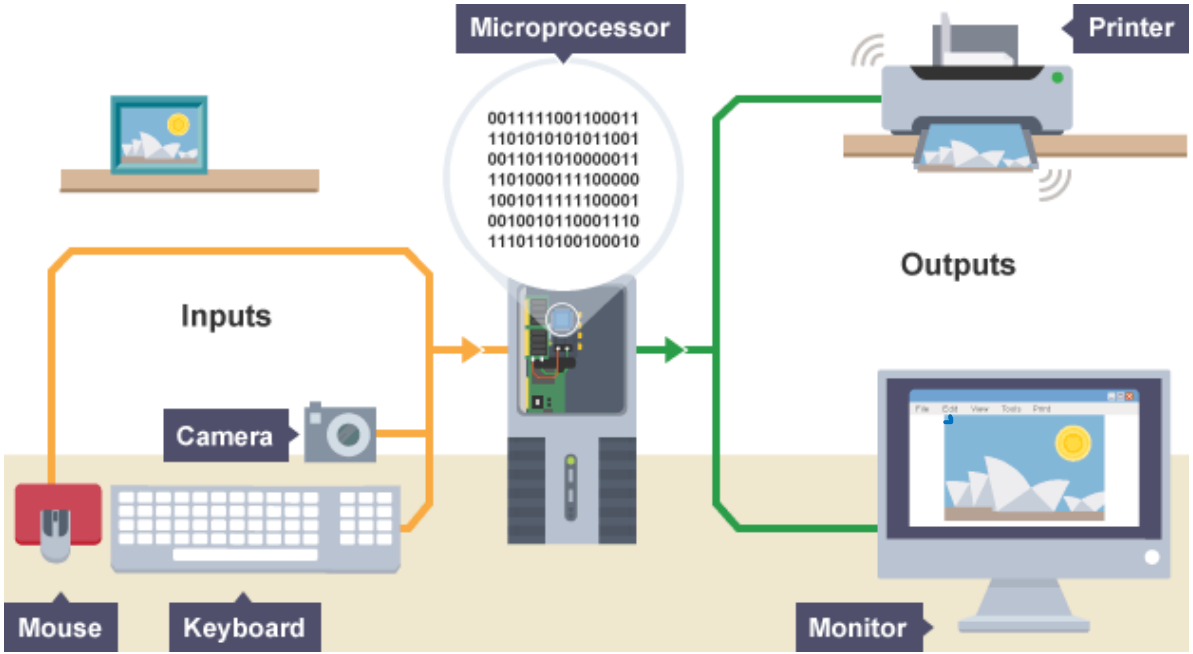
NUMBER SYSTEM

CONVERSION

Senior Capstone Courses

Defined as a system of writing to express numbers.

It is the mathematical notation for representing numbers of a given set by using digits or other symbols in a consistent manner.



Why is binary system used in computer?

APPLICATION

NUMBER SYSTEM

45_{10} 2_{10}

1001_2 11111_2

0 1 2 3 4 5 6 7 8 9

BASE 2 (0, 1)

BINARY

BASE 10 (0-9)

DECIMAL

45_8 74_8 4_8

10 11 12

A B C

0 1 2 3 4 5 6 7 8 9

D – 13

E – 14

F – 15

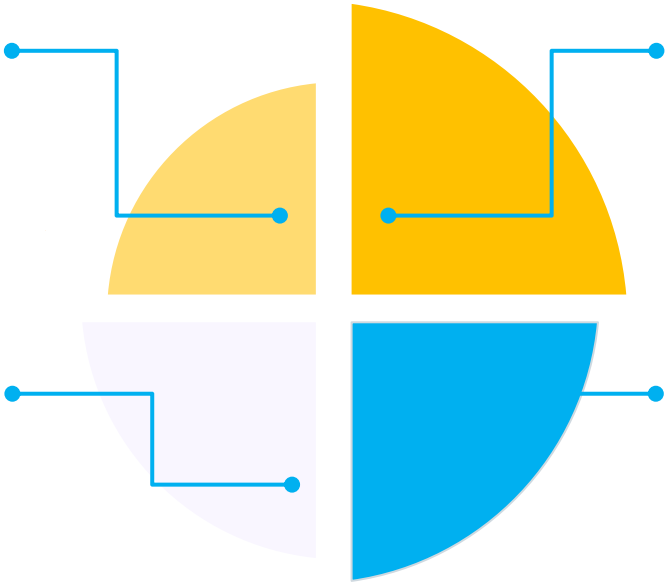
BASE 8 (0- 7)

