




**trivadis**



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## **DB2 UDB for Oracle DBA's**

The other side of the fence.



# Agenda

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## **A. Introduction**

B. Architecture

C. Installation

D. Tools

E. DB structure

F. Literature



# DB2 – Introduction

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- Goal of the presentation : gives an Overview of IBM DB2 to Oracle DBAs
- No DB2 know how required to understand this presentation
- Not a DB2 technocircle, not yet 😊, just an overview of the main features
- When possible comparison has been done with Oracle concepts
- Give an overview of the DB2 tools and distributions



# DB2 – Test environment

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- DB2 7.2 has been installed on Linux and W2K
- Linux Suse 7.2 kernel 2.4.4
- Hardware : PII 400Mhz / 256 MB and K6 2 500Mhz 92 MB
- For DB2 version 7.1 Pentium 233 MMX with 96 MB RAM works also
- Of course for huge productive systems an adapted server has to be configured



# DB2 – Presentation layout

- DB2 architecture
  - DB2 Products
  - DB2 process architecture
  - DB2 memory architecture
  - DB2 Instance/database concept
  - SQLs/PLSQL
  
- Installation
  
- Tools
  
- DB2 structure
  - Tablespace
  - Tables
  - Backup recovery
  - Tuning
  
- Literature



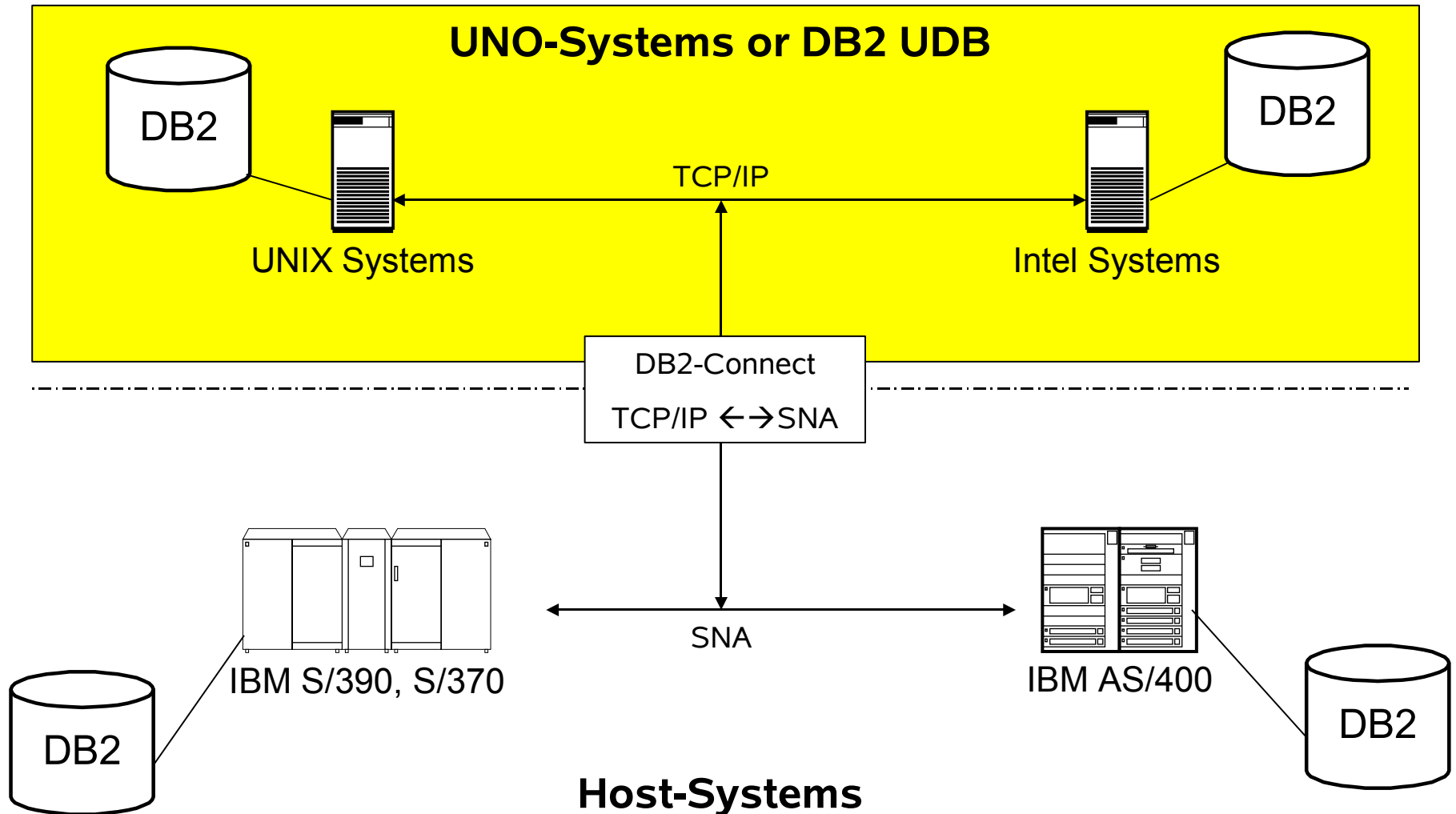
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- F. Literature

