ECE213: Digital Electronics

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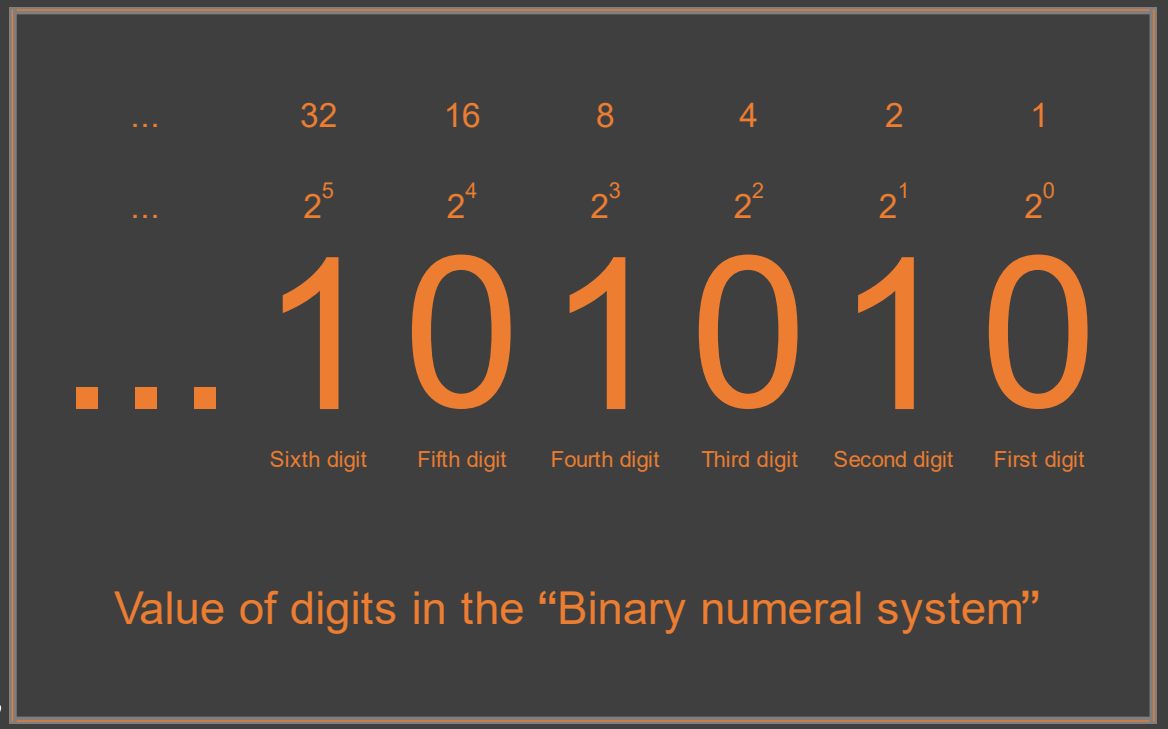
The Course Contents

Unit I

Number Systems : Digital Systems, Data representation and coding, Logic circuits, Implementation of digital systems, Number Systems, Codes- Positional number system, Binary number system, Methods of base conversions, Binary arithmetic, Representation of signed numbers, Fixed numbers, Binary coded decimal codes, Gray codes, Error detection code, Parity check codes, octal number system, Hexadecimal number system, Error correction code, Hamming code, Octal arithmetic, Hexadecimal arithmetic, Floating point numbers



Value of digits in the “Binary numeral system”

Number Systems

Counting - ~~Hex~~ Bin

Allow zero

Bin	Dec	Oct	Hex
0000	0	0	0
0001	1	1	1
0010	2	2	2
0011	3	3	3
0100	4	4	4
0101	5	5	5
0110	6	6	6
0111	7	7	7
1000	8	10	8
1001	9	11	9
1010	10	12	A
1011	11	13	B
1100	12	14	C
1101	13	15	D
1110	14	16	E
1111	15	17	F