OCTAL

BASE 16 (0- 9, A – F)

HEXADECIMAL

6 + 10 = 16



PRACTICE

64_8

111_2

2_2

100_{10}

995_8

100_2

$12D_{16}$

101_{16}

CONVERSION

BINARY → DECIMAL

101_2 = 5_{10}

$2^2\ 2^1\ 2^0$

$4 + 1 = 5$

2^n

POWER of 2's

2^0	1	2^5	32
2^1	2	2^6	64
2^2	4	2^7	128
2^3	8	2^8	256
2^4	16	2^9	512

$2 \times 2 =$

EXAMPLE

2^0	1	2^5	32
2^1	2	2^6	64
2^2	4	2^7	128
2^3	8	2^8	256
2^4	16	2^9	512

$110_2 = 6_{10}$

$2^2 \; 2^1 \; 2^0$

$4 + 2 + 0 = 6$

EXAMPLE

2^0	1	2^5	32
2^1	2	2^6	64
2^2	4	2^7	128
2^3	8	2^8	256
2^4	16	2^9	512

$1101_2 = 13_{10}$

$2^3\ 2^2\ 2^1\ 2^0$

$8 + 4 + 0 + 1 = 13$

EXAMPLE

2^0	1	2^5	32
2^1	2	2^6	64
2^2	4	2^7	128
2^3	8	2^8	256
2^4	16	2^9	512

$10101_2 = 21_{10}$

$2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0$

$16 + 0 + 4 + 0 + 1 = 21$

EXAMPLE

2^0	1	2^5	32
2^1	2	2^6	64
2^2	4	2^7	128
2^3	8	2^8	256
2^4	16	2^9	512

$11010_2 = 26_{10}$ 58_{10}

32 16 8 4 2 1

32 + 16 + 8 + 0 + 2 + 0

PRACTICE

$11011_2 = 27_{10}$

16 8 4 2 1

16 + 8 + 2 + 1

$1100_2 = 12_{10}$

~~8~~ 4 2 1

(8 x 1) + (4 x 1) + (2 x 0) + (1 x 0)

8 + 4 + 0 + 0

12_{10}

CONVERSION

BINARY

101_2

$2^2 \quad 2^1 \quad 2^0$

$4+0+1$

OCTAL

(0-7)

