z/OS Introduction and Workshop

Db2 Relational Database

Unit objectives

After completing this unit, you should be able to:

- Describe Db2
- List 4 types of SQL
- List SQL statements
- Understand Db2 Programming Language APIs
- Understand Db2 Structures
- Understand Active and Archive Logging
- List 4 Db2 bufferpool sizes

Relational Data Base Technology

A relational database allows you to easily find specific information.

It also allows you to sort based on any field and generate reports that contain only certain fields from each record. Relational databases use tables to store information.

The standard fields and records are represented as columns (fields) and rows (records) in a table.

Relational databases are created, updated and read using a special computer language, structured query language (SQL), that is the standard for database SQL is the foundation for all of the popular database applications available today.

Relational Data Base Technology

Edgar Frank "Ted" Codd invented the relational model for database management and the theoretical basis for relational databases while working for IBM.

While all relational databases follow Codd's theoretical basis, implementation differences exist between the various relational databases. As a result porting from one relational database platform to another relational database platform frequently requires some SQL adjustments.

The good news is that if you understand any specific relational database, then you can use that knowledge to quickly learn other relational database systems.

Db2 Concepts: Structured Query Language (SQL)

Database Administrator (DBA)

DDL - Data Definition Language(Structures)

DCL - Data Control Language (Security)

Application Developer

DML - Data Manipulation Language

TCL - Transactional Control Language

Db2 Concepts: Structured Query Language (SQL)

DDL - Data Definition Language
It is used to create and modify the structure of database objects in database.

Examples: **CREATE**, **ALTER**, **DROP** statements

DCL - Data Control Language
It is used to create roles, permissions, and referential integrity as well it is used to control access to database by securing it.

Examples: **GRANT**, **REVOKE** statements

Db2 Concepts: Structured Query Language (SQL)

DML - Data Manipulation Language.
It is used to retrieve, store, modify, delete, insert and update data in database.

Examples: **SELECT**, **UPDATE**, **INSERT** statements

TCL - Transactional Control Language.
It is used to manage different transactions occurring within a database.

Examples: **COMMIT**, **ROLLBACK** statements

Db2 Application Programming

Languages

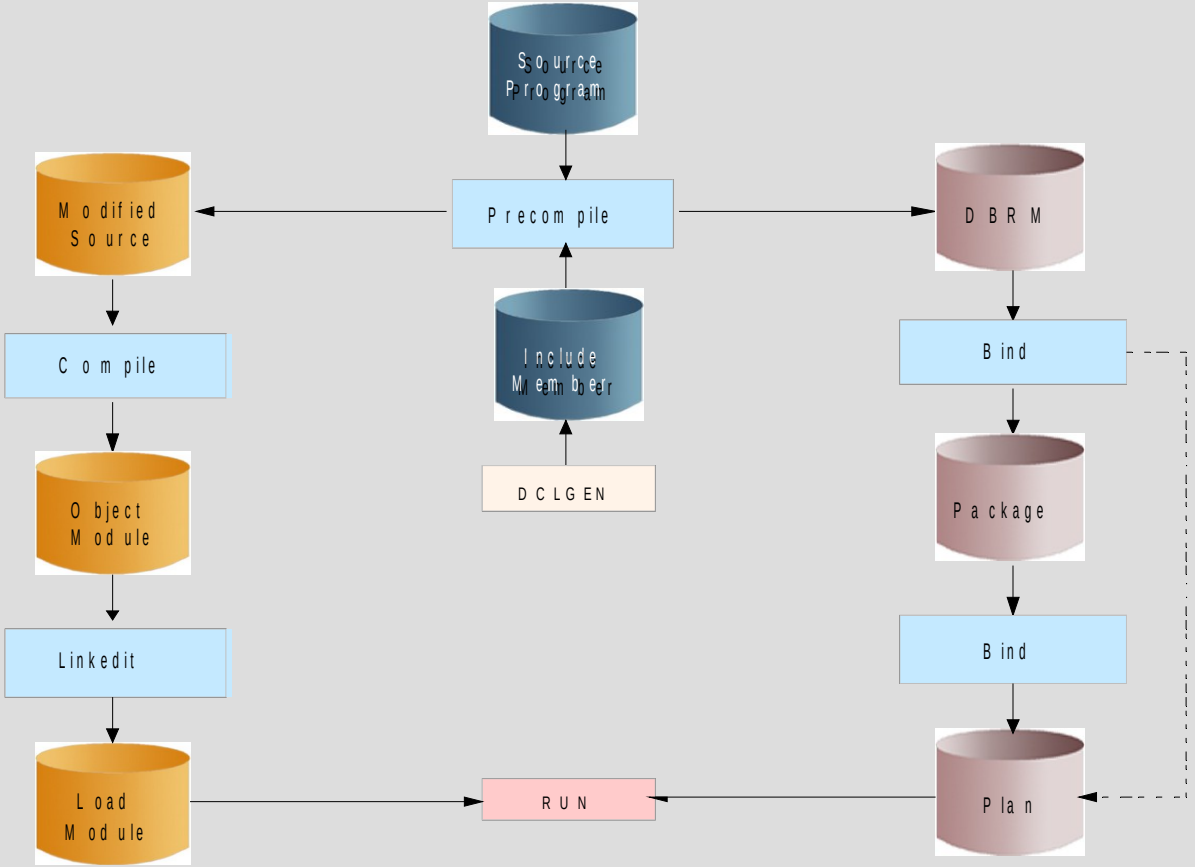
- **COBOL**
- **Java**
- **C/C++**
- **REXX**
- **Assembler**
- **PL/I**

