**Binary** – Base 2 (2^n): 0 and 1

Denotes with B. Eg: 10110B = 1×2^4 + 0×2^3 + 1×2^2 + 1×2^1 + 0×2^0

0 – a bit

1 – a bit

**8 bits = 1 Byte**

**Octal** – Base 8 (8^n): 0 to 7

Octal numerals can be made from binary numerals by grouping consecutive binary digits into **groups of three** (starting from the right)

Eg: Decimal 74 in binary is 74(10) = 1001010(B)

1 0 0 1 0 1 0

2^6 2^5 2^4 2^3 2^2 2^1 2^0 = 74

Divide these binary bits to groups of three, that becomes (1)(001)(010).

Two additional zeroes are added to the left to make the grouping easy. This turns to

(001) (001) (010)

1 1 2 = 112(8)

This is how the decimal of 74(10) becomes 112(8) in octal.

In addition to the above explanation, if we perform

112(8) = (1\* 8^2) + (1\* 8^1) + (2\* 8^0) = 64 + 8 + 2 = 74(10)

Hence, the 74 in decimal equals to 112 in octal number system.

**Decimal** – Base 10 (10^n): 0 to 9

Denotes with D. Eg: 735(D) = 7×10^2 + 3×10^1 + 5×10^0

**Hexadecimal** – Base 16 (16^n): 0to9 A to F

Each hex digit is equivalent to 4 binary bits. Denotes with H

Eg: A3C5(H) = 10 3 12 5

As per table in Appendix, hex A equals to decimal 10 and hex C equals to decimal 12.

On converting the above decimal numbers to binary, it results to

1010 0011 1100 0101

Hence,

A3C5(H) = 1010 0011 1100 0101 (B) = (10\* 16^3) + (3\* 16^2) + (12\* 16^1) + (5\* 16^0) = 41925(D)

= (001) (010) (001) (111) (000) (101) = 121705(8)

= (1\*8^5)+(2\*8^4)+(1\*8^3)+(7\*8^2)+(0\*8^1)+(5\*8^0) = 41925(D)

A3C5(H) = 1010 0011 1100 0101 (B) = 121705(8) = 41925(D)

**Convert Decimal to Binary**:

18(D) = Perform division by 2 as follows:

18%2 = Quotient 9 🡪 Reminder 0

9%2 = Quotient 4 🡪 Reminder 1

4%2 = Quotient 2 🡪 Reminder 0

2%2 = Quotient 1 🡪 Reminder 0

1%2 = Quotient 0 🡪 Reminder 1 (Quotient less than number dividing (1<2) means stop)

Hence, 18(D) = 10010(B)

Converting the fractional part

18.6875

18 is 10010

For .6875

.6875\*2=1.375 => whole number is 1

.375\*2=0.75 => whole number is 0

.75\*2=1.5 => whole number is 1

.5\*2=1.0 => whole number is 1 (The fraction became zero, hence stop)

Hence .6875D = .1011B

Therefore, 18.6875D = 10010.1011B

**Convert Decimal to Hex**:

18(D) = Perform division by 16 as follows:

18%16 = Quotient 1 🡪 Reminder 2

1%16 = Quotient 0 🡪 Reminder 1 (Quotient less than number dividing (1<16) means stop)

Hence,

18(D) = 12(H). Please check the appendix table for accuracy.

Take another example, 261(D)

261/16 => quotient=16 🡪 remainder=5

16/16 => quotient=1 🡪 remainder=0

1/16 => quotient=0 🡪 remainder=1 (quotient=0 stop)

Hence, 261D = 105H

Convert numbers with fraction.

18.6875

18(D) is 12(H)

Fractional Part = .6875D

.6875\*16=11.0 => whole number is 11

Hence .6875(D) = .B (H) (decimal 11 equals to B in Hex. Check the appendix table)

Therefore, 18.6875(D) = 12.B (H)

https://www3.ntu.edu.sg/home/ehchua/programming/java/datarepresentation.html

Appendix:

Numeral systems conversion table

|  |  |  |  |
| --- | --- | --- | --- |
| Decimal  Base-10 | Binary  Base-2 | Octal  Base-8 | Hexadecimal  Base-16 |
| 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 |
| 2 | 10 | 2 | 2 |
| 3 | 11 | 3 | 3 |
| 4 | 100 | 4 | 4 |
| 5 | 101 | 5 | 5 |
| 6 | 110 | 6 | 6 |
| 7 | 111 | 7 | 7 |
| 8 | 1000 | 10 | 8 |
| 9 | 1001 | 11 | 9 |
| 10 | 1010 | 12 | A |
| 11 | 1011 | 13 | B |
| 12 | 1100 | 14 | C |
| 13 | 1101 | 15 | D |
| 14 | 1110 | 16 | E |
| 15 | 1111 | 17 | F |
| 16 | 10000 | 20 | 10 |
| 17 | 10001 | 21 | 11 |
| 18 | 10010 | 22 | 12 |
| 19 | 10011 | 23 | 13 |
| 20 | 10100 | 24 | 14 |
| 21 | 10101 | 25 | 15 |
| 22 | 10110 | 26 | 16 |
| 23 | 10111 | 27 | 17 |
| 24 | 11000 | 30 | 18 |
| 25 | 11001 | 31 | 19 |
| 26 | 11010 | 32 | 1A |
| 27 | 11011 | 33 | 1B |
| 28 | 11100 | 34 | 1C |
| 29 | 11101 | 35 | 1D |
| 30 | 11110 | 36 | 1E |
| 31 | 11111 | 37 | 1F |
| 32 | 100000 | 40 | 20 |