GO CLASSES

Home Work 2

Homework 2

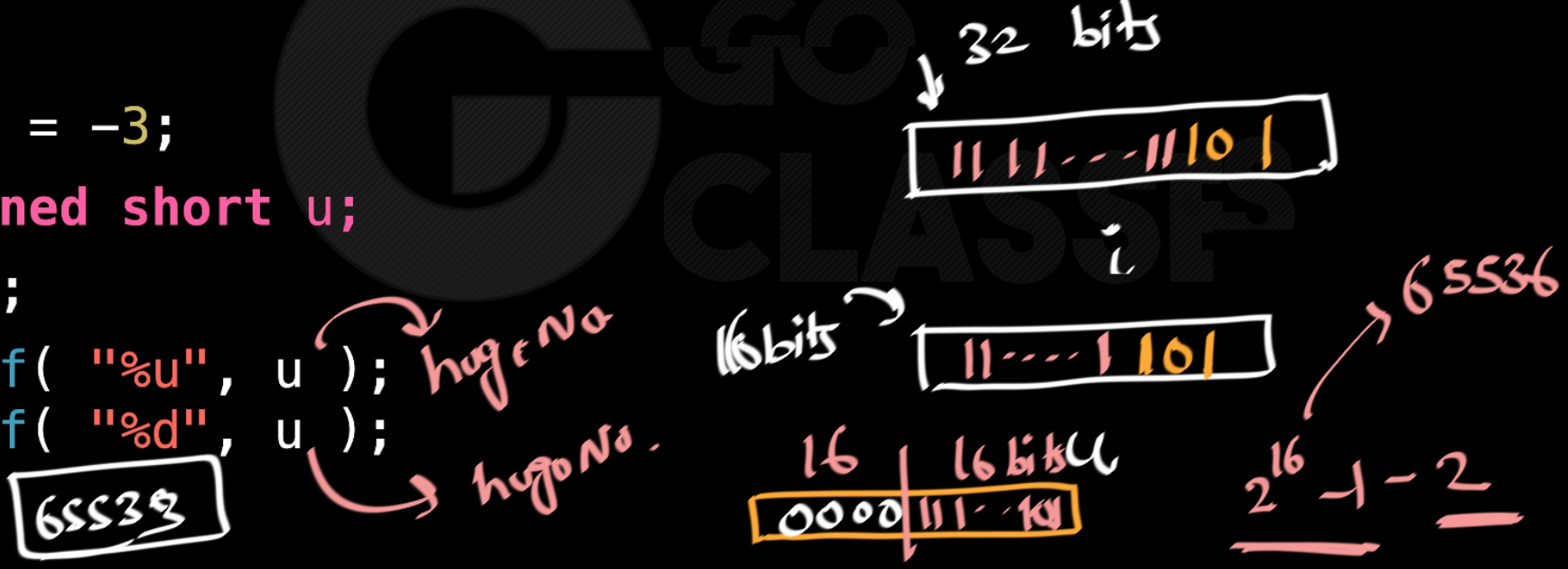
For all questions assume following sizes

Int – 32 bit
Short int – 16 bits
Char – 8 bits

Question on Truncation (higher bits to lower bits)

Question 1: what will be printed values?

```
int i = -3;
unsigned short u;
u = i;
printf( "%u", u );
printf( "%d", u );
```



Solution

```
int i = -3;                 i will be 1…1 1101 (total 32 bits)

unsigned short u;

u = i;                      u will be 1…1 1101 (total 16 bits)


printf( "%u", u );          u will get integer promoted in 32 bits (source unsigned)
                            000…0  11…1101

printf( "%d", u );          u will get integer promoted in 32 bits (source unsigned)
                            000…0  11…1101
```

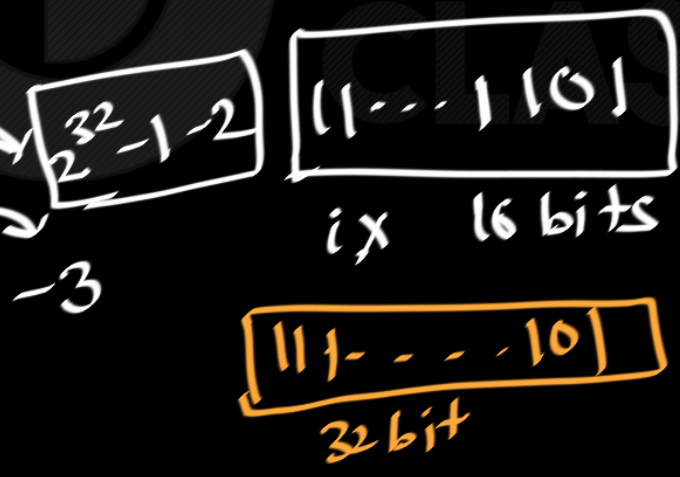
`000…0  11…1101` this number is 65533 in both signed and unsigned hence 65533 will get printed in both

Question on Extension (lower bits to higher bits)

(Integer promotion based extension)

Question2: what will be printed values in the code below?

```
signed short ix = -3;
printf( "%u", ix );
printf( "%d", ix );
```



Solution

```
signed short ix = -3;
```

ix will be 1…1 1101 (total 16 bits)

```
printf( "%u", ix );
```

ix will be integer promoted (source signed)

111…1 11…1101

```
printf( "%d", ix );
```

ix will be integer promoted (source signed)

111…1 11…1101

111…1 11…1101 this number is huge number ($2^{32} - 1 - 2$) in unsigned and -3 in signed

Answer: First printf will print huge number and 2nd print will print -3

Question3:

Consider k bit binary pattern.

T_{max} and T_{min} are maximum and minimum signed numbers we can represent using k bits.

