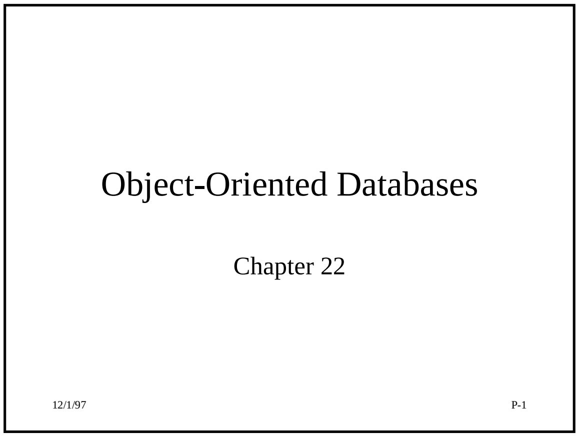
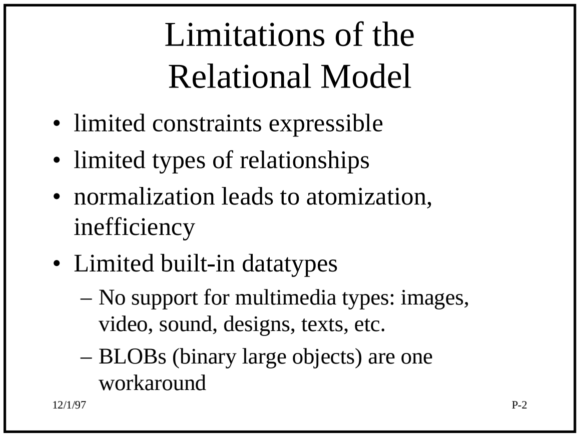


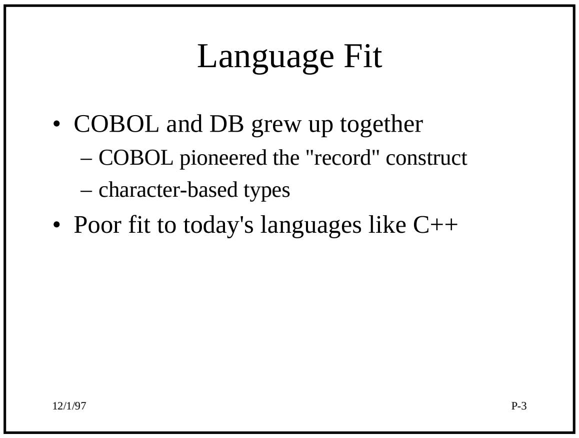
Object-Oriented Databases

Chapter 22



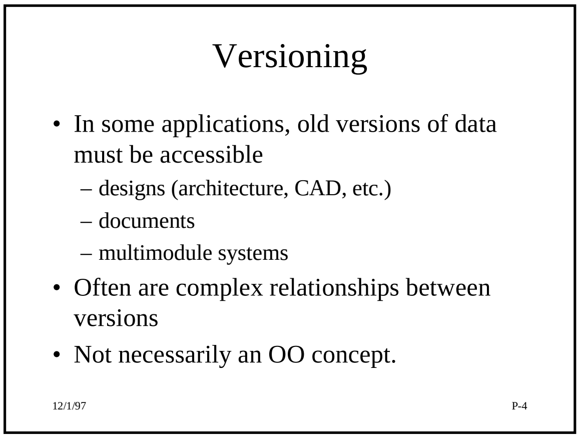
Limitations of the Relational Model

- limited constraints expressible
- limited types of relationships
- normalization leads to atomization, inefficiency
- Limited built-in datatypes
  - No support for multimedia types: images, video, sound, designs, texts, etc.
  - BLOBs (binary large objects) are one workaround



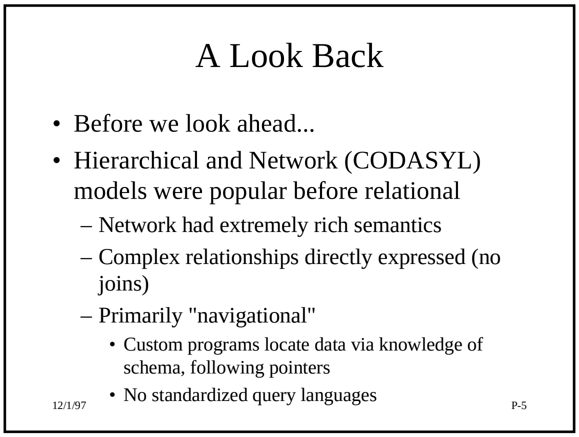
Language Fit

- COBOL and DB grew up together
  - COBOL pioneered the "record" construct
  - character-based types
- Poor fit to today's languages like C++



