CS 340

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Q1

~Code~
340

2’s complement | Virtual Memory

Updates

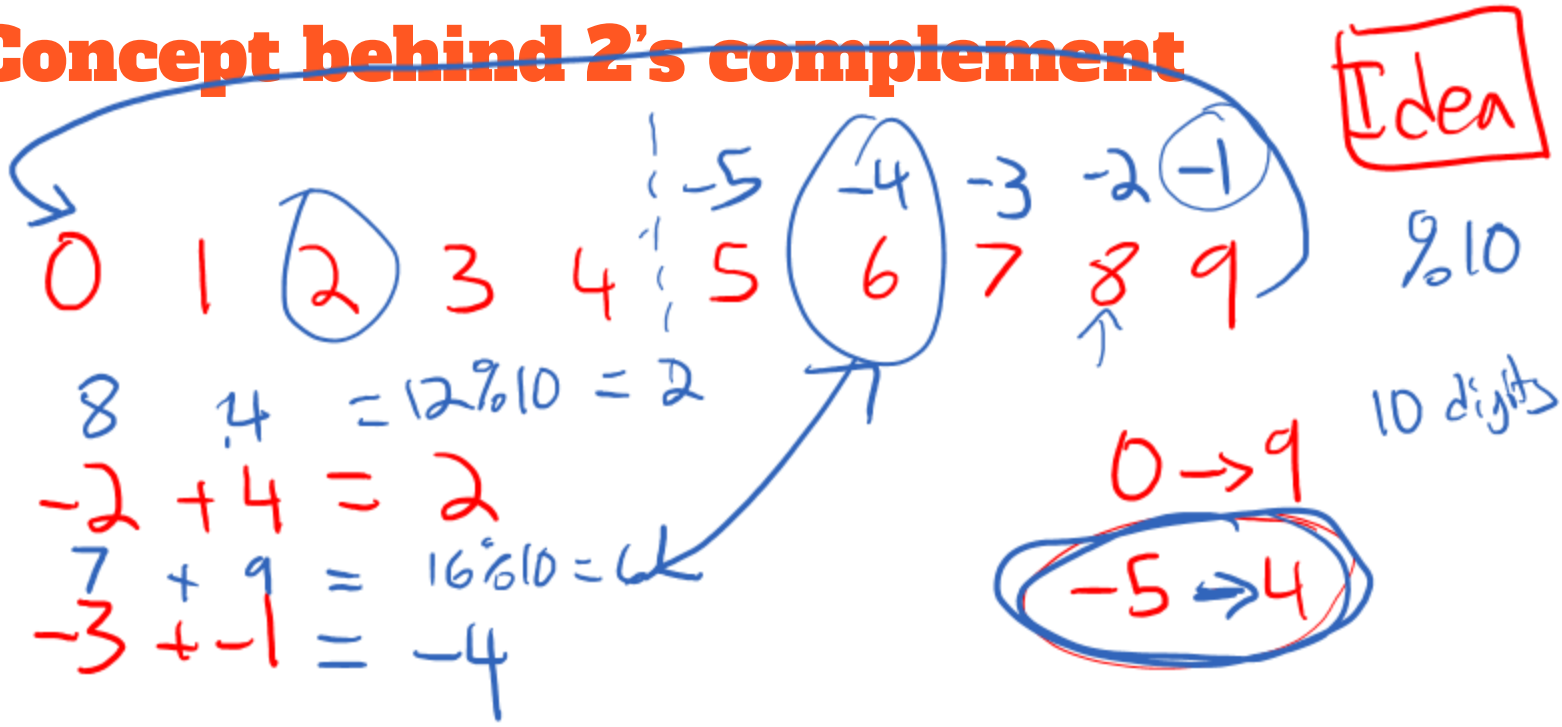
1. MP4 UTF-8 due next Tuesday

1. HW 4 due next Thursday
    a. Wednesday night at midnight if you prefer

