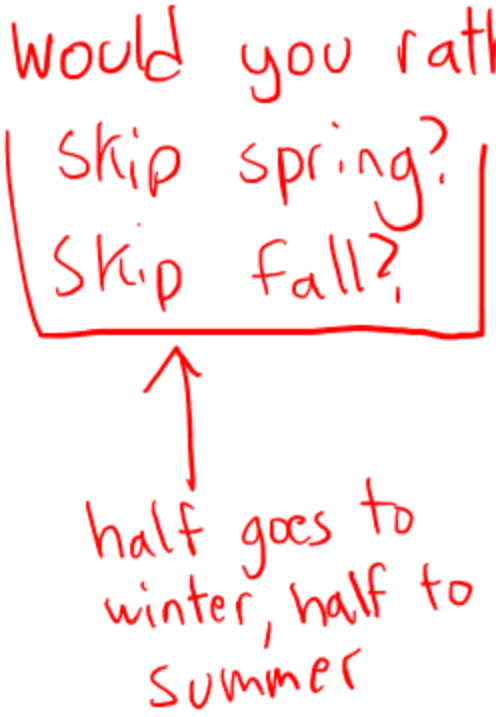

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Q1

~Code~
340

CS 340

Building Blocks 0b01
(Gates and Binary)

Updates

1. MP 0 - Setup due TODAY. 9pm
2. MP 1 - debugger due TODAY. midnight
3. MP 2 - C from C++ out TODAY
4. If you added late, let us know ASAP for possible extensions
5. HW 2 Due Thursday 1:59pm
    a. Overview and C coding

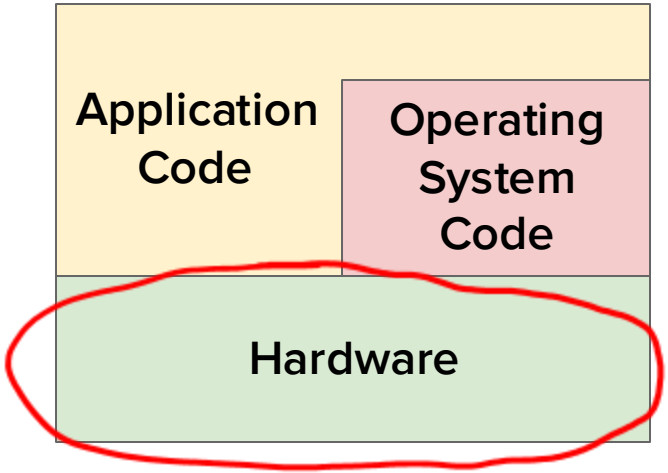
Building Blocks 0b01

Today's LGs:

- Be able to explain how logic, arithmetic calculations, and selection are built up using electrons
  - Knowing the terms, electricity, current, voltage, transistors, gates, binary
  - Be able to read a gate diagram and generate a corresponding truth table
  - Developing your intuition around the binary number system and skills around converting and using bits to do math
  - Be able to recognize how gates are used to do addition and selection

Summary Slide/Agenda

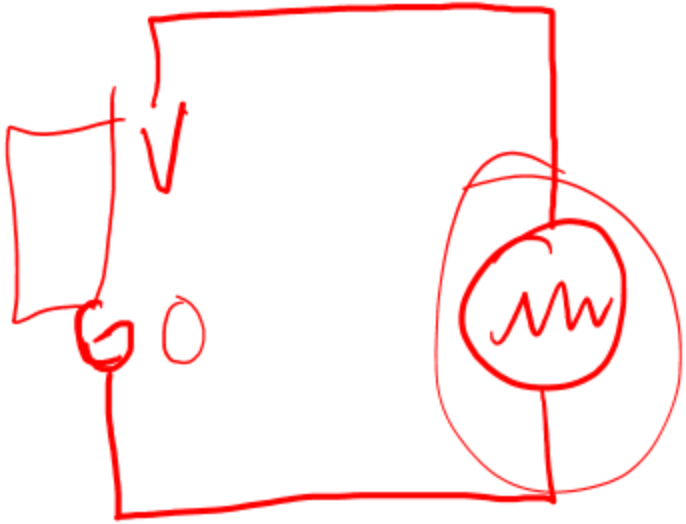
1. Circuit Basics
2. Gates
3. Binary
4. Arithmetic Computations
5. Selection



