Object-Oriented Databases
&
Relations Objects

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What is an OODB?

- OODB = Object-Oriented Database
- Some of the earliest data models were special cases:
  - Network or CODASYL model
  - Hierarchical model
- These models, being more focused, *potentially* provide for *more efficient* querying than relational models,
- at the expense of making queries more complex and less dynamic.

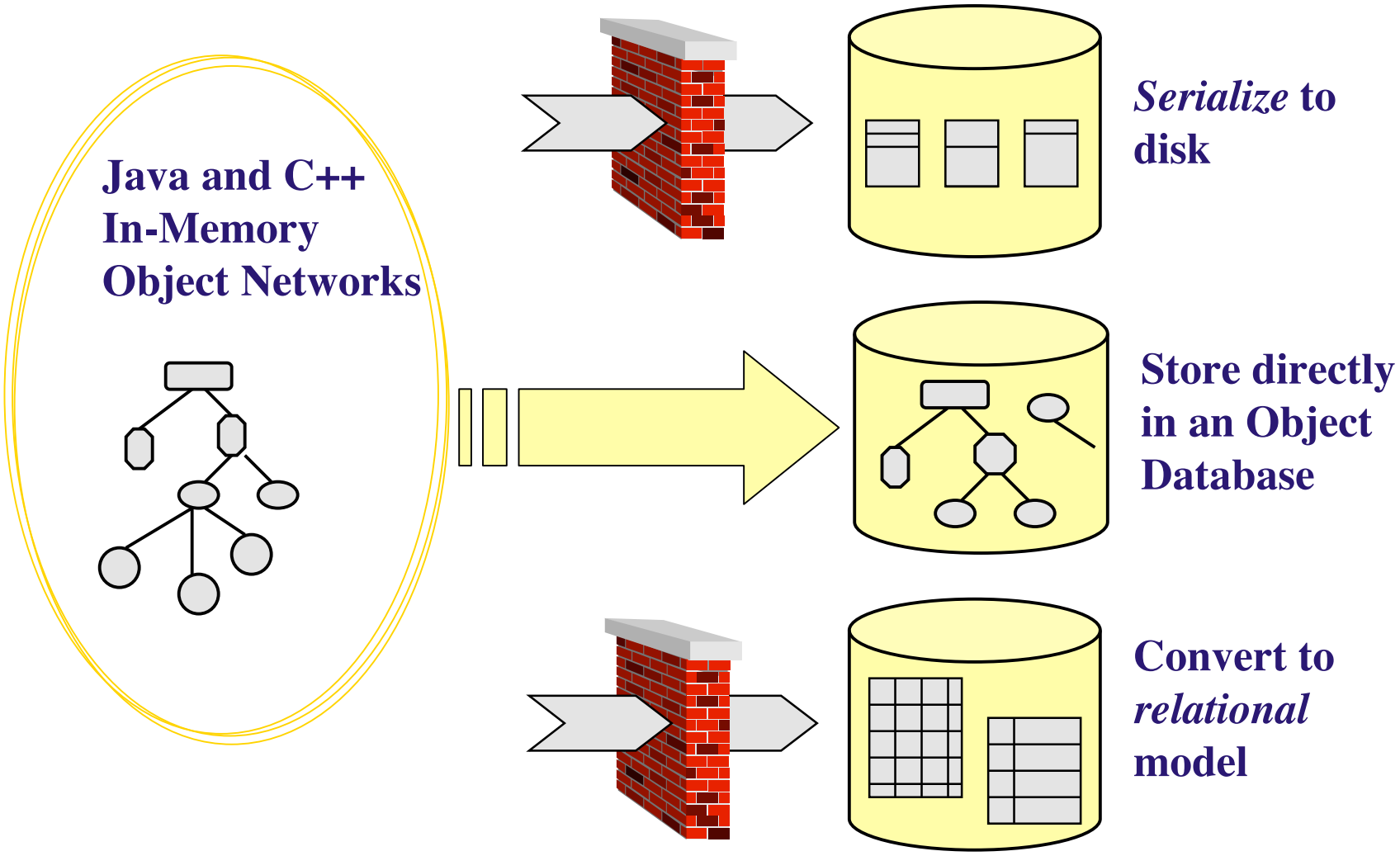
Programming View

- OODB is like Object-Oriented Programming, except that:
  - Objects are *persistent* (survive the current session)
  - Transaction mechanism is available:
    - Changes only **committed** at the end of a transaction.
- Essentially:
  - Your C++ or Java program becomes a database program.

OO vs. Relational

- OO doesn't use SQL or the equivalent
- Queries are typically "wired in"
- There is an emergent OQL (Object Query Language)
- OODB has closer ties to the Entity-Relationship model and UML (Unified Modeling Language).
- Another facet: CORBA standard (Common Object Request Broker)

3 Choices for Object Management ...



OODBMS Access Efficiency

- Typically data will be brought to main memory from secondary memory the first time the data are accessed.
- The code to transfer the data is *transparent* to the program.
- The data will remain in main memory until committing or until the end of the session.

Examples of OODBMS

(Object-Oriented Database Management Systems)

- A somewhat aging list:
  - POET™ (http://www.poet.com/)
  - ObjectStore™ (http://www.odi.com/)
  - Objectivity™ (http://www.objectivity.com/)
  - Versant™ (http://www.versant.com/) merged with POET
  - Gemstone™ (http://www.gemstone.com/)
  - O2™ (http://www.ardentsoftware.com/)
- Standards are emerging, thanks to the ODMG (Object Data Management Group)

Use POET™ as “Typical” (but now obsolescent) Use Java as the Language

- Data are stored on disk with symbolic name.
- Schema (through a schema file) determines the DB structure.
- Upon *opening* the database, the ***root*** of the structure on disk is *bound* to a reference **variable** in memory.
- Further bindings take place as the structure is navigated, using OOP.