U_{max} and U_{min} are maximum and minimum unsigned numbers we can represent using k bits.

Question 3.1
Question 3.2
Question 3.3

See Next Page

Question 3.1.

Given a binary pattern, which has value T_{max} when interpreted as signed number. Find out the value of same pattern if interpreted as unsigned number

A. T_{max} B. U_{max} C. $U_{max}-1$ D. $T_{max}+1$

Question 3.2.

Given a binary pattern, which has value T_{min} when interpreted as signed number. Find out the value of same pattern if interpreted as unsigned number

A. T_{max} B. U_{max} C. $U_{max}-1$ D. $T_{max}+1$

Question 3.3.

Given a binary pattern, which has value -1 when interpreted as signed number. Find out the value of same pattern if interpreted as unsigned number

A. T_{max} B. U_{max} C. $U_{max}-1$ D. $T_{max}+1$

Solution:

3.1 – A
3.2 – D
3.3- B

Positive values remain unchanged from 2's comp to unsigned. For example – 0101 is 5 in 2's complement then it is 5 in unsigned too.

Figure on right side shows the ranges of 2's compl and unsigned. And it also shows how mapping of positive integers in 2's compl happening for unsigned.

Tmax is mapping to Tmax and 0 is mapping to 0. It means there is no change for positive numbers in 2's compl range

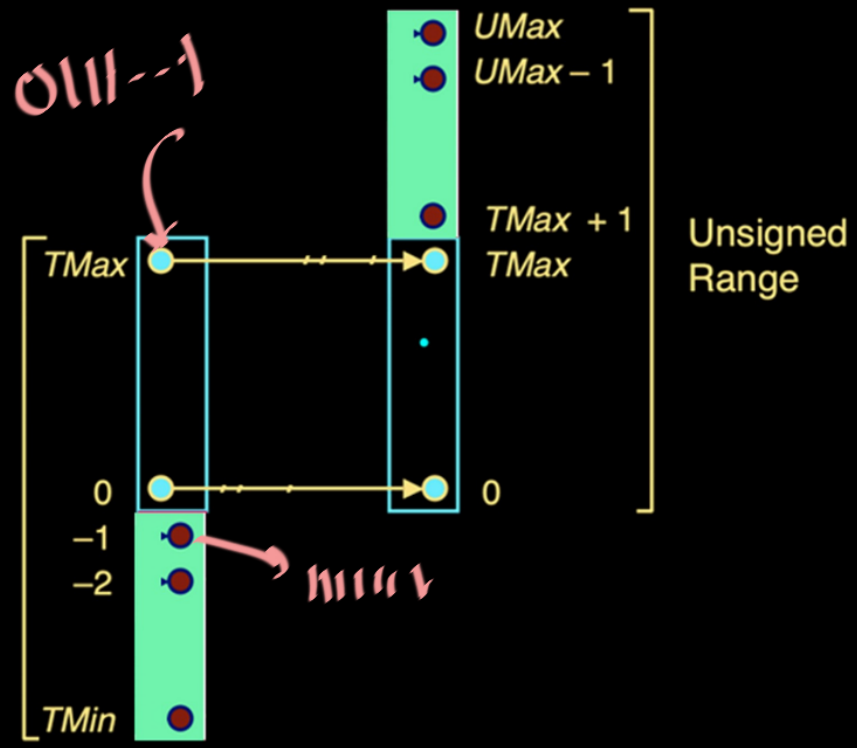
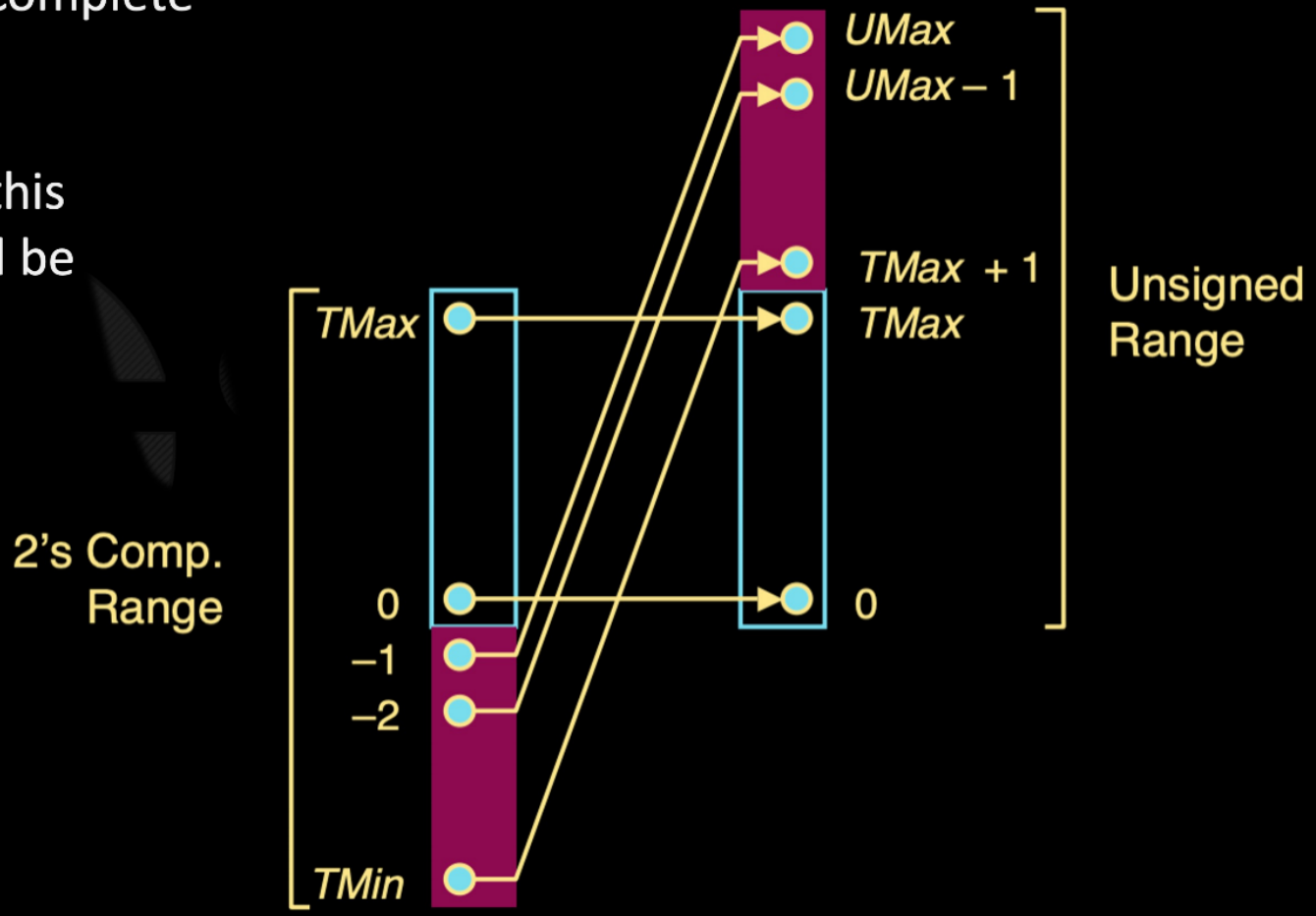
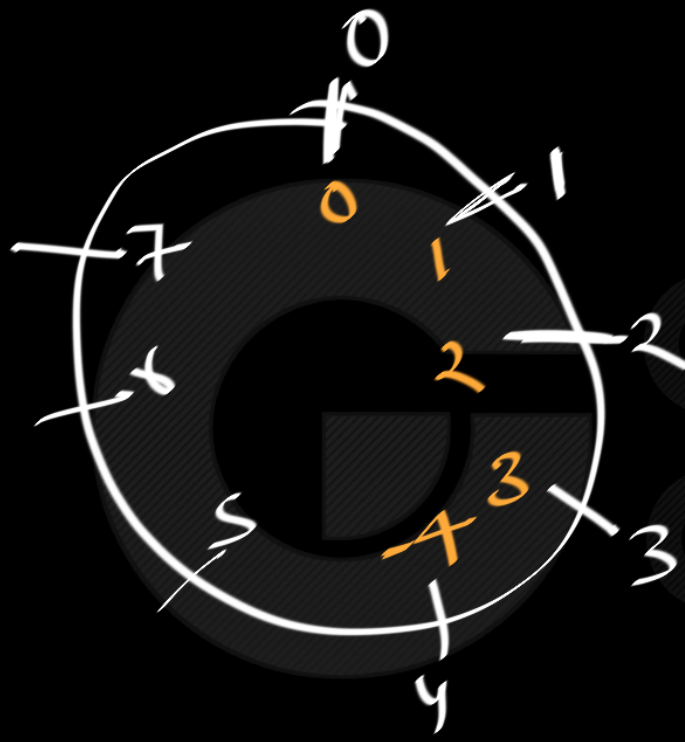


