Instructions: Work on homework assignments to further familiarize yourself with the topics in the class. The answers are provided for these problems. You can work with other students as desired. Turn in your work on canvas to be given a grade for completion (homework will not be checked for correctness; you need to verify this yourself.)

Upload each homework assignment to its own "dropbox" on Canvas.

This document is not formatted to be written on; do your homework on a separate sheet of paper.

Number Theory: Representations of Numbers

Ensley & Crawley: Chapter 2.6
Johnsonbaugh: Chapter 5.2

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1. Convert each of the following from base-2 to base-16.
   a. $(\texttt{0001})_2$
   b. $(\texttt{0110 0100})_2$
   c. $(\texttt{1111 0101 1011})_2$
2. Convert each of the following from base-16 to base-2.
   a. $(\texttt{A4})_{16}$
   b. $(\texttt{1337})_{16}$
   c. $(\texttt{A8B9 93FB})_{16}$
3. Convert each of the following from base-10 to base-2.
   a. $(1)_{10}$
   b. $(2)_{10}$
   c. $(3)_{10}$
   d. $(4)_{10}$
   e. $(7)_{10}$
   f. $(8)_{10}$
   g. $(15)_{10}$
   h. $(32)_{10}$

i. $(66)_{10}$
j. $(128)_{10}$
k. $(1024)_{10}$

4. Convert each of the following from base-2 to base-10.

a. $(\texttt{0001})_2$
b. $(\texttt{0010})_2$
c. $(\texttt{0011})_2$
d. $(\texttt{0100})_2$
e. $(\texttt{0101})_2$
f. $(\texttt{1000})_2$
g. $(\texttt{1001})_2$
h. $(\texttt{0110 0100})_2$
i. $(\texttt{1111 1111})_2$
j. $(\texttt{0001 0001 0001})_2$
k. $(\texttt{1000 1000 1000})_2$

5. Convert each of the following from base-16 to base-10.

a. $(A4)_{16}$
b. $(1337)_{16}$
c. $(\texttt{A8B9 93FB})_{16}$

6. Convert each of the following from its base-10 to base-16 by first converting to binary.

a. $(8)_{10}$
b. $(20)_{10}$
c. $(100)_{10}$

7. Convert each of the following from its base to base-10.

a. $(123)_4$
b. $(123)_5$
c. $(123)_6$

Answer key

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

1. Convert each of the following from base-2 to base-16.
   a. $(\texttt{0001})_2 = 1$
   b. $(\texttt{0110 0100})_2 = 64$
   c. $(\texttt{1111 0101 1011})_2 = \text{F5B}$
2. Convert each of the following from base-16 to base-2.
   a. $(\texttt{A4})_{16} = \texttt{1010 0100}$
   b. $(\texttt{1337})_{16} = \texttt{0001 1110 1110 0111}$
   c. $(\texttt{A8B9 93FB})_{16} = \texttt{1010 1000 1011 1001 1001 0011 1111 1011}$
3. Convert each of the following from base-10 to base-2.
   a. $(1)_{10} = \texttt{0001}$
   b. $(2)_{10} = \texttt{0010}$
   c. $(3)_{10} = \texttt{0011}$
   d. $(4)_{10} = \texttt{0100}$
   e. $(7)_{10} = \texttt{0111}$
   f. $(8)_{10} = \texttt{1000}$
   g. $(15)_{10} = \texttt{1111}$
   h. $(32)_{10} = \texttt{0010 0000}$
   i. $(66)_{10} = \texttt{0100 0010}$
   j. $(128)_{10} = \texttt{1000 0000}$
   k. $(1024)_{10} = \texttt{0100 0000 0000}$
4. Convert each of the following from base-2 to base-10.
   a. $(\texttt{0001})_2 = 1 \cdot 2^0 = 1$
   b. $(\texttt{0010})_2 = 1 \cdot 2^1 = 2$
   c. $(\texttt{0011})_2 = 1 \cdot 2^1 + 1 \cdot 2^0 = 3$
   d. $(\texttt{0100})_2 = 1 \cdot 2^2 = 4$
   e. $(\texttt{0101})_2 = 1 \cdot 2^2 + 1 \cdot 2^0 = 5$
   f. $(\texttt{1000})_2 = 1 \cdot 2^3 = 8$
   g. $(\texttt{1001})_2 = 1 \cdot 2^3 + 1 \cdot 2^0 = 9$

h. $(\texttt{0110 0100})_2$

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	1	1	0	0	1	0	0

$= 1 \cdot 2^6 + 1 \cdot 2^5 + 1 \cdot 2^2 = 64 + 32 + 4 = 100$

i. $(\texttt{1111 1111})_2$

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	1	1	1	1	1	1

$= 1 \cdot 2^7 + 1 \cdot 2^6 + 1 \cdot 2^5 + 1 \cdot 2^4 + 1 \cdot 2^3 + 1 \cdot 2^2 + 1 \cdot 2^1 + 1 \cdot 2^0$
$= 128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 255$

j. $(\texttt{0001 0001 0001})_2$

2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	0	0	1	0	0	0	1	0	0	0	1

$= 1 \cdot 2^8 + 1 \cdot 2^4 + 1 \cdot 2^0$
$= 256 + 16 + 1 = 273$

k. $(\texttt{1000 1000 1000})_2$

2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	0	0	0	1	0	0	0	1	0	0	0

$= 1 \cdot 2^{11} + 1 \cdot 2^7 + 1 \cdot 2^3$
$= 2048 + 128 + 8 = 2184$

5. Convert each of the following from base-16 to base-10.

   a. $(A4)_{16} = 164$

   b. $(1337)_{16} = 4919$

   c. $(\texttt{A8B9 93FB})_{16} = 2830734331$

6. Convert each of the following from its base-10 to base-16 by first converting to binary.

   a. $(8)_{10} = 8$

   b. $(20)_{10} = 14$

   c. $(100)_{10} = 64$

7. Convert each of the following from its base to base-10.

   a. $(123)_4$

4^2	4^1	4^0
1	2	3

$= 1 \cdot 4^2 + 2 \cdot 4^1 + 3 \cdot 4^0 = 16 + 8 + 3 = 27$

   b. $(123)_5$

5^2	5^1	5^0
1	2	3

$= 1 \cdot 5^2 + 2 \cdot 5^1 + 3 \cdot 5^0 = 25 + 10 + 3 = 38$

   c. $(123)_6$

6^2	6^1	6^0
1	2	3

$= 1 \cdot 6^2 + 2 \cdot 6^1 + 3 \cdot 6^0 = 36 + 12 + 3 = 51$