WebFormulate: A Web-Based Visual Continual Query System

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Welcome

T-Shirts, Caps, and Big Foam-Fingers will be available in the lobby after the show.

Presentation Overview

- What seems to be the problem?
- What do we need?
- What do you mean by a “visual” system?
- What is a “continual” query?
- How does *WebFormulate* work?
- How is *WebFormulate* going to change the world?
- What’s next?

Introduction

- *WebFormulate*: Web-based *visual continual query system*
- Addresses problems associated with formulating temporal ad hoc analyses over networks of heterogeneous, frequently-updated data sources

What distinguishes *WebFormulate*?

- provides necessary facilities to perform *continual* queries
- develops and maintains dynamic links such that Web-based computations and reports automatically maintain themselves
- specifically designed for users of spreadsheet-level ability, rather than professional programmers

What seems to be the problem?

Considerable amounts of Internet-distributed data go unnoticed and unutilized, particularly frequently-updated, Internet-distributed databases

Infrastructural constraints:

(1) Internet-distributed computing world was developed for one-time distribution of information, not the continuous flow of process communication

Infrastructural constraints:

(2) Heterogeneous nature of database systems makes it difficult to have a single user interface that handles different:

- connectivity protocols,
- schema metadata, and
- SQL syntax

Infrastructural constraints:

(3) Standards infrastructure for data exchange is underdeveloped

Infrastructural constraints:

(4) “Public programmers” lack necessary skills to access, query, and analyze data from heterogeneous, Internet-distributed databases

What do we need?

"Public programmers" need one tool to:

- simultaneously query multiple, disparate databases
- track changes in those databases through time,
- automatically update user-specified computations and visualizations

What do you mean by a “visual” system?

- Visual Programming Languages (VPLs) use more than one dimension to convey semantics
- Visual expressions include diagrams, sketches, icons, demonstrations of actions performed by graphical objects, etc.
- Not just an editing shortcut to generate (textual) code!

The goals of a VPL:

(1) to make programming more accessible to some particular audience

(2) to improve the correctness with which people perform programming tasks, and/or

(3) to improve the speed with which people perform programming tasks

Elimination of text is not a goal of VPLs!

What is a “continual” query?

A query that monitors updates of interest and notifies the user of changes whenever an update reaches specified thresholds or some time limit is reached

Example: Notify me weekly OR whenever the number of *Rana blairi* and *Rana catesbeiana* frogs increases by 10% since the last time the database was queried

What is a “continual” query?

Expressed in terms of:

- SQL-like query
- trigger condition
- stop condition
- notification condition

First introduced by Terry et al. in 1992
for append-only databases

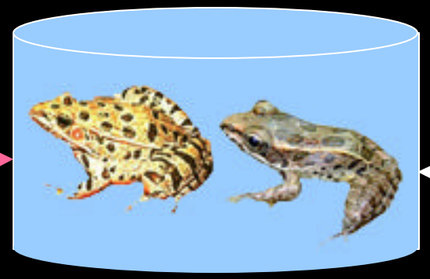
How does *WebFormulate* work?

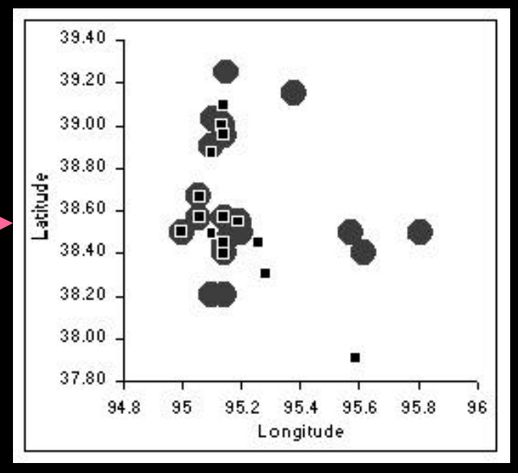
- Form-based VPL with a Web-browser GUI
- Place cells on a form
- Define formulas for cell attributes using pointing, typing, and gesturing
- Attributes of other cells can be referenced
- Programs developed using “live” data

