

Introduction to REXX Workshop

Sessions 12467-12468



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Agenda

- Rexx Overview and Related Topics
- Creating and Executing Rexx Programs
- Rexx Language
 - ▶ Basic Syntax
 - ▶ Strings, Operators, Expressions
 - ▶ Tracing, Parsing
 - ▶ Issuing Commands and use of Pipelines
 - ▶ Control Constructs
 - ▶ Subroutines & Functions
- Lab Exercises

Rexx Overview

- **RE**structured **eX**tended **eX**ecutor

- 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

Rexx Overview (cont.)

- 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 !
 - ▶ May document and initialize variables, but...
 - ▶ Implicit declarations take place during execution
 - ▶ **labels:** are the only true declarations

Rexx Platforms

- IBM Platforms
 - VM
 - TSO/E (z/OS)
 - VSE
 - AIX
 - OS/2

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

- Regina Rexx
 - ▶ Rexx interpreter ported to most UNIX platforms, including Linux

- NetRexx
 - ▶ Blend of Rexx 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 Rexx

(See references page for website information)

Creating Rexx Programs: z/VM

- 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

Lab Exercises: What to Expect...

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 to locate an available CMS file mode and define a temporary disk at that file mode
(uses a subroutine, Pipelines, stems, and various control constructs)

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

- Prefix area commands within the file:

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 del, **cc...cc** block copy

- Leaving XEDIT:

– **FILE** to save changes

– **QQUIT** to exit without saving changes

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
- Userids
- 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
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

```

/* 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

```


Exercise 1: Create Temp Disk Space - Answer

query disk

LABEL	VDEV	M	STAT	CYL	TYPE	BLKSZ	FILES	BLKS USED-(%)	BLKS LEFT	BLK TOTAL
-	DIR	A	R/W	-	-	4096	44	-	-	-
MNT190	190	S	R/O	115	3390	4096	694	14562-70	6138	20700
MNT19E	19E	Y/S	R/O	355	3390	4096	1875	49995-78	13905	63900

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

LABEL	VDEV	M	STAT	CYL	TYPE	BLKSZ	FILES	BLKS USED-(%)	BLKS LEFT	BLK TOTAL
-	DIR	A	R/W	-	-	4096	44	-	-	-
MNT190	190	S	R/O	115	3390	4096	694	14562-70	6138	20700
MNT19E	19E	Y/S	R/O	355	3390	4096	1875	49995-78	13905	63900
TMP555	555	Z	R/W	2	3390	4096	19	60-17	300	360

Exercise 1: Create Temp Disk Space – Answer..

```
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:PIPUSR00.) R/O
```

```
query disk
```

LABEL	VDEV	M	STAT	CYL	TYPE	BLKSZ	FILES	BLKS USED-(%)	BLKS LEFT	BLK TOTAL
TMP555	555	A	R/W	2	3390	4096	19	60-17	300	360
-	DIR	B/A	R/O	-	-	4096	44	-	-	-
MNT190	190	S	R/O	115	3390	4096	694	14562-70	6138	20700
MNT19E	19E	Y/S	R/O	355	3390	4096	1875	49995-78	13905	63900

Rexx Language Syntax

- Case **Insensitivity**

SanFrancisco is the same as **sanfrancisco**

- ▶ 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) "SHARE" "San Francisco" --> "SHARE San Francisco"

|| 'China' || 'town' --> 'Chinatown'

(abuttal) **abc** = 'China'

abc'town' --> 'Chinatown'

- Arithmetic Expressions

+ - * / % (int division) // (remainder)

** (power) Prefix - Prefix+

Input and Output

■ **say [expression]**

- ▶ writes output to the user's terminal

```
say 'Five Euros equals ' ,  
    5 * 1.35 'USD'
```

■ **pull**

- ▶ prompts for input from the user

```
pull rate  
say 'Five Euros equals' 5 * rate 'USD'
```

■ **parse arg**

- ▶ collects arguments passed to a Rexx Program

- Invoke program: **EXAMP input1 dataX moreData**

```
parse arg A1 A2 A3
```

```
say A1 A2 A3
```

