*).
- Many DSLs tend to be *declarative*, although this is not a requirement.

Remember Lab #1? You've already implemented two DSLs: both for computing arithmetic expressions.

STEPS Toward the Reinvention of Programming

(This won't be on the final, but I find this work interesting)

- Created by researchers at Viewpoints Research Institute, a research institute founded by Alan Kay (of Xerox PARC fame) in 2001 and remained in operation until 2018.
- **Problem:** The software stack required to implement a full-featured GUI operating system is too big for one person to fully comprehend.
 - The Linux kernel itself is millions of lines of code.
 - Imagine adding command-line utilities, either X11 or Wayland, and a full-featured desktop such as KDE or GNOME....
- **Solution:** Compose system by building components implemented in domain-specific languages.
 - Nile implements an entire 2D graphics system in 495 lines of code.
 - An entire TCP/IP system, which normally requires 10,000 lines of code (typically written in C), was written using less than 200 lines of code in another custom domain-specific language.
 - Entire system was written in just 20,000 lines of code.

SQL

Warning: SQL is large. To cover the entirety of SQL and relational databases will require its own course.

SQL

- Pronounced either "S-Q-L" or "Sequel"
- Stands for "Structured Query Language" and was originally called SEQUEL but was changed since the name was already trademarked.
- Originally designed by IBM in the 1970s for the System R database, the world's first relational database implementation.
- SQL is declarative.

SQL

- SQL has since become the standard querying language for many relational databases, many of which have SQL in their names. Examples include, but are not limited to:
 - Oracle Database
 - Microsoft SQL Server
 - MySQL (MariaDB is a fork of MySQL)
 - PostgreSQL
 - Google Spanner (a globally-distributed database)

functional programming

lambda calculus

logic programming

is the reification of



predicate logic

SQL and other relational database query languages

relational algebra

Relational Databases

- Inside a relational database, data is stored in tables called relations.
 - The terminology *table* and *relation* are generally interchangeable (though there are some nuances when studying relational algebra).
- Each relation has a *schema* associated with it.
 - Columns describe fields.
 - Each column has a type associated with it.
- **Structured data** is any type of data that has a schema associated with it.

Persons

id (integer)	first_name (varchar(20))	last_name (var_char(20))	joined (date)
7213	Bill	Gates	1975
23523	Elon	Musk	2005
124124	Satoshi	Nakamoto	2007
35345	Santa	Claus	1845

Purchases

purchase_id (integer)	person_id (integer)	product_id (integer)	quantity (integer)
100	7213	1246	2
101	7213	1434	3
102	124124	132	4
103	35345	65	1

Some SQL Pitfalls

- While there are standardized versions of SQL, each DBMS (database management system) has its own modifications to SQL syntax.
- What may work in PostgreSQL, for example, may not work in MySQL, and vice versa.

Demo Using SQLite