Circuit and Gate Basics

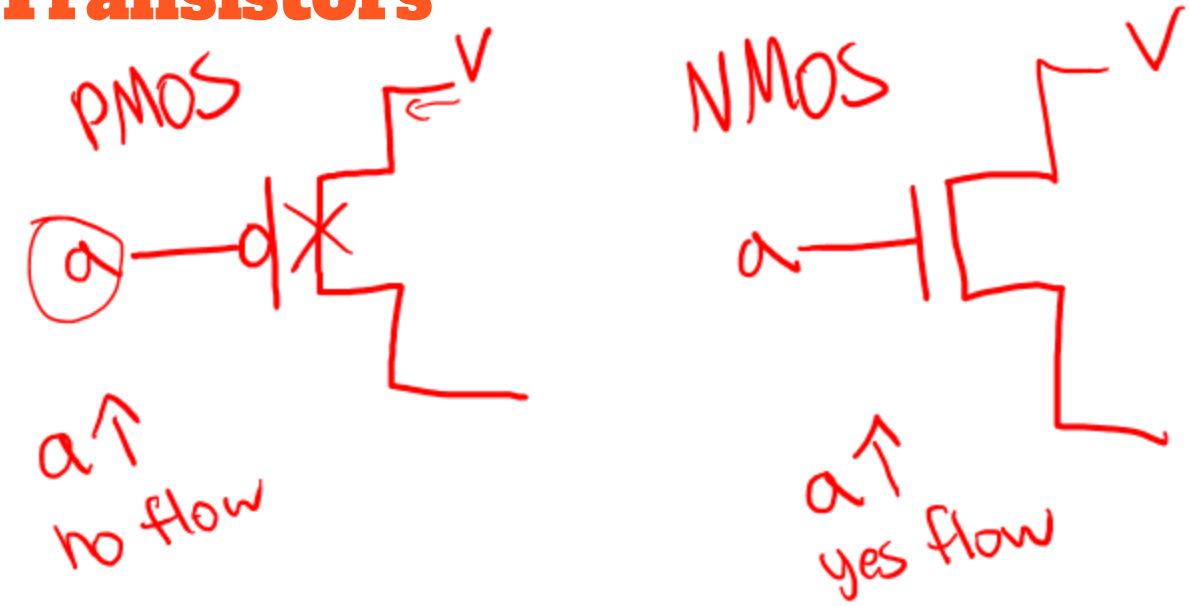
Circuit Basics

- Electricity
- Current
- Voltage

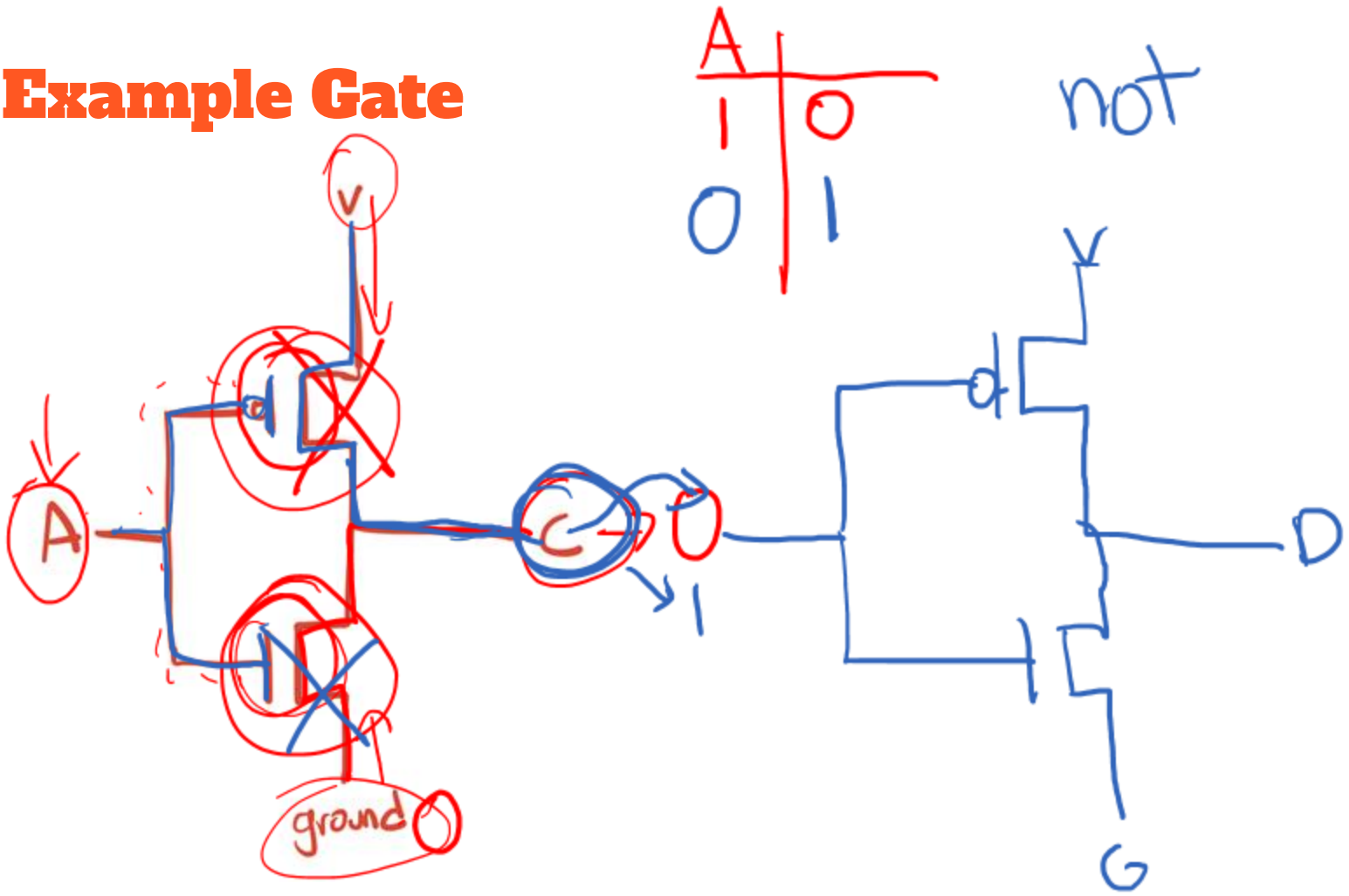


Gates

