

CS1800 (Discrete Structures)

Day 1

Welcome to CS1800 :)

Agenda:

- Make some friends
- What does it take to be effective at math?
- how to be successful in CS1800
- Admin stuff:
 - syllabus review
 - please use piazza!
- Numbers in different bases

note to self: record this

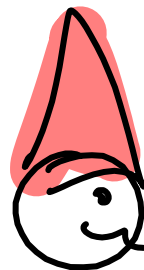
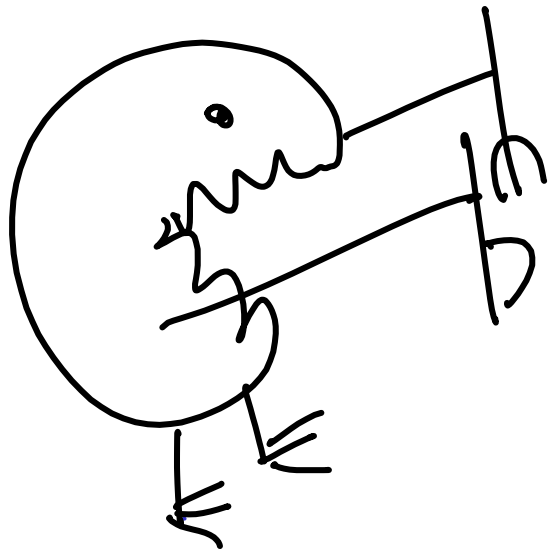
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WELCOME!

Make some friends :)

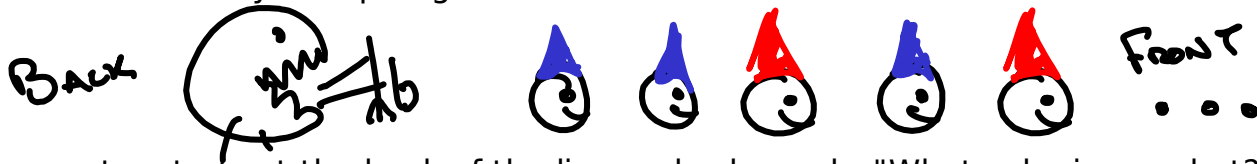
(I have some instructions)

My garden gnome friend is having a problem, can you help him out?



Garden Gnome Problem (please avoid working on this before day1, thank you!)

Given an arbitrary lineup of gnomes with red or blue hats:



A monster starts at the back of the line and asks each, "What color is your hat?":

correct response ----> gnome lives

incorrect response ----->gnome is eaten!

Where all the gnomes can:

- see all the gnomes in front of them
- hear the response (red / blue) and outcome (eaten / not eaten) of each response behind them

How can the gnomes use *only the responses to signal each other to maximize gnome survival?

In Class Activity 1 (no submissions for any in class activity)

Take 5 to 7 minutes and work on the gnome problem in a small group (no more than 5 please) of your new friends.

Be mindful of how you feel* during the course of the problem. I'll ask a few folks to share this (individually and collectively) just afterwards.

*yes I mean the touchy-feely stuff: e.g. confident, uncomfortable, embarrassed, frustrated, excited, angry, fatigued, proud

How did we feel doing math?

felt kind dumb

Being an effective math student:

- Being confused is part of doing a math problem, you're welcome to be confused!
- Hard feelings (frustration, self-doubt, fatigue) will tax our motivation / sharpness:
 - work with a good friend (and be a good math friend)
 - be generous and patient helping each other
 - take care of your circumstances:
 - eat / sleep well
 - start work early to allow more time if needed
- Don't ignore hard thoughts (e.g. "that HW grade is much lower than I would've liked"), take productive steps for yourself (visit me in office hours!)
- Have fun! (really, no joke: math can be fun). Fun will sustain you while you're working

Succeeding in CS1800:

1. Attend all classes in person
2. Work hard and be super friendly / cooperative in recitation
3. Start your HW early
(read it on the day assigned)
4. Make use of office hours
(tip: further from due date its super quick to get an appointment)

