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The Road to a Full Migration of Relational Database (RDB) to Object Relational Database (ORDB): Semantic Enrichment, Target Schema, Data Mapping

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***Abstract*—This document summarizes an approach for migration of RDB to ORDB, the first part explains the semantic enrichment represented as New Data Model NDM which flattened the database in a form enriched through metadata classification, physical schema model object is created with new types, focusing on the aggregation, associations and inheritance, ultimately achieving a migration of data from the RDB to ORDB thanks to selection methods and insert that fits any situation that either internal or external classes or even inheritance.**

Index terms –Database migration, Relational database, Object relational database, Semantic enrichment.

I. INTRODUCTION

A great similarity between RDB and ORDB, this similarity exists because the object relational model encompasses both the relational model and the object model [6]; the object relational model offers several advantages, creating new types, the use of encapsulation, inheritance, and polymorphism [7].

The object relational model is conceived to address the limitations of the relational model [8], not only the addition of the object concept, but also give designers a wide choice for modeling, because they may focus on problems at a high level of abstraction to provide easy solutions to implement [11].

several approaches have been devoted to migration from RDB to ORDB , some approach is based on a data model called semi object types that SOT's role is, in the first phase; the transformation of the relational schema with reverse engineering, the 2nd step is the re-design SOT which is based on the transformation of the SOT to an object-oriented scheme with the use of a Framework , which develops a formal basis for the migration of legacy relational schemas, and the last step is the migration of data[1].

Another approach is based on the passage of the *Unified Modeling Language* to relational object that takes place in 3 stages, analysis, means and implementation, which takes as start element the class diagram, then the diagram extends the stereotypes required for Relational Object, the use of graphical annotation helps the developer to choose which *user*-defined type must be compiled[2].Other approach takes all of the relational database and transformed it in a structured table [3][4][5] which have a lot of parameters to take , tables, attributes, classifications, class types (abstract / concrete), the names of the relationships, class that interacts with the relationship and cardinalities in order to realize the schema Translation [12].

This paper shows the way forward to achieve a complete migration of relational to object relational in an automatic way without the interference of human factors, applying generation algorithms.

The content of this article is organized as follows. Section 2 discusses the semantic enrichment of the RDB, translated as NDM, Section 3 describes the passage of NDM to target schema (the creation of types and tables), and the last section describes the mapping of data to the target schema.

II. SEMANTIC ENRICHMENT: NDM

A. *The New Data Model*

NEW DATA MODEL is a type of table describing the different classes extracted from a RDB with the data necessary for the realization of an ORDB.

NDM is defined as a collection of classes NDM: = {C | C: = (cn, degree, cls, a, contributor)}

- Cn =the name of the class.
- Degree = first degree (the tables that contain PK) | 2nd degree (the tables that contain FK without PK).
- Cls=aggregation, association, inheritance, simple class (the class that does not belong to the other classifications).
- Contributor=class list.
- A=attribute:={a | a := (an, t, tag, l, n, d)} (An :name of the attribute, T:type of the attribute, Tag: primary key(PK) | foreign key(FK),L: length of the attribute, N:if the attribute takes the parameter null, D:the default value of the attribute)

The translation of the RDB to the NDM is the first step of the migration into the ORDB.

Consider that the RDB includes: The PKs are underlined in bold **ex,**The FKs are underlined ex

kids

kno	kname	sexe	pno
34	badr	m	d543
23	sarah	f	d543
21	jeff	m	g234

proj

prno	pname	description
1	Payment Management	integration of a module in an erp open source
2	tramway casa	realization of management complette Tramway casa

works_on

pno	prno
d543	1
f552	2
e234	1

employ

pno	salary	grade
d543	9000	engineer
g234	12000	director
f552	7000	commercial

trainee

pno	level	type
e234	master	hiring

dept

dno	dname
1	computer
2	commercial
3	after-sales service

person

pno	pname	bdate	adress	dno	pnosup
d543	alae	15/03/1987	residence ibn sina appt 3	1	g234
e234	fouad	03/01/1987	rayhan imm 4 appt 5	2	d543
g234	azar	24/04/1984	lotissemnt 34 rue des far appt 6	1	null
f552	jean	28/05/1975	rue la fayette residence bmo imm majid appt 9	3	d543

Figure 1. The tables representing the relational database

B. Algorithm of Generation

1st Fragment flowchart dedicated to the heritage

+ inkKey to increment the primary key.

