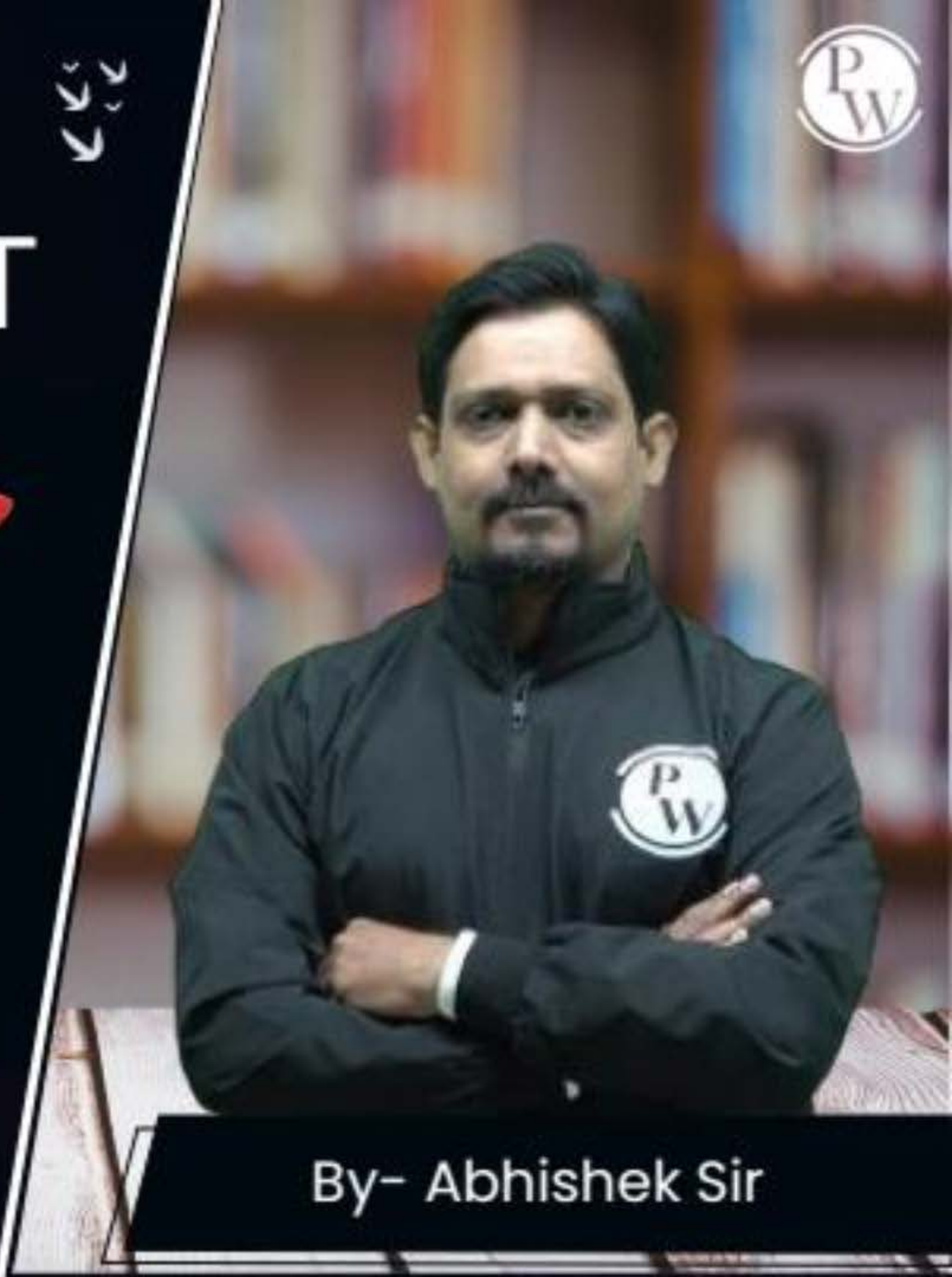
Computer Science & IT

C programming

Data Types & Operators

Lecture No. 01



By- Abhishek Sir

Recap of Previous Lecture

Topic — Tokens

Topic — Binay Conversion

Topic — Signed No. one extra bit. (0 - +Ve No)