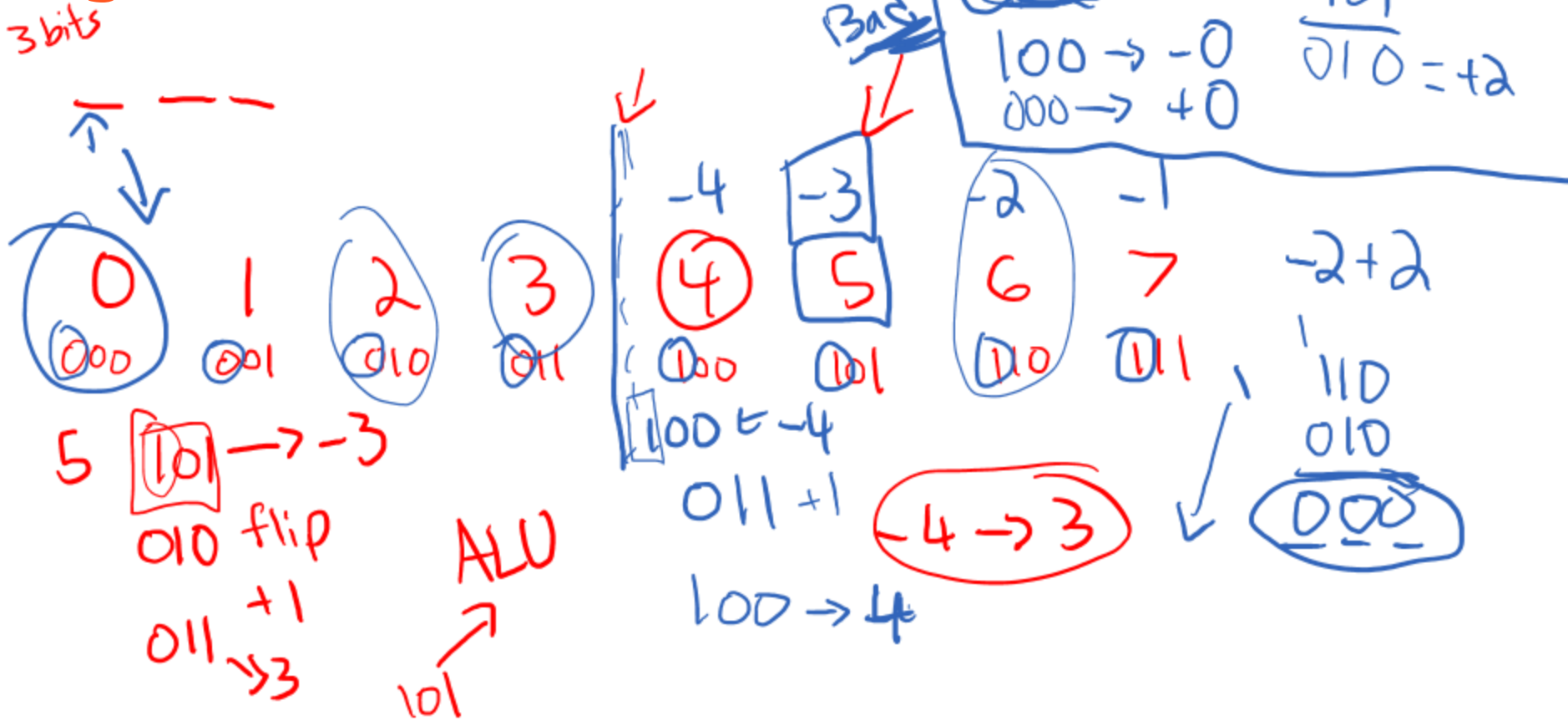
Agenda

1. Negative Numbers - 2's complement
2. Virtual Memory
3. Bit shifting practice

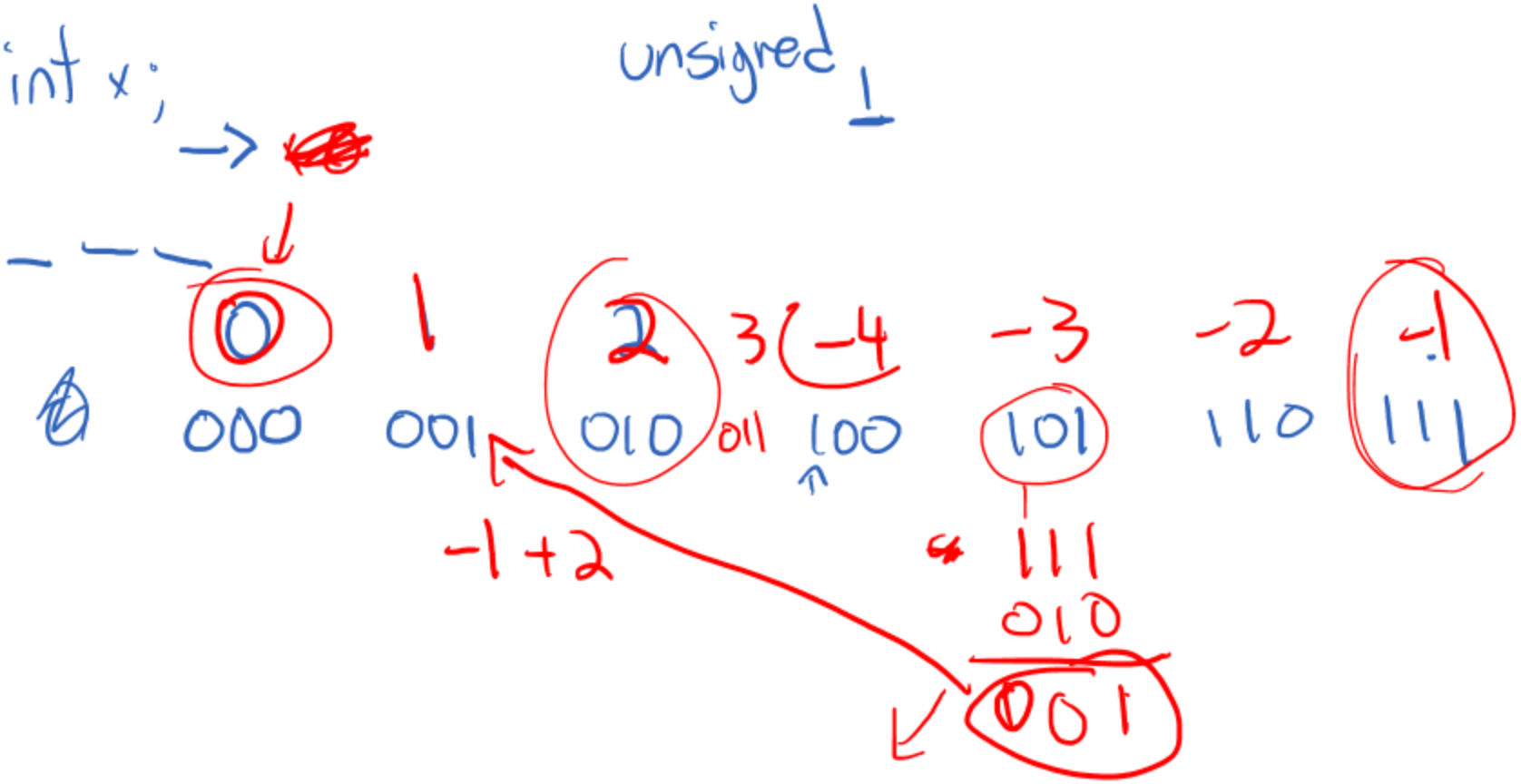
Concept behind 2's complement



Negative Numbers with Bits



Negative Numbers with 2's complement



