

Binary Conversion



Basics of Computing

Binary to Decimal



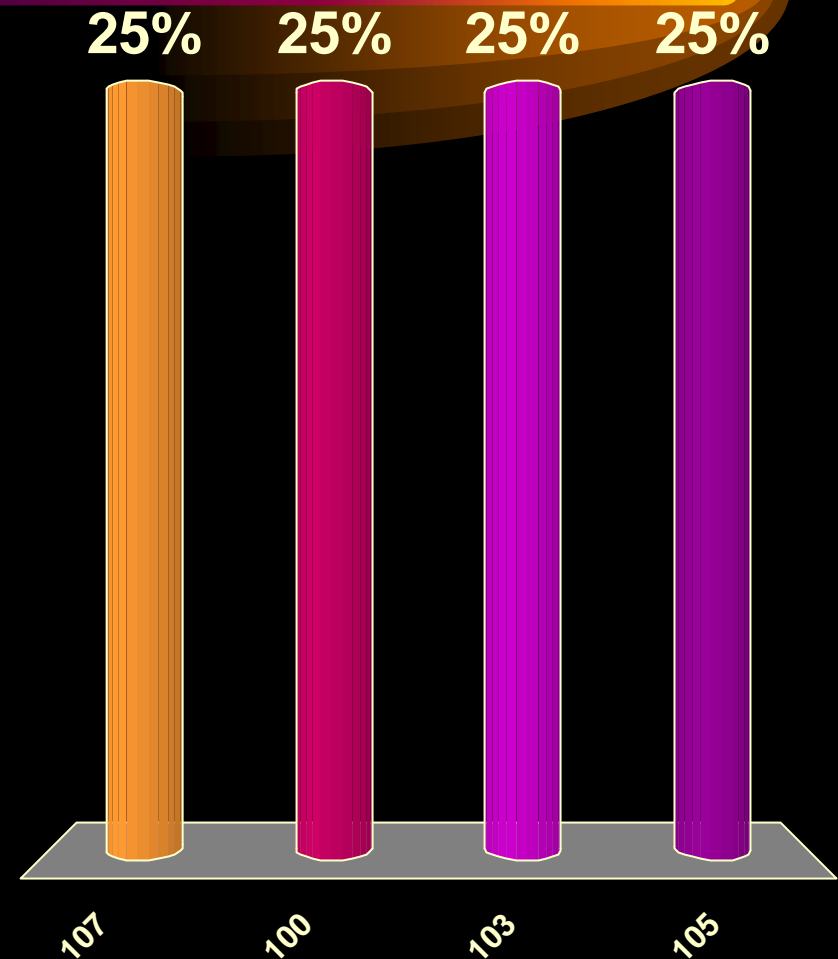
Binary to Decimal

- Starting from the RIGHT the values are:
 - 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024...
- Let's use 110010 as our example
- There are 0 1's, 1 2's, 0 4's and 8's
- There are 1 16's and 1 32's
- Add $2 + 16 + 32$ to get 50