Application Program Interface (API)

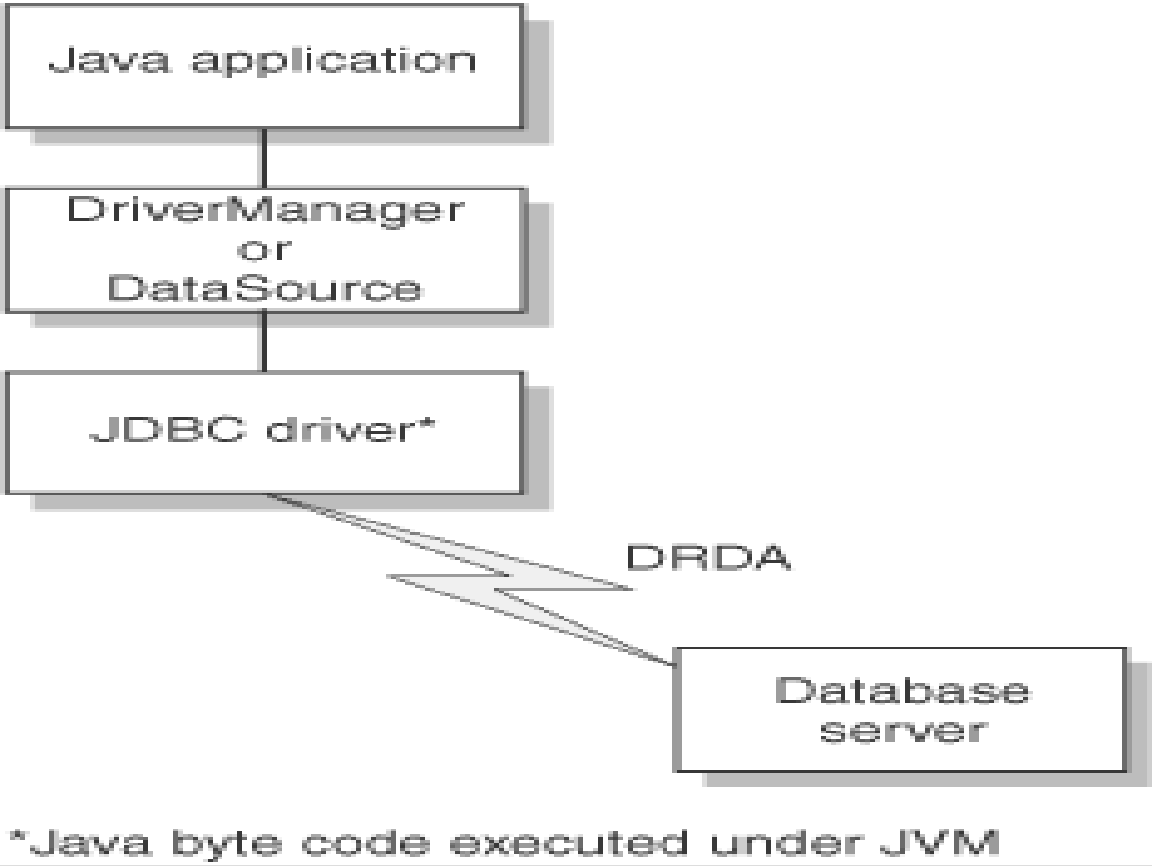
EXEC SQL ….