Figure on right side shows the complete mapping of all numbers.

Tmin is 100…0, when we treat this number as unsigned then it will be Tmax+1





100

3 bits

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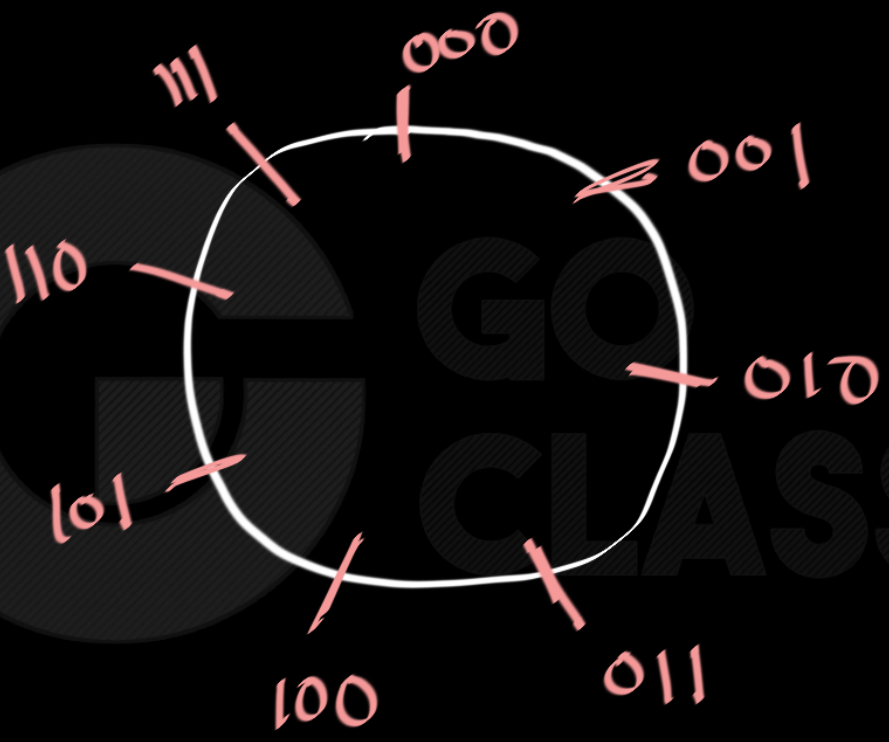
3 bits



