

## Db2 Application Programming and Design v11

### Course Summary

#### Description

This course focuses on best practices used to design, create, and process a Relational Database structure using up to and including version 11 of Db2 for z/OS.

The student will demonstrate how to use Entity Relationship Modeling and Normalization techniques to design logical data models that can support Referential Integrity.

The student will learn how to define basic Db2 objects, such as Tables, Indexes, Views and Aliases. The student will demonstrate how to effectively and efficiently use SQL to extract and manipulate data in Db2 database objects, with an emphasis on performance considerations. Participants will design, code and test application programs using embedded SQL to process data in Db2. The students will demonstrate the process of precompiling, compiling, linking and binding Db2 application programs. Students will learn how security is implemented in Db2.

There are many labs throughout the course where the student will be able to practice the skills they have learned in this extensive 5-day course.

#### Objectives

After taking this course, students will be able to:

- Students will demonstrate how to use Entity Relationship Modeling and Normalization techniques to design logical data models that can support Referential Integrity.
- Students will learn how to define basic Db2 objects, such as Tables, Indexes, Views and Synonyms.
- Students will demonstrate how to effectively and efficiently use SQL to extract and manipulate data in Db2 database objects, with an emphasis on performance considerations.
- Participants will design, code and test application programs using embedded SQL to process data in Db2.
- Students will demonstrate the process of precompiling, compiling, linking and binding Db2 application programs.
- Students will learn how security is implemented in Db2.

#### Topics

- Db2 Concepts, Terminology, and Storage Concepts
- Entity Relationship Modeling Techniques
- Logical and Physical Database Design
- Referential Integrity Rules
- Basic SQL - Using SELECT, INSERT, UPDATE, DELETE, TRUNCATE and MERGE
- Advanced SQL – Using JOIN, Subquery, UNION, EXCEPT, INTERSECT and Nested Table Expression
- Basic Data Definition Language (DDL) - Used to Create and Modify Db2 Objects, such as Tables, Views, Indexes and Synonyms
- Application Coding Considerations, including use of Host Variables, Standard Cursors, Scrollable Cursors and Non-Cursor Processing
- Program Preparation, Bind and Locking Strategies
- SQL Performance Considerations
- Benefits of EXPLAIN
- Implementing Security by using GRANT and REVOKE to control Object Privileges

## **Db2 Application Programming and Design v11**

### **Course Summary (cont'd)**

#### **Audience**

This course is designed for application programmers and programmer/analysts who will write SQL statements in a high level programming language (such as COBOL, C, PL/1) to manipulate Db2 tables in a mainframe CICS, TSO or IMS/TM environment. This course would also be beneficial to analysts and database administrators who support application teams.

#### **Prerequisites**

Students should have experience coding in one the programming languages listed (COBOL, C, PL/1), experience with TSO/ISPF and experience with file structures such as VSAM, IMS, or QSAM.

#### **Duration**

Five days

## Db2 Application Programming and Design v11

### Course Outline

- I. Entity Relationship Modeling**
  - A. Introduction to Database Design
  - B. Defining the Mission
  - C. Entity Relationships – Modeling and Diagrams
  - D. Entity Relationship Diagrams - Notational Conventions
  - E. Association Entities
    - 1. Drawings Guidelines
    - 2. EXERCISE - Entity Relationship Diagrams
  - F. Data Elements and Primary Keys
    - 1. EXERCISE – Assign Data Elements and Primary Keys
- II. Normalization**
  - A. Introduction to Normalization
  - B. First Cut
  - C. Overview of Normal Forms
  - D. First Normal Form (1NF)
  - E. Second Normal Form (2NF)
  - F. Third Normal Form (3NF)
  - G. Derived Columns
  - H. Logical Design Evaluation
  - I. Benefits of Normalization
  - J. Denormalization
  - K. Referential Integrity
    - 1. Delete Concepts
    - 2. Insert and Update Implications
    - 3. Summary
  - L. Transition from Logical to Physical
    - 1. EXERCISE – Normalization
- III. Db2 Overview and Storage Concepts**
  - A. What is Db2?
  - B. What is the History behind Db2?
  - C. What are Db2's Objectives?
  - D. What is a Relational DBMS?
  - E. What are Db2's Features?
  - F. Operational Environment
  - G. SQL
  - H. Program Preparation Process
  - I. Unit of Recovery
  - J. Commit / Rollback
  - K. Db2 Terminology
  - L. Physical Hierarchy of Db2 Objects
- M. Naming Conventions**
- N. Object Naming Conventions**
- O. Databases**
- P. Db2 and VSAM**
- Q. Storage Groups**
- R. Page Management**
- S. Tablespace**
- T. Segmented Tablespaces**
- U. Partitioned Tables**
- V. Base Tables**
- W. View Table**
- X. Synonym**
- Y. Indexes**
- Z. Stored Procedures and Functions**
- AA. Db2 String Data Types**
- BB. Db2 Numeric Data Types**
- CC. Data and Time Data Types**
- DD. Display Formats**
- EE. ROWID Data Type versus Identity Column Attribute**
- FF. User-Defined Data Type**
- GG. Db2 Catalogs**
- IV. Basic SQL - SELECT**
  - A. Table Names
  - B. Basic SELECT Statement
  - C. WHERE Clause
  - D. INEQUALITIES
  - E. Specific Column Selection
  - F. Case Expression
  - G. Derived Columns
  - H. Date and Time Usage
  - I. Common Special Registers
  - J. User Request #1
  - K. ORDER BY Clause - The Results Table Sort
  - L. Ordering Derived Columns
  - M. Order By and Fetch First n Rows ONLY
  - N. DISTINCT Operand
  - O. Expanding on the WHERE Clause
  - P. Multiple Conditions
  - Q. BETWEEN Clause
  - R. IN Clause
  - S. LIKE Clause
  - T. User Request #2

