Binary N um ber Syst em

(Continued from previous slide..)

$$10101_{2} = (1 \times 2^{4}) + (0 \times 2^{3}) + (1 \times 2^{2}) + (0 \times 2^{1}) \times (1 \times 2^{0})$$

$$= 16 + 0 + 4 + 0 + 1$$

$$= 21_{10}$$

Oct al N um ber Syst em

(Continued from previous slide..)

§ Since there are only 8 digits, 3 bits = 8) sufficient to represent any octal number in binarye

$$2057_8 = (2 \times 8^3) + (0 \times 8^2) + (5 \times 8^1) + (7 \times 8^0)$$
$$= 1024 + 0 + 40 + 7$$
$$= 1071_{10}$$

Hexadecim al N um ber Syst em

Characterist ics

- § A positional number system
- § Has total 16 symbols or digits (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F). Hence its base = 16
- § The symbols A, B, C, D, E and F represent the decimal values 10, 11, 12, 13, 14 and 15 respectively
- § The maximum value of a single digit is 15 (one less than the value of the base)

Hexadecim al N um ber Syst em

(Continued from previous slide..)

- § Each position of a digit represents a specific power of the base (16)
- § Since there are only 16 digits, 4 bits $(2^4 = 16)$ are sufficient to represent any hexadecimal number in binary

$$1AF_{16} = (1 \times 16^{2}) + (A \times 16^{1}) + (F \times 16^{0})$$

= $1 \times 256 + 10 \times 16 + 15 \times 1$
= $256 + 160 + 15$
= 431_{10}

Convert ing a N um ber of Anot her Base to a Decim al N um ber

Method

Step 1: Determine the column (positional) value of

each digit

Step 2: Multiply the obtained column values by the

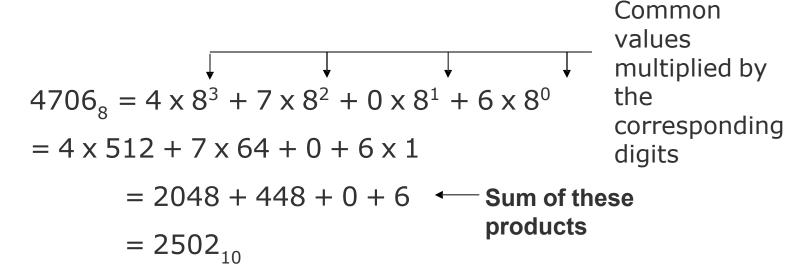
digits in the corresponding columns

Step 3: Calculate the sum of these products

Convert ing a N um ber of Anot her Base to a Decim al N um ber

(Continued from previous slide..)

$$4706_8 = ?_{10}$$



Converting a Decim al N um ber to a N um ber of Anot her Base

(Continued from previous slide..)

Exam ple

Solut ion:

Hence,
$$952_{10} = 1670_8$$

Converting a Number of Some Base to a Num ber of Anot her Base

Method

Step 1: Convert the number to a

original number decimal

Step 2: (base 10) Convert the decimal number so obtained to

the new base number

(Continued from previous slide..)

Exam ple

$$545_6 = ?_4$$

Solution:

Step 1: Convert from base 6 to base 10

$$545_6 = 5 \times 6^2 + 4 \times 6^1 + 5 \times 6^0$$

= $5 \times 36 + 4 \times 6 + 5 \times 1$
= $180 + 24 + 5$
= 209_{10}

Convert ing a N um ber of Som e Base of Anot her Base

toa Num ber

(Continued from previous slide..)

Step 2: Convert 209₁₀ to base 4

Hence,
$$209_{10} = 3101_4$$

So,
$$545_6 = 209_{10} = 3101_4$$

Thus,
$$545_6 = 3101_4$$

Short cut Met hod for Convert ing a Binary N um ber to it s Equivalent Oct al N um ber

Met hod

Step 1: Divide the digits into groups of three starting

from the right

Step Convert each group of three binary digits to

2: one octal digit using the method of binary

to decimal conversion

Short cut Met hod for Convert ing a Binary Number to it s Equivalent Oct al Number

(Continued from previous slide..)

Exam ple

$$1101010_2 = ?_8$$

Step 1: Divide the binary digits into groups of 3 starting from right

001101010

Step 2: Convert each group into one octal digit

$$001_2 = 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = 1$$

 $101_2 = 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = 5$
 $010_2 = 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 2$

Hence, $1101010_2 = 152_8$

Short cut Met hod for Convert ing an Oct al N um bert o I t s Equivalent Binary N um

Met hod

Step 1: Convert each octal digit to a 3 digit binary

number (the octal digits may be treated

as decimal for this conversion)

Step 2: Combine all the binary groups

resulting

formber each) into a single binary

digits

Short cut Met hod for Convert ing an Oct al N um ber to I ts Equivalent Binary N um

(Continue Xamiople.)

$$562_8 = ?_2$$

Step 1: Convert each octal digit to 3 binary digits

$$5_8 = 101_2$$
, $6_8 = 110_2$, $2_8 = 010_2$

Step 2: Combine the binary groups $562_8 = 101 \quad 110 \quad 010$

Hence,
$$562_8 = 101110010_2$$

Computer Fundamentals: Pradeep K. Sinha & Priti Sinha Short cut Met hod for Converting a Binary

Step Divide the pinary digits into groups of

1: four starting from the right

Step 2: Combine each group of four binary digits to

one hexadecimal digit

Short cut Met hod for Convert ing a Binary N um ber to its Equivalent Hexadecim al N um ber

(Continued from previous slide..)

