CST 334: Operating Systems

Dr. Glenn Bruns

# Translating between binary, hex, and decimal numbers

This semester you will often translate between binary, decimal, and hexadecimal numbers. I assume you know how to do these translations -- see the next page if you don't. These problems will help you get comfortable with the process. Please solve the problems by hand and do not use web resources except as needed to understand the process.

Edit file [binhex.txt](https://drive.google.com/file/d/1UsDRFy63OSWwv8hAFJVG6d1vXzSlLXms/view?usp=sharing) to enter your answers to the following problem.

Write the following binary numbers as decimal numbers. For example, write 10110 as 22.

1. 10110
2. 111
3. 0011
4. 11001
5. 11111111

Write the following decimal numbers in binary. For example, write 13 as 1101.

1. 13
2. 21
3. 16
4. 55
5. 80

Write the following hexadecimal numbers as decimal numbers. For example, write 0x2C as 44 (which is 2\*16 + 12\*1). The “0x” is often used to indicate hex numbers (The '0' in "0x" is digit zero).

1. 0x2C
2. 0x12
3. 0x1D7
4. 0xFF
5. 0x7B

Write the following decimal numbers as hex. For example, write 18 as 0x12 (which is 1\*16 + 2\*1). Do not forget to provide the “0x”.

1. 18
2. 5
3. 88
4. 123
5. 100

**Submission**. Submit your homework on iLearn as your edited file binhex.txt.

**Translating binary to decimal:**

Example: binary number 100.

* Look at the digits from right to left.
* The digit on the right is in the 2^0 place, the next digit is in the 2^1 place, and the next digit is in the 2^2 place.
* So 100 in binary is 0 x 2^0 + 0 x 2^1 + 1 x 2^2. This is equal to 0 + 0 + 4, so the answer in decimal is 4.

Example: binary number 1010.

* The decimal value is 0 x 1 + 1 x 2 + 0 x 4 + 1 x 8. This is equal to 0 + 2 + 0 + 8, so the answer in decimal is 12.

**Translating decimal to binary:**

Example: decimal number 19.

* Find the largest power of 2 that's not greater than 19. It's 16, which can written as 2^4.
* Subtract 16 from 19 to get 3. Find the largest power of 2 that's not greater than than 3. It's 2, which can be written 2^1.
* Subtract 2 from 3 to get 1. Find the largest power of 2 that's not greater than 1. It's 1, which can be written 2^0.
* Subtract 1 from 1 to get 0. Since we got 0, we're done and just need to assemble the binary number.
* 19 is 2^4 + 2^1 + 2^0, so the answer in binary 10011. In other words, we have 1s at location 4, 1, and 0.

**Translating hexadecimal to decimal:**

Example: hexadecimal number 0x3A

This is similar to translating binary to decimal, but you have to remember that the hexadecimal digit 'A' means 10 decimal, 'b' means 11 decimal, …, and 'F' means 15 decimal.

* Look at the digits from right to left.
* The hexadecimal digit on the right is in the 16^0 place, the next digit is in the 16^1 place.
* So 0x3A in hexadecimal is 10 x 16^0 + 3 x 16^1. This is equal to 10 + 28, so the answer in decimal is 38.

**Translating decimal to hexadecimal:**

Example: decimal number 74

* Find the largest power of 16 not greater than 74. It's 16^1, which is just 16. How many 16's in 74? There are 4 (plus change). 4 x 16 = 64.
* Subtract 64 from 74 to get 10. Find the largest power of 16 not greater than 10. It's 16^0, which is just 1. How many 1's in 10. Obviously, just 10.
* 74 is 4 x 16^1 + 10 x 16^0, so (remembering that 10 in hexadecimal is 'a') we the answer in hexadecimal is 0x4A.