

COMP 122/L Practice Exam #1 (With Answers)

This is representative of the kinds of topics and kind of questions you may be asked on the midterm. In addition to this practice exam, you should also review:

- The handout we did together in class
- Labs 1-3

1.) In decimal, how much is a 8 in position 5 worth?

$$8 * 10^5$$

2.) In binary, how much is a 1 in position 7 worth?

$$1 * 2^7$$

3.) In hexadecimal, how much is a E in position 4 worth?

$$14 * 16^4$$

4.) Convert decimal 19 into 8-bit unsigned binary. Show all work, including value of each digit.

$$0001\ 0011$$

$$2^4 + 2^1 + 2^0 = 16 + 2 + 1$$

5.) Convert unsigned binary 1101 1101 into decimal. Show all work, including value of each digit.

$$2^0 + 2^2 + 2^3 + 2^4 + 2^6 + 2^7 = 1 + 4 + 8 + 16 + 64 + 128 = 221$$

6.) Convert **two's complement** binary 1101 1101 into decimal. Show all work, including value of each digit.

Negation:
 $0010\ 0010$

Add one:
 $0010\ 0011$

$$2^0 + 2^1 + 2^5 = 1 + 2 + 32 = 35$$

7.) Consider the following binary number:

1110 0110

Is it possible to tell if this number is in unsigned or two's complement representation? If yes, explain how. If not, explain why.

It's not possible to tell. Binary numbers are not self-describing. This could be an unsigned number, a two's complement number, a character, or any number of other things.

8.) Convert decimal 2028 to 4-digit hexadecimal. Show all work, including value of each digit.

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

$2028 / 16^2 = 7$, remainder 236
 $236 / 16^1 = 14$ (E), remainder 12
 $12 / 16^0 = 12$ (C), remainder 0

0x07EC

$7 * 16^2 + 14 * 16^1 + 12 * 16^0 = 1792 + 224 + 12 = 2028$

9.) Convert decimal -882 to 4-digit hexadecimal. Show all work, including value of each digit.

$882 / 2^9 = 1$, remainder 370
 $370 / 2^8 = 1$, remainder 114
 $114 / 2^7 = 0$, remainder 114
 $114 / 2^6 = 1$, remainder 50
 $50 / 2^5 = 1$, remainder 18
 $18 / 2^4 = 1$, remainder 2
 $2 / 2^3 = 0$, remainder 2
 $2 / 2^2 = 0$, remainder 2
 $2 / 2^1 = 1$, remainder 0
 $0 / 2^0 = 0$, remainder 0

Unsigned magnitude: 0000 0011 0111 0010

$(2^9 + 2^8 + 2^6 + 2^5 + 2^4 + 2^1 = 512 + 256 + 64 + 32 + 16 + 2 = 882)$

Flip bits: 1111 1100 1000 1101

Add one: 1111 1100 1000 1110

To hex: 0xFC8E

10.) What is: 1111 1101 + 0100 0101? Specify if the result has a carry-out set and if the result sets the overflow bit. Show all work.

```
1 1 1 1 1 1 0 1 0
  1 1 1 1 1 1 0 1
+ 0 1 0 0 0 1 0 1
-----
  0 1 0 0 0 0 1 0
```

Carry set, overflow not set

11.) What is 1111 1100 + 1000 0000? Specify if the result has a carry-out set and if the result sets the overflow bit. Show all work.

```
1 0 0 0 0 0 0 0 0
  1 1 1 1 1 1 0 0
+ 1 0 0 0 0 0 0 0
-----
  0 1 1 1 1 1 0 0
```

Carry set, overflow set

12.) What is 1111 1100 - 1000 0000? Specify if the result has a carry-out set and if the result sets the overflow bit. Show all work.

Flip bits: 0111 1111

Adding one achieved by an initial carry-in of 1 below:

```
1 1 1 1 1 1 1 1
  1 1 1 1 1 1 0 0
+ 0 1 1 1 1 1 1 1
-----
  0 1 1 1 1 1 0 0
```

Carry set, overflow not set

13.) What is 0x3F & 0x5A? Provide the answer in two-digit hexadecimal. Show all work.