+ tInherits for the specified table that contains the maximum possibility for the use cases of the Heritage.

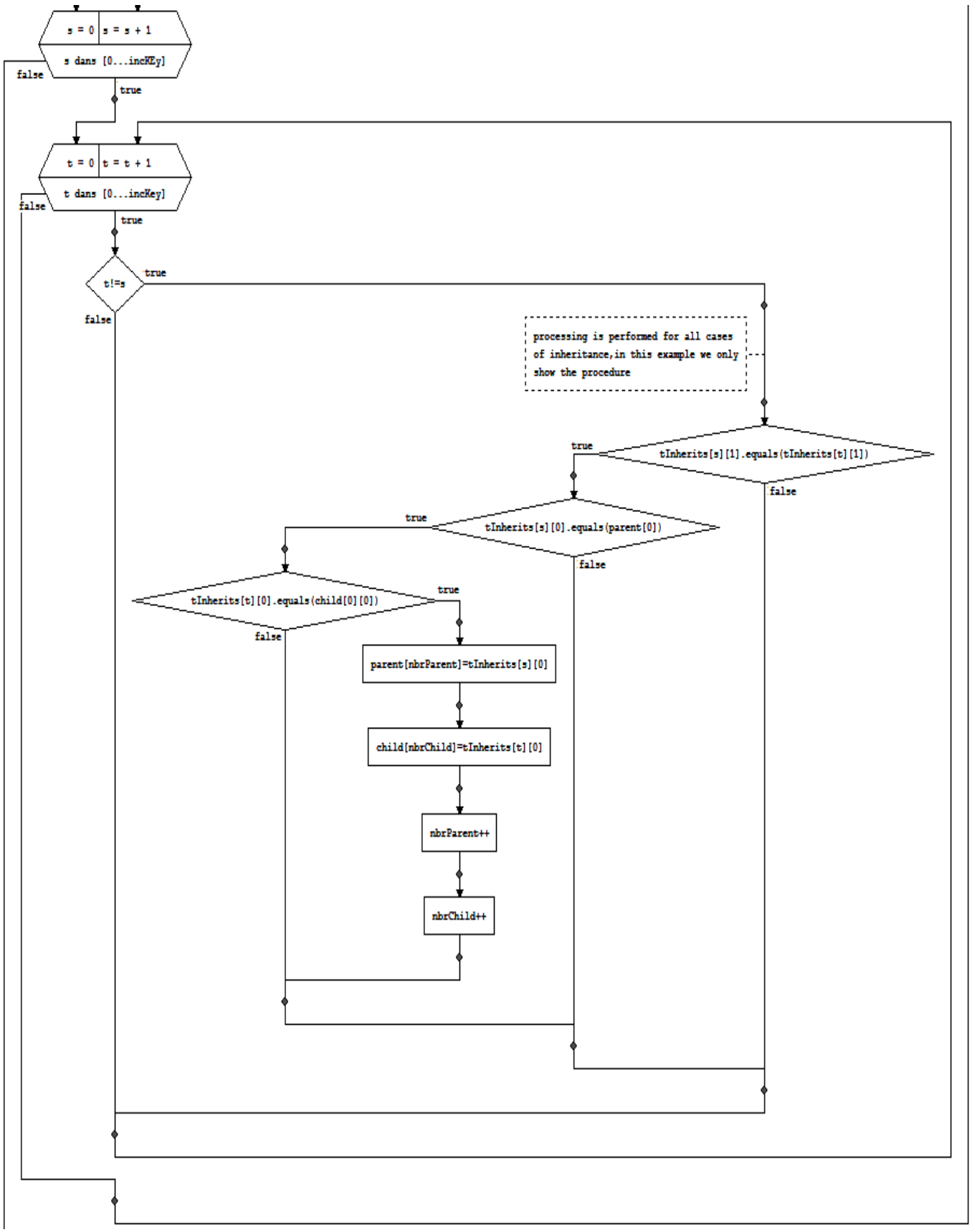

Figure 2. First figure representing how to obtain inheritance

2nd Fragment flowchart dedicated to the heritage

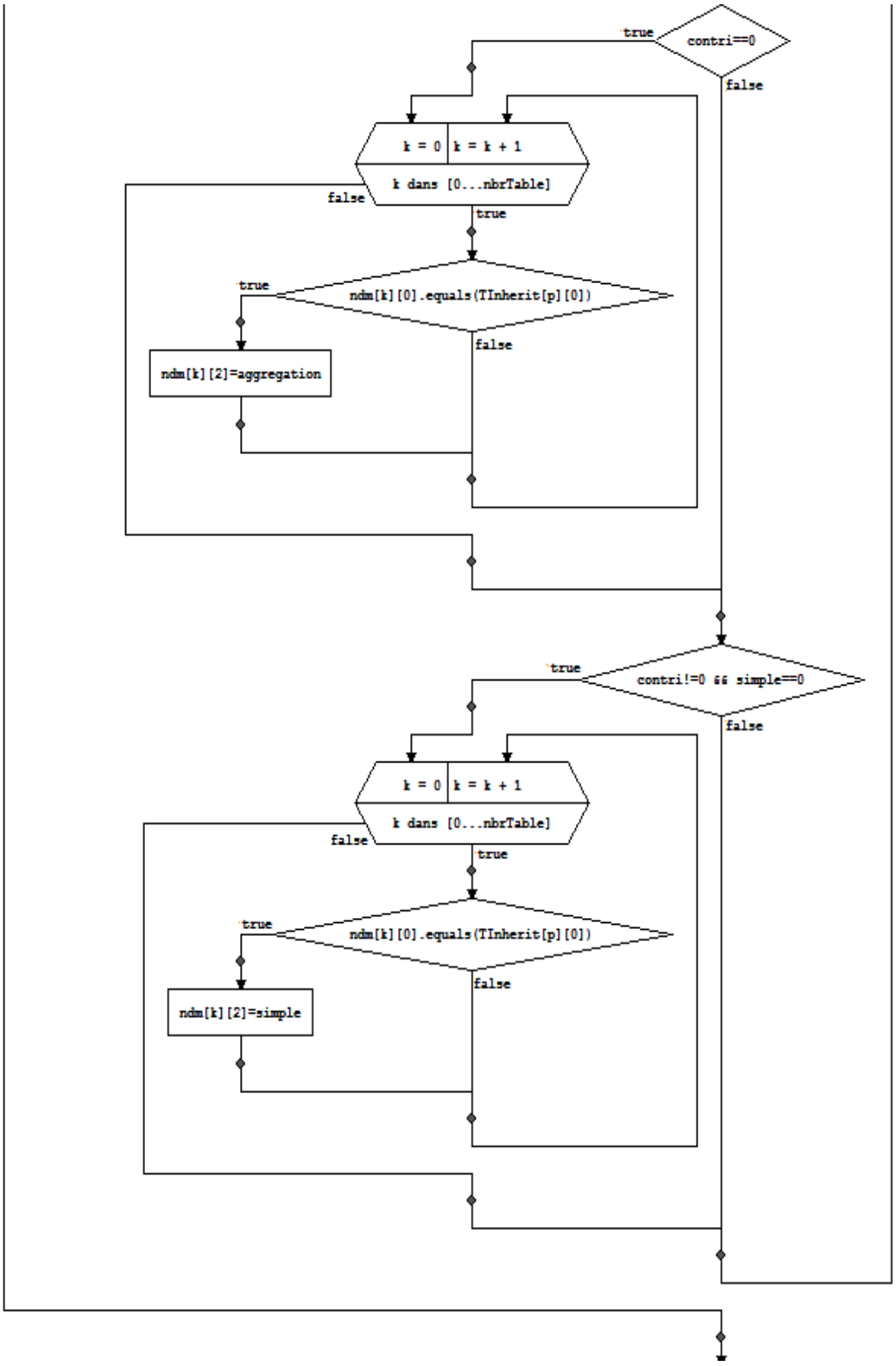

Figure 3. Second figure representing how to obtain inheritance

table 1.The Representation of the NDM Obtained

Cn	Degré	Classification	Attribut						Contributor
			An	Type	tag	l	N	D	
Person	1er	inherBy	Pno	Varchar	PK		N		Kids
									Works_on
									Trainee
									Employ
			Pname	Varchar			N		
			Bdate	Date			N		
			Adress	Varchar		255	N		
			Dno	Int	FK		N		Dept
			PnoSup	Varchar	FK		Y		Person
Trainee	2eme	Inherts	Pno	Varchar	FK		N		Person
			Level	Varchar			N		
			Type	Varchar			N		
Employ	2eme	Inherts	Pno	Varchar	FK		N		Person
			Salary	Int			Y		
			Grade	Varchar			N		