Topic

Topic

Slide

Topics to be Covered

- Topic — 2's complement form
- Topic — integer unsigned
- Topic — integer Singned
- Topic
- Topic

Slide

Topic : Unsigned Integer Representation

Binary Coversion Divide by 2 and tract the remainder

string

printf("%d", a)

formal Specifier

%d format specifier Singed int :(4B)

int a = 19; ← Singned declaration

unsigned int a = 19;

integer Size = 4 Byte

4 x 8 = 32 bits

%hd - 16 bits

%hhd - 8 bits

Slide

Topic : Signed Interger Representation

int a = -6;

0 1 1 0 ← (+6)

↑ Sign

-6 Representation 2's complement of (+6)

0 1 1 0

1's complement 1 0 0 1

+1 1 1

1 0 1 0

(1010) 2's (+6)

This No. is -6

Slide

Topic : Signed Interger Representation

-5 in 2's complement form

0 1 0 1 (+5)

1's complement 1 0 1 0

add 1 1

1 0 1 1 (-5)

1 0 1 1

3 2 1 0

$1 \times -2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$

$-8 + 0 + 2 + 1 = (-5)$

Slide

Topic : Signed Interger Representation

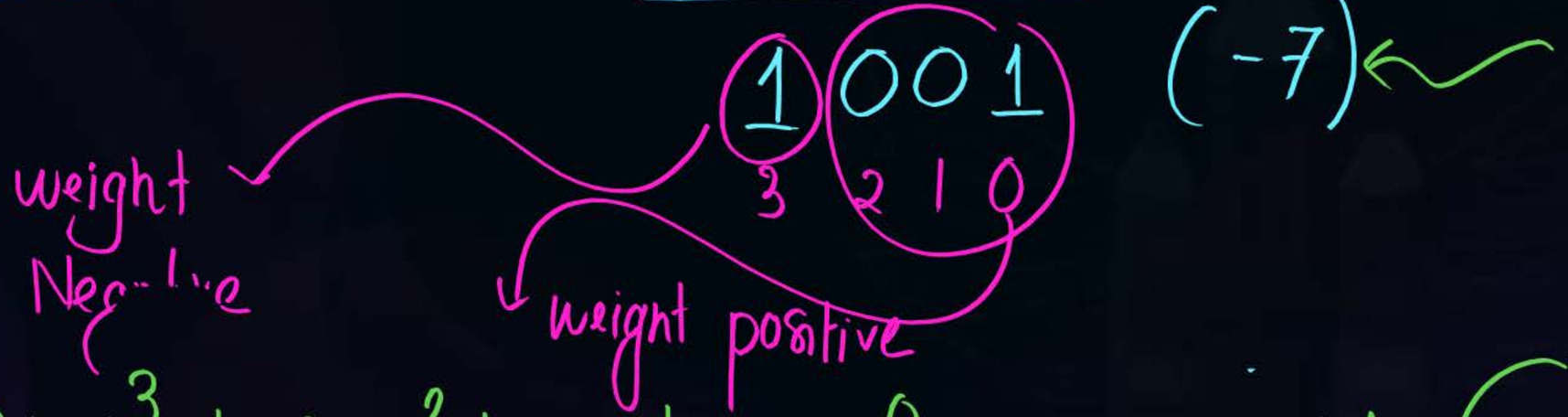
(-7) $+7 - 0111$ 2's complement

1's complement: 1000

add 1 $\quad\quad 1$

Sign bit is 1

Negative



$1 \times -2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = -8 + 0 + 0 + 1 = (-7)$