Example

Biologist in California

Database of frogs in Kansas



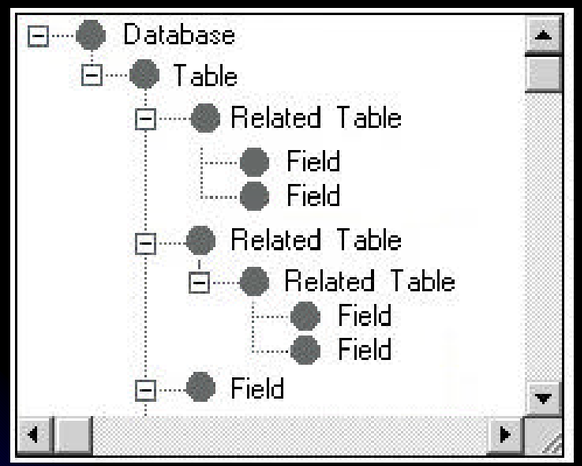


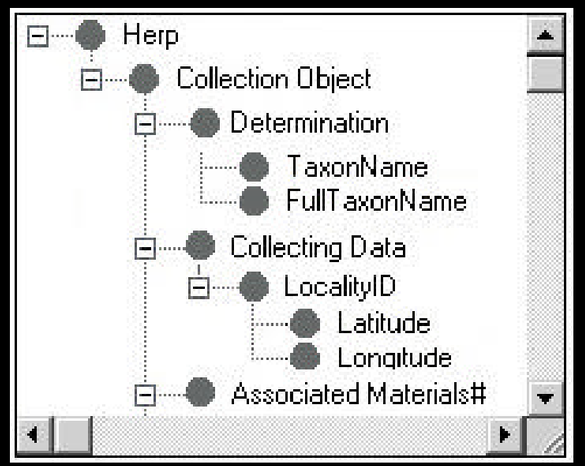
Weekly updates

Graduate students doing field work

Example

(1) Create a ‘database’ object and specify the URL of an Internet-accessible database



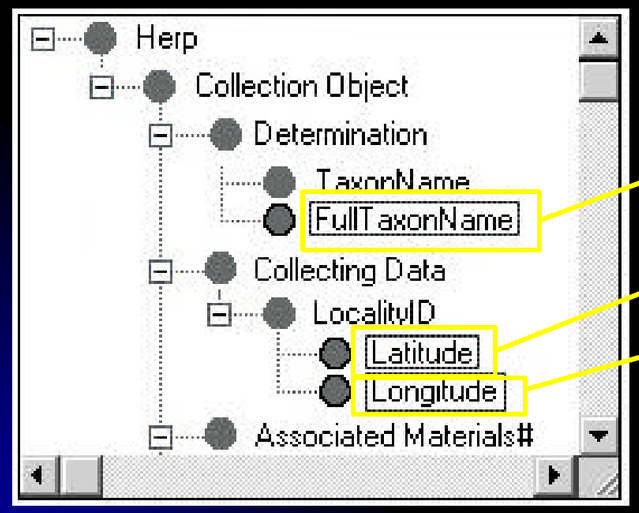


Database schema displayed as hierarchical tree of table and field names

Example

(2) Create a ‘database query’ object and construct a continual query equation

(i) List of fields to return in query results



(CQSELECT (

FullTaxonName

Latitude

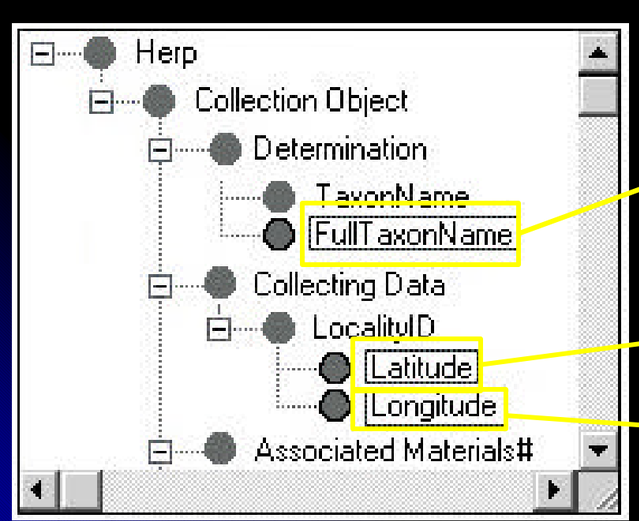
Longitude

) …)

