

## Mainframe Developer Bootcamp

### Course Summary

#### Description

As more of the so-called "Baby Boomer" generation retires, organizations are looking to replace legacy staff. ProTech has been training mainframe developers for over twenty-five years, most recently as part of IBM's Academic Initiative.

This rigorous hands-on course is designed to mold students into competent developers utilizing instructor-led classroom discussion and real-world lab environment with a true z/OS mainframe system. Clients may also opt to have this course delivered using their own system.

This multi-week course can include a number of optional modules on various mainframe subsystems, customer-specific developer tools and life-cycle information. Additionally ProTech's instructors can be retained for ongoing mentoring and project support

#### Topics

- TSO/ISPF, JCL & Utilities (5)
- COBOL Application Programming (10)
- VSAM (4)
- DB2 Application Programming and Design (5)
- CICS/TS Command Level Application Programming (5) - Optional
- IMS Basic Programming Techniques (3) – Optional
- Developer tools - Optional

#### Audience

This course is intended for existing programmers who have not yet worked with the mainframe system, entry-level developers interested in starting their careers in COBOL development, or new-hires.

#### Prerequisites

Experience in programming concepts and at least one high-level language such as Java or C/C++ is beneficial but not required.

#### Duration

24-33 days (by option)

## Mainframe Developer Bootcamp

### Course Outline

#### I. MVS Overview

- A. zSeries & S/390 Operating Systems
- B. A Typical zSeries Data Center
- C. Real & Virtual Memory
- D. Multiprogramming vs. Multiprocessing
- E. Interrupts
- F. Bits and Bytes
- G. EBCDIC vs. ASCII
- H. The CPU (Central Processing Unit)
- I. MVS in a TCP/IP Network
- J. Understanding the Network Controllers
- K. Understanding the 3270 Terminal
- L. S/390 Printer Hardware Categories
- M. Storage Devices: DASD
- N. Storage Device Connections
- O. Storage Subsystems
- P. MVS Address Spaces
- Q. MVS Data Spaces
- R. z/OS 64 Bit Address Space
- S. MVS HiperSpaces
- T. MVS Dispatching
- U. MVS Customization
- V. The MCS Console
- W. MVS Data Management
- X. MVS Data Set Types
- Y. Sequential Datasets
- Z. Partitioned Datasets
- AA. VSAM Datasets
- BB. Systems Managed Storage (SMS)
- CC. Catalogs
- DD. VTOC: Volume Table of Contents
- EE. Tape Labels
- FF. Recovery / Termination Mgmt
- GG. SMF - System Management Facilities
- HH. Serialization: ENQ / DEQ
- II. Shared DASD & Reserve/Release
- JJ. Security Overview
- KK. JES Overview
- LL. Job Life Cycle Phases
- MM. Job Execution Phase
- NN. JES2 vs. JES3
- OO. A Parallel Sysplex
- PP. UNIX System Services
- QQ. The UNIX Hierarchical File System
- RR. The UNIX Shell
- SS. Using the OMVS TSO Command
- TT. File Mgmt using the ISPF Shell
- UU. Program Products: CICS
- VV. Program Products: DB2

- WW. Program Products: IMS
- XX. Today's Application Architectures
- YY. Program Products: WebSphere MQ
- ZZ. What is a Job Scheduler?

#### II. TSO/E and ISPF Overview

- A. TSO/E Overview: Features
- B. TSO Operating Modes
- C. Interactive TSO Commands
- D. TSO/E Logon and Logoff
- E. TSO/E Line Mode
- F. ISPF/PDF Option 6
- G. Issuing TSO cmd from ISPF Panel
- H. TSO/E Command Syntax
- I. TSO/E PROFILE
- J. TSO/E REXX & CLIST
- K. Example REXX EXEC
- L. REXX Language Features
- M. Languages: Compiled vs. Scripting
- N. ISPF Overview
- O. What is a Panel?
- P. Menu Panel
- Q. List Panel
- R. EDIT PANEL
- S. ISPF Primary Option Menu
- T. Standard CUA Format
- U. ISPF Panel Terminology
- V. ISPF Hierarchy
- W. ISPF Panel Hierarchies
- X. ISPF Navigation
- Y. ISPF Line and Primary Commands
- Z. ISPF Primary Commands
- AA. ISPF Split Screen
- BB. ISPF Help

