Capital University of Science and Technology

Department of Computer Science

CS2523 – Computer Organization and Assembly Language

ASSIGNMENT NO. 1

CLO: 2. Describe how the basic units of the Intel 8088 architecture work together to represent Integer Numbers, Floating Numbers and register representation inside the microprocessor. [C2-Understanding]

Semester: Summer 22 **Max Marks:** 10

Instructor: Ms. Tayyaba Zaheer

Assigned Date: August 12, 2022 **Due Date:** August 15, 2022

Name: **Reg. No.**

Guidelines:

You are required to submit the **screenshots of code and output of the program (where required) and concepts in your own words i.e. must be hand written** in the assignment file (word or pdf – pictures attached must be readable and in portrait mode) as **courseCode_studentReg#_studenName** via Microsoft Teams.

Important Note:

1) Must not copy from other students, so do it all yourself.
2) Assignment should be hand written.

Objectives:

After completion of this Assignment, you will have gained basic knowledge of computer organization and assembly. You will be able to understand different data representation techniques used in computers.

Data Representation: Topic: Number Systems, and Conversion between Decimal, Binary, Hexadecimal, and other bases. **Related Reading:** Class Lectures and Reading Material Shared with the assignment.

Tools/Software Requirement (Optional):

1. Microsoft Word.
2. emu8086.

Description:

Emu8086 is an 8086-microprocessor emulator and disassembler. Emu8086 permits to assemble, emulate and debug 8086 programs (16bit/DOS).

Tasks:

Task#1: Number systems: **(06 marks)**

Question#1: Convert Decimal 25 to binary:

Answer:

Given decimal number is 25.

Divide this number by 2 until the reminder is 0 or 1.

2 | 25

_____
2 | 12……1

_____
2 | 6…….0

_____
2 | 3…….0

_____
1…….1

So, the binary equivalent is,

$(25)_{10} = (11001)_2$

Question#2: Convert Decimal 451 to octal form:

Answer:

Given decimal number is 451

Start the division process

Start the division process

8 | 451

8 | 56 -- 3

8 | 7 -- 0

8 | 0 -- 7

Correct answer is the equivalent octal number for $(451)_{10}$ is $(7038)_8$

Question#3: Convert Decimal 146 to hexadecimal:

Answer:

46 is greater than 16 , so we have to divide by 16.

After dividing by 16 , quotient is 9 and remainder is 2.

remainder is less than 16.

the hexadecimal number of remainder is 2.

Quotient is 9 and hexadecimal number of remainder is 2.

so, the 92 is the hexadecimal number is equivalent to decimal number 146.

16 | 146
---
16 | 9 -- **2**
---
0 -- **9**

Correct answer is 92
Question#4: Convert Binary 01011101_2 to decimal number:
Answer:

Binary number is 01011101.

$01011101 = (0 \text{ X } 2^7) + (1 \text{ X } 2^6) + (0 \text{ X } 2^5) + (1 \text{ X } 2^4) + (1 \text{ X } 2^3) + (1 \text{ X } 2^2) + (0 \text{ X } 2^1) + (1 \text{ X } 2^0)$

$= (0 \text{ X } 128) + (1 \text{ X } 64) + (0 \text{ X } 32) + (1 \text{ X } 16) + (1 \text{ X } 8) + (1 \text{ X } 4) + (0 \text{ X } 2) + (1 \text{ X } 1)$

$= 0 + 64 + 0 + 16 + 8 + 4 + 0 + 1$

Correct answer is 93
Question#5: Convert Binary 1010101_2 to octal:
Answer:

Given binary number is 1010101_2

First we convert given binary to decimal

$1010101_2 = (1 * 2^6) + (0 * 2^5) + (1 * 2^4) + (0 * 2^3) + (1 * 2^2) + (0 * 2^1) + (1 * 2^0)$

$= 64 + 0 + 16 + 0 + 4 + 0 + 1$

$= 64 + 21$

$= 85$ (Decimal form)

Now we will convert this decimal to octal form

8 | 85

---
8 | 10 -- 5
---
8 | 1 -- 2
---

8 | 0 --1

Correct answer is equivalent octal form is 125_8
Question#6: Convert Binary 00010111 in hexadecimal number:
Answer:

The given binary number is 00010111

Now, we convert it first to decimal number

So, 00010111 =

$(0 \times 2^7) + (0 \times 2^6) + (0 \times 2^5) + (1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (1 \times 2^0)$

$= (0 \times 128) + (0 \times 64) + (0 \times 32) + (1 \times 16) + (0 \times 8) + (1 \times 4) + (1 \times 2) + (1 \times 1)$

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

= 23 (It is in decimal from)

Now, we have to change it to hexadecimal number.

So, 23 is greater than 16, so we have to divide it by 16.

After dividing by 16 , quotient is 1 and remainder is 7.

