

Exercise Sheet 3
 # Data representation

Directive: the use of the calculator is not permitted, except for complicated operations.

Exercise 1

- Convert the following numbers to Gray code : 28 29 96
- Find the decimal value for each Gray code : $(11000)_{gc}$ $(10001)_{gc}$ $(1110111)_{gc}$

Exercise 2

- Convert the following numbers (8-bits) to sign-magnitude representation, 1's and 2' complement.
 +35 -43 -79 -128
- Complete the following table by the decimal equivalent

		Decimal
Unsigned integer	$(00011010)_2$	
	$(10001101)_2$	
Signed-Magnitude	$(00101100)_2$	
	$(10001110)_2$	
1's complement	$(00010111)_2$	
	$(11001011)_2$	
2's complement	$(00011001)_2$	
	$(10101110)_2$	

Exercise 3

In JAVA, signed integers are represented in 2's complement with different types.

byte: (1 byte) **short:** (2 bytes)

int: (4 bytes) **long:** (8 bytes)

- For each type, find the range of the possible values.
- The following program is written in JAVA
 - Perform the addition operation ($c=a+b$) in each case and mention the overflow problem.
 - Propose a solution to the problem.
- Is the following instruction correct? `short a=45000;`

```
public static void main(String []args)
{
    byte a,b,c;
    a=18;
    b=25;
    c=a+b; // 1st case

    a=96;
    b=50;
    c=a+b; // 2nd case

    a=77;
    b=-50;
    c=a+b; // 3rd case

    a=-50;
    b=-80;
    c=a+b; // 4th case
}
```

Exercise 4

1. Express the following numbers in IEEE 754 single-precision. (abbreviate the results in Hexa)

$$+ 19 \qquad - 0.625 \qquad - 33.0625 \qquad - \frac{17.25}{64} \qquad \frac{0}{0}$$

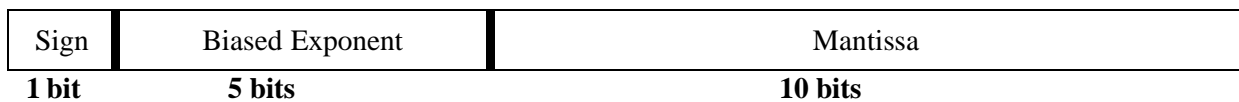
2. Write the decimal equivalent for the following IEEE 754 floating point numbers

Single-Precision: $(42960000)_{16}$ $(C1640000)_{16}$ $(BFA00000)_{16}$ $(7FD40000)_{16}$
Double-Precision: $(C044200000000000)_{16}$ $(4049800000000000)_{16}$

Extra exercises

Exercise #1

Assume that a computer represents real numbers in 16-bit floating point



1. What is the value of the bias (shift)?
2. Represent the following values: -9.25 +100.75
3. Abbreviate the results in Hexadecimal.

Exercise #2

Consider the following C++ code

- **short:** integer type in 16-bit 2's complement
- **float:** real type in IEEE 754 single precision
- **double:** real type in IEEE 754 double precision

```

{
  short A, B ;
  float X, Y;
  double Z;
  A=-99 ;
  B= 128 ;
  X=A-0.25 ;
  Y=A*B ;
  Z=X ;
}

```

Questions

1. Express the internal representations of all variables A,B,X,Y and Z, and abbreviate the results in hexadecimal.
2. Find the decimal values of the following numbers.

short $(0015)_{16}$ $(8044)_{16}$
float $(C0E80000)_{16}$ $(7FE00000)_{16}$
double $(C044200000000000)_{16}$ $(7FF0000000000000)_{16}$

help : $2^{15} = 32768$