If you're doing all of this and you'd still like more support, know that we'll be starting a small group TA-led weekly HW tutor session. (details to come)

<website / syllabus policy review & q/a>

(there's some fun math coming just after, I promise!)

no coincidence: "digits" are anatomical and numerical

ANATOMY



NUMBERS

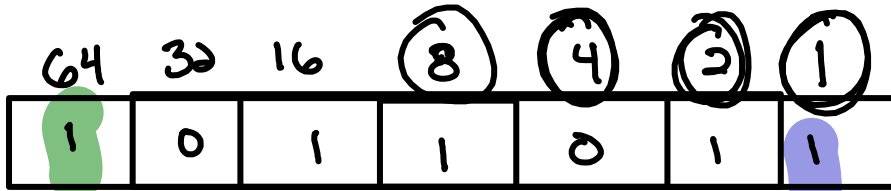
0, 1, 2, 3, ..., 9

ARE OUR 10 DIGITS

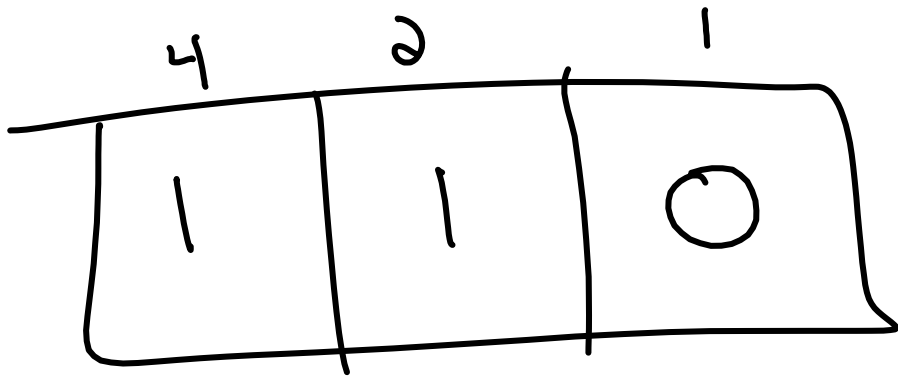
How Do FROGS (8 FINGERS) OR COMPUTERS
(2 FINGERS) REPRESENT VALUES?

BASE 2 - BINARY: INTUITION

WHAT VALUE DOES $(101101)_2$ REPRESENT?

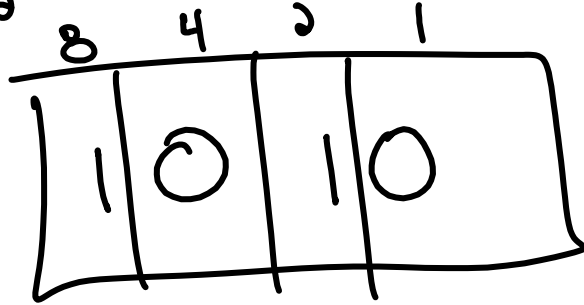


$$64 + 0 + 16 + 8 + 0 + 2 + 1$$



$$(110)_2 = 6$$

$(1010)_2$



$$1 \cdot 8 + 0 \cdot 4 + 1 \cdot 2 + 0 \cdot 1$$

$$8 + 0 + 2 + 0 = 10$$

BINARY SEEMS ODD,
WHERE DOES THAT REPRESENTATION
SYSTEM COME FROM?

BASE-10 (DECIMAL):

REPRESENTING VALUES w/ 10 DIGITS

192

$$\begin{aligned} &= 100 \cdot 1 + 10 \cdot 9 + 1 \cdot 2 \\ &= 10^2 \cdot 1 + 10^1 \cdot 9 + 10^0 \cdot 2 \end{aligned}$$

$i=2$ $i=1$ $i=0$

EACH PLACE VALUE REPRESENTS A VALUE OF 10^i

BASE-2 (BINARY): REPRESENTING VALUES w/ 2 DIGITS

$$(110)_2 = 4 \cdot 1 + 2 \cdot 1 + 1 \cdot 0 = 6$$
$$= 2^2 \cdot 1 + 2^1 \cdot 1 + 2^0 \cdot 0$$