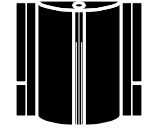


# Terms / DB2 products



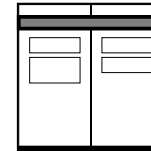


**Enterprise Extended Edition  
(EEE)**



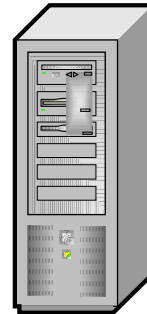
Cluster / MPP

**Enterprise Edition (EE)**



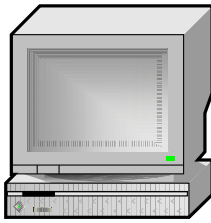
Company Server

**Workgroup Edition (WGE)**



Server

**Personal Edition  
(PE)**



Desktop PC

**Satellite Edition  
(SE)**

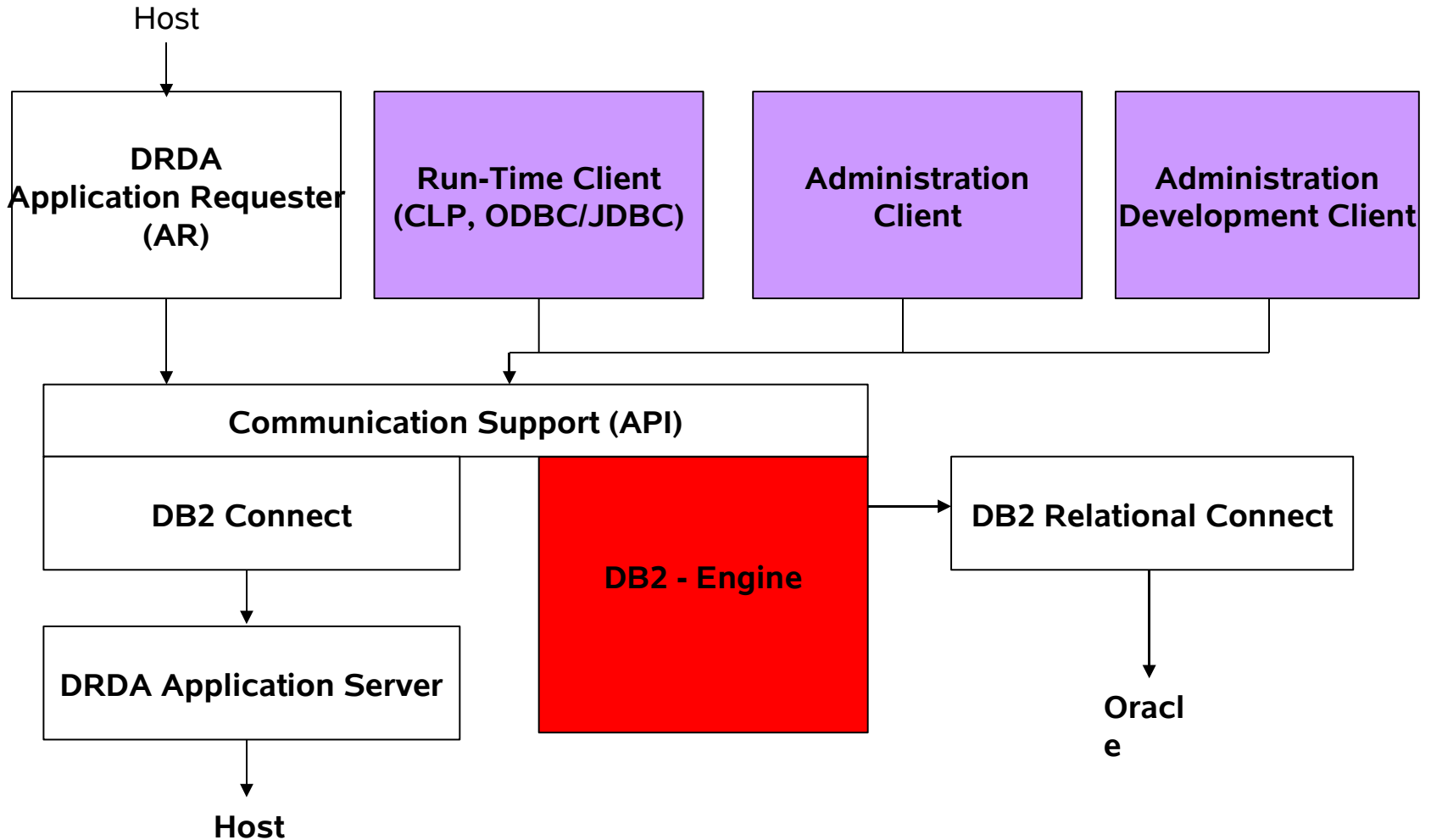


Laptop



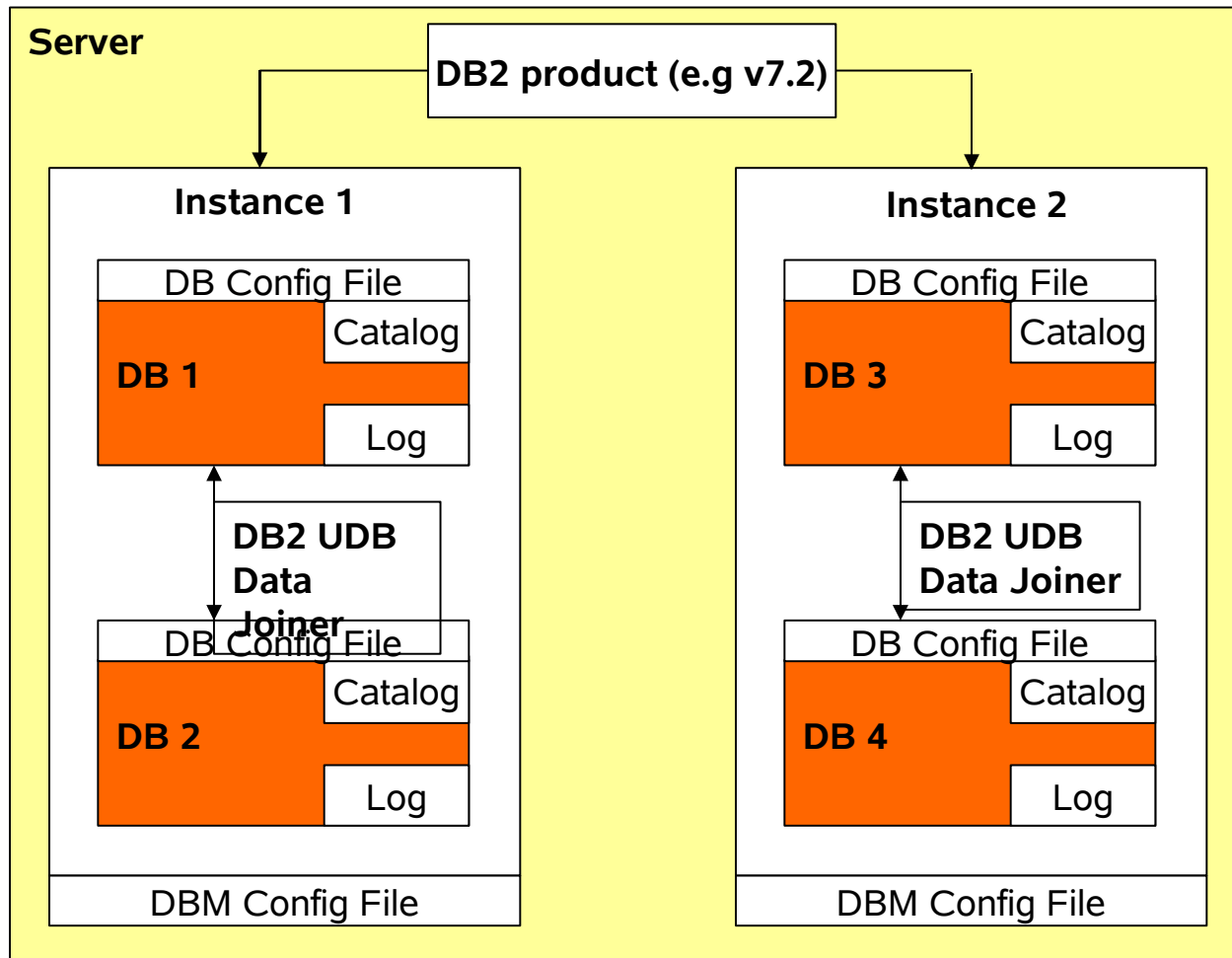


# Components of DB2 UDB



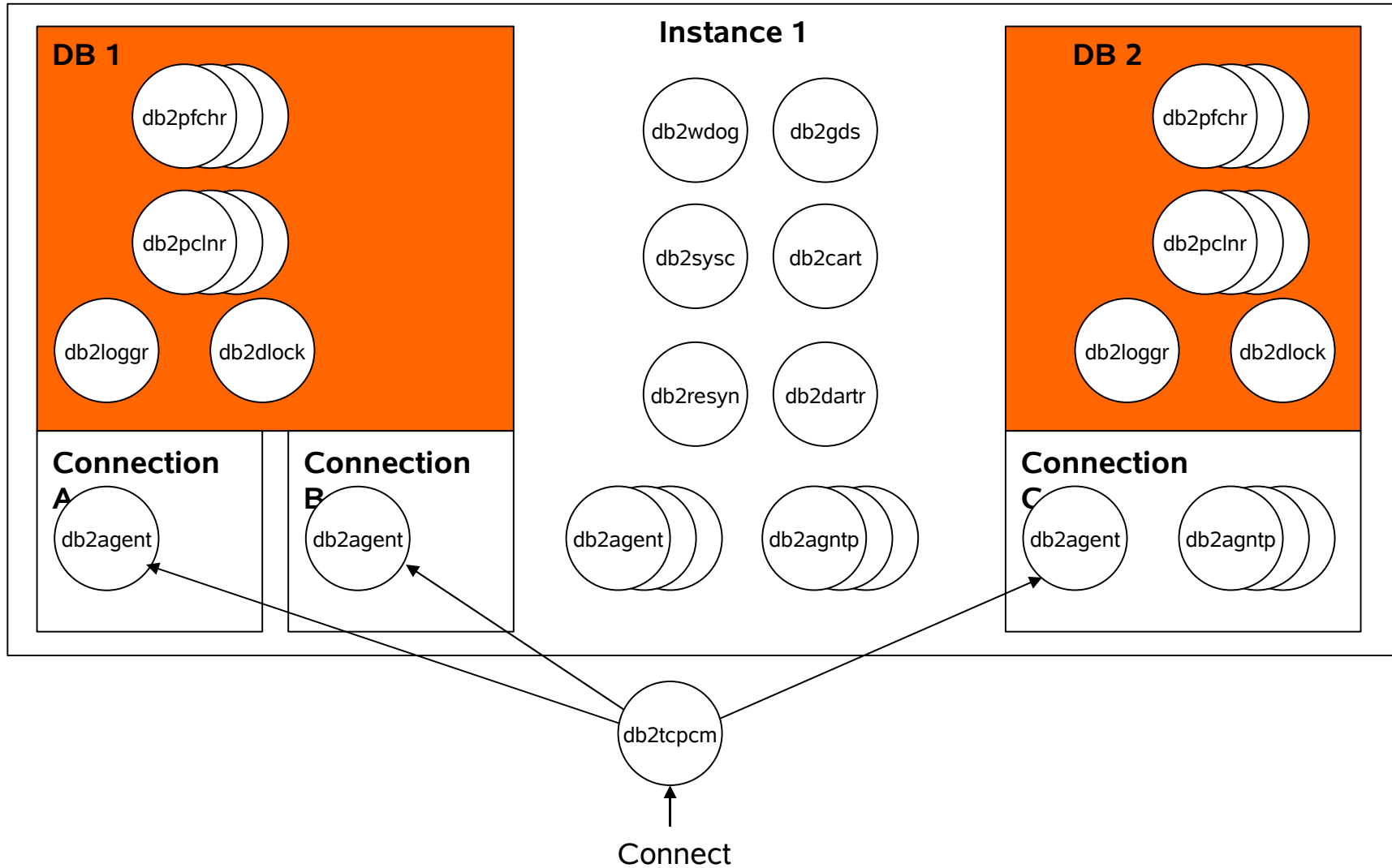


# Instance Concept





# Processes model





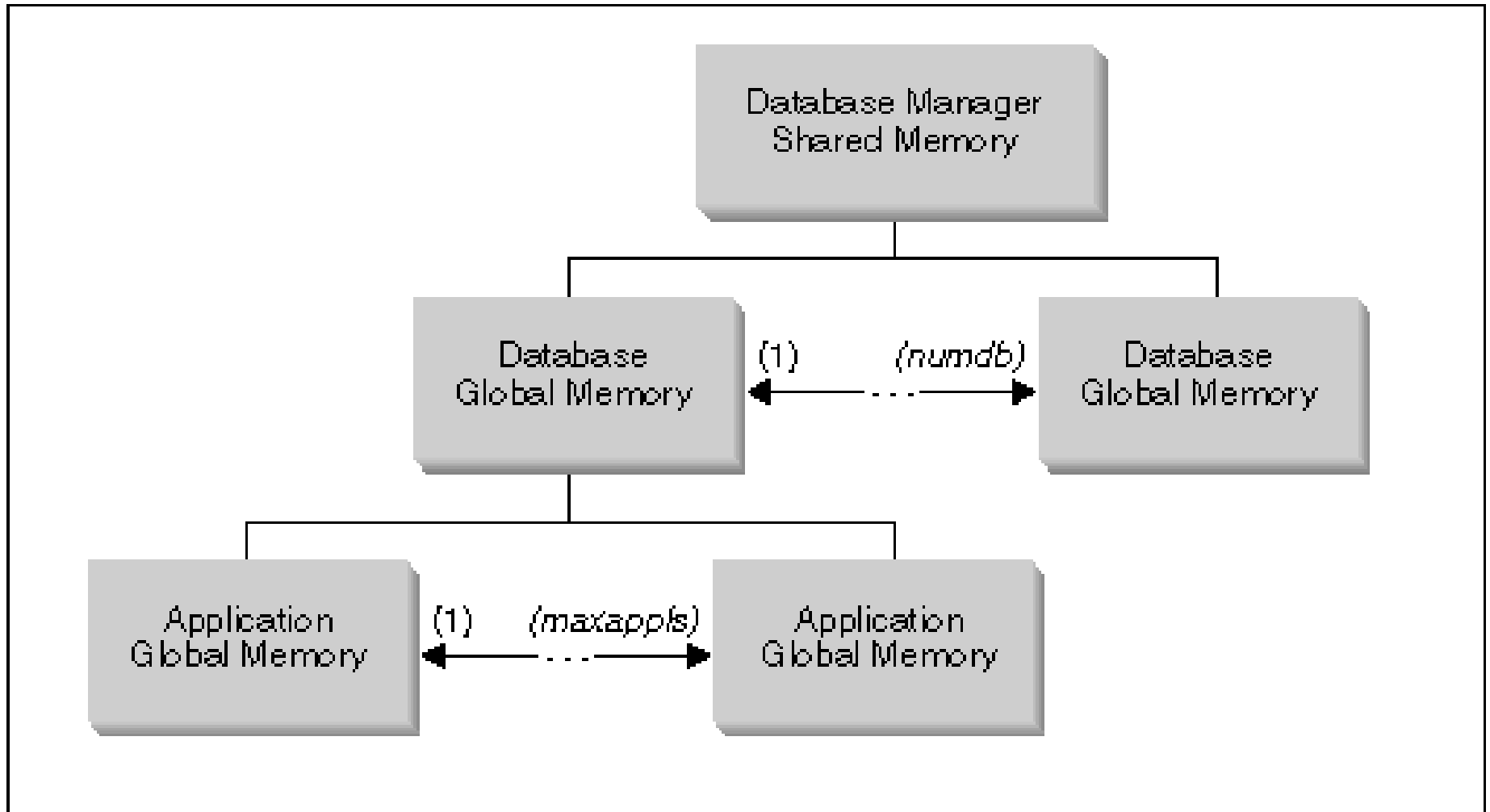
# Processes on NT

The screenshot shows the Windows Services console window. The title bar reads 'Services'. Below the title bar is a menu bar with 'Action' and 'View', and a toolbar with various icons. The main area is a table with columns: Name, Description, Status, Startup ..., and Log On As. The 'Tree' pane on the left shows 'Services (Local)'. The table lists various services, including Application Management, DB2 services, and DefWatch.

Name	Description	Status	Startup ...	Log On As
Application Management	Provides software installation ser...	Started	Manual	LocalSystem
Ati HotKey Poller		Started	Automatic	LocalSystem
ClipBook	Supports ClipBook Viewer, which a...		Manual	LocalSystem
COM+ Event System	Provides automatic distribution of ...	Started	Manual	LocalSystem
Computer Browser	Maintains an up-to-date list of co...	Started	Automatic	LocalSystem
DB2 - DB2		Started	Automatic	.\db2admin
DB2 - DB2CTLSV		Started	Automatic	.\db2admin
DB2 - DB2DA500		Started	Automatic	.\db2admin
DB2 Governor			Manual	.\db2admin
DB2 JDBC Applet Server		Started	Automatic	LocalSystem
DB2 JDBC Applet Server - Control Center			Manual	.\db2admin
DB2 License Server		Started	Automatic	LocalSystem
DB2 Security Server		Started	Automatic	LocalSystem
DefWatch		Started	Automatic	LocalSystem
DHCP Client	Manages network configuration b...	Started	Automatic	LocalSystem
Distributed Link Tracking Client	Sends notifications of files moving...	Started	Automatic	LocalSystem
Distributed Transaction Coordinator	Coordinates transactions that are...		Manual	LocalSystem
DNS Client	Resolves and caches Domain Nam...	Started	Automatic	LocalSystem
Event Log	Logs event messages issued by pr...	Started	Automatic	LocalSystem
Fax Service	Helps you send and receive faxes		Manual	LocalSystem