POET/Java Examples

string

- `Database db = Database.open(dbName, Database.openReadWrite);`

class

static method

static constant

transaction

string

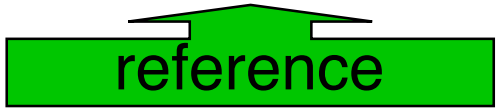
- `Extent e = new Extent(trans, classname);`

Java Enumeration of class objects

```
while( e.hasMoreElements() )
  {
  … e.nextElement() …
  }
```

POET/Java Examples

- `db.add(myobject, trans);`



- `ObjectServices.delete(myobject);`

Transactions

- All access (even read-only) is done within a **transaction**.

- ```
  Transaction trans = new Transaction(db);

  trans.begin();
       .
       .
       .
  trans.checkpoint();
       .
       .
       .
  trans.commit();
  ```
  ```

Schema File

```
[schemata\poetOgreDict]
oneFile = true

[databases\poetOgreDB]
schema = poetOgreDict
location = SAME
oneFile = true

[classes\poetOgreObject]
persistent = true
hasextent = true
schema = poetOgreDict
```

Connecting Objects to Relations

- Model 1: Store object (reference) as **values** in relations
  - 1 object (reference) = 1 attribute value
  - An object is of a specific data type.
    Thus a set of objects of the same type can be stored as a single relation.
  - Object's methods are over-and-above the relational model.

Connecting Objects to Relations

- Model 2: Relations are **associations** in OOP
  - Objects are free-standing
  - Each association between classes is a relation.

Connecting Objects to Relations

- Model 3: Objects identified with tuples
  - Attributes become fields.
  - Values of attributes become values of fields.