Slide

Topic : Signed Interger Representation

Range of unsigned No

4 bit unsigned

Minimum : 4 bits all zero

0000

Maximum : 4 bits all 1's

$\underset{3\,2\,1\,0}{1\,1\,1\,1} - 1\times2^3+1\times2^2+1\times2^1+1\times2^0$

$8+4+2+1=15$

(2^4-1)

0000	1000	4 bit - 2^4 = 16
0001	1001	
0010	1010	3 bits : 2^3 = 8
0011	1011	
0100	1100	
0101	1101 (13)	0 - 15
0110	1110	
0111	1111	17

Slide

Unsigned

Topic : ~~Signed~~ Interger Representation

Unsigned range

- 4 bit range : $0 \longrightarrow 2^4 - 1$

  $0 - 15$

- 6 bit range : $0 \longrightarrow 2^6 - 1$

  $0 - 64 - 1$

  $0 - 63$

Slide

Topic : Question

What is the range of n bit unsigned Integer

A. 0 to 2^{n-1}

B. 0 to $2^n - 1$ ✓

C. 0 to $2^{n-1} + 1$

D. $-2^n + 1$ to 2^{n-1}

unsigned 32 bit

format specifier

%u — 32 bits

"%hu" — 16 bits

%hhu — 8 bits

unsigne int a;

0 —— $2^{32} - 1$

if No. in range then

-1 will print otherwis

it leads overflow

Slide

$2^0 = 1$

$2^1 = 2$

$2^2 = 4$

$2^3 = 8$

$2^4 = 16$

$2^5 = 32$

$2^6 = 64$

$2^7 = 128$

$2^8 - 256$

$2^9 - 512$

$2^{10} - 1024$

$2^{11} - 2048$

$2^{12} - 4096$

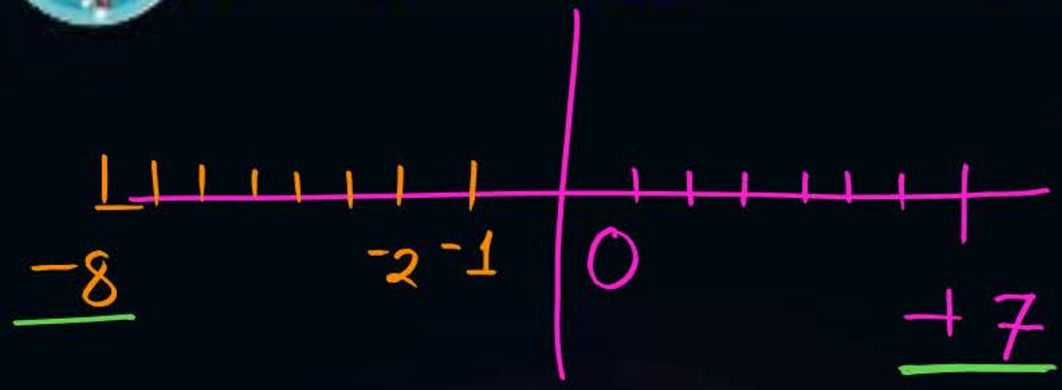
$2^{13} - 8192$

$2^{14} - 16384$

$2^{15} - 32768$

$2^{16} - 65536$

Topic : Signed Interger Representation



$\underline{1}\,1\,0\,\underline{1}$

$3\ 2\ 1\ 0$

positive Range

$0 - 7$

$0 - 2^{4-1} - 1$

$1 \times -2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$-8 + 4 + 0 + 1 = (-3)$

