



# Java in the Database

Rick Hillegas

Apache Derby

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## Plug It!

- Dock a free database in your code
- Dock your code to the database





## Sample Function

```
public static int computeAge  
( java.sql.Date date)  
{  
    long interval =  
        System.currentTimeMillis() - date.getTime();  
    return (int)  
        (interval / MILLISECOND_IN_YEAR);  
}
```



# General Overview

- Derby Overview
- User Code in the Database
- Demo



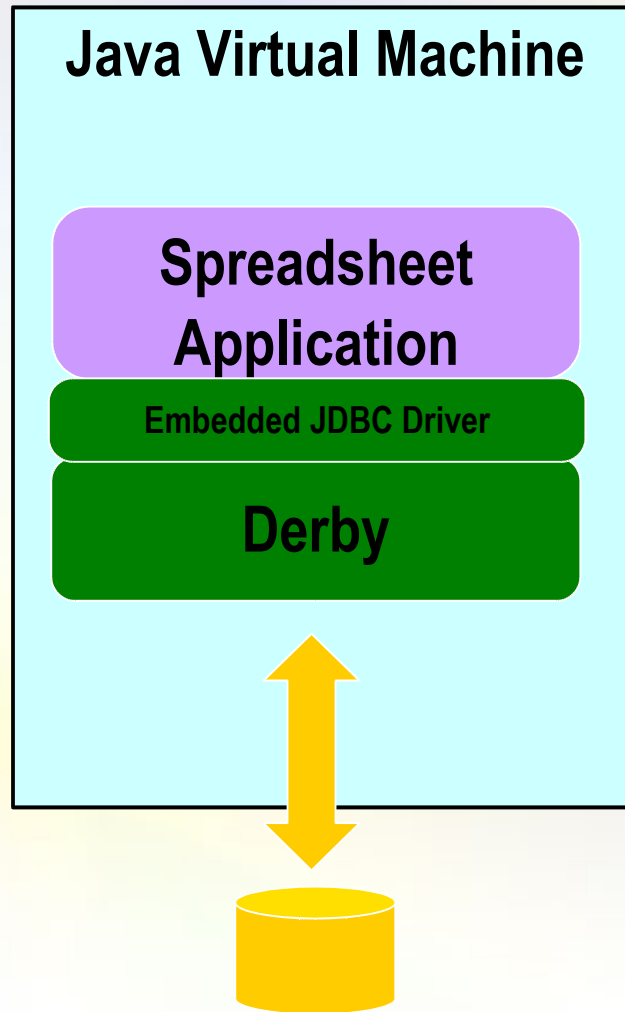


# Derby Overview

- Lightweight, 0-admin, pure Java database
- Follows ANSI-SQL and JDBC standards
- Usage: embedded or client/server

