Tutorial 3: Number Systems

Problem 1: Data Representation

Consider the number \( A = 0x\text{F2} \). What is the value of this number when represented in; 8-bit unsigned number, 8-bit sign-magnitude, 8-bit one's complement, and 8-bit two's complement?

Unsigned: \( 1 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^1 = 128 + 64 + 32 + 16 + 2 = 242 \)

Signed-magnitude: \( -(1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^1) = -(64 + 32 + 16 + 2) \)
\( = -114 \)

One's complement: \( (1 \times 2^7 - 1) + 1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^1 = 128 + 64 + 32 + 16 + 2 = -13 \)

Two's complement: \( -1 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^1 = -128 + 64 + 32 + 16 + 2 = -14 \)

Problem 2: Data Types

Consider the C code in Figure 1. Answer the following questions.

What are the outputs of the printf statements?

What are the outputs of the printf statements if \( (a = 0x\text{FFFFFFE5}) \) and \( (b = 0x\text{FFFFFFE5}) \)?

```c
#include <stdio.h>

int main (void)
{
    int a = 0xE5;
    char b = 0xE5;

    printf("integer = \"\%d\"\n\n", a);
    printf("char = \"\%d\"\n\n", b);
    return 0;
}
```

Figure 1: Program on Data Type Conversion
Problem 3: More Data Type Conversion

Consider the C code in Figure 4. Answer the following questions.

Which of the print statements will be printed out?

```c
#include <stdio.h>
int main (void)
{
    unsigned int a =0xFFFFFFFB;
    int b =0xFFFFFFFB;
    char c = 0xFD;

    if (a < (unsigned) c)
        {printf("a < c \n\n");}
    if (b < (int) c)
        {printf("b < c \n\n");}
    return 0;
}
```

Figure 4: Program on Data Type Conversion

Problem 4: Binary Prefixes

How much is $2^{27}$ Byes?

We need to access a memory organisation as large as 2.4 Mi Bytes. How many address lines are required for this purpose?