5 8

4 2 1

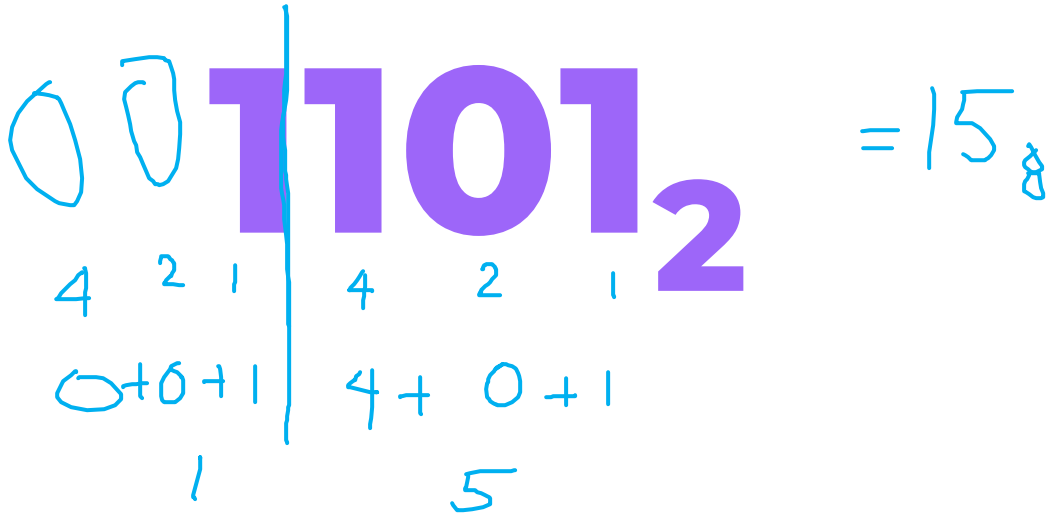
EXAMPLE

$$110_2 = 6_8$$

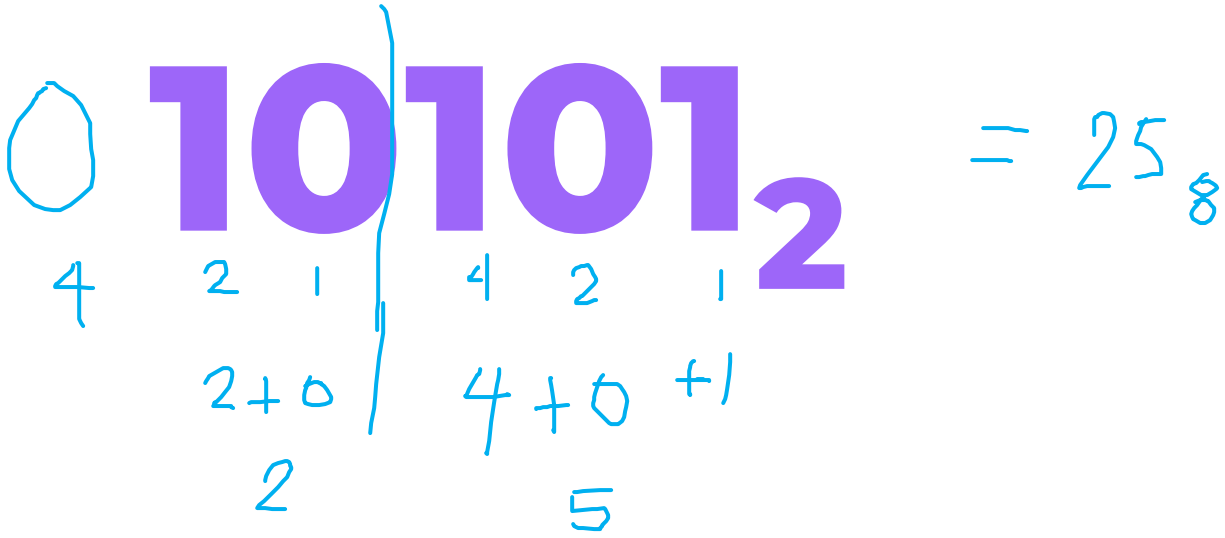
4 2 1

4 + 2 + 0 = 6

EXAMPLE



EXAMPLE



EXAMPLE

$111010_2 = 72_8$

4 2 1 | 4 2 1

7 2

PRACTICE

$11011_2 = 33_8$

$11100_2 = 14_8$

CONVERSION

BINARY

HEXADECIMAL

101_2

4+0+1

5

5

16

8 4 2 1 = 15 = F

A = 10
B = 11
C = 12
D = 13
E = 14
F = 15

EXAMPLE

1110_2 = $1E_{16}$

8	4	2	1
1	1	1	0

8 + 4 + 2 + 0 = 14 = E_{16}

EXAMPLE

$$1101\,|\,1101_2 = 6D_{16}$$

4 2 1 | 8 4 2 1

4 + 2 + 0 | 8 + 4 + 0 + 1 = 13 = D

6

EXAMPLE

$$11|0101_2 = 35_{16}$$

3 5

EXAMPLE

$$11010_2$$

PRACTICE

1100011_2 = 63_{16}

4 2 1

6 3

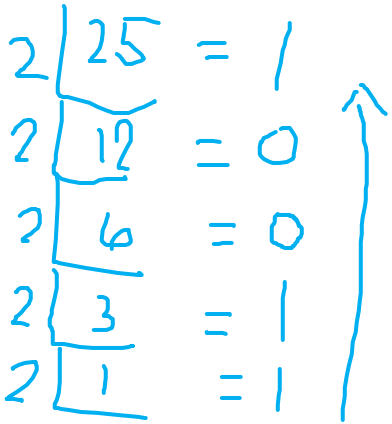
1100000_2 = 60_{16}

6 0

CONVERSION

