

ECE3120: Computer Systems Arithmetic Programming

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□ Today:

- Multi-precision Subtraction Example
- Introduce Multiplication and Division Instructions
- Pseudo code

Example 2.8' Write a program to subtract the hex number stored at \$804-\$807 from the hex number stored at \$800-\$803 and save the result at \$900-\$903.

*The subtraction starts from the LSBs and proceeds toward the MSBs.

```
org      $1000
ldd      $802      ; place the lowest 2 bytes of the minuend D
subd     $806      ; subtract the lowest 2 bytes of the subrahend from D
std      $902      ; save
```

* subtract and save the difference of the second to most-significant bytes

```
ldaa     $801
sbca     $805
staa     $901
```

*subtract and save the difference of the most significant bytes

```
ldaa     $800
sbca     $804
staa     $900
end
```

Multiplication and Division

Table 2.1 Summary of 68HC12 multiply and divide instructions

Mnemonic	Function	Operation
EMUL	unsigned 16 by 16 multiply	$(D) \times (Y) \rightarrow Y:D$
EMULS	signed 16 by 16 multiply	$(D) \times (Y) \rightarrow Y:D$
MUL	unsigned 8 by 8 multiply	$(A) \times (B) \rightarrow A:B$
EDIV	unsigned 32 by 16 divide	$(Y:D) \div (X)$ quotient $\rightarrow Y$ remainder $\rightarrow D$
EDIVS	signed 32 by 16 divide	$(Y:D) \div (X)$ quotient $\rightarrow Y$ remainder $\rightarrow D$
FDIV	16 by 16 fractional divide	$(D) \div (X) \rightarrow X$ remainder $\rightarrow D$
IDIV	unsigned 16 by 16 integer divide	$(D) \div (X) \rightarrow X$ remainder $\rightarrow D$
IDIVS	signed 16 by 16 integer divide	$(D) \div (X) \rightarrow X$ remainder $\rightarrow D$

Pseudo Code

- Is a high level description of the logic behind the assembly language program
- Ex: Write a Pseudo code for adding an array of N numbers

Pseudo Code

```
array = []
```

```
sum = 0
```

```
for I = 1: N
```

```
    sum = sum + array[i]
```

```
end
```



Next...

- Multiplication and Division Examples
- BCD