



# Computer Fundamentals

Dr. Safdar Nawaz Khan Marwat  
DCSE, UET Peshawar

Lecture 7



# Number System Conversion


- Direct conversions possible for
  - ❑ Binary to octal and vice versa
  - ❑ Binary to hexadecimal and vice versa
  - ❑ Decimal to octal and vice versa
  - ❑ Decimal to hexadecimal and vice versa
- Numbers with other bases
  - ❑ ???



# Decimal - Octal Conversion

➤ Convert  $(75)_{10}$  to octal

8	75	remainder
8	9	3
8	1	1
	0	1



$(113)_8$



# Decimal - Octal Conversion (cont.)

➤ Convert 113 from octal to decimal

$$(113)_8 = 1 \times 8^2 + 1 \times 8^1 + 3 \times 8^0$$

$$= 64 + 8 + 3$$


$$= (75)_{10}$$



# Decimal - Hexadecimal Conversion

➤ Convert  $(75)_{10}$  to hexadecimal

16	75	remainder
16	4	B
	0	4



$(4B)_{16}$



# Decimal - Hexadecimal Conversion (cont.)

- Convert 4B from hexadecimal to decimal

$$(4B)_{16} = 4 \times 16^1 + 11 \times 16^0$$

$$= 64 + 11$$

$$= (75)_{10}$$



# Numbers with Other Bases

- Numbering systems possible with other bases
  - ❑ Base 3, 4, 5 etc.
- Conversion to decimal or any other base possible



# Base-3 System

- Base 3 numbers expressed in positional notation

The right-most is the least significant digit

$$1202 = 1 \times 3^3 + 2 \times 3^2 + 0 \times 3^1 + 2 \times 3^0$$

The left-most is the most significant digit





# Base-3 System (cont.)

## ➤ Constituents of a decimal number

$$1202 = 1 \times 3^3 + 2 \times 3^2 + 0 \times 3^1 + 2 \times 3^0$$

1's multiplier

1



# Base-3 System (cont.)

- Constituents of a decimal number

$$1202 = 1 \times 3^3 + 2 \times 3^2 + 0 \times 3^1 + 2 \times 3^0$$

3's multiplier

Diagram illustrating the expansion of the decimal number 1202 into its base-3 components. The number 1202 is shown with the digit 0 highlighted in green. A green bracket above the 0 is labeled with the number 3. A green arrow points from the text "3's multiplier" below to the 0 in the number 1202.



# Base-3 System (cont.)

## ➤ Constituents of a decimal number

$$1202 = 1 \times 3^3 + 2 \times 3^2 + 0 \times 3^1 + 2 \times 3^0$$

9's multiplier

9



# Base-3 System (cont.)

- Constituents of a decimal number

$$1202 = 1 \times 3^3 + 2 \times 3^2 + 0 \times 3^1 + 2 \times 3^0$$

27's multiplier


Diagram illustrating the expansion of the decimal number 1202 into its base-3 components. The number 1202 is shown with green arrows pointing to the digits 1, 2, 0, and 2. Above the equation, the number 27 is shown with a green bracket, indicating the base. Below the equation, the text "27's multiplier" is written, indicating the base used for the expansion.



# Base 3 - Decimal Conversion

➤ Convert 75 from decimal to base 3

3	75	remainder
3	25	0
3	8	1
3	2	2
	0	2



$(2210)_3$



# Base 3 - Decimal Conversion (cont.)

- Convert 2210 from base 3 to decimal

$$\begin{aligned}(2210)_3 &= 2 \times 3^3 + 2 \times 3^2 + 1 \times 3^1 + 0 \times 3^0 \\ &= 54 + 18 + 3 + 0 \\ &= 75\end{aligned}$$



# Exercise

- Convert  $(95)_{10}$  to base 2, base 3 and base 16 numbers

$$\begin{array}{r} 2 \overline{) 95} \\ 47 \end{array} \quad \begin{array}{r} 3 \overline{) 95} \\ 31 \end{array} \quad \begin{array}{r} 16 \overline{) 95} \\ 5 \end{array}$$