#### III. Navigating MVS Documentation

- A. IBM Library Reader on CD
- B. IBM Internet Library
- C. MVS/QuickRef Overview
- D. Abend Code Display
- E. Select Information By Category
- F. Sample JCL Information: NOTIFY  
Keyword
- G. Looking up an Error by Message ID
- H. Example Error Message Info: IOS000I
- I. Selecting Vendor, Product, Release
- J. Selecting DASD Free Space Information
- K. Displaying DASD Hardware  
Characteristics

## Mainframe Developer Bootcamp

### Course Outline (cont'd)

#### IV. ISPF Hierarchy & Settings

- A. Primary Option Menu
- B. Utility Selection Panel (=3)
- C. Library Utility 3.1
- D. Data Set Utility 3.2
- E. Move Copy Utility 3.3
- F. Data Set List Utility 3.4
- G. ISPF Jump Function
- H. Allocating Data Sets w/ ISPF
- I. Data Set Allocation
- J. Allocation Suggestions
- K. ISPF Settings
- L. PF Key Definitions and Labels
- M. Keylist Utility
- N. FKA / PFSHOW Example
- O. Other ISPF Settings: Color, Environ

#### V. ISPF Edit and View

- A. ISPF Edit, View, Browse
- B. Edit Panel: Action Bar Choices
- C. ISPF Edit Primary Commands
- D. ISPF Edit Scroll Commands
- E. Browse and Edit FIND command
- F. Edit Change Command
- G. Change Command Examples
- H. FIND command: Advanced topics
- I. Edit Session: Sequence Numbers
- J. Special Editing Keys: Insert, Delete, & EOF
- K. Line Edit Commands
- L. Advanced Edit Line Commands
- M. Text Entry mode
- N. Text Flow Line Command
- O. MASK and TS Line Command
- P. Column and Data Shifting
- Q. ISPF Edit Primary Commands
- R. Locate Primary Commands
- S. Delete Primary Commands
- T. SORT Primary Command
- U. COPY & MOVE Primary Commands
- V. CUT & PASTE Primary Commands
- W. Data Movement Commands
- X. Nesting Edit

#### VI. SDSF Overview & Features

- A. SDSF Primary Option Menu
- B. SDSF Key End-User Commands

- C. SDSF Input Queue Display
- D. SDSF Input Action Characters
- E. SDSF Active Display
- F. SDSF Held Output Queue Display
- G. SDSF Output Queue Display Cmd
- H. More SDSF Commands

#### VII. MVS Job Control Language

- A. JCL Overview and Syntax
- B. JCL Statement Types Covered
- C. JCL Statement Categories
- D. JCL Syntax: Fields
- E. JCL Syntax: Parameters
- F. JCL Syntax: Comments
- G. JCL Syntax: Continuation
- H. JES JCL Statements
- I. JOB Statement
- J. JOB Statement: Jobname
- K. JOB Statement: Accounting Info
- L. JOB Statement: Programmer-Name
- M. JOB Statement: Apostrophe Rules
- N. JOB Statement: Keyword Parameters
- O. JOB Statement: CLASS Keyword
- P. JOB Statement: MSGCLASS Keyword
- Q. JOB Statement: MSGLEVEL Keyword
- R. JOB Statement: NOTIFY Keyword
- S. JOB Statement: TYPRUN Keyword
- T. JOB Statement: RESTART Keyword
- U. JOB Statement: Other Keywords
- V. MVS Utilities: IEFBR14
- W. EXEC Statement
- X. Big Picture: Compile & Link Process
- Y. EXEC Statement: PGM Keyword
- Z. EXEC Statement: PROC Keyword
- AA. EXEC Statement: PARM Keyword
- BB. Using PARM in a COBOL Program
- CC. EXEC Statement: TIME Keyword
- DD. EXEC Statement: REGION Keyword
- EE. EXEC Statement: COND Keyword
- FF. DD Statement
- GG. DD Statement: DDNAME
- HH. Referring to the DDNAME in COBOL
- II. DD Statement: SYSOUT=
- JJ. DD Statement: \*
- KK. DD Statement: DATA
- LL. DD Statement: DUMMY
- MM. MVS Utilities: IEBGENER

