CE 150 COMPUTER PROGRAMMING

OCTAL and HEXADECIMAL NUMBER SYSTEM

by

Prof. Dr. M. Akram Tahir

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OCTAL Number System

- The numbers with base 8 are termed as OCTAL Numbers.
- The eight decimal numbers 0, 1, 2, …7 make the basic set of 8 symbols.
- The dec number 8 is denoted by pattern 10
- The rules for conversion are same as for binary numbers, if 2 is replaced by 8.

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DEC to OCT

- DECIMAL 631

$$
\begin{array}{r|l}
8 & 631 \\
\hline
& 78 \quad \text{---} 7 \\
& 9 \quad\;\; \text{---} 6 \\
& 1 \quad\;\; \text{---} 1 \\
& 0 \quad\;\; \text{---} 1 \\
\end{array}
$$

$$631 = 1167_O$$

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OCT to DEC

- 1167_O

Using concept of local values :

$= 7 \times 8^0 + 6 \times 8^1 + 1 \times 8^2 + 1 \times 8^3$

$= 7 + 48 + 64 + 512$

$= 631$

$$1167_O = 631$$

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OCT to DEC

- 3602_O

$= 2 \times 8^0 + 0 \times 8^1 + 6 \times 8^2 + 3 \times 8^3$

$= 2 + 0 + 384 + 1536$

$= 1922$

$$3602_O = 1922$$

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DEC to OCT

- DECIMAL 1922

$$
\begin{array}{r|l}
8 & 1922 \\
\hline
& 240 \quad \text{---} 2 \\
& 30 \quad\;\; \text{---} 0 \\
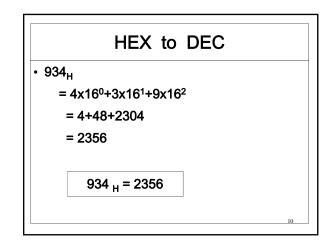& 3 \quad\;\;\; \text{---} 6 \\
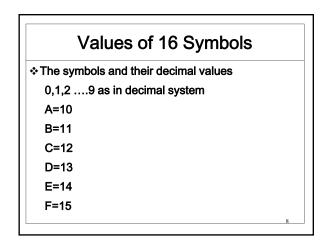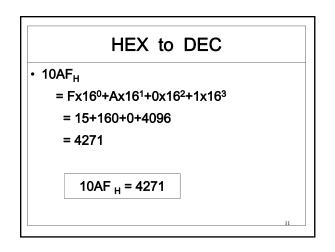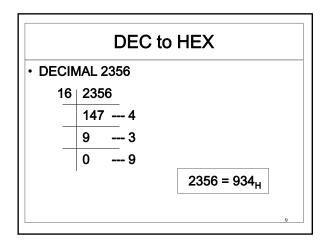& 0 \quad\;\;\; \text{---} 3 \\
\end{array}
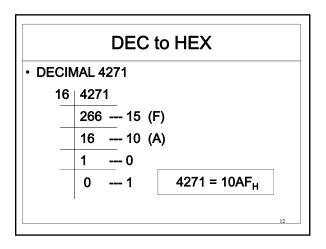$$

$$1922 = 3602_O$$

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HEXADECIMAL Number System

- The numbers with base 16 are called HEXADECIMAL Numbers.
- The sixteen letters 0, 1, 2, …9 plus A, B, C, D, E and F make the basic set of 16 symbols.
- The dec number 16 is denoted by pattern 10
- The rules for conversion are same as for binary numbers, if 2 is replaced by 16.

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HEX to DEC

- 934_H

  $= 4 \times 16^0 + 3 \times 16^1 + 9 \times 16^2$

  $= 4 + 48 + 2304$

  $= 2356$

  | $934_H = 2356$ |

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Values of 16 Symbols

❖ The symbols and their decimal values

  0,1,2 ….9 as in decimal system

  A=10

  B=11

  C=12

  D=13

  E=14

  F=15

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HEX to DEC

- $10AF_H$

  $= F \times 16^0 + A \times 16^1 + 0 \times 16^2 + 1 \times 16^3$

  $= 15 + 160 + 0 + 4096$

  $= 4271$

  | $10AF_H = 4271$ |

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DEC to HEX

- DECIMAL 2356

  16 | 2356

  147 --- 4

  9   --- 3

  0   --- 9

  | 2356 = 934_H |

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DEC to HEX

- DECIMAL 4271

  16 | 4271

  266 --- 15 (F)

  16   --- 10 (A)

  1   --- 0

  0   --- 1

  | 4271 = $10AF_H$ |

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Usage

- If image of memory is printed it will consist of a long string of 0s and 1s.
- It would be difficult to visualize the image.
- It would be difficult to interpret the image.
- Hence memory is printed either in OCTAL or HEXADECIMAL system of numbers.

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PRINT IN OCTAL

- 011 111 001 010 110 100 000 101
- Will be written as 37 12 64 05 starting from right. (24 bits reduced to 8 patterns)
- 0 010 011 110 101 111 (16 bit pattern) gives 02 36 57 in Octal notation. Here 16 bits are reduced to 6 patterns.

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PRINT IN OCTAL

- Historically first image other than binary was printed in Octal notation.
- It may be noted that three bit patterns give a value ranging between 0—7.
- Thus three bits are combined together (right to left) and an equivalent number is obtained in Octal system from each 3 bit pattern.

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PRINT IN HEXADECIMAL

- Soon it was realized that octal was not a proper system for taking a dump of memory.
- If 4 bits are combined the dec value will range between 0-15. (0-F)
- 4 bit combinations reduce the memory image to ¼ in size.

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BIN to OCT

- Note the following:

000	= 0
001	= 1
010	= 2
011	= 3
100	= 4
101	= 5
110	= 6
111	= 7

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BIN to HEX

- Note the following:

0000	= 0	1000	= 8
0001	= 1	1001	= 9
0010	= 2	1010	= A
0011	= 3	1011	= B
0100	= 4	1100	= C
0101	= 5	1101	= D
0110	= 6	1110	= E
0111	= 7	1111	= F

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BIN to HEX

- Watch the following memory dump in binary:
- 0000100101101111000111110101010101110010
  11010000111001011010001
- The 8 B pattern is quite difficult to visualize
- Note the HEX equivalent :
- 09 6F 1F 55 72 D0 E5 A1

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