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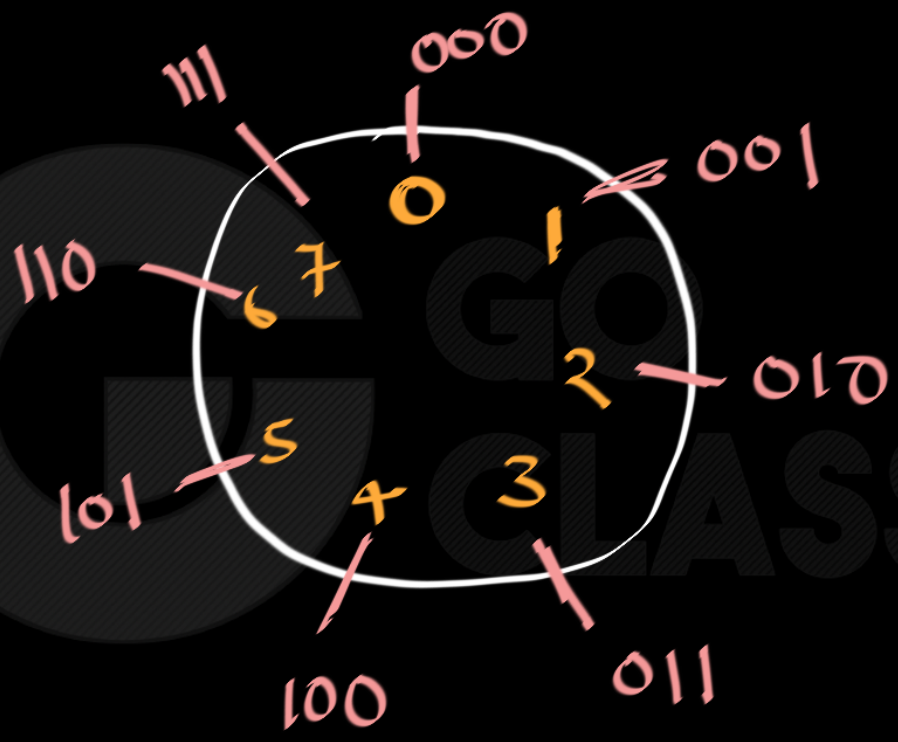
3 bits



if we treat these bit patterns as unsigned numbers then

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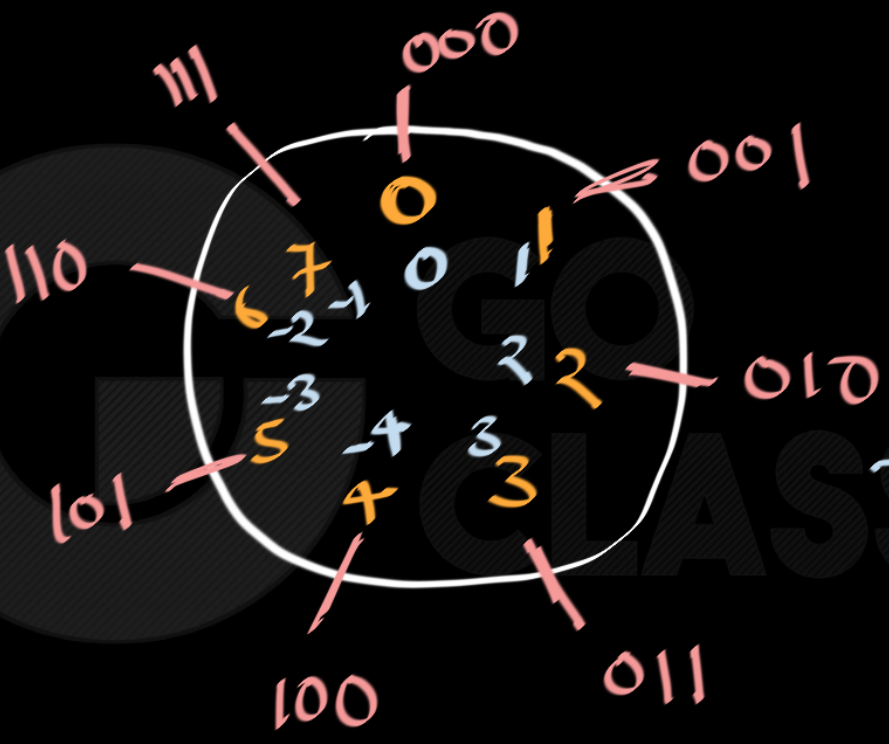
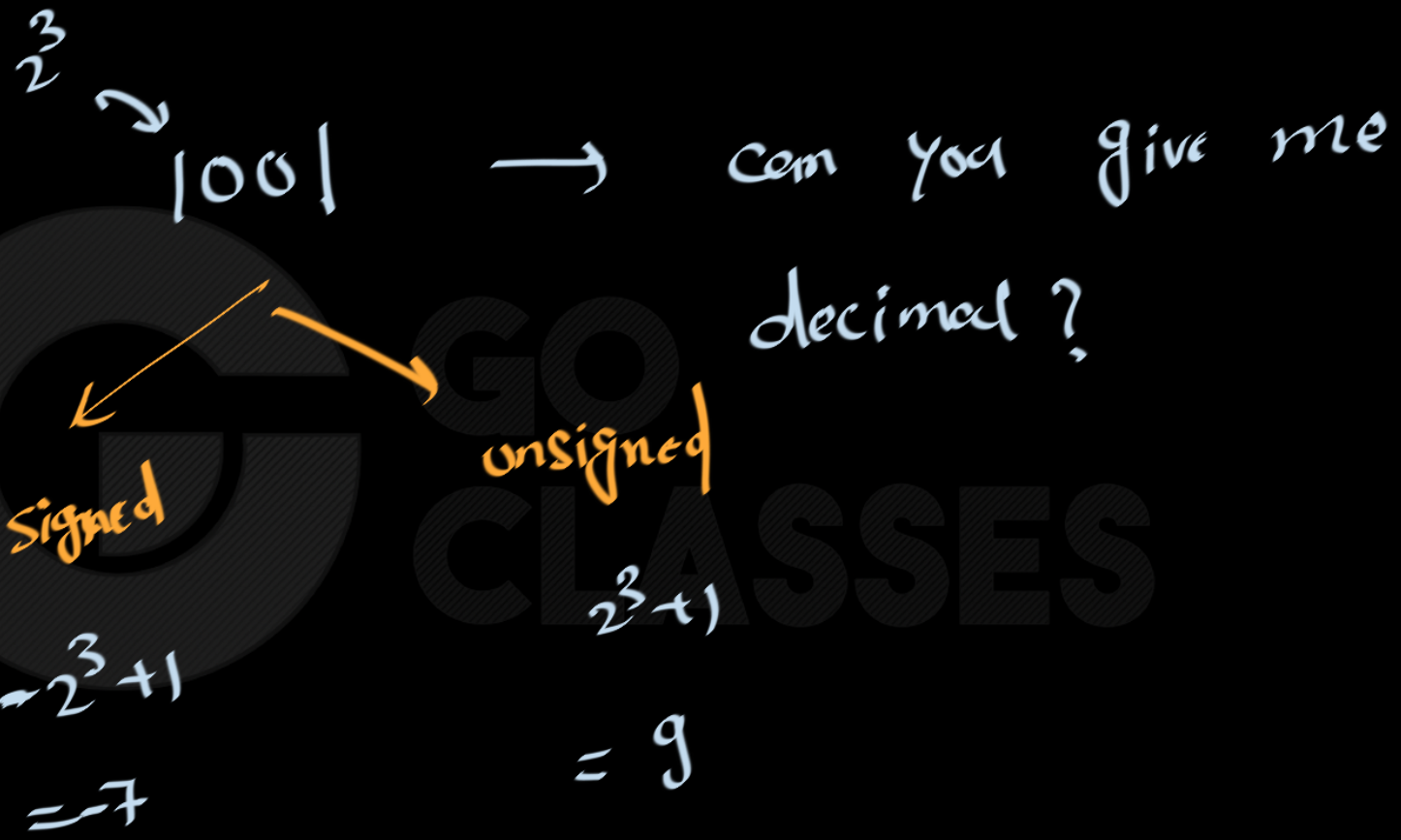
3 bits