Number Systems

Counting

MCQ

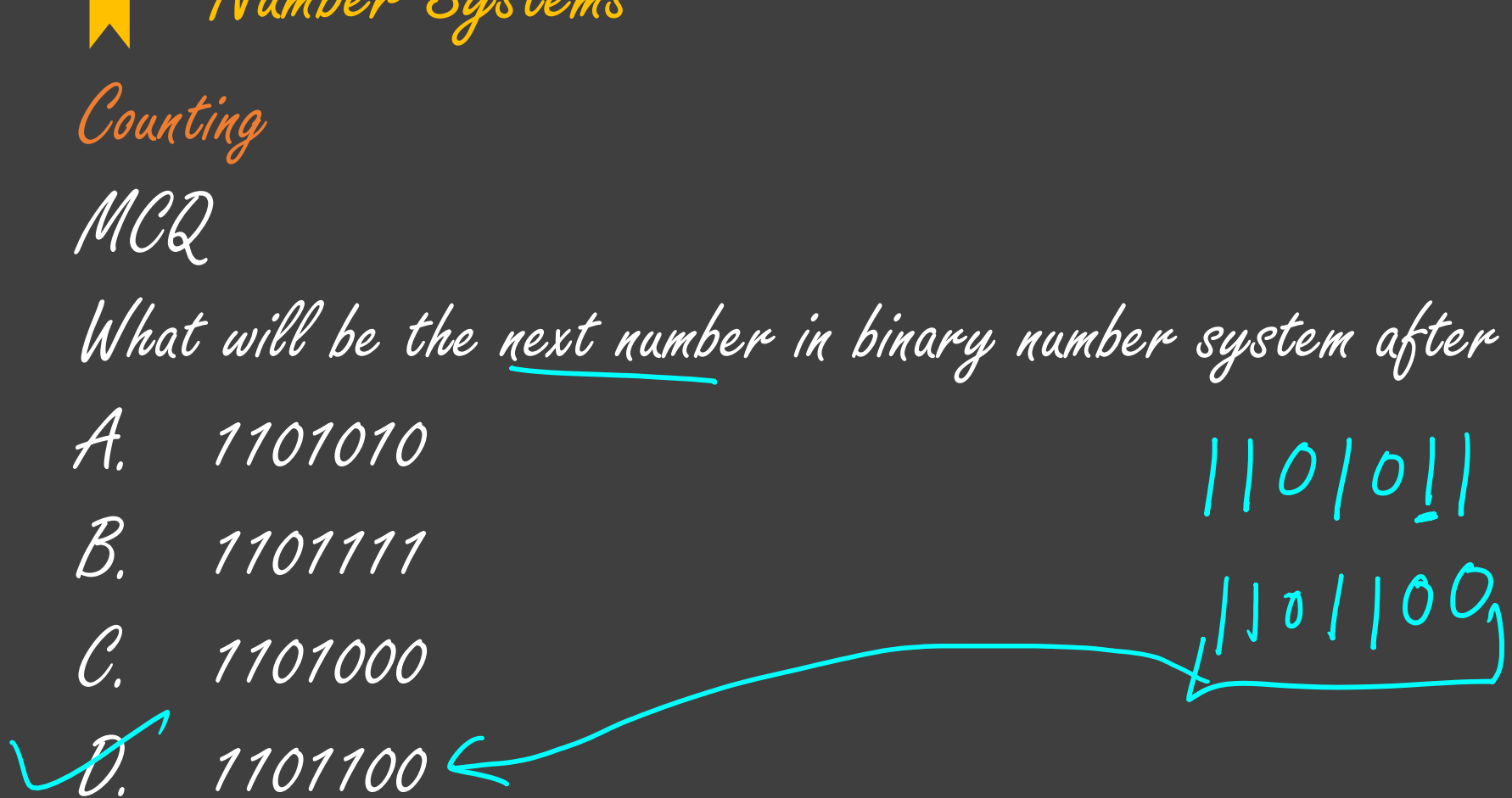
What will be the next number in binary number system after 1101011

