Efficient Integration of XML & Web Services for Electronic Health Records

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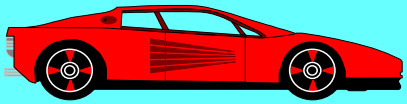
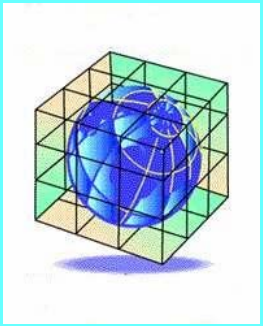
InterSystems

HIS DBMS:What to look for



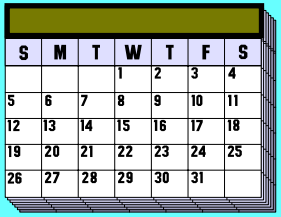
Fast

Quiet



Flexible

Scalable

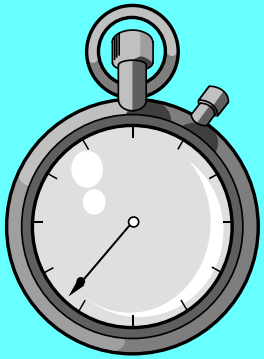


Available 24x7

Proven

Cost-Effective

Requirement : Fast



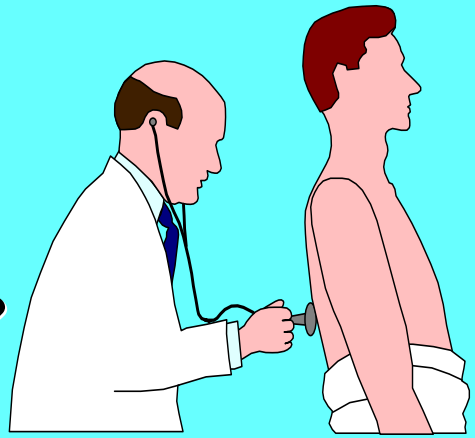
- A DBMS is never “Too fast”
- Healthcare staff cannot wait for the answer
- No lines of patients waiting for information, bills

Requirement : Quiet

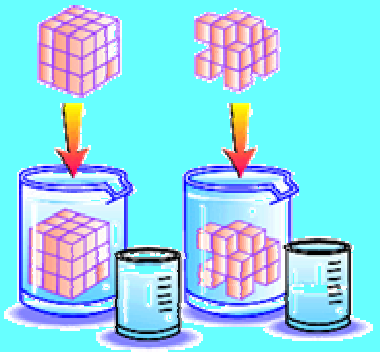
- Hospital staff are not computer experts
- Little tuning, database reorganization, indexing
- No high-level DBMS expertise
- Just make sure backup has run
- And watch that disks are not full

Requirement : Flexible

- HIS data is VERY complex
- Almost unlimited in every dimension
  - How many visits per patient ?
  - How many laboratory tests per patient?

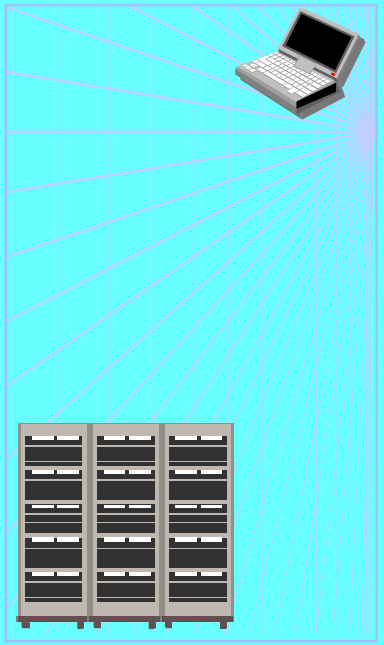


- Variable length
- Sparse storage
- Multimedia (images, sound, voice, photos,…)
- Ad-Hoc access = long-term data storage
- Open to the Web



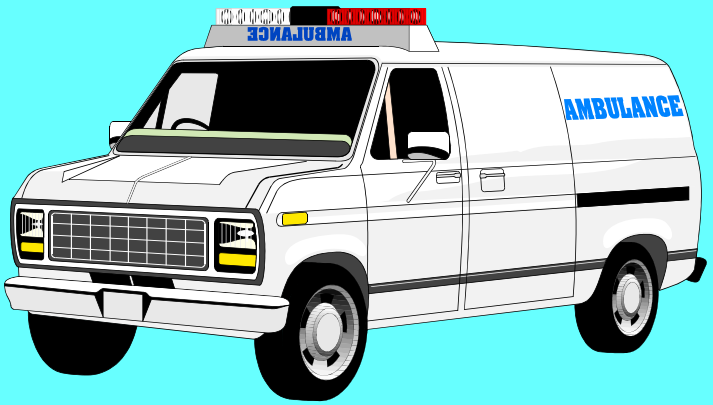
Requirement : Scalable

- If successful, more and more users
- Hospital mergers and reorganization
- Clinics, Remote Access, Community Medicine
- National systems ?
- Laptop, single-server, 2-tier, 3-tier, …
- Choice of OS (Windows, Unix, Linux)



Requirement : Available 24x7

- True 24x7 (x 365)
- Emergency room cannot stop
- Doctors need data “now”
- On-line database expansion, reorganization
- On-line backup
- On-line software updates



Requirement : Proven

- Confidence
- List of reference sites - major HIS with many years of experience
- Supported by people who understand hospitals
- Trouble-free installation
- International (Unicode)

Requirement : Cost-Effective

- Hospitals should spend their money on equipment, medicine and treating patients
- DBMS must be affordable
- Look at total cost : License, Hardware, Training, Consulting,…
- Look at 5-year cost : Upgrades, Training, Hardware Upgrades, People (DBAs), Enhancements, …
- Cost Control = Management = Ad Hoc Information

How does it match up?