0000
0001
0010
0011
0100
0101
0110
0111

↑ Sign bit

1000	-8
1001	-7
1010	-6
1011	-5
1100	-4
1101	-3
1110	-2
1111	-1

Slide

Topic : Signed Interger Representation

4 bit Singed

-8 to $+7$

-2^{4-1} to $2^{4-1}-1$

-2^{n-1} to $2^{n-1}-1$

4 bit unsigned

0 — 15

$0 — 2^4-1$

$0 — 2^n-1$ n bits

Slide

Topic : Question

What is the range of n bit signed Integer

A. -2^n to 2^{n-1}

B. -2^{n-1} to $2^{n-1}-1$

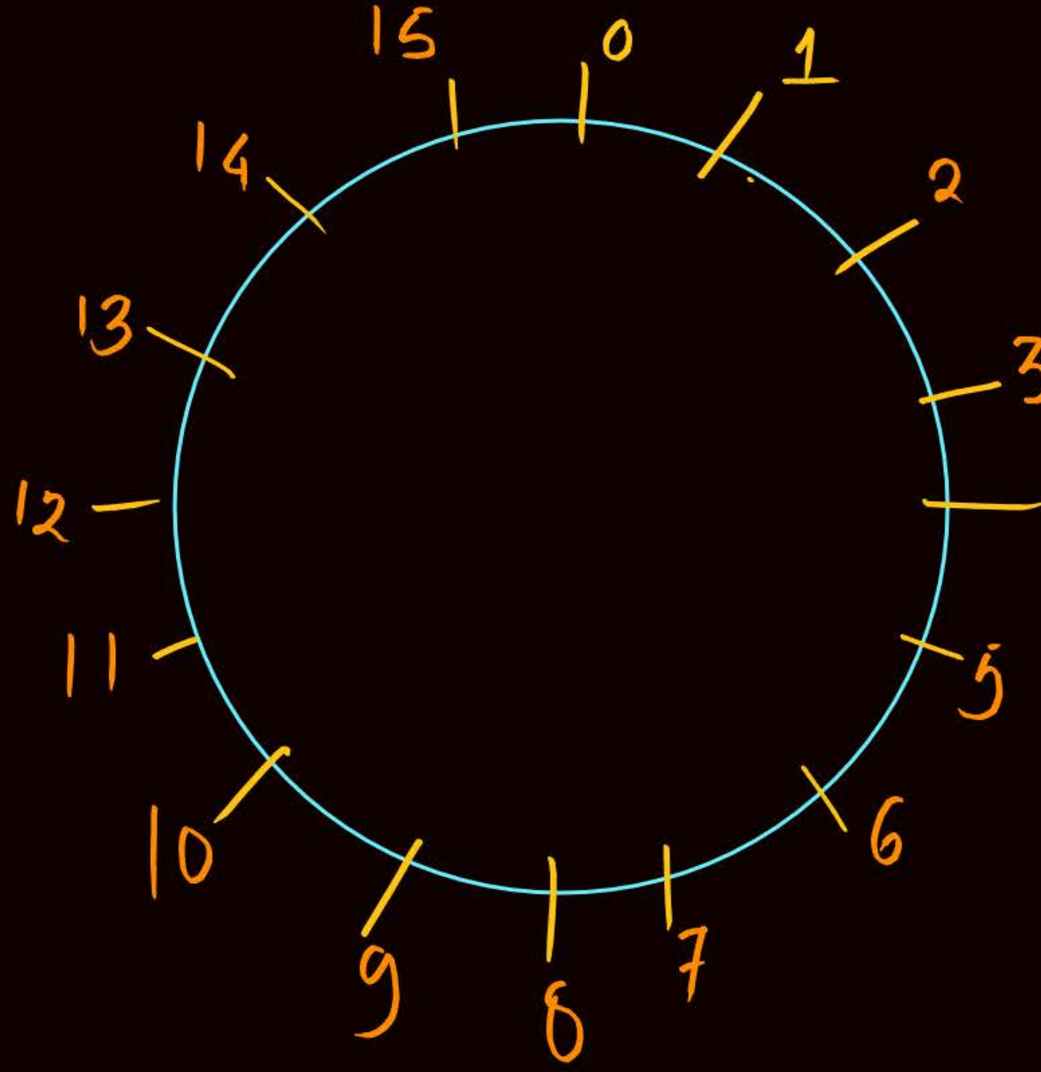
C. -2^n -1 to 2^{n-1}

D. -2^n +1 to 2^{n-1}

if range is violated it leads to overflow

Slide

Cyclic Property of unsigned No.



