

# Chapter 10: Computer Numbering Systems

謝仁偉 助理教授

[jenwei@mail.ntust.edu.tw](mailto:jenwei@mail.ntust.edu.tw)

國立台灣科技大學 資訊工程系  
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## Outline

- Conversion of Binary to Denary
- Conversion of Denary to Binary
- Conversion of Denary to Binary via Octal
- Hexadecimal Numbers

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## Conversion of Binary to Denary

- The **denary** or **decimal** system of numbers:
  - Using the digits 0 to 9
  - Having a **radix** or **base** of 10
  - $234.5 \equiv 2 \times 10^2 + 3 \times 10^1 + 4 \times 10^0 + 5 \times 10^{-1}$
- The **binary** system of numbers:
  - Using the digits 0 and 1
  - Having a radix of 2
  - $1101.1 \equiv 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1}$

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## Problems & Exercise 42

- **Problem 3.** Convert  $101.0101_2$  to a denary number.  
[5.3125<sub>10</sub>]
- **Exercise 4.** Convert the binary numbers given to denary numbers: (a) 11010.11 (b) 10111.011  
[(a) 26.75<sub>10</sub> (b) 23.375<sub>10</sub>]

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## Conversion of Denary to Binary

- An integer denary number can be converted to a corresponding binary number by **repeatedly dividing by 2** and noting the remainder at each stage, e.g.,  $39_{10} = 100111_2$ .
- The fractional part of a denary number can be converted to a binary number by **repeatedly multiplying by 2**, e.g.,  $0.625_{10} = 0.101_2$ .

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## Problems & Exercise 43

- **Problem 6.** Convert  $58.3125_{10}$  to a binary number.  
[111010.0101<sub>2</sub>]
- **Exercise 4.** Convert the denary numbers given to binary numbers: (a) 47.40625 (b) 30.8125 (c) 53.90625 (d) 61.65625  
[(a) 101111.01101<sub>2</sub> (b) 11110.1101<sub>2</sub>  
(c) 110101.11101<sub>2</sub> (d) 111101.10101<sub>2</sub>]

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## Conversion of Denary to Binary via Octal

- For denary integers containing several digits, repeatedly dividing by 2 can be a lengthy process.
- ➡ It is usually easier to convert a denary number to a binary number **via the octal system of numbers**.
- **Problem 9.** Convert  $5613.90625_{10}$  to a binary number, via octal.  
[1 010 111 101 101.111 01<sub>2</sub>]

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## Problems & Exercise 44

- **Problem 10.** Convert  $11\ 110\ 011.100\ 01_2$  to a denary number via octal.  
[243.53125<sub>10</sub>]
- **Exercise 3.** Convert the denary numbers given to binary numbers: (a) 247.09375 (b) 514.4375 (c) 1716.78125  
[(a) 11110111.00011<sub>2</sub> (b) 100000010.0111<sub>2</sub>  
(c) 11010110100.11001<sub>2</sub>]

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## Exercise 44

- **Exercise 4.** Convert the binary numbers given to denary numbers via octal: (a) 111.0111  
(b) 101001.01 (c) 1110011011010.0011  
[(a)  $7.4375_{10}$  (b)  $41.25_{10}$  (c)  $7386.1875_{10}$ ]

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## Hexadecimal Numbers (1/3)

- A **hexadecimal numbering system** has a radix of 16 and uses the following 16 distinct digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F 'A' corresponds to 10 in the denary system, B to 11, C to 12, and so on.
- **Problem 13.** Convert  $1A4E_{16}$  into a denary number.  
[ $6734_{10}$ ]

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## Hexadecimal Numbers (2/3)

To convert from **decimal to hexadecimal**:

- **Problem 15.** Convert the following decimal numbers into their hexadecimal equivalents: (a)  $162_{10}$  (b)  $239_{10}$   
[(a)  $A2_{16}$  (b)  $EF_{16}$ ]

To convert from **binary to hexadecimal**:

- **Problem 16.** Convert the following binary numbers into their hexadecimal equivalents: (a)  $11010110_2$  (b)  $1100111_2$   
[(a)  $D6_{16}$  (b)  $67_{16}$ ]

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## Hexadecimal Numbers (3/3)

To convert from **hexadecimal to binary**:

- **Problem 19.** Convert the following hexadecimal numbers into their binary equivalents: (a)  $7B_{16}$  (b)  $17D_{16}$   
[(a)  $1111011_2$  (b)  $101111101_2$ ]
- **Exercise 4.** Convert the given hexadecimal number into its decimal equivalent:  $2F1_{16}$   
[ $753_{10}$ ]

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## Exercise 45

- **Exercise 6.** Convert the given decimal number into its hexadecimal equivalent:  $200_{10}$   
[C8<sub>16</sub>]
- **Exercise 10.** Convert the given binary number into its hexadecimal equivalent:  $11101010_2$   
[EA<sub>16</sub>]
- **Exercise 13.** Convert the given hexadecimal number into its binary equivalent:  $37_{16}$   
[110111<sub>2</sub>]