Fast
- Benchmarks & Experience, 5-100 times faster

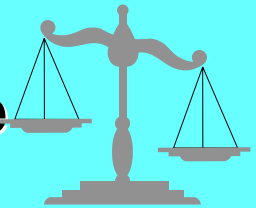
Quiet
- Simple Operations, 0.5 DBA

Flexible
- Designed by hospital, variable-length, sparse,

Scalable
- Laptop to 50,000 clients - no change

24x7
- On-line backup, Failover, …

Proven
- Top 10 Hospitals in USA, Worldwide



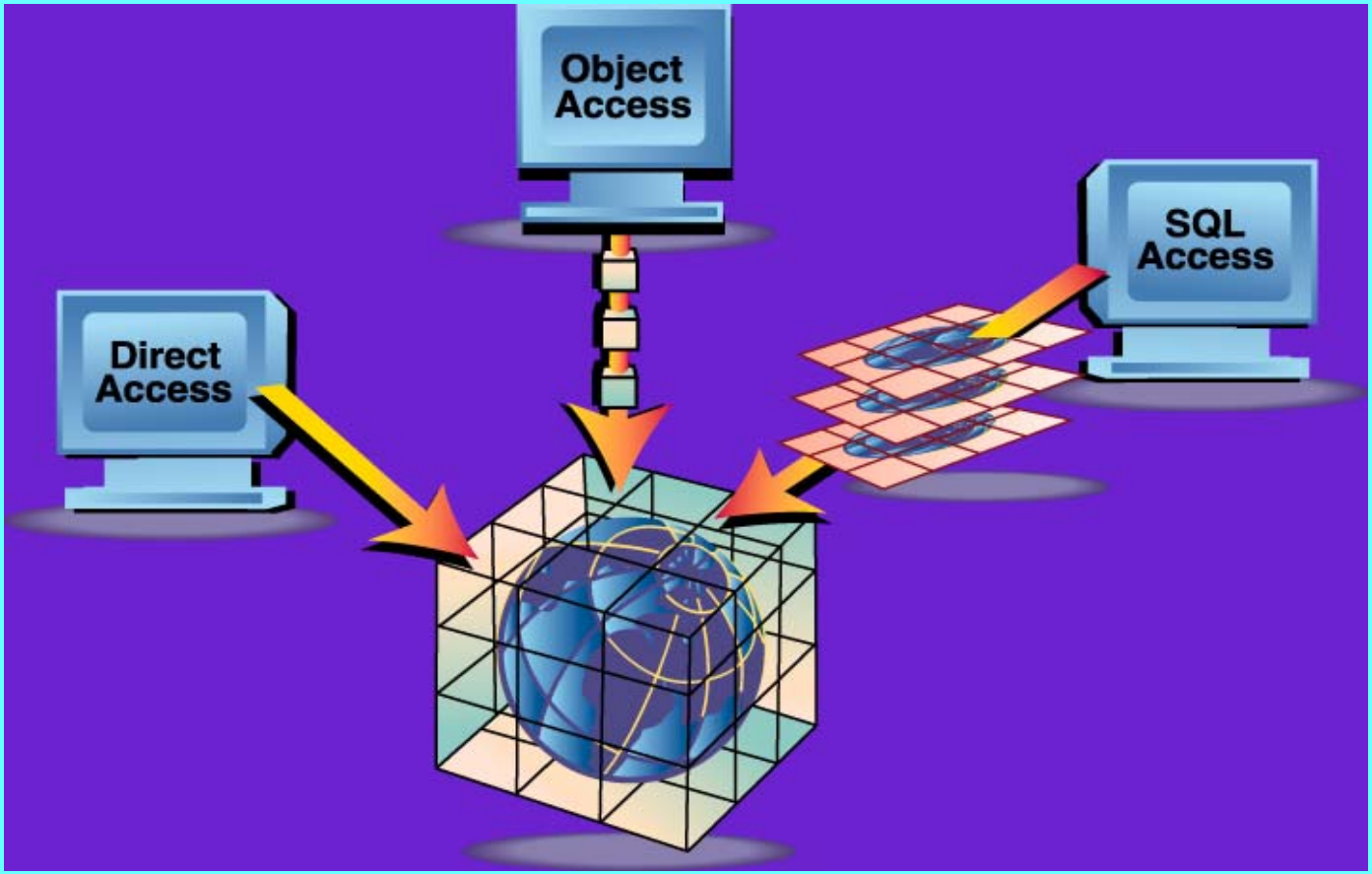
Cost-Effective
- 5-year cost 20-30% of alternatives

KLAS Report

- Based on in-depth interviews with 110 healthcare IT executives
- Measured real-world satisfaction with applications based on Caché and Oracle

"Caché rated better than Oracle in every satisfaction measurement."

