

computer?

calculator -> computer

computer -> 1 and 0

32 -> computer?

how?

convert 32 -> 10

convert decimal -> binary

0 -> 0  
1 -> 1  
2 -> 10  
3 -> 11  
4 -> 100  
5 -> 101  
6 -> 110  
7 -> 111

B

99 -> 000099

give -> size of page

1 GB -> 1024 MByte  
1 MB -> 1024 KByte  
1 KB -> 1024 Byte  
1 Byte -> 8 bits

8ms

4ms

1ms

6-77

100 101 102

101 102 103

1 byte -> 1/0

32

1

byte ->

8 bits

6-77  
6-77

7 6 5 4 3 2 1 0

Dec  $\rightarrow$  Bin

$$\begin{array}{r} 2 \overline{) 7} \\ 2 \overline{) 3} \quad -1 \uparrow \\ \underline{1} \rightarrow 1 \end{array}$$

Dec  $\rightarrow$  Bin

$$\begin{array}{r} 2 \overline{) 21} \\ 2 \overline{) 10} \quad -1 \uparrow \\ 2 \overline{) 5} \quad -0 \\ 2 \overline{) 2} \rightarrow 1 \\ \underline{1} \rightarrow 0 \end{array}$$

Dec  $\rightarrow$  Bin

$$\begin{array}{r} 16 \quad 8 \quad 4 \quad 2 \quad 1 \\ 1 \quad 0 \quad 1 \quad 0 \quad 1 \end{array}$$

(21)

Dec  $\rightarrow$  Bin

Dec  $\leftarrow$

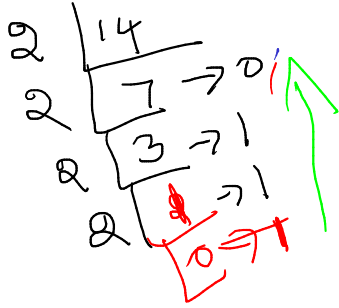
Dec  $\rightarrow$  Bin

$$\begin{array}{c} 1 \quad 0 \quad 1 \quad 0 \quad 1 \\ 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0 \end{array}$$

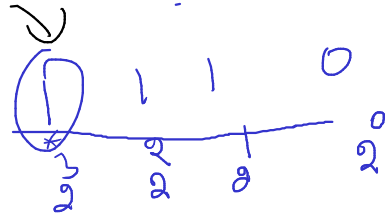
$$(2^4 * 1) + (2^3 * 0) + (2^2 * 1) + (2^1 * 0) + (2^0 * 1)$$

$$16 + 0 + 4 + 0 + 1 = 21$$

14

Dec  $\rightarrow$  Binary14  $\rightarrow$  1110

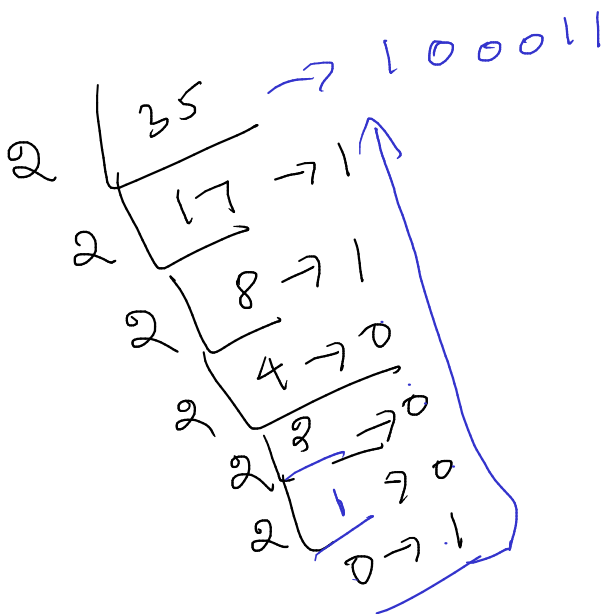
1110

Binary  $\rightarrow$  Dec

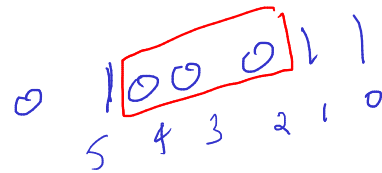
$$= (2^3 \times 1) + (2^2 \times 1) + (2^1 \times 1) + (2^0 \times 0)$$