Works_on	2eme	Association	Prno	Int	FK		N		Proj
			Pno	Varchar	FK		N		Person
Dept	1er	Simple	Dno	Int	PK		N		Person
			Dname	Varchar			N		
Proj	1er	Simple	Prno	Int	PK		N		Work_on
			Prname	Varchar			N		
			Description	Varchar		255	Y		
Kids	1er	Aggregation	Kno	Int	PK		N		
			Kname	Varchar			N		
			Sex	Char			N		
			Pno	Varchar	FK		N		Person

III. SCHEMA TRANSLATION: THE WAY TO SUCCEED

A. Translation Process

From the NDM we developed an algorithm which will realize the transformation of the relational Schema to the object relational Schema, respecting the standard sql3, and that in accordance with the classification derived from the NDM and for each classification we create an Oracle User-Defined Types (UDTs), internal or external UDTs.

In the object-relational schema, we have the possibility to define new complex types, simple or structured with manipulation functions, columns may contain collections, and lines can be considered as objects and the use of references to the removal of joints.

B. Syntax

- CREATE [OR REPLACE] TYPE nameRDB3_Type AS OBJECT

(column1 type1, column2 type2,ref_nameRDB2 REF nameRDB2_type,...)

To persist data type, they must be stored in tables, the tables can be created as in the SQL standard, or from our types, tables can support multiple inheritance (DBMS that supports inheritance multiple, in our study since oracle 11g)

- CREATE TABLE [schema.]nameTable OF [schema.] nameType

[(column [DEFAULT expression]
[constraintOnLine [constraintOnLine]...
| constraintREFOnLine]
| { constraintOffline | constraintREFOffline }
[,column...])]
;

Flowchart for the creation of type aggregation

+ contri The number of contributor which is situated in the NDM

+tabAtt the table which contains the list of the attributes extracted from the RDB