  - A whole relation is a set of objects of the same class.

OGRE

(Objects Generated From Relations)

A transformation tool developed by

Jeff Polakow ‘98 and Robert Keller

sponsored by JPL

Genesis of OGRE

- pre-1996 JPL: “Grok”
- 1996 JPL CS Clinic Project: “Condor”
- 1997 JPL CS Clinic Project: “Ogre” (originally Oracle-Grok Interface)
- 1998-1999: Two new versions, using some ideas from Condor.

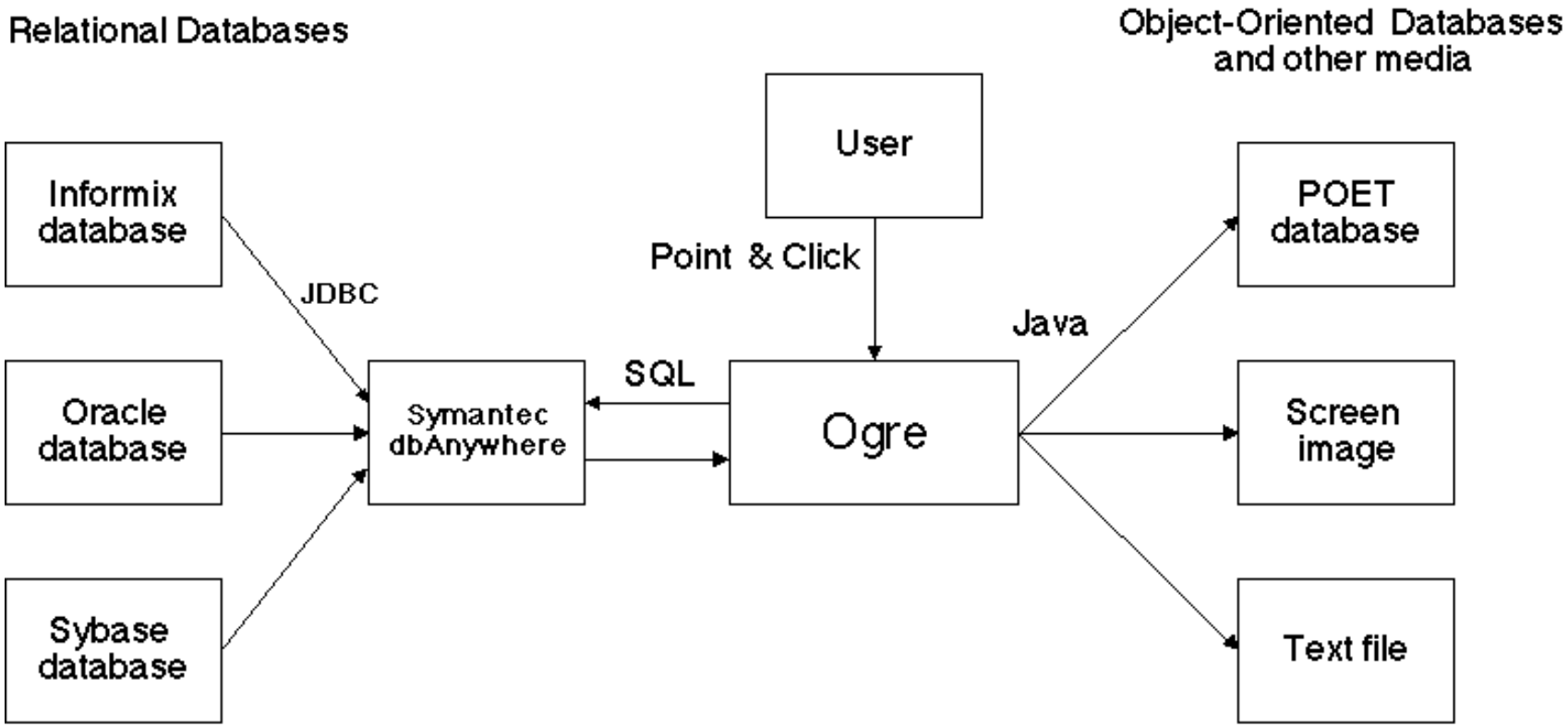
Ogre Features (1)

- “Any” JDBC/ODBC-Compliant Relational Database POET OODB using Model 2.