DML	**select**	**insert**	**update**
DDL	**create**	**drop**	**alter**
DCL	**grant**	**revoke**	
TCL	**commit**	**rollback**	

Db2 - Application Programming



Db2 - Application Programming



Db2 for z/OS Interfaces

Db2 tool set (3270 based)
- SPUFI
- DCLGEN
- Bind/Rebind
- Command Processor
- Utilities
- Defaults
- Administration
- Performance Expert

Control Center (GUI)
IDz (IDE) DB2 Workbench (GUI)
Data Studio (GUI)

Db2 for z/OS Disk Storage Allocation (volume)

z/OS controls many disk devices with unique **volume** labels

A Db2 created STOGROUP is assigned to use specific **volume** labels

z/OS Db2 DDL - **CREATE STOGROUP name ADD VOLUME**(……

z/OS Db2 DDL – **ALTER STOGROUP name ADD|DELETE VOLUME**(….

SYSDEFLT STOGROUP exists (best practice - never use it)

Each Database name is assigned to a STOGROUP
create database.tablespace is allocated on a **volume** from assigned STOGROUP

If DBA (SYSADM) creates databases without specifying STOGROUP,
then database.tablespace will use SYSDEFLT (which may have little disk space)

zOS Db2 One Table per Tablespace (Best Practice)

While it is common to create many tables in a single LUW tablespace, Db2 for z/OS best practice is only one table per tablespace.

Yes – this means DDL needs to include:
CREATE TABLESPACE
    for every
CREATE TABLE

Negative performance impact is the result of multiple tables in a single tablespace in Db2 for z/OS environment.

Db2 for z/OS Tablespace Data Set Name

When a tablespace is created, a VSAM Linear Data Set is defined with the following data set name format:

vcat.DSNDB**C**.*dbname*.*tsname*.*y0001.z001* (**C**luster name)
vcat.DSNDB**D**.*dbname*.*tsname*.*y0001.z001* (**D**ata component of cluster)

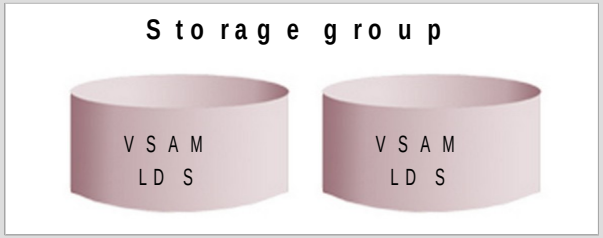
y0001.z001 (instance#. dataset #)

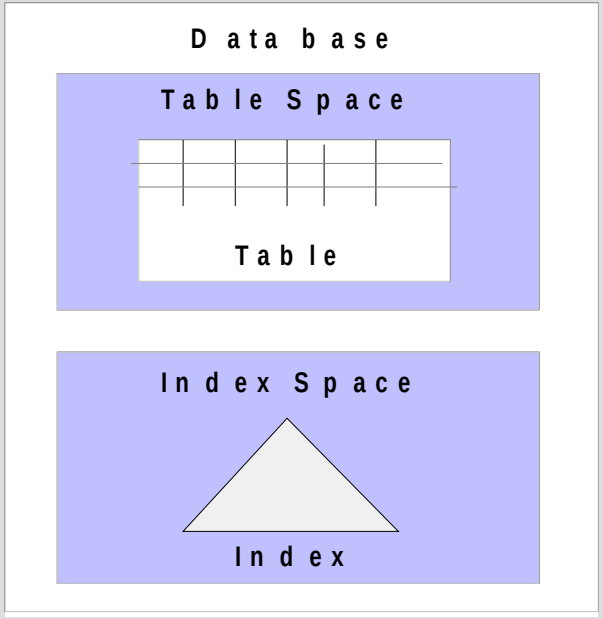
tsname (tablespace name)