What decimal number do these 8 bits represents? Assume it is a signed data type.

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Q2

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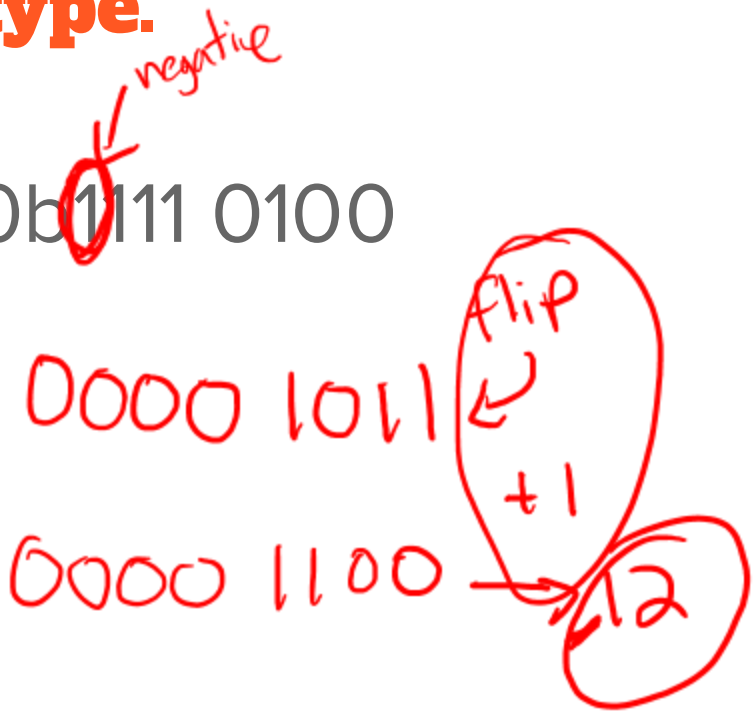

What decimal number do these 8 bits represents? Assume it is a signed data type.

