



# z/OS Introduction and Workshop

## DB2 for z/OS

# 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

Previous database systems stored information in one long text file, called a tab delimited file. Each entry in the tab delimited file is separated by a special character and contained multiple pieces of information (fields) about a particular object.

The text file makes it difficult to search for specific information or to create reports that include only certain fields from each record.

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**

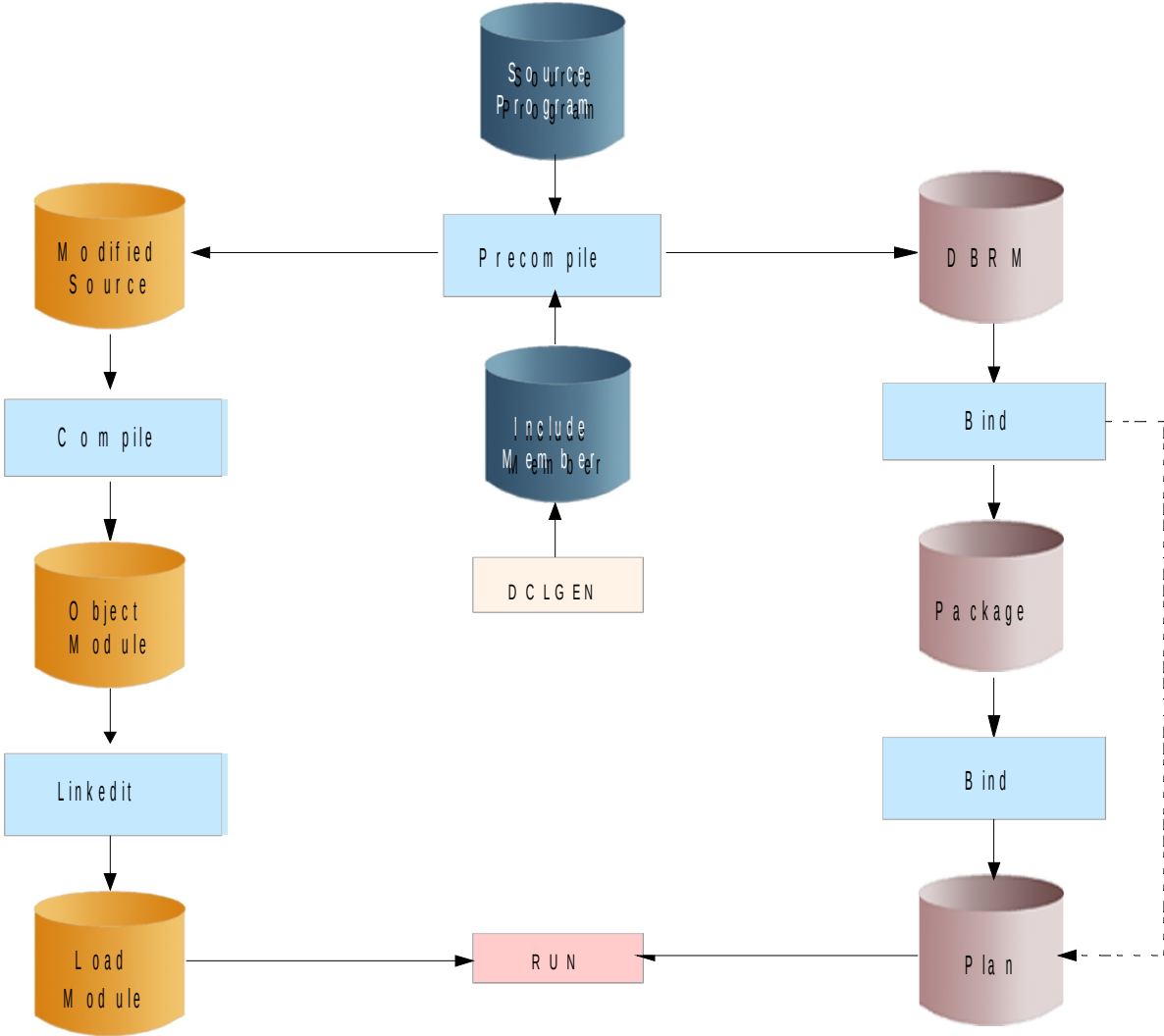
## Application Program Interface (API)