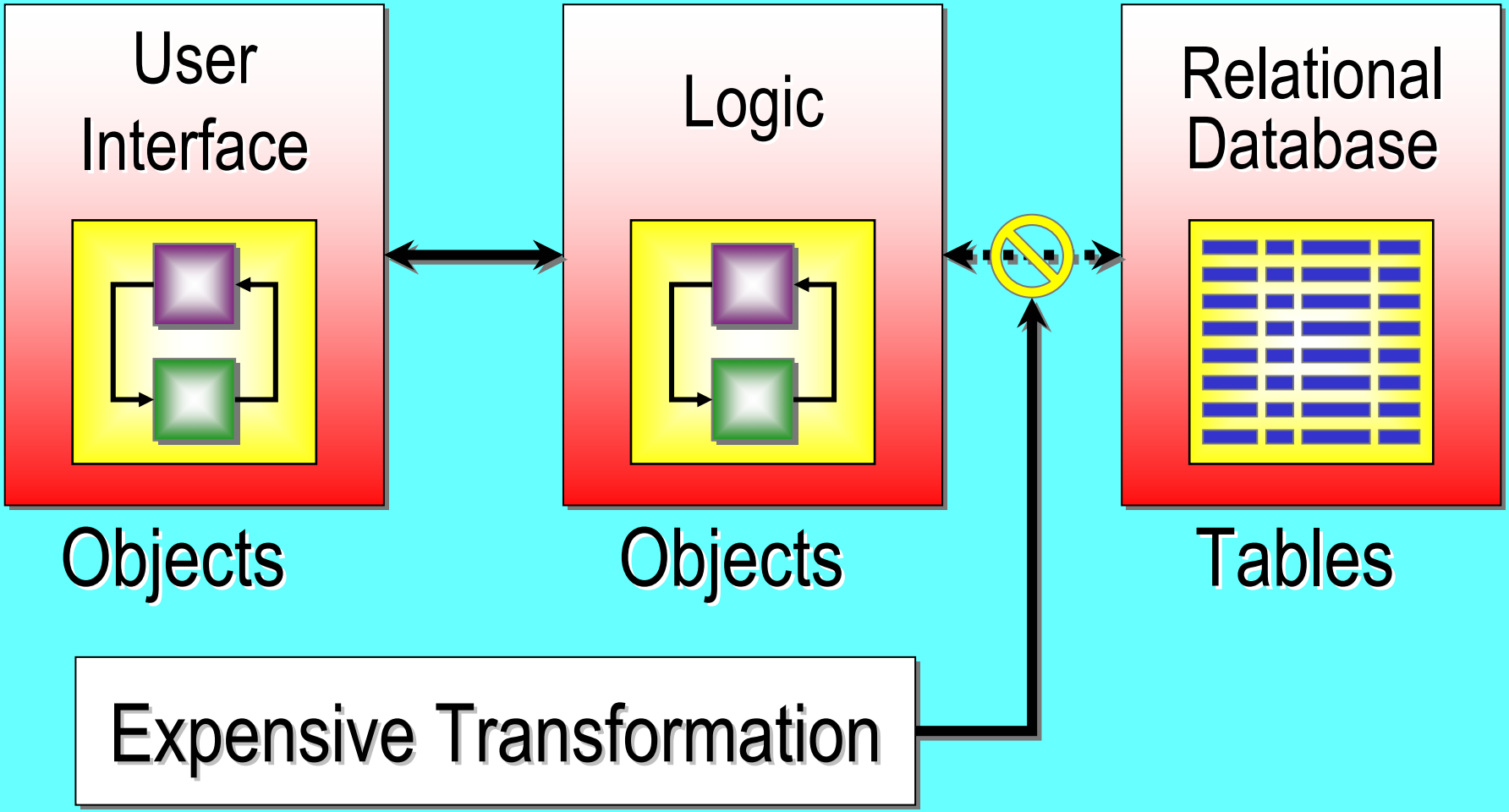
Post-Relational Database



Multidimensional Data Storage

Relational, Object and Native Access

Object / Relational Mismatch

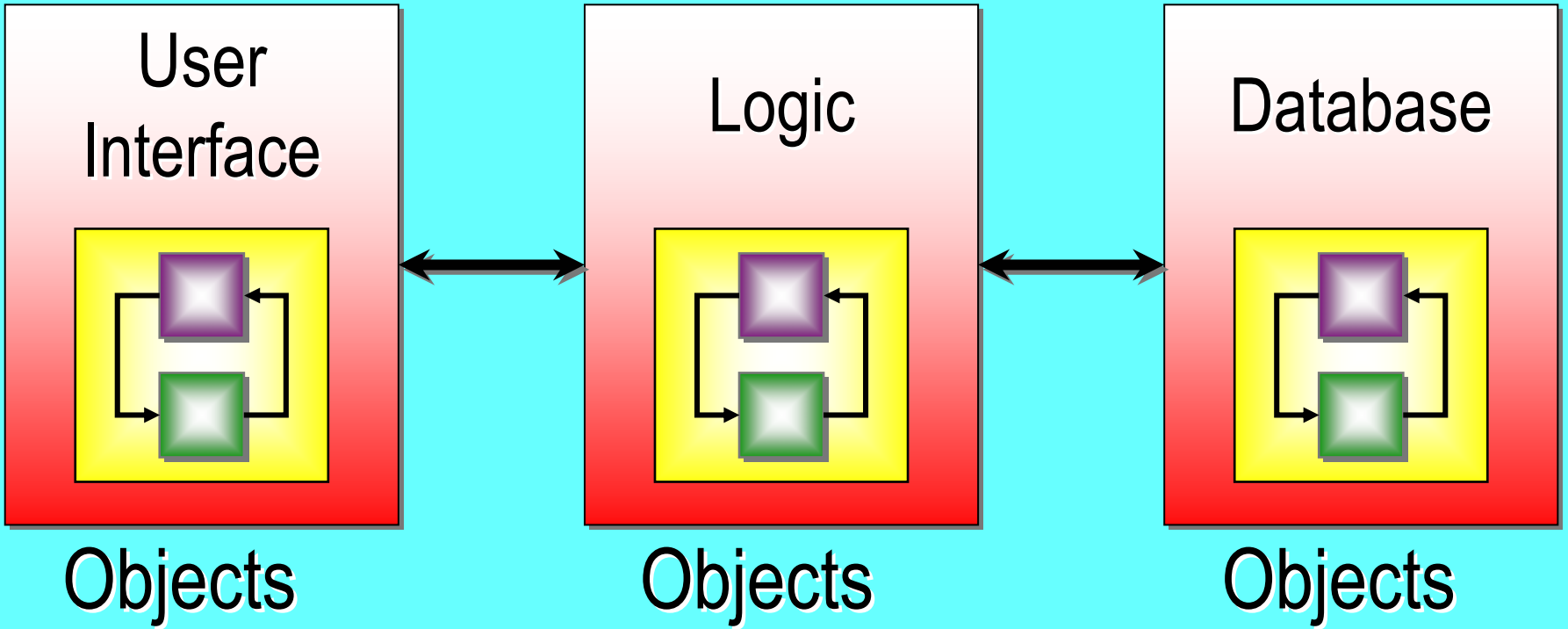


Object/Relational Mismatch