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Q3

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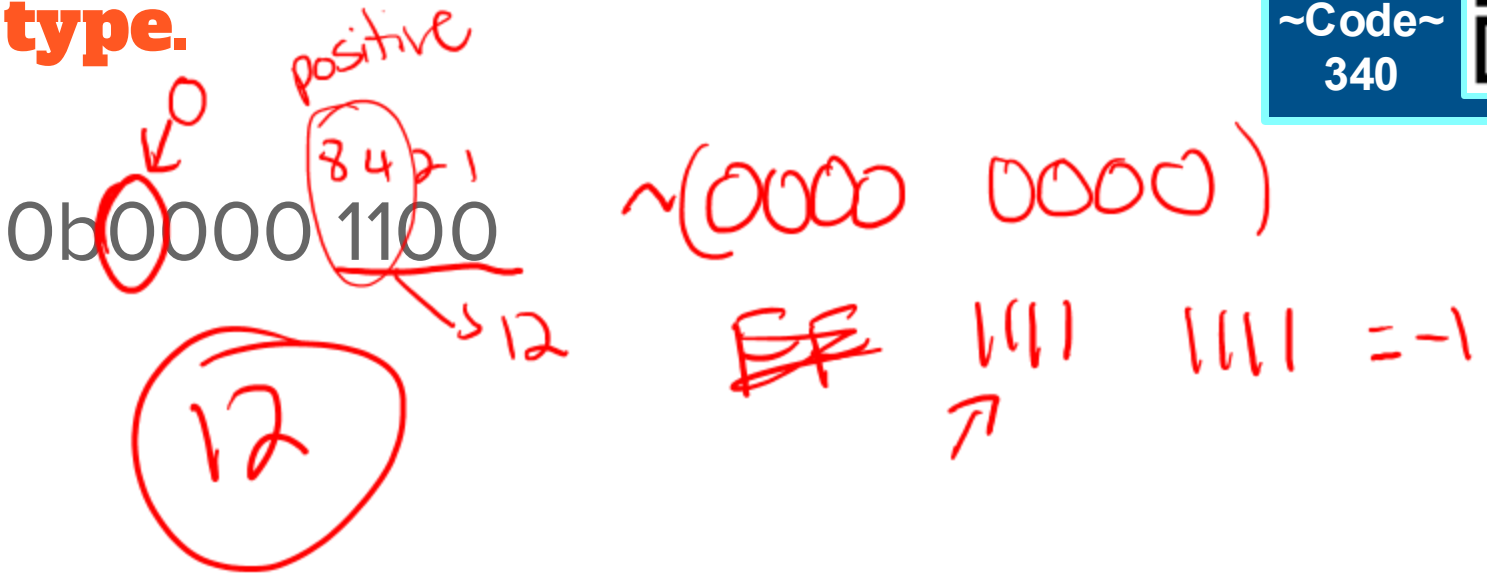

What decimal number do these 8 bits represents? Assume it is an unsigned data type.

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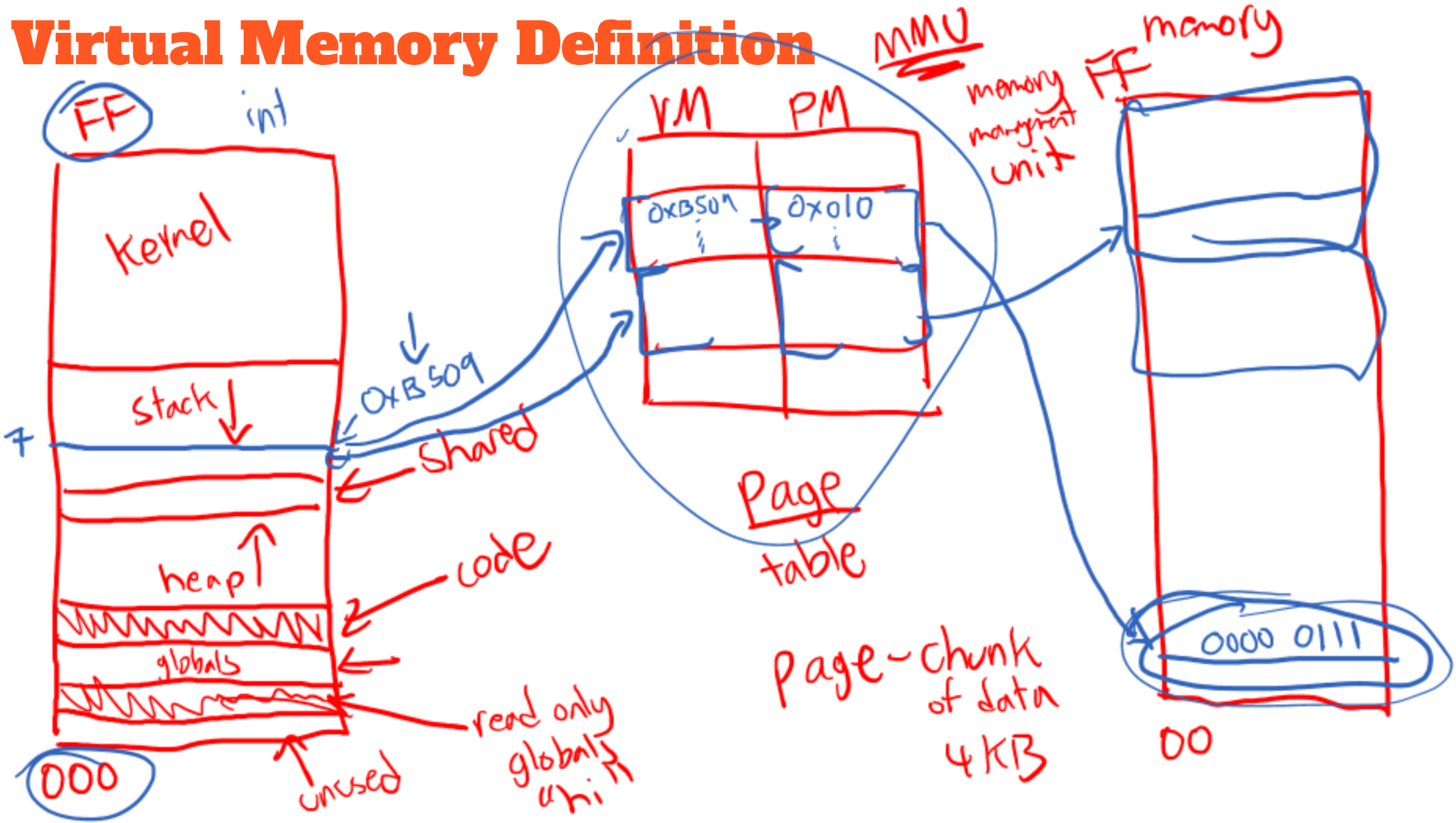
0b1000 0100