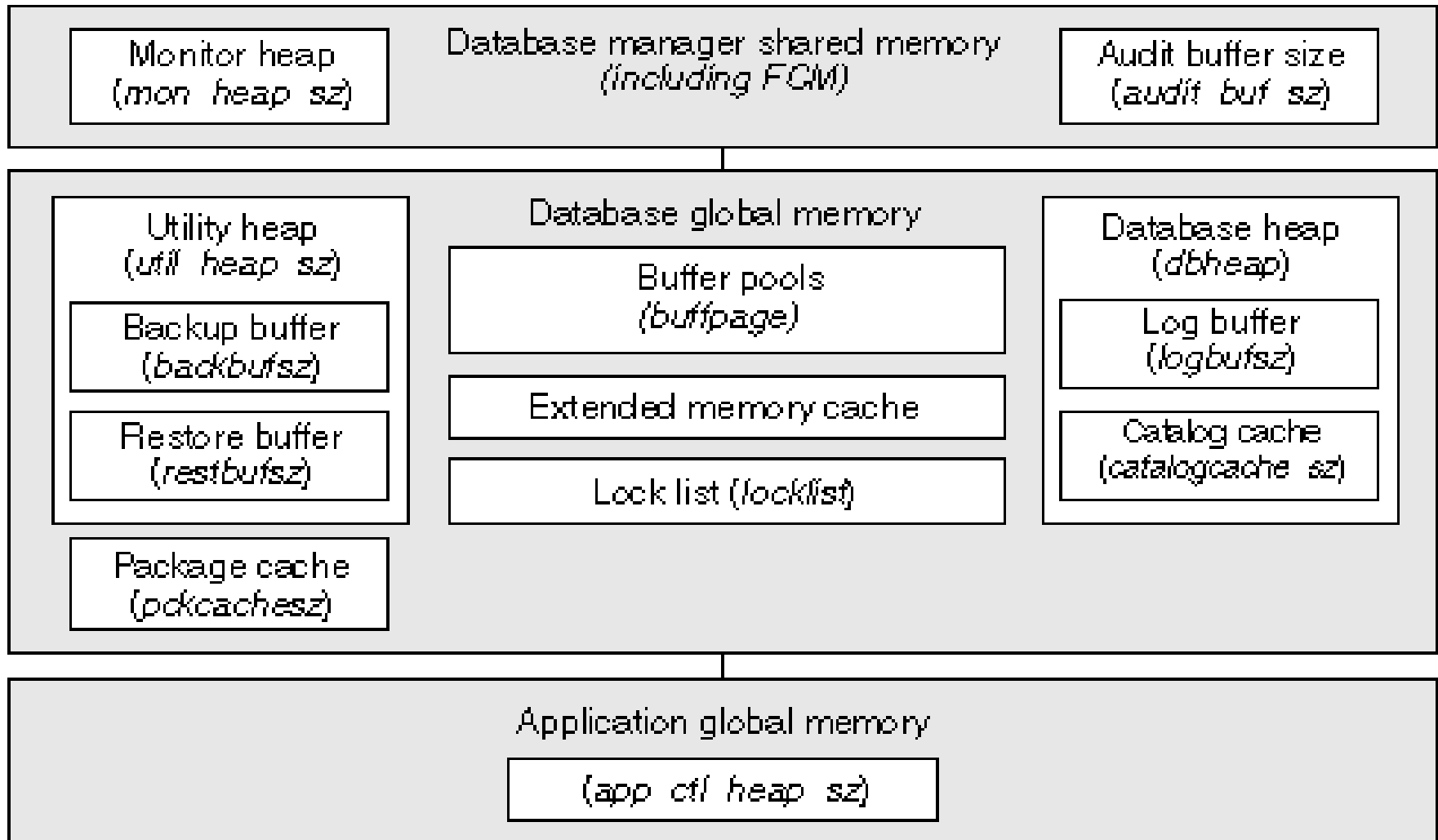


# Memory model I



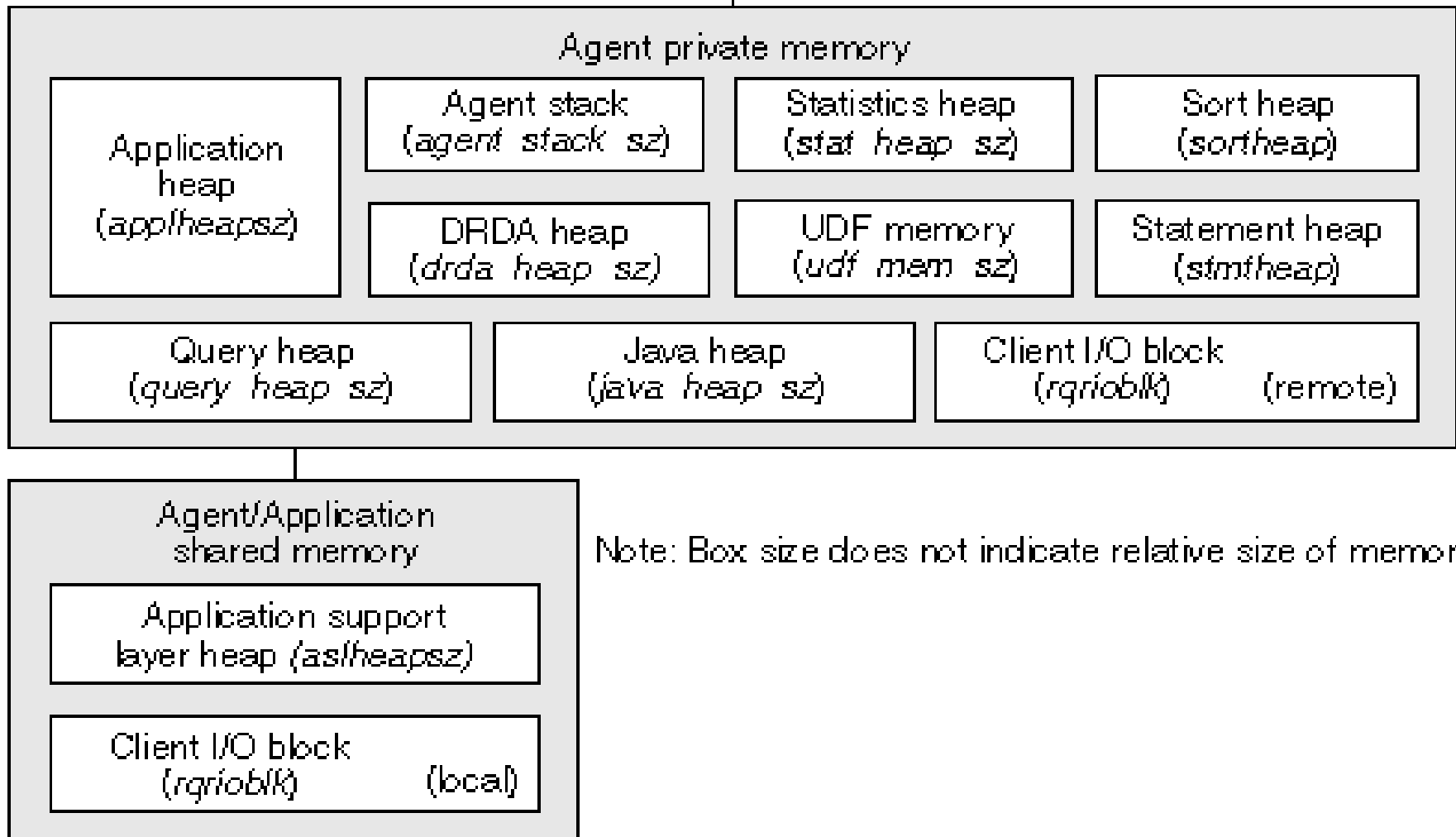


# Memory model II





# Memory model III





# Programming

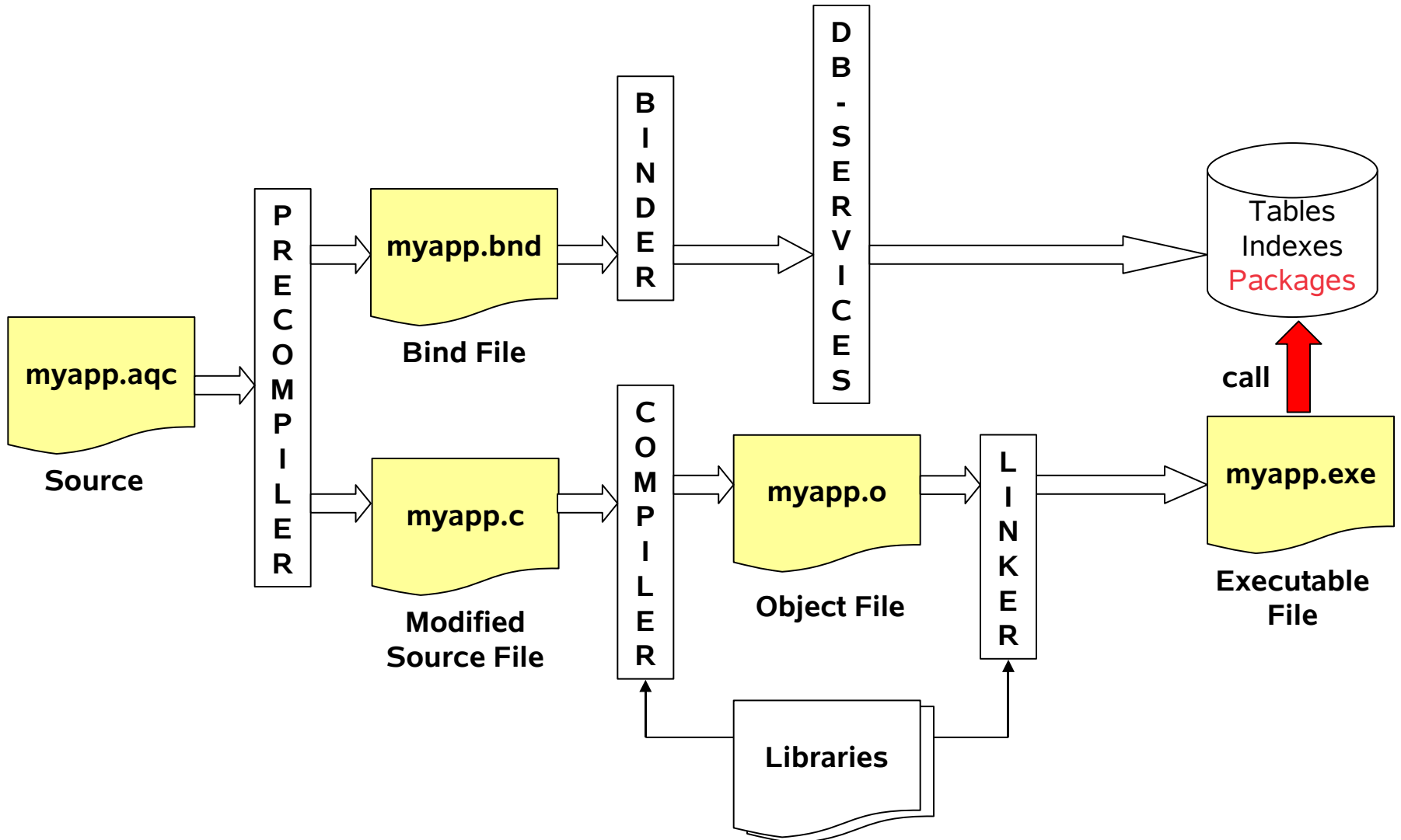
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- Client-Server
- Dynamic and static SQL
- Programming languages (C, C++, Java, etc.)
- Embedded SQL
- PL/SQL (ORA) → SQL PL (UDB)





# Embedded SQL





# SQL Procedure Language I

- SQL PL is for PORTING, not native!

SQL PL (UDB)	PL/SQL (ORA)
BEGIN	DECLARE
<b>DECLARE</b> variablea datatype1;	rowtype table1%ROWTYPE;
<b>DECLARE</b> variableb datatype2;	Variable9 datatype9 := value9;
<del><b>DECLARE</b> variable9 datatype9 DEFAULT value9;</del>	BEGIN
<del><b>WHILE</b>-Construct</del>	FOR-Loop
SELECT a,b INTO variablea, variableb	SELECT * INTO rowtype1 FROM table1
FROM table1 WHERE c = xxxx;	WHERE c = xxxx;
END;	END;



# SQL Procedure Language II

SQL PL (UDB)	PL/SQL (ORA)
<pre>FOR my_loop AS   SELECT a,b FROM table1   WHERE b=yyyy DO</pre>	<pre>DECLARE CURSOR mycursor IS   SELECT a,b FROM table1 WHERE b=yyyy; BEGIN</pre>
<pre>BEGIN ATOMIC DECLARE myerr CONDITION FOR SQLSTATE ,99999'; DECALRE UNDO HANDLER FOR NOT FOUND;</pre>	<pre>FOR table1_rec IN mycursor LOOP ..... EXCEPTION WHEN NO_DATA_FOUND THEN</pre>
<pre>DECLARE UNDO HANDLER FOR SQLEXCEPTION; ... END; IF condition</pre>	<pre>ROLLBACK; WHEN OTHERS THEN ROLLBACK; END;</pre>

SIGNAL myerror SET MESSAGE\_TEXT = 'Error'



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# Supported platforms UDB v7.2

OS	SE	PE	WGE	EE	EEE
OS/2		X	X	X	
Windows 95	X	X			
Windows 98	X	X			
Windows XP		X	X	X	
Windows NT	X	X	X	X	X
Windows 2000		X	X	X	
AIX			X	X	X
HP-UX			X	X	X
Linux		X	X	X	X
NUMA-Q				X	X
Solaris			X	X	X

Lit: <http://www-3.ibm.com/software/data/db2/udb/edition-eee.html>



# Requirements

- CD (90 days Trial)



[CD-Bestellungen](#)

[CD-Verwaltung \(nur mit Passwort\)](#)

[Anleitung / Documentation](#)

- On CD 300 MB (Linux), 500 MB (Windows)
- On Disk 500 MB should be enough (incl. sample DB)
- > 128 MB RAM recommended
- root/Admin account
- OS-Requirements



Devider

Devider

Devider

# Required OS-User/DB User

```
> cat /etc/passwd | grep db2
```

```
db2fenc1:x:46:46:DB2 Instance UDF user:/usr/lib/db2/db2fenc1:/bin/bash  
db2inst1:x:47:47:DB2 Instance main user:/usr/lib/db2/db2inst1:/bin/bash  
db2as:x:48:48:DB2 Administration:/usr/lib/db2/db2as:/bin/bash  
  
db2inst2:x:501:102: DB2 Instance main user:/home/db2inst2:/bin/bash
```

```
> cat /etc/group | grep db2
```

```
db2fadm1:x:46:  
db2iadm1:x:47:db2as  
db2asgrp:x:48:db2inst1,db2inst2  
db2iadm2:x:102:db2as
```

■ These users are OS authenticated!



