Introduction to REXX Workshop
Sessions 17472-17473

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Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.

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Topics

- Introducing the Rexx Language
- Rexx Language Basics
- Tracing and Debugging Rexx Programs
- Programming in Rexx
- Conclusion and Reference Information

- Lab Exercises follow each topic
  - Solutions are included in Appendix A at end of handout
Lab Exercises (following each topic)

1. Run an existing Rexx program to create temporary disk space

2. Write a program to accept an input argument, prompt for data, and display results

3. Trace and Debug existing Rexx programs

4. Write a program to obtain z/VM CP level information *(issues commands and Diagnose 8)*

5. Write a program using a subroutine to issue CMS commands and Pipes to query accessed disks
Introducing the Rexx Language
Rexx Overview

- **RE**structured eXtended eXecutor

- Rexx is a procedural, general purpose language
  - Intuitive - easy to use and read
  - Many uses, ranging from:
    - Personal tools and utilities
      - For example, frequently used command sequences
    - Complex applications and licensed programs
  - Available on many IBM and non-IBM platforms

- Rexx is designed to be *interpreted*
  - Each program statement translated and executed as the program runs
  - Programs can also be *compiled* to improve
    - Performance
    - Security
    - Change control
Few restrictions on program format
  ► Indentation
  ► 1 or more clauses on a line
  ► /* comments can be anywhere and any length */
  ► *Implied* semicolon delimiters at end of lines
  ► Comma (, ) as a continuation character

Nothing to Declare!
  ► Implicit declarations take place during execution
Rexxx Platforms

- **IBM Platforms**
  - VM
  - TSO/E (z/OS)
  - VSE
  - AIX

- **Object Rexxx**
  - Object-Oriented Rexxx supporting many utilities for a UNIX-type environment, including Linux for System z

- **Regina Rexxx**
  - Rexxx interpreter ported to most UNIX platforms, including Linux

- **NetRexx**
  - Blend of Rexxx and Java; compiles into Java classes

- **Language concepts are the same on all platforms**
  - Minor differences such as file names and structure
  - Operating system-specific tools that support Rexxx

(See references page for website information)
Create a file with filetype of EXEC using XEDIT, the CMS editor

```
XEDIT myrexx exec a
```

Rexx programs begin with a comment line:
```
/* beginning of program */            /* Rexx */
```

Can be run uncompiled and interpreted, or compiled with the Rexx compiler.
Executing Rexx Programs: z/VM

- Search order
  - Same for both compiled and interpreted execs
  - Loaded and started through CMS EXEC handler
  - Normal CMS Command search order:
    EXECs, synonyms, MODULEs…

- Invocation
  - Invoke as a CMS command or EXEC:
    myexec -or- exec myexec

  - Implied exec (IMPEX) settings control whether exec files are treated as commands
    - SET IMPEX ON|OFF (default is ON)
    - QUERY IMPEX
Creating and Executing Rexx Programs:

TSO/E

- REXX exec can be a sequential data set or a PDS member
- TSO/E EXEC command to invoke a REXX program or a CLIST
- Three ways to use the EXEC command:
  - Explicit execution:
    ```exec dataset(member) 'parameters' operands```
  - Implicit execution:
    ```membername parameters```
  - Extended implicit execution:
    ```%membername parameters```