0x3F = 0011 1111

0x5A = 0101 1010

$$\begin{array}{r}
 0\ 0\ 1\ 1\ 1\ 1\ 1\ 1 \\
 \& 0\ 1\ 0\ 1\ 1\ 0\ 1\ 0 \\
 \hline
 0\ 0\ 0\ 1\ 1\ 0\ 1\ 0
 \end{array}$$

$$0001 = 0x1$$

$$1010 = 0xA$$

$$0x1A$$

14.) What is $0x4E \mid 0xB2$? Provide the answer in two-digit hexadecimal. Show all work.

$$0x4E = 0100\ 1110$$

$$0xB2 = 1011\ 0010$$

$$\begin{array}{r}
 0\ 1\ 0\ 0\ 1\ 1\ 1\ 0 \\
 \mid 1\ 0\ 1\ 1\ 0\ 0\ 1\ 0 \\
 \hline
 1\ 1\ 1\ 1\ 1\ 1\ 1\ 0
 \end{array}$$

$$1111 = 0xF$$

$$1110 = 0xE$$

$$0xFE$$

15.) What is $0x7A \wedge 0x14$? Provide the answer in two-digit hexadecimal. Show all work.

$$0x7A = 0111\ 1010$$

$$0x14 = 0001\ 0100$$

$$\begin{array}{r}
 0\ 1\ 1\ 1\ 1\ 0\ 1\ 0 \\
 \wedge 0\ 0\ 0\ 1\ 0\ 1\ 0\ 0 \\
 \hline
 0\ 1\ 1\ 0\ 1\ 1\ 1\ 0
 \end{array}$$

$$0110 = 0x6$$

$$1110 = 0xE$$

$$0x6E$$

16.) What is $\sim 0x87$? Provide the answer in two-digit hexadecimal. Show all work.

$$0x8 = 1000$$

$$0x7 = 0111$$

$$\text{Flip bits: } 0111\ 1000$$

17.) What is $1101\ 0001 \ll 3$? Express your answer in 8-bit binary.

1000 1000

18.) What is $1100\ 0101 \gg 2$ for **logical** shift right? Express your answer in 8-bit binary.

0011 0001

19.) What is $1100\ 0101 \gg 2$ for **arithmetic** shift right? Express your answer in 8-bit binary.

1111 0001

20.) What is $0100\ 0101 \gg 2$ for **arithmetic** shift right? Express your answer in 8-bit binary.

0001 0001

21.) Specify the mask and operation you would need to isolate bit 6 of an unknown 8-bit number. The result of the operation should be 0 (0x00) if bit 6 is 0, and non-zero if bit 6 is 1. The mask should be represented in 8-bit binary.

```
XXXX XXXX
? ???? ????
-----
0X00 0000 (wanted)
```

```
X & 0 = 0
X & 1 = X
X | 0 = X
X | 1 = 1
```

```
XXXX XXXX
& 0100 0000 (mask and operation)
-----
0X00 0000
```

22.) Specify the mask and operation you would need to set bits 1 and 4 of an unknown 8-bit number to 1. The result of this operation results in a new number, which the unknown number will be subsequently set to. The mask should be represented in 8-bit binary.

```
XXXX XXXX
? ???? ????
-----
XXX1 XX1X (wanted)
```

```
X & 0 = 0
```

$X \& 1 = X$
 $X | 0 = X$
 $X | 1 = 1$

```
XXXX XXXX
| 0001 0010 (mask and operation)
-----
XXX1 XX1X
```

23.) Consider the following 32-bit binary number:

1000 0110 1111 1101 0000 0010 0000 0000

What is the value of this number, if treated as a 32-bit floating point number according to the IEEE-754 standard? Show all work.

Sign bit: 1
Exponent: 0000 1101
Mantissa: 111 1101 0000 0010 0000 0000

Sign is 1 (negative)
Exponent: $8 + 4 + 1 = 13$; $13 - 127 = -114$
Mantissa: $2^{-1} + 2^{-2} + 2^{-3} + 2^{-4} + 2^{-5} + 2^{-7} + 2^{-14} = 0.97662353515625$

Magnitude: $(1 + 0.97662353515625) * 2^{-114} = 9.517096137844945e-35$

Overall value: $-9.517096137844945e-35$

24.) Consider the following floating point number: 12.609375

Convert this to a 32-bit floating point number according to the IEEE-754 standard. Show all work, including each of the 8 steps.

Step 1: positive number, sign bit 0

Step 2: Integral portion: $12 = 1100$

Step 3: Fractional part: 0.609375

$0.609375 * 2 = 1.21875$; 1
 $0.21875 * 2 = 0.4375$; 0
 $0.4375 * 2 = 0.875$; 0
 $0.875 * 2 = 1.75$; 1
 $0.75 * 2 = 1.5$; 1
 $0.5 * 2 = 1.0$; 1

Step 4: normalization

1100.100111

left 3 places (exponent of 3)

Step 5: add bias

$$3 + 127 = 130$$

Step 6: bias to binary

1000 0010

Step 7: mantissa bits

1001 0011 1000 0000 0000 000

Step 8: putting it together

0 1000 0010 1001 0011 1000 0000 0000 000

0100 0001 0100 1001 1100 0000 0000 0000