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Agenda

- Overview
- Math functions
- Outputting messages
- Collecting error information.
- Manipulating date and time information
- Summary
- Appendix
Overview

- Language Environment provides a set of callable services that can be called by programs compiled with a Language Environment conforming compiler.
  - This includes assembler programs which use the CEEENTRY macro.
    - Fortran must use the AFHCEEN or AFHCEEF interfaces.
Overview

- Callable services beginning with CEE are valid on any platform.
- Callable services beginning with CEE3 are valid only on z/OS. (Yeah z/VM too)
Overview...

- Callable services may be called from AMODE 24 programs.
  
  - Language Environment will automatically switch to AMODE 31.
    
    - This may cause additional overhead with repeated calls.
    
    - Run AMODE 31 to avoid unnecessary switching.
Overview...

- Feedback codes are returned by most callable services when requested.
  - Indicate success or failure of service
  - Feedback codes may be omitted when calling a service
    - Language Environment will terminate if result of service is a severity 2 or greater feedback code.
Overview...

- **Call syntax COBOL**
  - CALL “CEExxxx” USING parm1, parm2, ...,fc
  - The feedback code may be omitted
    - CALL “CEExxxx” USING parm1, parm2, ...,OMITTED
  - Include file
    - COPY CEEIGZCT
Overview...

- **Call syntax PL/I**
  - Call CEExxxxx(parm1, parm2, ..., fc)
  - The feedback code may be omitted
    - Call CEExxxxx(parm1, parm2, ..., *)
  - Include file
    - %INCLUDE CEEIBMAW
    - %INCLUDE CEEIBMCT
Overview...

- Call syntax C/C++
  - CEExxxxx(&parm1,&parm2, ..., &fc)
  - The feedback code may be omitted
    - CEExxxxx(&parm1,&parm2, ...,NULL)
- Include file
  - #include <leawi.h>
  - #include <ceeedcct.h>
Overview...

- Call syntax Assembler
  - CALL CEExxxx
    -_Parms are OS style with R1 pointing to parmlist
      LA 1,PARM1
      ST 1,PARMLIST
      LA 1,PARM2
      ST 1,PARMLIST+4
      ...
      LA 1,PARMLIST
    - The feedback code may be omitted
      LA 1,0
      ST 1,PARMLIST+xx
  - Include file
    - CEEBALCT
Math functions

- Names are of the form
  - CEESxyyy
    - Where x is the precision
      - I  Integer 32 bit
      - S  Single 32 bit floating point
      - D  Double 64 bit floating point
      - Q  Extended 128 bit floating point
    - Complex types also available
Math functions...

- Names are of the form
  - CEESxxyy
    - Where yyy is the function name
      - ABS  Absolute value
      - COS  Cosine
      - EXP  Exponential base e
      - LG1  Log base 10
      - SIN  Sine
      - SQT  Square root
      - Many many more
Math Functions...

- Example CEESSSQT (Square Root)

WORKING-STORAGE SECTION.
01 FC.
  02 CONDITION-TOKEN-VALUE.
    COPY CEEIGZCT.
    03 CASE-1-CONDITION-ID.
      04 SEVERITY PIC S9(4) BINARY.
      04 MSG-NO PIC S9(4) BINARY.
      03 CASE-SEV-CTL PIC X.
      03 FACILITY-ID PIC XXX.
      02 I-S-INFO PIC S9(9) BINARY.
    01 MY-INPUT COMP-1.
    01 RESULT COMP-1.
    01 RESULT2 PIC ZZZZ.99.
Math Functions...

- Example CEESSSQT (Square Root)...

PROCEDURE DIVISION.
MAIN-PROG.
DISPLAY "IN MAIN PROG".
MOVE 9 TO MY-INPUT.
CALL "CEESSSQT" USING MY-INPUT, FC, RESULT.
IF NOT CEE000 OF FC THEN
    DISPLAY "SQUARE ROOT FAILED."
END-IF.
MOVE RESULT TO RESULT2.
DISPLAY "THE SQUARE ROOT OF 9 IS: " RESULT2.
Math Functions...