# „IFA“ → OFA?

## ■ Basically 2 different types of paths

- a) Binaries
- b) DB files

## ■ Binaries

- /usr/IBMd2/V7.2/...
- C:\Program Files\SQLLIB/...

## ■ Linked (UNIX only)

/home/db2inst1/sqllib/bin -> /usr/IBMd2/V7.2/bin

## ■ DB files

/specified\_path/\${DB2INSTANCE}/NODEnnnn/SQL00001

C:\<DB2INSTANCE>\<NODEnnnn>\<SQL00001>





Devider

Devider

Devider

# File structure

```
C:\DB2INST1\NODE0000\SQL00001\SQLOGDIR\Snnnnnnn.LOG
    \SQLT0000.0\SQL00001.DAT
        \SQL00001.INX
            .LB
            .LBA
            .LF
        \SQLTAG.NAM
    \db2rhist.asc
    \db2rhist.bak
    \SQLBP.1
    \SQLBP.2
    \SQLDBCON
    \SQLOGCTL.LFH
    \SQLSPCS.1
    \SQLSPCS.2
```



# Environment variables / DB2 variable values

**Environment Variables**

```
export var=...
```

```
DB2INSTANCE (${ORACLE_SID})
```

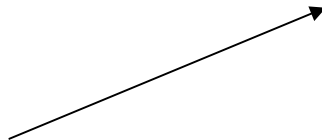
```
DB2DIR (${ORACLE_HOME})
```

```
INSTHOME (${ORACLE_BASE} / ${HOME})
```

**Instance-Level  
Registry Profile**

**db2set (without reboot)**

**Global-Level  
Registry Profile**





# Installation snap shots (Linux) as root I

```
Konsole
File Sessions Options Help

vsrvec50:/u00/tmp/040_EE_LNX_NLV # ./db2_install

Specify one or more of the following keywords, \nseparated by spaces, to install DB2 pr
oducts.\n

DB2.ENTP - DB2 UDB Enterprise Edition
DB2.CENT - DB2 UDB Connect Enterprise Edition
DB2.SDK - Application Development Client
DB2.CAE - Administration Client
Enter "help" to redisplay product names, enter "quit" to exit.
*****
DB2.ENTP
█
```



# Installation snap shots (Linux) as root II

```
Konsole
File Sessions Options Help

----- DB2 Setup Utility -----

Select Install to select products and their components to install, or
select Create to create the DB2 services.

To select products and their components, select                [ Install... ]
Install.

To create a DB2 Instance, an Administration Server,           [ Create... ]
or a Data Links Manager Administrator select Create.

[ Close ]                                                    [ Help ]
```



# Installation snap shots (Linux) as root III

```
Konsole
File Sessions Options Help

----- Create DB2 Services -----
Select the items you want to create, and select OK when finished.

A DB2 Instance is an environment where you store data and run
applications. An instance can contain multiple databases.

( ) Create a DB2 Instance.           : Customize... :
(*) Do not create a DB2 Instance.

An Administration Server provides services to support client tools that
automate the configuration of connections to DB2 databases.

: : Create the Administration Server.       : Customize... :
:*: Do not create the Administration Server.

[ OK ]           [ Cancel ]           [ Help ]
```



# Installation snap shots (Linux) as root IV

```
Konsole
File Sessions Options Help

----- Create DB2 Services -----
|+-- DB2 Instance -----+
||
|| Authentication:
||   Enter User ID, Group ID, Home Directory and Password that will be
||   used for the DB2 Instance.
||
||   User Name          [db2inst3]
||   User ID            :          :          [*] Use default UID
||   Group Name        [db2iadm3]
||   Group ID          :          :          [*] Use default GID
||   Home Directory    [<pp/db2/db2inst3]
||   Password          [          ]
||   Verify Password   [          ]
||
|| Select Properties to view or change more options.          [ Properties... ]
||
|| Select Default to restore all default settings.            [ Default ]
||
|| [ OK ]              [ Cancel ]              [ Help ]
|+-----+
|-----+
|-----+
```



# Installation snap shots (Linux) as root V

```
Konsole
File Sessions Options Help

----- DB2 Setup Utility -----
+-----+
| Status Report |
|                                     | [ More... ] |
+-----+
| DB2 Services Creation |
| ----- |
| DB2 Instance |
| Create new group name | SUCCESS |
| Create new user name | SUCCESS |
| Set password for new user | SUCCESS |
| DB2 Instance Creation | SUCCESS |
| Create new entry in /etc/services | SUCCESS |
| Update DBM configuration file for TCP/IP | SUCCESS |
| Auto start DB2 Instance | SUCCESS |
| Start DB2 Instance | SUCCESS |
+-----+
| [ View Log ] |
|                                     | [ OK ] |
+-----+
```



# Installation snap shots (Linux) as db2inst3 VI

```
Konsole
File Sessions Options Help
db2inst3@vsrvec50:~ > . ./sqllib/db2profile
db2inst3@vsrvec50:~ > db2sampl
db2inst3@vsrvec50:~ > db2ilist
db2inst1
db2inst2
db2inst3
db2inst3@vsrvec50:~ > db2 list database directory | grep "atabase name"
Database name           = SAMPLE
db2inst3@vsrvec50:~ > echo $DB2INSTANCE
db2inst3
db2inst3@vsrvec50:~ > export JAVA_HOME="/usr/lib/jdk1.1.8"
db2inst3@vsrvec50:~ > db2jstrt 6799
Licensed Materials -- Property of IBM
(c) Copyright International Business Machines Corporation, 1996, 2000.
    All Rights Reserved.

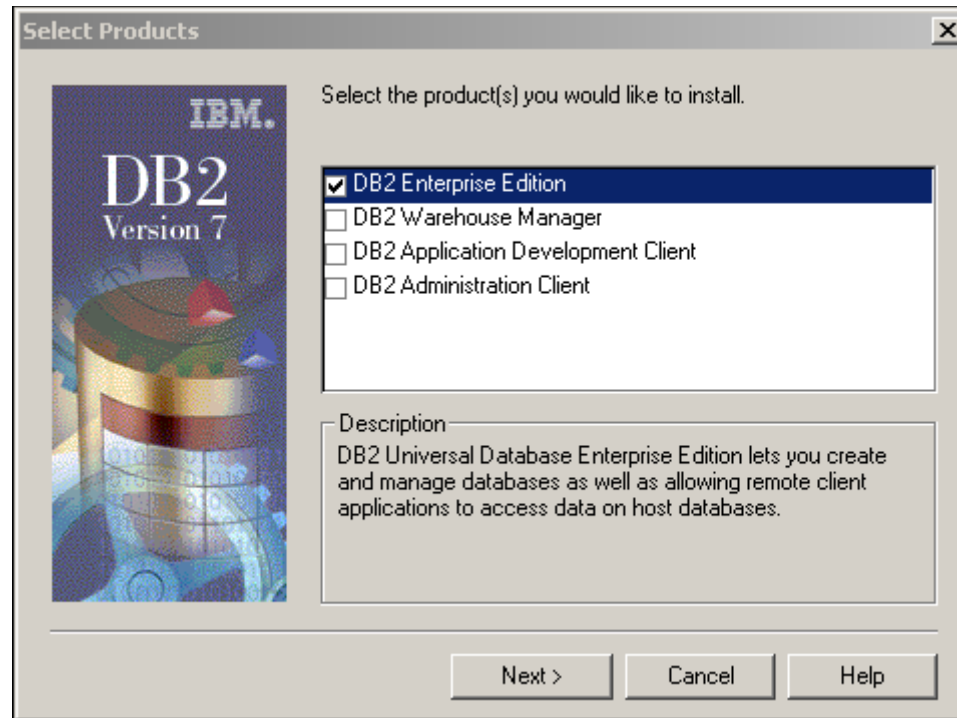
db2inst3@vsrvec50:~ > db2cc 6799 &
[1] 4519
db2inst3@vsrvec50:~ > █
```





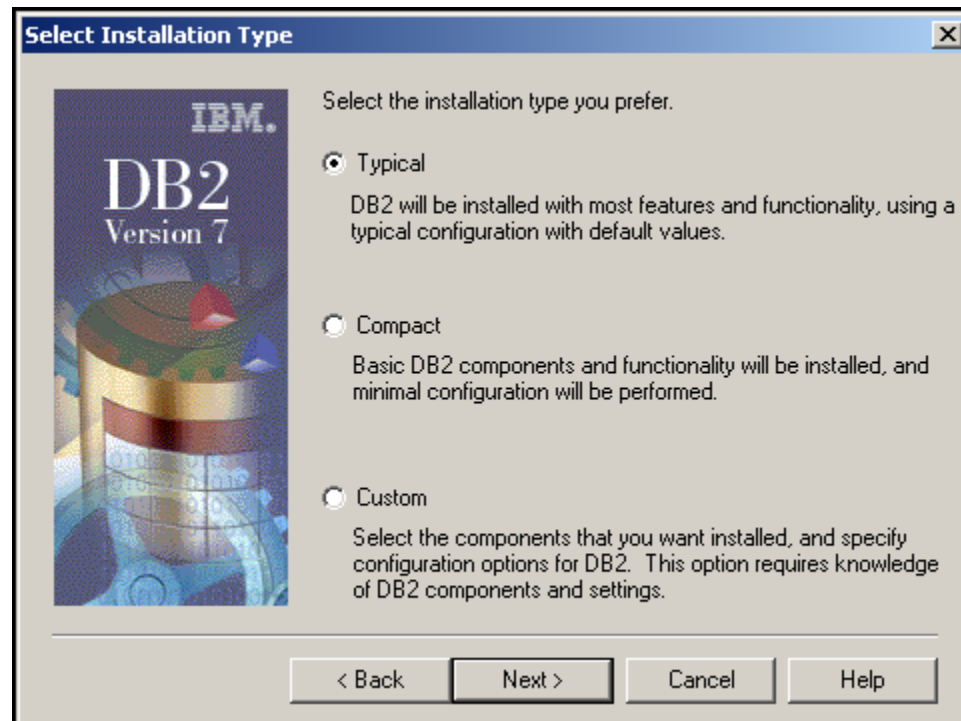
# Installation snap shots (NT) I

- Unzip CD
- Start setup.exe





# Installation snap shots (NT) II





# Installation snap shots (NT) III

Enter Username and Password for the Default Instance

IBM.  
DB2  
Version 7

Enter the username and password that the Default instance will use to log on to your system.

