METRO STATE UNIVERSITY

ICS 232 Computer Organization & Architecture
Homework 2 - Chapter 2 - 10 points
Due Date: 9/11/2024

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Note: Please post your homework to ICS232 D2L on or before the due date.

Chapter 2 – Data Representation

Essential Terms and Concepts

7. What does overflow mean in the context of unsigned numbers?
   It means nothing in the context of unsigned numbers. (textbook page 137)

18. What are the three components of a floating-point number?
   1. Sign bit
   2. Exponent
   3. Significand
   (textbook page 142)

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25. Explain the difference between ASCII and Unicode.

ASCII: (textbook page 158)

- American Standard Code for Information Language
- 7-bit codes
- 32 control characters, 10 digits, 52 letters, 32 special characters, and the space character.
- The high-order bit was intended to be used for parity.

Unicode: (textbook page 160 - 161)

- 16-bit alphabet that is downward compatible with ASCII and the Latin-1 character set.
- Enough capacity for every language in the world.
- Define an extension mechanism that will allow for the coding of an additional million characters.
- 5 character types
    1. Alphabets
    2. Symbols
    3. CJK
    4. Han
    5. User Defined

26. How many bits does a EBCDIC, ASCII and Unicode character require?

EBCDIC - 8 (textbook page 156)

ASCII – 7, but there is also 8-bit ASCII (textbook page 158)

Exercises

2. Perform the following base conversions using subtraction or division-remainder:

a) $588_{10} = 1001001100_2$

b) $2254_{10} = 4316_8$

c) $652_{10} = 28C_{16}$

d) $3104_{10} = C10_{16}$

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5. Perform the following base conversions.

a) $100011_2 = 43_8$

b) $4103_8 = 843_{16}$

c) $3236_{16} = 31066_8$

d) $13_{16} = 10011_2$

8. Convert the following decimal fractions to binary with a maximum of six places to the right of the binary point:

a) 25.84375 = 11001.11011_2

b) 57.55 = 111001.100110_2

c) 80.90625 = 10110000.11101_2

d) 84.874023 = 1010100.110111_2

10. Convert the following binary fractions to decimal:

a) 10111.1101 = 23.8125

b) 100011.10011 = 35.59375

c) 1010011.10001 = 83.53125

d) 11000010.111 = 194.875

15. Convert the hexadecimal number DEAD $BEEF_{16}$ to binary.

1101 1110 1010 1101 1011 1110 1110 1111 (added the spaces for readability)

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17. Represent the following decimal numbers in binary using 8-bit signed magnitude, one's complement, and two's complement representations:

a) 60

- Signed Magnitude: 00111100_2
- One's Complement: Positive numbers to not need one's or two's complement.
- Two's Complement: Positive numbers to not need one's or two's complement.

b) -60

- Signed Magnitude: 10111100_2
- One's Complement: 11000011_2
- Two's Complement: 11000100_2

c) 20

- Signed Magnitude: 00010100_2
- One's Complement: Positive numbers to not need one's or two's complement.
- Two's Complement: Positive numbers to not need one's or two's complement.

d) -20

- Signed Magnitude: 10010100_2
- One's Complement: 11101011_2
- Two's Complement: 11101100_2

22. What decimal value does the 8-bit binary number 10110100 have if:

a) it is interpreted as an unsigned number? 180
b) it is on a computer using signed-magnitude representation? 52
c) it is on a computer using one's complement representation? -75
d) it is on a computer using two's complement representation? -76
e) it is on a computer using excess-127 representation? 53

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33. Add the following unsigned binary numbers as shown.

```
a)  01000100   b)  01011011   c)  10101100
  + 10111011     + 00011111     + 00100100
```

11111111_2 01111010_2 11010000_2

44. Using arithmetic shifting, perform the following:

a) double the value 00010101_2 00101010_2

b) quadruple the value 01110111_2 111011100_2 (this would result in an overflow using 8-bit)

c) divide the value 11001010_2 in half 01100101_2

52. Show how each of the following floating-point values would be stored using IEEE-754 double precision (be sure to indicate the sign bit, the exponent, and the significand fields):

a) 12.5:

0 10000000010 1001000000000000000000000000000000000000000000000000

b) −1.5:

1 1111111111 1000000000000000000000000000000000000000000000000000

c) 0.75

0 0111111111 0100000000000000000000000000000000000000000000000000

d) 26.625

0 1000000011 1000000000000000000000000000000000000000000000000000

55. Given that the ASCII code for A is 1000001, what is the ASCII code for J?

01001010 or 74

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58. Decode the following ASCII message, assuming 8-bit ASCII characters and no parity:
    01001010 01001111 01001000 01001110 00100000 01000100 01001111 01000101

    JOHN DOE

X1. Encode the following four characters in Unicode:

    0 ∑ @ π(zero, summation, at-sign, pi)

    0 = 30
    ∑ = 2211
    @ = 40
    Π = 3C0

X2. Perform the following unsigned hexadecimal arithmetic:

```
a)  1AF4    b)  3DE7    c)  F938
  + 3304      + D496      - 395D
    ====        ======      ====
    10,210    54,422        78,485
```

X3. Decode the following hexadecimal ASCII message, assuming 8-bit ASCII characters:

    54 68 65 20 45 6E 64
    The End

On a Windows PC: Install WSL 2

1. Install WSL 2 by following these instructions:
   https://docs.microsoft.com/en-us/windows/wsl/install-win10
   You can install any Linux distribution you like. I used Ubunto.

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The following video may also help:
WSL2 Ubuntu GUI - Bing video
(https://www.bing.com/videos/search?q=wsl+ubuntu&&view=detail&mid=E14207E987583178E63EE14207E987583178E63E&&FORM=VRDGAR)

2. Install GCC compiler by
    a. Use `sudo apt update` to update the package database.
    b. Use `sudo apt upgrade` to make sure all of your packages are current.
    c. Use `sudo apt install gcc` to install the GNU C x86 and x86-x64 compiler.
    d. Use `sudo apt install gcc-multilib` to install the GNU C cross-compilation feature.
    e. Use `sudo apt install gdb` to install the GNU debugger.

On a Mac: You may need to install Xcode. Then use a terminal window which will act just like the WSL window.

3. Refer to https://stackoverflow.com/questions/2603489/how-do-i-compile-a-c-file-on-my-mac for more help.

If you unable to install a GCC compiler or run WSL on your PC, the web site Godbolt.org can also be used to compile the program. Make sure you use the correct compiler options.

Then either using WSL or the Mac terminal window:

4. Write or copy from the Internet any simple C program and run it. Include the program and the output here. Compile with `gcc <filename.c>` and run with `./a.out`.

Prepare for next class by reading Chapter 3 – Boolean Algebra and Digital Logic