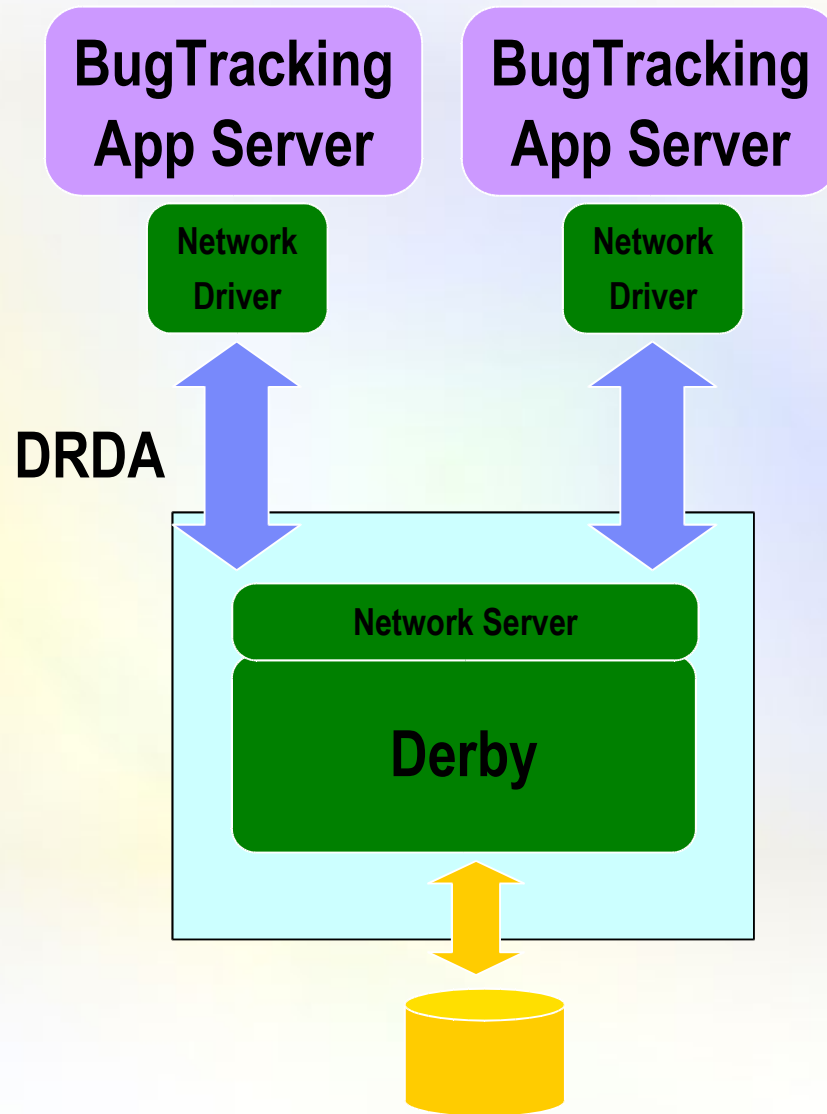


# Embedded





# Client/Server





# User Code

- Functions
  - Compute scalar result
  - Plug into query
- Procedures
  - Perform business operations
  - Plug into trigger or call from application

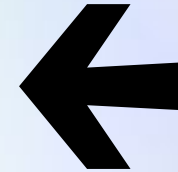
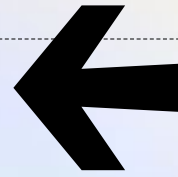




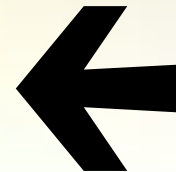


# Function Placement

```
select computeAge( birthday ), lastName  
from Student  
where computeAge( birthday ) > 5  
order by computeAge( birthday ), lastName
```



```
select birthday, count(*)  
from Student  
group by birthday  
having computeAge( birthday ) > 10
```





# Procedure Placement

call **ScoreTestTaking**( takingID )



create trigger ScoreTestWhenDone

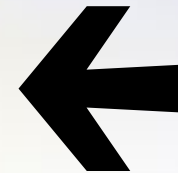
after update of takingDate

on TestTaking

referencing new as testTakingRow

for each row mode db2sql

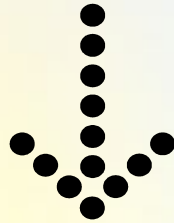
call **ScoreTestTaking**( testTakingRow.takingID )





# Triggered Procedure

Update table (client side)



Fires trigger (server-side)



Calls procedure (server-side)



Loops through many rows (server-side)

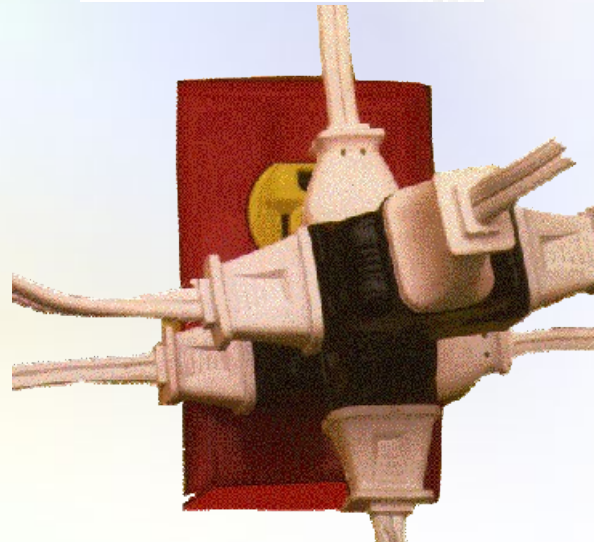


Updates table again (server-side)

# Why?



- Integrity
- Performance
- Integration





# Integrity

- Push business logic close to data
- Enforce business rules in one place





# Integrity Example

```
create table QuestionTaking
```

```
(  
  questionID int not null references Question( questionID ),  
  takingID   int not null references TestTaking( takingID ),  
  actualChoice int not null,  
  
  unique( questionID, takingID ),  
  check ( vetChoice( actualChoice, questionID ) > 0 )  
)
```