Example CEESSSQT (Square Root)...

MOVE 144 TO MY-INPUT.
CALL "CEESSSQT" USING MY-INPUT, FC, RESULT.
IF NOT CEE000 OF FC THEN
    DISPLAY "SQUARE ROOT FAILED."
END-IF.
MOVE RESULT TO RESULT2.
DISPLAY "THE SQUARE ROOT OF 144 IS: " RESULT2.
...
Math Functions...

Example CEESSSQT (Square Root)...

... 
MOVE -99 TO MY-INPUT.
CALL "CEESSSQT" USING MY-INPUT, FC, RESULT.
IF NOT CEE000 OF FC THEN
   DISPLAY "SQUARE ROOT FAILED."
END-IF.
MOVE RESULT TO RESULT2.
DISPLAY "THE SQUARE ROOT OF -99 IS: " RESULT2.
GOBACK.
Math Functions...

- Example CINESSSSQT (Square Root)...

Output.

IN MAIN PROG
THE SQUARE ROOT OF 9 IS: 3.00
THE SQUARE ROOT OF 144 IS: 12.00
THE SQUARE ROOT OF 2500 IS: 50.00
SQUARE ROOT FAILED.
THE SQUARE ROOT OF -99 IS: 50.00
Outputting messages

- Several services are available to output messages.
  - CEEMGET
    - Get a message for a condition token.
  - CEEMOUT
    - Output a message from a string
  - CEEMSG
    - Output a message for a condition token
Outputting messages…

We can use CEEMSG to output a Language Environment error message associated with the failure.

... MOVE -99 TO MY-INPUT.
CALL "CEESSSQT" USING MY-INPUT, FC, RESULT.
IF NOT CEE000 OF FC THEN
    CALL "CEEMSG" USING FC, MSG-DEST, OMITTED
    STOP RUN
END-IF.
MOVE RESULT TO RESULT2.
DISPLAY "THE SQUARE ROOT OF -99 IS: " RESULT2.
...
Outputting messages...

- The output now looks like:

```
IN MAIN PROG
THE SQUARE ROOT OF 9 IS: 3.00
THE SQUARE ROOT OF 144 IS: 12.00
THE SQUARE ROOT OF 2500 IS: 50.00
CEE2010E The argument was less than 0 in math routine SQRT.
```
Outputting messages...

- We can use CEEMOUT to output a string.
- String must be a 2 byte prefix string

```
...  
01 MY-MSG-STRING.  
  02 MY-STRING-LEN    PIC S9(4) BINARY.  
  02 MY-STRING-TEXT.  
    03 MY-STRING-CHAR PIC X,  
      OCCURS 0 TO 256 TIMES  
      DEPENDING ON MY-STRING-LEN  
      OF MY-MSG-STRING.  

...  
```
Outputting messages...