Transistors

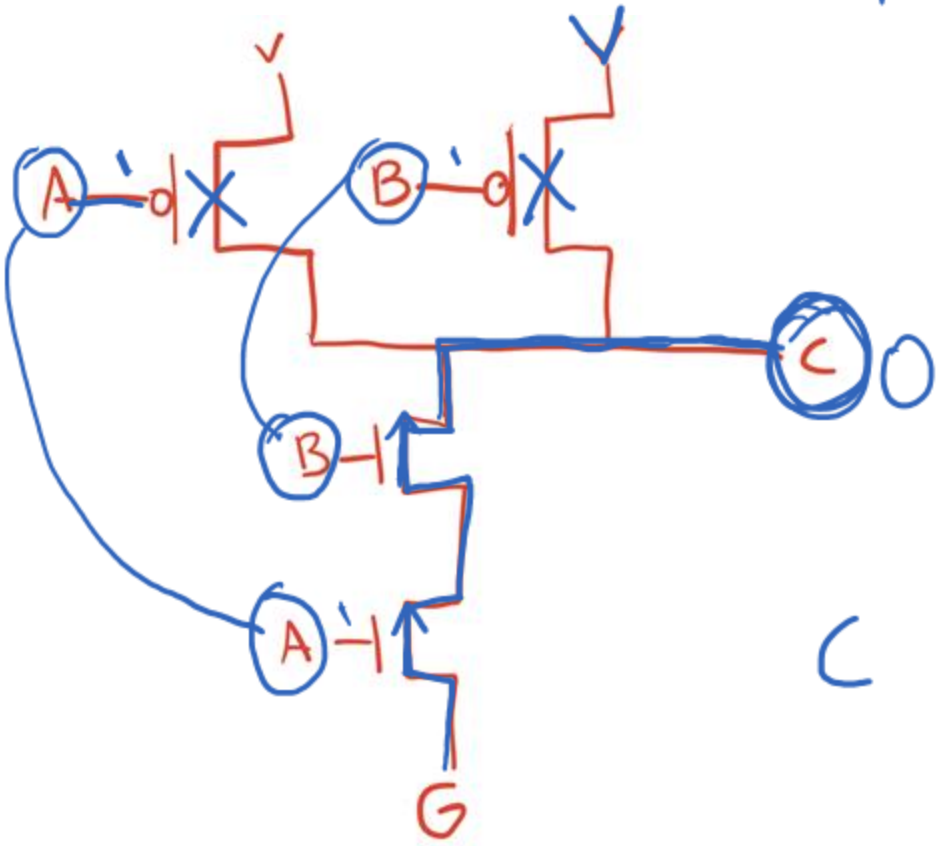


Example Gate



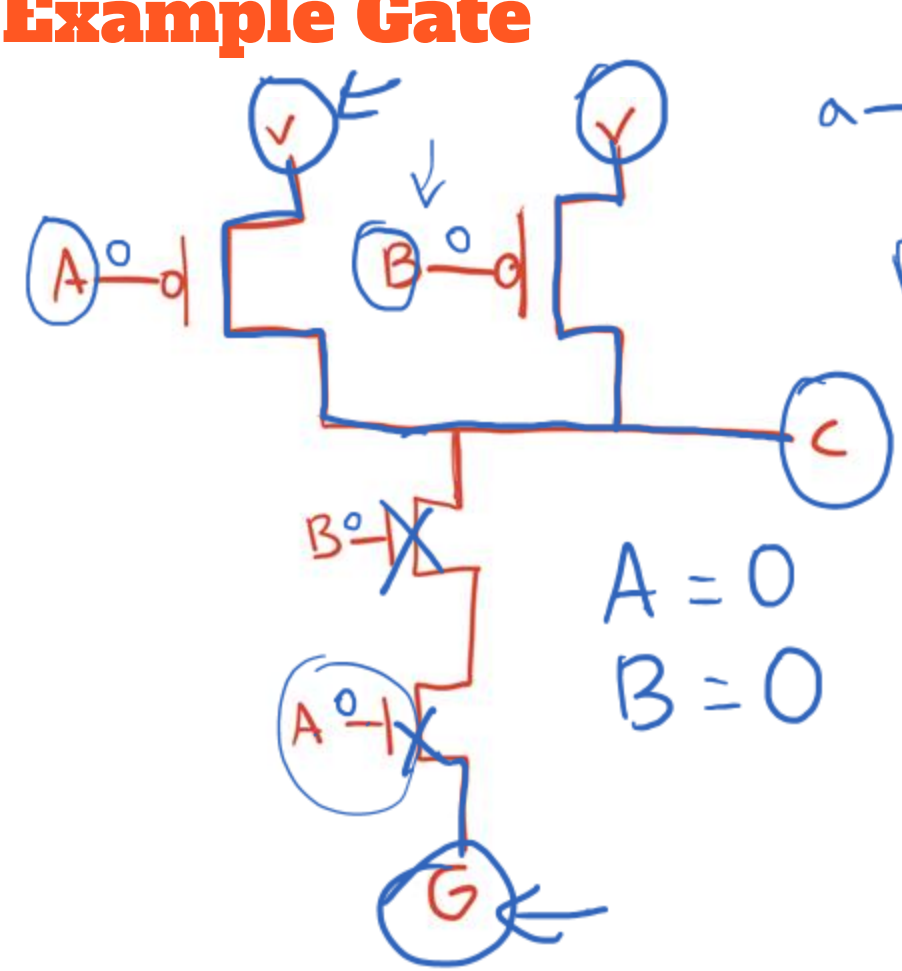
Example Gate

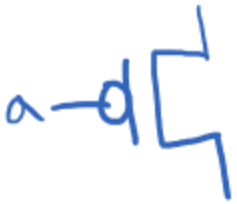
A	B	C