"Additional work, estimated as high as up to **40 percent** of the initial development effort, may be spent resolving this mismatch."

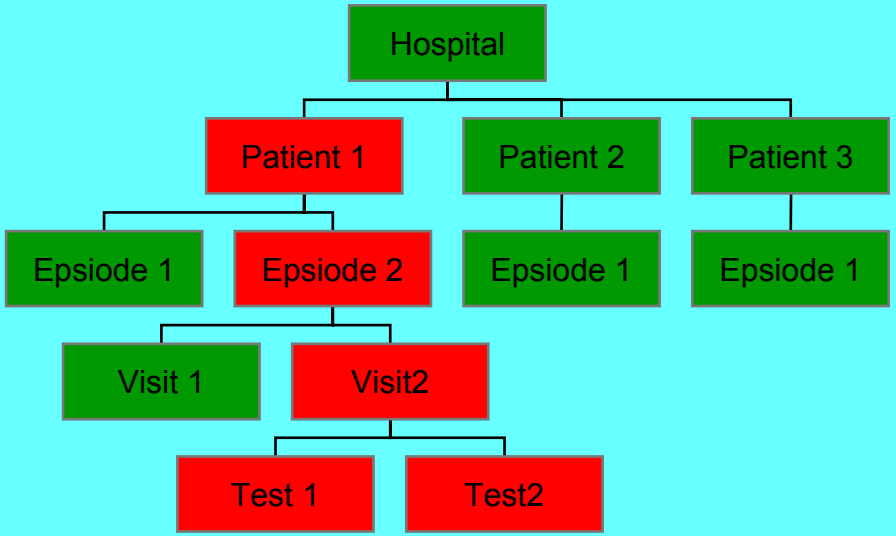
http://otn.oracle.com/oramag/oracle/03-jan/o13javamonkey.html