DECIMAL → BINARY

25_{10}



11001 2

CONVERSION

DECIMAL → BINARY

25_{10}

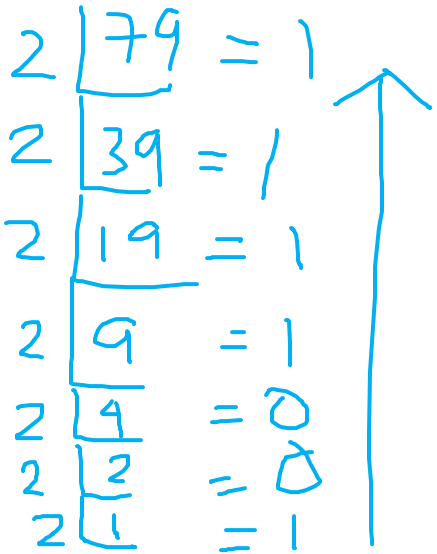
11001_2

				1	1	0	0	1
256	128	64	32	16	8	4	2	1

EXAMPLE

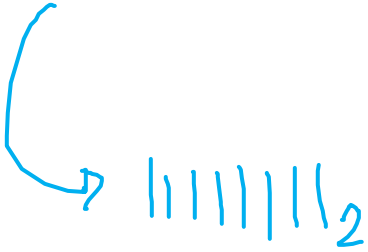
79_{10}

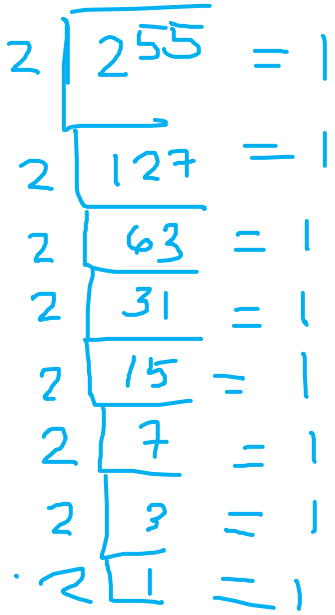
1001111_2



EXAMPLE

255_{10}

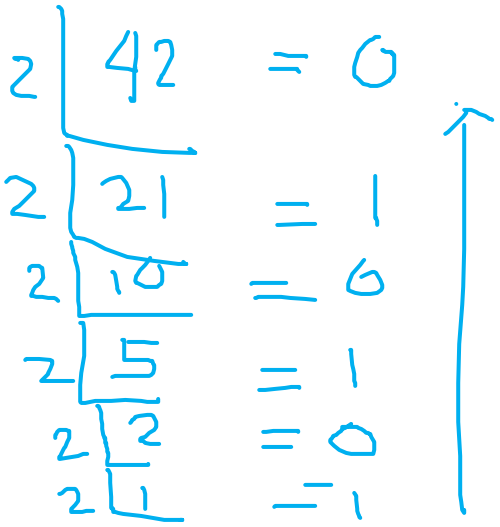




EXAMPLE

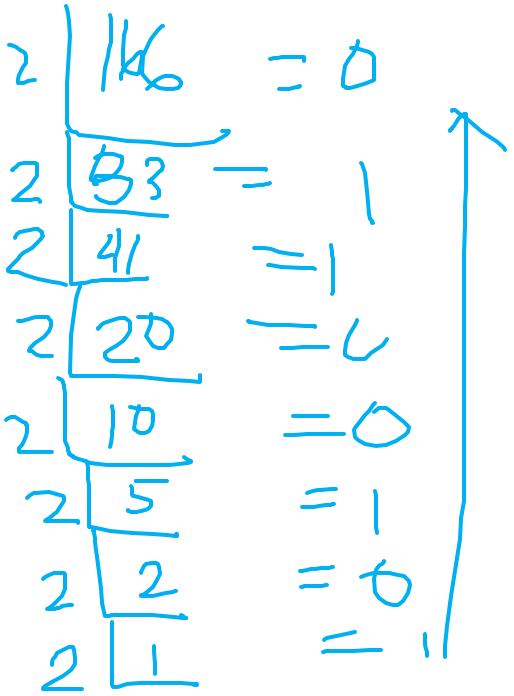
42_{10}

101010_2



EXAMPLE

$166_{10} =$



10110110_2 010100110_2

CONVERSION

DECIMAL

OCTAL

25_{10}

8 | 25 = 1 ↑
8 | 3 = 3 ↑

31

8

CONVERSION

DECIMAL → BINARY → OCTAL

25_{10}

11001 2

31 8

		1	1	0	0	1
64	32	16	8	4	2	1

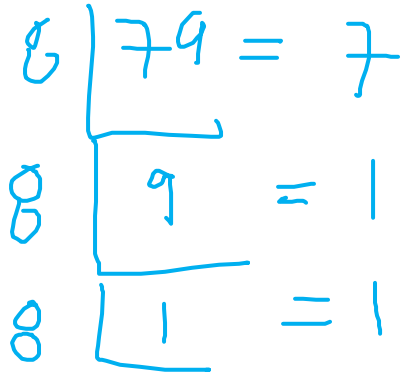
	1	1
4	2	1

0	0	1
4	2	1

EXAMPLE

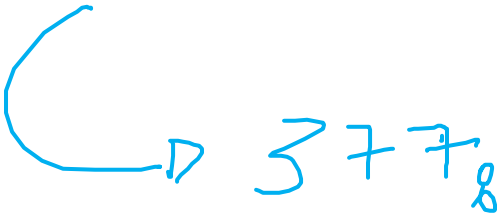