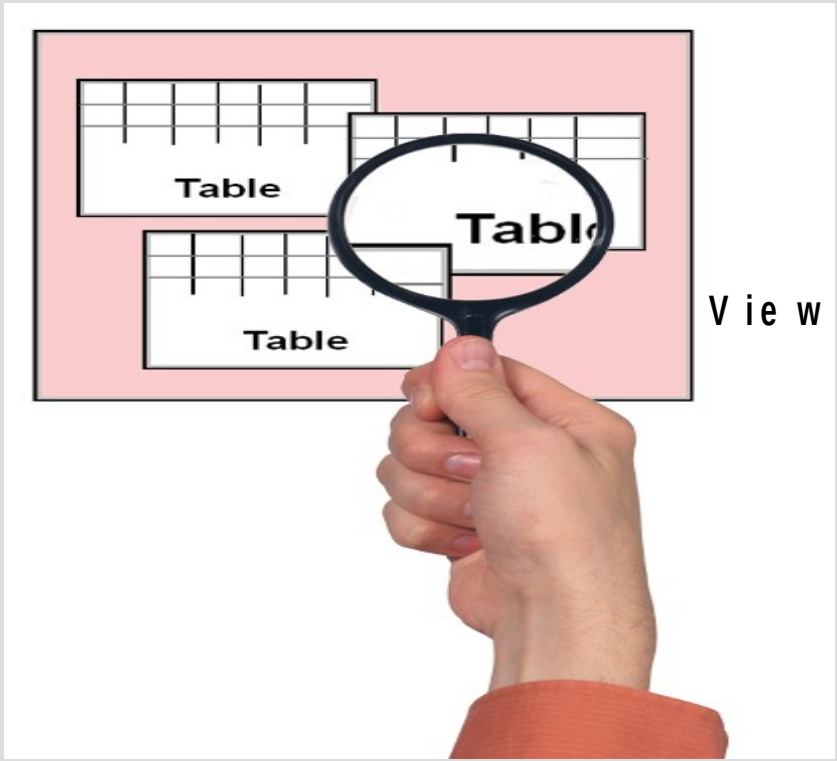
dbname (database name)

vcat (typically an ‘alias’ in the master catalog)

