**CSCI 360 Internal Subroutines**

**Subroutines**

**Two Types:**

1. Internal Subroutine  
   * subroutine that is located within the same CSECT as the calling routine
2. External Subroutine – Covered Later  
   * Subroutine that is located outside of the calling routine
   * A separate CSECT

**Internal Subroutines**

On entrance to a subroutine, register 1 holds the address of a parameter list (if the subroutine gets passed any parameters)

On entrance to a subroutine, the initial value in any register that will be altered by the subroutine should be saved

Before exiting a subroutine, the initial value in any register that was altered by the subroutine should be restored

**Subroutine Name:** rtnName DS 0H

**Setting up a parameter list:**

* must be a set of contiguous fullwords, each of which contains the address of a parameter to be passed
* use address constants (adcons): label DC A(expr)  
  + if expr is a non-negative integer, the generated fullword will contain the binary representation of the integer (same as doing F‘expr’)
  + if expr is a label or label+n, the generated fullword will contain the address of label or address of label+n

DC A(5) => 00000005

000100 SAVE DS F

DC A(SAVE) => 00000100

* + expr may be several non-negative integers or label separated by commas

DC A(5,SAVE) => 0000000500000100

A sample parameter list for a program with internal subroutines:

PARMLIST DC A(TABLE)

DC A(EOT)

**To call a subroutine**:

1. If the subroutine requires passed in parameters, put the address of the parameter list into register 1
2. Use the Branch and Link Instruction  
   * RX Format: label BAL R,D(X,B)  
     + **LINK:** The address of the instruction immediately following the BAL instruction is placed in R  
       (where does it get this address from?!)
     + **BRANCH:** Branches to D(X,B), which is usually rtnName

LA 1,PARMLIST

BAL 11,RTNNAME

**To exit a subroutine:**

Branch to the instruction immediately following the BAL instruction by executing a BR instruction with the register used in the calling routine BAL instruction

BR 11

**Example stripped down program with one internal subroutine:**

MAIN CSECT

USING MAIN,R15

STM R0,R15,MAINSAVE

...

BAL R14,SUBRTN

...

LM R0,R15,MAINSAVE

BR R14

LTORG

\*\*\*\* Storage for MAIN starts here \*\*\*

MAINSAVE DS 16F

...

\*\*\* Storage for MAIN ends here \*\*\*

SUBRTN DS 0H SUBRTN starts here

STM R0,R15,SUBSAVE

...

LM R0,R15,SUBSAVE

BR R14

LTORG

\*\*\* Storage for SUBRTN starts here \*\*\*

SUBSAVE DS 16F

...

\*\*\* Storage for SUBRTN ends here \*\*\*

END MAIN