4 bits : $0 - 2^n - 1$

$0 - 2^4 - 1 = 15$

(I) $\frac{17}{2^4 (4 \text{ bits})} = \frac{17}{16}$ Q - 1

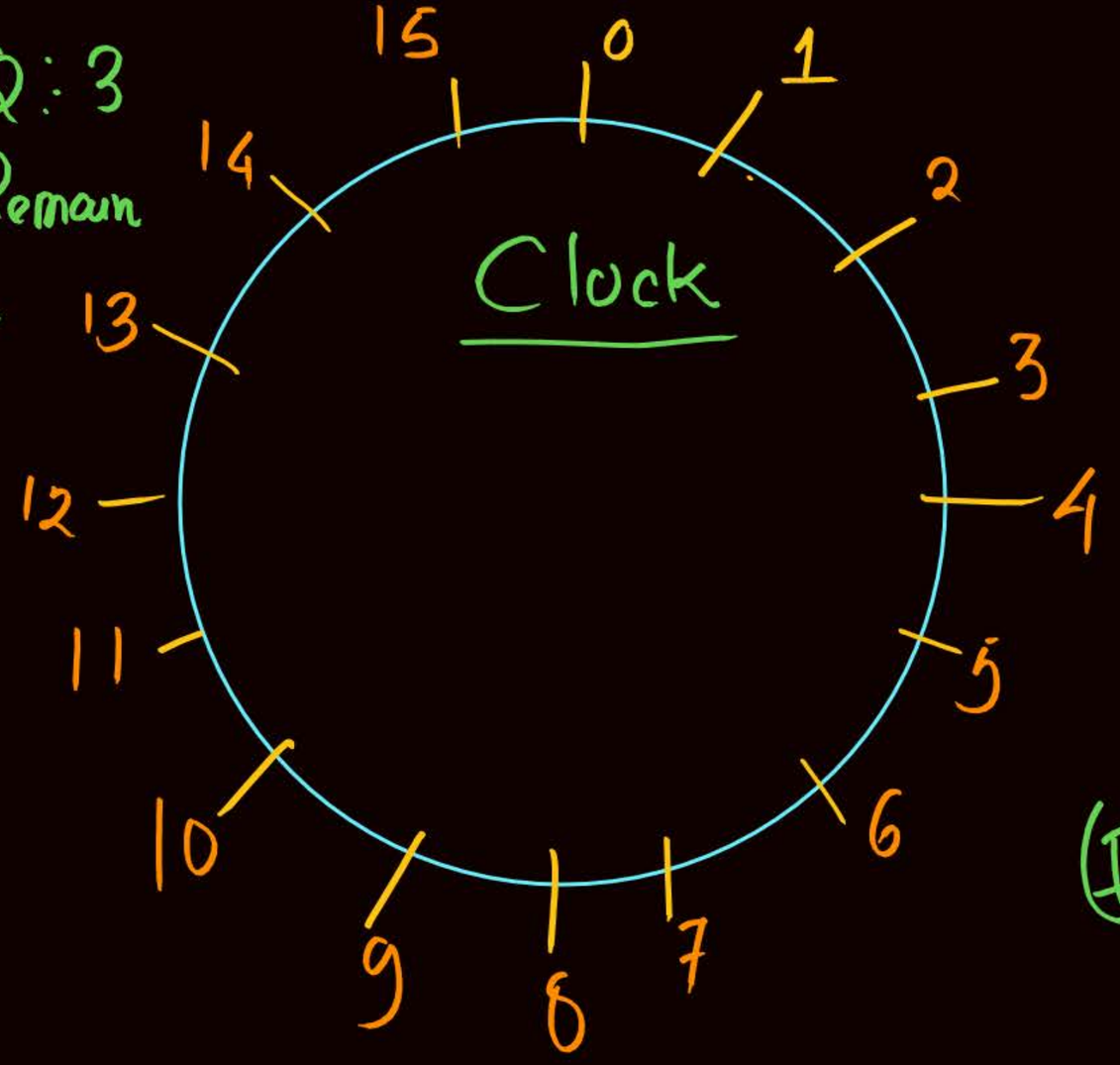
Remainder : 1

(II) $\frac{63}{2^4} = \frac{63}{16}$ = Q : 3

R : 15

Cyclic Property of unsigned No.

