Ch 14 (C) Number bases

14.2 The binary system

> The binary system is based upon powers of 2.

Converting binary → decimal

▼ Convert 110101_2 to decimal.

$$110101_2 = 1(2^5) + 1(2^4) + 0(2^3) + 0(2^1) + 1(2^0)$$
$$= 1(32) + 1(16) + 0(8) + 1(4) + 0(2) + 1(1)$$
$$= 32 + 16 + 4 + 1 = 53_{10}$$

Converting decimal → binary

2^0	1	2^4	16	2^8	256
2^1	2	2^5	32	2^9	512
2^2	4	2^6	64	2^{10}	1024
2^3	8	2^7	128		

▼ Convert 83_{10} to binary

Solution 1

$83 = 64 + 19$
$19 = 16 + 3$
$83 = 64 + 16 + 2 + 1$
$\quad = 2^6 + 2^4 + 2^1 + 2^0$
$\quad = 1(2^6) + 0(2^5) + 1(2^4) + 0(2^3) + 0(2^2) + 1(2^1) + 1(2^0)$
$\quad = 1010011_2$

Solution 2

$83 \div 2 = 41 \text{ r } 1 \qquad 1$
$41 \div 2 = 20 \text{ r } 1 \qquad 1$
$20 \div 2 = 10 \text{ r } 0 \qquad 0$
$10 \div 2 = 5 \text{ r } 0 \qquad 0$
$5 \div 2 = 2 \text{ r } 1 \qquad 1$
$2 \div 2 = 1 \text{ r } 0 \qquad 0$
$1 \div 2 = 0 \text{ r } 1 \qquad 1$

Working from bottom to top $\Rightarrow 1010011_2$

Octal system

> The octal system is based upon powers of 8.

Converting octal → decimal

▼ Convert 325_8 to decimal

$$325_8 = 3(8^2) + 2(8^1) + 5(8^0)$$
$$= 3(64) + 2(8) + 5(1)$$
$$= 192 + 16 + 5$$
$$= 213_{10}$$

Converting decimal → octal

8^0	1
8^1	8
8^2	64
8^3	512
8^4	4096
8^5	32768

▼ Convert 1001 to octal.

Solution 1

$1001 = 512 + 489$
$489 = 7(64) + 41$
$41 = 5(8) + 1$
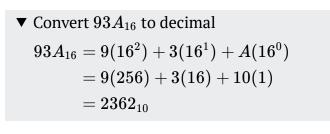$1001 = 1(8^3) + 7(8^2) + 5(8^1) + 1(8^0) = 1751_8$

Solution 2

$1001 \div 8 = 125$ r 1   1
$125 \div 8 = 15$ r 5   5
$15 \div 8 = 1$ r 7   7
$1 \div 8 = 0$ r 1   1

Working from bottom to top $\Rightarrow 1751_8$.

14.4 Hexadecimal system

Converting hexadecimal → decimal

Decimal	Hexadecimal
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	A
11	B
12	C
13	D
14	E
15	F

▼ Convert $93A_{16}$ to decimal

$$93A_{16} = 9(16^2) + 3(16^1) + A(16^0)$$
$$= 9(256) + 3(16) + 10(1)$$
$$= 2362_{10}$$

Converting decimal → hexadecimal

▼ Convert 14397_{10} to hexadecimal

$14397 = 3(4096) + 2109$
$2109 = 8(256) + 61$
$61 = 3(16) + 13$
$14397 = 3(16^3) + 8(16^2)3(16^1) + 13$
$14397_{10} = 383D_{16}$

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