Hiding Data in Images

Steganography Part II

Duke
UNIVERSITY

Decimal: Base 10

8237

7 * 1

- Decimal numbers: base 10
  - 1s place, 10 place, 100s place, 1000s place

Decimal: Base 10

8237

3 * 10
7 * 1

- Decimal numbers: base 10
  - 1s place, 10 place, 100s place, 1000s place

Decimal: Base 10

8237

2 * 100
3 * 10
7 * 1

- Decimal numbers: base 10
  - 1s place, 10 place, 100s place, 1000s place

Decimal: Base 10

8237

$$8 * 1000$$
$$2 * 100$$
$$3 * 10$$
$$7 * 1$$

- Decimal numbers: base 10
  - 1s place, 10 place, 100s place, 1000s place

Computers Use Binary: Base 2

10111

1 * 1

- Binary numbers: base 2
  - Hardware: 2 voltage levels

Computers Use Binary: Base 2

10111

1 * 2
1 * 1

- Binary numbers: base 2
  - Hardware: 2 voltage levels

Computers Use Binary: Base 2

10111

1 * 4
1 * 2
1 * 1

- Binary numbers: base 2
  - Hardware: 2 voltage levels

Computers Use Binary: Base 2

10111

0 * 8
1 * 4
1 * 2
1 * 1

- Binary numbers: base 2
  - Hardware: 2 voltage levels

Computers Use Binary: Base 2

	1 * 16
	0 * 8
10111	1 * 4
	1 * 2
	1 * 1

- Binary numbers: base 2
  - Hardware: 2 voltage levels

Computers Use Binary: Base 2

$$10111 \quad \begin{matrix} 1 * 16 \\ 0 * 8 \\ 1 * 4 \\ 1 * 2 \\ 1 * 1 \end{matrix} \quad = 23$$

- Binary numbers: base 2
  - Hardware: 2 voltage levels

0 to 255: 8 Binary Digits (“bits”)

11111111 = 255

00000000 = 0

- RGB values range from 0 to 255
  - 8 binary digits: called “bits”

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Steganography with Binary

Hide This In This

10110010 01110101

01111011

How do you do this with math?

- Can use same principle as for decimal
  - Use 4 bits (digits) from each number

Base 10 Math: Revisited

Hide This	In This	Result
8274	3568	3582

Math.floor(8274 / 100) = 82
Math.floor(3568 / 100) = 35

35 * 100 + 82 = 3582

- Return to more familiar: base 10
  - Good strategy in general

Revisit In Binary

Hide This In This

10110010 01110101

Math.floor(10110010 / 16) = 1011

Math.floor(01110101 / 16) = 0111

0111 * 16 + 1011 = 01111011

- Same principle, but powers of 2 instead of 10
  - 4 digits = $2^4 = 16$

What About Extraction?

Extract Hidden Message

01111011

Result

10110000

- How to get the lowest 4 digits?

Again, Consider Base 10

Extract Hidden Message	Result
3582	8200

3582 / 100 = 35 **Remainder** 82

3582 % 100 = 82

82 * 100 = 8200

Called “mod”

- Return to more familiar: base 10
  - Good strategy in general

What About Extraction?

Extract Hidden Message

01111011

Result

10110000

01111011 % 16 = 1011

1011 * 16 = 10110000

- Use “mod” 16 to get lowest 4 digits
- Multiply by 16 to “move over 4 places”

Binary Math

- Binary Representation
  - 1's, 2's, 4's, … places
  - Multiply/Divide by powers of 2
    - Analogous to powers of 10
    - Use Math.floor: get rid of fractions
  - Mod: remainder when dividing
    - Use to get lowest digits