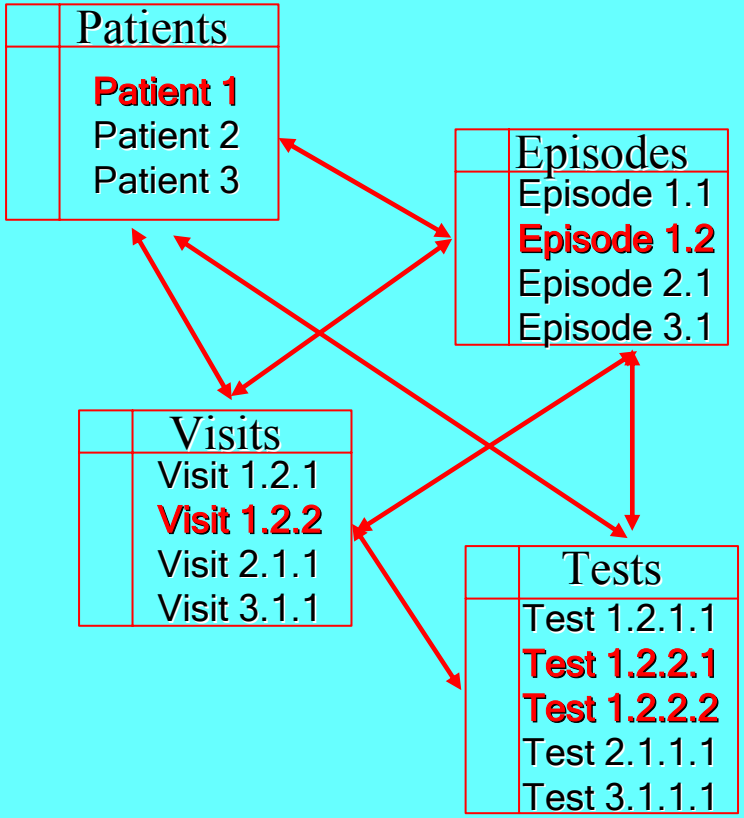
Objects in the Database



Consistent Representation End to End

HIS Data Model

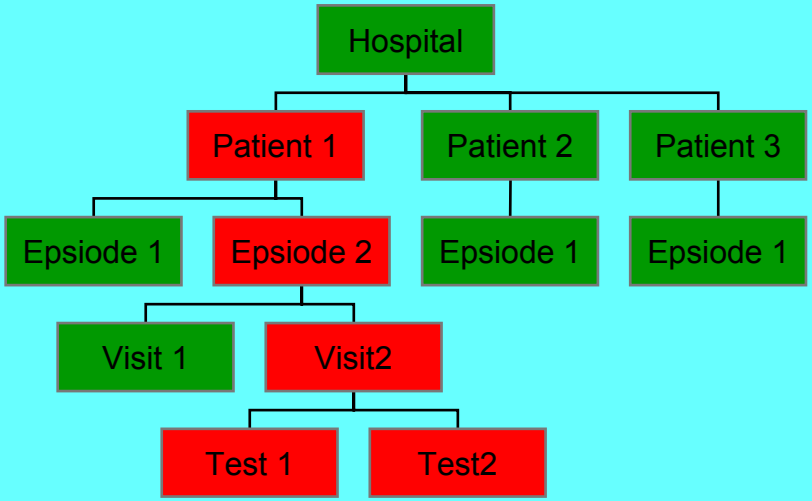




Natural structure is hierarchical

RDBMS tables (1000?)

HIS Data Model



Natural structure is hierarchical

Disk Block

Patient 1
- Episode 1
- Episode 2
  - Visit 1
  - Visit 2
    - Test 1
    - Test 2