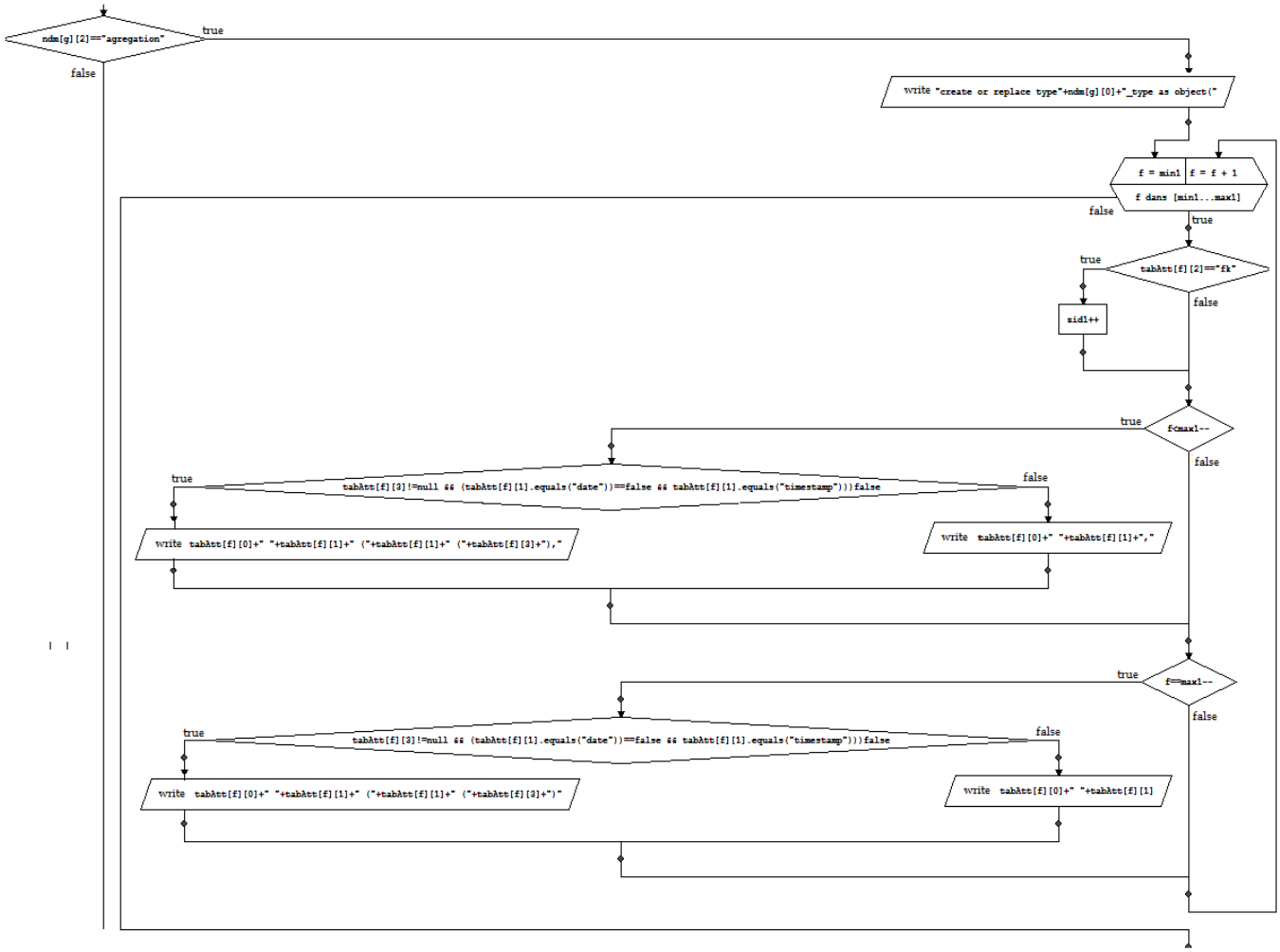

Figure 4. Figure representing the creation of aggregation

VI. DATA MAPPING: PROCEDURE PROCESSING

The data mapping is the last stage of the migration of a RDB towards an ORDB, which has for role the transformation of the data contained in a databases in object, a table in a list of object, a list of a table in an object, a field of database in an attribute of object, a value of a fields in a value of attribute of an object.

The mapping is based on the design pattern DAO that queries the DBMS, and the correspondence between the table fields in the database and the attributes of objects is made in an automatic way, having as starting point the NDM [13].

A. Data Selection

Data migration begins with the selection of data, with a selection method that iterates all the classes

of the NDM and stocks as a table A_i $\{A_i / 0 \leq i \leq l\}$ defined by, For all $0 \leq i \leq n$, A_i :{ $a_{k,j}$ / $0 \leq k \leq n$ / $0 \leq j \leq m$}.