Username

Password

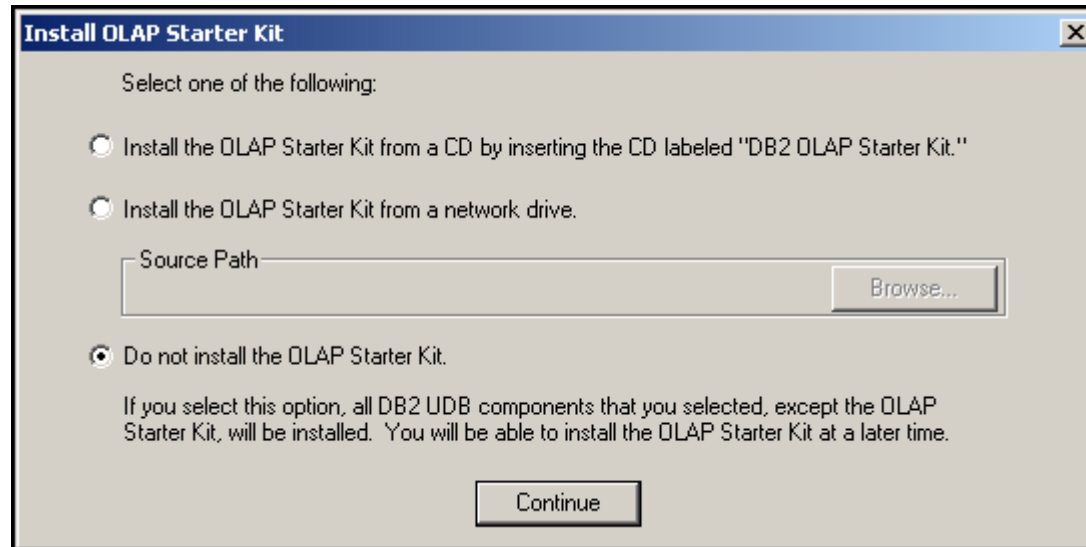
Confirm password

Use the same values for the remaining DB2 Username and Password settings

< Back   Next >   Cancel   Help



# Installation snap shots (NT) IV

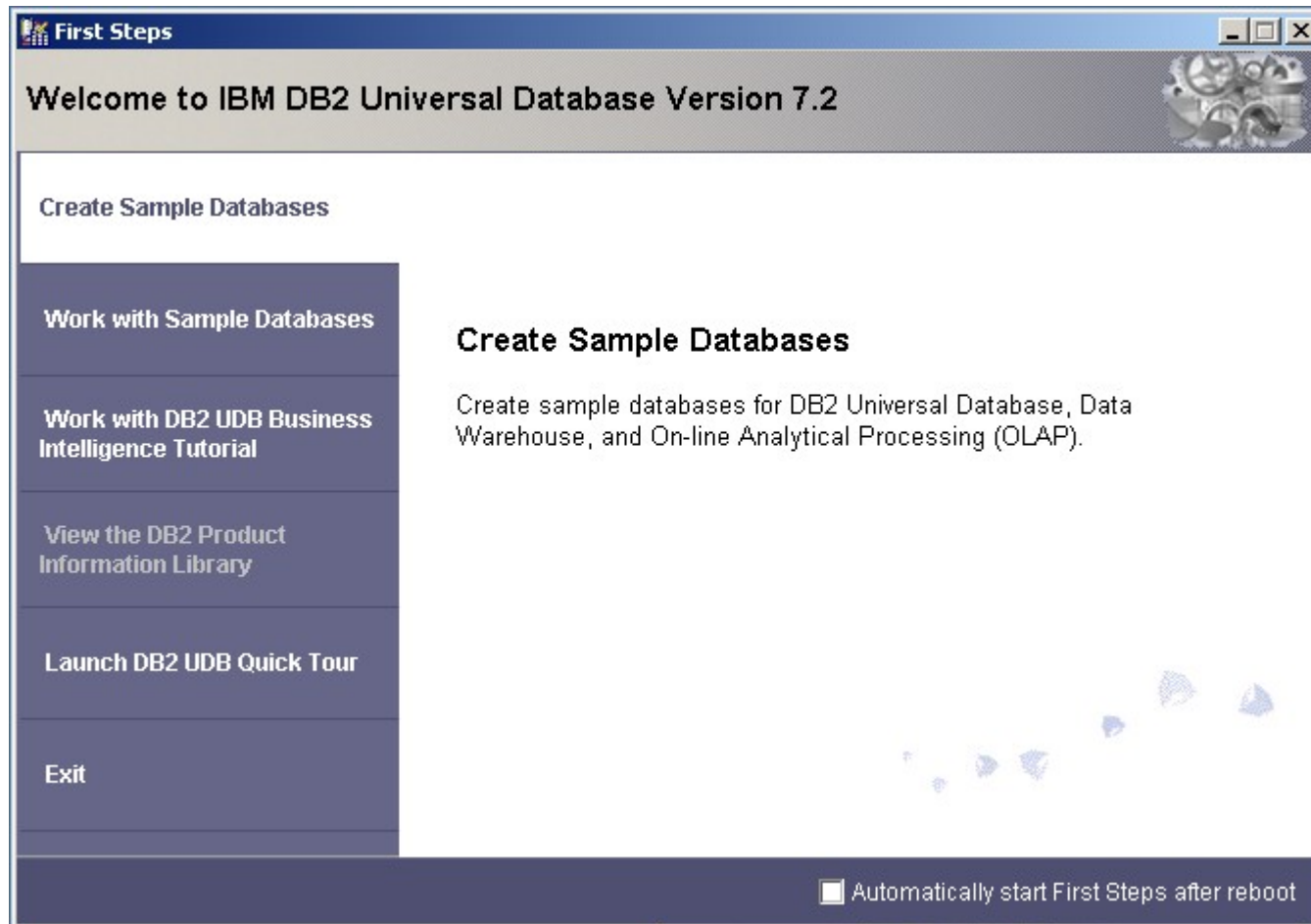


■ Restart ☹



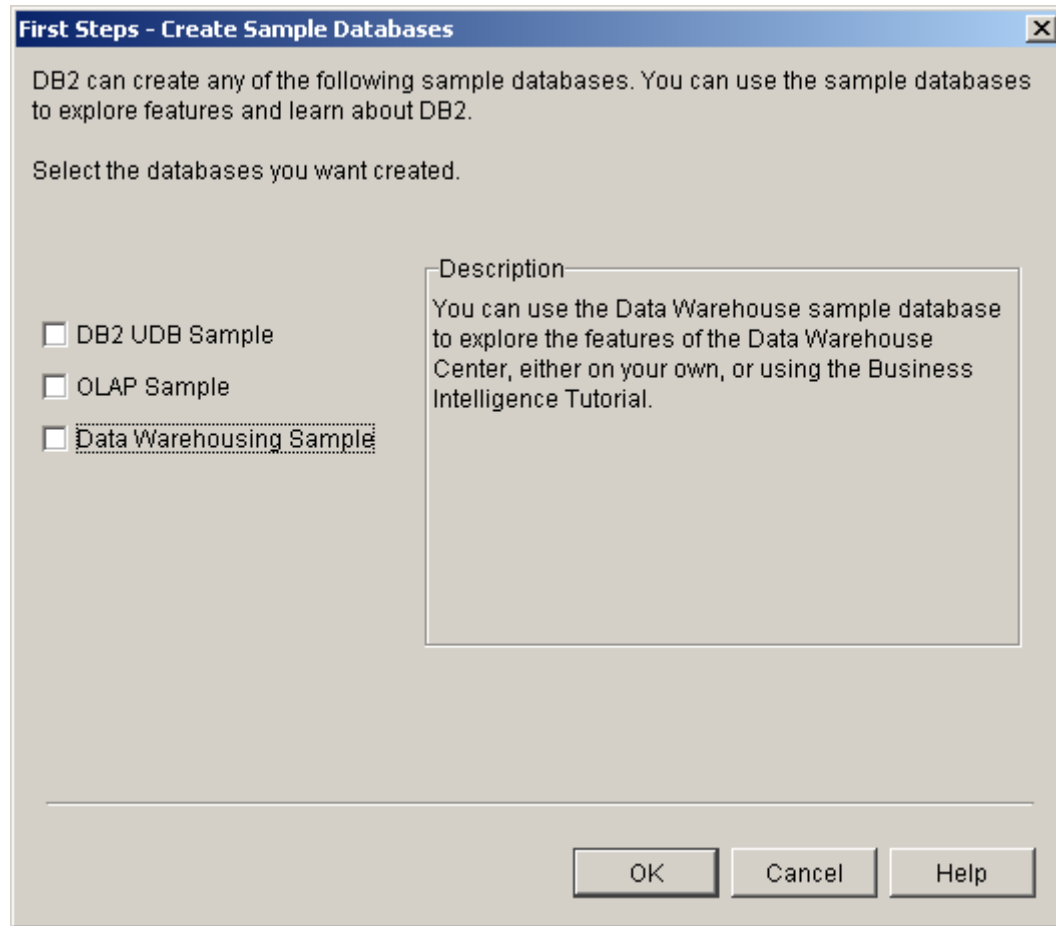
# Installation snap shots (NT) V

- After restart (or with First Steps)





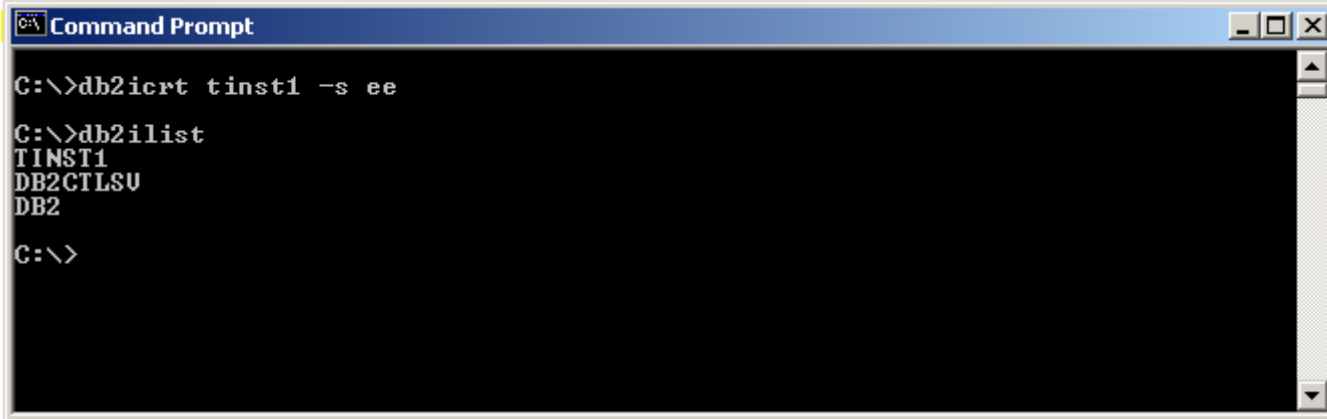
# Installation snap shots (NT) VI





# Installation snap shots (NT) VII

- For Trivadians there is an other way too! 😊



```
C:\>db2icrt tinst1 -s ee

C:\>db2ilist
TINST1
DB2CTLSU
DB2

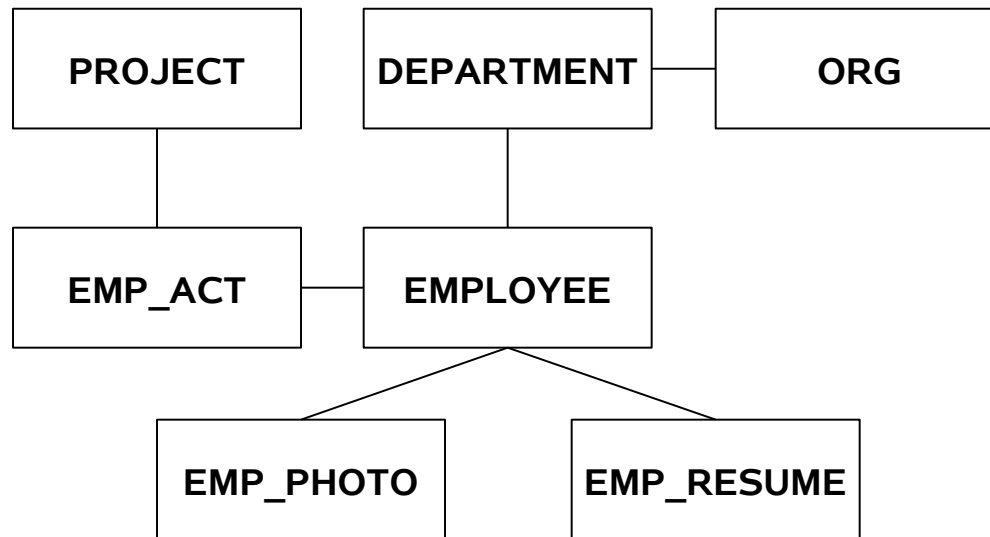
C:\>
```

- For a second instance it is a must!?!



# Sample DB I

- DB2 → „sample“ DB: emp, dept, etc. (ORA: scott/tiger)



- Installation: `db2sampl <path>`





# Sample DB II

Control Center Selected Edit View Tools Help

Systems  
  LTOLS02  
    Instances  
      DB2  
        Databases  
          DWCTRLDB  
          SAMPLE  
            Tables  
            Views  
            Aliases  
            Triggers  
            Schemas  
            Indexes  
            Table Spaces  
            Connections  
            Replication Sources  
            Replication Subscriptions  
            Buffer Pools  
          Application Objects  
          User and Group Objects  
          Federated Database Objects  
        Gateway Connections  
    DB2CTLSV

LTOLS02 - DB2 - SAMPLE - Tables

Name	Schema	Type	Table space	Index table s	Long data ta	Comment
CL_SCHED	OLS	T	USERSPACE1			
DEPARTMENT	OLS	T	USERSPACE1			
EMP_ACT	OLS	T	USERSPACE1			
EMP_PHOTO	OLS	T	USERSPACE1			
EMP_RESUME	OLS	T	USERSPACE1			
EMPLOYEE	OLS	T	USERSPACE1			
IN_TRAY	OLS	T	USERSPACE1			
ORG	OLS	T	USERSPACE1			
PROJECT	OLS	T	USERSPACE1			
SALES	OLS	T	USERSPACE1			
STAFF	OLS	T	USERSPACE1			
SYSATTRIBUTES	SYSIBM	T	SYSCATSPA...			
SYSBUFFERPOOL...	SYSIBM	T	SYSCATSPA...			
SYSBUFFERPOOLS	SYSIBM	T	SYSCATSPA...			
SYSCHECKS	SYSIBM	T	SYSCATSPA...			
SYSCOLAUTH	SYSIBM	T	SYSCATSPA...			
SYSCOLCHECKS	SYSIBM	T	SYSCATSPA...			
SYSCOLDIST	SYSIBM	T	SYSCATSPA...			
SYSOOPTIONS	SYSIBM	T	SYSCATSPA...			



