Tutorial series 2

Exercise 1

1. Let $N_1 = (-75)_{10}$ and $N_2 = (+95)_{10}$.
   - Represent N_1 and N_2 in 8-bit 1's Complement representation.
   - Calculate $N_1 + N_2$.
2. Let $N_3 = (10000011)_2$ and $N_4 = (00001010)_2$. Knowing that N_3 and N_4 are represented in 8-bit Sign and Magnitude (S&M) format,
   - calculate $N_3 + N_4$ in 2's Complement.
3. Let $N_5 = (01011111)_2$ and $N_6 = (01001100)_2$. Knowing that N_5 and N_6 are represented in 8-bit Sign and Magnitude:
   - Calculate $N_5 + N_6$ in 2's Complement. Provide the result in 2's Complement and decimal.
   - Represent N_5 and N_6 in decimal, then calculate $N_5 + N_6$.
   - What do you observe about the two obtained results? What conclusion can you draw?
4. Let $N_7 = (-128)_{10}$. Represent N_7 in Sign and Magnitude, 1's Complement, and 2's Complement formats using 8 bits. What do you notice? What conclusion can you draw?
5. Encode $|N_7|$ in Direct-Coded Binary (DCB) and Gray code (as seen in the appendix).
6. Assuming N_3 and N_5 are represented in DCB, provide their decimal values.

Exercise 2

In a machine, signed integers are represented on a 16-bit register.

1. Provide the [min, max] interval for decimal values that can be represented in 2's complement.
2. Perform the following operations in 2's complement:

   52 + 13 83 + 50 99 – 20 - 65 - 95

3. Repeat the previous calculations while representing the numbers using 8 bits? (Indicate cases of overflow).
4. When does an overflow occur in 2's complement?

Exercise 3

1. Represent the following real numbers in single-precision floating-point format (IEEE 754):

   + 18 -0.25 -32.625 +144.75

2. Convert the following numbers (expressed in IEEE 754 single-precision) into decimal:

   $(41960000)_{16}$ $(C1720000)_{16}$ $(BD800000)_{16}$ $(C2E00000)_{16}$

3. Provide the representation of the following values:

   +0 - 0 $+\infty$ $-\infty$

4. Convert the following numbers (written in IEEE 754 double-precision) into decimal:

   $(C044100000000000)_{16}$ $(4029800000000000)_{16}$

Exercise 4

The C programming language has the following main data types:

- `short`: Signed integer numbers represented in 2's complement on 16 bits.
- `int`: Signed integer numbers represented in 2's complement on 32 bits.
- `float`: Real numbers represented in IEEE754 single-precision format on 32 bits.
- `double`: Real numbers represented in IEEE754 double-precision format on 64 bits.

The following sequence of code is written in C:

```
short A ;
int B,C ;
float X,Y ;
double Z ;
{……
      A = 15 ;
      B = 128;
      C = - 32 ;
      X = - 63.5 ;
      Y = 0.03125 ;
      Z = -15.25
……
}
```

Questions :

1. Represent the variables `A,B,C,X,Y,Z` in binary.
2. Abbreviate the representations of variables `X` and `Z` in hexadecimal.
3. Provide the ranges of representable values for each type: `short, int, float, double`.
4. Provide the ranges of representable values for the two types: `unsigned short, unsigned int`.

Exercise 5

1. Encode the following string in ASCII: « **TC-INGENIEUR INFORMATIQUE** ».
2. What needs to be changed to convert the previous string to lowercase?
3. Complete the following tables:

Decimal	**19**		**59**	
DCB		**0010 0001**		**0011 1010**

Number	**$(111\ 1100)_2$**	**$(101\ 1110)_2$**	**$(92)_{10}$**	**$(74)_{10}$**
Gray Code				

Computer Architecture 1

Annex Tuto 02: Character coding tables

ASCII Table:

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0X	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	HT	LF	VT	FF	CR	SO	SI
1X	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
2X	SP	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3X	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4X	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5X	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6X	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7X	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	DEL

Extended Arabic ASCII Table:

8-	€	پ	‚	*f*	„	…	†	‡	ˆ	‰		‹	Œ	≒	ڤ	
9-	ک	‘	’	“	”	•	–	—		™		›	œ	ZNJ	ZJ	
A-		،	¢	£	¤	¥	¦	§	¨	©		«	¬	-	®	¯
B-	°	±	²	³	´	µ	¶	·	¸	¹	؛	»	¼	½	¾	؟
C-		ء	آ	أ	ؤ	إ	ئ	ا	ب	ة	ت	ث	ج	ح	خ	د
D-	ذ	ر	ز	س	ش	ص	ض	×	ط	ظ	ع	غ	ـ	ف	ق	ك
E-	à	ل	â	م	ن	ه	و	ç	è	é	ê	ë	ى	ي	î	ï
F-	ً	ٌ	ٍ	َ	ô	ُ	ِ	÷	ّ	ù	ْ	û	ü	LRM	LRM	