EEL 4744: Microprocessor Applications
Today's Menu

- Parameter Passing Methods
  - > Use the Internal Register(s)
  - > Use the Program Memory Space
  - > Use the Stack
  - > Use global memory

See examples on web-site: **`ParamPassing*.asm`** and see "***Parameter Passing Methods***" in Software and Documentation"

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Parameter Passing Methods

- How do you pass parameter(s) (data or pointer) between the subroutines (or interrupts) and the main routine or other subroutines?
  - > **Use the Internal Register(s)**
    - – Pass the parameter(s) (data or pointer) in the internal registers.
  - > **Use the Program Memory Space**
    - – Pass the parameter(s) (data or pointer) immediately after the call instruction, i.e. in the program memory space.
  - > **Use the Stack**
    - – Pass the parameter(s) (data or pointer) on the stack prior to the call.

Aside: After a pull, what exists above the stack pointer?

Depends! **No** guarantees!

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Passing Data in Internal Registers

- **Use the Internal Register(s):** Pass the parameter ***data*** in the internal registers.
  - > Problem: Finds the Average of Two Numbers
  - > Solution: See solution program
  - > Simulate

`ParamPassing1a.asm`

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Passing Pointers to Data in Internal Registers (Parameters in Program Memory)

- **Use the Internal Register(s):** Pass the parameter ***address (pointer)*** in the internal registers. The parameters are in **program** memory.
  - > Problem: Finds the Average of Two Numbers
  - > Solution: See solution program
  - > Simulate

`ParamPassing1b.asm`

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Passing Pointers to Data in Internal Registers (Parameters in Data Memory)

- **Use the Internal Register(s):** Pass the parameter ***address (pointer)*** in the internal registers. The parameters are in **data** memory.
  - > Problem: Finds the Average of Two Numbers
  - > Solution: See solution program
  - > Simulate

`ParamPassing1c.asm`

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Passing Data in Program Memory

- **Use the Program Memory Space**: Pass the parameter ***data*** immediately after the call instruction, *i.e.* in the program memory space. (This requires that the parameter(s) **be fixed** at assemble time).
  - > Problem: Finds the Average of Two Numbers
  - > Solution: See solution program
  - > Simulate

`ParamPassing2a.asm`

  - > Since data follows the call, the return address pushed on the top of the stack by the subroutine call **must be corrected** before returning from the subroutine
  - > Notice that the return address is both the return location and the location of the data

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Passing Data in Program Memory

- Since data follows the call, the return address pushed on the top of the stack by the subroutine call **must be corrected** before returning from the subroutine
- Notice that the return address is both the return location and the location of the data
- XMEGA chip addresses are 3 bytes
  - The data is copied to another register to protect the return address from changes

```
pop   R18
sts   CPU_RAMPX, R18
pop   XH
pop   XL
mov   ZH, XH
mov   ZL, XL
```

`ParamPassing2a.asm`

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Passing Data in Program Memory

- Since the address of the data is in program memory, it must be shifted left

```
lsl   ZH
lsl   ZL
ldi   R16, 0x00
mov   R0, R16
adc   ZH, R0
```

`ParamPassing2a.asm`

EEL 4744: Microprocessor Applications Passing Pointers to Data in Program Memory

- **Use the Program Memory Space**: Pass the parameter ***address (pointer)*** immediately after the call instruction.
  - > Similar to ParamPassing2a.asm except now a pointer to the data is passed (instead of the data itself), so that the data does not have to be know at assemble time.
  - > Does require a second process of shifting the address
  - > Problem: Finds the Average of Two Numbers
  - > Solution: See solution program
  - > Simulate

`ParamPassing2b.asm`

EEL 4744: Microprocessor Applications Passing Data on the Stack

- **Use the Stack**: Pass the parameter ***data*** on the stack prior to the call.
  - > Problem: Finds the Average of Two Numbers
  - > Solution: See solution program
  - > Simulate

`ParamPassing3A.asm`

.	.	.	.	.	.	.
.	.	Ret(2)	X	X	X	X
.	.	Ret(1)	X	X	X	X
.	.	Ret(0)	X	X	Ret(2)	X
.	A3	A3	A3	X	Ret(1)	X
.	37	37	37	X	Ret(0)	X
	Push data on stack	Call subroutine	Get return address	Get data	Put return address back for RET	RET

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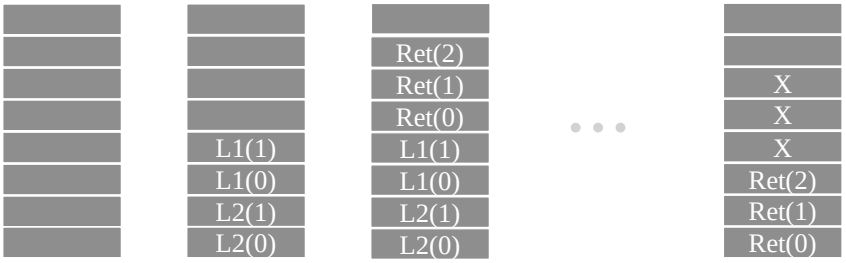
Passing Pointers to Data on the Stack

- **Use the Stack**: Pass the parameter ***address (pointer)*** on the stack prior to the call.
  - > Problem: Finds the Average of Two Numbers
  - > Solution: See solution program
  - > Simulate

`ParamPassing3b.asm`



Put data on stack

Call subroutine

Put return address back for RET

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Passing Data in Global Data Memory

- **Use Global Memory**: The most common way to pass data by neophyte assembly language programmers is by using ***global data memory***.
  - > Problem: Finds the Average of Two Numbers
  - > Solution: See solution program
  - > Simulate

`ParamPassing4.asm`

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Passing Data in Constants

- **Use Constants**: Pass the parameters as constants
  - > Problem: Finds the Average of Two Numbers
  - > Solution: See solution program
  - > Simulate

`ParamPassing5.asm`

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The End!