A. 1101010

B. 1101111

C. 1101000

D. 1101100



Number Systems

Codes- Positional number system

Pol → Bin (2), oct (8), Hex (16), Dec (10)

in Dec

	…					.					
	…	b^4	b^3	b^2	b^1	b^0 .	b^{-1}	b^{-2}	b^{-3}	b^{-4}	…
Bin		2^4	2^3	2^2	2^1	2^0 .	2^{-1}	2^{-2}	2^{-3}	2^{-4}	…
	…	16	8	4	2	1 .	0.5	0.25	0.125		…
oct		8^4	8^3	8^2	8^1	8^0 .	8^{-1}	8^{-2}	8^{-3}		…
Hex	…		16^3	16^2	16^1	16^0 .	16^{-1}	16^{-2}	16^{-3}		…
Dec.	…		10^3	10^2	10^1	10^0 .	10^{-1}	10^{-2}	10^{-3}		…

Number Systems

Methods of base conversions

Ex $(37)_{10} \rightarrow (\quad)_2$

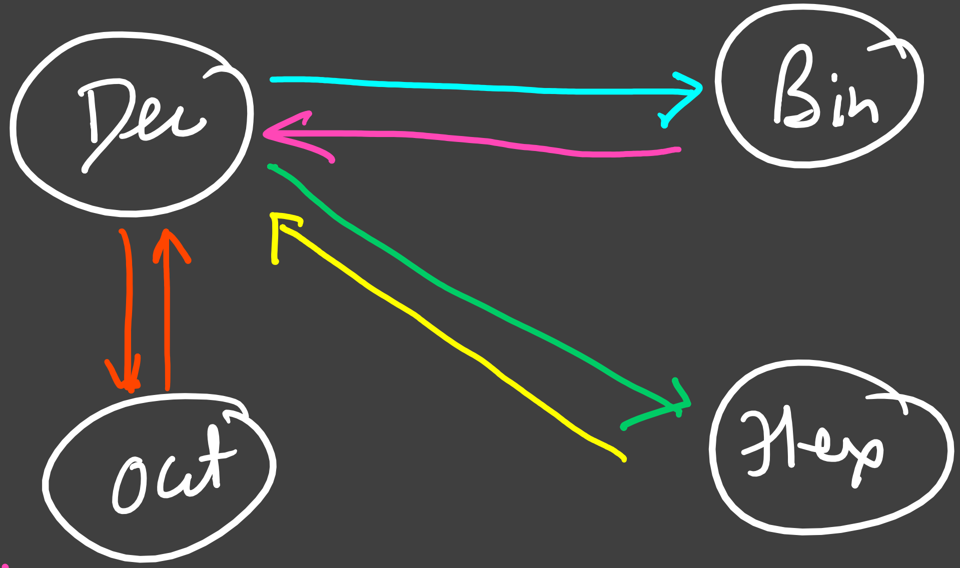
S| inter part

2	37	
2	18	1
2	9	0
2	4	1
2	2	0
	1	0

$(100101)_2$

1	0	0	1	0	1
2^5	2^4	2^3	2^2	2^1	2^0
32	16	8	4	2	1

$32+4+1 = (37)_{10}$



Number Systems

Methods of base conversions

$(37)_{10} \rightarrow (\ )_{16}$

16	37
	2 | 5

$(25)_{16}$

$(25)_{16} \rightarrow (37)_{10}$

$2 \quad 5$

$16^1 \quad 16^0$

$16 \quad 1$

$32 + 5 = 37$

Number Systems

Methods of base conversions

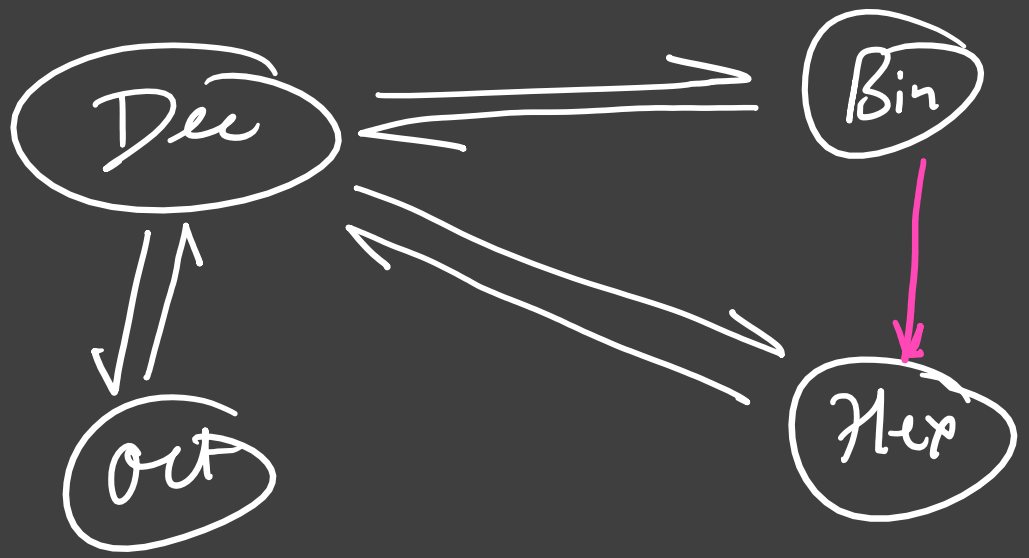
$(100101)_2 \longrightarrow$ Hex $(\quad)_{16}$