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# DB2 – tools

- Control center, DB2 administration with GUI
  - Needs the “db2jstrt” to be started

```
db2jstrt 6799 &
```

- db2, is the main db2 Tool, it allows to perform
  - Import
  - Load
  - Backup/restore/rollforward
  - Some select
  - Lists
  - Activate database
  - And so on

```
db2inst1@freemind:~ > db2 activate db DB2722  
DB20000I The ACTIVATE DATABASE command completed successfully.
```

- db2sql92
  - Performs SQL operations
  - DMLs/DDLs



# DB2 – tools db2

- db2 is an integration of srvmgrl/rman/export/sqlldr ...
- The help function is quite usefull (? Or ? COMMAND)

```
db2 => ?
```

```
ACTIVATE DATABASE          ECHO                      PREP/PRECOMPILE
ADD DATALINKS MANAGER     EXPORT                    PRUNE HISTORY/LOGFILE
...
DISCONNECT                LOAD                        UPDATE HISTORY
DROP DATABASE             LOAD QUERY                 UPDATE LDAP NODE
DROP NODE                 PING                          UPDATE MONITOR SWITCHES
```

Note: Some commands are operating system specific and may not be available.

```
For further help: ? db2-command - help for specified command
                  ? OPTIONS    - help for all command options
                  ? HELP      - help for reading help screens
```

The preceding three options can be run as DB2 <option> from an OS prompt.

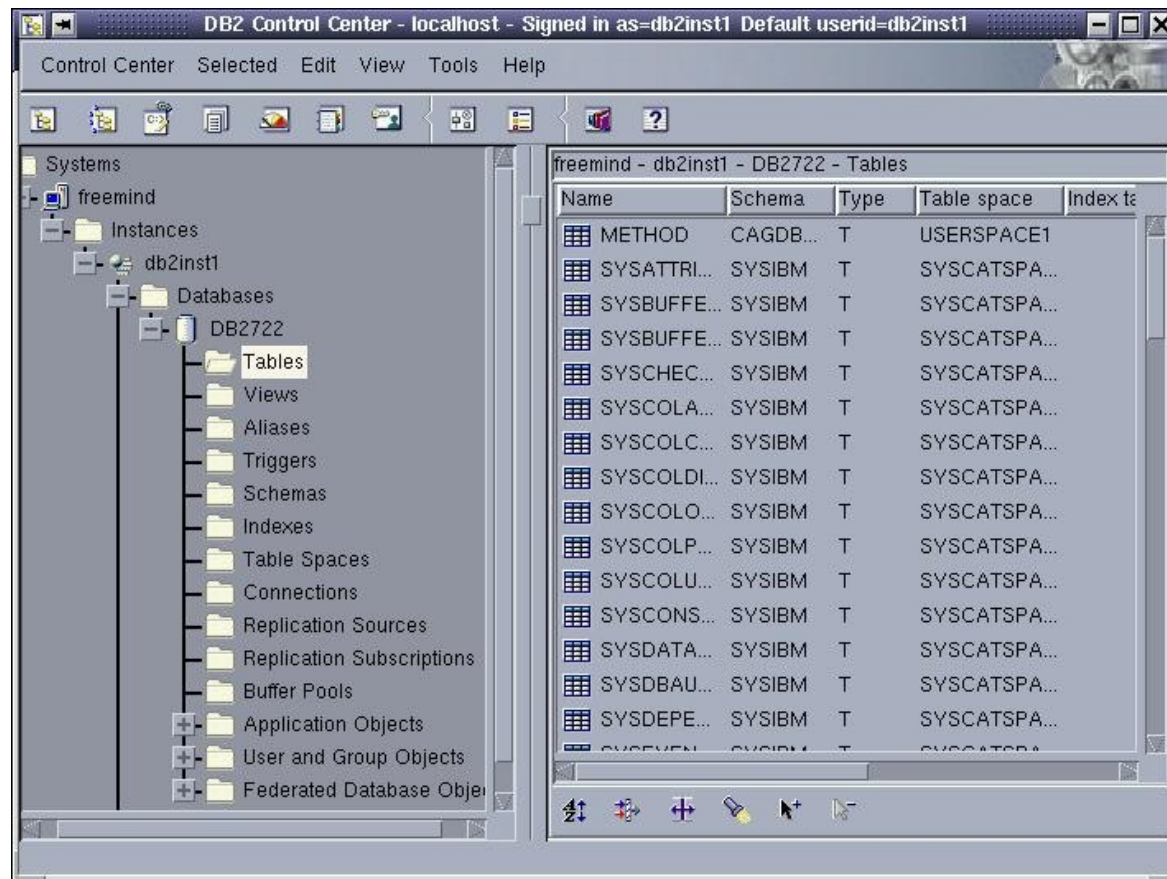
```
!db2ic - DB2 Information Center (Windows/NT and OS/2
only)
```

This command can also be run as db2ic from an OS prompt.



# DB2 – tools (control center)

- Control center like Oracle OEM
- Allows to do all admin tasks but sometimes with fewer options





# DB2 – tools (db2sql92)

- Start SQL commands ( $\approx$  oracle sqlplus)
- SQLs must be ended by “;”

```
db2inst1@freemind:~ > db2sql92 db2inst1/manager -d DB2722
```

```
SQL authorization ID = DB2INST1
```

```
Local database alias = DB2722
```

```
Running in Embedded Dynamic mode.
```

```
-----  
DB2SQL92> select count(*) from cagdbadmin.method;
```

```
Statement # 1 :
```

```
select count(*) from cagdbadmin.method
```

```
1
```

```
-----  
                232
```

```
Number of rows retrieved is:          1
```

```
Number of rows sent to output is:     1
```

```
Elapsed Time is:                      0,021      seconds
```

```
-----
```



## DB2 – alert log file (db2alter.log)

- DB2 has also an alert log file
- Located in <instance\_name>/sqllib/db2dump
- db2alert.log

```
Alert #:5
2002-05-15-13.14.32.257815 Instance:db2inst1 Node:000
PID:8286(db2agent (DB272)) Appid:*LOCAL.db2inst1.020514074828
database_utilities sqluCreateMsgQueue Probe:10
DIA9999E An internal error occurred. Report the following error code : "".
```

- If an error is determined to be an alert, then an entry is made in the db2alert.log file and to the operating system or native logging facility.



# DB2 – alert log file (db2diag.log)

- db2diag.log

```
2002-05-17-09.01.08.082834 Instance:db2inst1 Node:000
PID:9828(db2agent (DB272)) Appid:*LOCAL.db2inst1.020517090058
database_utilities sqlubcka Probe:0 Database:DB272

Backup terminated.
```

- When an error occurs, the db2diag.log file is updated with information about the error.





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# DB2 – Tablespaces – containers - types

- DB2 tablespace ≈ Same concept as in Oracle
- Oracle datafile ≈ DB2 container
- Under DB2 several tablespace types :
  - Regular : any data type
  - Long : long varchar, long vargraphic or LOB data types
  - Temporary : Temporary data
- Each tablespace has its own storage type :
  - SMS System Managed Space (Default)
  - DMS Database Managed Space



# DB2 – Tablespaces - containers

- SMS ( $\approx$  oracle autoextent) :
  - System Space Management
  - Space automatically allocated as required
  - The containers are directories where files are located
  - The containers contain files with the form :
    - SQLXXXXX.DAT
    - SQLXXXXX.INX
    - And so on ...
- DMS (space preallocated)
  - Containers are OS datafiles
  - A DMS tablespace defined with many containers with enable automatic data striping.
- In DMS, a table can have these 3 components (data index lob) in separate table space
- In SMS all the components are in the same table space



## DB2 – Tablespaces - containers

- DMS provides according to IBM better performances
- Each tablespace can be defined with its own page size (oracle block size)
- Each tablespace can have its own buffer pool
- Not only 3 buffer pool available (recycle, default, keep) like Oracle but for each tablespace a buffer pool can be defined.
- Data are striped across the containers (DMS or SMS)
- As soon as a new container is added to a tablespace, the data are redistributed across the new storage
- Long tablespace can only be created in DMS mode. Adding of containers to SMS tablespaces is NOT possible.



## DB2 – Tablespaces - containers

- For each tablespace a PREFETCHSIZE can be defined number of data which will pre fetched when prefetching is done
- For each tablespace the response time (OVERHEAD) and TRANSFERRATE of the disks have to be set (average over the containers)
- These values should help DB2 to create and access the data in an optimal way

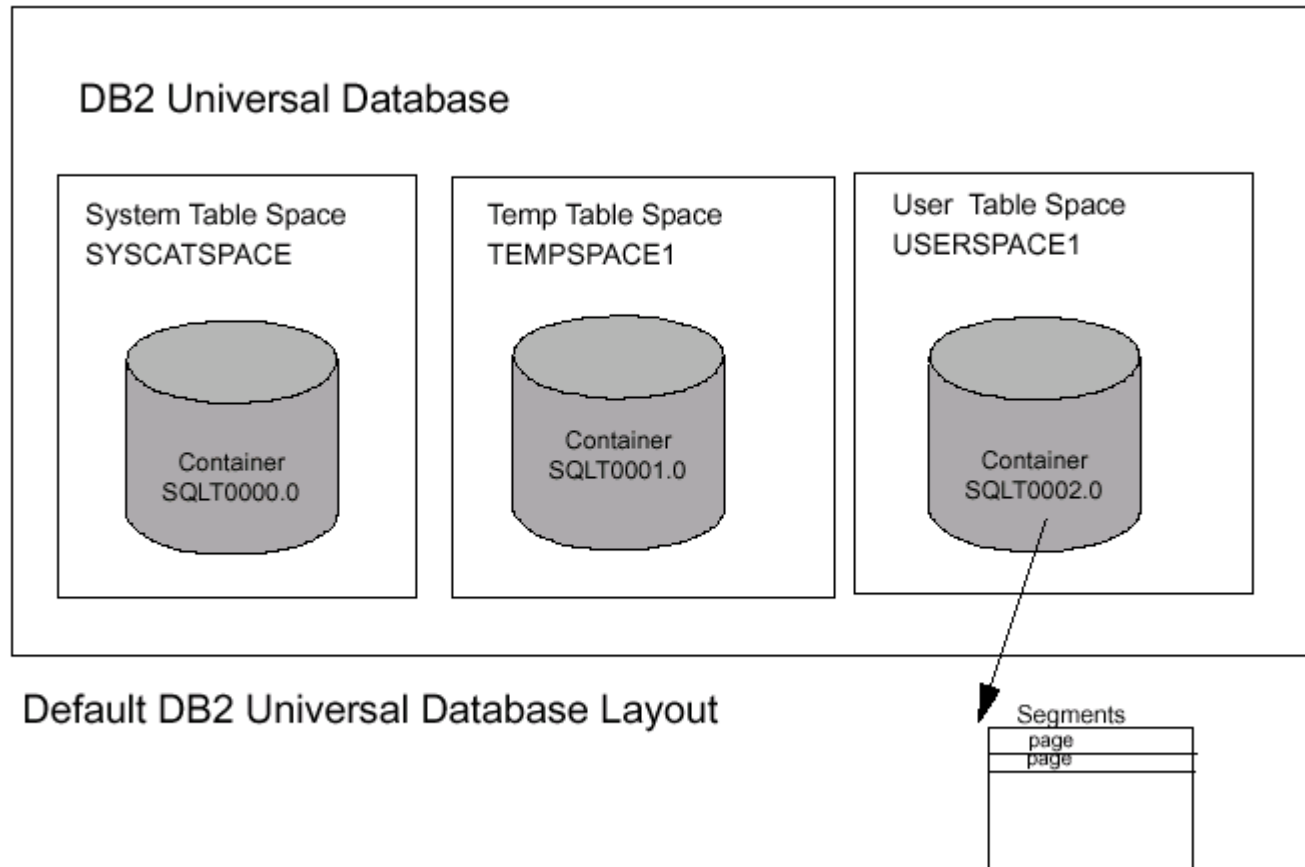


## DB2 – Tablespaces - containers

- A container can be directory (SMS) a file (DMS), a raw device (DMS), a partition (DMS) or a logical volume (DMS)
- The DB2 extent concept is the same as in Oracle
- Default extent size = 32 pages
- Parameter DFT\_EXTENT\_WZ to change the default extent size at DB creation level
- At tablespace level the parameter EXTENTSIZE is available
- EXTENT size cannot be set at table level
- Be careful when tablespace is created with a page size, the buffer pool for this page size has to be defined



