

# An Introduction to STEM Programming with Python 3 – Chapter 2 Other Bases - Hexadecimal

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# In this video we will cover:

- ✓ What is hexadecimal (base 16)
- ✓ Representing the 16 different digits
- ✓ Converting binary (base 2) to hexadecimal (base 16)
- ✓ Converting hexadecimal (base 16) to binary (base 2)
- ✓ Common ways to write hexadecimal numbers
- ✓ Hexadecimal numbers in Python

# Hexadecimal

- Big numbers become very difficult to represent in binary (lots of ones and zeros)
- Hexadecimal is base 16.
- 4 binary digits are represented by a single character in base 16.
- More compact than decimal.
- 0-9 = 0-9,  
A = 10, B = 11, C = 12,  
D = 13, E = 14, F = 15

# Hexadecimal Numbers

- Using the positional notation for understanding and converting hexadecimal back to decimal:

- $10A_{16}$  can be thought of as

- $$\begin{array}{r} 1 \times 16^2 + 0 \times 16^1 + 10 \times 16^0 \\ 256 + \quad + 10 \\ 266_{10} \end{array}$$

- And  $AB1B_{16}$  can be written as

$$\begin{array}{r} 10 \times 16^3 + 11 \times 16^2 + 1 \times 16^1 + 11 \times 16^0 \\ 40960 + 2816 + 16 + 11 \\ 43803_{10} \end{array}$$

# Powers of 16

- $16^0 = 1$
- $16^1 = 16$
- $16^2 = 256$
- $16^3 = 4096$
- $16^4 = 65536$
- $16^5 = 1048576$
- $16^6 = 16777216$
- $16^7 = 268435456$

# Binary To Hexadecimal

- Add zeros to the left side until you have enough digits to break into groups of 4.
- Starting at the left convert each group of 4 digits to the hexadecimal character.

<b>BIN</b>	<b>HEX</b>	<b>BIN</b>	<b>HEX</b>	<b>BIN</b>	<b>HEX</b>	<b>BIN</b>	<b>HEX</b>
0000	0	0100	4	1000	8	1100	C
0001	1	0101	5	1001	9	1101	D
0010	2	0110	6	1010	A	1110	E
0011	3	0111	7	1011	B	1111	F

# Binary To Hexadecimal

- Convert  $101011_2$  to base 16

0010 1011

2B<sub>16</sub>

- Convert  $1111111100001111_2$  to base 16

1111 1111 0000 1111

FF0F<sub>16</sub>

# Hexadecimal to Binary

- Starting from the left. Convert each digit to the corresponding 4 binary digits.

BIN	HEX	BIN	HEX	BIN	HEX	BIN	HEX
0000	0	0100	4	1000	8	1100	C
0001	1	0101	5	1001	9	1101	D
0010	2	0110	6	1010	A	1110	E
0011	3	0111	7	1011	B	1111	F



# Binary To Hexadecimal

- Convert  $FEA9_{16}$  to base 2

1111 1110 1010 1001

1111111010101001<sub>2</sub>

- Convert  $ABBACAB_{16}$  to base 2

1010 1011 1011 1010 1100 1010 1011

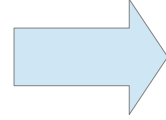
1010101110111010110010101011<sub>2</sub>

# Hexadecimal in Python

- Literal values in Hexadecimal
  - prefix with '0x'
  - Case insensitive
- Decimal to Hexadecimal
  - `hex( number )`
  - Returns string with 0x prefix

# Hexadecimal in Python

```
1 # hexadecimal literal
2 a = 0xf12
3 print(a)
```



3858  
0x182ad

```
4
5 # convert decimal to hex
  string
6 x = 98989
7 print(hex(x))
```

# Thank you

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