

1.3 Binary, hexadecimal, and octal

Hexadecimal

While decimal means a base 10 number, **hexadecimal** (or **hex**) means a base 16 number. Each digit is an increasing power 16^2 , etc.

16 symbols are needed for a digit. The symbols are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.

Hexadecimal is popular due to being a compact representation of a binary number. Four binary digits can be represented a since both have 16 possibilities. Thus 0000 is 0, 0001 is 1, 0010 is 2, ..., 1110 is E, and 1111 is F.

More binary digits use more hex digits. Ex: 00101111 is 2F (0010 is 2, and 1111 is F).

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1.3.1: Hex is popular due to compactly representing binary.

Start ☐ 2x speed

1 1 0 0 0 1 1 1
C 7

Binary	Hex	Decimal
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	A	10
1011	B	11
1100	C	12
1101	D	13
1110	E	14
1111	F	15

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1.3.2: Converting binary to hex.

1) 0011

☐ B☐ 3

2) 1010

☐ A☐ 10

3) 1111

☐ F☐ Not possible

4) 11110000

☐ FF☐ F0

5) 10100101

☐ A5☐ 5A

6) 10011

☐ 91☐ 13

7) 0001111100001111

☐ 1F0F☐ F0F1**PARTICIPATION
ACTIVITY**

1.3.3: Converting hex to binary.

1) AA

Check**Show answer**

2) 0F

Check**Show answer**

3) 00

Check**Show answer**

4) FF0077

Check**Show answer****PARTICIPATION
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1.3.4: Hex example: Colors on the web.

Colors on web pages are specified using 24 bits: 8 bits for red, 8 green, and 8 blue. Hex is a convenient way to specify those 24 bits. Thus FF0000 is bright red, 990000 is a darker red, FF00FF is a bright purple, and 000000 is black. Modify some colors below and press "Render HTML".

Reset

Type HTML below

```
<!DOCTYPE html>
<html>
<body>

<p style="background-color:#FF0000">
Line1 </p>
<p style="background-color:#990000">
Line2 </p>
<p style="background-color:#FF00FF">
Line3 </p>
<p style="background-color:#00FF00">
Line4 </p>
<p style="background-color:#777777">
Line5 </p>
```

Rendered HTML

Line1

Line2

Line3

Line4

Line5

Line6

Render HTML

Hex to decimal

A hex number is converted to decimal simply by multiplying each digit's decimal value by that digit's weight and summing.
 $+ 7 \times 16^1 + 15 \times 16^0 = 2560 + 112 + 15 = 2687.$

1.3.5: Hex to decimal.

ACTIVITY

1) A

☐ 1☐ 10

2) A7

☐ 17☐ 107☐ 167

3) FFF

☐ 45☐ 4095☐ 151515**Decimal to hex**

Decimal is converted to hex by finding the highest hex digit where a 1 doesn't exceed the decimal value, incrementing as m without exceeding the decimal value, and repeating for lower digits.

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1.3.6: Decimal to hex.

1) 20 decimal

Check**Show answer**

2) 40 decimal

Check**Show answer**

3) 258 decimal

Check**Show answer**

Octal

Octal means a base 8 number. Octal is sometimes used as a compact binary representation because three bits can be represented by one octal digit, though hex is more common. The eight symbols for an octal digit are 0, 1, 2, 3, 4, 5, 6, 7.

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1.3.7: Binary to octal, octal to binary.

1) 101010 binary is ____ octal.

☐ 52☐ 42

2) 1010 binary is ____ octal.

☐ 22☐ 12

3) 14 octal is ____ binary.

☐ 001100☐ 1110

4) 07 octal is ____ binary.

☒ 111☐ Invalid

5) 80 octal is ____ binary.

☐ 1000☐ Invalid**CHALLENGE
ACTIVITY**

1.3.1: Binary, hexadecimal, and octal conversions.

Start

1

Convert from hex to decimal

2

25 =

Ex: 73

3

1

2

3

4

5

4

5

Check

Next

 **Provide feedback on this section**