

# General Operations

*Because, in the end, you're still to write something useful.*

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Communications  
Security Establishment

Centre de la sécurité  
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# ALU instructions

Instruction	Example	Description
<b>add</b>	add eax, 0x04	Add 4 to the content of eax.
<b>and</b>	and eax, 0x01	Do a binary <b>and</b> between eax and 0x01.
<b>or</b>	or eax, 0xFF	Do a binary <b>or</b> between eax and 0xFF.
<b>sub</b>	sub eax, 0x01	Subtract 0x01 from eax.
<b>test</b>	test eax, eax	This is equivalent to cmp and does not change the register values.
<b>xor</b>	xor eax, eax	Do a binary <b>xor</b> between eax and eax.

# SHIFT instructions

Instruction	Example	Description
<b>sal</b>	sal eax, 0x01	Proceed to a left shift while keeping the sign of the data in eax
<b>sar</b>	sar eax, 0x01	Same as sal but shift is done to the right.
<b>shl</b>	shl eax, 0x01	Proceed to a left shift. The sign bit is not kept.
<b>shr</b>	shr eax, 0x01	Same as shl but shift is done to the right.
<b>rol</b>	rol eax, 0x01	Rotate the bits to the left.
<b>ror</b>	ror eax, 0x01	Rotate the bits to the right.



# Shift arithmetic VS. Shift VS. Rotation

## Shift arithmetic (on a byte):

Let's pretend we have the following value

**0b00000001**

After applying a 1 bit left shift the value will be:

**0b00000010**

Had the value been **0b10000001** the new value would have been

**0b10000010**

## Shift (on a byte):

Let's pretend we have the following value

**0b00000001**

After applying a 1 bit left shift the value will be:

**0b00000010**

Had the value been **0b10000001** the new value would have been

**0b00000010**

## Rotation (on a byte):

Let's pretend we have the following value

**0b00000001**

After applying a 1 bit left rotation the value will be:

**0b00000010**

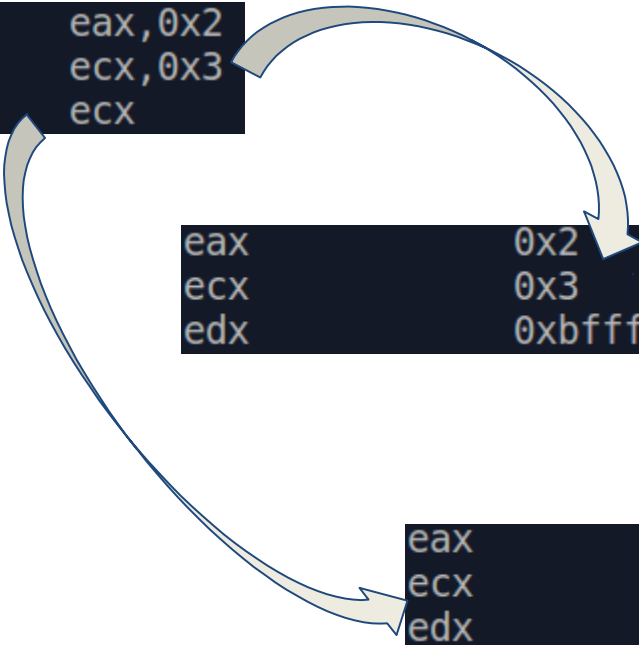
Had the value been **0b10000001** the new value would have been

**0b00000011**



# Multiplication - unsigned (mul)

```
0x080483e3 <+3>:  mov    eax,0x2
0x080483e8 <+8>:  mov    ecx,0x3
0x080483ed <+13>: mul    ecx
```



eax	0x2	2
ecx	0x3	3
edx	0xbffff0a4	-1073745756

Both terms of the multiplication are set in **EAX** and in **another register**. After the multiplication, the **result** will be in **edx:eax** where **eax** contain the **lower 32 bits** of the result.

eax	0x6	6
ecx	0x3	3
edx	0x0	0

# Multiplication - signed (imul)

```
0x080483e3 <+3>:  mov    eax,0x2
0x080483e8 <+8>:  mov    ecx,0x3
0x080483ed <+13>: imul   eax,eax,0x3
```

eax	0x2	2	
ecx	0x3	3	
edx	0xbffff0a4		-1073745756

imul allows for this form:  
 imul <dst>, <src1>, <src2>  
 There are 3 variants of the instructions, you should have a look at intel documentation should you be interested!  
 (volume2)

eax	0x6	6	
ecx	0x3	3	
edx	0xbffff0a4		-1073745756

# Division - unsigned (div) AND signed (idiv)

There is a catch using idiv.  
Can you guess it?

```
0x080483e3 <+3>:  mov    eax,0x5
0x080483e8 <+8>:  xor     edx,edx
0x080483ea <+10>: mov     ecx,0x2
0x080483ef <+15>:  div     ecx
```

eax	0x5	5
ecx	0x2	2
edx	0x0	0

eax	0x2	2
ecx	0x2	2
edx	0x1	1

Both div and idiv work the same way!

The **div** instruction uses **edx:eax** to hold the **number to be divided**. The **divisor** is then determined by the **operand** used with the div instruction.

After the div, **eax** will **contain** the result (**quotient**) of the division while **edx** will **contain** the **remainder**.

Be careful!, AH:AL will be used for division on bytes and DX:AX for division on words (16 bits).

# Lets write some code!