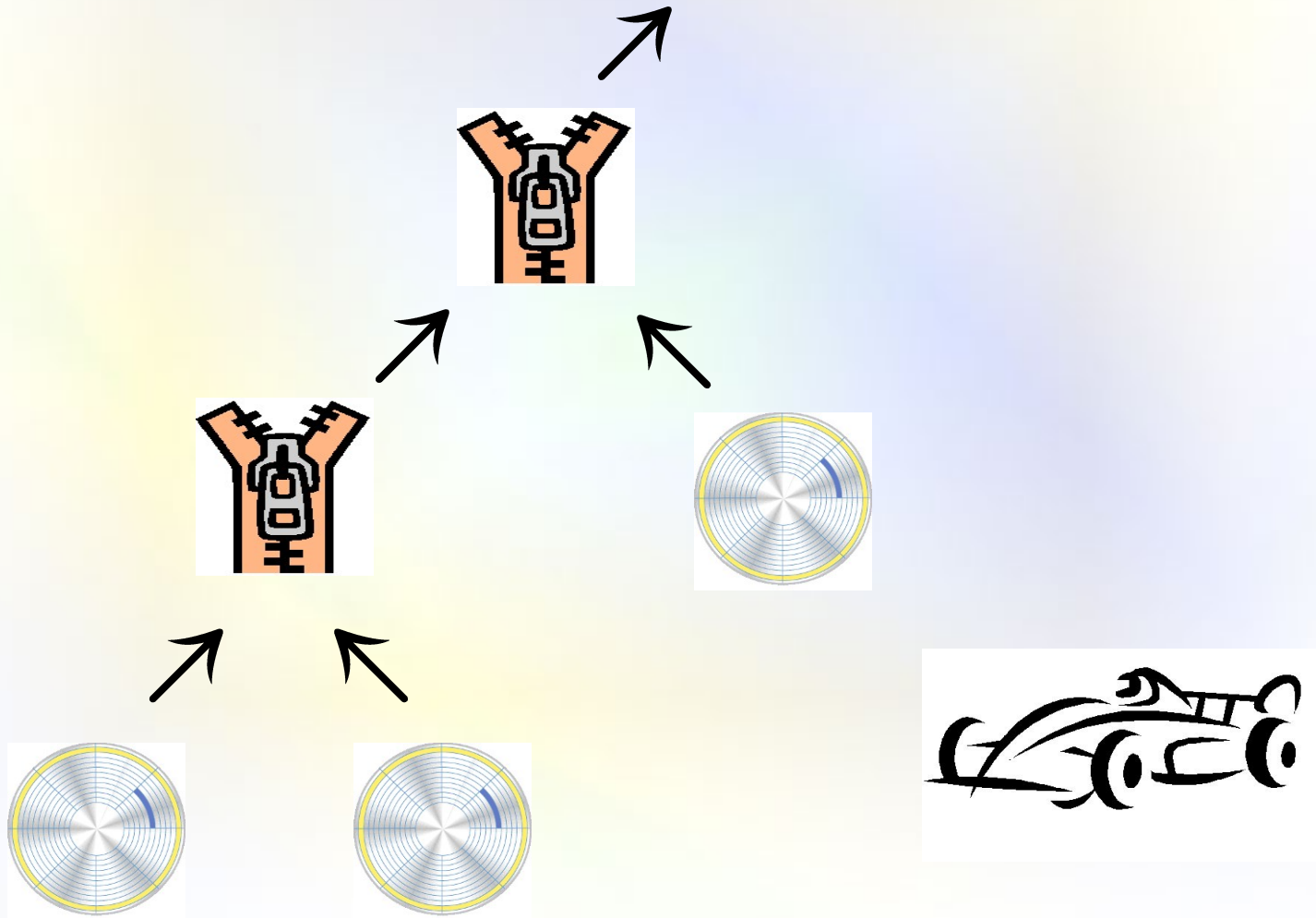
# Performance

- Filter out noise early on
- Reduce query execution time
- Reduce network traffic