- Search includes:
  ```//SYSEXEC DD concatenation
  then
  //SYSPROC DD concatenation for membername on the command line```
Helpful Hints for Exercises

- List Files on A-disk:  
  FILELIST ** A  or…  LISTFILE ** A

- XEDIT a file
  - from command line:  
    Xedit <filename> <filetype> <filemode>
  - from prefix area on FILELIST Screen, PF11 or :

    x PROFILE EXEC A1 V 75 74 1 09/17/07 15:48:18

- XEDIT Prefix area commands:
  a  add (insert) a single line to the file
  d  delete a line  (d5 deletes 5 lines)
  m  move a line  (f following or p preceding)
  c  copy a line  (f following or p preceding)
  mm…mm block move, dd…dd block delete, cc…cc block copy

- Leaving XEDIT:
  - Save changes:  
    FILE
  - Quit (restore file without changes):  
    QQUIT
Helpful Hints for Exercises (cont.)

- Screen execution modes
  - **CP Read**
    - CP is waiting for a command
  - **VM Read**
    - CMS is waiting for a command
  - **Running**
    - System is ready for commands or is working on some
  - **More ...**
    - More information than can fit on the screen is waiting to be displayed
      - Clear screen manually or let CP clear after x seconds determined by TERM command setting
  - **Holding**
    - Waiting for you to clear screen manually
  - **Not Accepted**
    - Too many commands in buffer; wait for executing command to complete
Logging on to the z/VM Lab System

- 3270 Session
- Userid
- Password
Exercise 1: Create Temp Disk Space

1. **LOGON** to your VM lab userid
2. Issue command **QUERY DISK** to see which disks are accessed
3. Run existing exec **GETTEMP mode** (*mode* is input parameter) to:
   - create a temporary disk at filemode *mode*
   - copy existing EXEC programs from a-disk to new temp disk
   - Note: – *mode* can be a letter from *b - z* representing an unused disk mode
4. Issue **QUERY DISK** again – notice new disk at *mode*
5. Issue command **FILELIST * * mode**
6. Run **GETTEMP** again with mode *a*
7. Issue **QUERY DISK** again – notice new disk at mode *a*
8. **LOGOFF**
Exercise 1: Create Temp Disk Space – Answer

query disk

<table>
<thead>
<tr>
<th>LABEL</th>
<th>VDEV</th>
<th>M</th>
<th>STAT</th>
<th>CYL</th>
<th>TYPE</th>
<th>BLKSZ</th>
<th>FILES</th>
<th>BLKS USED-%</th>
<th>BLKS LEFT</th>
<th>BLK TOTAL</th>
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<tbody>
<tr>
<td>-</td>
<td>DIR</td>
<td>A</td>
<td>R/W</td>
<td>-</td>
<td>-</td>
<td>4096</td>
<td>44</td>
<td>-</td>
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<tr>
<td>MNT190</td>
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<td>S</td>
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<td>115</td>
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<td>R/O</td>
<td>355</td>
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<td>13905</td>
<td>63900</td>
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<tr>
<td>TMP555</td>
<td>555</td>
<td>Z</td>
<td>R/W</td>
<td>2</td>
<td>3390</td>
<td>4096</td>
<td>19</td>
<td>60-17</td>
<td>300</td>
<td>360</td>
</tr>
</tbody>
</table>

gettemp z

HCPDTV040E Device 0555 does not exist
DASD 0555 DEFINED
DMSFOR603R FORMAT will erase all files on disk Z(555). Do you wish to continue?
Enter 1 (YES) or 0 (NO).
DMSFOR605R Enter disk label:
DMSFOR733I Formatting disk Z
DMSFOR732I 2 cylinders formatted on Z(555)

query disk
Exercise 1: Create Temp Disk Space - Answer..

```plaintext
gettemp a

DASD 0555 DETACHED
DASD 0555 DEFINED
DMSFOR603R FORMAT will erase all files on disk A(555). Do you wish to continue?
Enter 1 (YES) or 0 (NO).
DMSFOR605R Enter disk label:
DMSFOR733I Formatting disk A
DMSFOR732I 2 cylinders formatted on A(555)