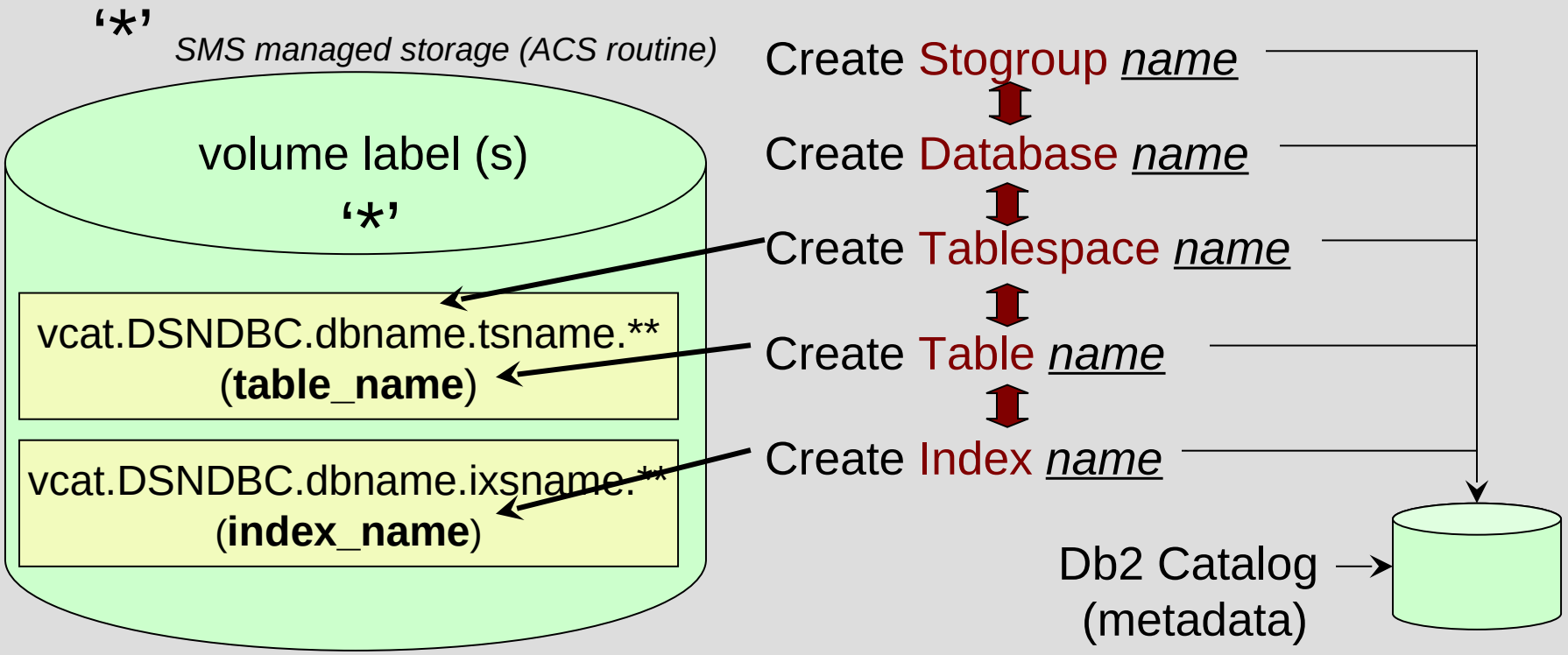
Db2 for z/OS Data Structures







Db2 for z/OS Data Structures



Db2 – DBA View

1. Create Storage Group
   a. disk volumes specified
   b. catalog alias name (VCATNAME) specified
2. Create Database
   a. storage group specified
   b. buffer pool specified
3. Create Tablespace
   a. database name specified
   b. buffer pool specified
   c. primary and secondary disk space quantity specified
4. Create Table
   a. fields and respective data types specified
   b. database.tablespace specified to contain table

Db2 DDL – CREATE STOGROUP and DATABASE

```
CREATE STOGROUP ACCTDISK VOLUMES (VPARC1) VCAT ACCOUNTS;
----------------------------------------------------------------------------------------------------
COMMIT ;
----------------------------------------------------------------------------------------------------
CREATE DATABASE ACCOUNTS STOGROUP ACCTDISK BUFFERPOOL BP0;
```

Db2 DDL – CREATE TABLESPACE and TABLE

```
CREATE TABLESPACE TS01 IN ACCOUNTS
  USING STOGROUP ACCTDISK PRIQTY 20 SECQTY 20 ERASE NO
  LOCKSIZE PAGE LOCKMAX SYSTEM
  BUFFERPOOL BP0 CLOSE NO COMPRESS YES;
-------------------------------------------------------------------------------------------------
COMMIT;
-------------------------------------------------------------------------------------------------
CREATE TABLE ZIBM001.TBL01
          (ACCTNO              CHAR(8)          NOT NULL,
           LIMIT          DECIMAL(9,2),
           BALANCE              DECIMAL(9,2),
           SURNAME              CHAR(20)         NOT NULL,
           FIRSTN               CHAR(15)         NOT NULL,
           ADDRESS1             CHAR(25),
           ADDRESS2             CHAR(20),
           ADDRESS3             CHAR(15),
           RESERVED             CHAR(7),
           COMMENTS             CHAR(50),
           PRIMARY KEY(ACCTNO))
      IN ACCOUNTS.TS01;
```

Db2 DDL – CREATE INDEX

```
CREATE UNIQUE INDEX ZIBM001.XTBL01
        ON ZIBM001.TBL01 (ACCTNO    ASC)
        USING STOGROUP ACCTDISK PRIQTY 12 ERASE NO
        BUFFERPOOL BP0 CLOSE NO;
```

Db2 DCL – GRANT

```
GRANT DBADM ON DATABASE ACCOUNTS TO PUBLIC;

GRANT USE OF STOGROUP ACCTDISK TO PUBLIC;

GRANT STATS ON DATABASE ACCOUNTS TO PUBLIC;

GRANT USE OF TABLESPACE ACCOUNTS.TS01 TO PUBLIC;

GRANT DELETE, INSERT, SELECT, UPDATE ON TABLE ZIBM001.TBL01 TO PUBLIC;
```

