

**TECH 3232**

Digital Technology  
**Number Systems**

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**Decimal – Base 10**

- Decimal has digits 0 - 9.
- Number system we commonly use in our day to day lives.

Hundreds	Tens	Ones
$10^2$	$10^1$	$10^0$

2

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**Binary – Base 2**

- Binary has digits 0 and 1.
- Commonly used in digital logic, computers and networking.

128	64	32	16	8	4	2	1
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$

3

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**Example Decimal to Binary Conversion**

- Convert 100 to binary using weighting factors.

128	64	32	16	8	4	2	1
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$

4

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**Example Decimal to Binary Conversion**

- Convert 200 to binary using weighting factors.

128	64	32	16	8	4	2	1
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$

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**Convert 100 to binary**  
(division method)

Convert 100 to binary using division method.

Division	Quotient	Remainder

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## Example Binary to Decimal Conversion

Convert  $1010110_2$  to decimal

128	64	32	16	8	4	2	1
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$

7

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## Example Binary to Decimal Conversion

Convert  $11010010_2$  to decimal

128	64	32	16	8	4	2	1
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$

8

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## Octal – Base 8

- Octal has digits 0 through 7.
- Used to be used in computers (but rarely used today).
- Why base 8? Because 3 bits can be converted to decimal digits 0 -> 7.

4	2	1
$2^2$	$2^1$	$2^0$

9

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**Example Decimal to Octal Conversion**

Convert 100 to Octal via Binary.

256	128	64	32	16	8	4	2	1
$2^8$	$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
4	2	1	4	2	1	4	2	1

10

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**Example Decimal to Octal Conversion**

Convert 200 to Octal via Binary.

256	128	64	32	16	8	4	2	1
$2^8$	$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
4	2	1	4	2	1	4	2	1

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**Example Octal to Decimal Conversion**

Convert 127 Octal to Decimal.

4	2	1	4	2	1	4	2	1
256	128	64	32	16	8	4	2	1

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## Example Octal to Decimal Conversion

Convert 476 Octal to Decimal.

4	2	1	4	2	1	4	2	1
256	128	64	32	16	8	4	2	1

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## Hex – Base 16

If Binary (base 2) uses digits 0 and 1 and Octal (base 8) uses digits 0 through 7.

What would Base 16 use?

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## Hex – Base 16

If Binary (base 2) uses digits 0 and 1 and Octal (base 8) uses digits 0 through 7.

What would Base 16 use?

But we represent 10 through 15 as "A" through "F"

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## Hex – Base 16

Base 10	Base2	Base 16	Base 10	Base2	Base 16
0	0000	0	8	1000	8
1	0001	1	9	1001	9
2	0010	2	10	1010	A
3	0011	3	11	1011	B
4	0100	4	12	1100	C
5	0101	5	13	1101	D
6	0110	6	14	1110	E
7	0111	7	15	1111	F

16

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## Hex – Base 16

- Most commonly used in computers and networking (error messages in windows and mac addressing)
- Why base 16? Because 4 bits can be converted to decimal digits 0 -> 15.

8	4	2	1
$2^3$	$2^2$	$2^1$	$2^0$

17

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## Example Decimal to Hex Conversion

Convert 100 to Hex via Binary.

128	64	32	16	8	4	2	1
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
8	4	2	1	8	4	2	1

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### Example Decimal to Hex Conversion

Convert 200 to Hex via Binary.

128	64	32	16	8	4	2	1
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
8	4	2	1	8	4	2	1

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### Example Hex To Decimal Conversion

Convert A5 Hex To Decimal.

8	4	2	1	8	4	2	1
128	64	32	16	8	4	2	1

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### Example Hex To Decimal Conversion

Convert 7D Hex To Decimal.

8	4	2	1	8	4	2	1
128	64	32	16	8	4	2	1

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## Binary Coded Decimal

- Binary Coded Decimal (BCD for short) is a way of storing decimal digits in a binary format.
- Each nibble (4 bits) is used to store a digit 0-9 of the decimal value.



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## Example Decimal to BCD Conversion

Convert 97 Decimal to BCD.

8	4	2	1	8	4	2	1



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