$T_{min} \longrightarrow T_{max} + 1$

$-2 \longrightarrow$ Umax

$-1 \longrightarrow V_{max}$


2^3
1001
can you give me decimal ?
signed
unsigned
-2^3+1
$=-7$
2^3+1
$=9$

Question 4

What will be the output of below program segment ?

```
a = 100;
b = 200;
c = a+b;
printf("%d %d %d\n", a,b,c);
```

A. 100 200 300
B. 100 200 44
C. 100 -56 44
D. Can't say

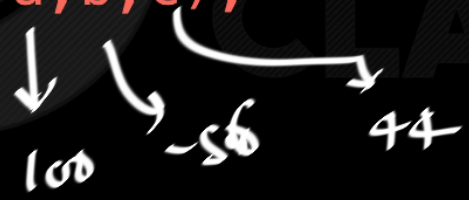
Answer D

It depends on how we initialize a and b.
depending on we will have answer.

Question 5:

What will be the output of below program segment ?

```
signed char a = 100;
signed char b = 200;
signed int c = a+b;
printf("%d %d %d\n", a,b,c);
```



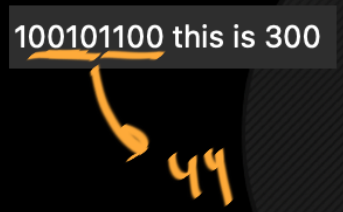
in 8 bits

max signed No. =

$0111\ldots1 = 2^7 - 1$

$= 127$

A. 100 200 300
B. 100 200 44
C. 100 -56 44
D. Can't say


100101100 this is 300
44

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200 ≡ 0000 11001000

signed char b = 200;

11001000

b

-56

printf ("%d" , b)

-56

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$a = 100$

$b =$

$c = a + b$

100 $-56 = 44$

1100 1000

b

Solution

`signed char a = 100;` a will be 8 bits 0110 0100

`signed char b = 200;` b will be 8 bits 1100 1000

`signed int c = a+b;` first a and b both will be converted to int because of integer promotion. In both source is signed.

a in 32 will be 00…0 0110 0100 which is 100 in decimal

b in 32 will be 11…1 1100 1000 which is same as 100 1000 (ignoring leading one's)
Which is $-2^6+2^3 = -64+8 = -56$

C = 100-56 = 44

`printf("%d %d %d\n", a,b,c); // 100 -56 44 will be printed`

(a and b will be integer promoted first)

Question 6

What will be the output of below program segment ?

```
signed char a = 100;
signed char b = 200;
signed char c = a+b;
printf("%d %d %d\n", a,b,c);
```

A. 100 200 300
B. 100 200 44
C. 100 -56 44
D. Can't say

Solution: Same as question 5

```
signed char a = 100;
```

a will be 8 bits 0110 0100

```
signed char b = 200;
```

b will be 8 bits 1100 1000

```
signed char c = a+b;
```

first a and b both will be converted to int because of integer promotion. In both source is signed.

a in 32 will be 00…0 0110 0100
which is 100 in decimal

b in 32 will be 11…1 1100 1000 which is same as 100 1000 (ignoring leading one's)
Which is $-2^6+2^3 = -64+8 = -56$