Remainder is less than 16.

The hexadecimal number of remainder is 7.

Quotient is 1 and hexadecimal number of remainder is 7.

That is, $23 = 16 \times 1 + \mathbf{7}$

$1 = 16 \times 0 + \mathbf{1}$

So, 17 is the hexadecimal number is equivalent to decimal number 23.

Question#7: Convert Octal 5746_8 to decimal:

Answer:

The given number is 5746_8

$5746_8 = (5 * 8^3) + (7 * 8^2) + (4 * 8^1) + (6 * 8^0)$

$=5 * 512 + 7 * 64 + 4 * 8 + 6 * 1$

$= 2560+448+32+6$

$= 3046$

The equivalent decimal number for 5746_8 is 3046

$5746_8 = 3046$

Question#8: Convert Octal 27_8 to a binary number:

Answer:

Given number is 27_8

$27_8 = (2 * 8^1) + (7 * 8^0)$

$= 2 * 8 + 7 * 1$

$= 16 + 7$

$= 23$(Decimal number)

Now convert this decimal number to a binary number.

2 | 23
2 | 11 -- 1
2 | 5 -- 1
2 | 2 --1
2 | 1 -- 0
2 | 0 -- 1

The binary number is 10111_2

$27_8 = 10111_2$

Question#9: Convert Octal 1002_8 to hexadecimal:

Answer:

The given number is 1002_8

$1002_8 = (1 * 8^3)+ (0 * 8^2) + (0 * 8^1) + (2 * 8^0)$

$=1 * 512 + 0 * 64 + 0 * 8 + 2 * 1$

$= 512 + 0 + 0+ 2$

$= 514$(decimal number)

Now we convert the above decimal to hexadecimal

16 | 514
16 | 32 --2
2 -- 0

The hexadecimal number is 202

$1002_8 = 202_{16}$

Question#10: Convert Hexadecimal CA_{16} to decimal:

Answer:

Given hexadecimal number is CA_{16}.

CA_{16}

$= 16^1 \times C + 16^0 \times A$

$= 16 \times C + 1 \times A$

$= 16 \times C + A$

$= 16 \times 12 + 9$

$= 192 + 9$

$= 202$

Answer is 202.

Question#11: Convert Hexadecimal $A2B_{16}$ to binary:

Answer:

Given hexadecimal number is A2B

$A2B_{16} = (A * 16^2) + (2 * 16^1) + (B * 16^0)$
$= (A * 256) + (2 * 16) + (B * 1)$

$= (10 * 256) + 32 + 11$

$= 2560 + 43$

$= 2603$(Decimal number)

Now we have to convert 2603 to binary

2 | 2603
2 |1301 -- 1
2 | 650 -- 1
2 | 325 -- 0
2 | 162 -- 1
2 | 81 -- 0
2 | 40 -- 1
2 | 20 -- 0
2 | 10 -- 0
2 | 5 -- 0
2 | 2 -- 1
2 | 1 -- 0
2 | 0 -- 1

The binary number is 101000101011_2

$A2B_{16} = 101000101011_2$

Question#12: Convert Hexadecimal 105_{16} to octal:

Answer:

Given hexadecimal number is 105

$105_{16} = (1 * 16^2) + (0 * 16^1) + (5 * 16^0)$

$= 1*256 + 0 * 16 + 5 * 1$

$=256 + 0 +5$

$= 261$(Decimal form)

Now we have to convert this decimal to octal

8 | 261
8 | 32 -- 5
8 | 4 -- 0
8 | 0 --4

The octal number is 405_8

$105_{16} = 405_8$

Task#2: Signed Numbers Representation: **(02 marks)**

Question: Find the signed magnitude of –130 using 8-bit binary sequence? If you think that -130 cannot be represented in 8 bits using signed magnitude representation then justify your answer.

Solution:

Binary representation of 130 is 10000010 i.e. 8 bits magnitude. Whereas in Signed Magnitude 8-bit representation most significant bit is reserved for Sign so magnitude can be 7 bits maximum.
Range of numbers that can be represented in 8 bits signed magnitude is -128 to +127 (-2^7 to (2^7 - 1)).
That is why, -130 would require at least 9 bits i.e. 110000010 in signed magnitude representation. So, we can represent the given number i.e. -130 in 16 bits which is word.

Task#3: Read the file "A01ReadingMaterial" shared with this assignment and answer the following questions: **(02 marks)**

Question#1: What are decimal, binary, octal and hexadecimal systems?

Question#2: Write the generic way to convert from decimal system to any other:

Question#3: Write the generic way to convert from any other system to decimal:

Question#4: How signed numbers can be represented? How overflow could happen in the given scenario of subtraction of two numbers?

Question#5: In emu8086, how you could access the handy tools to convert numbers? Differentiate between Base converter and Multi base calculator. What type of operations are supported or allowed?