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1. How does an external device indicate an Interrupt event to the processor? How does the processor response to this event?

-> interrupt 발생 시 CPU로 인터럽트 요청 신호(INTR)을 보낸다. 그러면 CPU가 인터럽트 응답 신호(INTA)를 보내는데, 이 신호들은 control bus를 통해 전달된다.

2. A DMA module is transferring characters to memory using cycle stealing, from a device transmitting at 9600bps
   The processor is fetching instructions at the rate of 1 MIPS. By how much will the processor be slowed down due to the DMA activity? Assume the processor only access memory to fetch instructions

-> character는 8bit이므로 9600 bit per second = 1200 char per second

slow down : $1200/10^6*100 = 0.12\%$

3. Convert the decimal numbers (15.15) to binary and hexadecimal number
   Convert the binary number (101.101) to decimal and hexadecimal number

-> 15.15 : binary - 1111.0010011… (0011 반복)
   hexadecimal - F.28406… (28406 반복)
   101.101 : decimal - 5.625
   hexadecimal - 5.A

4. Represent the following decimal number in 2's complements using 8bits:-85, +52

-> 85 : 01010101_2 => -85 : 10101011_2
   52 : 00101010_2

5. Assume numbers are represented in 5-bit 2's complement representation.
   Show the calculation of the followings
   1) 5 + 11 2) -5 + 11 3) 5 - 11 4) -5 - 11

-> 5 : 00101_2 11 : 01011_2
   -5 : 11011_2 -11 : 10101_2
   5-bit로 표현할 수 있는 범위 : $-2^4 \sim 2^4-1$
   1) 5 + 11 : 00101 + 01011 = 10000_2 => 범위를 넘기 때문에 overflow
   2) -5 + 11 : 11011 + 01011 = 100110_2 (carry 발생) => 6
   3) 5 - 11 : 5 + (-11) = 00101 + 10101 = 11010 => 2's complement : 00110_2 ∴ -6
   4) -5 - 11 : -5 + (-11) = 110000 => 2's complement : 10000_2 ∴ -16

6. Express the following numbers in IEEE 32bit floating-point format
   1) -1.5 2) 1/16

-> 1) -1.5 : $-1.1_2 = -1.1 * 2^0$ => 1 01111111 10000000000000000000000
   2) 1/16 : $0.0625 = 0.0001_2 = 1.0 * 2^{-4}$ => 0 01111011 00000000000000000000000

7. What is the equivalent decimal value of the following IEEE 32bit floating-point representation?

1) 1 10000010 00100000000000000000000

2) 0 01111010 00000000000000000000000

-> 1) $-1.001_2 * 2^3 = -1001_2 = -9$

2) $1.0_2 * 2^{-5} = 0.00001_2 = 0.0625$

8. A given processor has words of 2 bytes. What is the smallest and largest integer that can be represented in the following representations

1) unsigned 2) sign-magnitude

3) 2's complement 4) signed packed decimal

-> 2 bytes = 16bits

1) smallest : 0 largest : 2^{16}

2) smallest ; $-2^{15} + 1$ largest : $2^{15} - 1$

3) smallest : -2^{15} largest : $2^{15} - 1$

4) smallest ; -999 largest : 999

9. Do the calculation of adding +8 and -8. Assume numbers are represented in 8-bit 2's complement representation. Show the following flags after the addtion

1) C 2) O 3) S 4) Z 5) AC

-> +8 : 00001000_2 => 2's complement => -8 : 11111000_2

8 + (-8) : 100000000_2 => 4번째 자리에서 carry 발생하고, 연산 결과가 0이다.

1) C : 1 2) O : 0 3) S : 0 4) Z : 1 5) AC : 1

10. For the following data structure, draw the big-endian and little-endian layouts, and comment on the result

1) struct {
int i; //0x11121314
int j; //0x15161718
} s1;

2) struct {
short i; //0x1112
short j; //0x1314
short k; //0x1516
short l; //0x1718
} s2;

-> 1) i, j는 int형이므로 4bytes이다. 16진수이므로 각각의 수는 4bit이고, 2개의 수가 8bit = 1byte이다.

	00	01	02	03	04	05	06	07
Big	11	12	13	14	15	16	17	18
Little	14	13	12	11	18	17	16	15

2) i, j, k, l은 short형이므로 2bytes이다. 16진수이므로 각각의 수는 4bit이고, 2개의 수가 8bit = 1byte이다.

	00	01	02	03	04	05	06	07
Big	11	12	13	14	15	16	17	18
Little	12	11	14	13	16	15	18	17

11. How many different numbers can be represented in the IEEE 32bit floating-point representation?

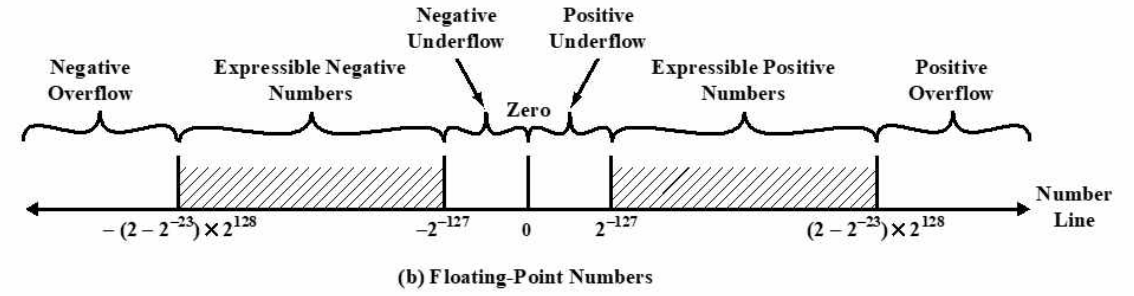

Figure 10.19 Expressible Numbers in Typical 32-Bit Formats

-> IEEE 32bit floating-point로 zero와 infinity는 다음과 같이 나타낸다.

	sign	biased exponent	fraction
positive zero	0	0	0
negative zero	1	0	0
plus infinity	0	all 1s	0
minus infinity	1	all 1s	0

따라서 나타낼 수 있는 수는 $-(2-2^{-23})*2^{127}$ ~ -2^{-126}, 2^{-126} ~ $(2-2^{-23})*2^{127}$ 그리고 0이다.

12. List and explain five important fundamental issues in designing Instruction Set

-> ① operation repertoire : how many and which operations to provide and how complex operations should be

② data types : the various types of data upon which operations are performed

③ instruction format : instruction length in bits, number of addresses, size of various field, etc

④ registers : number of processor registers that can be referenced by instructions and their use

⑤ addressing : the mode or modes by which the address of and operand is specified