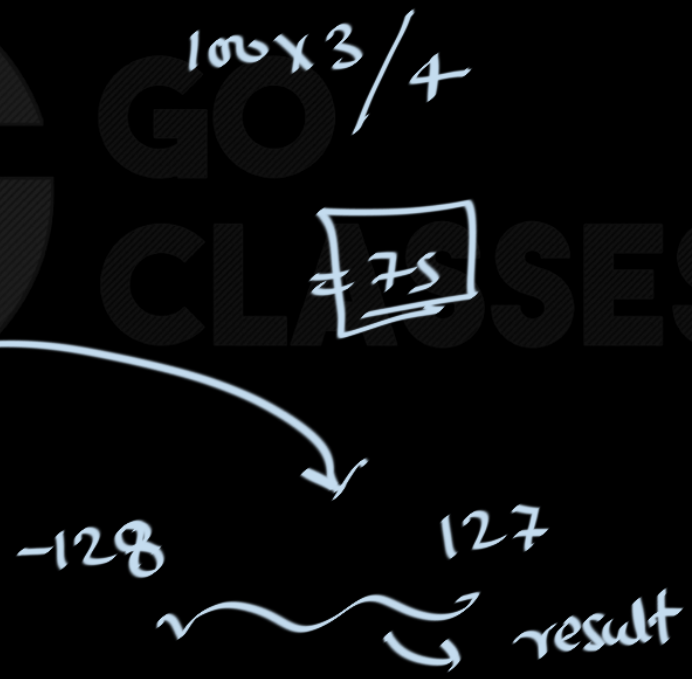
C = 100-56 = 44

```
printf("%d %d %d\n", a,b,c); // 100 -56 44 will be printed
(a, b and c will be integer promoted before printing)
```

Question 7

```
signed char a = 100;
signed char b = 3;
signed char c = 4;
signed char result = a*b / c;

printf("%d", result);
```



Solution

```
signed char a = 100;
signed char b = 3;
signed char c = 4;
signed char result = a*b / c;
```

* and / are left to right operators with same precedence
(will study in details in next class)
a*b will happen first as integer multiplication. Which is 300.
300/4 = 75

```
printf("%d", result);    // 75 is output
```

Question 8

Fill one of the value below in method column of given table

- Sign Extension
- Zero Extension
- Truncation
- No truncation or extension required

From	To	Method
unsigned char	signed char	
unsigned char	signed short int	
signed char	signed int	
unsigned int	signed char	
signed short int	unsigned char	
Signed int	Signed short int	

Solution

1. Sign Extension
2. Zero Extension
3. Truncation
4. No truncation or extension required

From	To	Method
unsigned char	signed char	4
unsigned char	signed short int	2
signed char	signed int	1
unsigned int	signed char	3
signed short int	unsigned char	3
Signed int	Signed short int	3

Weekly Quiz 12

GO Classes 2024 | Weekly Quiz 12 | Programming | Question: 1

asked in **Programming** Apr 18, 2022 • edited 2 days ago by **Lakshman Bhaiya**

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12

In C programming, constant integers are considered to be signed integers by default. One way to represent them as an unsigned constant is by appending U as a suffix. For example, -1 is signed, whereas $-1\mathrm{U}$ is unsigned.

Which of the following condition(s) is/are TRUE?

A. $-3 > -4\mathrm{U}$

B. $-1\mathrm{U} > -2$

C. $-1\mathrm{U} > 0\mathrm{U}$

D. $-1 > 1$

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asked in **Programming** 2 days ago • edited 2 days ago by **Lakshman Bhaiya**

58 views

2

Given that $(1001)_2$ is a 4-bit signed number.

If the system is $2's$ complement, the equivalent decimal value is _____

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Value of $(1001)_2$ (signed number) in 2's complement system is $-2^3 + 1 = -7$

3

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4

Minimum Number of bits to present $+14$ in binary in $2's$ complement system?

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14 is 1110 but in $2's$ complement system we need to represent it as 01110.

8

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3

Consider a $2's$ complement system with 16-bit short integer size. What is the smallest value that can be stored in a signed short?

A. -2^{15}
B. $-2^{15} - 1$
C. -2^{16}
D. $-2^{16} - 1$

goclasses2024_wq12 goclasses programming programming-in-c number-representation 1-mark

2

Range of n bit binary number is -2^{n-1} to $2^{n-1}-1$

Bit pattern of smallest inumber s $1000000..0(n-1times)$

Bit pattern of largest number is $0111111.....1(n-1times)$

For $n=16$ bits, smallest value is -2^{15}

answered 2 days ago • edited 1 day ago by **Vineeth Rambhiya**

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asked in **Programming** 2 days ago • edited 2 days ago by **Lakshman Bhaiya**

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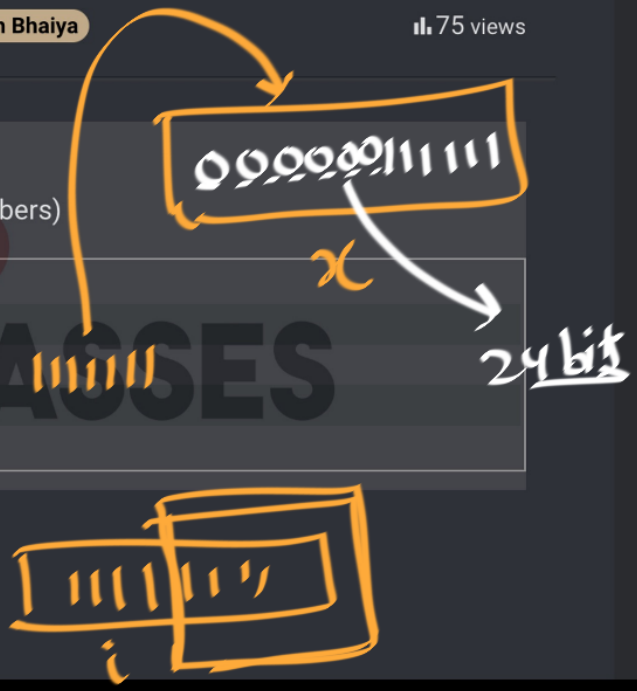
7

What will be the output of the following program?

