Hexadecimals (part 2) [Andy Chong Sam]

(I) In this article we'll discuss how hexadecimals are used to summarize binary strings. Here is a chart showing hexadecimals with their decimal and binary equivalents:

Decimal	Hexadecimal	Binary
0	0	0000
1	1	0001
2	2	0010
3	3	0011
4	4	0100
5	5	0101
6	6	0110
7	7	0111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111

(II) A string of 0's and 1's is difficult to read, so we will instead divide the binary string into segments of 4 bits. We can then use the table to replace each segment with the corresponding hexadecimal digit. Consider the string 000111000011:

$$(0001 \quad 1100 \quad 0011)_2 = (1\ \mathrm{C}\ 3)_{16}$$

000111000011 and 1C3 are the binary and hexadecimal representations of 451, which we can verify:

Binary Verification:

$$2^8 + 2^7 + 2^6 + 2^1 + 2^0 = 451$$

Hexadecimal Verification:

$$(1)(16)^2 + (12)(16)^1 + (3)(16)^0 = 451$$

(III) Let's try to rewrite the binary string 0100101111110101 using hexadecimals:

$$(0100 \quad 1011 \quad 1111 \quad 0101)_2 = (4\ \mathrm{B}\ \mathrm{F}\ 5)_{16}$$

We can see that both are representations of the decimal 19445. The hexadecimal verification is shown below:

$$(4)(16)^3 + (11)(16)^2 + (15)(16)^1 + (5)(16)^0 \\ = 19445$$

(IV) To convince ourselves that this technique works we can decompose 4BF5 in the following manner:

$$\begin{array}{r} 4\ 0\ 0\ 0 \\ +\,\mathrm{B}\ 0\ 0 \\ +\,\mathrm{F}\ 0 \\ +\,5 \\ \hline 4\ \mathrm{B}\ \mathrm{F}\ 5 \end{array}$$

Let's calculate the decimal representation of each row:

$$\begin{aligned} (4)(16)^3 &= 16384 \\ (11)(16)^2 &= 2816 \\ (15)(16)^1 &= 240 \\ (5)(16)^0 &= 5 \end{aligned}$$

Finally, we can see that adding all of these results give us the original decimal: $16384 + 2816 + 240 + 5 = 19445$.