- In principle, could be made to work with any OODB.
- Could also generate text or XML.

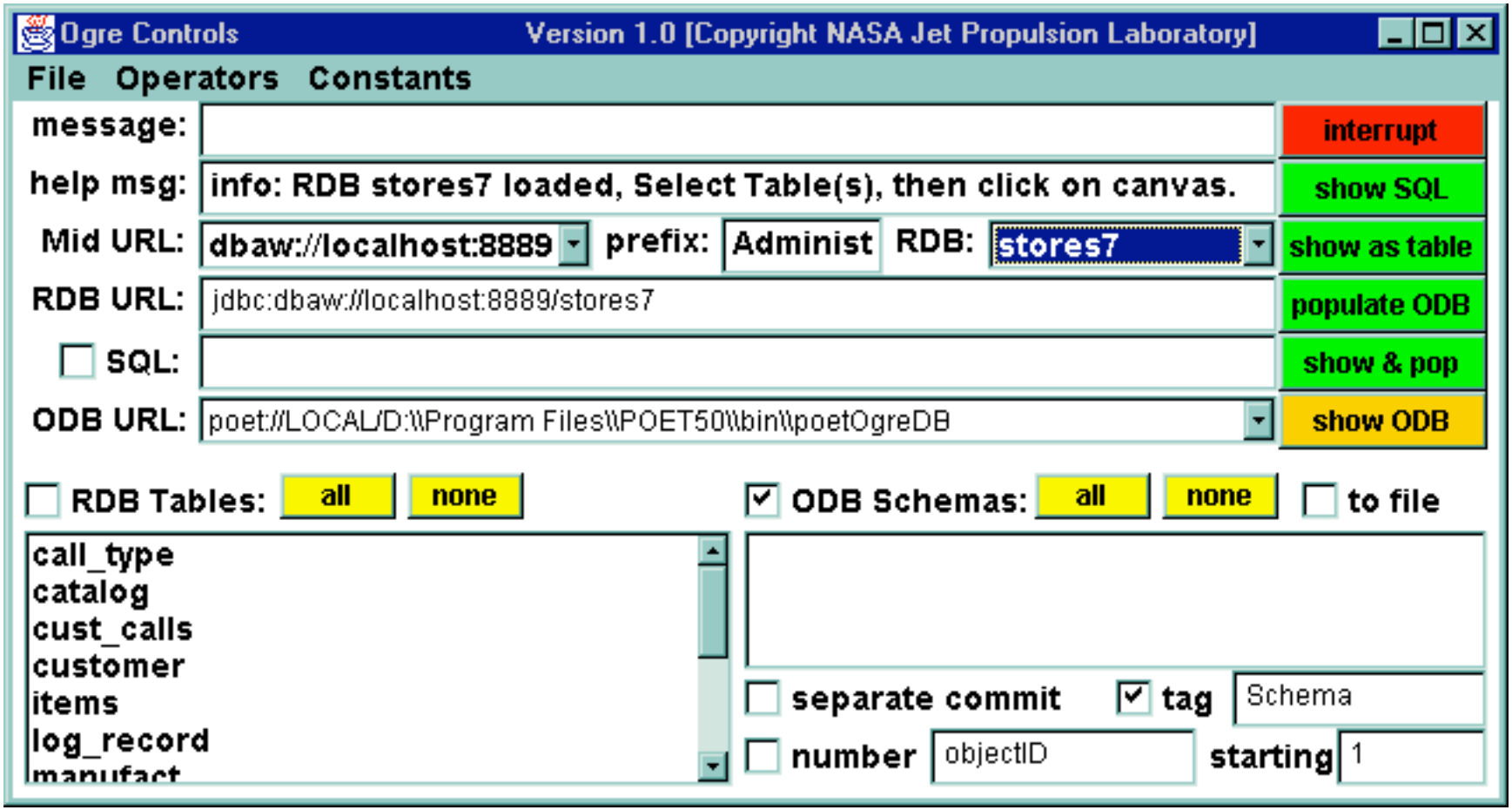
Ogre Features (2)

- GUI allows a naïve user to generate the OODB; essentially converts graphical queries into SQL to access RDB.
- The conversion alone may be of interest, aside from the connection with OODBs.

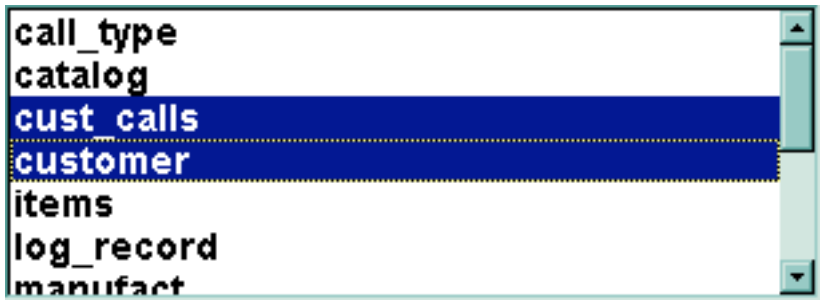
Ogre Architecture

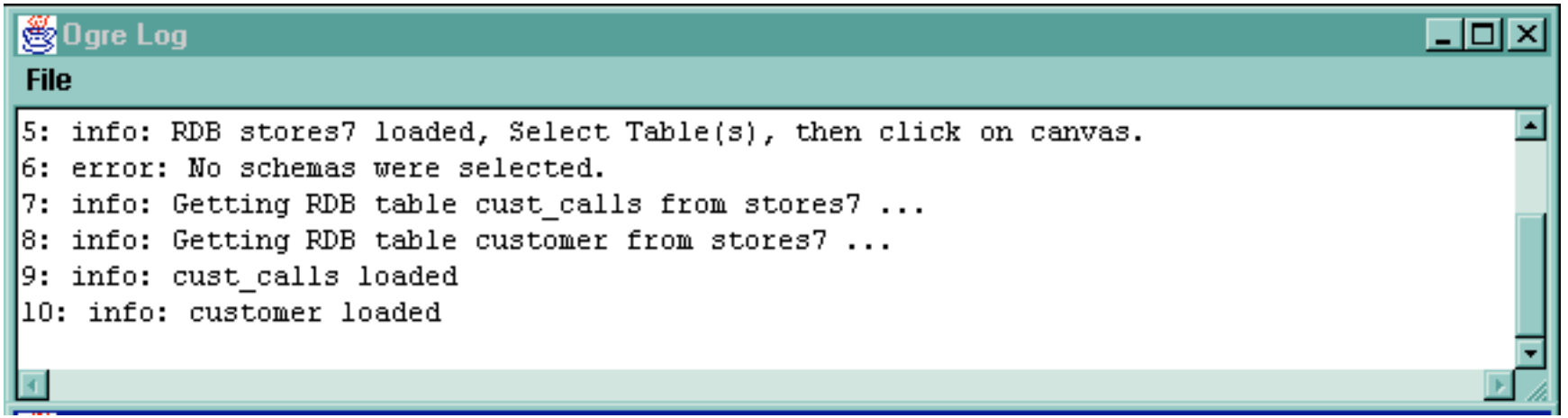


Loading an RDB into Ogre