## Mainframe Developer Bootcamp

### Course Outline (cont'd)

- NN. DD Statement: DSN=
- OO. DD Statement: DISP=
- PP. DD Statement: UNIT=
- QQ. DD Statement: VOL= & VOL=SER=
- RR. DD Statement: DCB=
- SS. DD Statement: SPACE=
- TT. DD Statement: AVGREC=
- UU. DD Statement: LIKE=
- VV. DD Statement: Generation Data Sets
- WW. DD Statement: Backward Reference
- XX. IF / THEN / ELSE / ENDIF
- YY. Data Set Concatenation
- ZZ. Special DD Names
- AAA. JOBLIB Statement
- BBB. STEPLIB DD Statement
- CCC. JCLLIB Statement
- DDD. OUTPUT Statement
- EEE. INCLUDE Statement
- FFF. Procedures: Symbolic Parameters
- GGG. Procedures: Statement Overrides
- HHH. Procedures: Adding In-stream data
- III. SET Statement
- JJJ. SORT Overview
- KKK. Example Sort JCL
- LLL. SORT DD Statements
- MMM. SORT control statements
- VIII. COBOL Overview**
  - A. Language advantages
  - B. Coding requirements
- IX. COBOL Divisions**
  - A. Identification division
  - B. Environment division
  - C. Data division
  - D. Copy statement
  - E. Procedure division
  - F. COBOL statements
- X. I/O Operations**
  - A. OPEN statement
  - B. READ command
  - C. WRITE statement
  - D. DISPLAY statement
- XI. MOVE Statement**
  - A. Statement overview
  - B. Moving different data types
- XII. Logic Flow Control**
  - A. Dowhile vs. Dountil
  - B. PERFORM statement
  - C. Goback statement
- XIII. COBOL Compiler**
  - A. Reserved words
  - B. Compiler output improvement
  - C. Run time options
- XIV. Data Validation**
  - A. IF conditional statement
  - B. Conditional types
  - C. Nested conditionals
  - D. EVALUATE statement
- XV. Numeric Editing**
  - A. Editing concepts
  - B. Numeric sign handling
  - C. Floating dollar signs
- XVI. CICS/TS Overview**
  - A. Batch vs. on-line
  - B. Real-time
  - C. Think-time
  - D. Transactions
  - E. Pseudo-conversational
  - F. Components, functions and features
  - G. Definitions
  - H. Tables.
- XVII. Command Language Interface**
  - A. Program characteristics
  - B. Interface with CICS/TS
  - C. EXEC CICS/TS command format and argument conventions translator
  - D. Execute interface block

## Mainframe Developer Bootcamp

### Course Outline (cont'd)

#### XXVIII. Program Structure

- A. Language considerations and restrictions
- B. Linkage section usage

#### XXIX. Exception Processing

- A. Handle condition and Ignore condition
- B. Resp and Nohandle
- C. EIBRESP

#### XX. Program Control

- A. Modular structure using XCTL, LINK, CALL and RETURN
- B. Pseudo-conversational tasks using transid and commarea

#### XXI. Terminal Control

- A. SEND and RECEIVE
- B. Attention identifiers
- C. DFILAID
- D. HANDLEAID

#### XXII. File Control

- A. Random processing commands (read, update, delete, add)
- B. Browsing commands (start browse, read next, read previous, end or reset browse)
- C. Move mode (INTO) versus locate mode (SET)
- D. Exclusive control
- E. Syncpoint

#### XXIII. Basic Mapping

- A. Overview of BMS facilities
- B. Map creation (mapset definition macro, map definition macro, field definition macro)
- C. Attribute modification
- D. Cursor positioning
- E. mapping commands (SEND, RECEIVE)