- Must move length first.

```plaintext
... PROCEDURE DIVISION.
MAIN-PROG.
  MOVE 16 TO MY-STRING-LEN
  OF MY-MSG-STRING.
  MOVE "IN MAIN PROGRAM!" TO MY-STRING-TEXT
  OF MY-MSG-STRING.
  CALL "CEEMOUT" USING MY-MSG-STRING, MSG-DEST, FC.
  IF NOT CEE000 OF FC THEN
    CALL "CEEMSG" USING FC, MSG-DEST, OMITTED
    STOP RUN
  END-IF.
...```

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Collecting error information…

- Output looks like.

IN MAIN PROGRAM!
THE SQUARE ROOT OF  9.00 IS:   3.00
THE SQUARE ROOT OF  144.00 IS:  12.00
THE SQUARE ROOT OF 2500.00 IS:  50.00
CEE2010E The argument was less than 0 in math routine SQRT.
Collecting error information

- CEE3DMP service.
  - Requests a CEEDUMP be taken
    - Provide your own dump title
    - Pass options that control which information is included in the dump
      - Options we use when TERMTHDACT(TRACE)
        - NOENTRY COND TRACE THR(ALL) NOBLOCK NOSTOR TRCE GENOPTS
      - Options we use when TERMTHDACT(DUMP)
        - NOENTRY COND TRACE THR(ALL) BLOCKS STOR GENOPTS
Collecting error information…

- CEE3DMP service.
  - Recommended options when you call CEE3DMP.
    - ENCLAVE(ALL) default
    - THREAD(CURRENT) default
    - TRACE default
    - FILES default
    - VARIABLES default
    - NOBLOCKS default
    - NOSTORAGE default
    - NOCONDITION not default
    - ENTRY default
    - GENOPTS default
Collecting error information...

- CEE3DMP service.
- Add service to our program.

...  
01 DUMP-TITLE PIC X(80).  
01 DUMP-OPTIONS PIC X(255).  
PROCEDURE DIVISION.  
MAIN-PROG.  
    MOVE "SAMPLE DUMP TAKEN BY CEE3DMP." TO DUMP-TITLE.  
    MOVE "NOCOND" TO DUMP-OPTIONS.  
...
Collecting error information...

- CEE3DMP service.
  - Add service to our program.

  ...
  MOVE -99 TO MY-INPUT.
  CALL "CEESSSQT" USING MY-INPUT, FC, RESULT.
  IF NOT CEE000 OF FC THEN
    CALL "CEEMSG" USING FC, MSG-DEST, OMITTED
    CALL "CEE3DMP" USING DUMP-TITLE, DUMP-OPTIONS, FC
    STOP RUN
  END-IF.
  ...

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Collecting error information…

- Output looks like.

IN MAIN PROGRAM!
THE SQUARE ROOT OF 9.00 IS: 3.00
THE SQUARE ROOT OF 144.00 IS: 12.00
THE SQUARE ROOT OF 2500.00 IS: 50.00
CEE2010E The argument was less than 0 in math routine SQRT.
Collecting error information…

- We also have CEEDUMP output

```
COMMAND INPUT ===>
PREFIX=*  DEST=(ALL)  OWNER=JMONTI  SYSNAME=
NP   DDNAME   StepName ProcStep DSID Owner
JESMSGLG JES2                        2   JMONTI
JESJCL    JES2                        3   JMONTI
JESYSMSG JES2                        4   JMONTI
SYSPRINT STEP1  COBOL                  101 JMONTI
SYSPRINT STEP1  LKED                   102 JMONTI
CEEDUMP STEP1  GO                     104 JMONTI
SYSOUT STEP1  GO                      106 JMONTI
```
Date and Time information

- Language Environment provides a robust assortment of date and time services.
  - All services based on Lilian time – seconds/days since October 14, 1582
  - Valid through December 31, 9999
  - This timeframe chosen since it is a superset of all supported language time ranges.
Date and Time information...

- Let’s add some to our program.

