Carry Flag, Auxiliary Flag and Overflow Flag in Assembly

Asked 10 years, 11 months ago Modified 3 years, 11 months ago Viewed 154k times

36

I Cannot seem to tell the difference between the Carry Flag, Auxiliary Flag and Overflow Flag in Assembly. I'm currently studying it in school and the teacher didn't go into any details. Please help me to understand, I will be needing it for the exam. I will be really grateful!! From what I seem to know by now is that the Carry Flag is used when you try, let's say, 255+9 when you only have 8 bits for data, The Auxiliary Flag is the same, but only for the 4 last bits?? And The Overflow is used when you have 7 bits for the binary number and the 8(left-most) is used for the sign???

assembly x86 overflow eflags

Share Improve this question Follow

edited Sep 27, 2020 at 0:40
Peter Cordes
354k ● 49 ● 685 ● 934

asked Oct 10, 2013 at 16:39
user2322960

What microprocessor are you talking about? If it's x86, then here are links to all of the flags, with detailed descriptions: en.wikipedia.org/wiki/FLAGS_register. But in x86, it's actually "adjust flag" not "auxiliary flag". – lurker Oct 10, 2013 at 16:43

1 Yes, you got that about right. Generally `carry` is for unsigned, `overflow` is for signed, and `auxiliary carry` is an obscure thing not really used :) But it's indeed the carry from the low 4 bits to the high 4 bits. – Jester Oct 10, 2013 at 16:45

Well I would like to know the difference with each type of processors so I could better understand it. – user2322960 Oct 10, 2013 at 16:45

what about 16 bit processors or x64? – user2322960 Oct 10, 2013 at 16:46

it should be all the same for each processor on this planet ;) – Michał Walenciak Oct 10, 2013 at 16:51

2 Answers

Sorted by: Highest score (default)

64

Carry Flag

The rules for turning on the carry flag in binary/integer math are two:

1. The carry flag is set if the addition of two numbers causes a carry out of the most significant (leftmost) bits added. 1111 + 0001 = 0000 (carry flag is turned on)
2. The carry (borrow) flag is also set if the subtraction of two numbers requires a borrow into the most significant (leftmost) bits subtracted. 0000 - 0001 = 1111 (carry flag is turned on) Otherwise, the carry flag is turned off (zero).
   - 0111 + 0001 = 1000 (carry flag is turned off [zero])
   - 1000 - 0001 = 0111 (carry flag is turned off [zero])

In unsigned arithmetic, watch the carry flag to detect errors.

In signed arithmetic, the carry flag tells you nothing interesting.

Overflow Flag

The rules for turning on the overflow flag in binary/integer math are two:

1. If the sum of two numbers with the sign bits off yields a result number with the sign bit on, the "overflow" flag is turned on. 0100 + 0100 = 1000 (overflow flag is turned on)
2. If the sum of two numbers with the sign bits on yields a result number with the sign bit off, the "overflow" flag is turned on. 1000 + 1000 = 0000 (overflow flag is turned on)

Otherwise the "overflow" flag is turned off

- 0100 + 0001 = 0101 (overflow flag is turned off)
- 0110 + 1001 = 1111 (overflow flag turned off)
- 1000 + 0001 = 1001 (overflow flag turned off)
- 1100 + 1100 = 1000 (overflow flag is turned off)

Note that you only need to look at the sign bits (leftmost) of the three numbers to decide if the overflow flag is turned on or off.

If you are doing two's complement (signed) arithmetic, overflow flag on means the answer is wrong - you added two positive numbers and got a negative, or you added two negative numbers and got a positive.

If you are doing unsigned arithmetic, the overflow flag means nothing and should be ignored.

For more clarification please refer: http://teaching.idallen.com/dat2343/10f/notes/040_overflow.txt

Share Improve this answer Follow

answered Sep 19, 2014 at 4:51
dark_knight
649 ●5 ●3

See also Sign, Carry, and Overflow Flag (Assembly) for visual animations of adding or subtracting 1 to a 4-bit counter, showing the value wrap around, and unsigned vs. signed interpretation of each value, and flags after that operation. – Peter Cordes Jul 30, 2022 at 21:04

45

✓

Carry Flag is a flag set when:

a) two unsigned numbers were added and the result is larger than "capacity" of register where it is saved. Ex: we wanna add two 8 bit numbers and save result in 8 bit register. In your example: 255 + 9 = 264 which is more that 8 bit register can store. So the value "8" will be saved there (264 & 255 = 8) and CF flag will be set.

b) two unsigned numbers were subtracted and we subtracted the bigger one from the smaller one. Ex: 1-2 will give you 255 in result and CF flag will be set.

Auxiliary Flag is used as CF but when working with BCD. So AF will be set when we have overflow or underflow on in BCD calculations. For example: considering 8 bit ALU unit, Auxiliary flag is set when there is carry from 3rd bit to 4th bit i.e. carry from lower nibble to higher nibble. (Wiki link)

Overflow Flag is used as CF but when we work on signed numbers. Ex we wanna add two 8 bit signed numbers: 127 + 2. the result is 129 but it is too much for 8bit signed number, so OF will be set. Similar when the result is too small like -128 - 1 = -129 which is out of scope for 8 bit signed numbers.

You can read more about flags on wikipedia

Share Improve this answer Follow

edited Aug 17, 2017 at 13:36
José Castro
671 ●6 ●14

answered Oct 10, 2013 at 16:50
Michał Walenciak
4,345 ●4 ●35 ●65

Highly active question. Earn 10 reputation (not counting the association bonus) in order to answer this question. The reputation requirement helps protect this question from spam and non-answer activity.