**EXEC SQL** ....

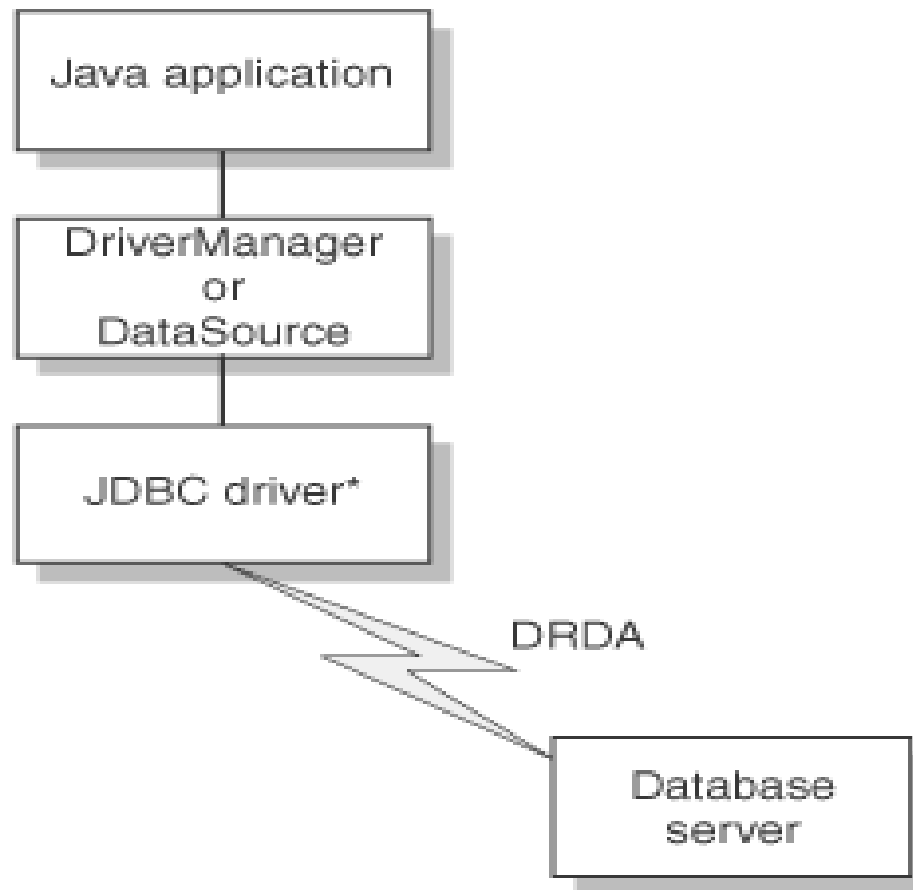
DML	<b>select</b>	<b>insert</b>	<b>update</b>
DDL	<b>create</b>	<b>drop</b>	<b>alter</b>
DCL	<b>grant</b>	<b>revoke</b>	
TCL	<b>commit</b>	<b>rollback</b>	



# DB2 - Application Programming



## DB2 - Application Programming



\*Java byte code executed under JVM

## DB2 for z/OS Interfaces

DB2 tool set (3270 based)

SPUFI

DCLGEN

Bind/Rebind

Command Processor

Utilities

Defaults

Administration

Performance Expert

Control Center (GUI)

RDz (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* (**Cluster name**)  
*vcat*.DSNDB**D**.*dbname.tsname.y0001.z001* (**Data component of cluster**)