# Logical Operations Revisited

- Truth table for three or more input variables
  - ❑ Follow stepwise approach

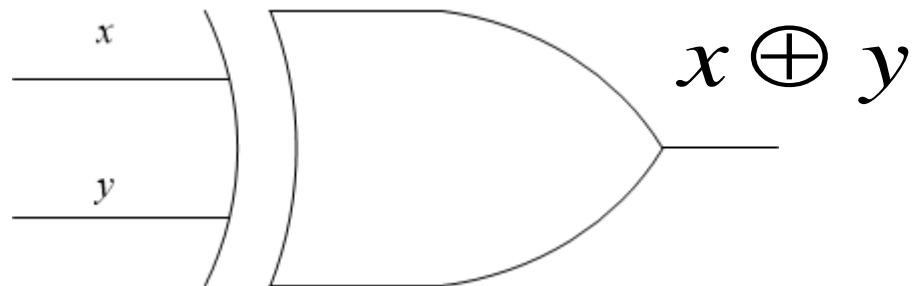
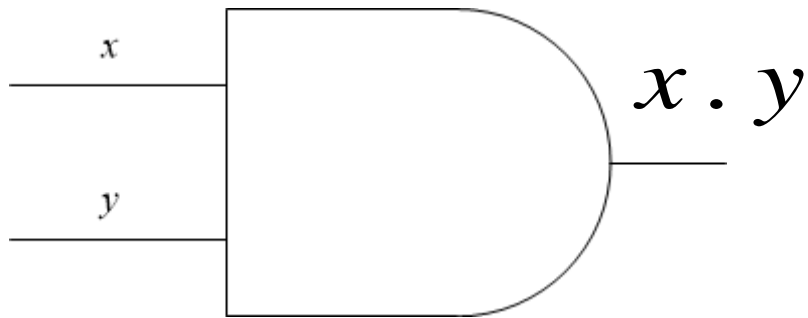
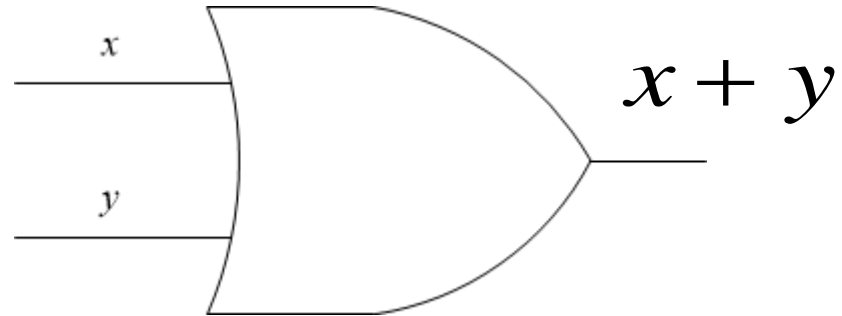
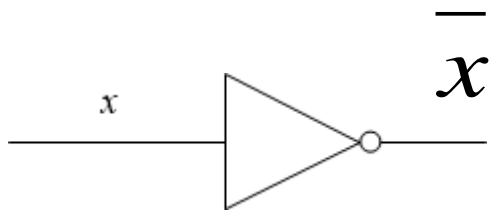
$x$	$y$	$z$	$x \oplus y$	$(x \oplus y) \cdot z$
0	0	0	0	0
0	0	1	0	0
0	1	0	1	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	1
1	1	0	0	0
1	1	1	0	0