# DB2 – Tablespaces



Default DB2 Universal Database Layout



# DB2 – Tablespaces creation with CC

linux - db2inst1 - DB272

Table space name

Type of table space

- Regular
- Long
- System temporary
- User temporary

Space management

- System
- Database

Container name

Comment





# DB2 – Tablespaces – containers – creation script

- Creation of DMS tablespace
- 1000 pages of 4K
- Extentsize 64

```
CREATE REGULAR TABLESPACE DATA_TBS  
PAGE SIZE 4K MANAGED BY DATABASE  
USING (FILE '/u03/db2data/DB272/data_tbs_01.dbf' 1000)  
EXTENTS SIZE 64
```

- At database creation, three tablespaces are mandatory :
  - Catalog tablespace
  - User tablespace
  - System tablespace



# DB2 – Tablespaces – containers

- To list the tablespaces :

```
db2inst1@freemind:~/DB2-TC > db2 list tablespace
```

```
Tablespaces for Current Database
```

```
Tablespace ID          = 0  
Name                   = SYSCATSPACE  
Type                   = System managed space  
Contents               = Any data  
State                  = 0x0000
```

```
Detailed explanation:
```

```
Normal
```

```
db2inst1@freemind:~/DB2-TC > db2 list tablespace CONTAINERS FOR 0
```

```
Tablespace Containers for Tablespace 0
```

```
Container ID          = 0  
Name                  = /u03/db2data/DB272/catalog.dbf  
Type                  = Path
```



## DB2 – Buffer pools

- Each tablespace can have its own buffer pool
- However a buffer pool cannot be defined per table
- A buffer pool has a page size ( $\approx$  several buffers for several block sizes under Oracle)
- Many tablespaces can use the same buffer pool as soon as the page size matches
- A bufferpool activation needs a restart of the database ☹️



## DB2 – Objects - tables

---

- DB2 allows creation of tables 😊
- A table created in a DMS tablespace allows to create the index in another tablespace but which is also DMS
- With SMS tablespaces the tables and index are in the same tablespace and container
- A table in an SMS tablespace creates a new SQLXXXXX.DAT file



# DB2 – Objects – tables with CC

linux - db2inst1 - DB272

Create Table

Table Columns Primary Key Foreign Keys Check Constraints

Table schema DB2INST1

Table name test\_users2

Table space USERS2

Index table space USERS2

Long data table space

Comment

Data capture for propagation



# DB2 – Objects – table creation script

- Table creation with DMS tablespaces
- Separate index tablespace and LONG tablespace

```
CREATE TABLE DB2INST1.TABLE_WITH_LONG  
("PK_COL" INTEGER, "LONG_V_CHAR" LONG VARCHAR, PRIMARY KEY (PK_COL))  
DATA CAPTURE NONE  
IN USERS2  
INDEX IN USERS2  
LONG IN TBS_LONG
```

- Of course we can also define constraints : referential integrity and other constraints types (check)



## DB2 – Objects - indexes

- Index tablespace is given at table creation (not as flexible as Oracle)
- An index in a SMS tablespace creates a new SQLXXXX.INX file
- For unique indexes, include columns can be added to avoid table accesses ( $\approx$  Oracle IOT ?)
- Indexes can be bidirectionnal ( $\neq$  REVERSE indexes from Oracle), eases min and max search
- Also indexes can be ascending or descending
- Indexes can be clustered based on page clustering. DB2 tries to maintain the cluster structure over the DML operations
- PCTFREE can be defined for an Index



# DB2 – Other objects

---

- Trigger can also be created in DB2
  - On UPDATE/INSERT/DELETE operations
  - No cascade before/after
  - For each row / statement (at row level or transaction level)





# DB2 – export / import features

- The DB2 export import features are integrated in db2 utility
- Works on SQL level (we can choose what we want to export)
- Under 7.1 3 supported format :
  - DEL (delimited ASCII)
  - WSF (user by Lotus for example ☺)
  - IXF which includes the table definition and creates the table (whereas the 2 other one)
  - IXF also exports the indexes
- XML supported (XML extender for each DB2 product)
- No proprietary format like Oracle export
- Import feature can be compared to SQL\*loader from Oracle
- However not as powerful as Oracle export/import : no trigger , functions, views exported, for this purpose : db2move



## DB2 – export example

- Exports all the rows of table MODULE
- Use ASCII delimited format

```
db2 => export to /tmp/module_dump.txt of DEL select * from  
cagdbadmin.module  
SQL3104N  The Export utility is beginning to export data to file  
"/tmp/module_dump.txt".  
  
SQL3105N  The Export utility has finished exporting "16" rows.  
  
Number of rows exported: 16
```



# DB2 – export/import example

```
db2 => export to /tmp/module_dump.txt of DEL select * from cagdbadmin.module
SQL3104N  The Export utility is beginning to export data to file "/tmp/module_dump.txt".

SQL3105N  The Export utility has finished exporting "16" rows.
Number of rows exported: 16

db2 => import from /tmp/module_dump.txt of DEL insert into CAGDBADMIN.MODULE_2
SQL3109N  The utility is beginning to load data from file
"/tmp/module_dump.txt".

SQL3110N  The utility has completed processing.  "16" rows were read from the
input file.
SQL3221W  ...Begin COMMIT WORK. Input Record Count = "16".
SQL3222W  ...COMMIT of any database changes was successful.
SQL3149N  "16" rows were processed from the input file.  "16" rows were
successfully inserted into the table.  "0" rows were rejected.

Number of rows read           = 16
Number of rows skipped        = 0
Number of rows inserted       = 16
Number of rows updated        = 0
Number of rows rejected       = 0
Number of rows committed     = 16
```



# DB2 –import from Oracle

---

- However import has more options :
  - Defines the column separator
  - Defines the date format, and so on
- We used it to import data from Oracle tables
- Some “gateway” tools exists to transfert data from Oracle but they have a cost



# DB2 –import from Oracle example

- 1. On Oracle generate the dump file
- 2. On DB2 import the data (syntax generated from the CC 😊)

```
spool dump_table_MODULE.lst
```

```
@@settings
```

```
select
```

```
MODULE_TEXT_ID||''',
```

```
MODULE_NUMERIC_ID||''',
```

```
...
```

```
USR_DEF_NUM_FIELD_3||''',
```

```
USR_DEF_NUM_FIELD_4||''',
```

```
IMPORT FROM /home/db2inst1/DB2-TC/import_data_demo/dump_table_MODULE.lst OF DEL MODIFIED BY  
codel| chardel"" decpt. dateformat=""DD/MM/YYYY"" MESSAGES /tmp/message.out INSERT INTO  
CAGDBADMIN.MODULE
```

```
spool off
```



# DB2 –Load utility

- Used to import faster data into Oracle tables
- Able to handle exception records (NULL in NOT NULL columns, primary key violation)
- FOR EXCEPTION clause can be specified
- Exception table has some rules to accept invalid records
- Load creates temporary files in  
/home/db2inst1/db2inst1/NODEXXXX/SQLXXXXX
- The load utility needs that the DB is set in the ROLLFORWARD mode for some operations
- The ROLLFORWARD mode will also be needed to perform backups
- The load can be stopped, replace the data and so on ...



# DB2 –Load utility - settings

- To set the database in ROLLFORWARD mode :

```
db2 => db2 update db cfg for filerdb using logretain recovery
```

- Once the load has been performed the database is in backup pending state (backup has to be performed)

```
db2 => list tablespaces
```

```
Tablespaces for Current Database
```

```
Tablespace ID          = 2
Name                    = USERSPACE1
Type                    = Database managed space
Contents                = Any data
State                   = 0x0020
```

```
Detailed explanation:
```

```
Backup pending
```



# DB2 –Load utility - options

- The backup pending state requires a backup of the tablespace
- 3 Load mode are available :
  - NO COPY (default) : inserts the data in the table and set the tablespace in backup pending
  - COPY : performs a copy of each changed rows in the table. Will allow the rollforward operations
  - NONRECOVERABLE ( $\approx$  Oracle NOLLOGING) just loads and doesn't allow recovery
- Load/Import Summary
  - Fine for basics tests
  - For professional use : “DB2 relational connect” for Oracle which allows to import Oracle export file or perform “insert into ... select from ...”
  - Will be integrated in V8





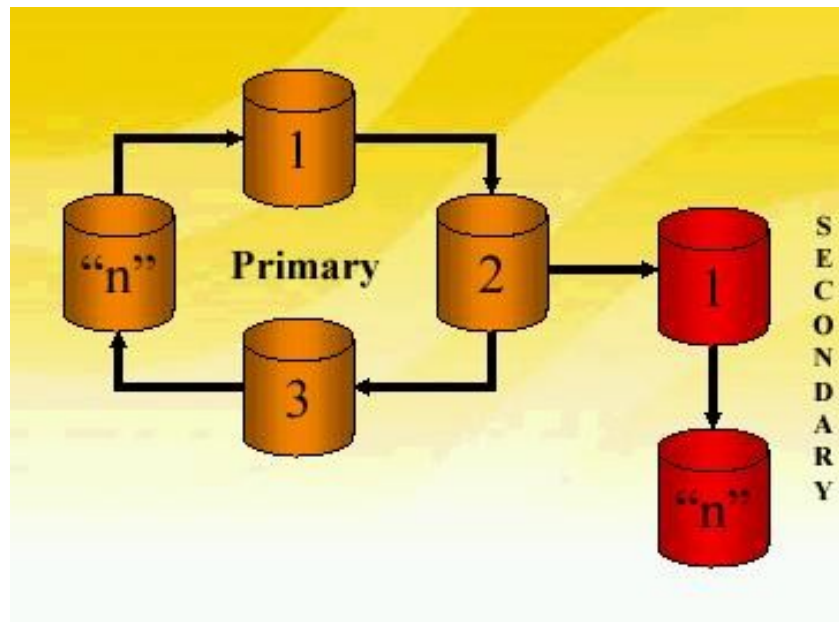
# DB2 –Backup / Recovery

- DB2 also has a redo log concept
- Pages are written from redolog buffer to disk when buffer is FULL or commit (Oracle has a much complicated algorithm for the checkpoints : 1/3 log buffer, commit, when number of dirty blocks reaches a may value)
- Log files are located under  
`/home/db2inst1/db2inst1/NODEXXXX/SQLXXXXX/SQLOGDIR`
- DB2 offers 2 types of logging mechanism : circular OR archival
- The redo log files can be mirrored since V7.2 (DB2\_NEWLOGPATH)



# DB2 –Backup / Recovery circular logging

- The DB2 circular concept is different than Oracle
- The main idea is the same than Oracle : write to redo 1,2,..N and back to 1,2... and so on
- If redo 1 is unavailable (overflow) because of transaction still ongoing and not committed a secondary redo can be allocated ( $\approx$  Oracle RBS)





# DB2 –Backup / Recovery circular logging

- As with Oracle support recovery from a specified DB backup
- Doesn't allow point in time DB recovery (rollforward recovery)
- Logging parameters can be set with : “update db”

```
db2 => get db cfg for DB2722
```

```
Database Configuration for Database DB2722
```

```
Log file size (4KB)                (LOGFILSIZ) = 1000
Number of primary log files         (LOGPRIMARY) = 3
Number of secondary log files       (LOGSECOND) = 2
Changed path to log files           (NEWLOGPATH) =
Path to log files                   =
    /home/db2inst1/db2inst1/NODE0000/SQL00002/SQLOGDIR/
First active log file               =
    S0000004.LOG
```



# DB2 –Backup / Recovery archival logging

- To enable :

```
db2 => update db cfg for DB272 using logretain recovery
```

- The redo log can have 3 status :
  - Active , DB2 is currently using these file(s) because opened transaction are stored
  - Online , Not in use by transaction but in the same directory than active file
  - Offline , the redo log has been moved in a archive directory (archived file)



# DB2 –Backup / Recovery Linux requirements

- db2 utility uses message Linux queue
- On SUSE 7.2 per default 16 message queues, not enough for backup

```
freemind:~ # sysctl -A | grep kernel.msgmni
kernel.msgmni = 16
```

```
freemind:~ # cat /proc/sys/kernel/msgmni
16
```

- When updated to 50 the backup works, some notes advice 128

```
freemind:~ # sysctl -w kernel.msgmni=50
kernel.msgmni = 50
```

- If not set the backup fails

```
db2 => BACKUP DB db2722 TABLESPACE userspace1 ONLINE TO
' /u03/db2backup/DB2722 '
SQL2044N  An error occurred while accessing a message queue.  Reason
code: "1".
```