79_{10}

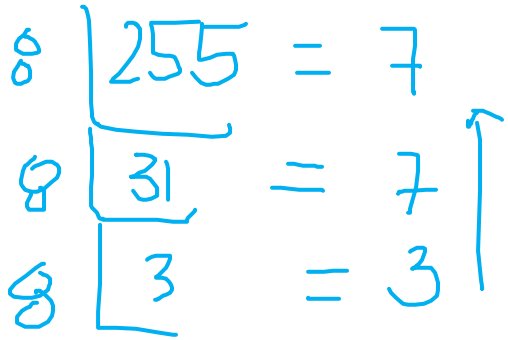
117_8



EXAMPLE

255_{10}

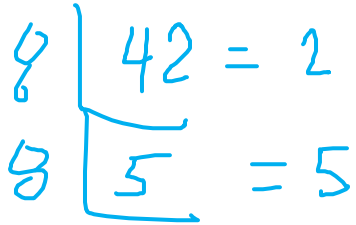




EXAMPLE

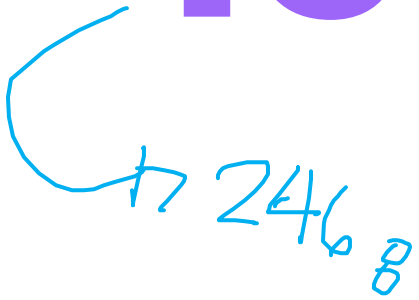
42_{10}

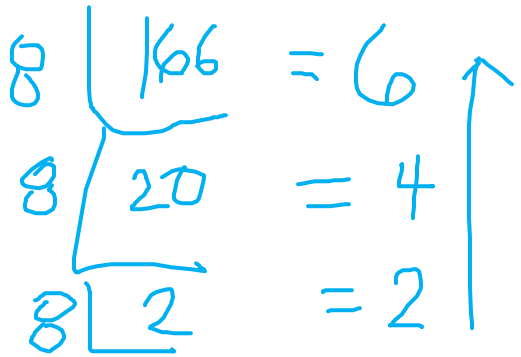
52_8



EXAMPLE

166_{10}





CONVERSION

16

DECIMAL → HEXADECIMAL

25_{10}

16 | 25 = 9 ↑
16 | 1 = 1 ↑

19_{16}

CONVERSION

DECIMAL → BINARY → HEXADECIMAL

25_{10}

		1	1	0	0	1
64	32	16	8	4	2	1

2

1

			1
8	4	2	1

19 16

9

1	0	0	1
8	4	2	1

EXAMPLE

A=10
B=11
C=12
D=13
E=14
F=15

79_{10} = $4F_{16}$

16 | 79 = 15 = F
16 | 4 = 4

79
-64
15

EXAMPLE

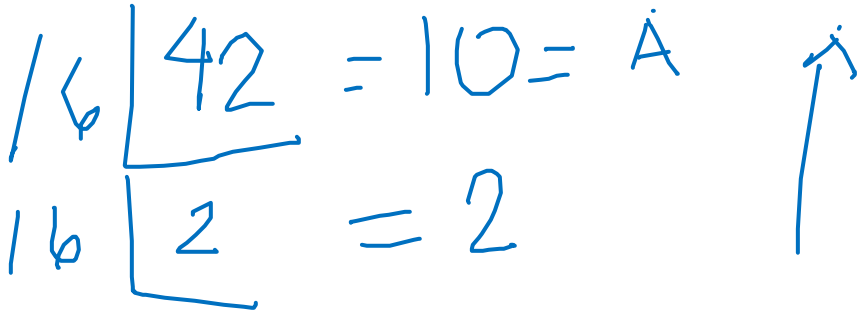
$16 \overline{)255} = 15 = F$

$16 \overline{)15} = 15 = F$

$255 - 240 = F$

$$255_{10} = FF_{16}$$

