Temporal Databases

Temporal DBs – Motivation

- Conventional databases represent the state of an enterprise at a single moment of time
- Many applications need information about the past
 - Financial (payroll)
 - Medical (patient history)
 - Government
- Temporal DBs

A system that manages time varying data

Database that stores information about the state of real world across time.



Comparison

- Conventional DBs:
 - Evolve through transactions from one state to the next
 - Changes are viewed as modifications to the state
 - No information about the past
 - Snapshot of the enterprise
- Temporal DBs:
 - Maintain historical information
 - Changes are viewed as additions to the information stored in the database
 - Incorporate notion of time in the system
 - Efficient access to past states



Temporal Database Models

- Temporal Data Models: extension of relational model by adding temporal attributes to each relation
- Temporal Query Languages: TQUEL,
 SQL3
- Temporal Indexing Methods and Query Processing



Taxonomy of time

- Transaction time databases
 - Transaction time is the time when a fact is stored in the database
- Valid time databases:
 - Valid time is the time that a fact becomes effective in reality
- Bi-temporal databases:
 - Support both notions of time



Example

- Sales example: data about sales are stored at the end of the day
- Transaction time is different than valid time
- Valid time can refer to the future also!
 - Credit card: 03/01-04/06



Example: Queries

· Queries:

- Timestamp (timeslice) queries: ex. "Give me all employees at 05/94"
- Range-timeslice: "Find all employees with id between 100 and 200 that worked in the company on 05/94"
- Interval (period) queries: "Find all employees with id in [100,200] from 05/94 to 06/96"



What is time varying data?

- You want a reprint of a customer's invoice of August 12, 1999.
- What was the stock value of the Oracle shares on June 15th, last year?
- What was the lowest stock quantity for every product last year? How much money will you save, if you keep the stocks at those levels?
- Where do you enter the new address of this customer as from the first of next month?
- What will your profits be next month, given the price list and cost prices by then?



What is time varying data?

Examples of application domains dealing with time varying data:

- Financial Apps (e.g. history of stock market data)
- Insurance Apps (e.g. when were the policies in effect)
- Reservation Systems (e.g. when is which room in a hotel booked)
- Medical Information Management Systems (e.g. patient records)
- Decision Support Systems (e.g. planning future contigencies)
- CRM applications (eg customer history / future)
- HR applications (e.g Date tracked positions in hierarchies)



What is time varying data?

In fact, time varying data has ALWAYS been in business requirements - but existing technology does not deal with it elegantly!



Temporal DB Design Approaches

- Several implementation strategies are available
- Use a date type supplied in a non-temporal DBMS and build temporal support into applications (*traditional*)
- Implement an abstract data type for time (object oriented)
- Provide a program layer (API) above a nontemporal data model.



Implementation Approaches

- Generalise a non-temporal data model into a temporal data model (*Temporal Normal Form*)
- Re-design core database kernel (pure Temporal Database)