1	1	0



C

Example Gate





PMOS

if a↑
no flow

A = 0
B = 0

A	B	C
0	0	1

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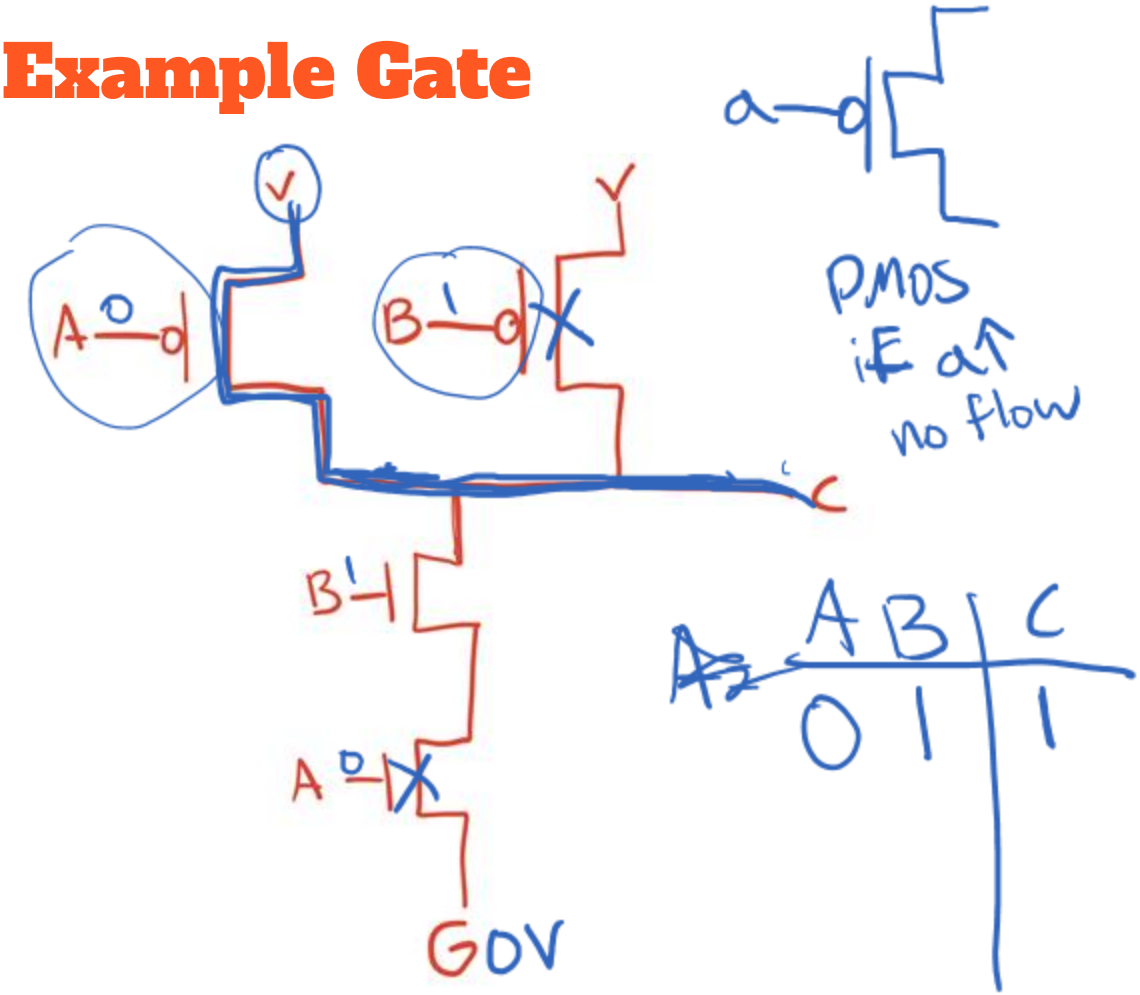
Q2