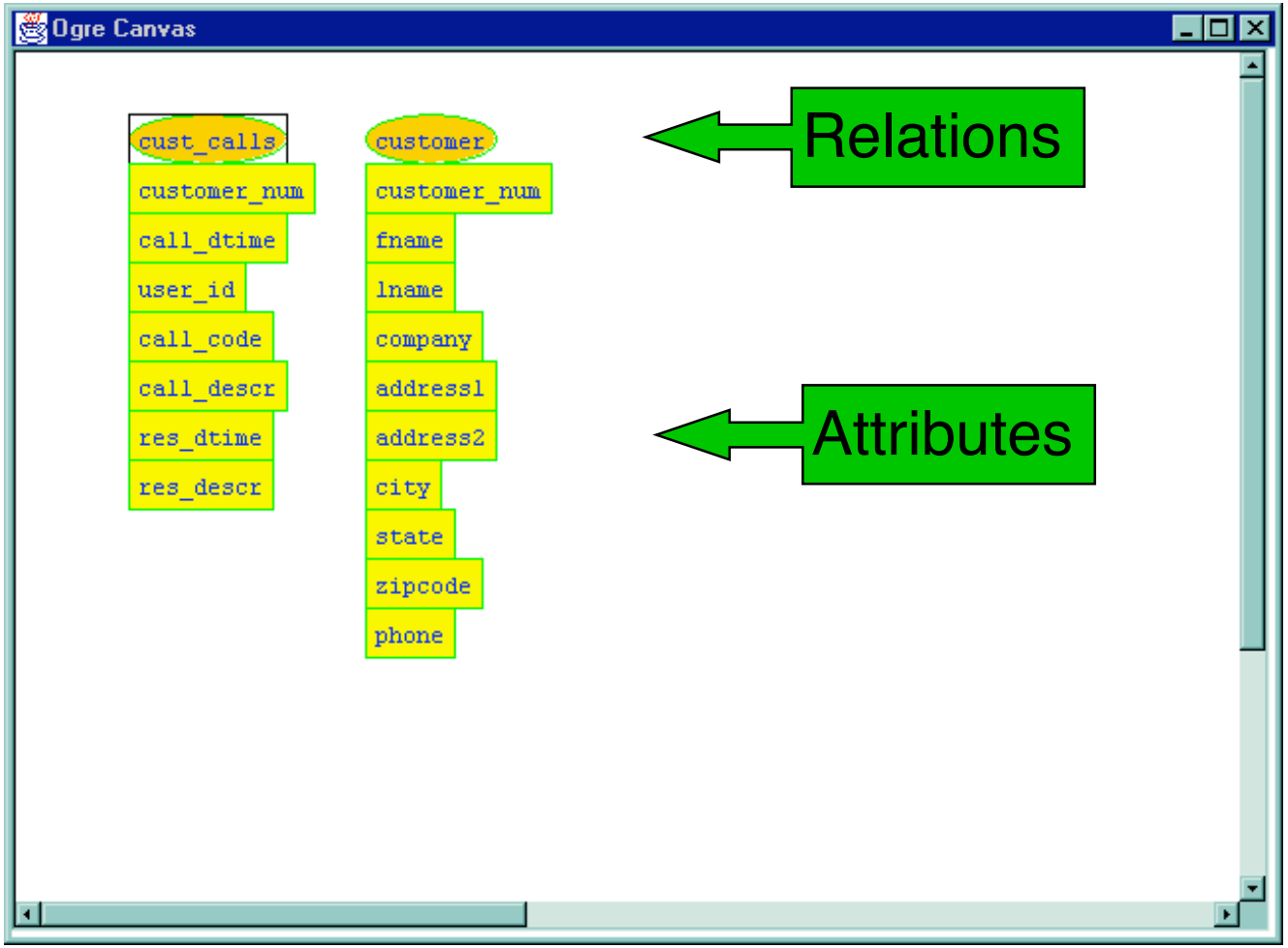


Selecting Tables

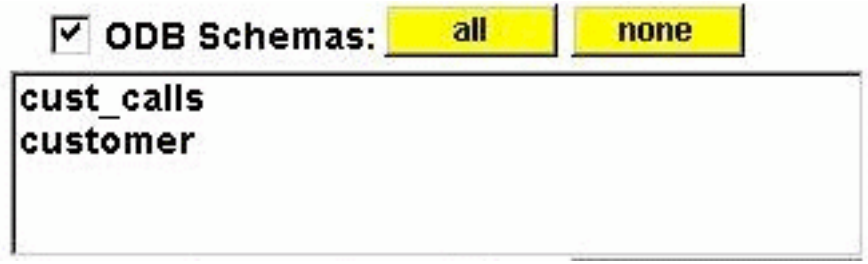


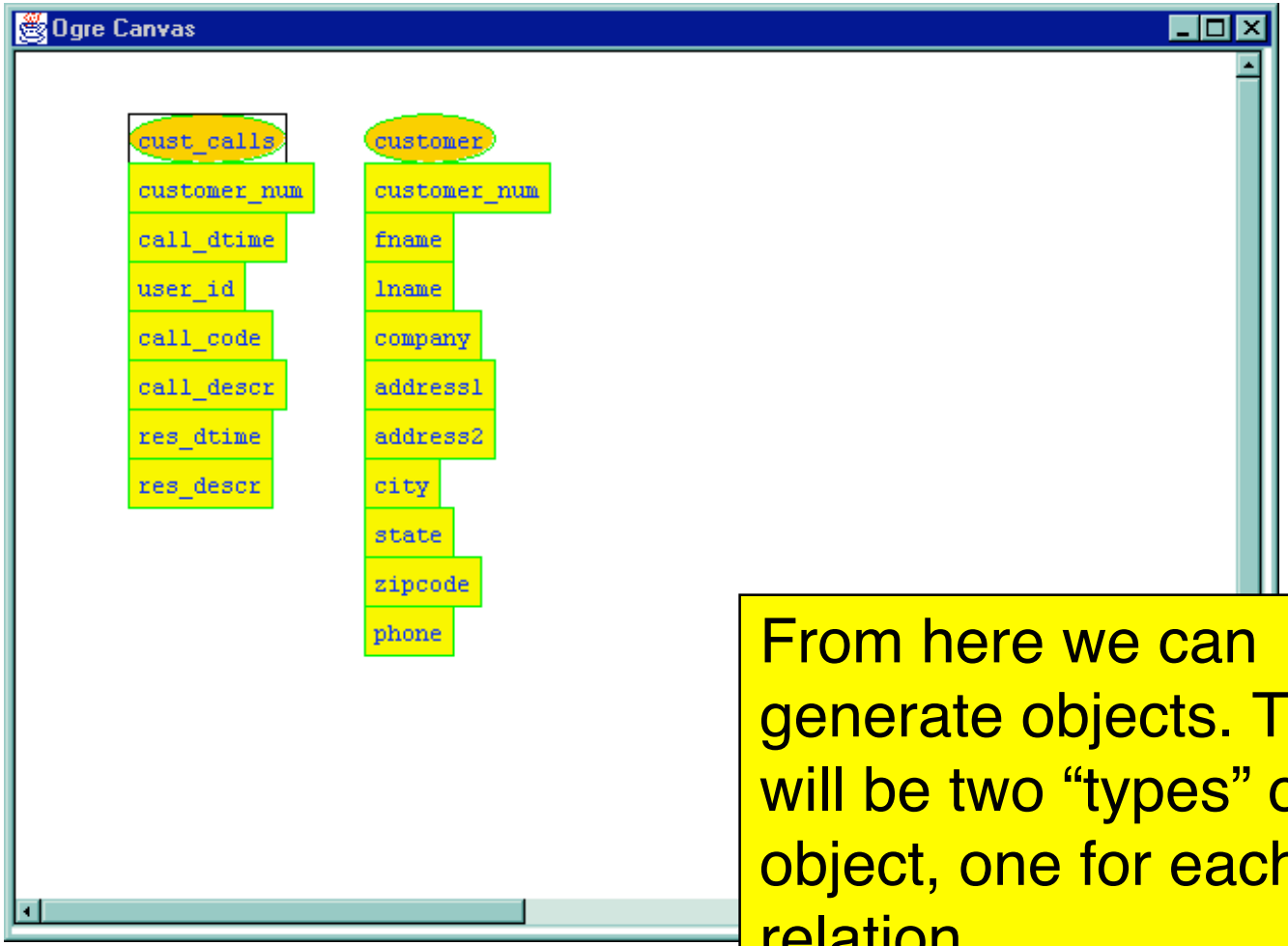


Displaying Selected Relations



Putative object types:



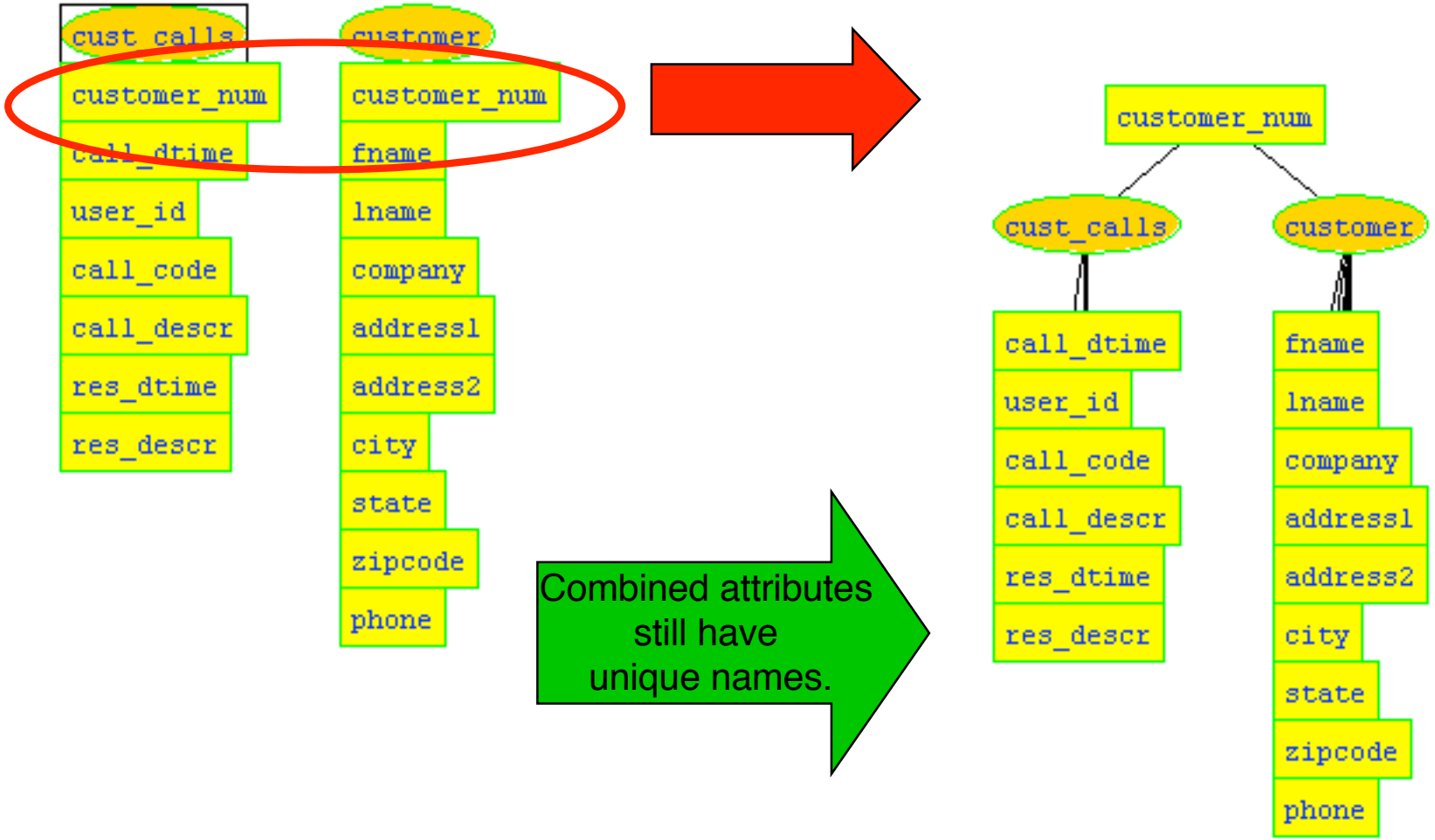


From here we can generate objects. There will be two “types” of object, one for each relation.

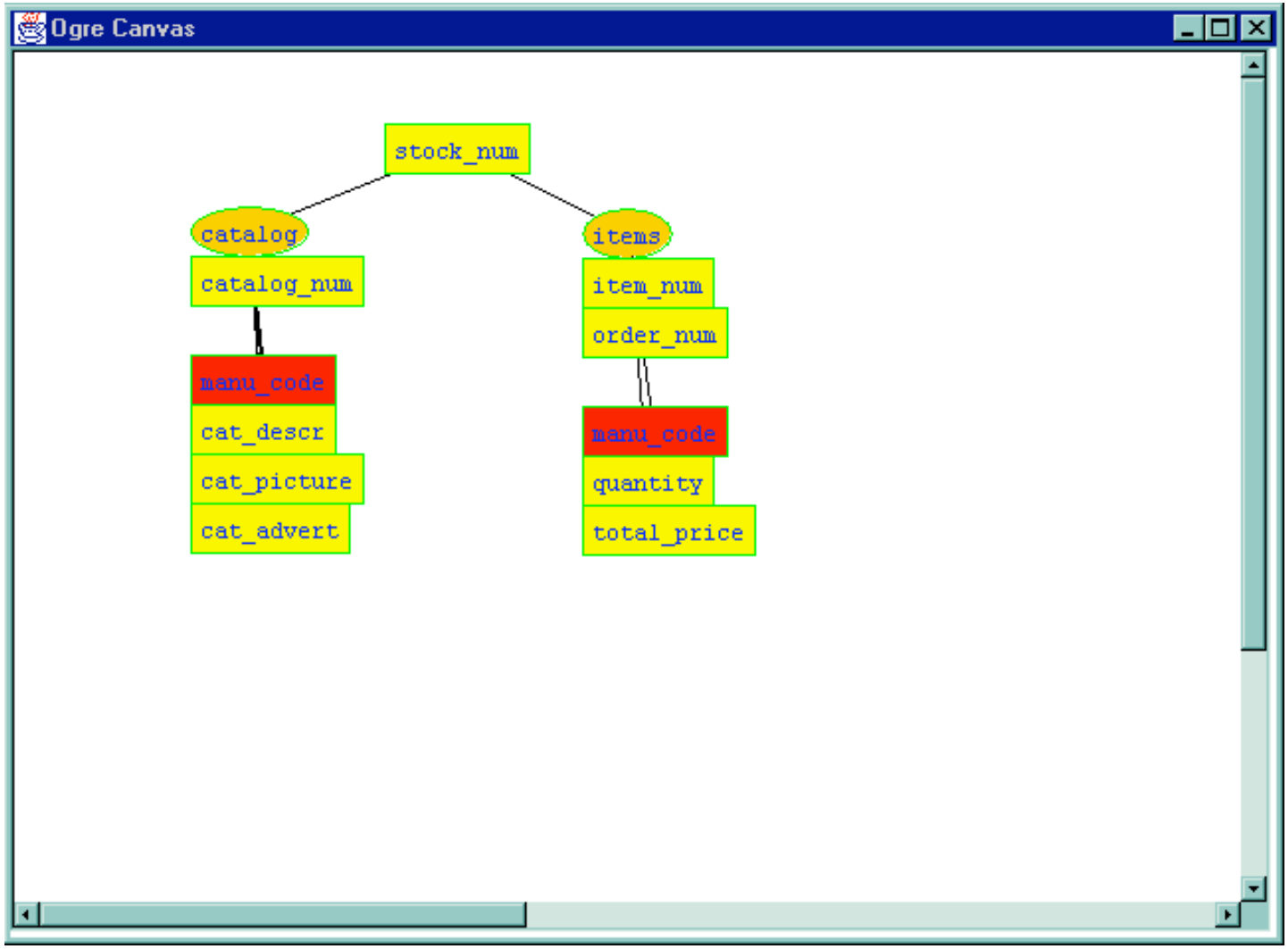
“Universal” Object Type

- In the case of Ogre, objects are actually all the same Java class:
  - The principal field is an *association list* (attribute-value pairs).