128 64 32 16 8 4 2 1

132

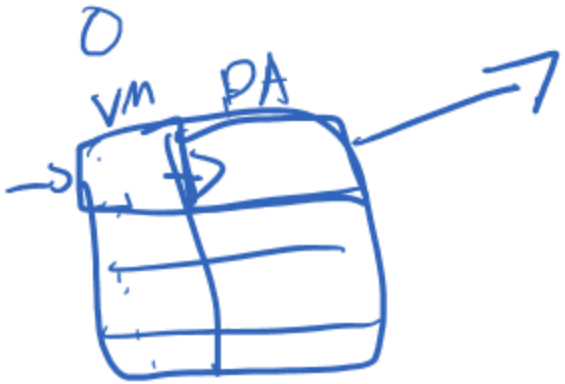
Virtual Memory Definition



Virtual Memory

int * x = 0x FF06AB

(*x) <



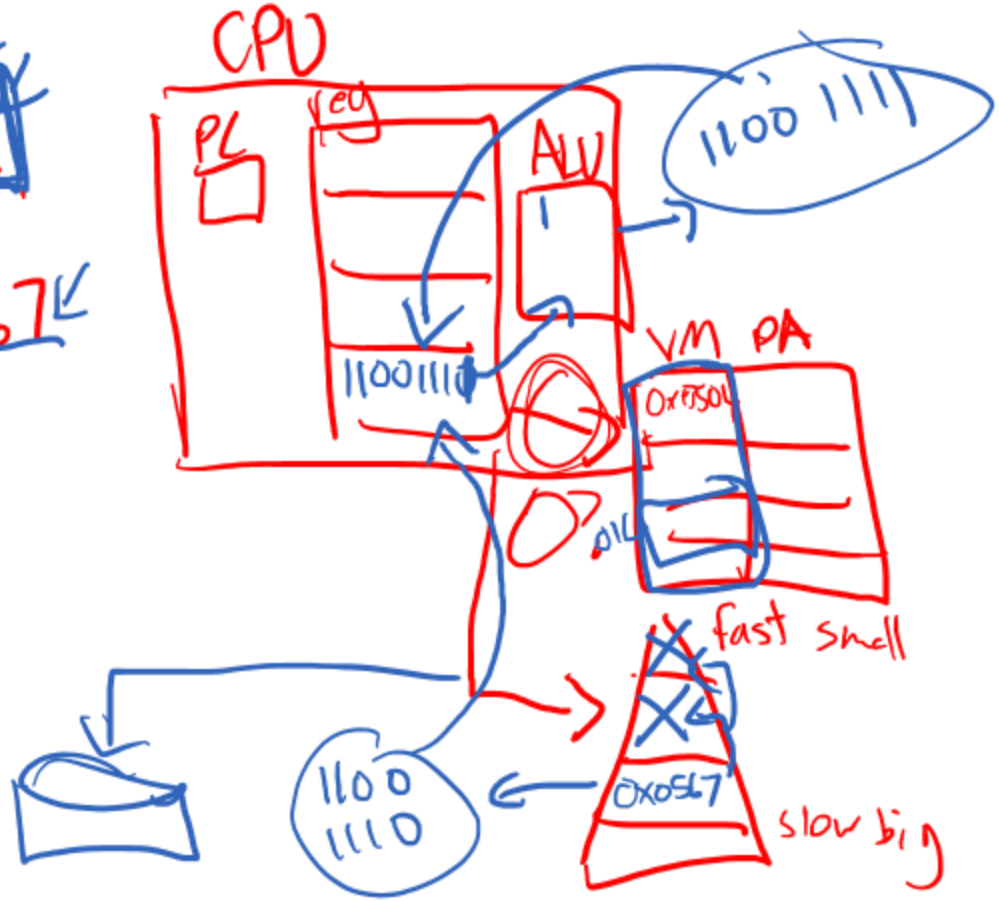
Virtual Memory Example #1

char x = -50; → 1100 1110

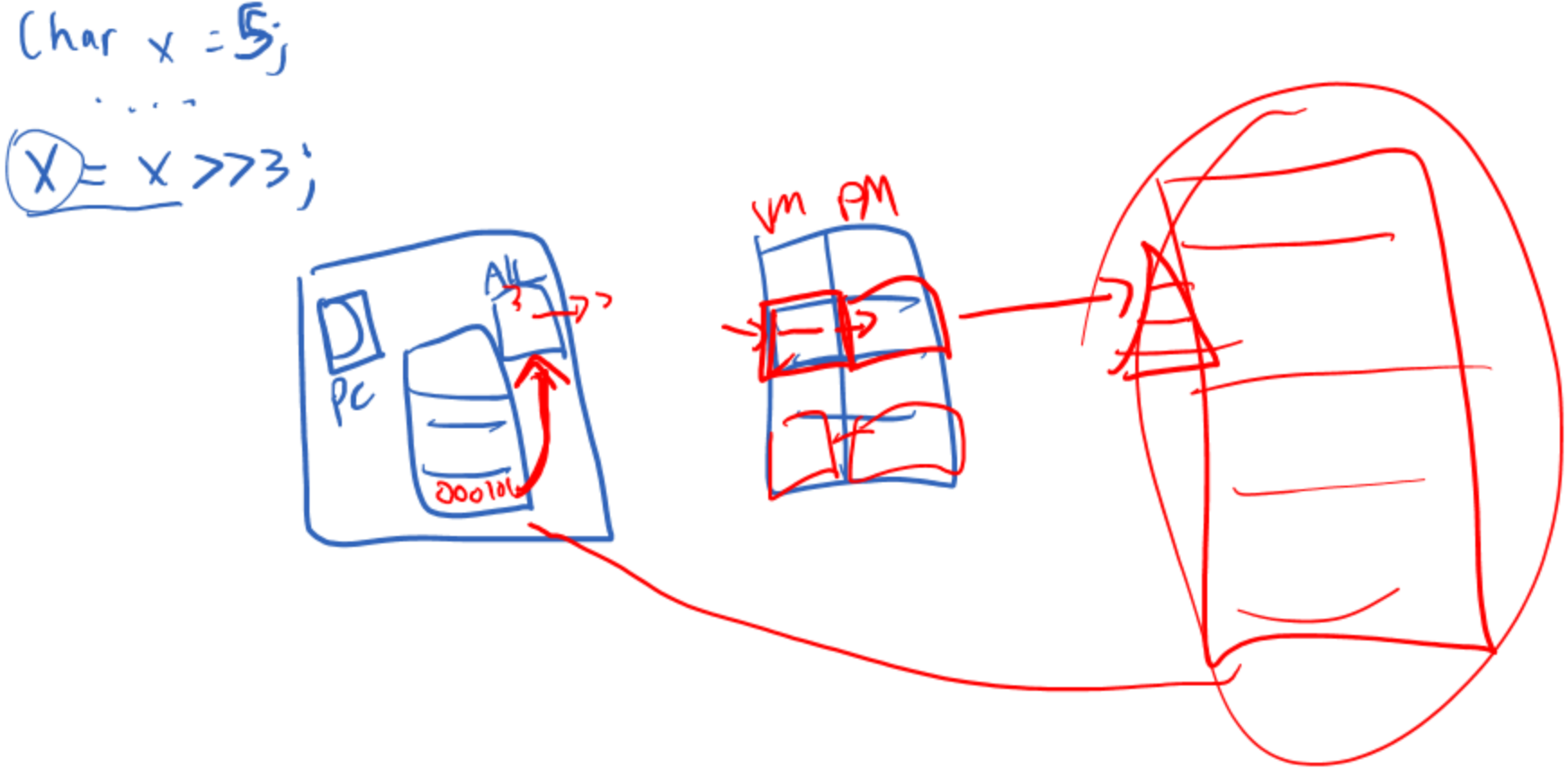
printf("%#x", &x) → 0x0567

x = x + 1

x ← -49



Virtual Memory Example #2



Am I guaranteed that ptr and ptr2 hold values 6,000 bytes apart in physical memory?

NO

```
char x = 7;
char *ptr = &x;
char *ptr2 = ptr + 6000;
```

1 byte

1 bytes

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Am I guaranteed that ptr and ptr2 hold values 6,000 bytes apart in virtual memory?

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Q6

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```
char x = 7;
char *ptr = &x;
char *ptr2 = ptr + 6000;
```

yes

If program 1 stores my password in a c-string at virtual address 0xB50632 will this code in program 2 get me that password?

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```
char *ptr = 0xB50632;
printf("%s", ptr);
```

Is it possible for these two programs to print out the same value while running concurrently?