Example

(2) Construct a continual query equation

(ii) Conditional expression for selection criteria

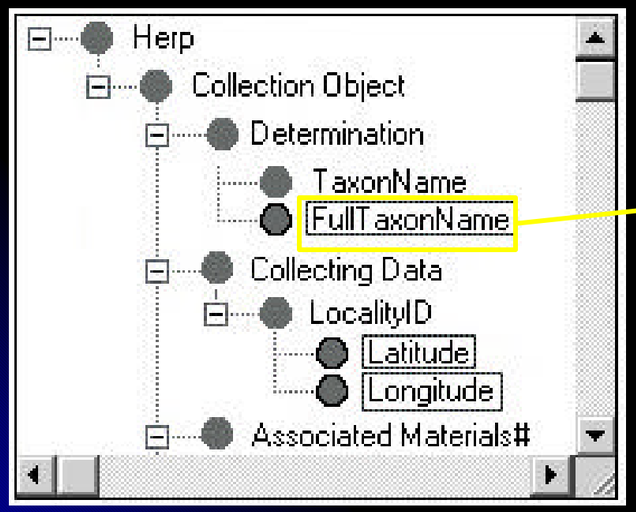


(CQSELECT ...
(AND
(IN FullTaxonName
(“Rana blairi”
”Rana catesbeiana”))
(>= *Latitude* 37.8) …
(>= *Longitude* 94.8)) …)

Example

(2) Construct a continual query equation

(iii) Order to sort query results



(CQSELECT …

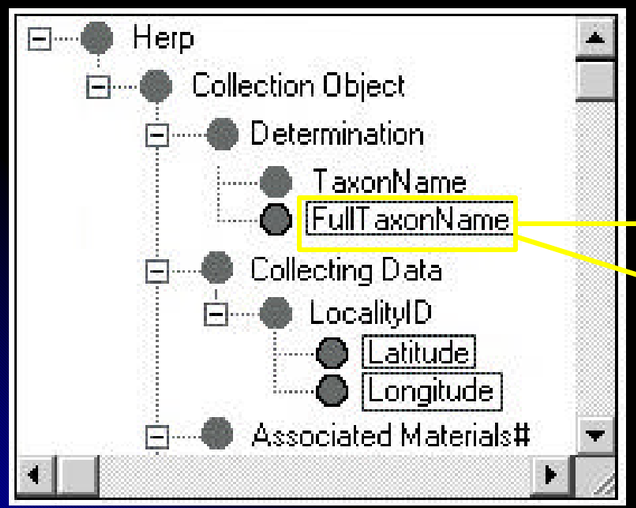
((ASC FullTaxonName)

…)

Example

(2) Construct a continual query equation

(iv) Notification condition



(CQSELECT …
(OR (WEEKLY)
(> (COUNT
FullTaxonName)
(+ (PREVCOUNT
FullTaxonName)
1000))) …)

Example

(2) Construct a continual query equation

(v) Trigger condition (i.e., how often database will be queried)

(CQSELECT … (DAILY) …)

Example

(2) Construct a continual query equation

(vi) Stop condition (i.e., termination of this continual query process)

(CQSELECT … (DATE 10 31 2002))

Example

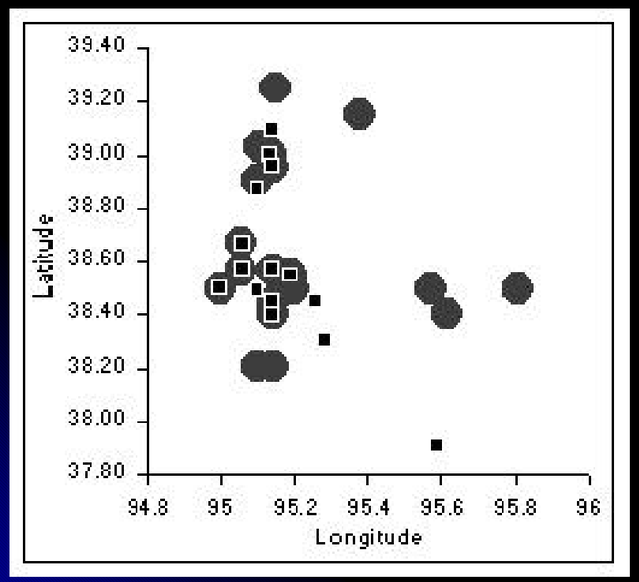
(3) Submit continual query equation for evaluation

