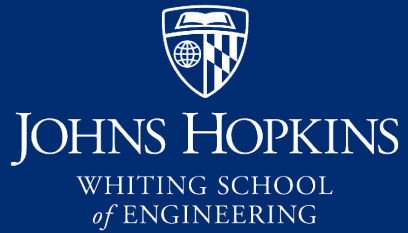

Introduction to Databases and SQL

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Databases

- Store your bytes
  - And return them
- Efficient filtering
  - Thousands of man-years
  - Optimally pick from many strategies

Databases

- SQL basics
  - filtering, aggregation, joins
- SQL programming
  - variables, functions, procedures
  - data management, transactions
- Tools

SQL: Structured Query Language

- Standard declarative language
- Filter the data
- Powerful analysis tool
- Possible to extend

Transactions

ACID Properties

The Elevator Problem

- People on multiple levels
  - Press the button…

Mutual Exclusion

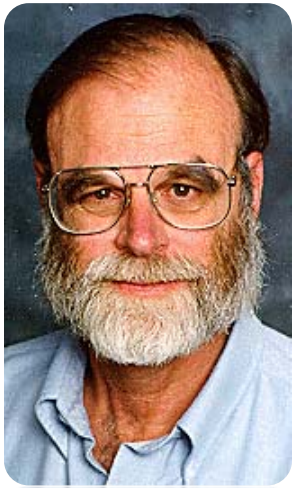
- Multiple processes or threads
  - Access shared resources in critical sections
    - E.g., call the elevator when it's time to go
- Locking
  - Elevators, etc…

Dining Philosophers

- Five silent philosophers sit at the table
  - Alternate between eating and thinking
  - Need both forks left & right to eat
    - Must be picked up one by one!
  - Infinite food in front of them
- How can they all think & eat forever?

Transactions

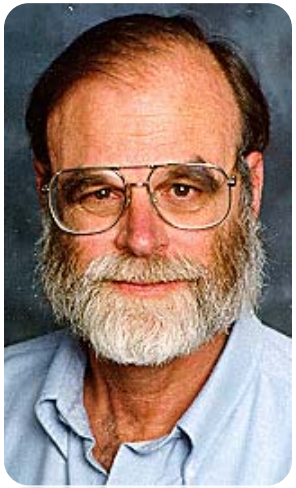
- ACID Properties
  - Atomicity
  - Consistency
  - Isolation
  - Durability



Defined by Jim Gray

Atomicity

- All parts of a transaction succeed
- Or rollback to previous state



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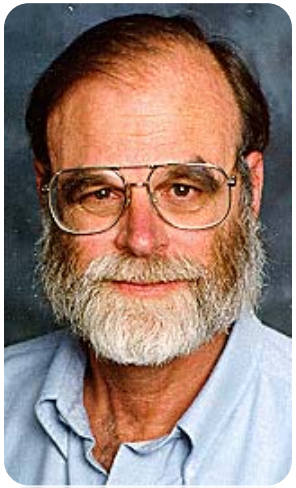
Consistency

- Data always meets validation rules
  - Any type of constraints



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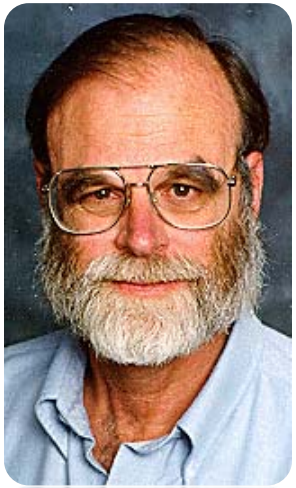
Isolation

- No interference across transactions
  - Even if concurrent



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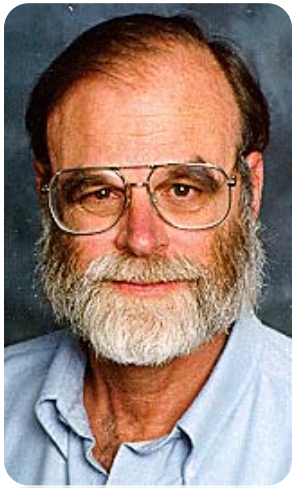
Durability

- Committed transaction will remain so
  - Even in the event of power failure, errors
    - Caching in harddrives, etc.



