

Solutions Document for Assignment 2
Alyssa Kelley

4. Convert the following hex values to decimal assuming that they are stored as 32-bit 2's complement integers.

whenever this is said = signed.

a. 0x0000000C6

- 1) convert to binary: $\begin{array}{cccccccc} 0 & 0 & 0 & 0 \\ 0000 & 0000 & 0000 & 0000 \end{array}$ $\begin{array}{ccccccccc} 0 & 0 & 0 & C & 6 \\ 0000 & 0000 & 1100 & 0110 \end{array}$
- 2) check the sign: sign = 0 = positive
- 3) convert to decimal: $1100\ 0110$
 $128 + 64 + 4 + 2 = 198$

answer = 198

b. 0xFFFFFEC6

- 1) convert to binary: $\begin{array}{cccccccc} F & F & F & F & F & E & C & 6 \\ 1111 & 1111 & 1111 & 1111 & 1111 & 1110 & 1100 & 0110 \end{array}$
- 2) check the sign: sign = 1 = negative
- 3) convert to decimal:
(A trick for this when all leading one's...
→ find the first "1" from the right.
→ flip everything to the left of that "1")
 $\begin{array}{cccccccc} F & F & F & F & F & E & C & 6 \\ 1111 & 1111 & 1111 & 1111 & 1111 & 1110 & 1100 & 0110 \\ 0000\ 0000\ 0000\ 0000\ 0000\ 0001\ 0011\ 1010 \end{array}$
 $256 + 32 + 16 + 8 + 2 = -314$ **Then remember to add the sign**

answer = -314

c. 0xFFFFFFFF

Note: this is a special case because the binary representation is a string of all "1"s which is always going to be equal to the decimal representation of (-1).

answer = -1

5. Convert the following decimal numbers to hex encoded as IEEE 754 single-precision floating-point numbers.

a. 0x80000000

- 1) convert to binary 
- 2) split into 3 parts:
sign (1 bit) = 1
Exp (8 bit) = 000 0000 0
frac (23 bit) = 000 0000 0000 0000 0000
- 3) check the sign
sign = 1 = negative
- 4) convert exp + frac to decimal
exp = 0 / frac = 0
- 5) = sign/exp/frac $\rightarrow -0.0 \rightarrow$ special case = 0

ANSWER = $-0.0 = 0$

b. 0x439D0000

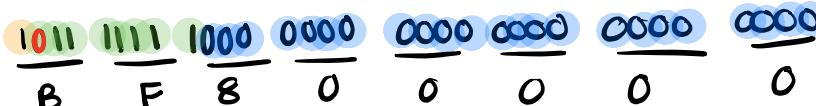
- 1) binary \rightarrow 0100 0011 1001 1101 0000 0000 0000 0000
- 2) sign = 0
- 3) sign = 0 = positive
- 4) Exp \rightarrow decimal $\begin{cases} .100\ 0011\ 1\dots \\ 128 + 4 + 2 + 1 = 135 \end{cases}$
 $135 - 127 = 8$
bias
- 5) convert frac \rightarrow decimal $\begin{cases} 1.001\ 1101\ 0000\ 0000\ 0000 * 2^8 \\ 1001\ 1101\ 0.000\ 0000\ 0000\ 0000 \\ 256 + 32 + 16 + 8 + 2 = 314 \end{cases}$ sign is positive

ANSWER = 314

- c. 0xC1340000
- 1) convert to binary → 
 - 2) sign = 1
 $\text{exp} = 100\ 0001\ 0$
 $\text{frac} = \begin{matrix} 011 & 0100 & 0000 & 0000 & 0000 & 0000 \\ & 011 & 0100 & 0000 & 0000 & 0000 \end{matrix}$
 - 3) sign = 1 = negative
 - 4) convert exp to decimal → $100\ 0001\ 0 \rightarrow 130 - 127 = 3$
 $128 + \frac{1}{2} = 130$
 - 5) convert frac to decimal
 $1.011\ 0100\ 0000\ 0000\ 0000 * 2^3$
 $1011.0100...0$
 $8+2+1 \uparrow \frac{1}{2^2} = 1/4 = 0.25$
 $= -11.25$

ANSWER = -11.25

6. Convert the following decimal numbers to hex encoded as IEEE 754 single-precision floating-point numbers.

- a. -1.0
- 1) sign = negative = 1
 - 2) convert 1 to binary = 0001.
 - 3) normalize = already is!
 $\text{exp} = 0 + 127 = 127 \rightarrow \text{binary} = 01111111$ needs to be 8 digits long so the zero remains on the L side
 - 4) $\text{frac} = 0...0$
 - 5) sign + exp + frac
- | |
|--|
|  |
| B F 8 0 0 0 0 0 |

ANSWER = 0xBF800000

- b. 16.75
- 1) sign = positive = 0
 - 2) convert to binary → 10000.11
 - 3) normalize → make into $1.\overline{xxxxxx}...$
 10000.11 exp = 2^4 because decimal had to move over 4 to normalize.
 $= 1.000011 * 2^4$ \uparrow frac
 - 4) $\text{frac} = 000011 * 2^4$
- Trick to decimal → bin:
* for fractions:
0.75 → binary
 $0.75 * 2 = 1.5$
 $0.5 * 2 = 1.0$ until $\text{frac} = 0$, then done!
add together the whole #'s = 0.11 (bin.)

$$\text{exp} = 4 + 127 = 131 \text{ convert to binary} \dots 1000\ 0011$$

$\xrightarrow{\text{bias}}$

5) sign + exp + frac

$$0100\ 0001\ 1000\ 0110\ 0000\ 0000\ 0000$$

6) convert binary to hex.

$$\begin{array}{r} 0100\ 0001\ 1000\ 0110\ 0000\ 0000\ 0000 \\ \hline 4 \quad 1 \quad 8 \quad 6 \quad 0 \quad 0 \quad 0 \end{array} = 0x41860000$$

Answer = 0x41860000

c. -314.0

1) sign = negative = 1

2) convert \rightarrow binary \rightarrow 100111010 $\xleftarrow{314}$

$2^8 + 2^5 + 2^4 + 2^3 + 2^1 =$
 $256 + 32 + 16 + 8 + 2 = 314$

3) normalize

$$\begin{array}{r} 100111010.0 \cdot 2^8 \\ \hline 1.00111010 \cdot 2^8 \end{array}$$

4) frac = 00111010

$$\text{exp} = 8 + 127 = 135 \rightarrow \text{bin}$$

10000111

5) sign + exp + frac

$$1100\ 0011\ 1001\ 1101\ 0000\ 0000$$

6) convert binary to hex

$$\begin{array}{r} 1100\ 0011\ 1001\ 1101\ 0000\ 0000 \\ \hline 0 \quad 3 \quad 9 \quad D \quad 0 \quad 0 \end{array}$$

ANSWER = 0xC39D0000