NOTICE:

- WE USE PARENTHESES w/ SUBSCRIPT TO INDICATE BINARY (ASSUME BASE-10 OTHERWISE)
- BINARY HAS ONLY 2 DIGITS: 0, 1

DECIMAL AND BINARY: COMPARISON

$(192)_{10}$

$B=10$

100	10	1
1	9	2

$i = 2 \quad 1 \quad 0$

$(1011011)_2$

$B=2$

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

$i = 6 \quad 5 \quad 4 \quad 3 \quad 2 \quad 1 \quad 0$

THE i -TH PLACE REPRESENTS

B^i

BASE 16 (HEXADECIMAL) REPRESENTING VALUES w/ 16 DIGITS

$$(12F)_{16} = 1 \cdot 16^2 + 2 \cdot 16^1 + 15 \cdot 16^0$$

Hex Has 16 Digits

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
										A	B	C	D	E	F

BIT = BINARY DIGIT
(EITHER 0 OR 1)

In Class Activity 2

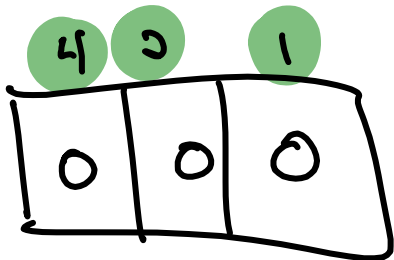
- What is the smallest and largest value you can represent with 3 binary digits (bits)?
- What are all the values you can represent with 3 binary digits?
- If you wrote these all out in a big column, the smallest on top and largest on bottom, what patterns do you notice?

Stuck?

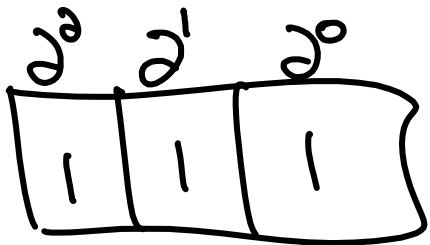
- Try solving a simpler problem by changing "binary" to "base-10" above.
- Ask for help (and check if your new friends need any), cooperation encouraged!

(++ if you still have time)

- What are all the values you can represent with 10 binary digits?
- What are all the values you can represent with N binary digits?
- What are all the values you can represent with N digits in base b?

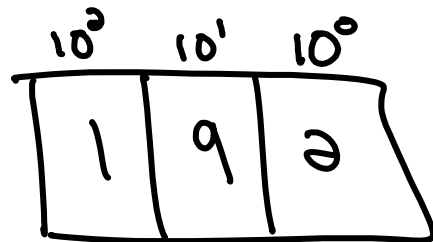


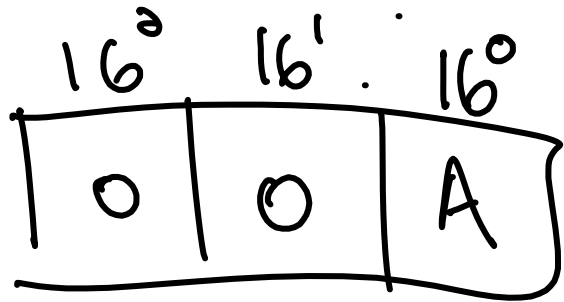
$$4 \cdot 0 + 2 \cdot 0 + 1 \cdot 0$$



$$4 \cdot 1 + 2 \cdot 1 + 1 \cdot 1 = 7$$

7





$$1 + 2 + 4 = 7$$

$$1 + 2 + 4 + 8 = 15$$

$$1 + 2 + 4 + 8 + 16 = 31$$

8
16
32

$(000)_{16}$

$(1000)_{16}$

$(10000)_{16}$

4	2	1	Decimal
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

all even numbers have a 0 in the 1's place
 "the 1's place tells us if the number is odd"