Defined by Jim Gray

SQL by Examples

Database Systems

- SQLite – minimalist db
  - To start with the smallest
  - Command line executable
    - Single library for coding
  - Also a pure C# implementation

Database Systems

- MySQL – open source
- PostgreSQL and Greenplum
- Microsoft SQL Server (Express Edition)
  - Same as the one under our LabDB
- IBM DB2 (Express-C)
- Oracle Database (XE-Express Edition)

Database Systems

- MonetDB
  - Column store
- SciDB
  - Array database under development

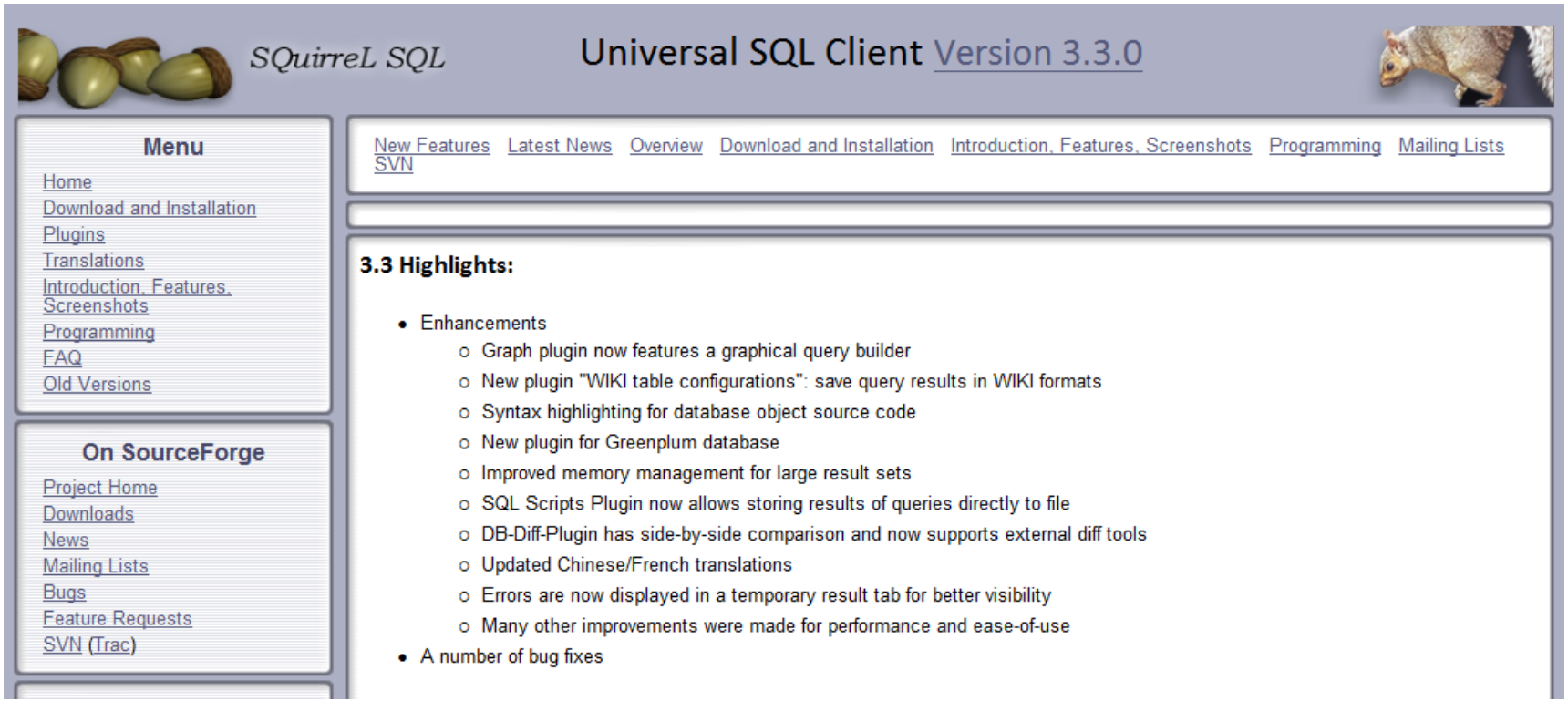
Server – Client

- Multiple clients
- Different client apps
  - Graphical UI
  - Command line
  - Your custom analysis

SQL by Examples

- Interactive session with exercises
  - See handouts...

A Universal GUI



Programmatic Interface

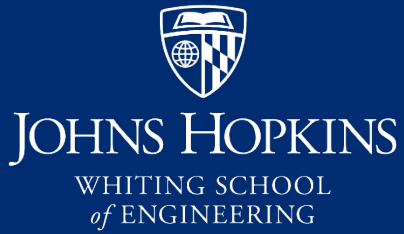
- Send SQL commands
- Read out the results

- Standard ODBC
  - Open Database Connectivity
  - C interface
- JDBC for Java

Research Them!

- Which one?
- Why?

- Things to consider
  - How much data? Scale to my problem?
  - Extensibility for scientific analysis?
  - Hardware requirements? What OS?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