7 / 2 Q: 3 Remain 1



4 bits : 0 — $2^n - 1$

$n = 2^4 - 1 = 15$

(III) 48

$\frac{48}{2^4} : \frac{48}{10} =$ Remainder $= 0$

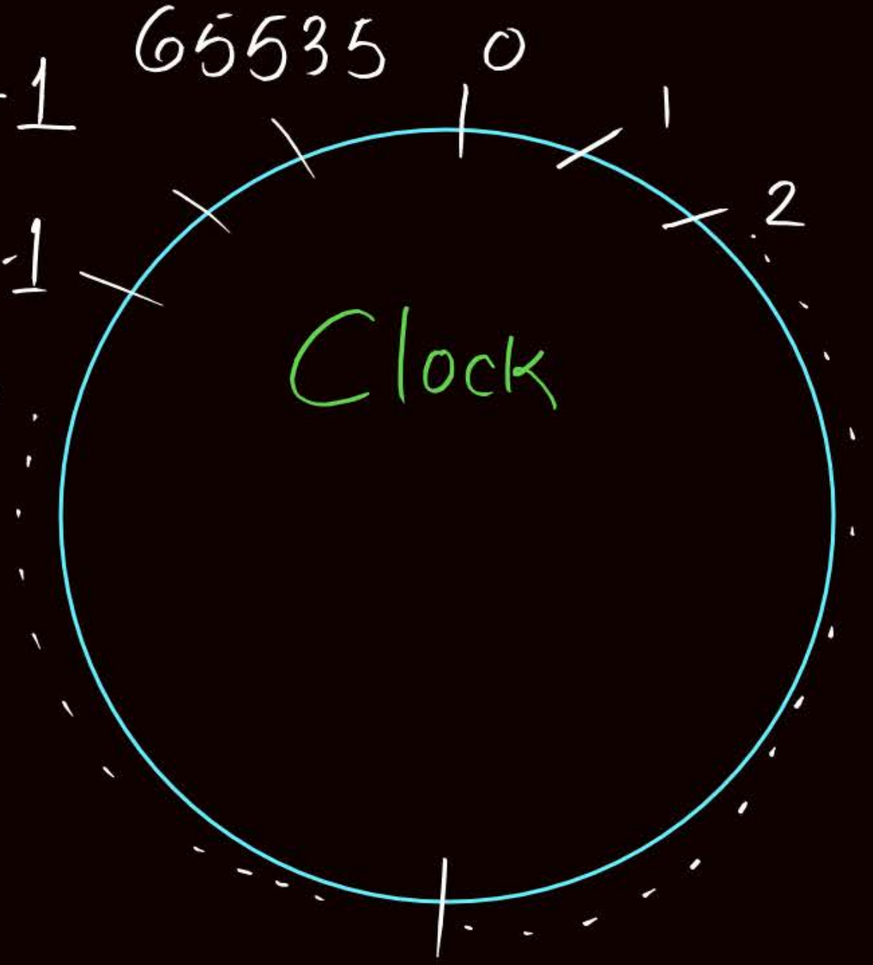
(IV) $\frac{50}{24} : \frac{50}{16} =$ Q 3 R: 2 print (0)