  - This is used because the schema would otherwise be unknown until runtime.
- In principle, a static-compilation approach is possible.

Joining Relations to create Single Objects

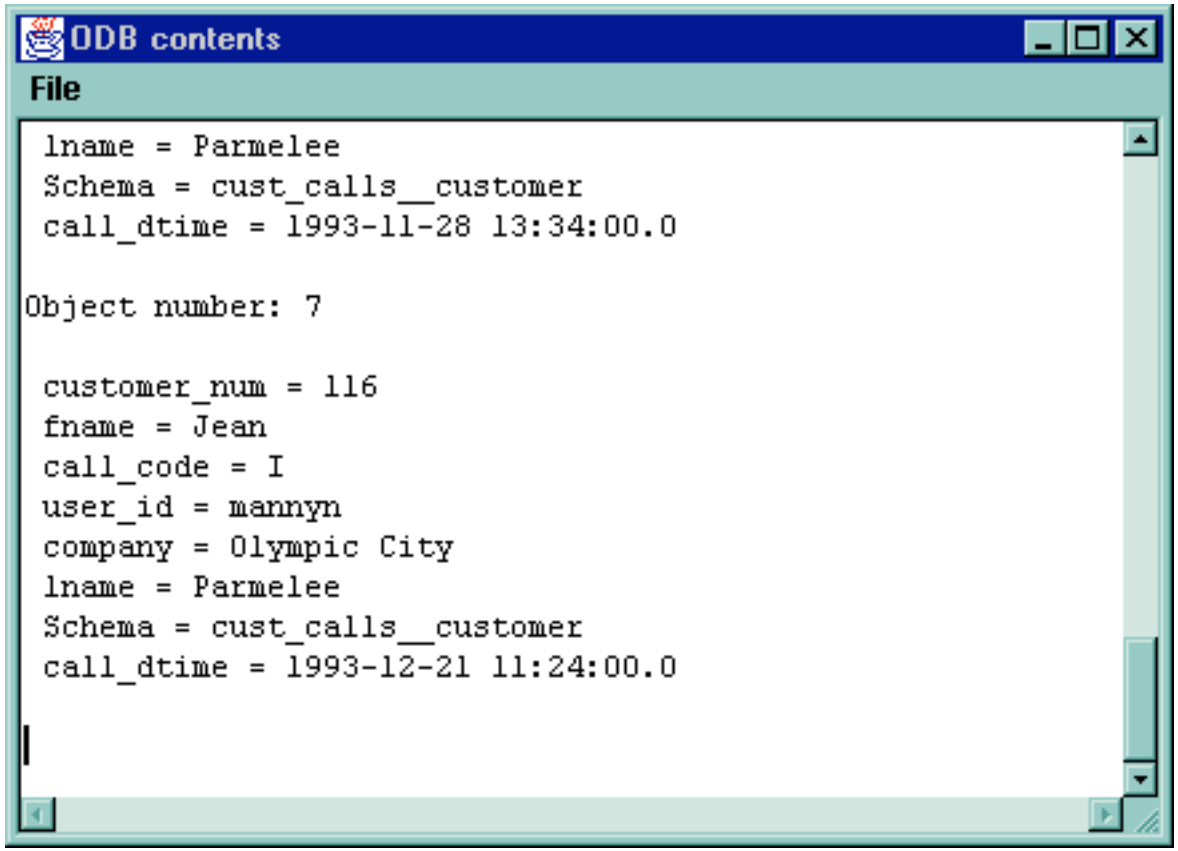


Joining Nuances

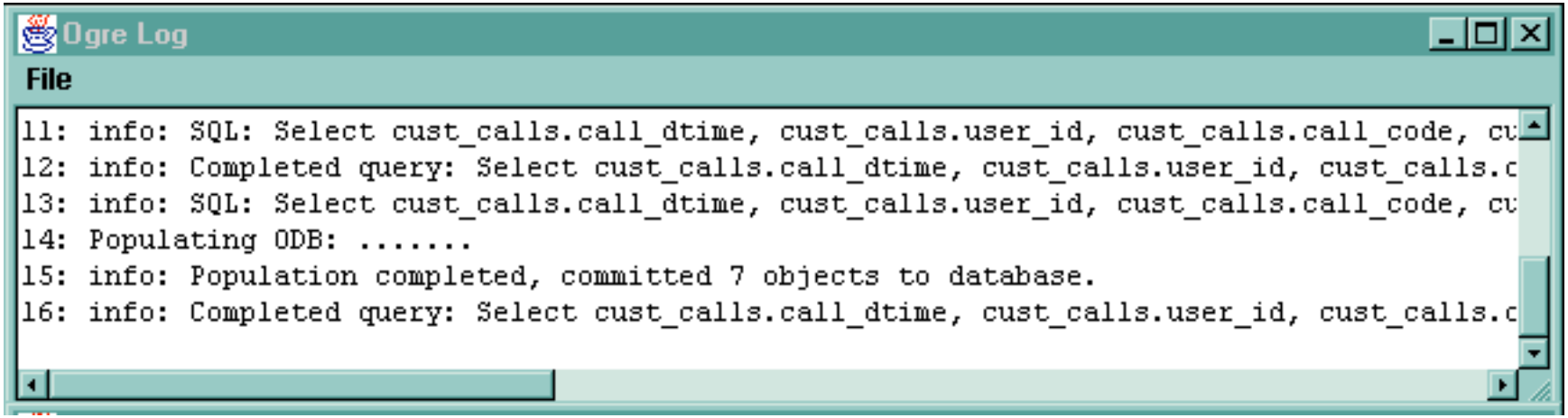


- unjoin
- rename
- hide
- mask

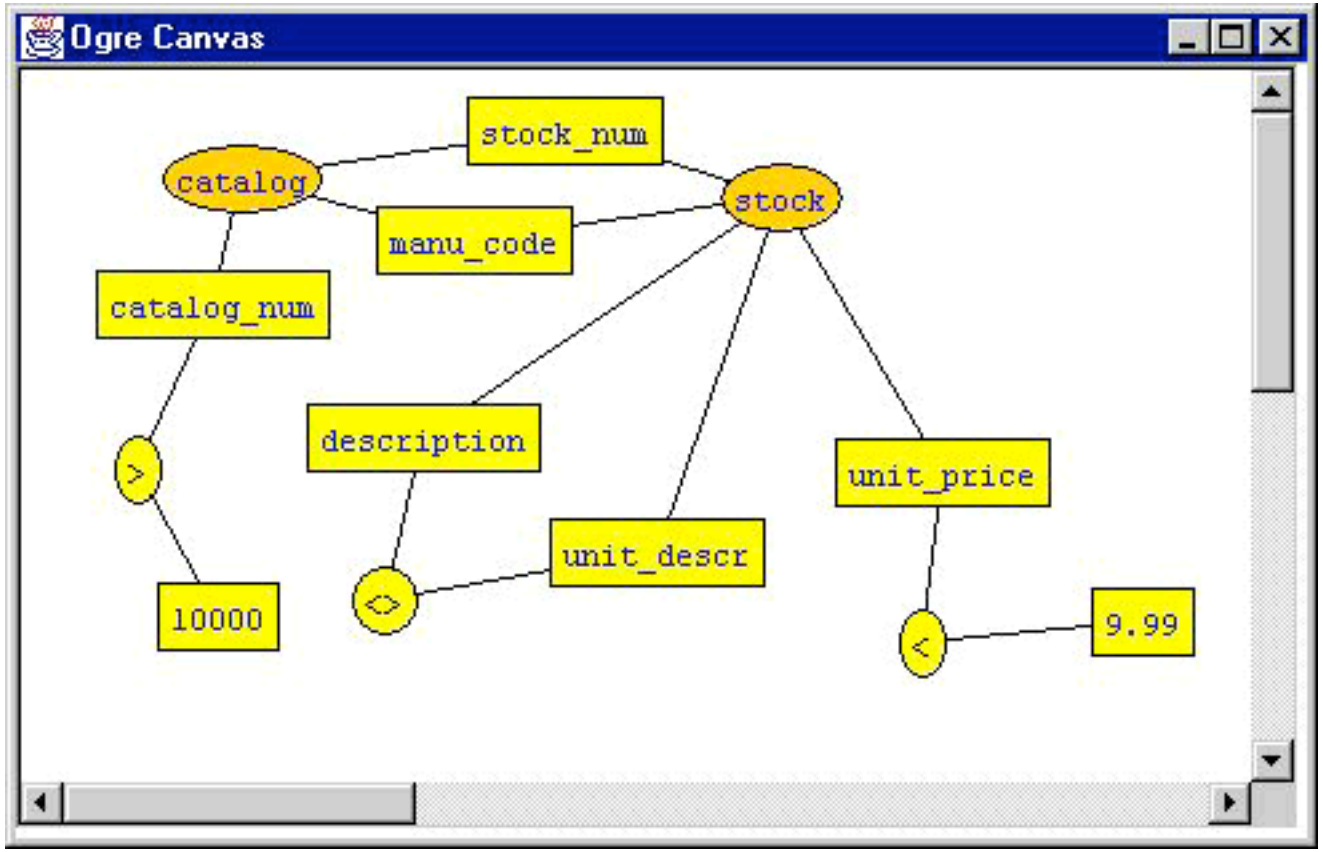
Viewing OODB



Generated SQL



Graphical Querying with Built-in Operators



Ogre Web Page

- http://www.cs.hmc.edu/~keller/ogre/