B (VMSYSU:PIPU0R0.) R/O

query disk

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<th>BLKSZ</th>
<th>FILES</th>
<th>BLKS USED- (%)</th>
<th>BLKS LEFT</th>
<th>BLK TOTAL</th>
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<td>TMP555</td>
<td>555</td>
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<td>R/W</td>
<td>2</td>
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<td>19</td>
<td>60-17</td>
<td>300</td>
<td>360</td>
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</table>
```
Exercise 1: Create Temp Disk Space

/* Get Temporary disk space */
/* File mode of temporary disk is input argument */

parse upper arg fmode rest
If (fmode = '') | (rest ≠ '') then
  Do
    say ''
    say 'ERROR: Input parm is FILEMODE.'
    say ''
    exit 4
  End

'CP DETACH 555' /* Get rid of old disk */
'CP DEFINE T3390 555 2' /* Define 2 cylinders of temp space */

queue 1 /* Answer YES to FORMAT prompt */
queue TMP555 /* Disk label is TMP555 */
'FORMAT 555 'fmode /* Format the disk for CMS files */

If (fmode = 'A') Then /* If input mode is "A" move A disk to B */
  Do
    Parse Value Diag(8,'QUERY 'UserId()) With thisuser.
    'access VMSYSU:'thisuser'. b/a'
    frommode = 'b'
  End
Else frommode = 'a'

'COPYFILE * exec ' frommode '="' fmode /* COPY existing EXEC files to new temp disk */
exit 0
Rexx Language Basics
Case Insensitivity

SHARE60 is the same as share60 is the same as Share60
► specific support for upper and lower case is provided
► cases in quoted strings are respected

All Rexx programs must begin with a comment
/* This is a comment */

Long lines are common
► Continuation with commas
say 'This text is continued ', 'on the next line'
► May wrap as a long single line (but don't do this)
say 'This text is continued on the next line'
Rexx Strings

- **Literal strings**: Groups of characters inside single or double quotation marks
  
  "Try a game of blackjack', 'and beat the odds!'"

- **Two " or ' indicates a " or ' in the string**

  'Guess the dealer''s top card'

  "The dealer""s card is an Ace"

- **Hexadecimal strings**: Hex digits (0-9,a-f,A-F) grouped in pairs:

  '123 45'x is the same as '01 23 45'x

- **Binary strings**: Binary digits (0 or 1) grouped in quads:

  '10000 10101010'b is the same as '0001 0000 1010 1010'b
Operators & Expressions

- **String Expressions**

  (blank) "REXX" "Workshop" --> "REXX Workshop"
  || 'Dol'||'phin' --> 'Dolphin'

  (abuttal) abc = 'Dol'
  abc'phin' --> 'Dolphin'

- **Arithmetic Expressions**

  +    -    *    /    % (int division)    // (remainder)
  ** (power) Prefix -    Prefix+
Input and Output

- **say [expression]**
  - writes output to the user's terminal
    ```rexx
    say 'Five Euros equals ', 5 * 1.12 'USD'
    ```

- **pull**
  - prompts for input from the user
    ```rexx
    pull rate
    say 'Five Euros equals' 5 * rate 'USD'
    ```

- **parse arg**
  - collects arguments passed to a Rexx Program
    ```rexx
    Invoke program: EXAMP instring1 5 moreinput
    parse arg A1 A2 A3
    say A1 A2 A3
    ```
    - Result:
      ```rexx
      instring1 5 moreinput
      ```
Operators & Expressions

- Comparative Express
  - Normal
    - Comparison is case sensitive
    - Leading/trailing blanks removed before compare
    - Shorter strings padded with blanks on right
  - Strict
    - Comparison is case sensitive
    - If 2 strings = except one is shorter, the shorter string is less than the longer string

- Logical Expressions
  - &   |   &&
    - \ (preceding expression)
  - Note: the "not" sign and backslash " \ " are synonymous
Numbers

- A Rexx character string that includes 1 or more decimal digits with an optional decimal point
  - May have leading and trailing blanks
  - Optional sign + or -
  - An "E" specifies exponential notation
    - Be careful with device addresses such as 1E00 (use quotes)

- Precision in calculations may be controlled by the NUMERIC DIGITS instruction
  - Default is 9 digits

- Examples (could also be enclosed in quotes):
  
  12  -17.9  + 7.9E5
Variables

- Data known by a unique name whose value may change
- Variable names
  - **NOT** case sensitive
  - **Cannot** begin with a digit 0-9
- Defined by assignment (give it a value)
  
  \[
  \text{population} = 184627
  \]
- Variables with no assigned value will have the uppercase variable name as its initial value
- Special variables:  \texttt{rc, result, sigl}
  - may be set automatically during program execution
 Parsing Strings

- Parse Arg – takes data passed into exec or internal routine
  - (see example on "Input and Output" chart)
- Parse Var – parses variable into other variable(s)
Assigns data to variables using parsing rules