00 | 00 | 10 |

$(2 \quad 5)_{16}$

Dec $\leftarrow$ 0080

8000 $\rightarrow$ X

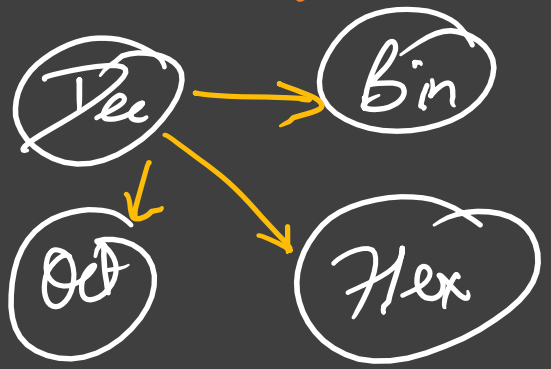


Number Systems

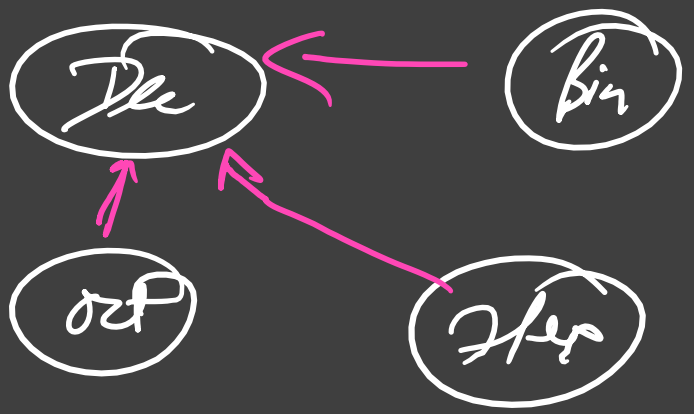
Codes- Positional number system

Number Systems

Methods of base conversions

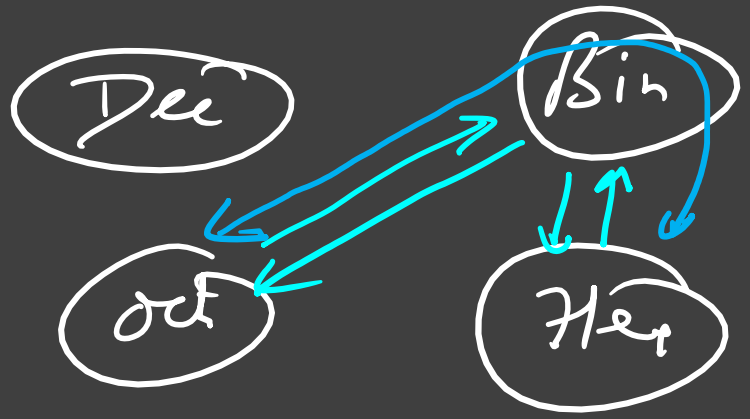


Dividing by base of new number system



follow the polynomials

$\cdots b^2 b^1 b^0 . b^{-1} b^{-2} b^{-3}$



for oct, 3-bit codes

for Hex 4-bit codes

Number Systems

00780 00

Methods of base conversions

☆ Bin to Oct

To represent 8 symbols we require 3 bits

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

Ex $(110101)_2 \rightarrow (165)_8$

001 110 101

1 6 5

Number Systems

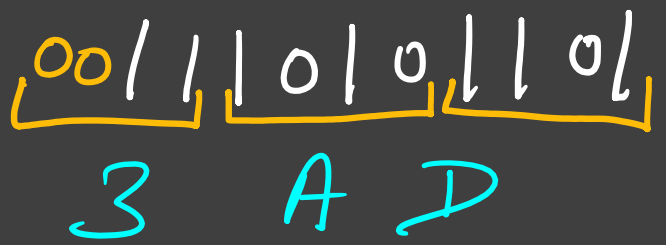
Methods of base conversions

☆ Bin to Hex

0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7

1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F

Ex $(1110101101)_2 \rightarrow (3AD)_{16}$



Number Systems

Methods of base conversions

Ex $(10.25)_{10} \rightarrow (\quad)_2$

$0.25 \times 2 = 0.5 \quad 0$

$.5 \times 2 = 1.0 \quad 1$

$.0 \times 2 \quad 0$

2	10
2	5 0
2	2 1
	1 0

$(12.2)_8$

Dec to oct

8	10
	1 2

$0.25 \times 8 = 2.0$

$.0 \times 8 =$

$(A.4)_{16}$

Dec to Hex

16	10
	0 - A

$0.25 \times 16 = 4.0$

$(12.2)_8$

$(10|0.01)_2$

$00|0|0.0|0$

$(12.2)_8$

$10|0.00|$

$(A.4)_{16}$

