Of Objects and Databases: A Decade of Turmoil
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Of Objects and Databases

- Overview of how the field of databases and objects developed from 1986 to 1996
- What ideas and projects fell out of favor
- Authors vision about the future
- Current (1996) research challenges

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State of research in databases and objects (1986)

- Managing traditional business data
  - Considered a solved problem
- Commercial relational databases were maturing
- the *"object"* buzzword
- *"it was the era of objects and databases"*

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Impact of object oriented technology on databases

Work grouped into:

- Extended relational database systems
- Persistent programming languages
- Object-oriented database systems
- Database system toolkits

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Extended Relational DB systems

- **Idea:** Extend the database data model.
  - incorporate complex data.
- ADT – user defined basic types
  - Written in languages like 'C'.
  - Registered with the database system.
  - Used in Queries.
- Eg: ADT-Ingres, Postgres at UC Berkeley
- Success!

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Persistent Programming Languages

- Different approach
  - Add DB features to an OO programming language
- **Main features**
  - Make data persistent
  - Check-pointing during program execution
- **Motivation:** The removal of *"impedance mismatch"*
- Failure !

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Object Oriented DB Systems

- **Idea** - combine modern OO language into a database
- **Motivation –**
  - Handle non-traditional database applications
  - Reduce / eliminate the *"impedance mismatch"*
- Combine the best of the two worlds - objects and databases
- **Supported**
  - queries
  - indexing
  - version management
- **Eg:** Gemstone, Vbase, Orion
- Limited success

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Object Oriented DB – Early Days

- No agreement on
  - the data model
  - the query language
  - the version management feature
- opened up new research from an OO perspective
  - data models
  - query optimization
  - system architectures

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Database System Toolkits

- **Idea:** Building domain-specific DBMS
  - Geographical information systems
- **Motivation:** No single type of DBMS can cater to
  - functional and
  - performance requirements
- **Features**
  - different query language
  - different storage organization
  - different transaction mechanisms
- Failure!

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Database System Toolkits - Examples

- **Eg:** Exodus, Genesis

- **Exodus**
  - Storage manager for objects
  - Persistent programming language.
  - Rule based query language specification
  - Query optimizer generator for domain specific languages.

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State of Affair in 1996

- Approaches which have died from a commercial/practical aspect
  - Database system toolkits
  - Persistent programming languages

- Approaches which have not lived up to the hype (wounded)
  - Object oriented database systems

- New approaches
  - language specific object wrappers for relational databases
  - object relational database systems (extended relational database systems renamed!)
    - most successful of the four approaches

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Reason for Casualties

- Database toolkits
  - not user friendly
    - needed lot of expertise to use the system
    - freedom provided -too low-level.
  - Substitute in object oriented and object relational database systems.
- Persistence programming language
  - No commercial implementation
- By products - persistence models, pointer swizzling, garbage collection schemes

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Object Oriented DB Systems

- Partial success!
- No agreement on
  - Programming interface
  - Query support
  - Implementation twist
- ODMG standard - supported in bits and pieces.
- Behind relational database systems in
  - Robustness
  - Scalability
  - Fault-tolerance
- Dominance of applications using ODBC
- Emergence of thin client- fat server paradigm

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Object Relational DB Systems

- **Idea:** Build OO support on top of the relational model

- **Manifesto:**
  - Support richer object structure
  - Subsume the relational model
  - Be open to other tools

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Object Relational DB

- Supports
  - **ADT**
    - User defined base types
  - **Row types**
    - Rows in tables enjoy object-like properties
      - Methods
      - Contain references
      - Multi-valued attributes
      - Inheritance

- Extensions to the SQL to incorporate the changes
- No agreement on many features supported by ORDBS.
  - SQL3 standards working towards incorporating the new features

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SQL-1999 Standard

- 6 years of work!!!
- "Object Oriented SQL"
- Foundation for object relational DB.
- New Features
  - Row type
  - Array – collection type
  - Recursive queries
  - Structured user types

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SQL-1999 Standard

- CREATE TYPE STUDENT UNDER PERSON AS (
  Id Integer
  Status CHAR(2))

- METHOD award_degree() RETURNS BOOLEAN

- CREATE TABLE TRANSCRIPT (
  Student STUDENT,
  Grade CHAR(1))

- SELECT S.Student.Name
  FROM STU S
  WHERE S.Student.Address.Street = "Red River"

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Object Oriented Client wrappers

- New approach
  - Popular in the commercial world
- **Idea:** Use of object wrappers
- **Motivation:** Interaction with the data - more natural
- Generates proxies for the underlying data
- Tools aid in
  - constructing proxy objects
  - key to Object ID mapping

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Object Client Wrappers

- **Advantages:**
  - Cleaner interface to build business objects using OO techniques.

- **Disadvantages:**
  - Query processing still based on the underlying relational schema

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Developments in the Objects world

- **CORBA**
  - Solve problems in developing large, distributed, object oriented applications
  - Interoperable object RPC mechanism
  - Standards for registering and locating named resources
  - Persistence service, Transaction service
    - Bound to fail!

- **OLE, COM and DCOM**
  - Microsoft Standards

- **Java**
  - Write ADT's that can be executed on both clients and servers

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Object and Databases - Vision 2006

- **Fully integrated solution**
  - Object relational database systems fulfill the promises of OODB
  - Full OO support for ADT's, row types
  - Integration of important features of SQL with the extended features.

- **OODB will be a niche solution**
  - Engineering design, telecommunications
- **Object oriented client wrappers**
  - Less mapping

- **Should ORDB be the winner?**

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Research Challenges

- Server functionality and performance

- Client integration

- Parallelism

- Standards

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Server Functionality and performance

- Improve object query processing
- ***"objectifying"*** SQL
  - Views
  - Triggers
  - Constraints
  - Path expressions
- ADT – support for extensible access methods

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Client Integration

- **Client Integration**
  - Programming interface to serve ORDB objects to OO programs
  - Tightly knit solution
    - Querying over cache and the database in an intelligent way
    - Consistency problem during updates
- Most Important –my opinion

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Parallelism and Standards

- Parallelize
  - Query execution
  - Operations on ADT's
- Standards
  - Specification of ADT's
  - Client-server interfaces
  - New query language standard.

Conclusion

- Big picture of where it was and where it is heading
- Sets a Database centric research agenda
- Declares ORDBS as the "winner"!
- Objects and databases - great future