```plaintext
str1 = 'August 9-14, 2015'

parse var str1 w1 w2 w3
  • w1 = August
  • w2 = 9-14,
  • w3 = 2015

parse upper var str1 w1 . w2
  • w1 = AUGUST
  • w2 = 2015

parse var str1 w1 w2
  • w1 = August
  • w2 = 9-14, 2015
```
Parsing Strings...

- Default token delimiter is a blank
  - May be changed on Parse statement

```plaintext
str1 = 'August*9-14,*2015'
parse var str1 w1 '*' w2 '*' w3
  - w1 = August
  - w2 = 9-14,
  - w3 = 2015
```
Tracing and Debugging Rexx Programs
Tracing

- **Trace All** - clauses before execution
- **Trace Commands** - commands before execution. If the command has an error, then also displays the return code
- **Trace Error** - any command resulting in an error after execution and the return code
- **Trace Failure/Normal** – default setting, any command with a negative return code after execution, and the return code
- **Trace Intermediates** – Trace All, plus intermediate results during evaluation of expressions and substituted names
- **Trace Labels** - only labels passed during execution
- **Trace Off** - traces nothing and resets options
- **Trace Results** – Trace All, plus results of an evaluated expression and values assigned during PULL, ARG, and PARSE instructions
- **Trace Scan** – Trace All, but without the clauses being processed
Tracing (cont.)

- output identifier tags:
  - `*-` source of a single clause
  - `>>>` result of expression
  - `>.>` value assigned to place holder
  - `+++` error messages

- prefixes if TRACE Intermediates in effect:
  - `>C>` data is compound variable
  - `>F>` data is result of function call
  - `>L>` data is a literal
  - `>O>` data is result of operation on 2 terms
  - `>P>` data is result of prefix op
  - `>V>` data is contents of variable
Tracing (cont.)

- Prefix Options `!` and `?` modify tracing and execution
  - `?` controls interactive debugging
    - `TRACE ?Results`

- `!` inhibits host command execution
  - `TRACE !C` causes command to be traced but not processed

- CMS command `SET EXECTRAC ON` allows you to switch tracing on without modifying the program

- `TS` and `TE` immed commands turn tracing on/off asynchronously
Tracing - Example

- Program

```c
/* Trace Sample Program */
Trace Intermediates
number = 1/7
say number
```

- Output

