

# Assignment 2 - Binary Arithmetic Operations

## ECE 222 - Digital Logic Design Lab

120200033 CSE Section 01

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## Questions 1:2

1) Obtain the 1's and 2's complements of the following binary numbers:

- a. 00010000
- b. 00000000
- c. 11011010
- c. 10101010

**Solution:**

| Binary Number | 1's complement | 2's complement |
|---|---|---|
| a) 00010000 | 11101111 | 11110000 |
| b) 00000000 | 11111111 | 100000000 |
| c) 11011010 | 00100101 | 00100110 |
| d) 10101010 | 01010101 | 01010110 |

2) Perform subtraction on the given unsigned binary numbers using the 2's complement of the subtrahend. Where the result should be negative, find its 2's complement and affix a minus sign:

- a. 10011 - 10010
- b. 100010 - 100110
- c. 1001 - 110101
- d. 101000 – 10101

**Solution:**

a) $10011 - 10010 \rightarrow (10011 + 01110)_2 = 100001 \Rightarrow 00001$ (Discard the Carry)

b) $100010 - 100110 \rightarrow (100010 + 011010)_2 = 111100 \Rightarrow -000100$

c) $1001 - 110101 \rightarrow (1001 + 001011)_2 = 010100 \Rightarrow -101100$

d) $101000 - 10101 \rightarrow (101000 + 01011)_2 = 110011 \Rightarrow 10011$ (Discard the Carry)

**Questions 3** 3) Formulate a weighted binary code for the decimal digits, using the following weights:

- a. 6, 3, 1, 1.
- b. 6, 4, 2, 1.

**Solution:**

| Decimal digit | 6,3,1,1 | 6,4,2,1 |
|---|---|---|
| 0 | 0000 | 0000 |
| 1 | 0001 | 0001 |
| 2 | 0011 | 0010 |
| 3 | 0100 | 0011 |
| 4 | 0101 | 0100 |
| 5 | 0111 | 0101 |
| 6 | 1000 | 1000 |
| 7 | 1001 | 1001 |
| 8 | 1011 | 1010 |
| 9 | 1100 | 1011 |
| 10 | 1101 | 1100 |
| 11 | 1111 | 1101 |
| 12 | — | 1110 |
| 13 | — | 1111 |

## Questions 4:5

4) Describe how can we assign a binary code in some orderly manner to the 52 playing cards. Use the minimum number of bits.

**Solution:**

Each card of the 52 has one of four suits(symbols) and a number from 1 to 10 or face cards(King,Queen,Jack); therefore a binary code that indicates the suit and the card number or face will suffice. For that we need a total of 6-bits and we can do the following

| — | ♣ (00) | ♦ (01) | ♠ (10) | ♥ (11) |
|---|---|---|---|---|
| 1 | 0001 | | | |
| 2 | 0010 | | | |
| 3 | 0011 | | | |
| 4 | 0100 | | | |
| 5 | 0101 | | | |
| 6 | 0110 | | | |
| 7 | 0111 | | | |
| 8 | 1000 | | | |
| 9 | 1001 | | | |
| 10 | 1010 | | | |
| King | 1011 | | | |
| Queen | 1100 | | | |
| Jack | 1101 | | | |

5) Convert decimal 6,514 to both BCD and ASCII codes. For ASCII, an even parity bit is to be appended at the left.

**Solution:**

In BCD : 6 5 1 4 $\Rightarrow$ 0110 0101 0001 0100

In ASCII : 6 5 1 4 $\Rightarrow$ 00110110 00110101 10110001 10110100 $1^{st}$ bit of every ASCII is the even parity bit

## Questions 6:8

6) Decode the following ASCII code:
1010011 1110100 1100101 1110110 1100101 0100000 1001010 1101111 1100010 1110011.

**Solution:**

S t e v e SP J o b s → Steve Jobs

7) The following is a string of ASCII characters whose bit patterns have been converted into hexadecimal for compactness: 73 F4 E5 76 E5 4A EF 62 73. Of the eight bits in each pair of digits, the leftmost is a parity bit. The remaining bits are the ASCII code:

- a. Convert the string to bit form and decode the ASCII.
- b. Determine the parity used: odd or even?

**Solution:**

a)
In bit form:
01110011 11110100 11100101 01110110 11100101 01001010 11101111 01100010 01110011
Decoded ASCII:
s t e v e J o b s → steveJobs
b) Odd Parity is used

8) What bit must be complemented to change an ASCII letter from capital to lowercase and vice versa?

**Solution:**

Only bit-6 as capital letters start with 100 while lowercase letters start with 110 and both uppercase and lowercase letters agree on the remaining 4 bits

## Questions 9

9) The state of a 12-bit register is 100010010111. What is the decimal equivalent of its content in each case if it represents?

- a. Three decimal digits in BCD.
- b. Three decimal digits in the excess-3 code.
- c. Three decimal digits in the 8 4 −2 −1 code.
- d. A binary number.

**Solution:**

a) (897)

b) (564)

c) (871)

d) (2199)

Tools used in creating this document:

- Texmaker 5.0.4
- Spyder IDE 5.1.5 with python 3.8.5



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