~Code~
340

Example Gate



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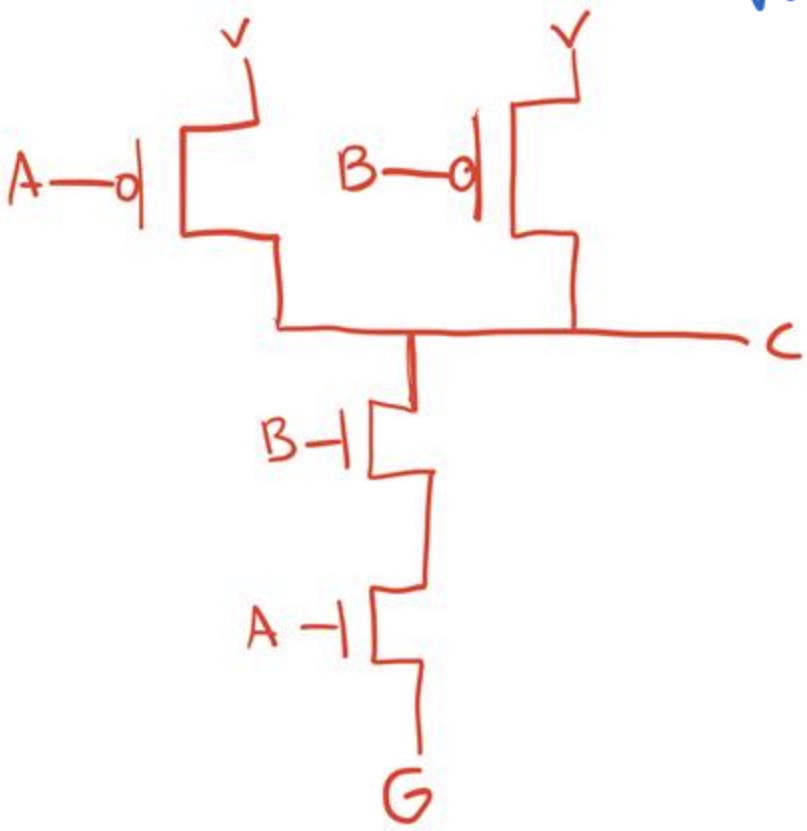
Q3

~Code~
340

Example Gate



Which gate?

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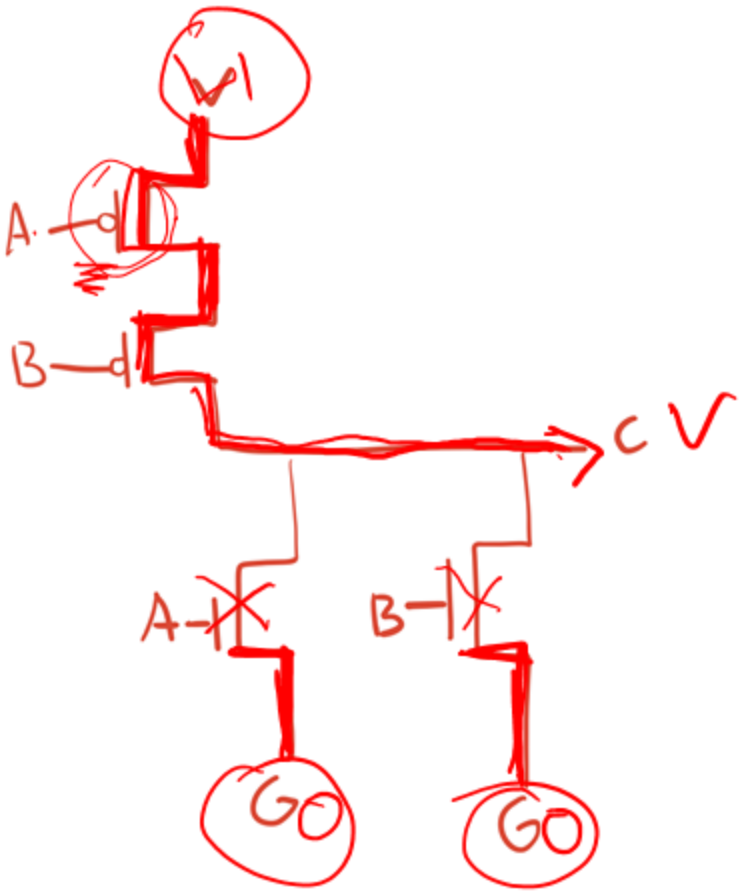
Q4