2.5 hr

2.05 hr

2.50 hr

Number Systems

Methods of base conversions

Ex $(1010.01)_2 \longrightarrow (\quad)_{10}$

$1\ 0\ 1\ 0\ .\ 0\ 1$

$2^3\ 2^2\ 2^1\ 2^0\ .\ 2^{-1}\ 2^{-2}$

$8+0+2+0+0+0.25$

$(10.25)_{10}$

Ex $(12.2)_8 \rightarrow (\quad)_{10}$

$1\ 2\ .\ 2$

$8^1\ 8^0\ 8^{-1}$

$8+2+\frac{1}{4} = (10.25)_{10}$

Ex $(A.4)_{16}$

$16^0 \cdot 16^{-1}$

$10+\frac{4}{16} = (10.25)_{10}$

Number Systems

Methods of base conversions

The representation of octal number (532.2)8 in decimal is _____

a) (346.25)10

b) (532.864)10

c) (340.67)10

d) (531.668)10

5 3 2 . 2

8^2 8^1 8^0 8^{-1}

64 8 1 $\frac{1}{8}$

$320 + 24 + 2 + \frac{1}{4}$

$(346.25)_{10}$

Number Systems

Methods of base conversions

The decimal equivalent of the binary number (1011.011)2 is

_____

a) (11.375)10
b) (10.123)10
c) (11.175)10
d) (9.23)10

$1\ 0\ 1\ 1 . 0\ 1\ 1$

$2^3\ 2^2\ 2^1\ 2^0\ \ 2^{-1}\ 2^{-2}\ 2^{-3}$

$8+0+2+1+0+0.25+0.125$

$(11.375)_{10}$

Number Systems

Arithmetic - Addition

(+, −, *, /) dec | oct

Ex 97 + 78

$$\begin{array}{r} 97 \\ +\ 78 \\ \hline 175 \end{array}$$

Ex

$$\begin{array}{r} 97834 \\ 5698 \\ 978 \\ +\ 97 \\ \hline 104607 \end{array}$$

Ex (octal)

$$\begin{array}{r} (76)_8 \\ +\ (53)_8 \\ \hline 151 \end{array}$$

Ex (octal)

$$\begin{array}{r} 76532 \\ 5674 \\ 677 \\ 65 \\ \hline 105412 \end{array}$$