HEXADECIMAL

- In one digit, there are 16 numbers

Binary	0	1														
Decimal	0	1	2	3	4	5	6	7	8	9						
Hexadecimal	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

- Programmers encounter problems reading long binary.
  - 10001000111001110011011O
- So, programmers use hexadecimal instead of binary.
  - 10001000111001110011011O
  - 88E736
  - It shorten code.
  - It reduces reading and writing errors.

CONVERTING DECIMAL TO HEXADECIMAL

- 2566 in decimal to hexadecimal
- Follow these steps
  1. Write place value table
  2. Multiple each place value with 0-9, A-F 1; Put an appropriate value into the place values that can make to total of result equals to the target

16^4	16^3	16^2	16^1	16^0
65536	4096	256	16	1

CONVERTING DECIMAL TO HEXADECIMAL

- Convert these denary numbers to hexadecimal

Hexadecimal	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

- 6
- 15
- 16
- 26
- 255

CONVERTING HEXADECIMAL TO DECIMAL

- A06 in hexadecimal to decimal
- Follow these steps
  1. Write place value table
  2. Put hexadecimal into the place value table (in the least most significant bit first)
  3. Multiply each place value between 0 – 15
     - A = 10, B = 11, C = 12, D = 13, E = 14, F = 15
  4. Sum up the value

16^4	16^3	16^2	16^1	16^0
65536	4096	256	16	1

CONVERTING DECIMAL TO HEXADECIMAL

- Convert these hexadecimal numbers to denary

Hexadecimal	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

- 8
- 11
- 15
- 180

CONVERTING BINARY TO HEXADECIMAL

- 2 methods
- 1st method
  - Binary to decimal, then decimal to hexadecimal
  - Example 1010 1011

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

16^4	16^3	16^2	16^1	16^0
65536	4096	256	16	1

CONVERTING BINARY TO HEXADECIMAL

- Convert these binary number to hexadecimal

- 0010
- 1110

CONVERTING BINARY TO HEXADECIMAL

- 2nd method
  - Example 1101010
  - 1) separate binary to 4 digits from right to left. Each part has four digits called “nibble”

0	1	1	0		1	0	1	0

  - 2) convert each set to decimal (binary to decimal method)