$$= 14 (8 + 4 + 2 + 0)$$

$$= 14$$



35



$$(2^5 \times 1) + (2^4 \times 0) + (2^3 \times 0) + (2^2 \times 0) + (2^1 \times 1) + (2^0 \times 1)$$

$$32 + 2 + 1$$

35

$$\begin{aligned}
 & \binom{2^5}{2^5 \neq 1} + \binom{2^4 \neq 0}{0} + \binom{2^3 \neq 0}{0} + \binom{2^2 \neq 0}{0} + \binom{2^1 \neq 1}{2} + \binom{2^0 \neq 1}{1} \\
 & = 32 + 0 + 0 + 0 + 2 + 1 \\
 & = 35
 \end{aligned}$$

[illegible]

8 11 3  
8 1 7  
0 7 1

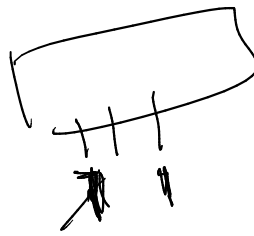
Bmer  $\rightarrow$  61

8 10 2 8

1 0  
(8/7) 8 8 0  
8

67

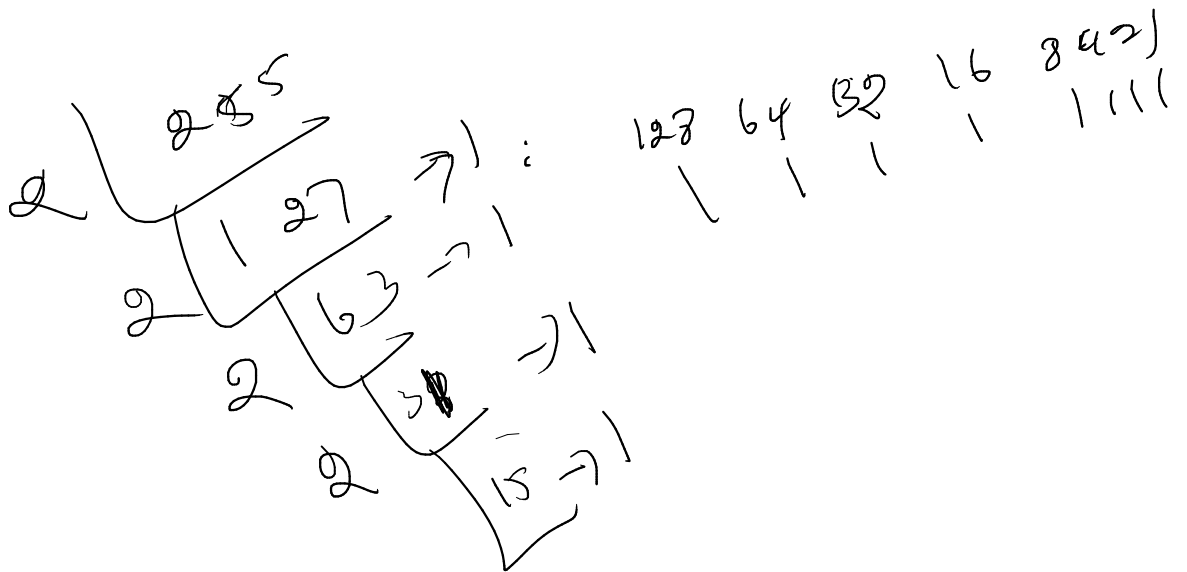
1010  
ASCII



ASCII

67

can you give me 32?