~Code~
340

A B	C
1 1	0
1 0	1
0 0	1

NAND

Example Gate



A	B	C
0	0	1
1	1	
0	1	
1	0	

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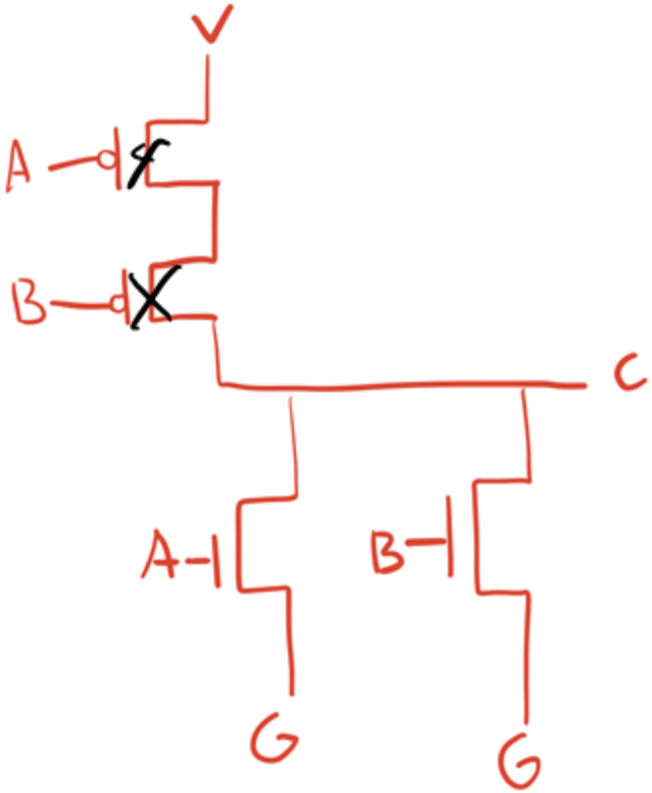
Q5

~Code~
340

Example Gate



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Q6

~Code~
340

Big Takeaways

AND
NAND
OR
XOR
NOT

math
selection
storage ← hardware

busses, clock

The Binary Number System

Binary Number System

0, 1

0, 1, 2, 3, 4, 5, 6, 7, 8, 9

203

10^2 10^1 10^0

2 100's 0 10's 3 1's

~~10~~ 0b01

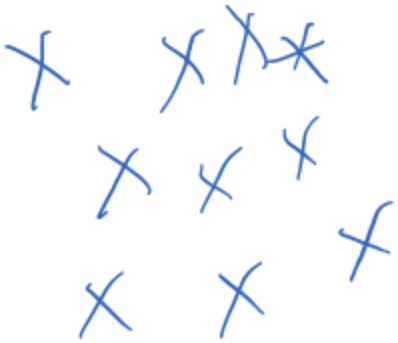
0b10

Going from Binary to Decimal

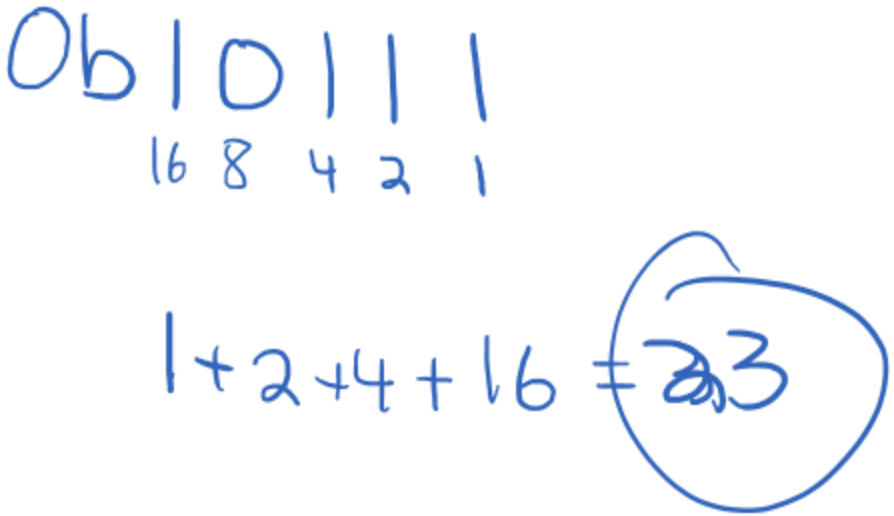
0b100101

32 16 8 4 2 1

32+4+1 = 37



What is 0b10111 in Decimal?



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Q7

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340

Going from Decimal to Binary

1056

0	1	0	0	0	0	1	0	0	0	0	0
↑	1024	512	256	128	64	32	16	8	4	2	1

2048

1056
−1024
0032

What is 14 in binary?