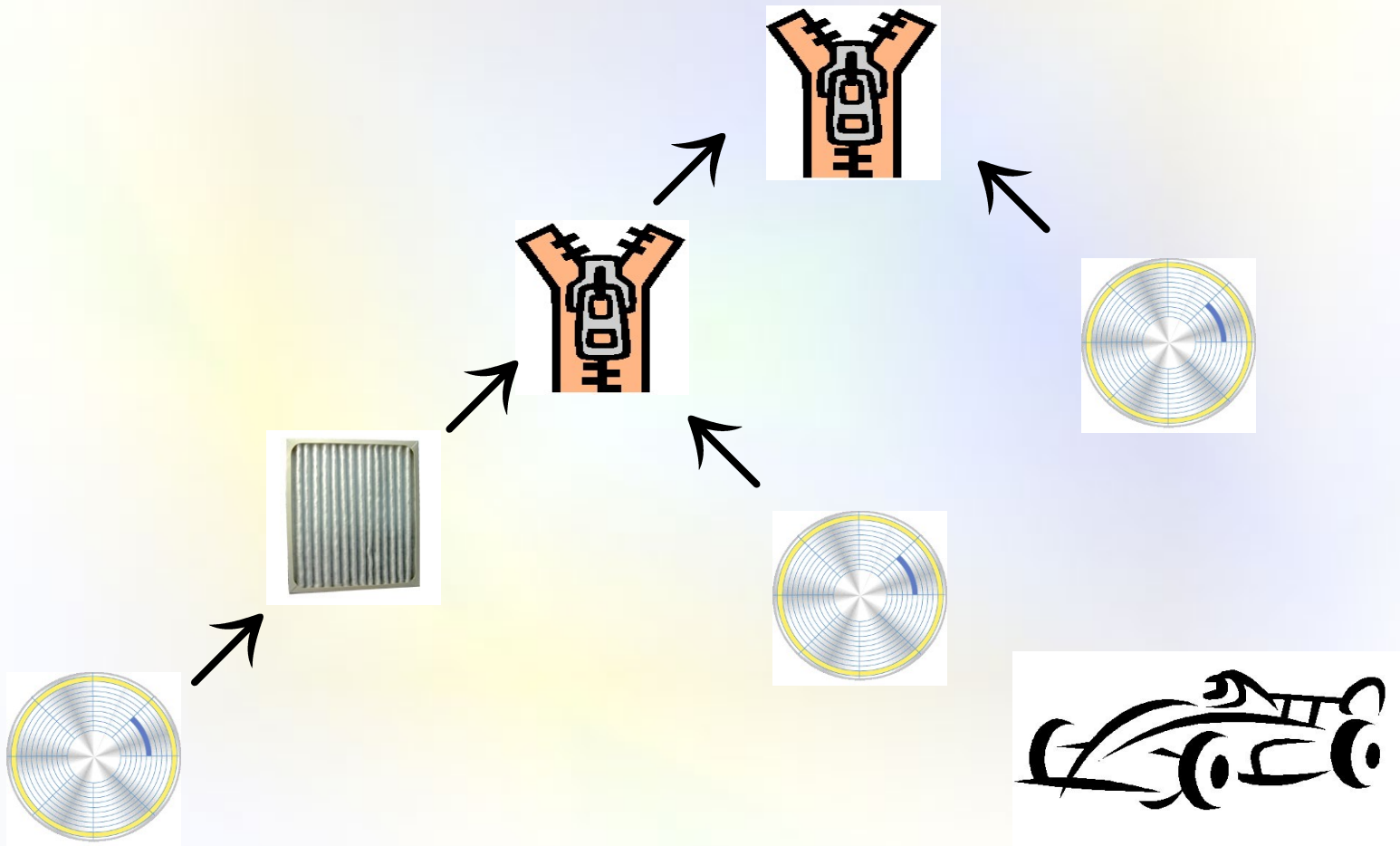
# Query Tree







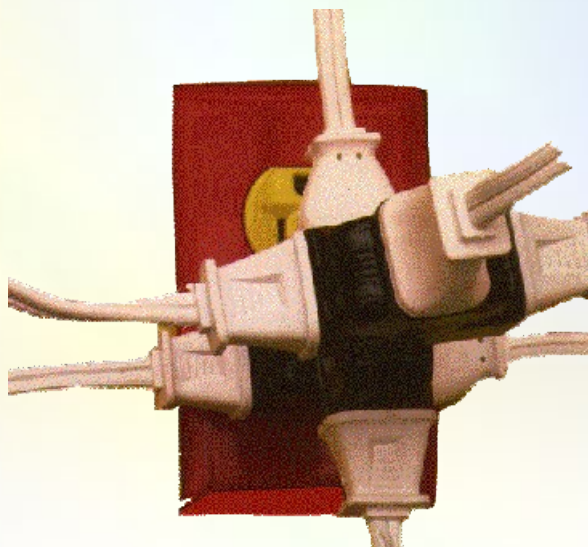
# Filtered Tree ↗





# Integration

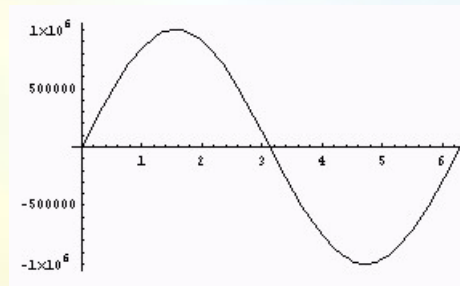
- Re-use existing freeware libraries
- Join with external data