(Assume $2's$ complement system for signed numbers)

```
int main() {
    int i = -1;
    int x = (unsigned char)i;
    printf("%d", x);
}
```

A. -1
B. 255
C. A huge number
D. 11111111



```
int i= -1;
```

Asumming int to be of 32 bit in size, $i = 11111111111111111111111111111111 = (FFFFFFFF)_{16}$

```
int x = (unsigned char)i;
```

The value of i is explicitly type casted to unsigned char and then copied to new signed integer variable x

Variable x in memory is $x = 00000000000000000000000011111111 = (000000FF)_{16}$

Zero extension after truncation happens here as source variable i is first type casted to unsigned character

```
printf("%d", x)
```

Display the value of x as signed integer.

x has 0 in MSB and is positive integer with value 255

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9

What is the output of the following code? Assume that int is 32 bits, short is 16 bits, and the representation is two's complement.

```
signed short ix = -2;
printf( "%u", ix );
```

A. -2
B. $2^{32} - 2$
C. $2^{32} - 1$
D. $2^{16} - 1$

32 bit
1111 1111 1111 1110
ix 16 bit

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111111 ⇒ $2^{32}-1$
1111 1110 ⇒ $2^{32}-1-1$

7

ix = – 2 = 111...110 (16 bit pattern of – 2) = **FFFE**.

for printing ix will be promoted to int, since ix is signed it will undergo **sign extension.**

Thus the program will print decimal number equivalent of 111...110 (32 bit pattern after sign extension) ie **FFFFFFFE**, which is equivalent to **2^32 – 2**.

Answer – B

answered Apr 18, 2022

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asked in Programming May 2, 2022 • edited 2 days ago by Lakshman Bhaiya

515 views

10

Consider two program fragments given below. UINT_MAX is the maximum unsigned number in the system

```
main()
{
    unsigned int  a = UINT_MAX;
    char c = -1;

    if (c == a)
        printf("GO Classes");

}
```

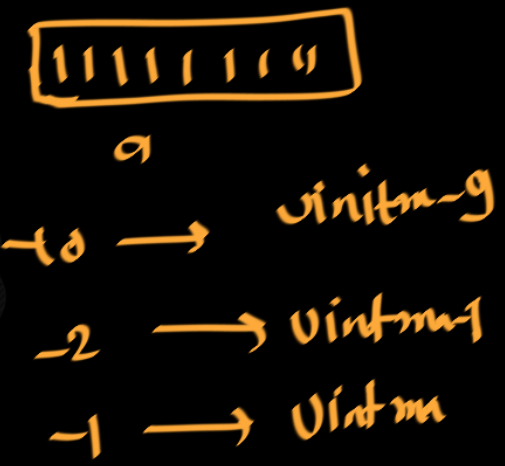
Program 1

```
main()
{
    unsigned int  b = UINT_MAX;
    char d = -10;

    if (d == b-10)
        printf("GATE Overflow");

}
```

Program 2

Which of the following(s) is/are true? All the prints are without double commas.

A. Program 1 prints "GO Classes"
B. Program 2 prints "GATE Overflow"
C. Program 1 does not print "GO Classes"
D. Program 2 does not print "GATE Overflow"

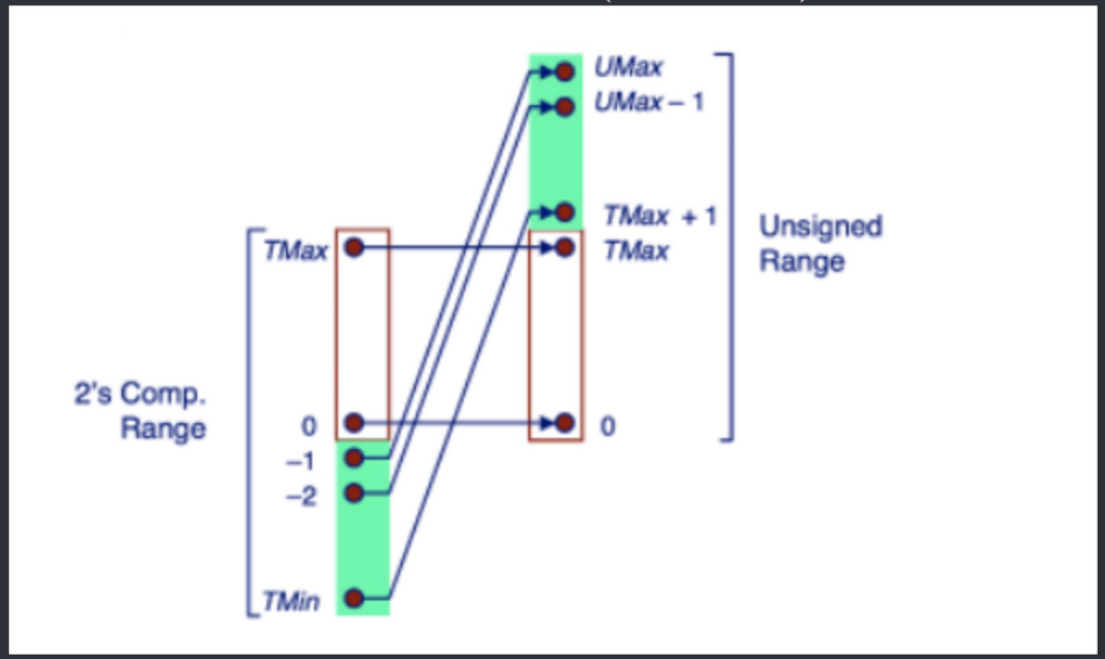


8

In Program 1:
if $(c == a)$, This is an unsigned comparison since one of the variables is unsigned.
-1 as unsigned is the same as UINT_MAX therefore the condition is true.