Db2 – DBA and Systems Programmer View

- System Parameters and Db2 ZPARMs
- JCL PROCLIB
- Boot Strap Data Set (BSDS)
- Active and Archive Logs
- Buffer Pools
- Distributed Data Facility (DDF)
- Db2 Directory (DSNDB01)
- Db2 Default Databases (DSNDB04)
- Db2 Catalog (DSNDB06)

Db2 for z/OS – Systems Programmer View

z/OS System Parameters - SSID - Db2 ZPARMs - Subsystem Name

PARMLIB (IEFSSNxx)
DBCG,DSN3INI,'DSN3EP,**-DBCG**,S,DBCG'

MVS command to start DB2 environment
-DBCG START DB2

DSNC10.NEW.SDSNSAMP(DSNTIJUZ)
DSNZPARM – aka ZPARMs global parameter values

Db2 – DBA and Systems Programmer View

JCL PROCLIB

ssnmMSTR - DB2 Master Facility

ssnmDBM1 - DB2 Data Base Manager Facility

ssnmDIST - DB2 Distributed Data Facility

ssnmIRLM - DB2 Lock Manager Facility

ssnmWLMx - DB2 Work Load Manager Facility

where **ssnm** (subsystem name) is selected during installation process

```
//DBCGMSTR   PROC
//IEFPROC    EXEC   PGM=DSNYASCP,PARM='ZPARM(DSNZPARM)‘
//STEPLIB    DD     DISP=SHR,DSN=DSNC10.DB9G.SDSNEXIT
//       DD     DISP=SHR,DSN=DSNC10.SDSNLOAD
//BSDS1      DD     DISP=SHR,DSN=DSNC10.DBCG.BSDS01
//BSDS2      DD     DISP=SHR,DSN=DSNC10.DBCG.BSDS02
```

Db2 – DBA and Systems Programmer View

Boot Strap Data Set (BSDS)

The bootstrap data set (BSDS) is a VSAM key-sequenced data set (KSDS) that contains information critical to Db2.

Specifically, the BSDS contains an inventory of all active and archive log data sets known to Db2. Db2 uses this information to track the active and archive log data sets.

Db2 also uses this information to locate log records to satisfy log read requests during normal Db2 system activity and during restart and recovery processing.

Db2 – DBA and Systems Programmer View

Active and Archive Logs

Active log data sets record significant events and data changes.

Active log data sets are periodically offloaded to the **archive log**.

Therefore, the storage requirements for your active log data sets depend on how often Db2 data is changed at your site and how often Db2 offloads those changes to the **archive log**.

-DBCG DISPLAY LOG

```
DSNJ370I  -DBCG DSNJC00A LOG DISPLAY
CURRENT COPY1 LOG = DSNC10.DBCG.LOGCOPY1.DS01 IS 18%
FULL
CURRENT COPY2 LOG = DSNC10.DBCG.LOGCOPY2.DS01 IS 18%
FULL
        H/W RBA = 0003C23D1819
        H/O RBA = 0003C1DFFFFF
        FULL LOGS TO OFFLOAD = 0 OF 6
        OFFLOAD TASK IS (AVAILABLE)
DSNJ371I  -DBCG DB2 RESTARTED 14:37:29 FEB 24, 2010
        RESTART RBA 0003C23CD000
        CHECKPOINT FREQUENCY 50000 LOGRECORDS
        LAST SYSTEM CHECKPOINT TAKEN 14:37:36 FEB 24, 2010
DSN9022I  -DBCG DSNJC001 '-DISPLAY LOG' NORMAL COMPLETION
```

Db2 – Buffer Pools

Buffer pools are areas of **virtual storage** in which DB2 temporarily stores pages of table spaces or indexes.

When an application program accesses a row of a table, DB2 retrieves the page containing that row and **places the page in a buffer**.

If the needed data is already in a buffer, the application program does not have to wait for it to be retrieved from disk, significantly **reducing the cost of retrieving the page**.

Buffer pools require monitoring and tuning.

The size of **buffer pools** is **critical to the performance** characteristics of an application or group of applications that access data in those buffer pools.