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A

```
int x = 5;
printf("%#x", &x);
```

B

```
int y = 2;
printf("%#x", &y);
```

proga.exe

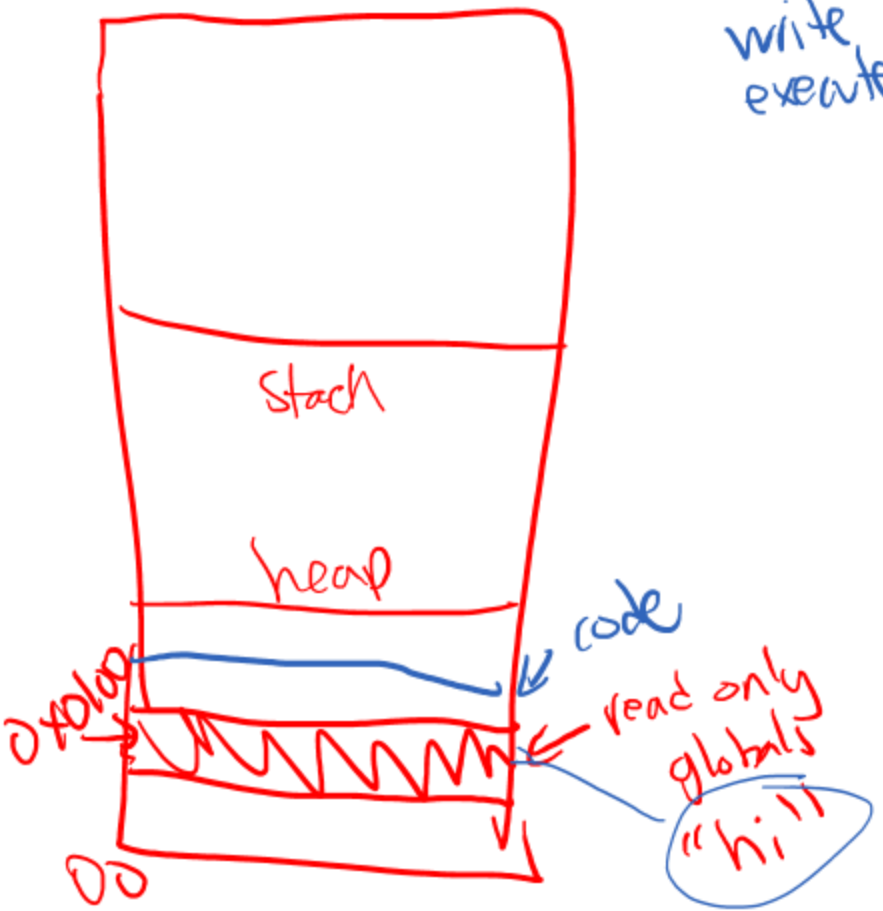
0xB506

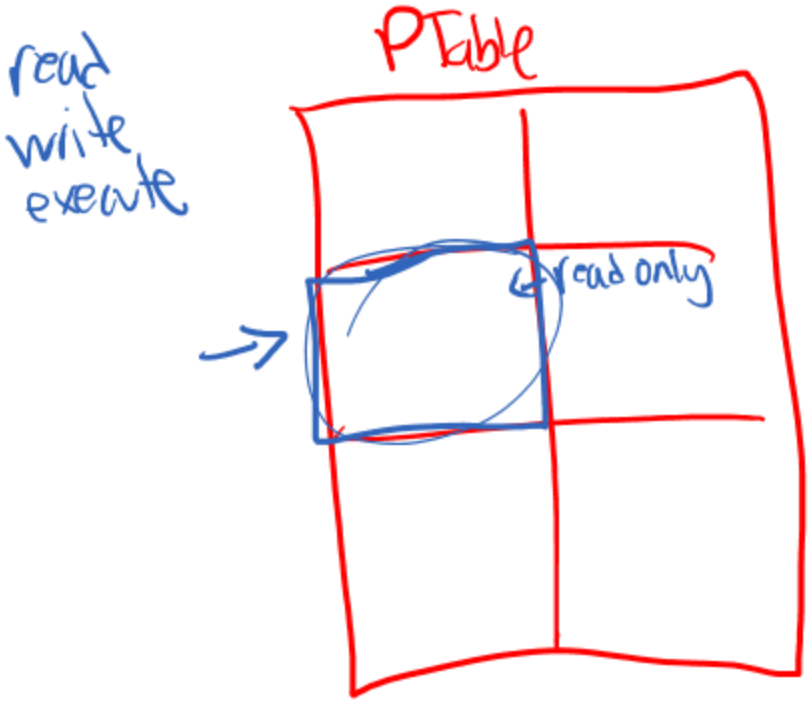
yes

progb.exe

Virtual Memory Definition

Permissions





Making Masks with Bitwise Operations

View

Assume that `char`, `short`, and `int` are signed integer types with 8, 16, and 32 bits respectively; and that we've declared and initialized `x` as

```
short x = (-1) << 4;
```

Which of the following causes `x == y` to be true?

(a) `short y = 0xf;`

(b) `short y = - 0xf;`

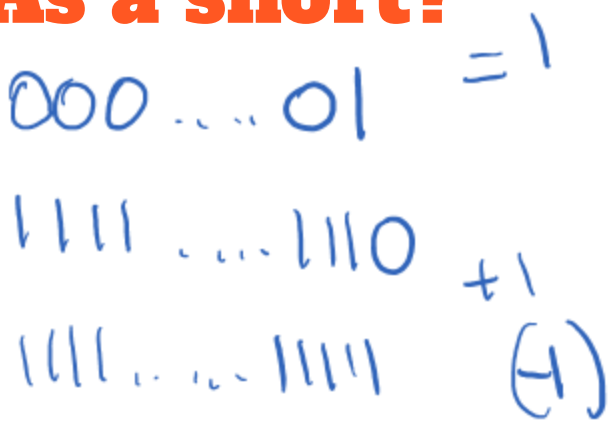
(c) `short y = 0xfff1;`

(d) `short y = - 0x10;`

= (-1) << 4

0000

What is -1? As a short?



