**Explorations of Technology – Hexadecimal Numbers**

Hexadecimal is a base 16 number system, meaning it uses 16 different symbols to produce numbers. It is a commonly used number system in fields of technology because of 16 being a power of 2 and therefore, easily converted to and from binary, which is the number system used by computers.

**Symbols**

The available symbols with hexadecimal are 0 though 9 and the letters A though F. The values of the letters are:

 A = 10 B = 11 C = 12 D = 13 E = 14 F = 15

**Steps for Converting between Binary and Hexadecimal**

Binary numbers are expressed in 8 bit chunks called bytes. We can convert 4 binary digits into 1 hexadecimal (hex) digit. Thus for every 8 bits, we can produce 2 hex digits. It's very simple.

1. Cut the binary expression in two 4 bit expressions. Example: 10010011 becomes 1001 and 0011

2. Convert each 4 bit expression from binary to decimal using an abbreviated place holder table:

3. Write down the decimal equivalent under each. If the value is > 9, use the symbol conversion shown above.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 4 | 2 | 1 |  | 8 | 4 | 2 | 1 |
| 1 | 0 | 0 | 1 |  | 0 | 0 | 1 | 1 |

 8 + 1 = 9 2 + 1 = 3

Thus 10010011(binary) = 93 (hex)

Ex: 11000101 would be 1100 and 0101

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8 | 4 | 2 | 1 |  | 8 | 4 | 2 | 1 |
| 1 | 1 | 0 | 0 |  | 0 | 1 | 0 | 1 |

 8 + 4 = 12 4 + 1 = 5

 12 = C

Thus 11000101 = C5

**Steps for Converting from Hex to Binary**

Repeat the process in reverse order. Given a 2 digit Hex expression, break it into 2 single hex digits and convert each to binary.

Example: Convert A6 to binary

Break the hex into A and 6

A = 10, which when converted to binary is 1010 (8+2) and 6 = 0110 (4 + 2). So A6 = 10100110

**Steps for Converting from Hex to Decimal or Decimal to Hex**

Use a 2 step approach. First convert to binary. Then convert from binary to either decimal or hex.

Example: Convert 4E to decimal

1. 4E becomes 4 and E. 4 = 0100 and E (14) = 1110, so 4E in binary is 01001110.

2. Now convert 01001110 to decimal

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |

 64 + 8 + 4 + 2 = 78

**So 4E (hex) = 78 (decimal)**

**RBG with Hex**

Some programs, like Fireworks, use hexadecimal to represent the RGB values. It gives 2 hex digits for each primary color, which gives the same number range as 8 binary digits. (0 to 255)

**Hexadecimal Problems**

**Directions**- Convert from one number system to the next. Show your work either on this page or on an attached page.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Hex** | **Binary** |  | **Binary** | **Hex** |
| **F8** |  |  | **11000001** |  |
| **AF** |  |  | **00110010** |  |
| **33** |  |  | **11100011** |  |
| **10** |  |  | **11111111** |  |
| **F2** |  |  | **10000000** |  |
| **BA** |  |  | **10000110** |  |
| **7C** |  |  | **11010100** |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Hex** | **Decimal** |  | **Decimal** | **Hex** |
| **B8** |  |  | **195** |  |
| **29** |  |  | **84** |  |
| **E3** |  |  | **216** |  |
| **AD** |  |  | **30** |  |
| **77** |  |  | **241** |  |
| **9B** |  |  | **169** |  |
| **\*4CC** |  |  | **\*2017** |  |

**RGB Conversion**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Hex** | **Color** |  | **Hex** | **Color** |
| **800080** |  |  | **902100** |  |
| **3A6340** |  |  | **D575E1** |  |