Results displayed as a table

FullTaxonName	Latitude	Longitude
Rana blairi	38.2023	95.102
Rana blairi	38.203	95.145
Rana blairi	38.402	95.614
Rana blairi	38.403	95.145
Rana blairi	38.403	95.145
Rana blairi	38.502	95.0008
Rana blairi	38.502	95.203
Rana blairi	38.673	95.056
Rana blairi	38.673	95.056

Example

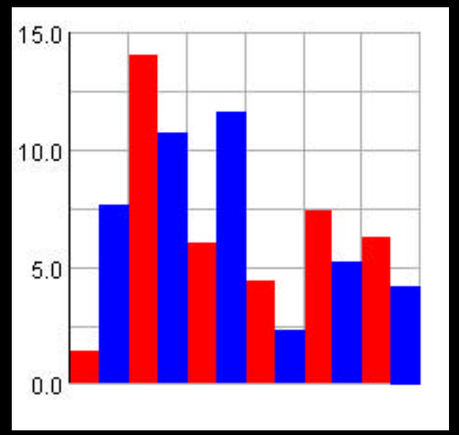
(4) Create a ‘graph’ object to plot occurrences by latitude and longitude

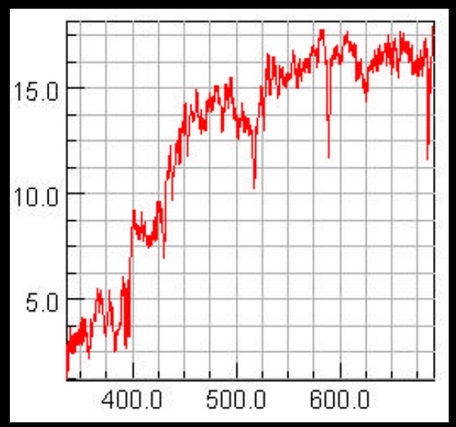


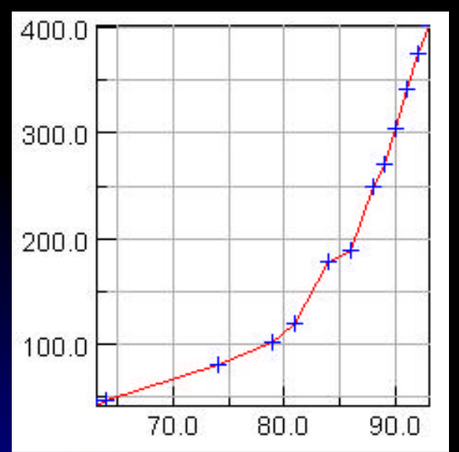

```
(GRAPH
  (([38.2…95.8]
   (BLACK-CIRCLE))
   ([37.9…95.6]
   (BLACK-SQUARE))))
```

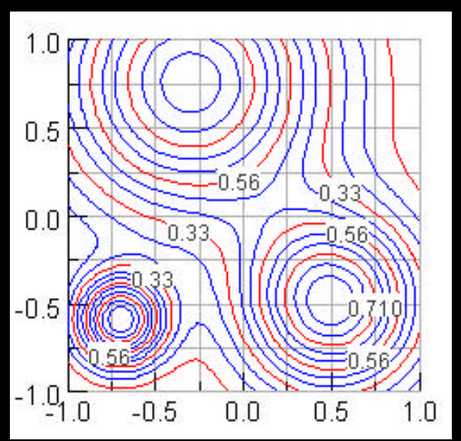
Ranges of latitude and longitude values selected from ‘database query’ (table) object

Other Types of Graph Functions









Automatic Updating

Each time continual query processor returns updated results, affected cells will recalculate and redisplay

Example: ‘Database Query’ object and associated “Graph” object display.

