

This is CS1 10H

binary  
bits



128s 64s 32s 16s 8s 4s 2s 1s

0 0 0 0 0 0 0 0

8 bits = byte

1,000 bytes = kilobyte

1,000,000 bytes = megabyte

128s 64s 32s 16s 8s 4s 2s 1s

0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 1

128s    64s    32s    16s    8s    4s    2s    1s

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

4?

5?

128s    64s    32s    16s    8s    4s    2s    1s

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

13?

4?

5?

128s 64s 32s 16s 8s 4s 2s 1s

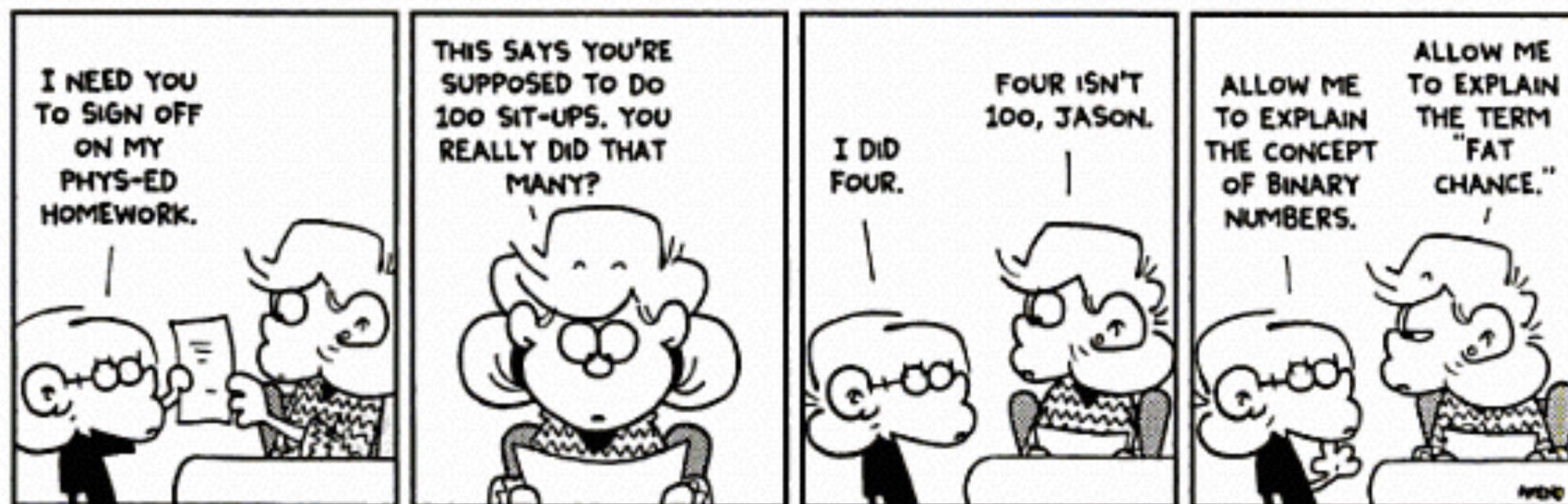
|   |   |   |   |   |   |   |   |    |
|---|---|---|---|---|---|---|---|----|
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | ?? |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | ?? |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | ?? |

| 128s | 64s | 32s | 16s | 8s | 4s | 2s | 1s |    |
|------|-----|-----|-----|----|----|----|----|----|
| 0    | 0   | 0   | 0   | 1  | 1  | 0  | 1  | ?? |
| 0    | 0   | 0   | 0   | 0  | 1  | 1  | 1  | ?? |
| 0    | 1   | 0   | 0   | 0  | 1  | 1  | 0  | ?? |

explain to neighbor

# everything in a computer is bits

- ✦ mp3
- ✦ Microsoft Word
- ✦ video file
- ✦ picture from a camera
- ✦ LED color values



I NEED YOU  
TO SIGN OFF  
ON MY  
PHYS-ED  
HOMEWORK.

THIS SAYS YOU'RE  
SUPPOSED TO DO  
100 SIT-UPS. YOU  
REALLY DID THAT  
MANY?

I DID  
FOUR.

FOUR ISN'T  
100, JASON.

ALLOW ME  
TO EXPLAIN  
THE CONCEPT  
OF BINARY  
NUMBERS.

ALLOW ME  
TO EXPLAIN  
THE TERM  
"FAT  
CHANCE."

# Recap

binary numbers

| ... | 32 | 16 | 8 | 4 | 2 | 1 |
|-----|----|----|---|---|---|---|
|     |    |    |   | 1 | 0 | 1 |
|     |    | 1  | 0 | 1 | 1 | 1 |

# 2 problems

- ✦ 1101001101011
- ✦ hard to remember the binary (decimal easier)
- ✦ hard to convert to decimal

# solution: octal

| $2^3$ | $2^2$ | $2^1$ | $2^0$ |
|-------|-------|-------|-------|
| 512s  | 64s   | 8s    | 1s    |
|       |       |       | 6     |
|       |       |       | 7     |
|       |       | 1     | 0     |
|       |       | 1     | 1     |

# solution: octal

- ✦ 1101001101011 (group into 3s starting at right)
- ✦ 1 5 1 5 3 (convert each group)

# problem: octal

- ✧ computers are built in binary (2s)
- ✧ octal is groups of 3
- ✧ a bit of a mismatch

# Hexadecimal

# hexadecimal

hexadecimal numbers

decimal:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

# hexadecimal

hexadecimal numbers

decimal:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

# hexadecimal

... 4096 256 16 1  
2 3

# hexadecimal

... 4096 256 16 1

2 3

$$32 + 3 = 35$$

# hexadecimal

|     |      |     |    |   |
|-----|------|-----|----|---|
| ... | 4096 | 256 | 16 | 1 |
|     |      |     | 1  | F |

# hexadecimal

... 4096 256 16 1

1 F

$$16 + 15 = 31$$

# hexadecimal

001001010111111

# hexadecimal

001001010111111

0010    0101    0111    1111

# hexadecimal

001001010111111

0010    0101    0111    1111

2    5    7    F

# Recap

octal numbers

001001010111111

0    010    010    101    111    111

0    ?    ?    ?    ?    ?

# question

Why do computer scientists confuse Christmas and Halloween?

colors

red green blue

# colors - hexadecimal

red green blue

00 00 00

# Arduino

Why is the max on the potentiometer 1023?

Sounds like an odd number.

512s 256s 128s 64s 32s 16s 8s 4s 2s 1s

0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 1

0 0 0 0 0 0 0 0 1 0

...

1 1 1 1 1 1 1 1 1 1

</done>