- Result:

```
input1 dataX moreData
```

Operators & Expressions

■ Comparative Expressions

▶ 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

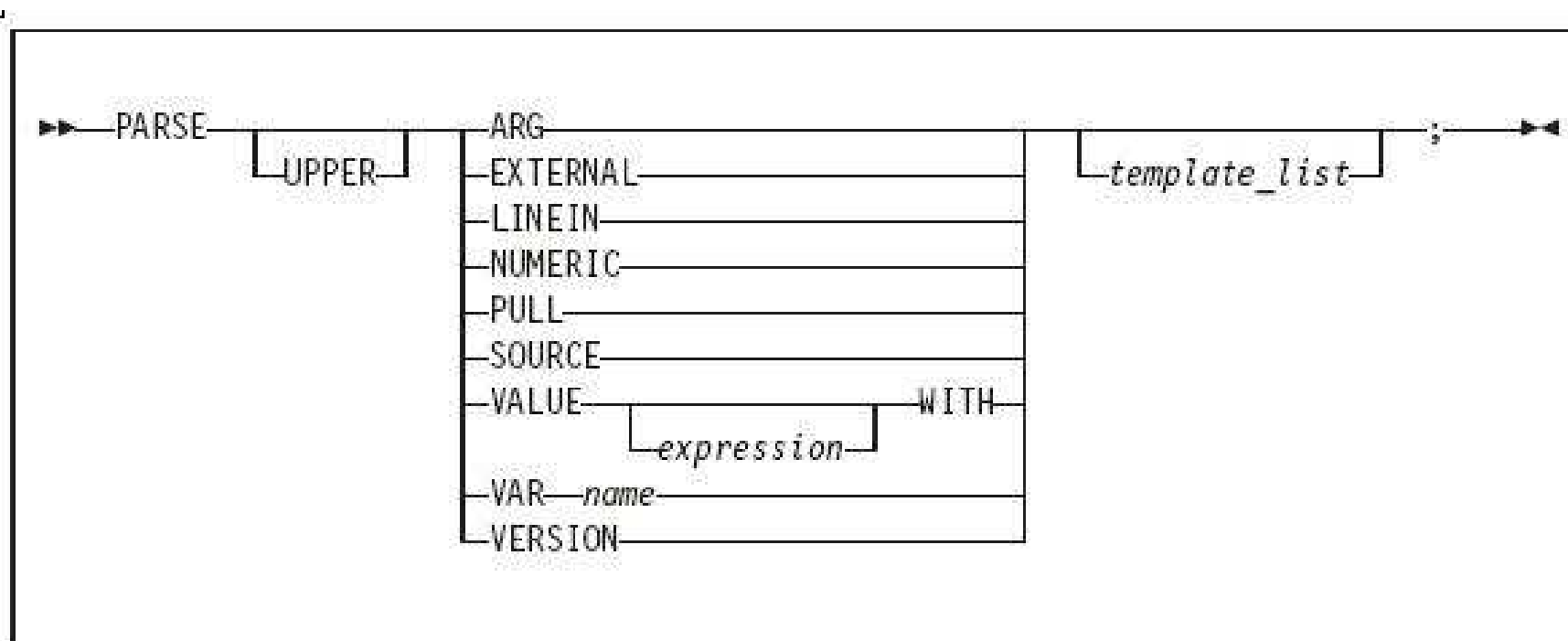
Variables

- 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)

population = 184627

- Variables with no assigned value will have the uppercase variable name as its initial value
- Special variables: **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)

Parsing Strings...

- Assigns data to variables using parsing rules

```
str1 = 'February 3-8, 2013'
```

```
parse var str1 w1 w2 w3
```

- w1 = February
- w2 = 3-8,
- w3 = 2013

```
parse upper var str1 w1 . w2
```

- w1 = FEBRUARY
- w2 = 2013

```
parse var str1 w1 w2
```

- w1 = February
- w2 = 3-8, 2013

Parsing Strings...

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

```
str1 = 'February*3-8,*2013'
```

```
parse var str1 w1 '*' w2 '*' w3
```

- w1 = February
- w2 = 3-8,
- w3 = 2013

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 2: Say, Pull, & Passing Parameters - Answer

```
/* */  
parse arg suit  
say 'Enter a number from 2-10:'  
pull num  
say 'Your card is a 'num' of ' suit
```

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 placehldr
 - +++ error messages

- prefixes if TRACE Intermediates in effect:
 - >C> data is compound variable
 - >F> data is result of func 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 EXEC TRAC ON** allows you to switch tracing on without modifying the program
- **TS** and **TE** immed commands turn tracing on/off asynchronously

Tracing - Example

- Program

```
/* 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  
>V>  "0.142857143"  
0.142857143
```

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

Exercise 3: Tracing and Debugging – Answer A

Trace Intermediate output:

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

STRING11

```
9 +++ string2 = "Exerc" || "ise'say string2"
```

Error 6 running REXXTR3A EXEC, line 9: Unmatched "/*" or quote

Exercise 3: Tracing and Debugging – Answer A

Corrected Rexx Program:

Trace I

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

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
```

Exercise 3: Tracing and Debugging – Answer B

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 .
```