FullTaxonName	Latitude	Longitude
Rana blairi	38.2023	95.102
Rana blairi	38.203	95.145
Rana blairi	38.402	95.614
Rana blairi	38.403	95.145
Rana blairi	38.403	95.145
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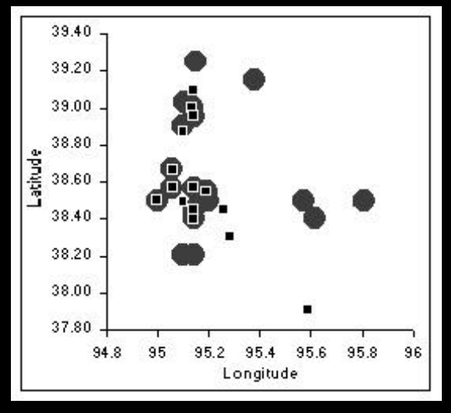
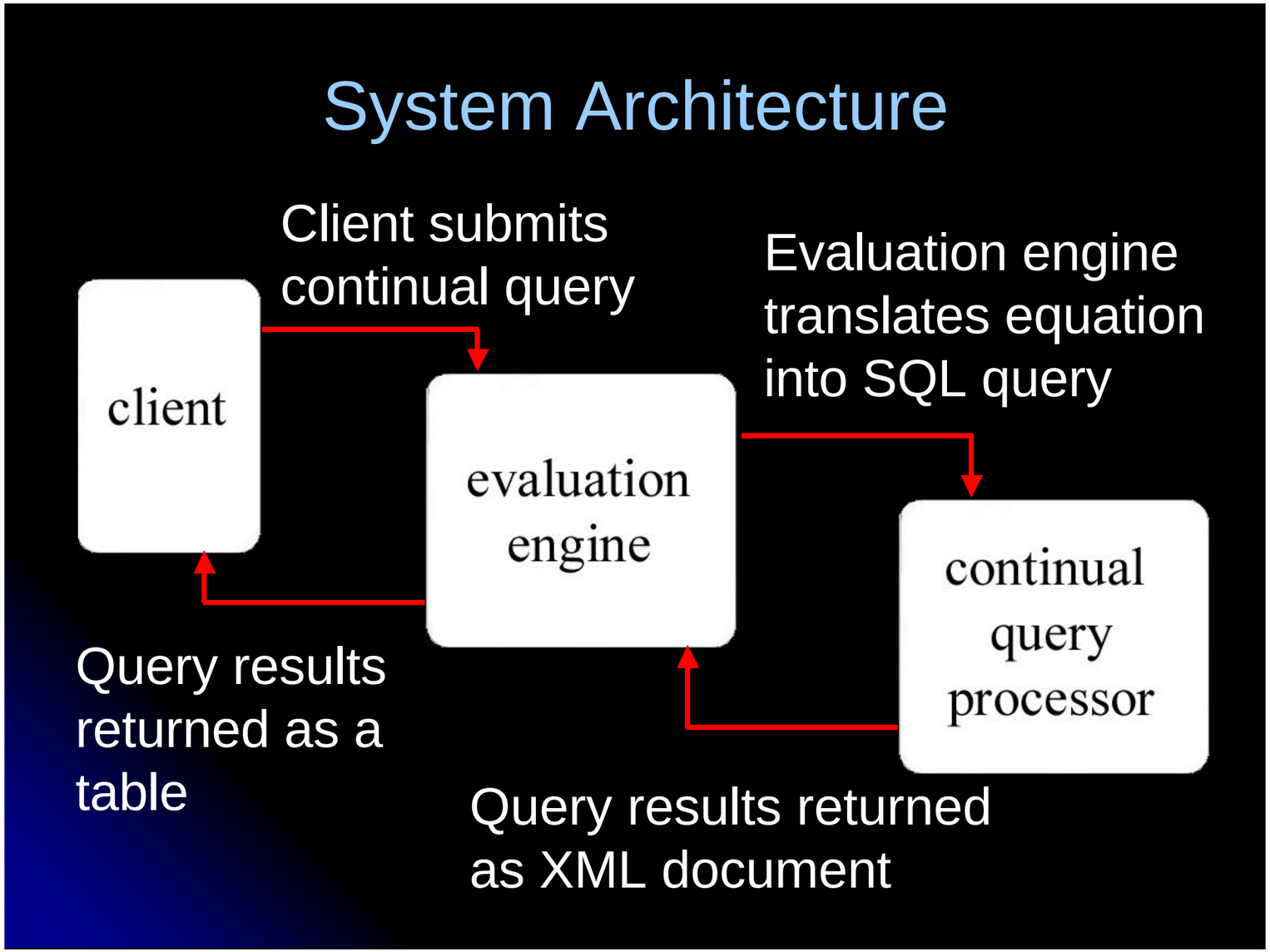


Automatic Updating

- If form closed, the next time it is opened, most recent data will be displayed
- Others can open a “copy” of the form
- “Copies” updated with recomputed data in same manner and timeframe as “original” form
- Facilitates sharing “live” form with others