In Program 2 : if $(d == b - 10)$, This is also an unsigned comparison since one of the variables is unsigned.
-10 as unsigned is same as UINT_MAX-9 therefore condition is false.

Following figure shows that -1 maps to UINT_MAX, -2 maps to UINT_MAX-1.
Similarly, -10 will map to UINT_MAX-9.
In case the condition could have been "if $(d == b - 9)$" then it is true.



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asked in **Programming** May 2, 2022 • edited 2 days ago by **Lakshman Bhaiya** 382 views

9

Consider Figure A and Figure B which represent 4 bit signed and unsigned numbers respectively in $2's$ complement system.

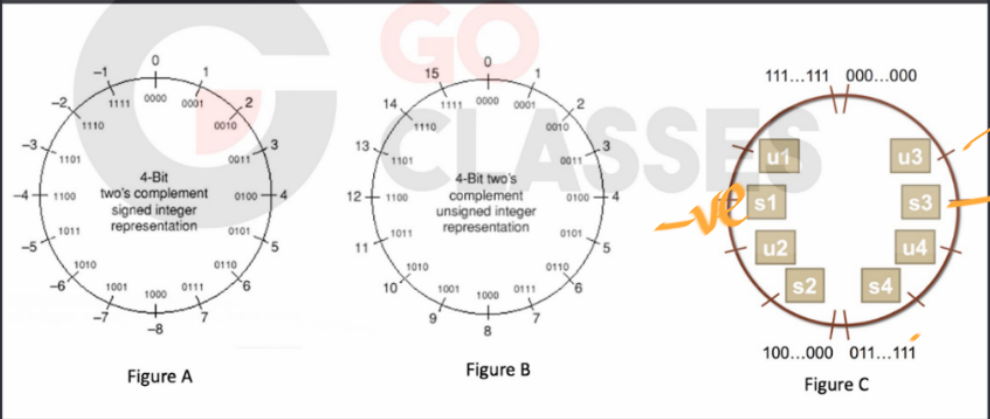

Figure A Figure B Figure C

Assume that a few variables are defined below and initialized in such a way that places them in the spot shown in Figure C.

```
int s1, s2, s3;
unsigned int u1, u2, u3;
```

A. $s3 > u3$
B. $s1 > s3$
C. $u1 > u3$
D. $s1 > u3$

5

We can take integers as k bits in the system. For an easy explanation, we are taking $k = 4$.

Let

$s1 = 1001 s3 = 0010$

$u1 = 1010 u3 = 0001$

$s3$ and $u3$ will be 2 and 1 in decimal respectively irrespective we treat them as signed numbers or unsigned numbers (MSb is 0).

$s1$ is 9 in unsigned and -7 in signed.

$u1$ is 10 in unsigned and -6 in signed.

Option A:

This is an unsigned comparison i.e., $s3$ will be treated as an unsigned number.

Although MSb of $s3$ is 0 hence it does not matter.

$s3 > u3$ is same as $2 > 1$, which is true

Option B:

both are signed hence signed comparison

$s1 > s3$ is same as $-7 > 2$, which is false.

Option C:

both are unsigned hence unsigned comparison

$u1 > u3$ is same as $10 > 1$, which is true.

Option D:

one of the variables is unsigned hence unsigned comparison

$s1 > u3$ is same as $9 > 1$, which is true.

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10

Consider k bit binary pattern.

- $T_{\max}$ and $T_{\min}$ are maximum and minimum signed numbers we can represent using k bits.
- $U_{\max}$ and $U_{\min}$ are maximum and minimum unsigned numbers we can represent using k bits.

Which of the following(s) is/are true for $k = 16$?

Here $|.|$ represents absolute value of a number i.e., $|r| = -r$ if $r < 0$ otherwise $|r| = r$.

A. $|T_{\min}| = T_{\max} + 1$
B. $U_{\max} = 2 * T_{\max} + 1$
C. $U_{\max} = |T_{\min}| + T_{\max} + 1$
D. $U_{\min} = |T_{\min}|$

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10

we do not need to take $k = 16$. We can verify options by taking some smaller value also for eg: $k = 4$.

- $T_{\min} = -8$
- $T_{\max} = 7$
- $U_{\min} = 0$
- $U_{\max} = 15$

only A and B are correct.

signed unsigned

Tmax → Tmax

Tmin → Tmax + 1

answered May 2, 2022 • edited May 2, 2022 by **Lakshman Bhaiya**

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10000


100
101
110
111
000
001
010
011
-4
-3
-2
-1
0
1
2
3
0
1
2
3
Unsigned

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asked in Programming May 2, 2022 • edited 2 days ago by Lakshman Bhaiya

405 views

8

What will be the output on the execution of the following code segment?

```
main()
{
    unsigned num1=-1;
    signed num2=1;
    if(num1 < num2)
        printf("less");
    else if(num1>num2)
        printf("greater");
    else if(num1==num2)
        printf("equal");
}
```

A. greater
B. less
C. equal
D. error

num1 will be a huge number (all one's in binary) when treated as unsigned

4

answered May 2, 2022

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