# A Simple Interface for Non Standard Knowledge Systems (SINKS)

By

*Harini Rao*

*Advisor: Dr.Christopher Pollett*

# Outline

- Objective
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# Objective

- To deploy a deductive database system such as XSB, as a back end for a relational database, Oracle.
- Application programmers can use SQL.

# Introduction

- Deductive databases - integration of relational databases and logic programming techniques.
- A deductive database system - a database system that includes capabilities to define deductive rules which can deduce or infer additional information from the facts that are stored in a database.

# Advantages

- Combine benefits of  two approaches.
- Provide means for expressing negation and disjunction.
- Query processing is much simpler and easier.

# Disadvantage

- Most database application programmers are unfamiliar with logic programming.

# XSB

- XSB - a deductive database system developed at the computer science department, Stony Brook University.

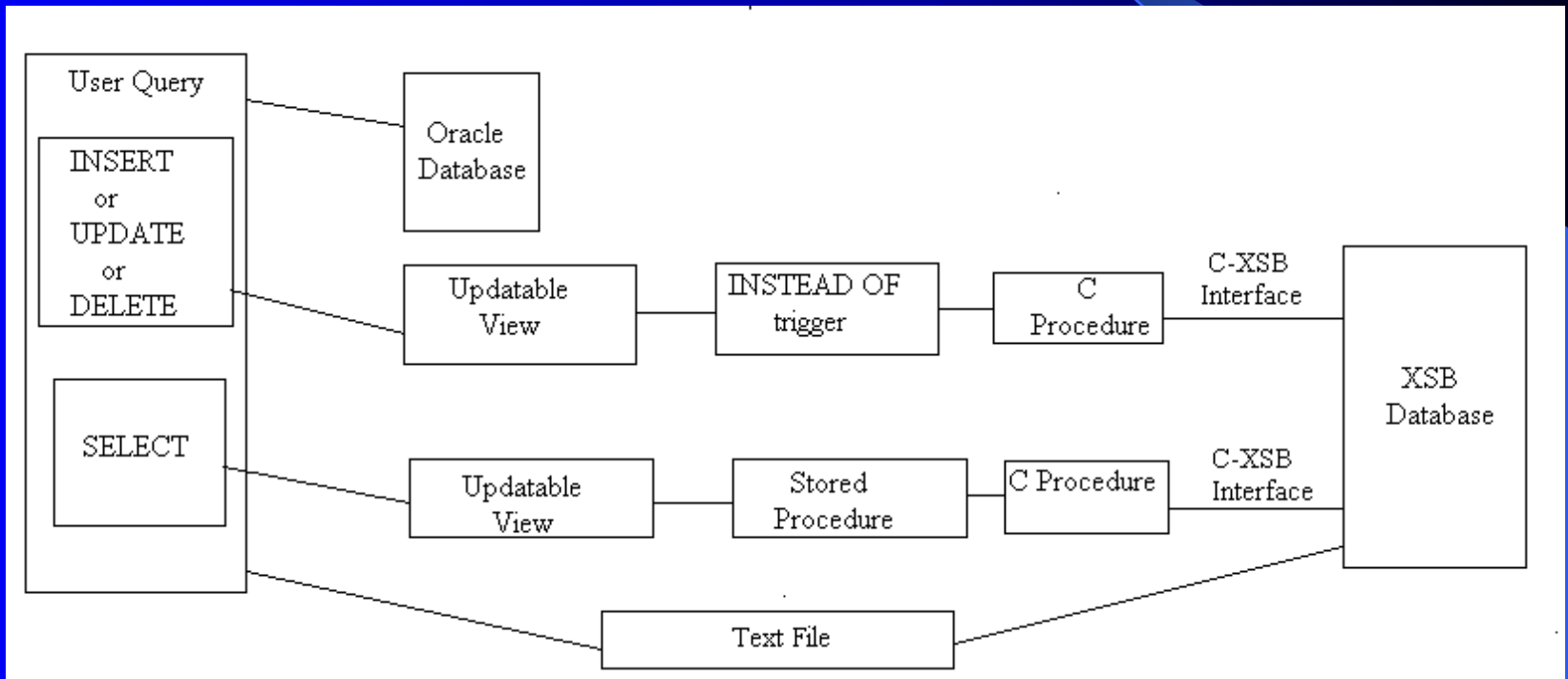
Features:

- Uses goal-directed resolution strategy to solve Prolog's problems.
- Evaluates stratified queries much faster.
- Tabling - to evaluate programs with negation.

# Design

- Oracle–XSB interface is a subsystem that allows Oracle users to access XSB databases.
- Allows facts in XSB to be accessed from Oracle's environment.
- Permits users to write explicit SQL statements.

# Data Flow Diagram



# Oracle-XSB Interface

The Oracle-XSB interface has two sub components.

- View Level Interface - translates SQL queries into Prolog clauses.
- C-XSB interface (provided with XSB) - allows a C program to pass queries to XSB.

# View Level Interface

- Translates a complex database query into a combination of one or more Prolog rules.
- Its design includes updatable views, instead of triggers or stored procedures and external C procedures.

# Updatable Views

- View - a virtual table whose contents is defined by a query.
- A view is not modifiable if its view query contains joins, set operators, aggregate functions, GROUP BY, CONNECT BY, START WITH clauses or DISTINCT operator.