```
3  *--* number = 1/7
>l>   "1"
>l>   "7"
>o>   "0.142857143"
4  *--* say number
>o>   "0.142857143"
0.142857143
```
Exercise 2: Say, Pull, & Passing Parameters

- Assume a card deck with suits of Hearts, Diamonds, Clubs, and Spades

- Write a Rexx program to:
  - pass in 1 of the 4 suits as an argument
  - prompt for a number from 2-10
  - display the number and the suit in the format:
    'Your card is a 10 of Hearts'

- Run the program with different suits and numbers
Exercise 3: Tracing and Debugging

The following Rexx Programs are on your VM A-disk:

► REXXEX3A.EXEC
► REXXEX3B.EXEC

There is something wrong with each program

► Using the TRACE instruction, debug each problem
► Fix the code so that it functions properly
Programming in Rexx
Symbols and Stems

- Constant symbol starts with a digit (0-9) or period:
  - 77   .123   12E5

- Simple symbol does not start with a digit and does not contain periods:
  - ABC   ?3

- Compound symbol contains at least one period, and at least 2 other characters
  - Stem (up to 1st period), followed by tail
    - ABC.3   Array.i   Total.$name   x.y.z
Symbols and Stems...

/* Stems as arrays */

do i=1 to 50 by 1
    array.i = i+5
end
say array.25  /* Output: "30" */
say array.51  /* Output: "ARRAY.51" */

/* Stems as records */

If attendee.payment == "LATE" then
do
    say attendee.$fullname
    say attendee.$email
    say attendee.$company.telephone
end
Issuing Commands from Rexx

- CP and CMS commands can be issued as a quoted string:
  - 'CP QUERY CPLEVEL'
  - 'STATE PROFILE EXEC'

- Use DIAG function to issue CP commands with Diagnose x'08'
  - \texttt{DIAG(8, 'QUERY CPLEVEL')}
    - Can be an expression as part of a longer statement
      - PARSE command output or parts of command output into variables

- Environment is selected by default on entry to a Rexx program
  - \texttt{ADDRESS} instruction can change the active environment
  - \texttt{ADDRESS()} built-in function used to get name of the currently selected environment
Issuing Commands – z/VM Example

Address CMS /* send cmds to CMS */
   'STATE PROFILE EXEC'

If RC=0 Then /* file found */
   'COPY PROFILE EXEC A TEMP = ='

   /* Save command output in variable */
Parse Value diag(8,'QUERY CLEVEL') With queryout
say queryout

z/VM Version 6 Release 3.0, service level 1401 (64-bit)
Generated at 08/27/14 18:19:22 EDT
IPL at 08/27/14 20:51:59 EDT
Issuing Commands – TSO

"CONSOLE ACTIVATE"

... 

ADDRESS CONSOLE  /* change environment to CONSOLE for all commands */
"mvs_cmd"

... 
"mvs_cmd"

ADDRESS TSO tso_cmd  /* change environment to TSO for one command */

... 
"mvs_cmd"

ADDRESS TSO    /* change environment to TSO for all commands */
"tso_cmd"

... 

"CONSOLE DEACTIVATE"
Using Pipelines with Rexx

- PIPE is a command that accepts *stage* commands as operands
  - Stages separated by a character called a *stage separator*
    - Default char is vertical bar  |  (x'4F')

- Allows you to combine programs so the output of one serves as input to the next
  - Like pipes used for plumbing: data flows through programs like water through pipes!

- User-written stages are Rexx programs
  - Reads in data, works on it, places it back into pipe
Invoking from CMS command line:

```bash
pipe < profile exec | count lines | console
```

Invoking from an Exec:

```rexx
/* Count number of lines in exec */
'PIPE < profile exec | count lines| console'

/* or ... on multiple lines */
'PIPE < profile exec',
  '|' count lines',
  '|' console'
```
Invoking commands and parsing output into a stem:

```rxml
/* Pipe example #2 */
'pipe',
'CMS LISTFILE * EXEC A', /* issue cmd */
'| SPECS w1 1', /* parse first word */
'| STEM response.' /* save in stem */

do i = 1 to response.0
    say response.i /* display file names */
end
```
DO ... END can be used to create a code block

if wins > losses then
  do
    say 'Congratulations!'
    say 'You have won!'
  end
else say 'Sorry, you have lost'
if wins > losses then say 'you have won'
   else say 'you have lost'

select
   when wins > losses then say 'winner'
   when losses > wins then say 'loser'
   otherwise say 'even'
end

select
   when wins > losses then say 'winner'
   when losses > wins then say 'loser'
   otherwise NOP
end
do forever
  say 'You will get tired of this'
end

do 3
  say "Roll, Roll, Roll the dice"
end

do i=1 to 50 by 1
  say i
end
More DO Loops

\begin{verbatim}

i=30
do until i > 21 /* Evaluate after DO executes */
  i=i+5
end
say i  \rightarrow  35

i=30
do while i < 21 /* Evaluate before DO executes */
  i=i+5
end
say i  \rightarrow  30

\end{verbatim}
Iterate, Leave, and Exit

- **Iterate** causes a branch to end of control construct