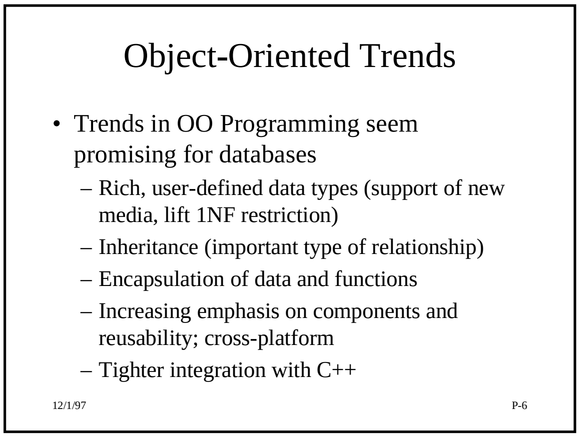
Versioning

- In some applications, old versions of data must be accessible
  - designs (architecture, CAD, etc.)
  - documents
  - multimodule systems
- Often are complex relationships between versions
- Not necessarily an OO concept.



A Look Back

- Before we look ahead...
- Hierarchical and Network (CODASYL) models were popular before relational
  - Network had extremely rich semantics
  - Complex relationships directly expressed (no joins)
  - Primarily "navigational"
    - Custom programs locate data via knowledge of schema, following pointers
    - No standardized query languages



Object-Oriented Trends

- Trends in OO Programming seem promising for databases
  - Rich, user-defined data types (support of new media, lift 1NF restriction)
  - Inheritance (important type of relationship)
  - Encapsulation of data and functions
  - Increasing emphasis on components and reusability; cross-platform
  - Tighter integration with C++

Review of OO Programming Concepts

- Class: description of data structure and operations (i.e. a data type)
  - encapsulation: data and ops are wrapped together; only an interface is externally visible.
- Object: an instance of a class
- Class B inherits from class A: B has all the properties of A, plus some new or altered properties (data/functions)

Strict OO Viewpoint

- Where possible: model the behavior and relationships of the real world
- Everything is an object
- Objects communicate only by passing messages
  - In practice, a message is a function name plus a set of arguments
- Types can be determined at run-time
- Smalltalk is the model: untyped; interpreted; interactive

Hybrids and Compromises

- Example: C++
  - retains all features of non-OO C language, adds classes, inheritance, polymorphism
- OODBs tend to be compromises
  - May retain relational facilities: ORDBMS
  - Add OO features such as: user-defined types & classes, inheritance, etc.
  - Add features like "persistence" and versioning
  - SQL3 will have OO features

OIDs

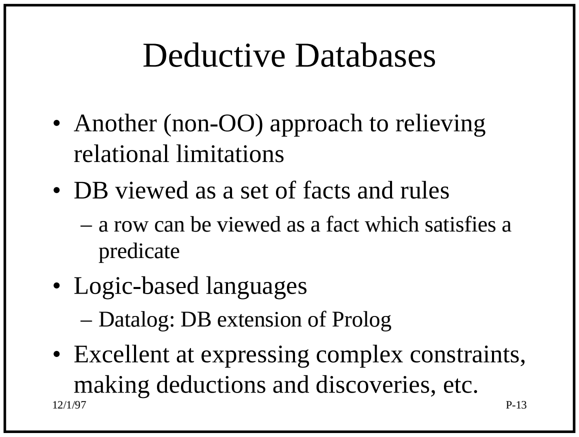
- Object Identifiers (OID)
- Unique (database-wide) identifier for each object
  - independent of key
- One object can reference another via OID
  - Allows complex embedding

Challenges for Query Languages

- DDL: coordinating PL with QL
- Encapsulation issues
  - how much is visible?
  - must all operations be predefined?
- Multimedia
  - what does "query" mean?
  - how to display results?

Persistence

- The idea: it's easy for a program to work with a complex data structure in memory, but hard to flatten it into a file. It would be convenient if some variables were *persistent*, i.e., could exist on disk between executions of the program, i.e., be part of the DB.
- Not strictly on OO concept
- One challenge: mapping OIDs between in-memory pointers and disk addresses
  - "pointer swizzling"



Deductive Databases

- Another (non-OO) approach to relieving relational limitations
- DB viewed as a set of facts and rules
  - a row can be viewed as a fact which satisfies a predicate
- Logic-based languages
  - Datalog: DB extension of Prolog
- Excellent at expressing complex constraints, making deductions and discoveries, etc.