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Q9

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Making Masks with Bitwise Operations

View

Assume that `char`, `short`, and `int` are signed integer types with 8, 16, and 32 bits respectively; and that we've declared and initialized `x` as

```
short x = (-1) << 4;
```

FF FF

What is x in bits?

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Q10

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Making Masks with Bitwise Operations View

Assume that `char`, `short`, and `int` are signed integer types with 8, 16, and 32 bits respectively; and that we've declared and initialized `x` as

```
short x = (-1) << 4;
```

Does x represent a positive or negative number assuming 2's complement?

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Q11

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Making Masks with Bitwise Operations

View

Assume that `char`, `short`, and `int` are signed integer types with 8, 16, and 32 bits respectively; and that we've declared and initialized `x` as

```
short x = (-1) << 4;
```

What is x as a negative hex?

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Q12

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Making Masks with Bitwise Operations

View

Assume that `char`, `short`, and `int` are signed integer types with 8, 16, and 32 bits respectively; and that we've declared and initialized `x` as

```
short x = (-1) << 4;
```

Making Masks with Bitwise Operations

View

Assume that `char`, `short`, and `int` are signed integer types with 8, 16, and 32 bits respectively; and that we've declared and initialized `x` as

```
short x = (-1) << 4;
```

Which of the following causes `x == y` to be true?

- (a) `short y = 0xf;`
- (b) `short y = - 0xf;`
- (c) `short y = 0xfff1;`
- (d) `short y = ~0x10;`

Making Masks with Bitwise Operations

View...

Assume that `char`, `short`, and `int` are signed integer types with 8, 16, and 32 bits respectively; and that we've declared and initialized `x` as

```
int x = ~((-1) << 24);
```

Which of the following causes `x == y` to be true?

- (a) `int y = 0x1000000;`
- (b) `int y = (1 << 24) - 1;`
- (c) `int y = - 0x1000000;`
- (d) `int y = - 0xffffff;`

What is -1 as an int?

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Q13

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Making Masks with Bitwise Operations

View...

Assume that `char`, `short`, and `int` are signed integer types with 8, 16, and 32 bits respectively; and that we've declared and initialized `x` as

```
int x = ~((-1) << 24);
```

What is -1 << 24 as an int?

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Q14

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Making Masks with Bitwise Operations

View...

Assume that `char`, `short`, and `int` are signed integer types with 8, 16, and 32 bits respectively; and that we've declared and initialized `x` as

```
int x = ~((-1) << 24);
```

What is x in bits?

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Q15

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Making Masks with Bitwise Operations

View...

Assume that `char`, `short`, and `int` are signed integer types with 8, 16, and 32 bits respectively; and that we've declared and initialized `x` as

```
int x = ~((-1) << 24);
```

Does x represent a positive or negative number assuming 2's complement?

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Q16

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Making Masks with Bitwise Operations

View...

Assume that `char`, `short`, and `int` are signed integer types with 8, 16, and 32 bits respectively; and that we've declared and initialized `x` as

```
int x = ~((-1) << 24);
```

What is the answer?

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Q17

~Code~
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Making Masks with Bitwise Operations

Assume that `char`, `short`, and `int` are signed integer types with 8, 16, and 32 bits respecti
that we've declared and initialized `x` as

```
int x = ~((-1) << 24);
```

Which of the following causes `x == y` to be true?

(a)
```
int y = 0x1000000;
```

(b)
```
int y = (1 << 24) - 1;
```

(c)
```
int y = - 0x1000000;
```

(d)
```
int y = - 0xffffff;
```

Bit Sets

Set - Collection of things with no repeats or enforced order

How many bytes do I need to represent a set of 16 items?

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Q18

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What operation would I need to find the union of two fruit basket sets?

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Q19

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What operation would I need to find the intersection of two fruit basket sets?

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Q20

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Bit Sets - Used as flags

```
NAME
       open, openat, creat - open and possibly create a file

LIBRARY
       Standard C library (libc, -lc)

SYNOPSIS
       #include <fcntl.h>

       int open(const char *pathname, int flags);
       int open(const char *pathname, int flags, mode_t mode);

       int creat(const char *pathname, mode_t mode);

       int openat(int dirfd, const char *pathname, int flags);
       int openat(int dirfd, const char *pathname, int flags, mode_t mode);
```

```
char path[PATH_MAX];
fd = open("/path/to/dir", O_TMPFILE | O_RDWR,
                          S_IRUSR | S_IWUSR);
```