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Q8

~Code~
340

0 0 0 0 0 1 1 1 0
16 8 4 2 1

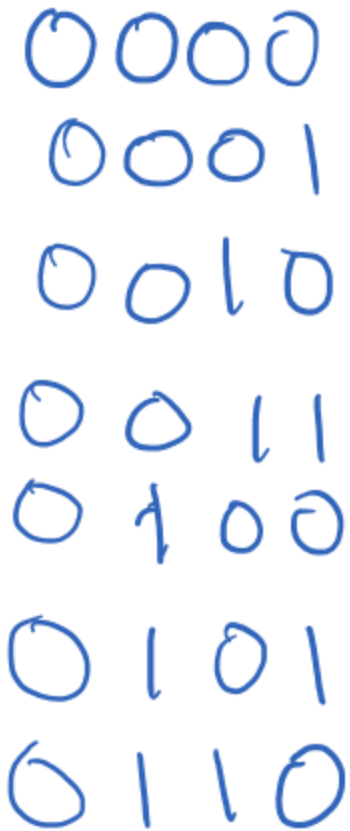
00032

14
- 8

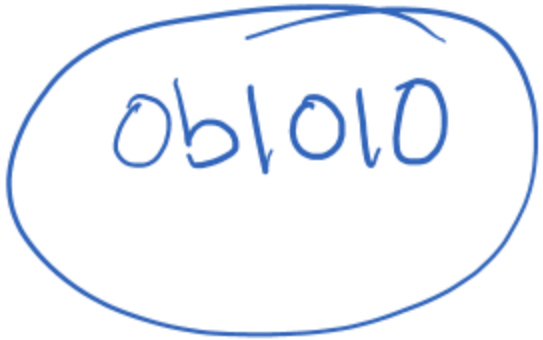
6
- 4

2

Counting in Binary



What is 0b0001 + 0b1001 in decimal?



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Q9

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340

What is 0b11111 in Decimal?

32 16 8 4 2 1

+1

1,00000

31

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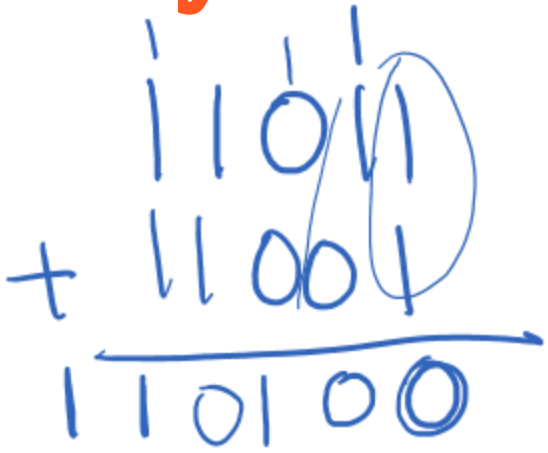
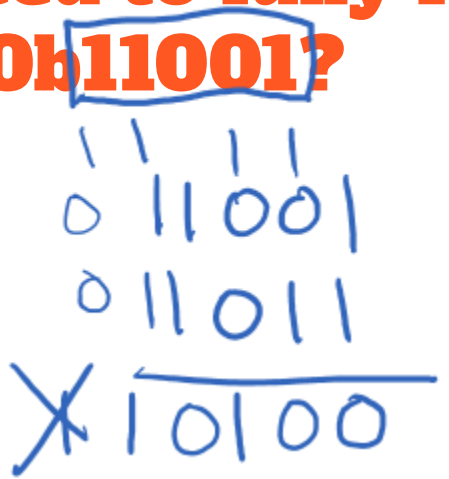
Q10

~Code~
340

Addition in Binary



Bits take up space in hardware. How many bits of space would I need to fully represent 0b11011 + 0b11001?