Convert from Binary To Decimal

Number : 1100111

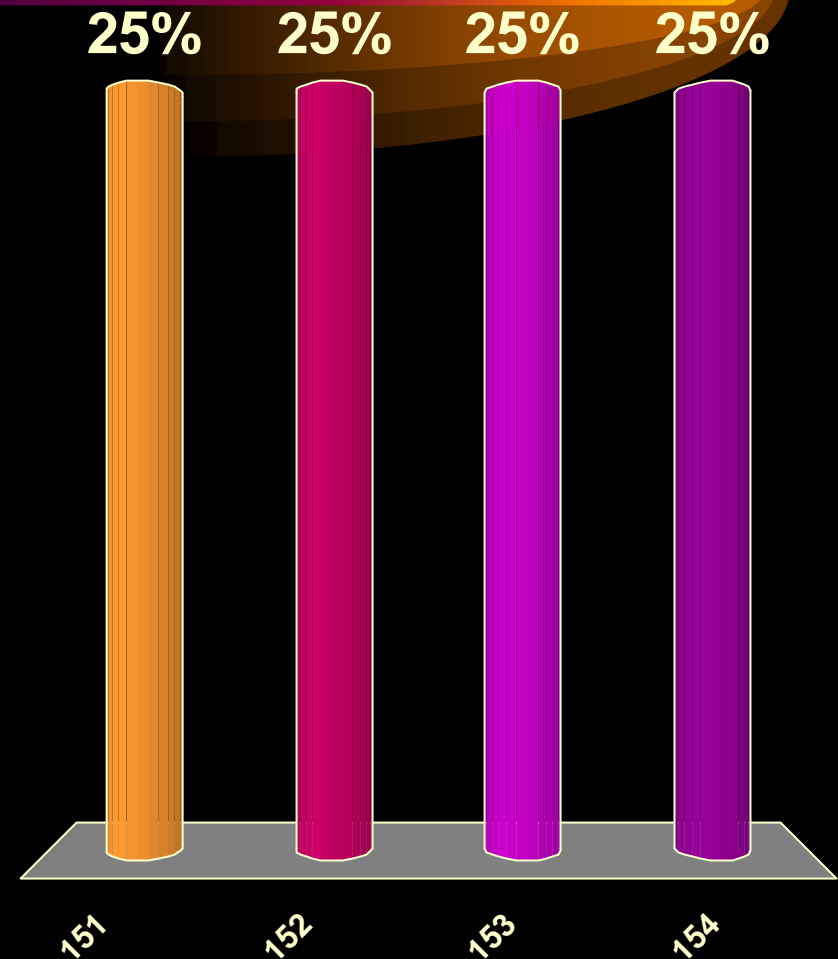
1. 107
2. 100
3. 103
4. 105



Convert Binary to Decimal

Number: 10011001

1. 151
2. 152
3. 153
4. 154



Decimal To Binary



Decimal to Binary Steps

- Using 241 as an example
- Step 1: Divide by two. Since 241 is indivisible, we write a 1. Then we subtract 1 from 241 to get 240 and divide by two to get 120.
- Step 2: Divide by two. Since 120 is divisible, we write a 0 to the left of the previous number and divide by two to get 60.

Decimal to Binary Conversion

- Step 3: Divide by two. Since 60 is divisible, we write a 0 to the left of the previous number and divide by two to get 30.
- Step 4: Divide by two. Since 30 is divisible, we write a 0 to the left of the previous number and divide by two to get 15.

Decimal to Binary Conversion

- Step 5: Divide by two. Since 15 is indivisible, we write a 1 to the left of the previous number. Then we subtract 1 from 15 to get 14 and when we divide we get 7.
- Step 6: Divide by two. Since 7 is indivisible, we write a 1 to the left of the previous numbers. Then we subtract 1 from 7 to get 6 and when we divide we get 3.

Decimal to Binary Conversion

- Step 7: Divide by two. Since 3 is indivisible, we write a 1 to the left of the previous numbers. Then we subtract 1 from 3 to get 2 and when we divide we get 1.
- Step 8: Divide by two. Since 1 is indivisible, we write a 1 to the left of the previous numbers. Then we subtract 1 from 1 to get 0, which means we are finished.

Decimal to Binary Conversion

- To Summarize the Steps:
- Step 1: See if the number is divisible by 2. If it is write 0 and divide by 2 to get the next number. If the number, on the other hand, is indivisible by 2, write a 1, then subtract 1 from the number and divide by two to get the next number.

Decimal to Binary Conversion



- Step 2: Continue this process, writing each 1 or 0 to the left of the previous 1 or 0, until the number which we are left to divide by is 0.

Practice Time



Binary Addition



- The key to adding binary numbers is to remember that we are dealing with base 2 numbers. In decimal addition we carry when we get a number 10 or larger. In binary we carry when we get a number 2 or larger.

Binary Addition

- Example

- $$\begin{array}{r} 11 \\ + 11 \\ \hline \end{array}$$

- Step 1: Add the numbers in the right most column.

- $$\begin{array}{r} 11 \\ + 11 \\ \hline 2 \end{array}$$

Binary Addition

- Since 2 is not one of our base 2 digits, we need to use it's binary equivalent 10. We keep the zero and carry the 1.

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

Binary Addition

- Step 2: Add the numbers in the next column to the left.

$$\begin{array}{r} 1 \\ 11 \\ + 11 \\ \hline 30 \end{array}$$

Binary Addition

- Since 3 is not one of our base 2 digits, we need to use it's binary equivalent 11. We keep the right most 1 and carry the left most 1.

1 1

1 1

+ 1 1

1 0

Binary Addition

- Step 3: Add the numbers in the next column to the left.

1 1

1 1

+ 1 1

1 1 0

Since 1 is a base 2 digit, we do not need to carry anything. $11 + 11 = 110$.

Binary Addition

- $$\begin{array}{r} 11 = 3 \\ + 11 = 3 \\ \hline 110 = 6 \end{array}$$

Binary Multiplication

- When multiplying two binary numbers multiply as usual. Remember when adding to use binary addition.

1 1

x 1 1

1 1 1 1

+ 1 1

1 0 0 1 (**Note the numbers in purple are carried in addition.)