# DB2 –Backup a database

- In db2 utility : backup command

```
db2 => ? backup
BACKUP DATABASE database-alias [USER username [USING password]]
[TABLESPACE (tblspace-name [ {,tblspace-name} ... ])]
[INCREMENTAL [DELTA]] [ONLINE]
[USE TSM [OPEN num-sess SESSIONS]] | TO dir/dev [ {,dir/dev} ... ] |
LOAD lib-name [OPEN num-sess SESSIONS]] [WITH num-buff BUFFERS]
[BUFFER buffer-size] [PARALLELISM n] [WITHOUT PROMPTING]
```

- To backup a database without shutdown key word : **ONLINE**

```
db2 => BACKUP DB db2722 TABLESPACE userspace1 ONLINE TO
      '/u03/db2backup/DB2722'
Backup successful. The timestamp for this backup image is :
      20020520073518
```

```
db2 => BACKUP DB db2722 ONLINE TO '/u03/db2backup/DB2722'
Backup successful. The timestamp for this backup image is :
      20020520073547
```



# DB2 –Backup a database

- Backup file looks like :

```
db2inst1@freemind:~ > ls /u03/db2backup/DB2722/  
DB2722.0.db2inst1.NODE0000.CATN0000.20020519092318.001
```

- To check the backup status “RMAN” integrated :

```
db2 => list history backup all for DB2722
```

```
          List History File for DB2722
```

```
Number of matching file entries = 9
```

```
Op  Obj  Timestamp+Sequence  Type  Dev  Earliest  Log  Current  Log  Backup ID
```

```
-----  
B   D   20020519092318001   F     D   S0000000.LOG S0000000.LOG  
-----
```

```
Contains 2 tablespace(s):
```

```
00001 SYSCATSPACE
```

```
00002 USERSPACE1 ...
```



# DB2 –Backup a database

- db2 utility can be easily integrated with ADSM (Tivoli) from IBM ☺
- Parallel backup can be performed (≈ Oracle multi channel)
- Buffer are used for backup, the size of the buffer can be set for each backup
- If backup crashes during critical stage, the DB is not accessible until back up again





# DB2 –Backup a database – recovery history (1)

- The history file is located in `/home/db2inst1/db2inst1/nodeXXXX/SQLXXXXX` and called `db2rhist.asc`
- The history file also contains table REORGS / alter tablespace / drop table and so on commands (DDL)
- The history file has a retention period of 366 days per default (parameter **rec\_his\_retentn**)
- The command “prune history” allows to delete entry from the history file
- DB2 history file  $\approx$  RMAN catalogue + Oracle dictionary



# DB2 –Backup a database – recovery history (2)

- We can search which backup contains a required table

```
db2 => list history containing cagdbadmin.module for DB2722
```

```
List History File for DB2722
```

```
Number of matching file entries = 4
```

Op	Obj	Timestamp+Sequence	Type	Dev	Earliest Log	Current Log	Backup ID
L	T	20020519194109001	I	S	S0000002.LOG	S0000002.LOG	

```
-----  
"CAGDBADMIN"."MODULE" resides in 1 tablespace(s):
```

```
00001 USERSPACE1
```

```
-----  
Comment: DB2
```

```
Start Time: 20020519194109
```

```
End Time: 20020519194114
```

```
-----  
00001 Location: /home/db2inst1/DB2-TC/import_data_demo/dump_table_MODULE.lst
```



# DB2 –Backup a database – restore/rollforward

- DB2 also offers restore possibilities 😊

```
db2 => ? restore
RESTORE DATABASE source-database-alias { restore-options | CONTINUE | ABORT }

restore-options:
  [USER username [USING password]] [{TABLESPACE [ONLINE] |
  TABLESPACE (tblspace-name [ {,tblspace-name} ... ] ) [ONLINE] |
  HISTORY FILE [ONLINE]}] [INCREMENTAL [AUTOMATIC | ABORT]]
  [{USE TSM [OPEN num-sess SESSIONS] |
  FROM dir/dev [ {,dir/dev} ... ] | LOAD shared-lib
  [OPEN num-sess SESSIONS]}] [TAKEN AT date-time] [TO target-directory]
  [INTO target-database-alias] [NEWLOGPATH directory]
  [WITH num-buff BUFFERS] [BUFFER buffer-size]
  [DLREPORT file-name] [REPLACE EXISTING] [REDIRECT] [PARALLELISM n]
  [WITHOUT ROLLING FORWARD] [WITHOUT DATALINK] [WITHOUT PROMPTING]
```

- Tablespaces or all databases can be restored
- Based on the history timestamp



# DB2 –Backup a database – restore/rollforward scenary

- Lost tablespace USERSPACE1 with datafile  
/u03/db2data/DB2722/users\_01.dbf

```
db2 => select count(*) from cagdbadmin.method
-----
SQL0290N  Table space access is not allowed.  SQLSTATE=55039
```

- List of the backup to find USERSPACE1 backup

```
List History File for DB2722 ...
Op Obj Timestamp+Sequence Type Dev Earliest Log Current Log Backup ID
-----
B D 20020520073547001 N D S0000005.LOG S0000007.LOG
-----

Contains 2 tablespace(s):
00001 SYSCATSPACE
00002 USERSPACE1
-----

Comment: DB2 BACKUP DB2722 ONLINE
Start Time: 20020520073547
End Time: 20020520073612
-----

00012 Location: /u03/db2backup/DB2722
```



# DB2 –Backup a database – restore/rollforward scenary

- Restore the tablespace USERSPACE1 based to timestamp

```
db2 => restore db DB2722 tablespace (USERSPACE1) online from
        /u03/db2backup/DB2722 taken at 20020520073547
DB20000I  The RESTORE DATABASE command completed successfully
```

- Check the status of the tablespace

```
db2 => LIST TABLESPACES show detail

          Tablespaces for Current Database

Tablespace ID          = 2
Name                   = USERSPACE1
Type                   = Database managed space
Contents               = Any data
State                  = 0x0080

  Detailed explanation:
    Roll forward pending
```



# DB2 –Backup a database – restore/rollforward scenary

- Rollforward ( $\approx$  recover) the tablespace USERSPACE1

```
db2 => rollforward db DB2722 to end of logs tablespace (USERSPACE1) online
```

## Rollforward Status

Input database alias	= DB2722
Number of nodes have returned status	= 1
Node number	= 0
Rollforward status	= not pending
Next log file to be read	= S0000008.LOG
Log files processed	= -
Last committed transaction	= 2002-05-20-05.52.19.000000

```
DB20000I The ROLLFORWARD command completed successfully.
```

- Check the status of the tablespace

```
db2 => select count(*) from cagdbadmin.method
```

```
1
```

```
-----
```

```
232
```

```
1 record(s) selected.
```



# Agenda

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- A. Introduction
- B. Architecture
- C. Installation
- D. Tools
- E. DB structure
- F. Literature**



# Links I

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- DB2 Home Page: [www.software.ibm.com/data/db2](http://www.software.ibm.com/data/db2)
  
- DB2 UDB Homepage: [www.ibm.com/db2/udb/](http://www.ibm.com/db2/udb/)
  - (Download Fixpaks & Clients, Knowledge Base, Technical Notes)
  
- DB2 Newsgroup:
  - [comp.databases.ibm-db2](mailto:comp.databases.ibm-db2)
  - [trivadis.db2](mailto:trivadis.db2)
  
- Business Partner Zugang zu IBM:
  - [www-100.ibm.com/partnerworld/software/pwswpub1.nsf](http://www-100.ibm.com/partnerworld/software/pwswpub1.nsf) (Trivadis/tvd2002)





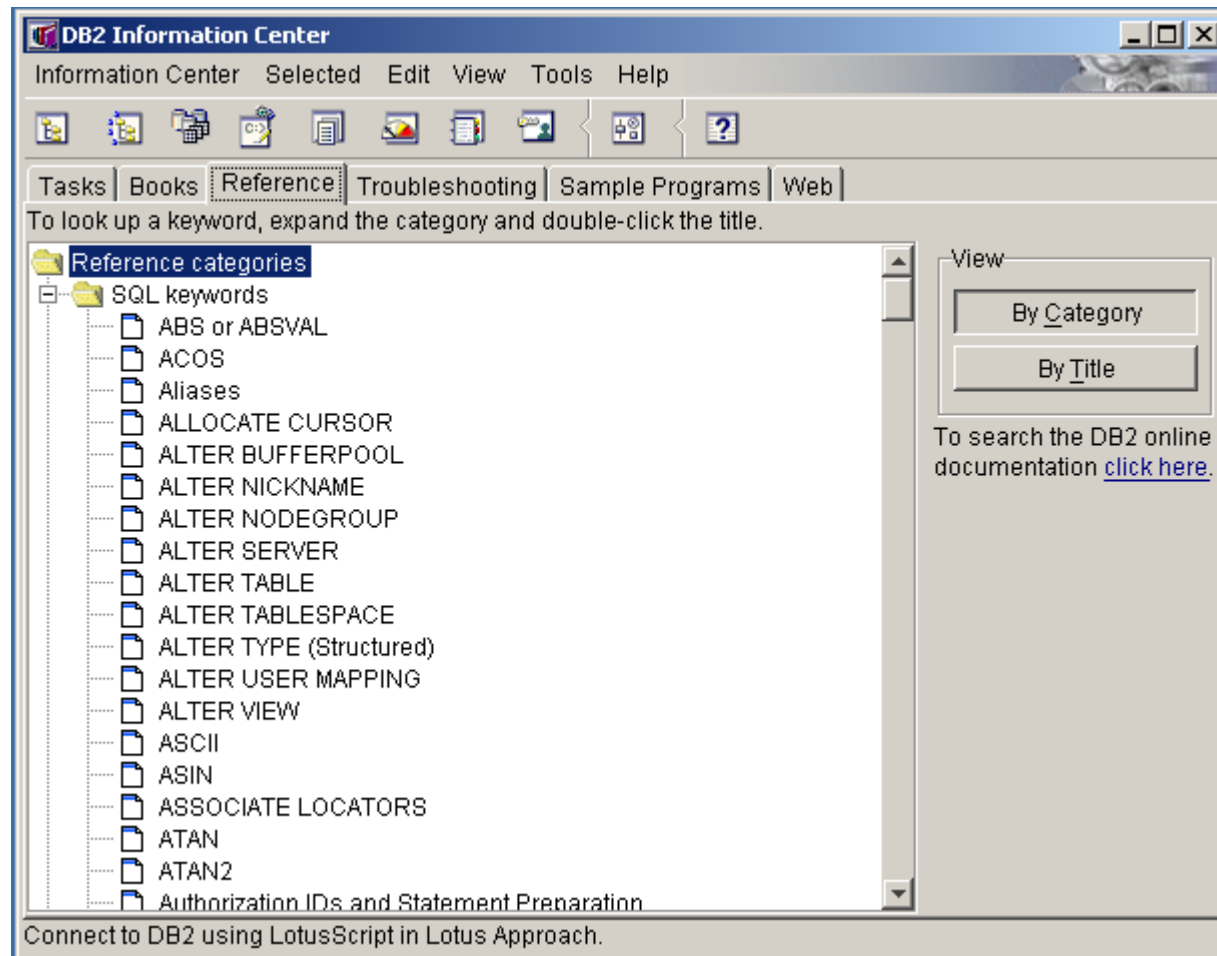
# Links II

- DB2@SuSE: [http://sdb.suse.de/en/sdb/html/dl\\_DB2\\_V71\\_en.html](http://sdb.suse.de/en/sdb/html/dl_DB2_V71_en.html)  
[http://sdb.suse.de/en/sdb/html/tdenis\\_db2inst\\_sl72.html](http://sdb.suse.de/en/sdb/html/tdenis_db2inst_sl72.html)
  - Installation guide
  
- DB2@Redhat
  - <http://www.it.redhat.com/ibm/db2redhat/>
  - Solo in italiano ☹ → IBM
  
- <http://www-3.ibm.com/software/data/db2/selfstudy/>
  - Selfstudy course download
  
- [http://www-3.ibm.com/cgi-bin/db2www/data/db2/udb/winos2unix/support/v7pubs.d2w/en\\_main](http://www-3.ibm.com/cgi-bin/db2www/data/db2/udb/winos2unix/support/v7pubs.d2w/en_main)
  - Dokus



# Documentation

## → Information Center (db2ic)





# Finish

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- Markus Reichert
- Oli Sennhauser
- Martin Wunderli
- ...



**trivadis**



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## **DB2 UDB for Oracle DBA's**

The other side of the fence.