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Q11

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340

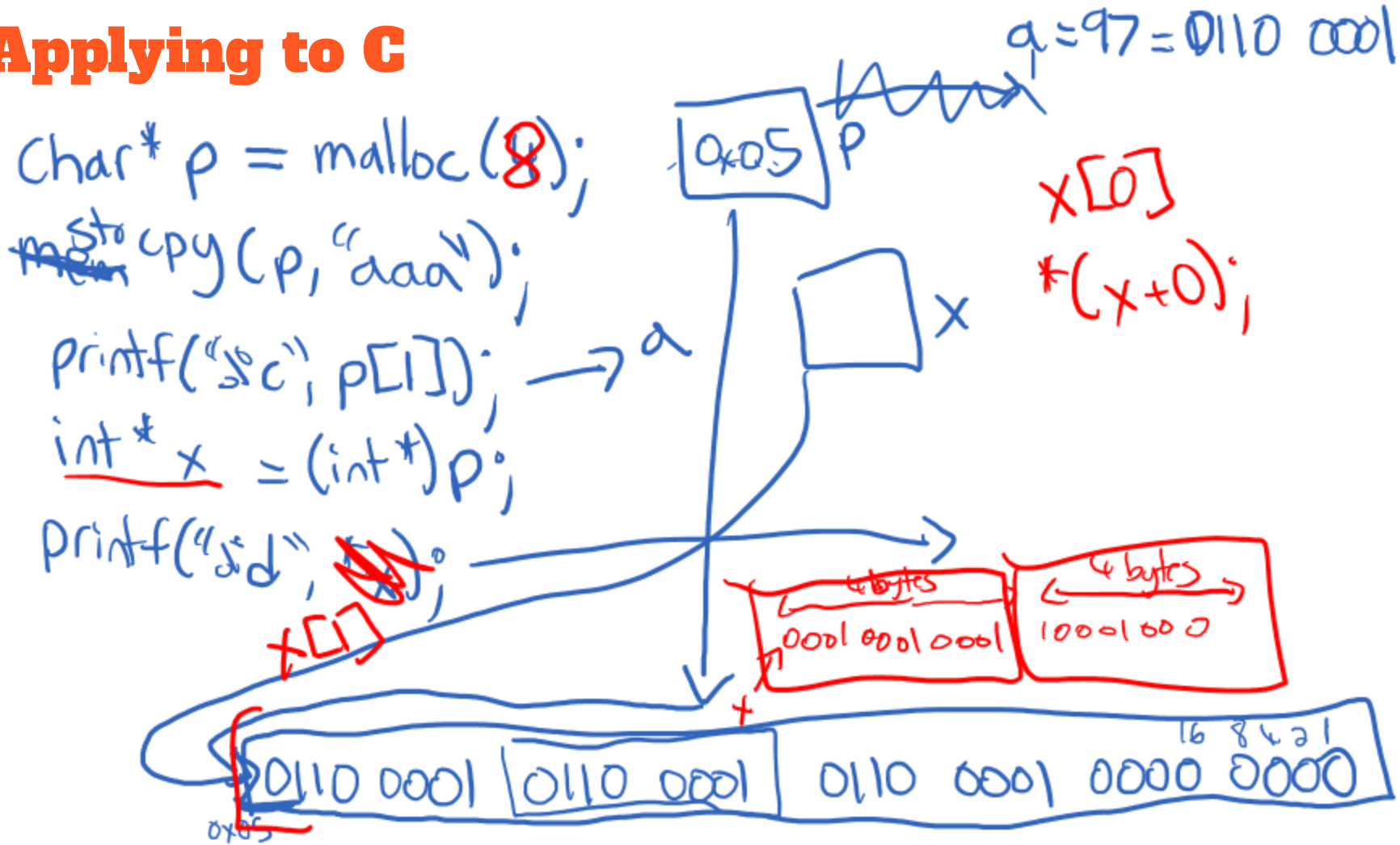
Subtraction in Binary

Big Takeaways

current, voltage, transistors, gates, binary

An Implication when coding in C

Applying to C



What happens?

```c
#include <stdio.h>
#include <stdlib.h>

int main() {
    int* p1 = malloc(sizeof(int));
    char* p2 = (char*)p1;
    p2[3] = 'a';
    printf("yay char: %c", p2[3]);
    free(p1);
}
```

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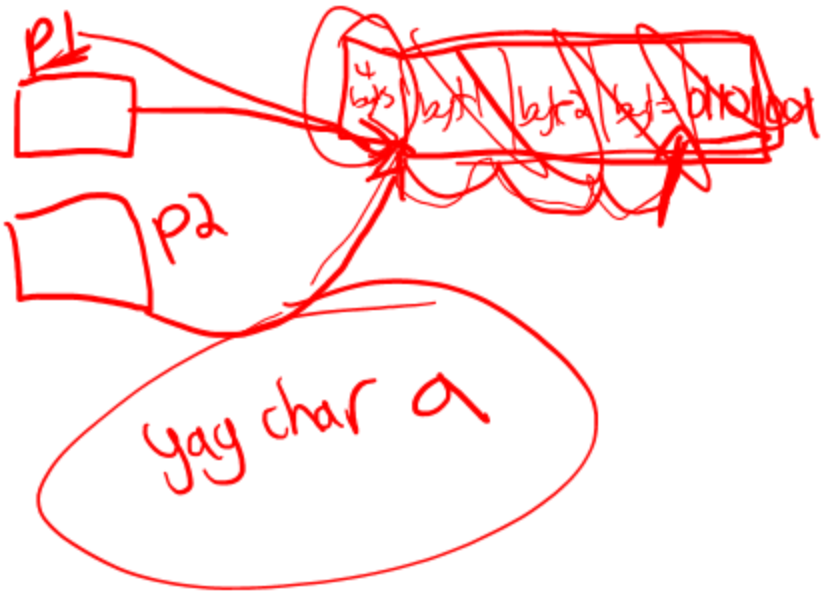
Q12

~Code~
340



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