# Instead of Triggers

- Instead of trigger - tells Oracle how to process a DML operation performed on a view.
- Execute the body of trigger instead of performing the actions that invoked the trigger.

# Stored Procedures

- Stored procedure - Named group of SQL statements previously created and stored in the server database.
- Reduce network traffic.
- Improve performance and security.

# External Routines

- External routine - a third-generation language procedure stored in a DLL, and called by the DBA to perform special-purpose processing.
- PL/SQL calls the routine as if it were a PL/SQL subprogram.

# C - XSB Interface

Calling XSB from C:

- Several functions - that allow a C program to initialize and interact with XSB.
- They pass commands or queries to the XSB system.

# C-Callable Functions

Some of these functions are:

- *int xsb_init(int argc, char *argv[]):* Used for initializing XSB.
- *int xsb_command():* Passes a command to XSB.
- *int xsb_query():* Used for passing a query to XSB.
- *int xsb_next():* Returns answers to the calling program if the query has multiple data answers.
- *int xsb_close():* Completely closes the connection and no other calls can be made to XSB .

# Deployment

- Combine queries from different database systems.
- Retrieve data from either XSB or Oracle or from both.

# Example - Retrieving Data only from XSB

Assume the table declarations:

emp(ename,job,sal,comm,deptno).

dept(deptno,dname,loc).

the SQL statement:

SELECT empno,comm,hiredate,dname from dept,emp;

generates the Prolog query,

emp(EMPNO,_,_,_,HIREDATE,_,COMM,_),dept(_,DNAME,_).

# Example (cont.)

and the results:

Answer

**********

| | | | |
|---|---|---|---|
| 7934 | 565 | 1-jun-1980 | research |
| 7934 | 565 | 1-jun-1980 | sales |
| 7934 | 565 | 1-jun-1980 | operations |
| 7834 | _ | 15-jan-1985 | research |
| 7834 | _ | 15-jan-1985 | sales |
| 7834 | _ | 15-jan-1985 | operations |
| 7782 | _ | 9-jun-1981 | research |
| 7782 | _ | 9-jun-1981 | sales |
| 7782 | _ | 9-jun-1981 | operations |

**********

# A more complicated example

The SQL statement:

SELECT dname,empno,mgr,hiredate, FROM dept,emp, where deptno=20');

generates the rule,

```
equalto(DNAME,EMPNO,MGR,HIREDATE) :-
dept(X,DNAME,_),emp(EMPNO,_,_,MGR,HIRED
    ATE,_,_,X), X = 20.
```

# Results

and the results:

Answer

**********

| | | | |
|---|---|---|---|
| research | 7844 | _ | _ |
| research | 7369 | 7902 | 17-dec-1980 |
| research | 7566 | 7839 | 2-apr-1981 |

**********

# Example - Retrieving Data both from XSB and Oracle

To retrieve the data from both Oracle and XSB, invoke a stored procedure as follows:

```
begin
    Select_From('SELECT empno,colmpos,colmname FROM
  emp,sampletable');
end;
```

Equivalent XSB query generated:

emp(EMPNO,_,_,_,_,_,_,_).

# Results

Answer

**********

| | |
|---|---|
| 7934 | roy |
| 7844 | keeth |
| 7780 | russell |
| 7834 | george |

**********

Oracle Results

**********

| | |
|---|---|
| 1 | col1 |
| 2 | col2 |
| 3 | col3 |
| 4 | col4 |

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# Insertions and deletions

Insertion:

To insert a new row to a table, invoke an instead of trigger as follows:

```
begin
   Insert_into('emp','#empno#ename#job#mgr#
   hiredate#sal#comm#deptno#');
end;
```

# Insertion

The SQL statement,

INSERT INTO emp VALUES(7390,'KIT','CFO',7342,'10-OCT-1960',56344,0,20);

adds a new fact to the database as

emp(7390,kit,cfo,7342,10-oct-60,56344,0,20).

# Deletion

To delete a fact from a table based on a condition:

```
begin
    Delete_from('emp','sal');
end;
```

The SQL statement,
DELETE FROM emp WHERE sal = 1680;

deletes the fact from the emp table.

# Applications

- Many applications - in the fields of biotechnology and genetic research.
- Use - potential replacement to access data, previously stored using legacy systems.
- Limit the scope of queries and potentially improve the speed of their evaluation.

# Sample application scenario

- Presence of two different database systems – provides access to both separately and simultaneously.
- Users and application programmers can access knowledge based systems use SQL.
- Reduces time and effort.

# Challenges

- Translation of SQL queries into prolog queries.
- Retrieval of data without updating it.
- Accessing external C procedures from Oracle.
- Calling XSB from C.
- Returning the results from XSB to Oracle.

# Future Enhancements

- A faster implementation of the interface reducing the data retrieval time.
- Creating a virtual drive and allocating some memory in RAM.
- Using Java external procedures.

# Conclusion

- Completely different from the XSB-Oracle interface.
- Uses a novel approach to access XSB from Oracle.
- Allows the users to retrieve facts(in XSB), from Oracle's environment as though they existed as tables.

# Conclusion (cont.)

- Permits the users to write SQL statements to access data from XSB.
- Does not require the user to be familiar with logic programming.
- Provides a method to perform updates on the logical databases.

# Questions

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