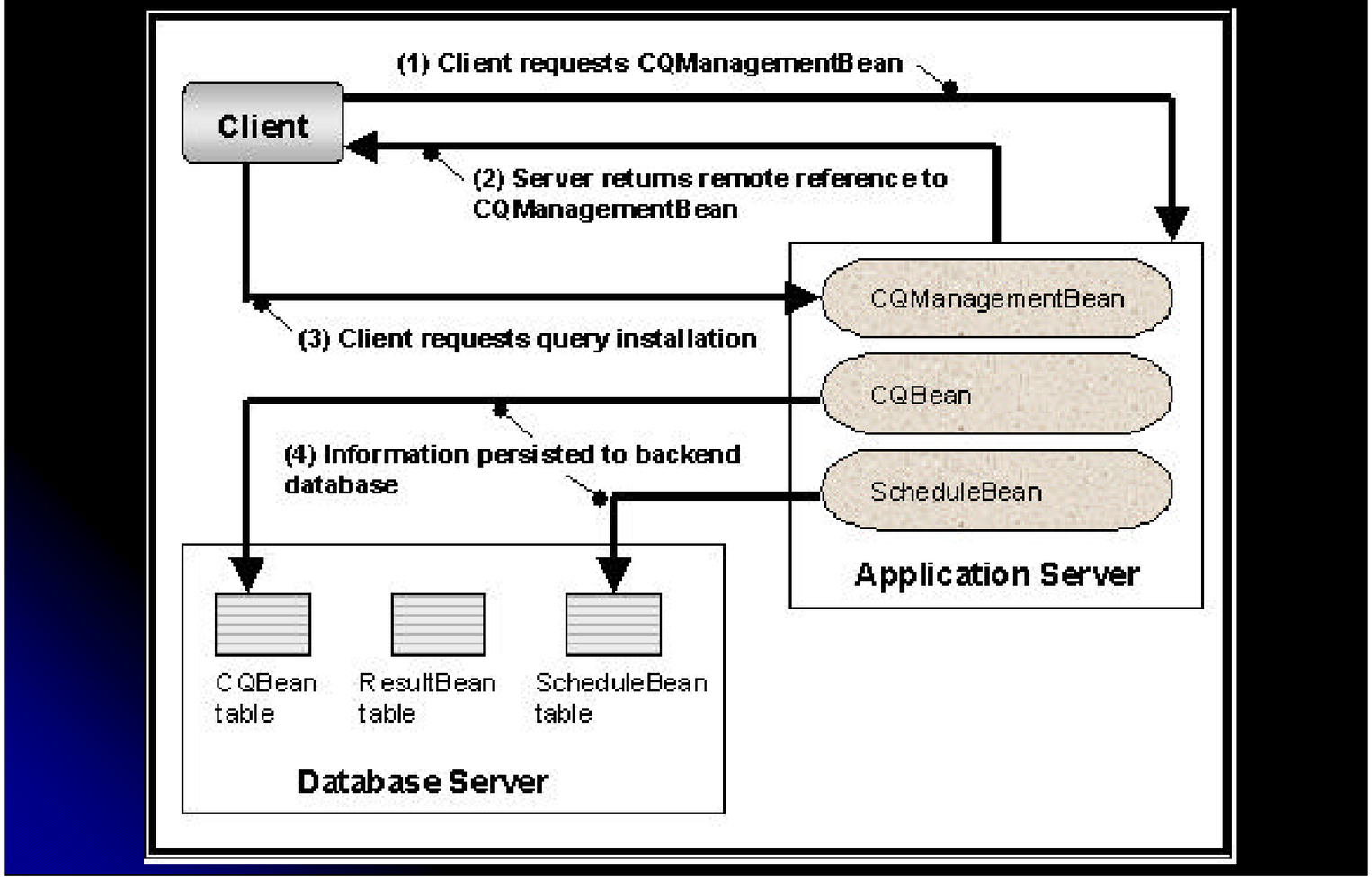
System Architecture



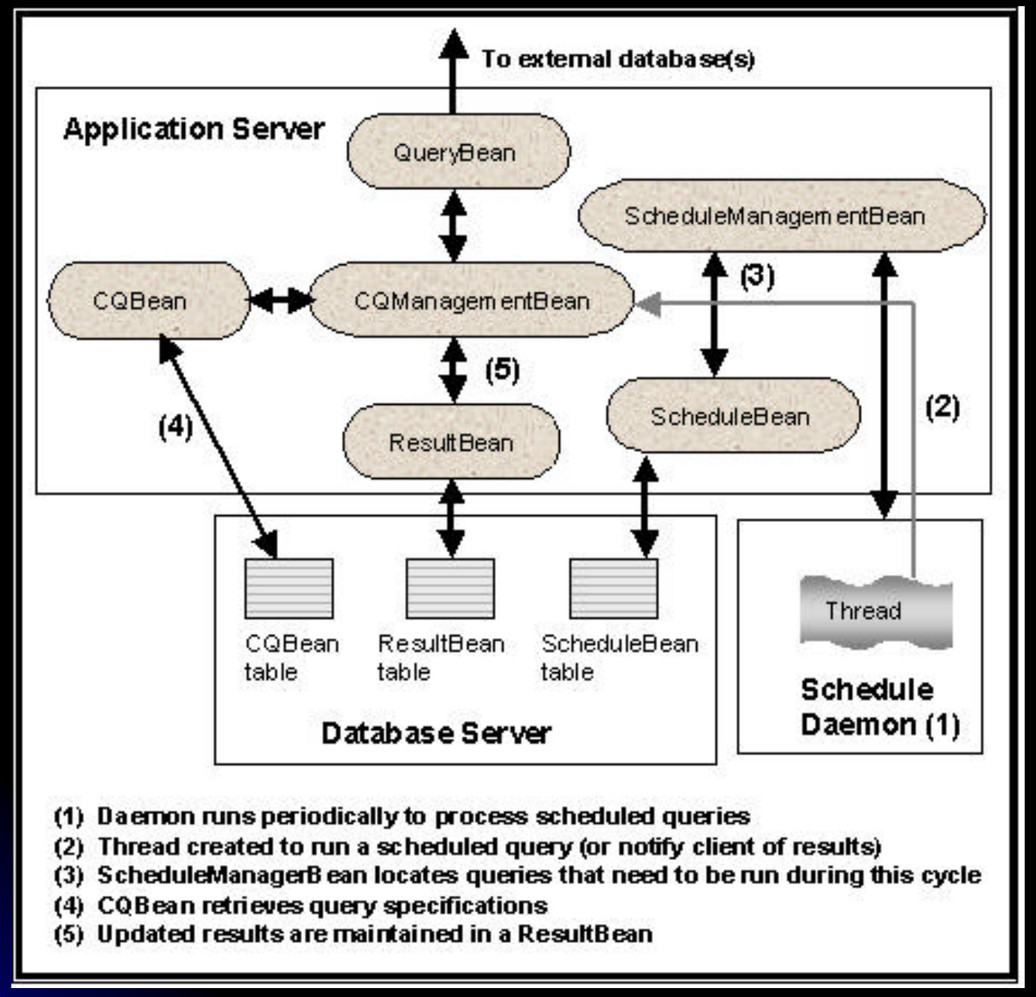
Continual Query Processor

- Uses Enterprise Java Beans (EJBs) and EJB server technologies
- Automatically manages transactions, object distribution, concurrency, security, persistence, and resource management
- Portable and scalable framework

Installing a Continual Query



Processing a Continual Query



How is *WebFormulate* going to change the world?

A Web-based data access + analysis tool that:

- Is usable by a diverse population
- Is not restricted to any one problem domain
- Will improve research productivity

How is *WebFormulate* going to change the world?

Motivate the development of Web-based continual query systems that apply J2EE methodology to achieve:

- scalability,
- platform-independence, and
- implementation-independence

What's next?

End-user programming side:

- Formal usability studies to evaluate usability and usefulness
- Inclusion of other forms of input (e.g., voice browsers)

What's next?

Continual query processing side:

- Performance evaluation of the continual query processor
- Extension to other types of Web-accessible data

Summary

It is important not only that information be accessible to the public, but that the same public be able to combine this information into effective analyses

Summary

Academic and commercial use of Internet-distributed databases has been hindered by:

- Incomplete, dynamic, and unknowable structure of databases
- Lack of standards for data model and query representations
- Inability of non-programmers to perform continual queries with automatic update of computations

Summary

WebFormulate addresses those problems allowing “public programmers” to:

- Query multiple, disparate databases
- Track changes through time
- Automatically update computations & visualizations

This work has been supported by
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The End!