  ```rexx
  do i=1 to 4
    if i=2 then iterate
    say i
  end
  ```

- **Leave** exits the control construct and continues the REXX program

  ```rexx
  do i=1 to 4
    say i
    if i=3 then leave
  end
  say 'I''m free!'
  ```

- **Exit** exits the REXX program unconditionally

  ```rexx
  i=1
  do forever
    say i
    if i=3 then exit
    i=i+1
  end
  say 'I''m free!'
Built-In Functions

ABS(-1.674) ➞ 1.674
/* absolute value */

C2D('a') ➞ 129
D2X(129,2) ➞ '81'
/* char to decimal, dec to hex*/

DATATYPE('10.5','W') ➞ '0'
DATATYPE('12 ') ➞ 'NUM'
/* determines if a string matches a provided type */

DATE('U') ➞ '03/03/15'
/* date function */

LENGTH('abcdef') ➞ 6
/* length of the string */
Built-In Functions

POS('day','Wednesday') /* starting position of substr inside a string */

RIGHT('12',4,'0') /* pad 12 out to 4 characters with 0's */

SUBSTR('abcdef',2,3) /* obtain substring of 3 characters beginning at second character */

WORDS('are we done yet?') /* return number of tokens inside a given string */

WORDPOS('the','now is the time') /* return position of a given substring */
/* inside a string */
Subroutines & Procedures

- **CALL** instruction is used to invoke a routine
  - May be an internal routine, built-in function, or external routine
- May optionally return a result
  - `RETURN expression`
    - variable `result` contains the result of the expression
- Parameters may be passed to the called routine
  - `CALL My_Routine parm1`
    - which is functionally equivalent to the clause:
      - `NewData = My_Routine(parm1)`
- Variables are global for subroutines, but not known to procedures unless passed in or EXPOSE option used
/* subroutine call example */
x = 5
y = 10
Call Calc x y               /* call subroutine Calc */
If result > 50 Then
    say "Perimeter is larger than 50"
Else
    say "Perimeter is smaller than 50"
exit

Calc:                      /* begin subroutine     */
Parse Arg len width        /* input args           */
return 2*len + 2*width     /* calculate perimeter  */
    /* ...and return it   */
Exercise 4: WHATTCP EXEC

- Write a Rexx program WHATTCP EXEC to show z/VM CP Level information
  - Issue CP command `QUERY CPLEVEL` to display CP level
  - Use **Rexx Diag** function to issue `QUERY CPLEVEL` command
    - **Parse command output** to display CP Version, Release, and Service level
Exercise 5: MYDISKS EXEC

- Write a Rexx program to show which disks your userid has accessed
  1. Call a subroutine that
     - Uses a PIPE to issue CMS command QUERY DISK and save response
     - Determine the number of disks accessed
     - Return the value to the main routine
  2. Display the returned number of disks accessed
  3. Display each of the disks that are accessed
  4. Issue the CMS command QUERY DISK without using a PIPE
  5. Verify that output from Steps 3 and 4 match
Reference Information
More Information on Rexx

- **Websites:**
  - http://regina-rexx.sourceforge.net/
  - Rexx webpage
  - Netrexx
  - Object Rexx
  - Regina Rexx

- **z/VM publications:**
  - Rexx/VM Reference - SC24-6113
  - Rexx/VM User's Guide - SC24-6114

- **z/OS publications:**
  - TSO/E Rexx Reference - SC28-1975

- **Rexx Compiler**
  - Products ordered separately from z/VM:
    - REXX370 Compiler, 5695-013
    - REXX370 Library, 5695-014

- **Other books:**

- **List servers:**
  - http://listserv.uark.edu/scripts/wa.exe?A0=ibmvm

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Thanks!

