CS 145 Day 16 worksheet – representing data

Part A: integers in 8-bit two's complement

1. Convert each bit sequence from signed 8-bit two's complement to decimal.

	-2^7 = −128	2^6 = 64	2^5 = 32	2^4 = 16	2^3 = 8	2^2 = 4	2^1 = 2	2^0 = 1	Decimal
a. 00100010	0	0	1	0	0	0	1	0	34
b. 11110000	1	1	1	1	0	0	0	0	−16
c. 10000001	1	0	0	0	0	0	0	1	−127

2. Write each negative number in two's complement: write the positive number, flip every bit, then add 1.

	-2^7 = −128	2^6 = 64	2^5 = 32	2^4 = 16	2^3 = 8	2^2 = 4	2^1 = 2	2^0 = 1
a. 9	0	0	0	0	1	0	0	1
flip	1	1	1	1	0	1	1	0
add 1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
−9	1	1	1	1	0	1	1	1
b. 100	0	1	1	0	0	1	0	0
flip	1	0	0	1	1	0	1	1
add 1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
−100	1	0	0	1	1	1	0	0

3. Add. Write each carry in the top row, and drop a carry out of the left end.
Then check in Thonny, e.g., `bin(45 - 12)`

	Binary								Check in decimal
carries	1	1	1	1	1	1			
	0	**0**	**1**	**0**	**1**	**1**	**0**	**1**	= 32+8+4+1 = 45
+	**1**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	= −128+64+32+16+4 = −12
sum	0	0	1	0	0	0	0	1	= 32+1 = 33

Part B: text

Use this ASCII table. The row is the first hex digit and the column is the second, so "A" is 41 in hex.
The × 16 column gives the row's value in decimal.

	× 16	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
2	32	sp	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3	48	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	64	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	80	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6	96	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	112	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	del

4. These hex bytes are ASCII codes. What word do they spell? Then check in Thonny, e.g., `chr(0x43)`

43	53	43	49
C	S	C	I

5. Write the ASCII codes for "Go". Then check in Thonny, e.g., `hex(ord("o"))` or `ord("G")`

	G	o
a. In hex	47	6F
b. In decimal	71	111

$47_{16} = 64 + 7 = 71$

$6F_{16} = 96 + 15 = 111$

6. What does `chr(ord("g") - 32)` give? Then check in Thonny by typing it.

"G"

"g" in hex: 67

decimal: 96 + 7 = 103

103
−32
71 ← ASCII for "G"