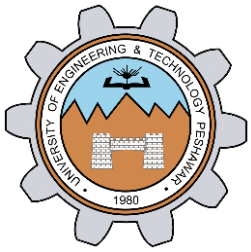
Numeric Formats

LAB # 03



CSE402L Digital Signal Processing Lab

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"On my honor, as a student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Student Signature: _____

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Thursday, December 24th, 2020

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Lab Objectives:

Objectives of this lab are as follows:

- Learning about different numeric formats

Task # 1:

Write a program that takes a decimal number from the user and prints its binary form.

Code:

```c
#include <stdio.h>

int main()
{
    int number,bit,i;
    printf("Enter a decimal number: ");
    scanf("%d",&number);
    printf("%d\n",number);
    printf("Binary representation of %d: ",number);
    for(i=31;i>=0;i--)
    {
        bit = number>>i;
        if(bit&1)
            printf("1");
        else
            printf("0");
    }
    return 0;
}
```

Output:

```
Breakpoint Hit at <ffa1138c>

Enter a decimal number: 37
Binary representation of 37: 00000000000000000000000000100101
Breakpoint Hit at <ffa1156a>
```

Task # 2:

In VisualDSP++ 4.5, write a program that computes addition, subtraction, multiplication and division on two numbers of type float and fract16, 20000 times. Study the Linear Profile of the processes.

Code:

```
#include <stdio.h>
#include <fract.h>


int main()
{
    float a=7.3,b=12.4,sum1,diff1,mult1,div1;
    fract16 c=7.3,d=12.4,sum2,diff2,mult2,div2;
    int i;

    for(i=0;i<20000;i++)
    {
        sum1=a+b;
        diff1=a-b;
        div1=a/b;
        mult1=a*b;

        sum2=c+d;
        diff2=c-d;
        mult2=c*d;
        div2=c/d;
    }
    return 0;
}
```

Output:

Linear Profiling: ADSP-BF537 Blackfin Memory Instruction Samples 1

Histogram	%	Execution Unit
	37.72%	___float32_add
	35.21%	___float32_div
	13.17%	___float32_mul
	9.76%	main()
	3.25%	___div32
	0.89%	___float32_sub
	0.00%	start
	0.00%	_mi_initialize
	0.00%	_exit
	0.00%	__getargv
	0.00%	__install_default_handlers
	0.00%	PC[0xffa10b42]
	0.00%	PC[0xffa10b40]

Questions:

1. What is the value 16-bit number 0x8888 in the following formats: Binary, Signed Integer, Unsigned Integer, Signed Fractional, Unsigned Fractional?

   Answer:

   Binary**:** 1000100010001000

   Signed int: -2^15+2^11+2^7+2^3 = -30584

   Unsigned int : 2^15+2^11+2^7+2^3 = 34952

2. What is the 16-bit 2's complement number representing the same value as the 8-bit numbers 01001100 and 10001110?

   Answer:

   0000000001001100: 1111111110110100

   0000000010001110: 1111111101110010

3. What is the decimal fractional number corresponding to the Q-7 format binary numbers 10010001, 01101100, 11010101 and 00011111?

   Answer:

   10010001 = 2^6+2^3+2^(-1) = 72.5.

   01101100 = 2^5+2^4+2^2+2^1 = 54

   11010101 = 2^6+2^5+2^3+2^1+2^(-1) = 106.5

   00011111 = 2^4+2^2+2^1+2^0+2^(-1) = 23.5

4. What are the drawbacks of scaling?

   Answer:

   Drawbacks:

   - Changes in frequency might occur.
   - Consumes Memory.
   - Overflow

5. For Q-7, perform 11100101+11111000, 00101101+10011101 and 10110011-11101110. Does overflow occur in any of them?

   Answer:

```
  11100101
+11111000
  ----------
 111011101 (OverFlow)

  00101101
+10011101
  ----------
  11001010 (No OverFlow)

  10110011
 -11101110
  ----------
  0110100001 (OverFlow)
```