## Db2 Application Programming and Design v11

### Course Outline (cont'd)

- U. Negative logic
  - V. NULLS
  - W. IS DISTINCT FROM
  - X. Types of Built-In Functions
  - Y. Aggregate Functions
  - Z. Functions Involving NULL Values
  - AA. NULL Values are Considered In
  - BB. User Request # 3
  - CC. Scalar Functions
    - 1. CHAR
    - 2. Date or Time
    - 3. Hour, Minute, Second, Year, Month, Day
    - 4. Days
    - 5. Decimal
    - 6. ROUND
    - 7. TRUNC
    - 8. Digits
    - 9. Integer
    - 10. CAST
    - 11. COALESCE
    - 12. UPPER and LOWER
    - 13. Strip
    - 14. POSSTR
    - 15. Substr
    - 16. Concatenation
  - DD. GROUP BY Clause
  - EE. HAVING Clause
  - FF. User Request # 4
- V. Advanced SQL - SELECT**
- A. Join
  - B. Inner Join
  - C. Full Outer Join
  - D. Left - Right Outer Join
  - E. Joins of More Than 2 Tables
  - F. User Request # 5
  - G. Subquery
  - H. Single Value Subquery
  - I. Multivalued Subqueries
  - J. Multivalued Subqueries - ALL
  - K. Multivalued Subqueries - ANY or SOME
  - L. Multiple Column Subqueries
  - M. User request # 6
  - N. Correlated Subqueries
  - O. Correlated Subqueries - Exists
  - P. Using Correlation Variables to Check R.I.
  - Q. Nested table Expression
  - R. Union
  - S. Union All
  - T. Rules for Union
  - U. Performance Considerations
  - V. INTERSECT
  - W. EXCEPT
  - X. User Request #7
- VI. Update Data Manipulation**
- A. Insert
  - B. Update
  - C. SELECT FROM UPDATE
  - D. Delete
  - E. Truncate
  - F. SELECT FROM Delete
  - G. merge
  - H. Db2 Valid SQL Return Codes for Updating
- VII. Creating Db2 Objects using Data Definition Language**
- A. Structured Query Language (SQL)
  - B. DDL - Create Table Statement
  - C. Identity Column
  - D. Check Constraints
  - E. Alter Table Statement
  - F. Not NULL with Default
  - G. Referential Integrity
  - H. Synonyms
  - I. Deleting Db2 Objects
  - J. Index
  - K. Unique Versus Non-Unique Indexes
  - L. Cluster versus Non-Cluster Indexes
  - M. Cluster Index
  - N. Index Create
  - O. Partitioned Table
  - P. Views
  - Q. Creating Common Tables Expressions

## Db2 Application Programming and Design v11

### Course Outline (cont'd)

#### VIII. Application Program Considerations

- A. Db2 Program Components
- B. Db2 Additions to a Program Structure
- C. Delimiters
- D. Program Storage - Host Variables
- E. Program Storage - DCLGEN
- F. DCLGEN Utility
- G. Expanded Include Member
- H. SQLCA - SQL Communication Area
- I. SQLCA Field Definitions
- J. SQLWarning Definition
- K. Error Handling
- L. Unit of Work in an Application Program
- M. Commit
- N. Overview of Cursor and Non-Cursor Processing
- O. Non-Cursor Processing
- P. Db2 to Host Language Data Type Conversion Chart
- Q. Host Structures
- R. Host Structure Arrays
- S. How to Handle NULLS
- T. Non-Cursor Exercise
- U. Cursor Processing Overview
- V. Declaring a Standard Cursor
- W. Declaring a Static, Dynamic or Rowset Scrollable Cursor
- X. OPEN Cursor
- Y. FETCH Standard Cursor
- Z. FETCH Scrollable Cursor
- AA. FETCH Rowset Cursor
- BB. Chapter Six - Application Program Considerations - continued
- CC. Cursor Update or Delete
- DD. CLOSE Cursor
- EE. Set Level Update in an Application Program
- FF. Example COBOL Program
- GG. Cursor Exercise

#### IX. Program Preparation, Bind and Locking

- A. Overall Procedure
- B. Precompile
- C. Db2 to Host Language Translations
- D. Bind Procedure
- E. Bind Panel
- F. Rebind and Free
- G. Validate Option
- H. Timestamp
- I. Program Isolation
- J. Lock Table
- K. Lock Duration

#### X. Security

- A. Security Overview
- B. Resources and Users
- C. Privileges
- D. Implicit Versus Explicit
- E. Grant
- F. Revoke
- G. Secondary Auth-ID
- H. Role

#### XI. Application Performance Considerations

- A. Application Tuning - Performance
- B. Application Tuning - Explain

#### XII. Db2 Application Programming Labs

- A. LAB 1 - Creating Tables
- B. LAB 2 - Loading Tables
- C. LAB 3 - DCLGEN
- D. LAB 4 - Coding Exercise
- E. Extra Challenge Problems - Optional for this Lab