Short int

$0 - 2^{16} - 1$

$0 - 65536 - 1$

$0 - 65535$



Short int a;

Size: 2B = 16 bits

Short int a = 65540;

printf("%hu", a); - 4

$$\frac{65540}{2^{16}} = \frac{65540}{65536}$$

Q: 1

R: 4

Topic: How To find Unsigned Value of signed value

Given number X

Suppose the given number is X

1. Calculate Remainder REM by dividing by 216
2. If the remainder is positive then that is the answer
3. If the remainder is negative then answer 65536 - |REM|

Topic :

What is the range of 8 bit unsigned Integer

A. 0 to 256

B. 1 to 256

C. 0 to 255 ✓

D. 1 to 255

[C]

$0 - 2^n - 1$

$0 - 2^8 - 1$

$0 - 256 - 1$

$0 - 255$

Slide

Topic : Question

What is the range of 7 bit unsigned Integer

A. 0 to 128

B. 0 to 127 ✓ [B]

C. 1 to 128

D. 1 to 127

$0 - 2^n - 1$

$0 - 2^7 - 1$

$0 - 128 - 1$

$0 - 127$

Slide

Topic : Question

What is the range of 8 bit signed Integer

A. 0 to 255

B. -128 to 127

C. -127 to 127

D. -126 to 128

Slide

Topic : Question

What is the range of 16 bit signed Integer

A. 0 to 65536

B. -32768 to 32767

C. -32767 to 32767

D. -16384 to 16384

short int a

Range

[B]

-2^{n-1} —— $2^{n-1}-1$

-2^{16-1} —— $2^{16-1}-1$

-2^{15} —— $2^{15}-1$

-32768 —— 32767

Slide

Topic : Question

What is the decimal value of unsigned 6 bit number 100000

543210

A. 64

B. 32 ✓

C. 63

D. 31

2's complement

100000 → 32

100000

Signed value

$1X-2^5+0+0+0+0+0$

−32

Slide

Topic : Question

What is the decimal value of signed 6 bit number 100000

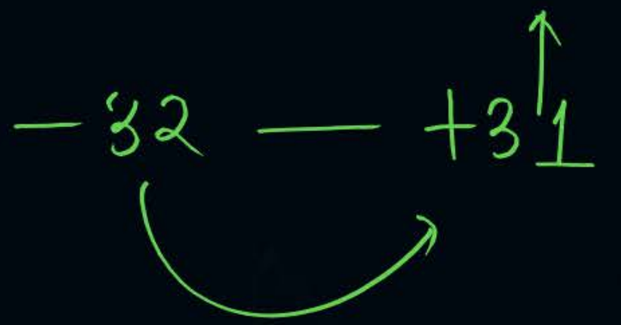
2's complement

A. -64

B. -32

C. 64

D. 32



Slide

Topic : Question

What is the decimal value of unsigned 6 bit number 100011

unsigned u

Signed d

A. 64

B. 32

C. 35

D. 31

unsigned

$1\ 0\ 0\ 0\ 1\ 1$

$5\ 4\ 3\ 2\ 1\ 0$

$1\times2^5 + 1\times2^1 + 1\times2^0$

$32+2+1=35$

Slide

Topic : Question

What is the decimal value of signed 6 bit number 100011

A. 64

B. 29

C. -29

D. 31

$1\ 0\ 0\ 0\ 1\ 1$

$-2^5 \times 1 + 1 \times 2^1 + 1 \times 2^0 = -32 + 2 + 1$

$= -29$

Slide

Topic : Question

```
#include <stdio.h>
int main(){
        short int a = 32770;
        printf("%hd", a);
        printf("%hu", a);
        return 0;
}
```

HW

Signed No → overflow?

2 mins Summary

Topic — Singned int, unsigned

Topic — Range

Topic — short int

Topic — Unsigned cycle property

Topic — practice problem

Slide

THANK - YOU