MCS 260 – Introduction to Computer Science – Fall 2020 – Emily Dumas

Week 1 Worksheet Solutions

One possible solution to each problem is shown. Problems in track 1 pertaining to installation of software are omitted.

Track 2: Number systems

(9) Convert `0b100000100` to decimal.

$$\texttt{0b100000100} = 2^2 + 2^8 = 4 + 256 = 260$$

(10) Convert `0x104` to decimal.

$$\texttt{0x104} = 4 * 16^0 + 1 * 16^2 = 4 + 256 = 260$$

(11) Convert the decimal number `66` to hexadecimal.

- 66 // 16 = 4, 66 % 16 = 2
- 4 // 16 = 0, 4 % 16 = 4

Collecting remainders as the digits, we have $66 =$ `0x42`.

(12) Convert `0xf0` to binary.

Since `f` $= 15 =$ `0b1111` we have `0xf0` $=$ `0b11110000`.

(13) Convert the decmial number `20` to binary.

- 20 // 2 = 10, 20 % 2 = 0
- 10 // 2 = 5, 10 % 2 = 0
- 5 // 2 = 2, 5 % 2 = 1
- 2 // 2 = 1, 2 % 2 = 0
- 1 // 2 = 0, 1 % 2 = 1

Collecting remainders as the digits, we have $20 =$ `0b10100`.

(14) Convert `0x704` to decimal.

$$\texttt{0x704} = 4 * 16^0 + 7 * 16^2 = 4 + 1792 = 1796$$

(15) What is the decimal value of the largest 5-digit binary number?

The largest number with any number of bits is the one where all bits are 1.
So the largest 5-bit number is `0b11111` $= 1 + 2 + 4 + 8 + 16 = 31$.
(It would also be acceptable to say that it must be one less than the smallest 6-digit binary number which is `0b100000` $= 32$.)

(16) What is the decimal value of the largest 3-digit hexadecimal number?

By similar reasoning as in the previous problem, the hexadecimal number in question is `0xfff`. We could calculate this directly, but another way is to notice that adding one to this number must give the smallest 4-digit hexadecimal number (that cannot be expressed in 3-digits). Let's call the smallest such number x. The first (i.e. most-significant) digit of x cannot be zero, or else we could simply omit the leading zero and express x in 3 digits. So the smallest allowable first digit is 1. The other digits can be zeros, so $x =$ `0x1000` $= 16^3 = 4096$ and the largest 3-digit hexadecimal number is $x - 1 =$ `0xfff` $= 4095$.