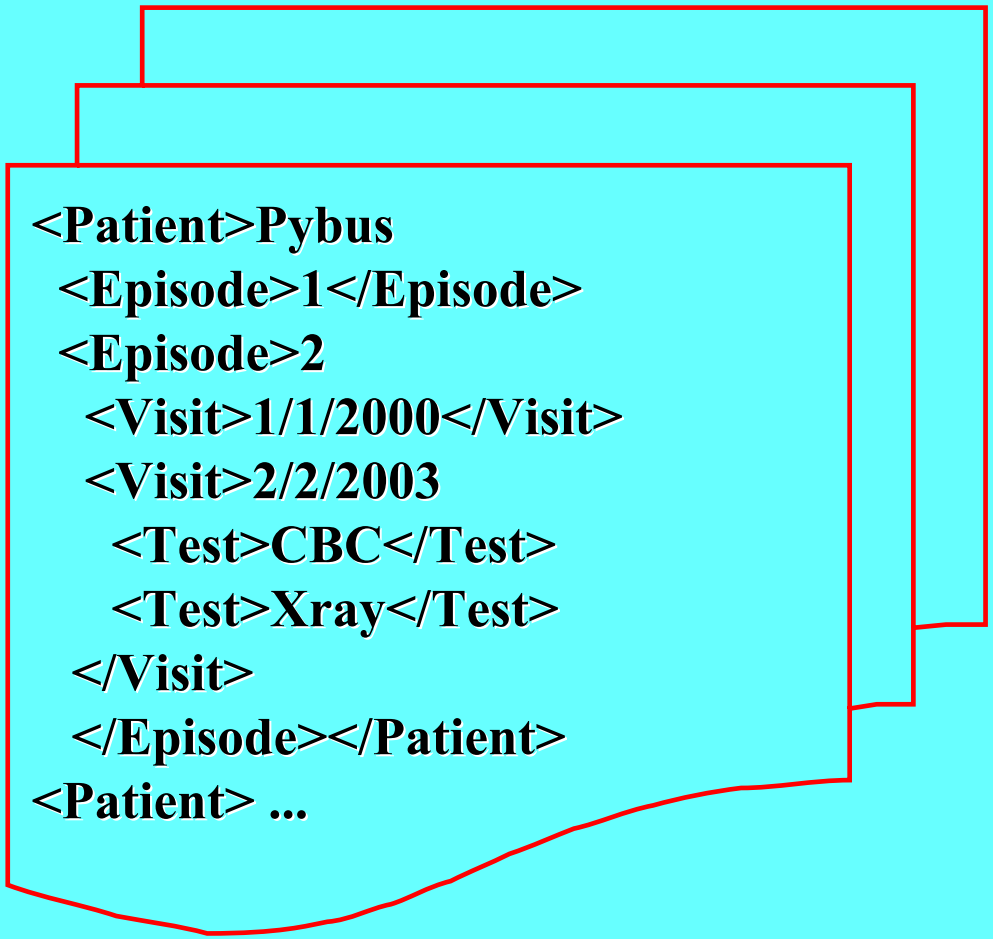
Patient 2
- Episode 1

Patient 3
- Episode 1

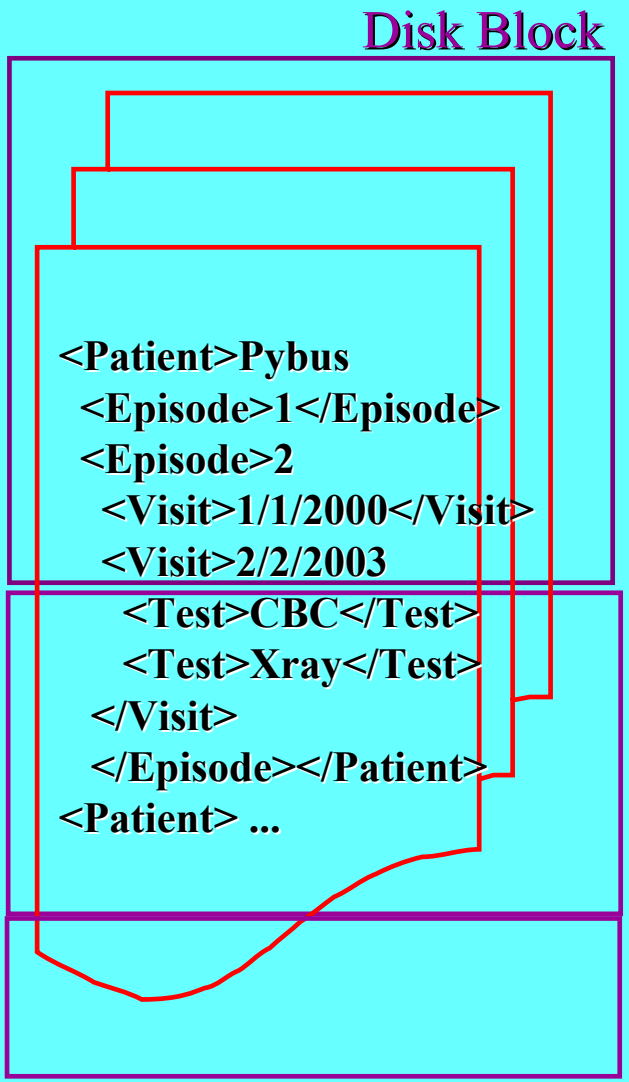
…….

MultiDimensional Objects

XML Storage

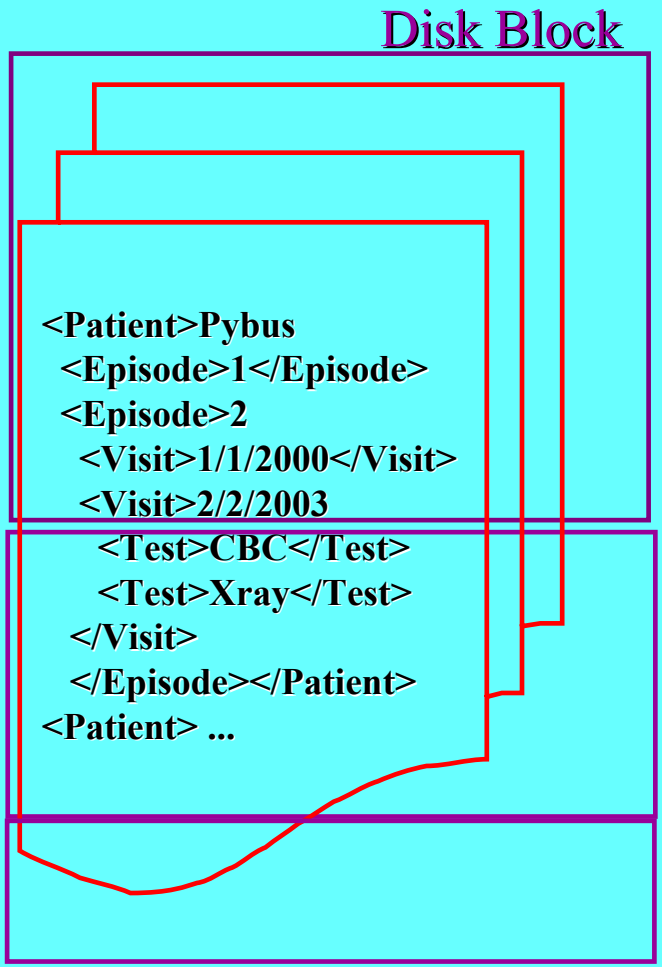


XML Document



Stored as XML

XML Storage



Stored as XML

-Large (2-5x)