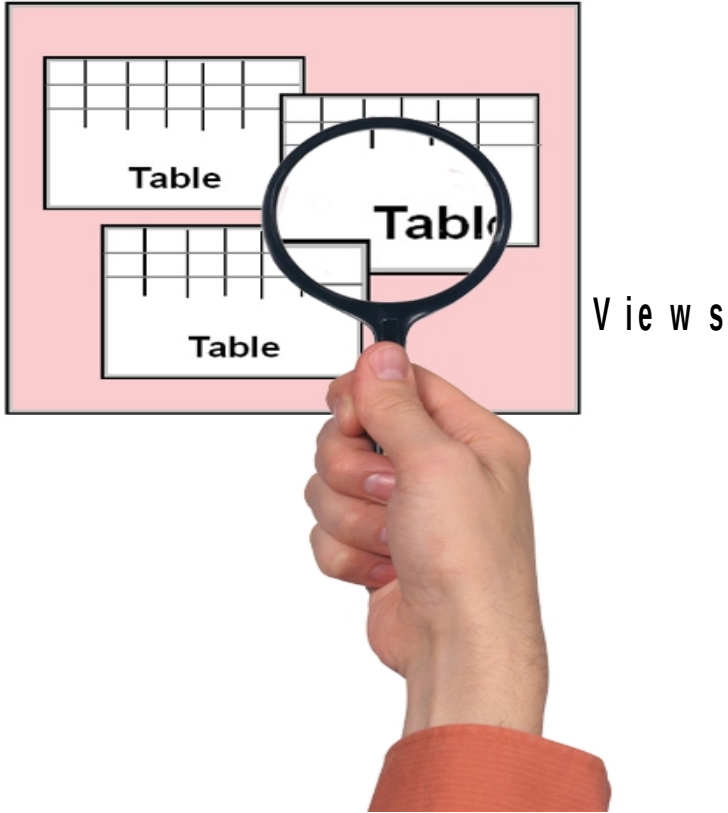
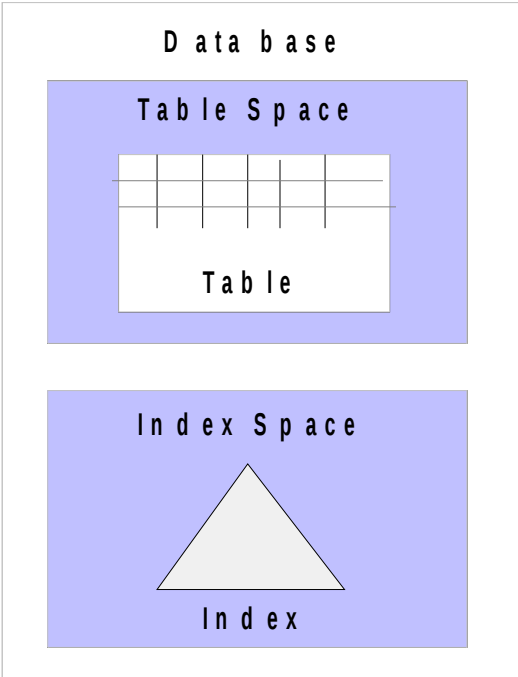
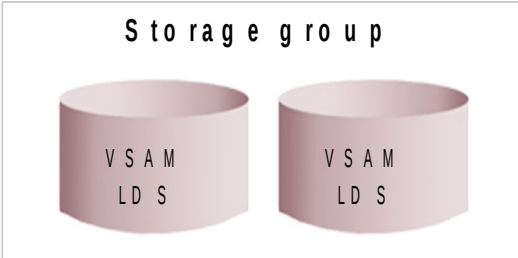
*y0001.z001* (instance#. dataset #)

*tsname* (tablespace name)

*dbname* (database name)