Exam ple

$$111101_2 = ?_{16}$$

Step 1: Divide the binary digits into groups of four starting from the right

<u>0011</u> <u>1101</u>

Step 2: Convert each group into a hexadecimal digit $0011_2 = 0 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 = 3_{10} = 3_{16}$ $1101_2 = 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = 3_{10} = D_{16}$

Hence,
$$111101_2 = 3D_{16}$$

Short cut Met hod for Convert ing a Hexadecim al N um bert o it s Equivalent Binary N um ber

Met hod

Step 1: Convert the decimal equivalent of each hexadecimal digit to a 4 digit binary number

Step 2: Combine all the resulting binary groups (of 4 digits each) in a single binary number

Short cut Met hod for Convert ing a Hexadecim al N um ber to it s Equivalent Binary N um ber

(Continued from previous slide..)

Exam ple

$$2AB_{16} = ?_2$$

Step 1: Convert each hexadecimal digit to a 4 digit binary number

$$2_{16} = 2_{10} = 0010_{2}$$
 $A_{16} = 10_{10} = 1010_{2}$
 $B_{16} = 11_{10} = 1011_{2}$

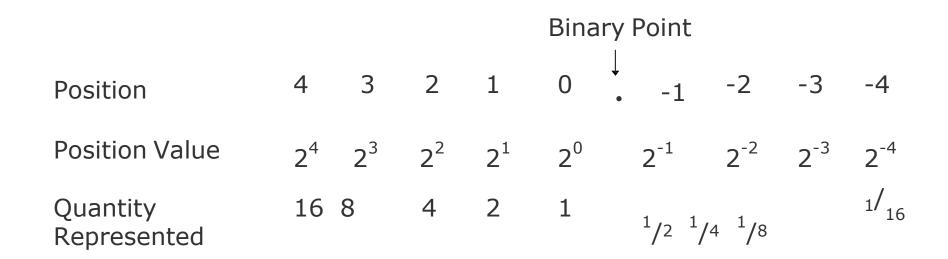
Short cut Met hod for Convert ing a Hexadecim al N um ber to its Equivalent Binary N um ber

(Continued from previous slide..)

Step 2: Combine the binary groups
$$2AB_{16} = \underline{0010} \quad \underline{1010} \quad \underline{1011}$$
 $2 \quad A \quad B$

Hence,
$$2AB_{16} = 001010101011_2$$

Form at ion of Fract ional N um bers in Binary N um ber Syst em (Exam ple)



Form at ion of Fract ional N um bers in Binary N um ber Syst em (Exam ple)

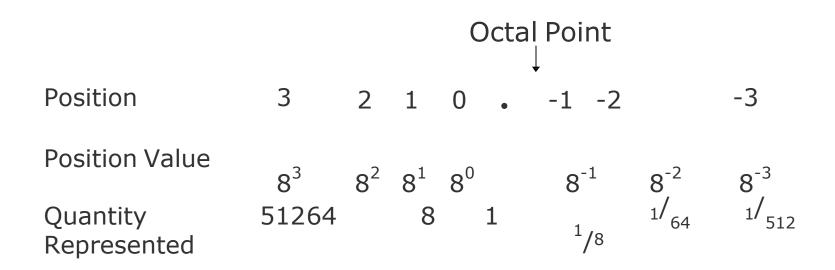
(Continued from previous slide..)

$$110.101_{2} = 1 \times 2^{2} + 1 \times 2^{1} + 0 \times 2^{0} + 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3}$$

$$= 4 + 2 + 0 + 0.5 + 0 + 0.125$$

$$= 6.625_{10}$$

Form at ion of Fract ional N um bers in Oct al N um berSyst em (Exam ple)



Form at ion of Fract ional N um bers in Oct al N um ber Syst em (Exam ple)

(Continued from previous slide..)

$$127.54_{8} = 1 \times 8^{2} + 2 \times 8^{1} + 7 \times 8^{0} + 5 \times 8^{-1} + 4 \times 8^{-2}$$

$$= 64 + 16 + 7 + \frac{5}{8} + \frac{4}{64}$$

$$= 87 + 0.625 + 0.0625$$

$$= 87.6875_{10}$$