```plaintext
... 01 MY-DATE-LILIAN PIC S9(9) BINARY.
01 MY-SECS-LILIAN  COMP-2.
01 MY-TIME-GREGORIAN PIC X(17).
01 MY-PIC-STRING.
   02 MY-STRING-LEN PIC S9(4) BINARY.
   02 MY-STRING-TEXT.
      03 MY-STRING-CHAR PIC X,
          OCCURS 0 TO 256 TIMES
          DEPENDING ON MY-STRING-LEN
          OF MY-PIC-STRING.
01 MY-TIMESTAMP PIC X(80).
```
Date and Time information...

Let’s call CEELOCT to get the current local time.

... 
CALL "CEELOCT" USING MY-DATE-LILIAN, MY-SECS-LILIAN, 
        MY-TIME-GREGORIAN, FC.
IF NOT CEE000 OF FC THEN
  CALL "CEEMSG" USING FC, MSG-DEST, OMITTED 
  CALL "CEE3DMP" USING DUMP-TITLE, DUMP-OPTIONS, FC
  STOP RUN
END-IF.
Date and Time information...

- Now convert MY-SECS-LILIAN to characters with CEEDATM.

... MOVE 22 TO MY-STRING-LEN OF MY-PIC-STRING.
MOVE "MM/DD/YYYY HH:MI:SS AP" TO MY-STRING-TEXT
OF MY-PIC-STRING.

CALL "CEEDATM" USING MY-SECS-LILIAN,
MY-PIC-STRING,
MY-TIMESTAMP, FC.

IF NOT CEE000 OF FC THEN
    CALL "CEEMSG" USING FC, MSG-DEST, OMITTED
    CALL "CEE3DMP" USING DUMP-TITLE, DUMP-OPTIONS, FC
STOP RUN
END-IF.
Date and Time information…

- Now output MY-TIMESTAMP with CEEMOUT.

...  
MOVE 22 TO MY-STRING-LEN OF MY-MSG-STRING.  
MOVE MY-TIMESTAMP TO MY-STRING-TEXT  
OF MY-MSG-STRING.  
CALL "CEEMOUT" USING MY-MSG-STRING, MSG-DEST, FC.  
IF NOT CEE000 OF FC THEN  
  CALL "CEEMSG" USING FC, MSG-DEST, OMITTED  
  CALL "CEE3DMP" USING DUMP-TITLE, DUMP-OPTIONS, FC  
  STOP RUN  
END-IF.
Let’s terminate with an ABEND

... 
MOVE 1234 TO ABDCODE 
MOVE 0 TO TIMING 
... 
CALL "CEEMOUT" USING MY-MSG-STRING, MSG-DEST, FC. 
IF NOT CEE000 OF FC THEN 
   CALL "CEEMSG" USING FC, MSG-DEST, OMITTED 
   CALL "CEE3DMP" USING DUMP-TITLE, DUMP-OPTIONS, FC 
   CALL "CEE3ABD" USING ABDCODE, TIMING 
END-IF.
Date and Time information...

- Job output now shows U1234 ABEND:

```
08.35.57 JOB05201  IEA995I SYMPTOM DUMP OUTPUT  360
360  USER COMPLETION CODE=1234 REASON CODE=00000000
360  TIME=08.35.57  SEQ=10636  CPU=0000  ASID=0037
360  PSW AT TIME OF ERROR  078D1000  A0CC401A  ILC 2  INTC 0D
360  ACTIVE LOAD MODULE     ADDRESS=20C29260 OFFSET=0009ADBA
360  NAME=CEEPLPKA
360  DATA AT PSW  20CC4014 - 00181610  0A0D58D0  D00498EC
360  AR/GR 0: 9856AFDE/84000000  1: 00000000/84000000
360       2: 00000000/A0EA94D8  3: 00000000/20EA94D0
360       4: 00000000/20C265B8  5: 00000000/20C26140
360       6: 00000000/20E86BE8  7: 00000000/20E890E0
360       8: 00000000/00000002  9: 00000000/20E85448
360       A: 00000000/20EA94D0  B: 00000000/A0CC3EF8
360       C: 00000000/20C27908  D: 00000000/20E893C0
360       E: 00000000/A0CD9884  F: 00000000/00000000
360  END OF SYMPTOM DUMP
```

08.35.57 JOB05201  IEF450I JMONTIGO GO - ABEND=S000 U1234 REASON=00000000  361
Date and Time information...

- Our final output looks like the following along with our CEEDUMP from the CEE3DMP call:

  02/14/2003 03:36:04 PM
  IN MAIN PROGRAM!
  THE SQUARE ROOT OF 9.00 IS: 3.00
  THE SQUARE ROOT OF 144.00 IS: 12.00
  THE SQUARE ROOT OF 2500.00 IS: 50.00
  CEE2010E The argument was less than 0 in math routine SQRT.
Other services

- Many other services are available.
  - Condition handling services
  - National Language services
  - Storage services
  - And more...
Summary

- Details on callable services available in the Language Environment Programming Reference. (SA22-7562-03)
- Callable services available from language environment conforming compilers
  - CEE* available on any platform
  - CEE3* available only on z/OS, z/VM
- Feedback codes report results of service
Appendix

- Full COBOL example
- Full PL/I example
- Full C example
- Full Assembler example