2^3	2^2	2^1	2^0
8	4	2	1

  - 3) convert the result to hexadecimal

CONVERTING BINARY TO HEXADECIMAL

- Convert these binary numbers to hexadecimal

- 1010
- 1111 1111
- 11 1100

CONVERTING HEXADECIMAL TO BINARY

- Example 6A
  - 1) separate each digit

6	A

  - 2) convert each digit to decimal

6	A
6	10

  - 3) convert each number to hexadecimal

6	A
6	10
110	1010

CONVERTING BINARY TO HEXADECIMAL

- Convert these hexadecimal numbers to binary

- C
- 1F
- ABC

CONVERTING HEXADECIMAL

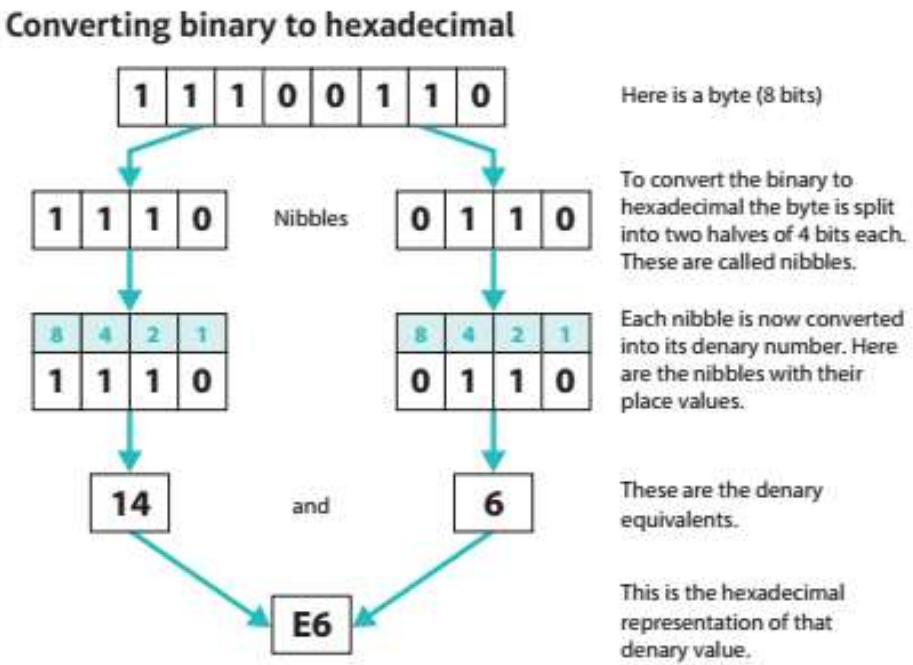

Figure 3.1 Converting binary numbers to hexadecimal

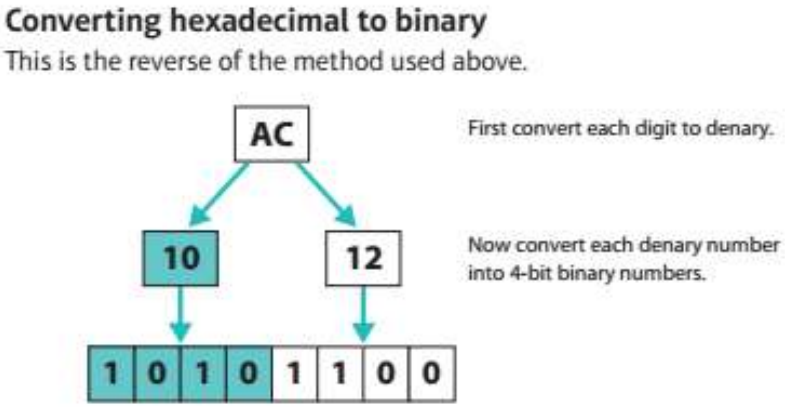

Figure 3.2 Converting hexadecimals to binary numbers

USES OF HEXADECIMAL

- ASCII code (American Standard Code for Information Interchange)
- each character on a keyboard can be represented by hexadecimal or decimal

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
32	20	<SPACE>	64	40	@	96	60	`
33	21	!	65	41	A	97	61	a
34	22	"	66	42	B	98	62	b
35	23	#	67	43	C	99	63	c
36	24	$	68	44	D	100	64	d
37	25	%	69	45	E	101	65	e
38	26	&	70	46	F	102	66	f
39	27	'	71	47	G	103	67	g
40	28	(	72	48	H	104	68	h
41	29	)	73	49	I	105	69	i
42	2A	*	74	4A	J	106	6A	j
43	2B	+	75	4B	K	107	6B	k
44	2C	,	76	4C	L	108	6C	l
45	2D	-	77	4D	M	109	6D	m
46	2E	.	78	4E	N	110	6E	n
47	2F	/	79	4F	O	111	6F	o
48	30	0	80	50	P	112	70	p

USES OF HEXADECIMAL

- Color code in HTML language
  - color in computer system is RGB. Red Green Blue
  - #000000 is black
  - #FFFFFF is white
  - #FF0000 is red
  - #00FF00 is green
  - #0000FF is blue
  - #FFFF00 is yellow
  - #FF00FF is pink

FFFFFF	000000	333333	666666	999999	CCCCCC	CCCC99	9999CC	666699
660000	663300	996633	003300	003333	003399	000066	330066	660066
990000	993300	CC9900	006600	336666	0033FF	000099	660099	990066
CC0000	CC3300	FFCC00	009900	006666	0066FF	0000CC	663399	CC0099
FF0000	FF3300	FFFF00	00CC00	009999	0099FF	0000FF	9900CC	FF0099
CC3333	FF6600	FFFF33	00FF00	00CCCC	00CCFF	3366FF	9933FF	FF00FF
FF6666	FF6633	FFFF66	66FF66	66CCCC	00FFFF	3399FF	9966FF	FF66FF
FF9999	FF9966	FFFF99	99FF99	66FFCC	99FFFF	66CCFF	9999FF	FF99FF
FFCCCC	FFCC99	FFFFCC	CCFFCC	99FFCC	CCFFFF	99CCFF	CCCFF	FFCCFF

USES OF HEXADECIMAL

- Error code or memory dump
  - Address of memory and the value
  - to trace errors in a program
  - if it was binary, what would happen?

```
00990F60   54 68 69 73 20 69 73 20 61 6E 20 65 78 61 6D 70 6C 65 20 6F 66
00990F77   61 20 6D 65 6D 6F 72 79 20 64 75 6D 70 20 66 72 6F 6D 20 20 61
00990E8E   74 79 70 69 63 61 6C 20 20 63 6F 6D 70 75 74 65 72 20 20 6D 85
00990EA5   6D 6F 72 79 20 73 68 6F 77 69 6E 67 20 74 68 65 20 20 63 6F 6E
00990EBC   74 65 6E 74 73 20 6F 66 20 61 20 6E 75 6D 62 65 72 20 20 6F 66
00990ED3   6C 6F 63 61 74 69 6F 6E 73 20 20 69 6E 20 20 68 65 78 20 20 20
00990EEA   6E 6F 74 61 74 69 6F 6E 20 20 00 00 00 00 00 00 00 00 00 00 00
```

USES OF HEXADECIMAL

- MAC address (Media Access Control)
  - like ID number of each person
  - each computer connecting to the internet has unique number
  - in form of :

    NN – NN – NN – DD – DD – DD
    or
    NN:NN:NN:DD:DD:DD

  - hexadecimal in each unit
  - first six numbers refer to manufacturer
  - last six numbers refer to serial number of device

CONVERTING NUMBERS

Binary	Denary	Hexadecimal
	120	
1101001		
		1FA