# Diagrammatic Representation

- Graphical depiction of boolean expression

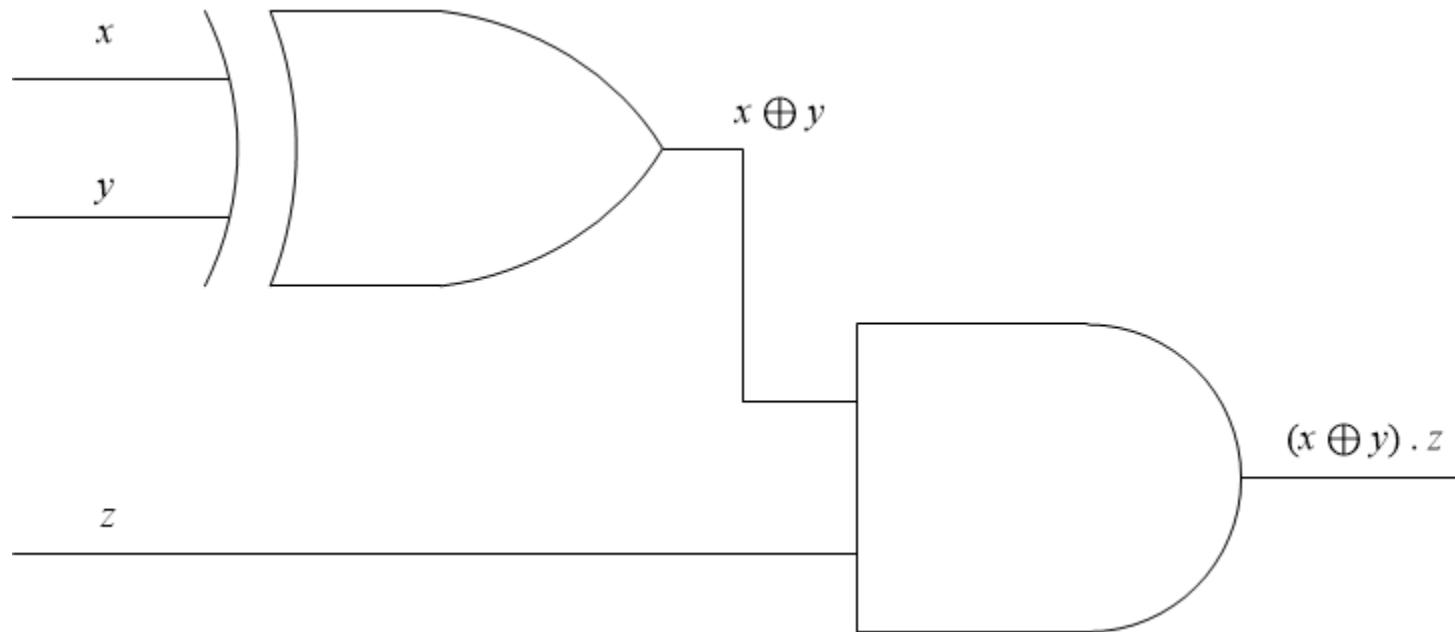




# Diagrammatic Representation (cont.)

- Draw diagram for representation of boolean expression

$$(x \oplus y) \cdot z$$





# Exercise

➤ Derive truth table for  $(x + y) \oplus z$

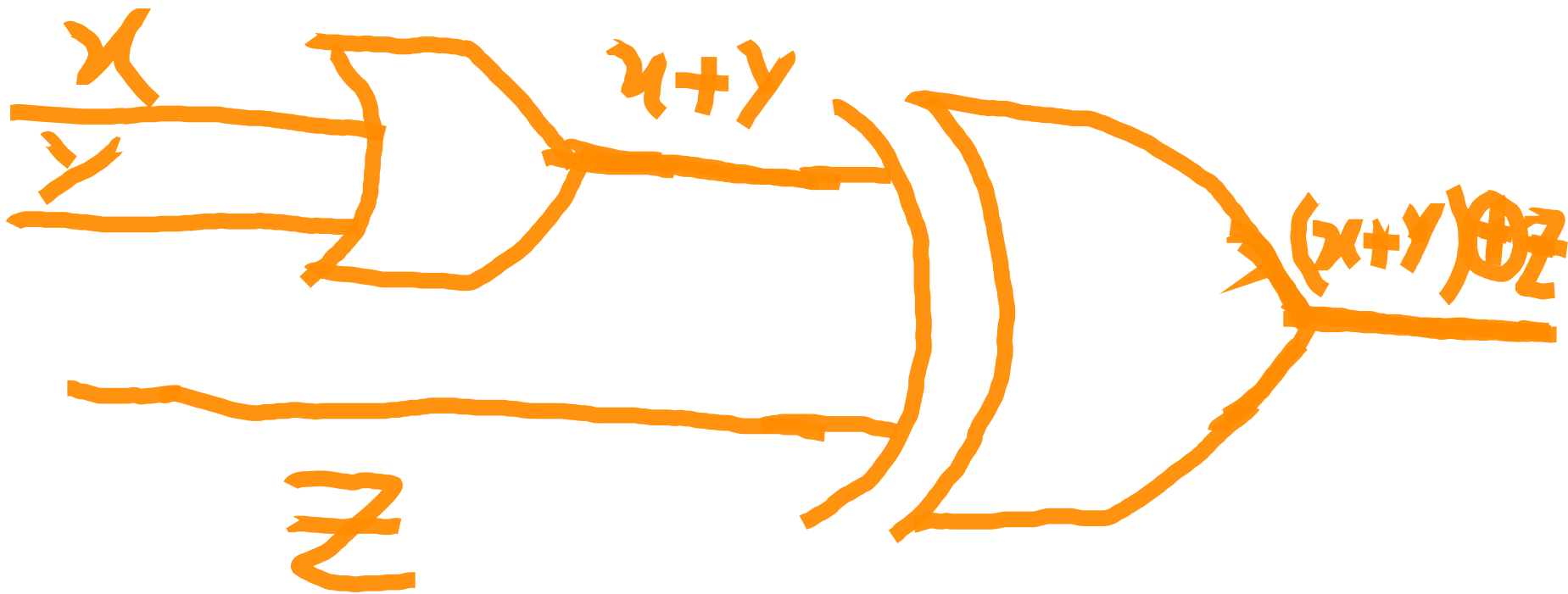
$x$	$y$	$z$	<del><math>x + y</math></del>	$(x + y) \oplus z$
0	0	0	0	0
0	0	1	0	1
0	1	0	1	1
0	1	1	1	0
1	0	0	1	1
1	0	1	1	0
1	1	0	1	1
1	1	1	1	0