#### XXIV. Transient Data and Temporary Storage

- A. Reading writing and deleting queues

#### XXV. Programing Considerations

- A. Access to system information (ADDRESS, ASSIGN)
- B. Abnormal termination and recovery (HANDLEABEND, ABEND, DUMP)
- C. Debugging facilities (CEDF)

#### XXVI. 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
- F. Drawings Guidelines
- G. EXERCISE - Entity Relationship Diagrams
- H. Data Elements and Primary Keys
- I. EXERCISE – Assign Data Elements and Primary Keys

#### XXVII. 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
- L. Delete Concepts
- M. Insert and Update Implications
- N. Summary
- O. Transition from Logical to Physical
- P. EXERCISE – Normalization

#### XXVIII. 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

## Mainframe Developer Bootcamp

### Course Outline (cont'd)

- 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
- XXIX. 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
- 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
- DD. CHAR
- EE. Date or Time
- FF. Hour, Minute, Second, Year, Month, Day
- GG. Days
- HH. Decimal
- II. ROUND
- JJ. TRUNC
- KK. Digits
- LL. Integer
- MM. CAST
- NN. COALESCE
- OO. UPPER and LOWER
- PP. Strip
- QQ. POSSTR
- RR. Substr
- SS. Concatenation
- TT. GROUP BY Clause
- UU. HAVING Clause
- VV. User Request # 4
- XXX. 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

## Mainframe Developer Bootcamp

### Course Outline (cont'd)

- 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
- XXXI. 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
  - I. Creating DB2 Objects using Data Definition Language
  - J. Structured Query Language (SQL)
  - K. DDL - Create Table Statement
  - L. Identity Column
  - M. Check Constraints
  - N. Alter Table Statement
  - O. Not NULL with Default
  - P. Referential Integrity
  - Q. Synonyms
  - R. Deleting DB2 Objects
  - S. Index
  - T. Unique Versus Non-Unique Indexes
  - U. Cluster versus Non-Cluster Indexes
  - V. Cluster Index
- XXXII. Index Create**
- A. Partitioned Table
  - B. Views
  - C. Creating Common Tables Expressions
- XXXIII. 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
- XXXIV. 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

## Mainframe Developer Bootcamp

### Course Outline (cont'd)

#### XXXV. Security

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

#### XXXVI. Application Performance Considerations

- A. Application Tuning - Performance
- B. Application Tuning - Explain
- C. DB2 Application Programming Labs
- D. LAB 1 - Creating Tables
- E. LAB 2 - Loading Tables
- F. LAB 3 - DCLGEN
- G. LAB 4 - Coding Exercise
- H. Extra Challenge Problems - Optional for this Lab

#### XXXVII. Introduction to IMS Concepts

- A. File structures
- B. Hierarchical concepts
- C. SEGMENT
- D. FIELD
- E. Sequence field
- F. Search key
- G. Parent
- H. Child
- I. Root segment
- J. Database record
- K. Twins
- L. Maximums

#### XXXVIII. Basic Database Definition

- A. The purpose
- B. Components
- C. DBD statement
- D. DATASET statement
- E. SEGM statement
- F. FIELD statement
- G. Other optional statements
- H. LCHILD statement
- I. XDFLD statement
- J. Other required statements

- K. DBDGEN statement
- L. FINISH statement
- M. END statement

#### XXXIX. Program Specific Block

- A. The purpose
- B. Application views
- C. Control statements
- D. PCB statement
- E. Program Specific Block
- F. SENSEG statement
- G. SENFLD statement
- H. PSBGEN statement

#### XL. Program Components

- A. IMS and the program
- B. IMS interface
- C. Program setup overview
- D. Program communication blocks
- E. ENTRY statement
- F. CALL statement

#### XLI. Get Calls

- A. GU
- B. GN
- C. GNP

#### XLII. Update Calls

- A. Insert
- B. Replace
- C. Delete

#### XLIII. JCL Considerations

- A. Compilation JCL
- B. Execution JCL

#### XLIV. IMS Workshop

- A. IMS workshop
- B. Client
- C. Consultant
- D. Problem
- E. Solution
- F. Procedures
- G. Database description
- H. Useful Copy Book members