Pseudo code of the selection method:

```
INITIALIZE {req="select *from "+tableName}
INITIALIZE {sql=database.createStatement()}
INITIALIZE {rs=sql.executeQuery(req)}
INITIALIZE {rsm=rs.getMetaData()}
INITIALIZE {columns=rsm.getColumnCount()}
INITIALIZE {rs.last()}
INITIALIZE {rows=rs.getRow()+1}
INITIALIZE {data= String [rows][columns]}
FOR {i} = {1} UP TO {columns} DO
   {data[0][i-1]=rsm.getColumnName(i)}
ENDFOR
INITIALIZE {rs.beforeFirst()}
INITIALIZE {row=1}

WHILE {rs.next()} DO
   {
      FOR {i} = {1} UP TO {columns} DO
       {data[0][i-1]=rs.getString(i)}
      ENDFOR
      INITIALIZE {row=row+1}
   }
ENDWHILE
PRINT {data}
```

B. Transformation and Insertion

The mapping continues by a treatment on the various classify extracted from the RDB, by formatting the data extracted by the algorithm of selection[9], by making the correspondence enter our object and the new classes of our ORDB, and realizing a hierarchical insertion, and instantiate our classes by calling the constructor.

The insert query in combination with the JAVA language [10] is as follows:

```
public int insertO(String tableName,String values[]) {
    StringBuffer req = new StringBuffer("INSERT INTO " +
tableName + " VALUES('" + values[0] + "'");
    for (int i = 1; i < values.length; i++) {
          req.append(", '" + values[i] + "'");
    }
  req.append(")");
  try {
  int type = ResultSet.TYPE_SCROLL_INSENSITIVE;
  int mode = ResultSet.CONCUR_UPDATABLE;
  Statement sql=db.createStatement(type,mode);
  return sql.executeUpdate(req.toString());
  }
  catch (Exception e) {
  e.printStackTrace();
  return -1;
  }
```

Schema mapping: mapping begins by retrieving data, a method must be created to retrieve data that take a parameter, the name of the extracted class NDM based on the data model Object Access DAO, which makes the link between the access layer data and application business layer.

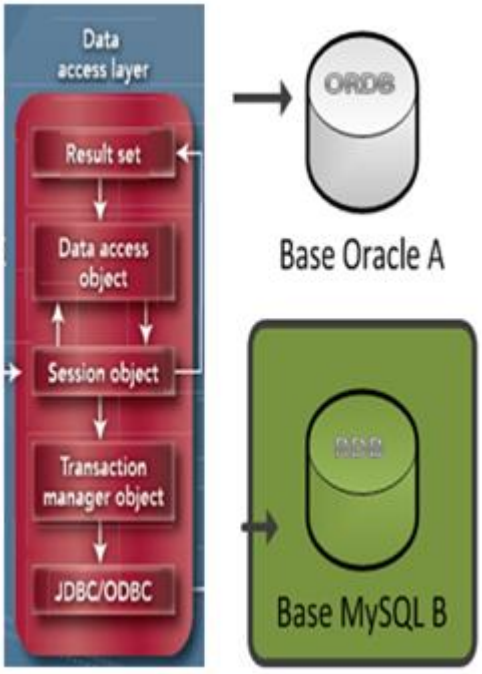

Figure 5. Figure representing data mapping from RDBMSs to ORDBMSs

VI. CONCLUSION

This article shows the steps for a complete migration of RDB to ORDB, starting first by the semantic enrichment, with different mechanism of object concept which is extracted, including inheritance, then the enchainment of conversion to a relational schema to object-relational schema, while letting a choice to the user make modifications because the prototype is realized with an IDE based on JAVA. The last step of the migration is the data mapping.

All stages of the migration is done in an automatic way without the interference of human factors, a prototype is already created which proves the effectiveness of this approach , we are going to propose methods for the migration of the procedures and the transactions for which adapts itself to the new database in a new article.

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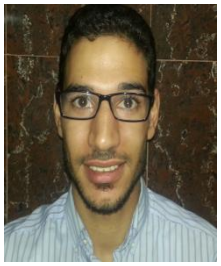

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