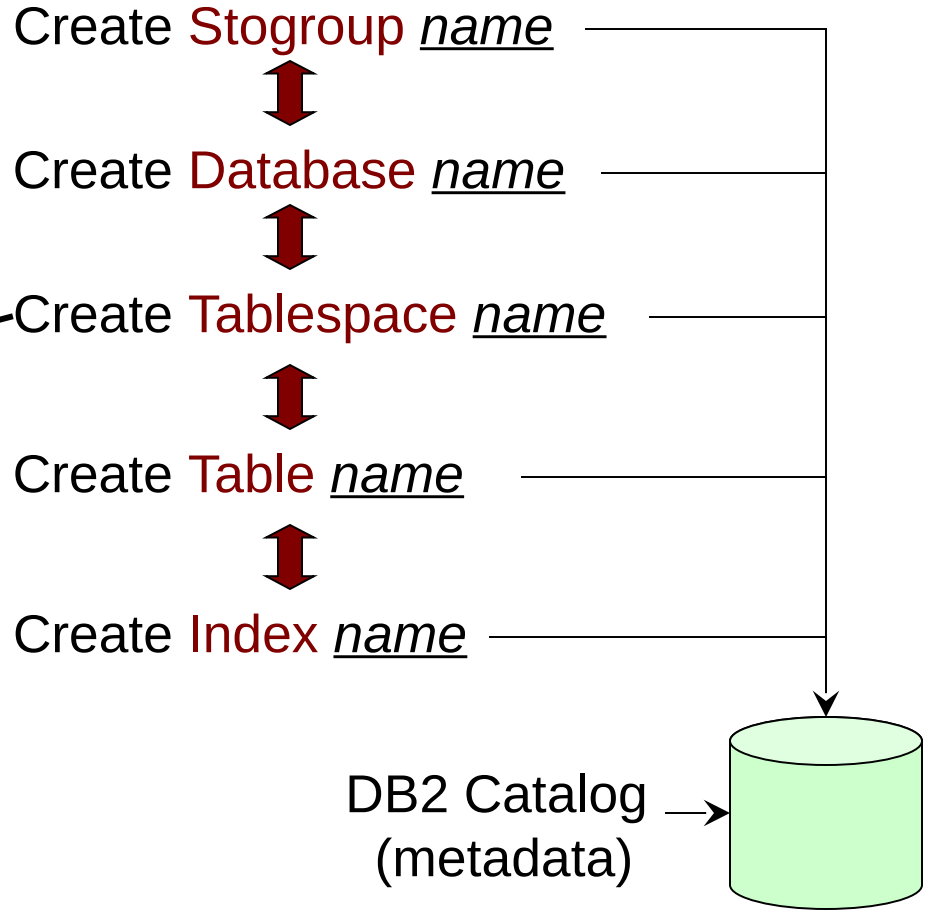
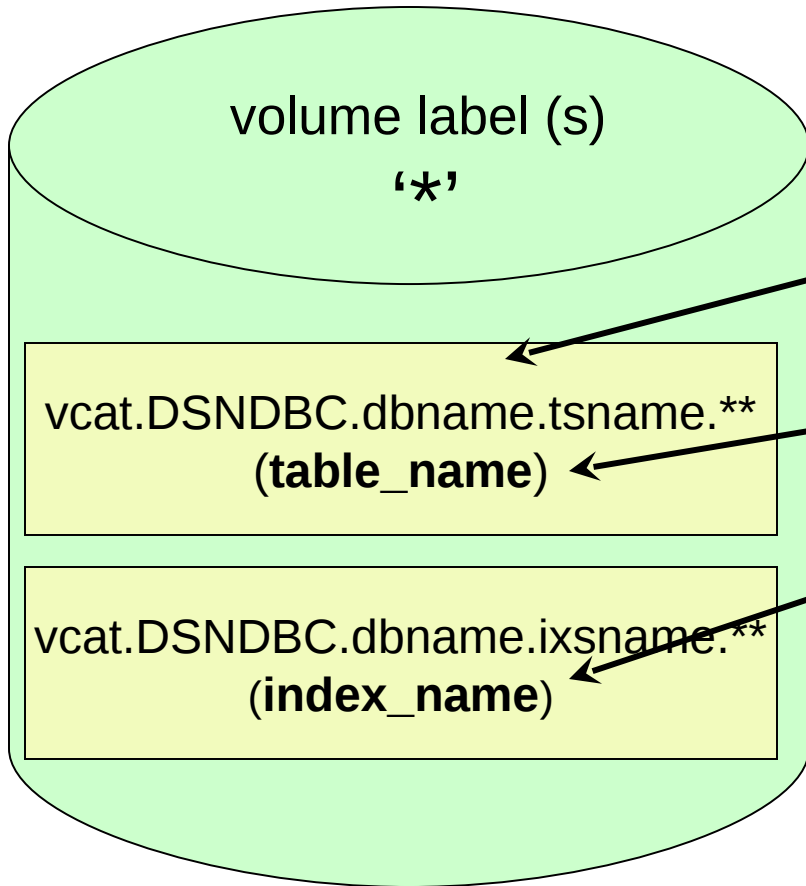
*vcat* (typically an 'alias' in the master catalog)