Db2 – Buffer Pools

80 virtual buffer pools

- 50 **4K** page buffer pools
  BP0–BP49
- 10 **8K** page buffer pools
  BP8K0–BP8K9
- 10 **16K** page buffer pools
  BP16K0-BP16K9
- 10 **32K** page buffer pools
  BP32K0-BP32K9

-DBCG DISPLAY BUFFERPOOL(BP0)

```
DSNB401I  -DB9G BUFFERPOOL NAME BP0, BUFFERPOOL ID 0, USE COUNT 10
DSNB402I  -DB9G BUFFER POOL SIZE = 20000 BUFFERS  AUTOSIZE = NO
          ALLOCATED      =    20000   TO BE DELETED   =       0
          IN-USE/UPDATED  =       0   BUFFERS ACTIVE  =     120
```

-DBCG DISPLAY BUFFERPOOL(BP1)

```
DSNB401I  -DB9G BUFFERPOOL NAME BP1, BUFFERPOOL ID 1, USE COUNT 0
DSNB402I  -DB9G BUFFER POOL SIZE = 0 BUFFERS  AUTOSIZE = NO
          ALLOCATED      =       0   TO BE DELETED   =       0
          IN-USE/UPDATED  =       0   BUFFERS ACTIVE  =       0
```

Db2 – DBA and Systems Programmer View

-DBCG DISPLAY DDF

DSNL080I -DBCG DSNLTDDF DISPLAY DDF REPORT FOLLOWS:
DSNL082I LOCATION LUNAME
DSNL083I **DALLASC** USASDV02.DBCGLU1
DSNL084I TCPPORT=**5040** SECPORT=0 RESPORT=5041
DSNL085I IPADDR=::**192.86.32.67**
DSNL086I SQL DOMAIN=S0W1.DAL-EBIS.IHOST.COM

Starting Db2 for z/OS

-DB9G START DB2

S DB9GMSTR
$HASP373 DB9GMSTR STARTED
DSNY024I -DB9G DSNYASCP MSTR INITIALIZATION IS STARTING
DSNZ002I -DB9G DSNZINIT SUBSYSTEM DB9G SYSTEM PARAMETERS LOAD MODULE NAME IS DB9GPARM

S DB9GIRLM
$HASP373 DB9GIRLM STARTED
DXR117I DJ9G001 INITIALIZATION COMPLETE
DSNY001I -DB9G SUBSYSTEM STARTING
DSNJ127I -DB9G SYSTEM TIMESTAMP FOR BSDS= 10.055 08:31:11.86
DSNJ001I -DB9G DSNJW007 CURRENT COPY 1 ACTIVE LOG DATA SET IS DSNAME=DSN910.DB9G.LOGCOPY1.DS01, STARTRBA=0003C1E00000,ENDRBA=0003C3FBFFFF
DSNJ099I -DB9G LOG RECORDING TO COMMENCE WITH STARTRBA=0003C23CD000

S DB9GDBM1
$HASP373 DB9GDBM1 STARTED
DSNY024I -DB9G DSNYASCP DBM1 INITIALIZATION IS STARTING

S DB9GDIST
$HASP373 DB9GDIST STARTED
DSNY024I -DB9G DSNYASCP DIST INITIALIZATION IS STARTING
DSNR001I -DB9G RESTART INITIATED

Db2 for z/OS in EXECTION

SDSF STATUS DISPLAY ALL CLASSES

PREFIX=DB* DEST=(ALL) OWNER=*

NP	JOBNAME	JobID	Owner	Prty	Queue
	DB9GDIST	STC01095	STCOPER	15	EXECUTION
	DB9GDBM1	STC01094	STCOPER	15	EXECUTION
	DB9GIRLM	STC01093	STCOPER	15	EXECUTION
	DB9GMSTR	STC01092	STCOPER	15	EXECUTION

Db2 Professional Manuals and Documentation

Db2 12 for z/OS Product Documentation

Unit summary

Having completed this unit, you should be able to:

- Describe Db2
- List 4 types of SQL
- List SQL statements
- Understand Db2 Programming Language APIs
- Understand Db2 Structures
- Understand Active and Archive Logging
- List 4 Db2 bufferpool sizes