Example: Converting to IEEE 754 Form

Put 0.085 in single-precision format

1. **The first step is to look at the sign of the number.**
   Because 0.085 is positive, the sign bit =0.

   $(-1)^0 = 1$.

2. **Write 0.085 in base-2 scientific notation.**
   This means that we must factor it into a number in the range [1 <= n < 2] and a power of 2.

   $0.085 = (-1)^0 * (1+\text{fraction}) * 2^{\text{power}}$, or:
   $0.085 / 2^{\text{power}} = (1+\text{fraction})$.

   So we can divide 0.085 by some power of 2 to get the (1 + fraction).

   $0.085 / 2^{-1} = 0.17$
   $0.085 / 2^{-2} = 0.34$
   $0.085 / 2^{-3} = 0.68$
   $0.085 / 2^{-4} = 1.36$

   Therefore, $0.085 = 1.36 * 2^{-4}$

3. **Find the exponent.**
   The power of 2 is -4, and the bias for the single-precision format is 127.
   This means that the exponent = -4 + 127 = 123_{ten}.
   In binary, it's 01111011_{bin}

4. **Write the fraction in binary form**
   We know that the number we calculated in step 2 is in the range [1 <= n < 2]. Therefore, we don't have to store the leading 1.

   The fraction = 0.36 . Unfortunately, this is not a "pretty" number, like those shown in the book. The best we can do is to approximate this value. Single-precision format allows 23 bits for the fraction.

   Binary fractions look like this:

   $0.1 = (1/2) = 2^{-1}$
   $0.01 = (1/4) = 2^{-2}$
   $0.001 = (1/8) = 2^{-3}$

To approximate 0.36, we can say:

0.36 = (0/2) + **(1/4)** + (0/8) + **(1/16)** + **(1/32)** +...
$0.36 = 2^{-2} + 2^{-4} + 2^{-5}$+...

$0.36_{ten} \sim 0.01011100001010001111011_{bin}$.

The binary string we need is: 01011100001010001111011.

It's important to notice that you will not get 0.36 exactly. This is why floating-point numbers have error when you put them in IEEE 754 format.

5. **Now put the binary strings in the correct order -**
1 bit for the sign, followed by 8 for the exponent, and 23 for the fraction. The answer is:

	Sign	Exponent	Fraction
Decimal	0	123	0.36
Binary	**0**	**01111011**	**01011100001010001111011**

Example: IEEE 754 to Float ->