A (char to binary)

1. get ascii value(decimal) of A
2. convert this decimal to binary
3. store

32 (Decimal to binary)

divide by 2

C A N  
1000011   11000001   100110

Addition

$$\begin{array}{r} 10 \\ 20 \\ \hline 30 \end{array}$$

$$\begin{array}{r} A + B \\ \hline 1 \quad 1 \\ 1 \quad 0 \\ 0 \quad 1 \\ 0 \quad 0 \end{array}$$

$$\begin{array}{r} 10 \rightarrow 0 \quad 1 \quad 0 \quad 1 \quad 0 \\ 20 \rightarrow 1 \quad 0 \quad 1 \quad 0 \quad 0 \\ \hline 1 \quad 1 \quad 1 \quad 1 \quad 0 \\ \hline 2 \quad 4 \quad 2 \quad 2 \quad 2 \end{array}$$

$$16 + 8 + 4 + 2 = 30$$

$$\begin{array}{r} 10 \quad 1 \quad 0 \quad 1 \quad 0 \\ 5 \quad 0 \quad 1 \quad 0 \quad 1 \end{array}$$

$$\begin{array}{r} 15 \quad 1 \quad 1 \quad 1 \quad 1 \end{array}$$

$$\begin{array}{r} 10 \quad 1 \quad 8 \quad 4 \quad 2 \quad 1 \\ 10 \quad 0 \quad 1 \quad 0 \quad 1 \quad 0 \end{array}$$

$$\begin{array}{r} 20 \quad 1 \quad 0 \quad 1 \quad 0 \quad 0 \end{array}$$

$$\begin{array}{r} 1 \quad 1 \\ \hline 10 \end{array}$$

$$\begin{array}{r} 8 \quad 4 \quad 2 \\ \hline 6 \quad 0 \quad 1 \quad 1 \quad 0 \\ 6 \quad 0 \quad 1 \quad 1 \quad 0 \\ \hline 12 \quad 1 \quad 1 \quad 0 \quad 0 \end{array}$$

$$\begin{array}{r} 1 \\ \hline 10 \end{array}$$

$$\begin{array}{r} 10 \\ 10 \\ 10 \\ 10 \end{array}$$

$$\begin{array}{r}
 2 \overline{) 20} \\
 2 \overline{) 10} \rightarrow 0 \\
 2 \overline{) 5} \rightarrow 0 \\
 2 \overline{) 2} \rightarrow 1 \\
 2 \overline{) 1} \rightarrow 0 \\
 0 \rightarrow 1
 \end{array}$$

(20)

16	8	4	2	1
1	0	1	0	0
2 <sup>4</sup>	2 <sup>3</sup>	2 <sup>2</sup>	2 <sup>1</sup>	2 <sup>0</sup>

$$\begin{array}{r}
 1 \quad 0 \quad 1 \quad 0 \quad 1 \\
 1 \quad 1 \quad 1 \quad 1 \quad 1 \\
 \hline
 1 \quad 1 \quad 0 \quad 1 \quad 0
 \end{array}$$

$11 \rightarrow 10$

$(11) \rightarrow 11$

$$= (2^4 * 1) + (\cancel{2^3 * 0}) + (2^2 * 1) + (\cancel{2^1 * 0}) + (\cancel{2^0 * 0})$$

= 20

$3 * 2$

$$\begin{array}{r}
 3 \\
 3 \\
 \hline
 6
 \end{array}$$

$$3 * 4$$

10

20

(30)

$$\begin{array}{r}
 0 \quad 1 \quad 0 \quad 1 \quad 0 \\
 1 \quad 0 \quad 1 \quad 0 \quad 0 \\
 \hline
 1 \quad 1 \quad 1 \quad 1 \quad 0 \\
 16 \quad 8 \quad 4 \quad 2 \quad 0
 \end{array}$$

$$\begin{array}{r}
 3 \\
 3 \\
 3 \\
 3 \\
 \hline
 12
 \end{array}$$

multiplication

Reverse  
Addition

$$10 * 4$$

$$\begin{array}{r}
 10 \\
 10 \\
 10 \\
 10 \\
 \hline
 40
 \end{array}$$

$$\begin{array}{r} 1 \rightarrow 001 \\ 1 \rightarrow 001 \\ \hline 2 \rightarrow 0010 \end{array}$$