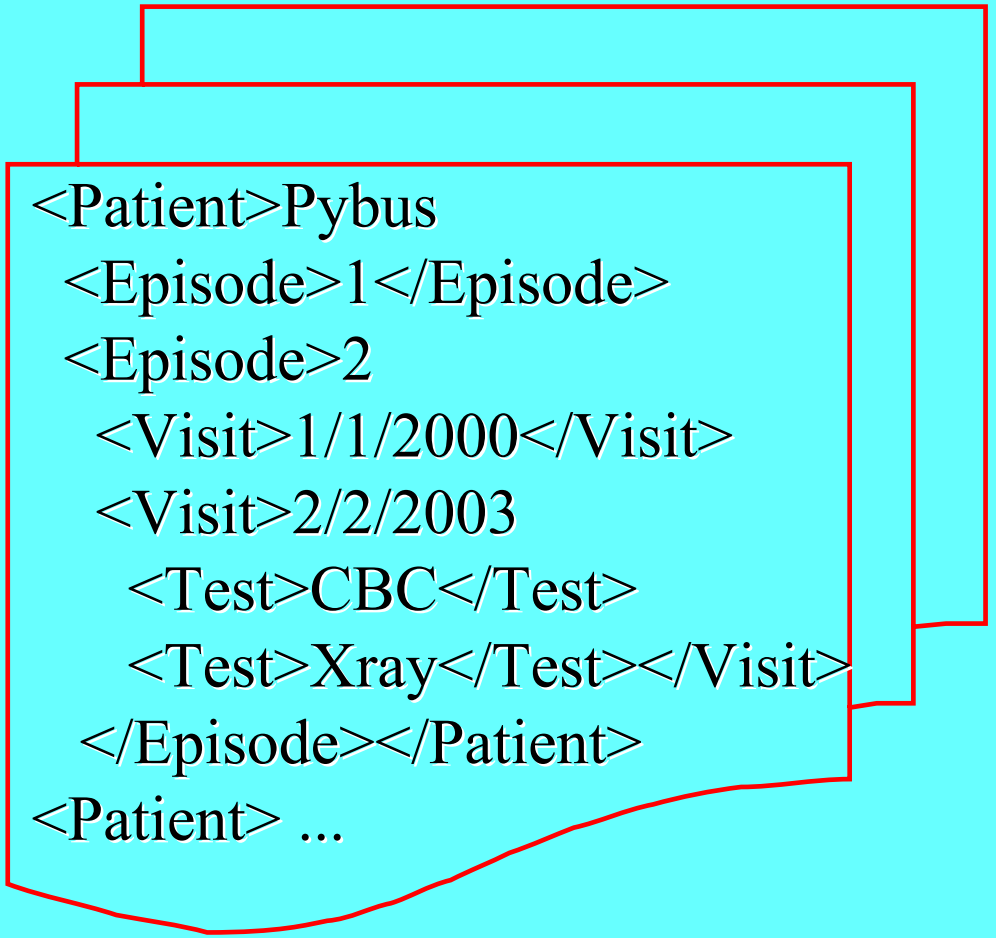
-XPath (etc)

-Limited

-Slow

-Few tools

XML Storage



XML Document

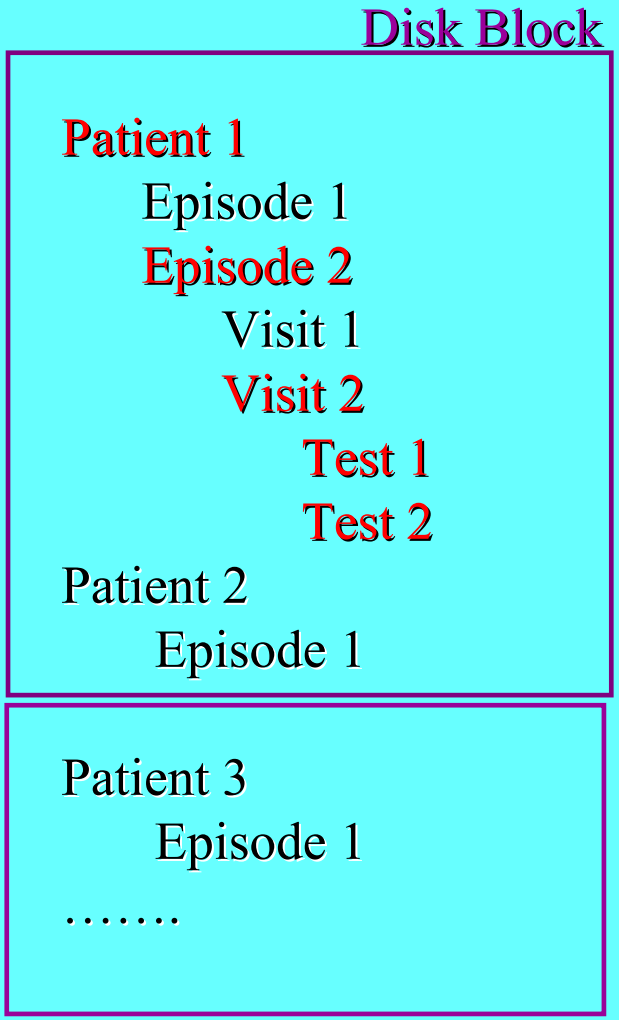
Disk Block

Patient 1
Episode 1
Episode 2
Visit 1
Visit 2
Test 1
Test 2
Patient 2
Episode 1

Patient 3
Episode 1
…….

