ENR145 Computational Methods:
Basics of Numerical Method and One Cool Application

Xiang Li

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Coe College

Basics of Numerical Method

- Numerical conversion between base 2, 10 and 16.
- Logic operation with AND, OR, NOT, and XOR.
- Practice time!

Tech demo #1, peer review submission:

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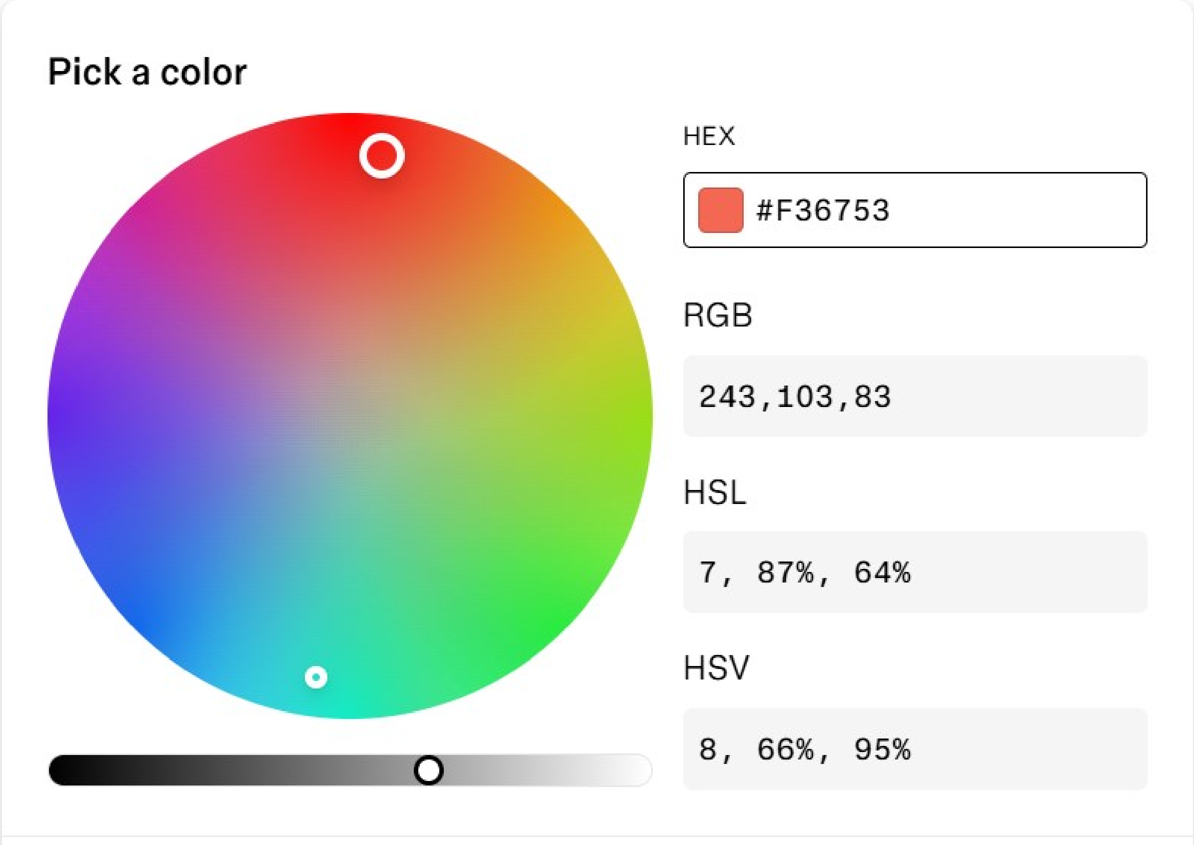
Tech demo#1: RGB (8bit) color to Hex



https://www.figma.com/color-wheel/

Your mission, shall you accept it, is to show your peer how this conversion is **mathematically** done, in python.

RGB

243,103,83

↔

HEX

#F36753

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Basics of Numerical Method: More reading of the truth table (1/3)

- Different presentation, same truth:

A	B	A NAND B
0	0	1
0	1	1
1	0	1
1	1	0

↔

B \ A	0	1
0	**1**	**1**
1	**1**	**0**

Looking up how we do Booleans and Bitwise operations in python. I have a feeling it will be useful.