# Exercise (cont.)

- Draw diagram of boolean expression

$$(x + y) \oplus z$$





# Exercise (cont.)

➤ Derive truth table for  $\overline{(x + y)} \oplus \bar{z}$

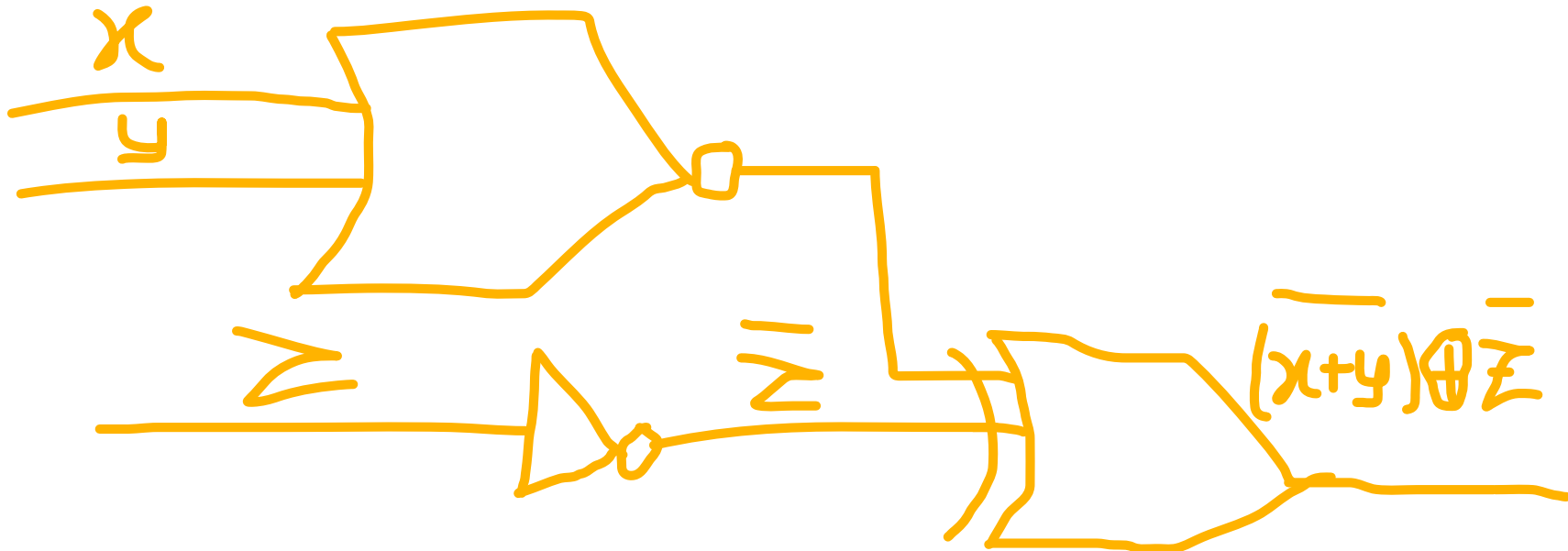
$x$	$y$	$z$	$x + y$	$\overline{x + y}$	$\bar{z}$	$x + y \oplus \bar{z}$
0	0	0	0	1	1	0
0	0	1	0	1	0	1
0	1	0	1	0	1	1
0	1	1	1	0	0	0
1	0	0	1	0	1	1
1	0	1	1	0	0	0
1	1	0	1	0	1	1
1	1	1	1	0	0	0



# Exercise (cont.)

- Draw diagram for representation of boolean expression

$$\overline{(x + y)} \oplus \bar{z}$$





# Exercise (cont.)

- Label the diagram
- Write the boolean expression for this diagram
- Determine truth table for the following logic diagram

$$(x+y)+z$$