MultiDimensional Objects

XML Storage



MultiDimensional Objects

- Indexing
  - Traditional
  - Bitmap
- SQL Access
  - SQL Queries
  - ODBC (tools)
  - Stored Procedures
- Object Access
  - Active X
  - Java
- Native Access
  - Top Speed
- Integrated
  - with other functions
  - TP system
  - OLAP/DW

XML is :

- Excellent for *communicating* data
  - . SOAP, Web Services, HL7
  - . Platform Independent

- Poor for *storing* data
  - . Store multidimensional
  - . Quick and easy Import/Export of XML

Rapid Application Development Caché XML Export

- Any class
  - Inherit from %XML.Adaptor
  - Call XMLDTD()
  - Call XMLSchema()
  - Call object.XMLExport()

Rapid Application Development Caché XML Import

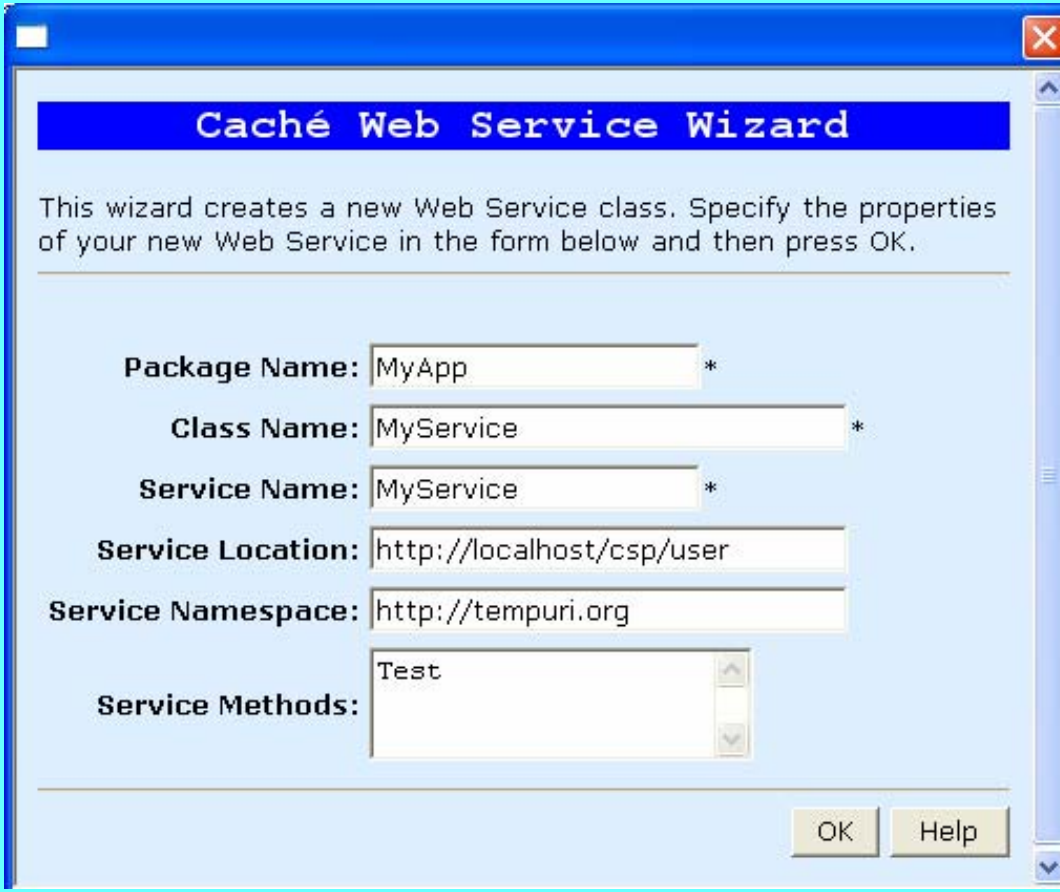
- Any class (from file)
  - Make new %XML.Reader() object
  - Open the file
  - Call Correlate() // match class
  - Call Next()
  - Call Save()

Rapid Application Development
Caché XML Schema Wizard

- Any XML Schema (from file)
  - Makes class(es) to match
  - Can then import the data

Rapid Application Development
Caché Web Service Wizard

- Make any method into a Web Service in seconds
  - Includes WSDL



Conclusion

- "Efficient Integration of XML & Web Services for Electronic Health Records"
  - Use proven, reliable Healthcare DBMS
  - Model data as objects, but retain SQL usefulness
  - Avoid Object/Relational Issues
  - Store data in multidimensional DBMS
  - Use Rapid Application Development tools for XML Import/Export/Web Services
  - Compare Total Price/Performance