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Session 17472
Appendix A: Lab Exercise Solutions
/* */
parse arg suit
say 'Enter a number from 2-10:'
pull num
say 'Your card is a 'num' of ' suit
Exercise 3: Tracing and Debugging – Answer A

Trace Intermediate output:

6 ** string1 = "Rexx" 'Lab'
  >L>  "Rexx"
  >L>  "Lab"
  >O>  "Rexx Lab"
7 ** say string11
  >L>  "STRING11"

STRING11

9 +++ string2 = "Exerc"||"ise'say string2
Error 6 running REXXTR3A EXEC, line 9: Unmatched "/*" or quote
Corrected Rexx Program:
Trace I

string1 = "Rexx" 'Lab'
say string1 /* Was: say string11 */

string2 = "Exerc||ise" /* Was: string2 = "Exerc||ise" */
say string2

Result:
6 ** string1 = "Rexx" 'Lab'
   >L> "Rexx"
   >L> "Lab"
   >O> "Rexx Lab"
7 ** say string1
   >V> "Rexx Lab"
Rexx Lab
9 ** string2 = "Exerc||ise"
   >L> "Exerc"
   >L> "ise"
   >O> "Exercise"
10 ** say string2
   >V> "Exercise"
Exercise
Exercise 3: Tracing and Debugging – Answer B

**Trace Intermediate output:**

```
7 --* Nums = "25 35 71"
  >L> "25 35 71"
9 --* parse arg w1 . w2 w3
   >>> ""
   >.> ""
   >>> ""
   >>> ""
 11 --* $average = (w1 + w2 + w3) // 3
   >V> ""
   >V> ""
 11 ++ $average = (w1 + w2 + w3) // 3
```

DMSREX476E Error 41 running REXXTR3B EXEC, line 11: Bad arithmetic conversion
Corrected Rexx Program:

Trace I
Nums = "25 35 71"

parse var Nums w1 w2 w3 /* Was: parse arg w1 . w2 w3 */

$average = (w1 + w2 + w3) / 3 /* Was: (w1 + w2 + w3) // 3 */
say "The average value of these numbers is" $average "."
Exercise 3: Tracing and Debugging – Answer B

**Result:**

7 **--** Nums = "25 35 71"

> L> "25 35 71"

9 **--** parse var Nums w1 w2 w3

>>> "25"

>>> "35"

>>> "71"

11 **--** $average = (w1 + w2 + w3) / 3

> V> "25"

> V> "35"

> O> "60"

> V> "71"

> O> "131"

> L> "3"

> O> "43.6666667"

12 **--** say "The average value of these numbers is" $average "."

> L> "The average value of these numbers is"

> V> "43.6666667"

> O> "The average value of these numbers is 43.6666667"

> L> ".

> O> "The average value of these numbers is 43.6666667 ."

The average value of these numbers is 43.6666667 .
Exercise 4: WHATCP – Answer

/* Display CP Level information for the z/VM system */

'CP QUERY CPLEVEL'

Parse value diag(8,'QUERY CPLEVEL') with ,
    . . version . release . ',' . . servicelvl .

say 'z/VM Version = ' version
say 'z/VM Release = ' release
say 'Service Level = ' servicelvl
/* Find Number of disks accessed and list them */
Call GetDisks
Say 'This user has' NumDisks 'disks accessed.'
Say ''

Do i = 1 to Numdisks
    Say DiskList.i
End

Say ''
ADDRESS CMS 'QUERY DISK'
Exit

/* Subroutine: Get list of disks and return number of disks accessed*/
GetDisks:
    'PIPE',
    'CMS QUERY DISK',
    '| Drop 1',
    '| STEM DiskList.'
    NumDisks = DiskList.0
Return NumDisks
/* Find Number of disks accessed and list them */
Call GetDisks
Say 'This user has' NumDisks 'disks accessed.'
Say '  '

