What is a "register"?

It is a special location of a fixed size of bits, where binary (base 2) arithmetic takes place.

For example: Java has a 32 bit, signed integer register (1 byte = 8 bits) (32 bits = 4 bytes) (So, what's a nybble?4 bits)

This is an example of a 16 bit register (size = 16 bits):

R: 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0

How do we note a "register"?

R:

The values listed after the "R" are assumed to be binary (base 2), and DO NOT require a subscript. ("R" implies a binary value to follow.)

You must include all leading zero's (0) in a register as "padding".

The decimal value 4 is illustrated in the above 16 bit register.

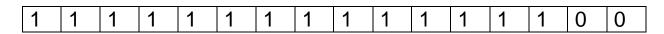
How many values can we store in a register?

 2^{n} , where n = size of the register.

Thus, a 16 bit register can store 2¹⁶ values or 65,536 values

Hence the range of values 0 to 65,535 (for an unsigned register) or 2ⁿ -1 (the minus 1 representing the value 0)

How do we represent -4 (negative 4)?



Let's see why this is the correct answer....

Signed Integer Registers

How do they work? (2's complement method)

How many values can be stored in a 4 bit register?	Binary # (or all possible bit combinations)	Decimal Value Of Binary Number	Integers are Positive (0) Or Negative (1)	R: □□□□ 4-bit Register "R" Uses Signed integers
$2^4 = 16$				(The bit pattern represents this decimal value.)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

Finding 2's complement representation of a binary value within a register:

- 1. Find the positive value
- 2. Flip the bits (0's become 1's, and 1's become 0's)
- 3. Add One (+1)
- 4. Result is your answer.

More Issues With Integer Registers...

Detecting Overflow – when the sign bit of the result value is negative after adding 2 positive values.

Adding 2 positive values always results in a positive value.

Why isn't this a problem for mixed sign addition, or subtraction?

You will always remain within the range of the register!

So what is the "range" of a signed integer register?

$$-2^{n-1}$$
 to $+(2^{n-1}-1)$

Let's look at the 16 bit register again...this time as a "signed integer register":

n=16

- 32,768 to +32,767

Note: Range is always expressed from negative to positive value.