# ANSI SQL

- User-written functions
- User-written procedures





# Why Java?

- Expressive
- Good exception handling





# Why Java?

- Portable datatypes





## Why Java?

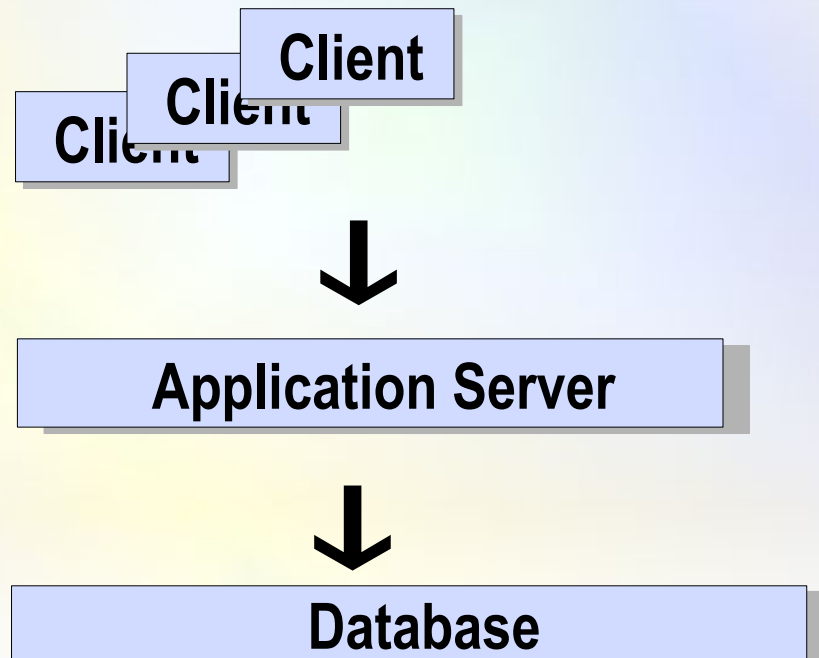
- Large body of available freeware
- Off-the shelf tool support, including debuggers





# Java Everywhere

- Same code can run in client, middle tier, and server





# Supporting Databases

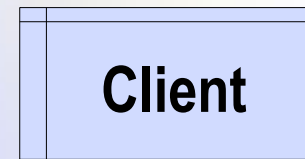
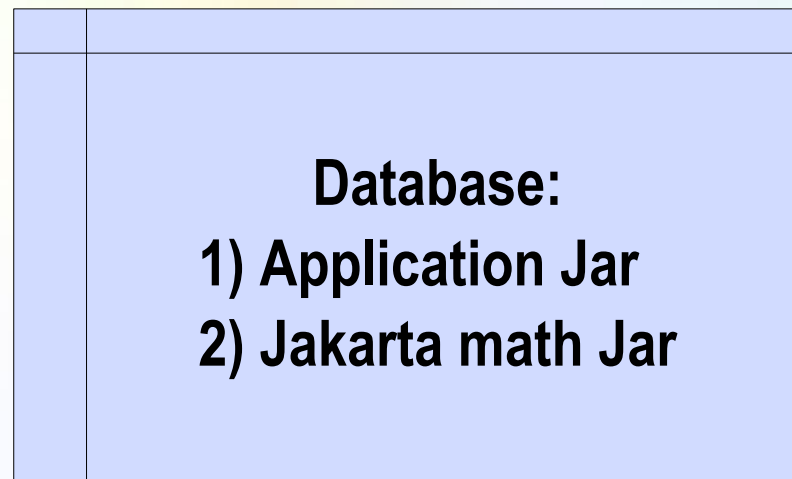
- Derby
- Postgres
- Oracle
- DB2
- Sybase







# Jars in Database





# Derby References

- Developer's Guide
  - “Loading classes from a database”
  - “Derby server-side programming”





# Demo Concepts

- Educational testing application
- Students, Schools, Tests, Questions, Takings