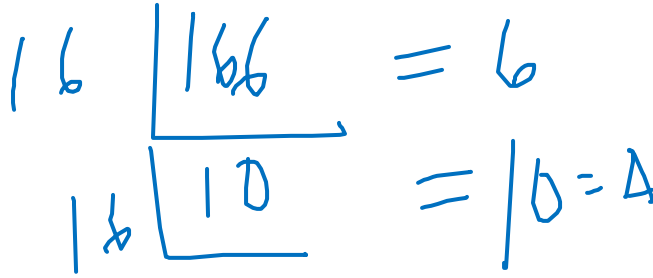
EXAMPLE



$$42_{10} = 2A_{16}$$

EXAMPLE

$$166_{10} = A6$$



CONVERSION

OCTAL

BINARY

25_8

010101_2

2

5

0	1	0
4	2	1

1	0	1
4	2	1

EXAMPLE

166_8 = 1110110$_2$

4 2 1 4 2 1 4 2 1

0 0 1 1 1 0 1 1 0

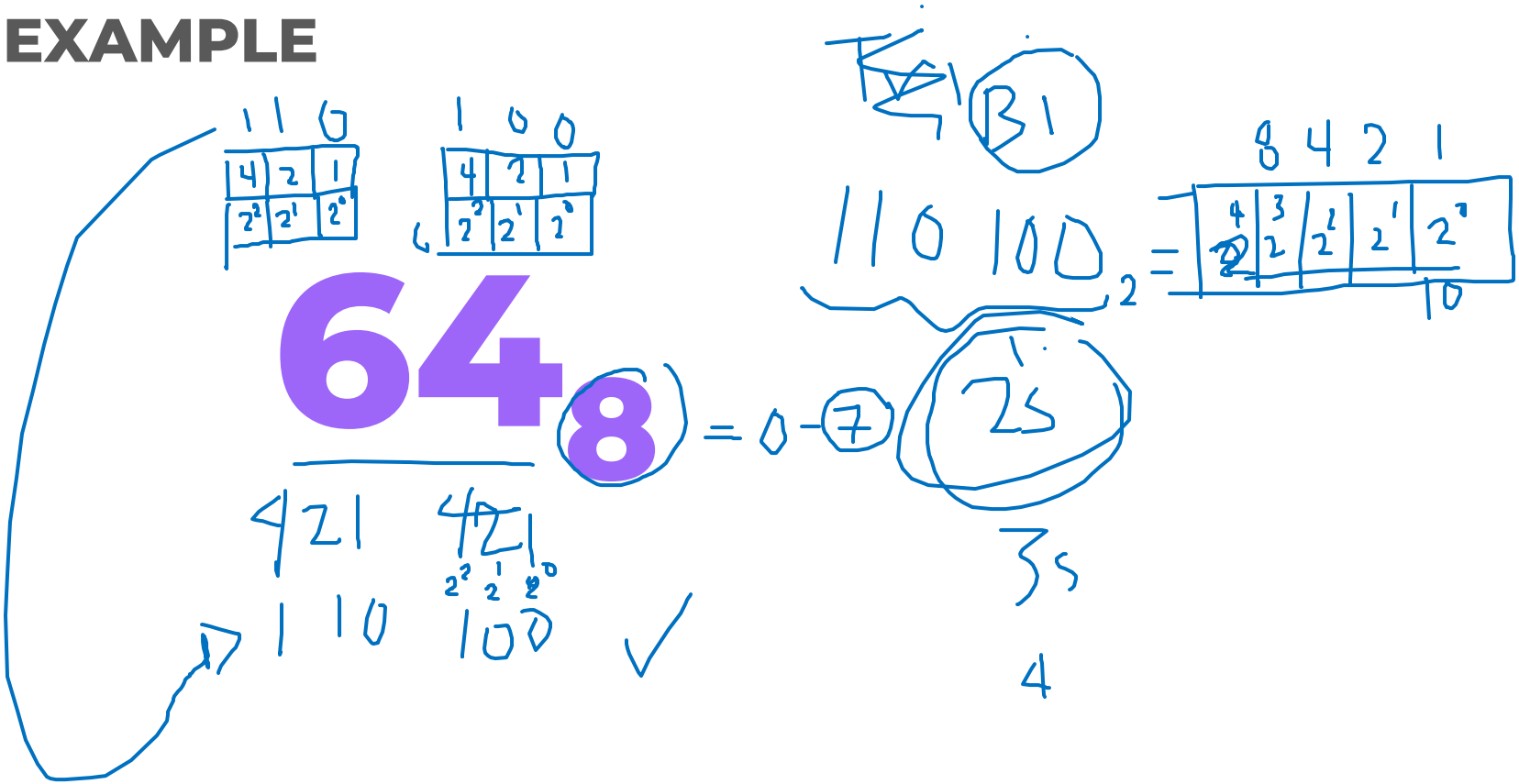
EXAMPLE

1054_8 → 1000101100_2

421 421 421 421

1 000 101 100

EXAMPLE



EXAMPLE

$77_8 = 111111_2$

4 2 1 4 2 1

1 1 1 1 1 1

CONVERSION

OCTAL

DECIMAL

25_8

$8^1 \quad 8^0$

$2 \times 8^1 + 5 \times 8^0 =$

$2 \times 8 + 5 \times 1$

$16 + 5$

$= 21$

21_{10}

EXAMPLE

166_8 $= 118_{10}$

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

$1 \times 64 + 6 \times 8 + 6 \times 1$

$64 + 48 + 6$

$= 118_{10}$

EXAMPLE

$1054_8 = 556_{10}$