# DB2 for z/OS Data Structures



# DB2 for z/OS Data Structures

'\*' SMS managed storage (ACS routine)





## 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 and DB2 ZPARMs  
SubSystem Name ID = SSID

PARMLIB (IEFSSNxx)  
**DB9G,DSN3INI,'DSN3EP,-DB9G,S,DB9G'**

MVS command to start DB2 environment  
**-DB9G START DB2**

DSN910.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

```
//DB9GMSTR  PROC
//IEFPROC   EXEC  PGM=DSNYASCP,PARM='ZPARAM(DSNZPARAM)'
//STEPLIB   DD    DISP=SHR,DSN=DSN910.DB9G.SDSNEXIT
//          DD    DISP=SHR,DSN=DSN910.SDSNLOAD
//BSDS1    DD    DISP=SHR,DSN=DSN910.DB9G.BSDS01
//BSDS2    DD    DISP=SHR,DSN=DSN910.DB9G.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**.

### -DB9G DISPLAY LOG

```
DSNJ370I -DB9G DSNJC00A LOG DISPLAY
CURRENT COPY1 LOG = DSN910.DB9G.LOGCOPY1.DS01 IS 18% FULL
CURRENT COPY2 LOG = DSN910.DB9G.LOGCOPY2.DS01 IS 18% FULL
      H/W RBA = 0003C23D1819
      H/O RBA = 0003C1DFFFFFF
      FULL LOGS TO OFFLOAD = 0 OF 6
      OFFLOAD TASK IS (AVAILABLE)
DSNJ371I -DB9G 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 -DB9G 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

### **-DB9G 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

### **-DB9G 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

-DB9G DISPLAY DDF

DSNL080I -DB9G DSNLTDDF DISPLAY DDF REPORT FOLLOWS:

DSNL082I LOCATION LUNAME

DSNL083I **DALLAS9** USASDV02.DB9GLU1

DSNL084I **TCPPORT=5025** SECPOR=0 RESPOR=5026

DSNL085I **IPADDR=::204.90.115.184**

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
```

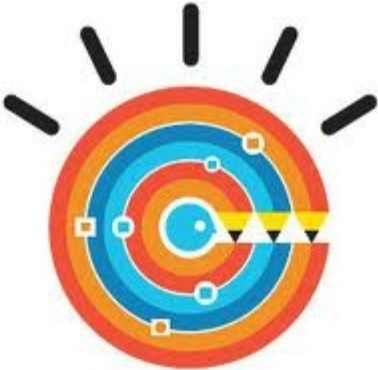
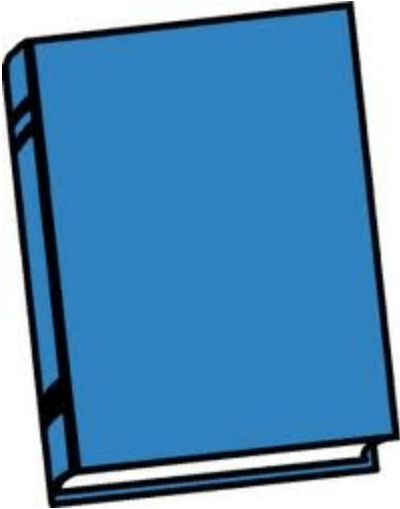
# DB2 for z/OS in EXECUTION

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





# 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