35 → 35

$$\begin{array}{r} 1 \\ \hline 10 \end{array}$$

$$\begin{array}{r} 1 \\ \hline 0 \end{array}$$

Recap  
1. computer  
2. 1/0 → binary

$$\begin{array}{cccccc} 5 & 4 & 3 & 2 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 & 1 \end{array}$$

$$(2^5 \times 1) + (2^4 \times 0) + (2^3 \times 0) + (2^2 \times 0) + (2^1 \times 1) + (2^0 \times 1)$$

$$32 + 0 + 0 + 0 + 2 + 1 = 35$$

$$\begin{array}{r} 2 \mid 35 \\ \hline 17 - 1 \\ 2 \mid 17 \\ \hline 8 - 1 \\ 2 \mid 8 \\ \hline 4 - 0 \\ 2 \mid 4 \\ \hline 2 - 0 \\ 2 \mid 2 \\ \hline 1 - 0 \\ 2 \mid 1 \\ \hline 0 - 1 \end{array}$$

0 → black  
1 → white  
110 → yellow

110	110	110	110
0	0	0	110
1	1	1	1
110	110	110	110

data stored in computer  
1/0

image → 1/0

Y	Y	Y	Y
B	B	B	Y
W	W	W	W
Y	Y	Y	Y

48x48

encode  
10009 → 100



add

multi

A \* B

4 \* 5

A + A

4 + 4 + 4 + 4 + 4

sub

A - B  
1 - 1  
1 - 0  
0 - 0  
0 - 1

0/8

0

1

6

-1

(borrow)

8 4 2 1  
0 1 0 1 1  
- 9 0 1 0 0 1  
-----  
0 0 1 0

div's  
10/2 = 5

1 2  
10 - 2 8 - 2  
8 6

3  
6 - 2  
4

4  
4 - 2  
2

5  
2 - 2  
0

22 16 8 4 2 1  
20 1 0 1 1 0  
1 0 1 0 0  
-----  
0 0 0 1 0

10/3 = 3 res 1  
1 3 3  
10 - 3 7  
7 4 1

addition -> adding  
subtraction -> sub

multiplication -> repetitive addition  
division -> repetitive subtraction

11 → 10

111 → (11)

$$\begin{array}{r} 1 \\ 10 \\ \hline 11 \end{array}$$

$$\begin{array}{r} 12 \\ 14 \\ \hline 26 \end{array}$$

$$\begin{array}{r} 16 \quad 8 \quad 4 \quad 2 \quad 1 \\ (2 \rightarrow) \quad \hline 1 \quad 1 \quad 0 \quad 0 \\ (4 \rightarrow) \quad 1 \quad 1 \quad 1 \quad 0 \\ \hline 26 \quad 11 \quad 0 \quad 1 \quad 0 \end{array}$$

11 →

8 4 2 1

$$\begin{array}{r} 1 \quad 0 \quad 0 \quad 0 \quad 1 \\ 1 \quad 0 \quad 0 \quad 0 \quad 1 \\ \hline 2 \quad 0 \quad 0 \quad 1 \quad 0 \end{array}$$

Adding two numbers

num1, num2  
ans = num1+num2

## algorithm for adding two numbers

1. start
2. input num1 and num2
3. do addition and store it ans.  $\text{ans} = \text{num1} + \text{num2}$
4. output the ans
5. stop

### psudocode

1. start
2. input num1, num2
3.  $\text{ans} = \text{num1} + \text{num2};$
4. output ans
5. stop

