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
- $1x16^2 + 0x16^1 + 10x16^0$

  $256 + \quad + 10$

  266_{10}
- And $AB1B_{16}$ can be written as

  $10x16^3 + 11x16^2 + 1x16^1 + 11x16^0$

  $40960 + 2816 + 16 + 11$

  43803_{10}

Powers of 16

- $16^0 = 1$
- $16^1 = 16$
- $16^2 = 256$
- $16^3 = 4098$
- $16^4 = 65536$
- $16^5 = 1048576$
- $16^6 = 16777216$
- $16^7 = 268435456$

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.

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 101011_2 to base 16

  0010 1011

  $2B_{16}$

- Convert 1111111100001111_2 to base 16

  1111 1111 0000 1111

  $FF0F_{16}$

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_2

- Convert $ABBACAB_{16}$ to base 2

  1010 1011 1011 1010 1100 1010 1011
  $1010101110111010110010101011_2$

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

```
3858
0x182ad
```

Thank you

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2. Contact me at jreneau@shawnee.edu
3.