$1 \times 8^3 + 0 \times 8^2 + 5 \times 8^1 + 4 \times 8^0$

$1 \times 512 + 0 + 5 \times 8 + 4 \times 1$

$512 + 0 + 40 + 4$

$= 556_{10}$

EXAMPLE

$$64_8 = 52_{10}$$

EXAMPLE

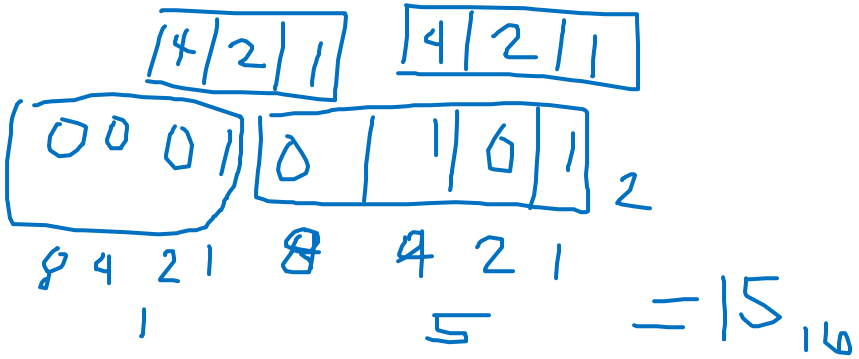
$$77_8$$

CONVERSION

0-9, A-F
6 + 10 ≠ 16

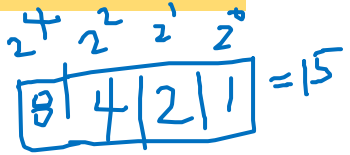
OCTAL

25_8



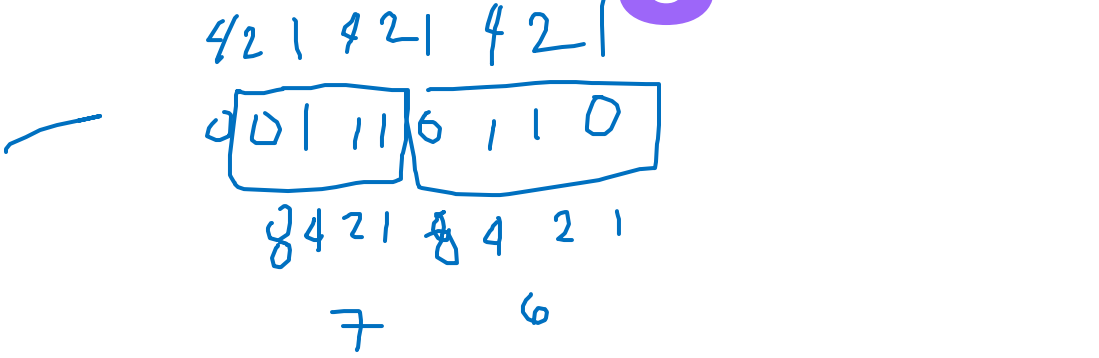
HEXADECIMAL

15_{16}



EXAMPLE

$166_8 = 76_{16}$



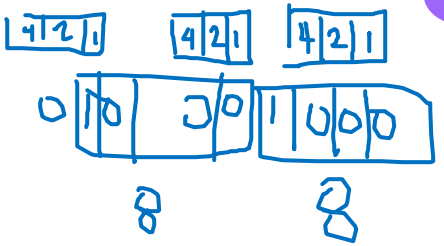
EXAMPLE

invalid octal

649_8 = 349_{16}

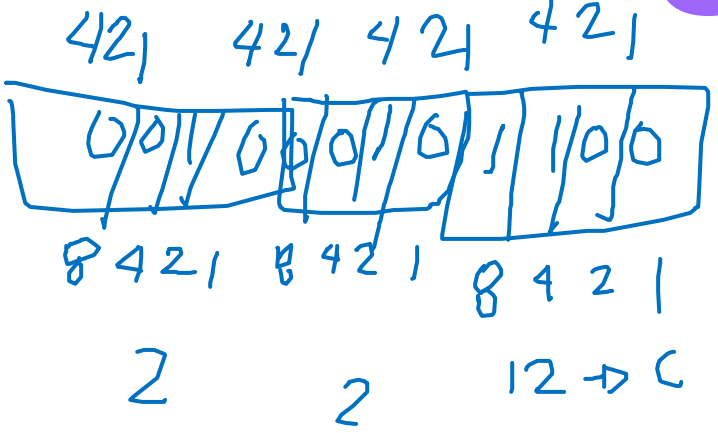
EXAMPLE

210_8 = 88₁₆



EXAMPLE

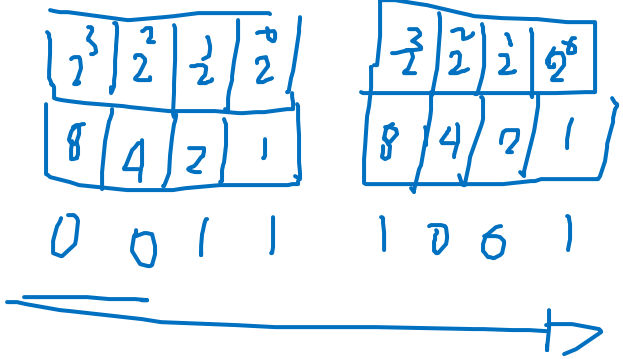
1054_8 = $22C_{16}$



CONVERSION

HEXADECIMAL → BINARY

39_{16}



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

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

$0\ 0\ 1\ 1\ 1\ 0\ 0\ 1_2$

EXAMPLE

168_{16}

8421 8421 8421

0 0 0 1 0 1 1 0 1 0 0 0 $_2$

EXAMPLE

$$210_{16}$$

EXAMPLE

$40E_{16}$

8421 8421 8421

0100 0000 1110 $_2$

EXAMPLE

$$AF_{16}$$

CONVERSION

HEXADECIMAL

OCTAL

39_{16}

8

EXAMPLE

$$168_{16}$$

EXAMPLE

$$210_{16}$$

EXAMPLE

$$40E_{16}$$

EXAMPLE

$$AF_{16}$$

CONVERSION

HEXADECIMAL

DECIMAL

39_{16}

10

EXAMPLE

$$168_{16}$$

EXAMPLE

$$210_{16}$$

EXAMPLE

$$40E_{16}$$

EXAMPLE

$$AF_{16}$$

TUROTEAM

Kezia Velasco

INSTRUCTOR 1

Kenno Fortz

INSTUCTOR 1

Josifina Llagas

INSTRUCTOR 1

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https://thebestschools.org/careers/best-information-technology-jobs/