Do i = 1 to NumDisks
   Say DiskList.i
End

Say '  '
ADDRESS CMS
'QUERY DISK'
Exit

/*Subroutine: Get list of disks and return number of disks accessed*/
GetDisks:
   'PIPE',
      'CMS QUERY DISK',
      '| Drop 1',
      '| STEM DiskList.',
      '| count lines',
      '| var NumDisks'
Return NumDisks
Appendix B: Sample Program:
GETTMODE
Sample Program: GETTMODE EXEC

- Rexx program GETTMODE locates the first unused file mode (A-Z) and creates a temporary disk at that file mode
  
  - Illustrates usage of many Rexx features covered in this lab
    - Subroutine
    - Issuing commands
    - Building and parsing strings
    - Built-in functions
    - Stems
    - Pipelines
    - Displaying output
Logic:

Calls subroutine that:

- Uses a PIPE to issue CMS command QUERY SEARCH to obtain the used modes (file mode is 3rd word of response); saves it in a stem
- Builds a string of used modes from the output stem of the PIPE
- Creates a string of possible file modes (A-Z)
- Builds a stem containing the possible file modes
- Marks the used file modes "unavailable" in the list of possible modes
- Locates the first available mode and returns it to the main program

If a file mode is returned:

- Issues commands to define and format a temporary disk at the returned mode
/* Get temporary disk space and access it at an available file mode */

'CP DETACH 555'          /* Get rid of old disk */

/* Call subroutine Findmode to locate the first available file mode. */
/* Once found, define a temporary disk and format and access it at */
/* the returned file mode. */

Call Findmode

If rtnmode <> 0 Then
  Say 'Temp disk will be accessed at mode' rtnmode
Else
  Do
    Say 'No Filemodes available for temp disk'
    Exit 8
  End

'CP DEFINE T3390 555 2'          /* Define 2 cylinders of temp space */

queue 1          /* Answer YES to FORMAT prompt */
queue TMP555    /* Disk label is TMP555 */
'FORMAT 555 'rtnmode   /* Format the disk for CMS files */

Exit rc
/* Subroutine Findmode will locate the first available (A-Z) file mode */
/* and return it in variable rtnmode. If no file modes are available, */
/* rtnmode will be set to zero. */

Findmode:
   'PIPE',
   'CMS QUERY SEARCH',
   '|' SPEC WORDS 3 1',
   '|' STEM usedmode.'

/* Build string of accessed file modes */
acc_modes = ''
Do I = 1 TO usedmode.0
   acc_modes = acc_modes || SUBSTR(usedmode.I,1,1)
End

/* Build stem containing all possible file modes */
possible_modes = 'ABCDEFGHIJKLMNOPQRSTUVWXYZ'
Do i = 1 TO 26
   modelist.i = SUBSTR(possible_modes,i,1)
End

/* Remove all accessed file modes from possible file mode list */
mlength = LENGTH(acc_modes)
Do n = 1 TO mlength
   Do i = 1 TO 26
      If (SUBSTR(acc_modes,n,1) = modelist.i) Then
         Do
            modelist.i = ''
            Leave
         End
   End
End

Sample Program: GETTMODE EXEC (2 of 3)
/* Locate the first possible file mode that is "available" and return it */

foundmd = 'NO'
Do i = 1 TO 26
   If modelist.i ≠ ' ' Then
      Do
         rtnmode = modelist.i
         foundmd = 'YES'
         Leave
      End
   End
End

/* If no file modes available, return zero */

If foundmd = 'NO' Then
   rtnmode = 0
End
Sample Program: GETTMODE EXEC – Pipelines Only

FINDMODE: procedure

'Pipe',
' literal A B C D E F G H I J K L M N O P Q R S T U V W X Y Z',
'| Split ',
'| Spec 1.1 13',
'| Append CMS Q disk *',
'| Nlocate 8.4 /VDEV/',
'| Spec 13.1',
'| Sort ',
'| Unique Single ',
'| Take 1',
'| Var freefm'