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Basics of Numerical Method:
More reading of the truth table (2/3)

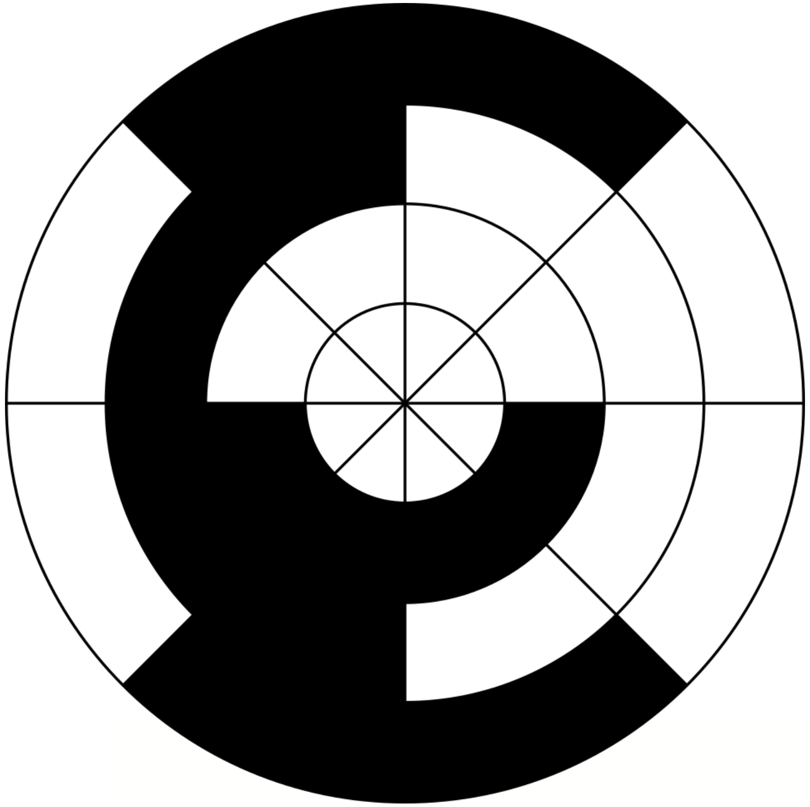
Gray code:

- Old habits die hard
- Weird order of numbering with no apparent reason:

2 bit Gray code, still everywhere in EE

$\overline{A}\overline{B}$	00
$\overline{A}B$	01
AB	11
$A\overline{B}$	10

3-bit binary-reflected Gray code (BRGC)



https://en.wikipedia.org/wiki/Gray_code

Basics of Numerical Method: More reading of the truth table (3/3)

Turn truth table read into Boolean operation:

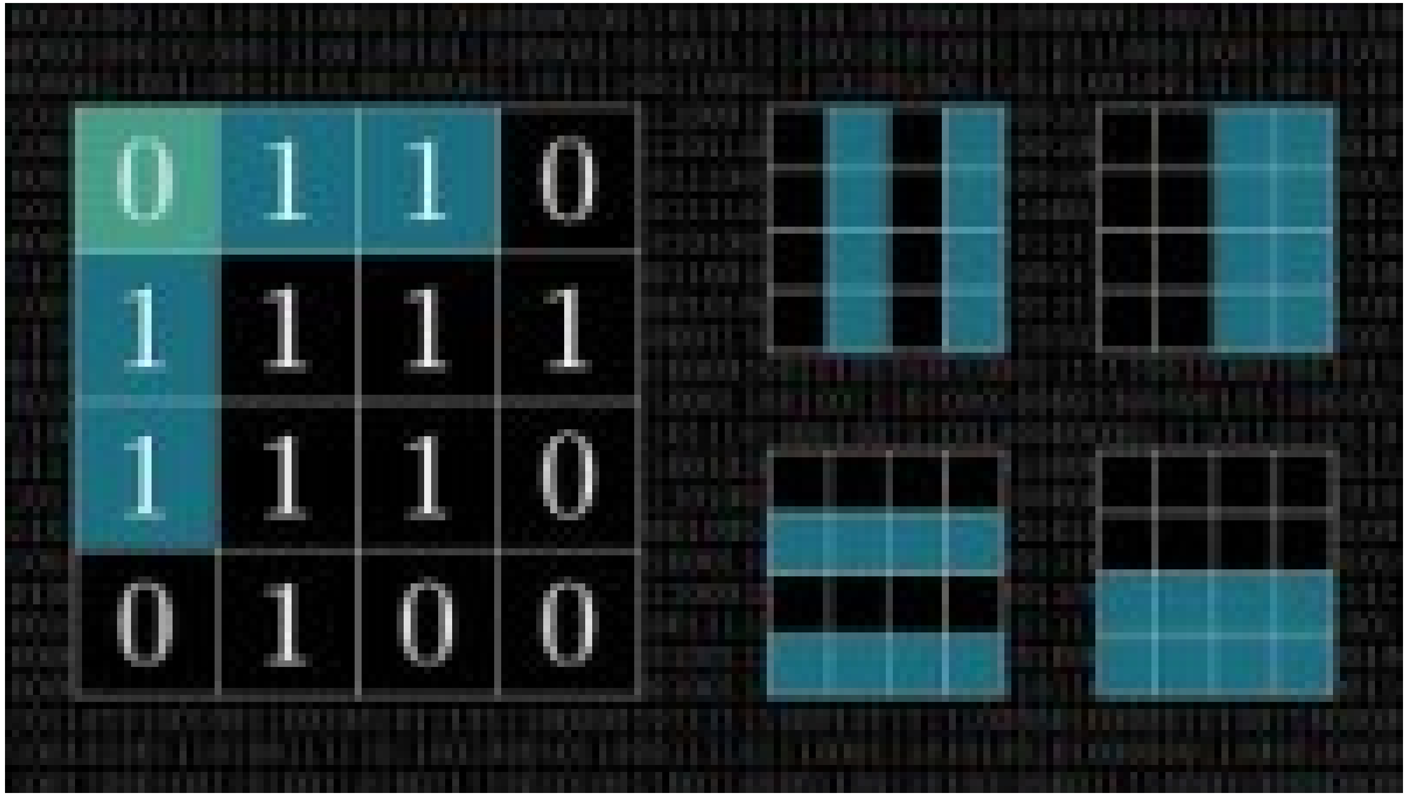
CD \ AB	00	01	11	10
00	**0**	**0**	**1**	**0**
01	**1**	**1**	**1**	**1**
11	**0**	**0**	**1**	**0**
10	**0**	**0**	**1**	**0**

CD \ AB	00	01	11	10
00	**0**	**0**	**1**	**1**
01	**1**	**1**	**0**	**0**
11	**0**	**0**	**0**	**0**
10	**0**	**0**	**1**	**1**

A \ BC	00	01	11	10
0	**0**	**1**	**1**	**1**
1	**1**	**1**	**1**	**0**

The hamming code

- Introduce redundancy, aka parity bits to check for errors.
- The receiver can use the parity bits to pinpoint and correct single-bit error.



https://www.youtube.com/watch?v=X8jsijhllIA&t=156s

Can also check:
https://harryli0088.github.io/hamming-code/

The hamming code

A bit more information to cover:

MONOGRAPH 1757

BELL TELEPHONE SYSTEM

TECHNICAL PUBLICATIONS

Error detecting and error correcting codes

by

R. W. Hamming

We shall require that this checking number give the position of any single error, with the zero value meaning no error in the symbol. Thus the check number must describe $m + k + 1$ different things, so that

$$2^k \geq m + k + 1$$

Parity bits	Total bits	Data bits
m	$n = 2^m - 1$	$k = 2^m - m - 1$

https://en.wikipedia.org/wiki/Hamming_code

Total bits	Information	Detection Cost

TABLE I

n	m	Corresponding k
1	0	1
2	0	2
3	1	2
4	1	3
5	2	3
6	3	3
7	4	3
8	4	4
9	5	4
10	6	4
11	7	4
12	8	4
13	9	4
14	10	4
15	11	4
16	11	5
	Etc.	

2^8=256	256-8-1=247	8

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