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'
 - ▶ `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
 - ▶ **ADDRESS** instruction can change the active environment
 - ▶ **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 CPLEVEL') With queryout  
say queryout
```

```
z/VM Version 6 Release 2.0, service level 1101 (64-bit)  
Generated at 05/09/12 19:47:52 EDT  
IPL at 06/03/12 16:29:17 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

Using Pipelines with Rexx - Examples

- Invoking from CMS command line:

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

- Invoking from an Exec:

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

```
/* or ... on multiple lines */  
'PIPE < profile exec',  
  '| count lines',  
  '| console'
```

Using Pipelines with Rexx - Examples

- Invoking commands and parsing output into a stem:

```
'pipe',  
'CMS LISTFILE * EXEC A', /* issue cmd */  
  '| SPECS 1 1 , /* parse first word */  
  '| STEM response.' /* save in stem */  
  
do i = 1 to response.0  
  say response.i /* display file names */  
end
```


Control Constructs – DO...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'
```

Control Constructs - Selection

```
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
```

Control Constructs – DO Loops

```
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

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

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

Iterate, Leave, and Exit

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

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

1, 3, 4

Leave exits the control construct and continues the REXX program

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

1, 2, 3
I'm free!

Exit exits the REXX program unconditionally

```
i=1
do forever
  say i
  if i=3 then exit
  i=i+1
end
say 'I'm free!'
```

1, 2, 3

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')` → '02/05/13'

`/* date function */`

`LENGTH('abcdef')` → 6

`/* length of the string */`

Built-In Functions

`POS('day','Wednesday')` → `7`
/* starting position of substr inside a string */

`RIGHT('12',4,'0')` → `'0012'`
/* pad 12 out to 4 characters with 0's */

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

`WORDS('are we done yet?')` → `4`
/* return number of tokens inside a given string */

`WORDPOS('the','now is the time')` → `3`
/* 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 Example: Returning a Value

```
/* 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: WHATCP EXEC

- Write Rexx program WHATCP 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: GETTMODE EXEC

- Write Rexx program GETTMODE to locate the first available file mode (A-Z) and create a temporary disk at that file mode
 1. **Call a subroutine** that will:
 - Use a PIPE to **issue** CMS command **QUERY SEARCH** to obtain the used modes (file mode is 3rd word of response) – **save in stem**
 - **Build a string** of used modes from the **output stem** of the PIPE
 - **Create a string** of possible file modes (A-Z)
 - **Build a stem** containing the possible file modes
 - **Mark** the used file modes "unavailable" in the list of possible modes
 - *(Hint: blank out the unavailable modes in the list)*
 - **Locate** the first available mode and **return** it to the main program
 2. **If a file mode is returned:**
 - **Issue commands** to define and format a temporary disk at the returned mode
 - *(Hint: Use commands from GETTEMP EXEC)*

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
```

Exercise 5: GETTMODE EXEC – Answer (1 of 3)

```
/* 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
```

Exercise 5: GETTMODE EXEC – Answer (2 of 3)

```

/* 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
End
End

```

Exercise 5: GETTMODE EXEC – Answer (3 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

Return
```

Exercise 5: GETTMODE EXEC – Alternate Answer

```
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'
```


For More Information...

- **Websites:**

- ▶ <http://www.ibm.com/software/awdtools/rexx/> Rexx webpage
- ▶ <http://www.ibm.com/software/awdtools/netrexx/> Netrexx
- ▶ <http://www-01.ibm.com/software/awdtools/rexx/opensource.html> Object Rexx
- ▶ <http://regina-rexx.sourceforge.net/> Regina Rexx

- **z/VM publications:**

- ▶ Rexx/VM Reference - SC24-6113
- ▶ Rexx/VM User's Guide - SC24-6114
- ▶ website for library downloads: <http://www.vm.ibm.com/library/>

- **z/OS publications:**

- ▶ TSO/E Rexx User's Guide - SC28-1974
- ▶ TSO/E Rexx Reference - SC28-1975
- ▶ website for library downloads: http://publibz.boulder.ibm.com/cgi-bin/bookmgr_OS390/Shelves/IKJOSE10?filter=rexx

- **Rexx Compiler**

- ▶ Products ordered separately from z/VM:
 - REXX/370 Compiler, 5695-013
 - REXX/370 Library, 5695-014

- **Other books:**

- ▶ [The Rexx Language](#) ISBN 0-13-780651-5
- ▶ [The Netrexx Language](#) ISBN 0-13-806332-X

- **List servers:**

- ▶ <http://listserv.uark.edu/scripts/wa.exe?A0=ibmvm>



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