CS1800
Discrete Structures
Fall 2019

Lecture 1
9/6/19

Today:

* Administrivia
* CS in general
* CS1800 in specific
* Magic trick
* Decimal and binary representations
* Conversions: dec to bin; bin to dec
* Counting in binary; powers of 2
* Hexadecimal

* Addition and subtraction in binary

Decimal

$$8792_{10} = 8\times10^3 + 7\times10^2 + 9\times10^1 + 2\times10^0$$

$$= 879\cdot10 + 2$$

$$= (87\cdot10+9)\cdot10 + 2$$

$$= ((8\cdot10+7)\cdot10+9)\cdot10+2$$

	2^5	2^4	2^3	2^2	2^1	2^0
$\ldots$	32	16	8	4	2	1
	1	0	1	1	0	$_2$

$$= 1\times2^4 + 0\times2^3 + 1\times2^2 + 1\times2^1 + 0\cdot2^0$$

$$= ((\ldots+1)\cdot2+1)2+0$$

$$16 + 4 + 2 = 22_{10}$$

Decimal → Binary

MSB → LSB

41_{10}

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

$41-32=9$

$9-8=1$

27_{10}

32	16	8	4	2	1
	1	1	0	1	1

$27-16=11$

$11-8=3$

$3-2=1$

24_{10}

32	16	8	4	2	1
	1	1	0	0	0

$24-16=8$

LSB → MSB

$41 \rightarrow 1$ LSB

$(41-1)\div 2 = 20 \rightarrow 0$

$(20-0)\div 2 = 10 \rightarrow 0$

$(10-0)\div 2 = 5 \rightarrow 1$

$(5-1)\div 2 = 2 \rightarrow 0$

$(2-0)\div 2 = 1 \rightarrow 1$ MSB

$27 \rightarrow 1$

$13 \rightarrow 1$

$6 \rightarrow 0$

$3 \rightarrow 1$

$1 \rightarrow 1$

$24 \rightarrow 0$

$12 \rightarrow 0$

$6 \rightarrow 0$

$3 \rightarrow 1$

$1 \rightarrow 1$

Binary → Decimal

16 8 4 2 1

10110_2

$16+4+2 = 22_{10}$

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64 32 16 8 4 2 1

1101001_2

$64+32+8+1 = 105_{10}$

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64 32 16 8 4 2 1

1001011_2

$64+16+2+1 = 83_{10}$

MSB	1	1	1
	0	$1\times2+0 = 2$	10
	1	$2\times2+1 = 5$	101
	1	$5\times2+1 = 11$	1011
LSB	0	$11\times2+0 = 22$	

1	1
1	3
0	6
1	13
0	26
0	52
1	105

1	1
0	2
1	5
0	10
0	20
1	41
1	83

	8 4 2 1
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111

$2^0 = 1$

$2^1 = 2$

$2^2 = 4$

$2^3 = 8$

$2^4 = 16$

$2^5 = 32$

$2^6 = 64$

$2^7 = 128$

$2^8 = 256$

$2^9 = 512$

$2^{10} = 1024$

2^{10} = "kilo" = K $1024 \approx 1000$

2^{20} = "mega" = M $1{,}048{,}576 \approx 1{,}000{,}000$

2^{30} = "giga" = G $\sim 1{,}000{,}000{,}000$

2^{40} = "tera" = T $\sim 1{,}000{,}000{,}000{,}000$

$$2^{38} = \underbrace{2^8}_{256} \cdot \underbrace{2^{30}}_{\text{billions}}$$