Homework 1

● Graded

Student

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Total Points

100 / 100 pts

Question 1

Overview — **0** / 0 pts

✓ **+ 0 pts** Correct

+ 0 pts Incorrect

Question 2

Decimal ↔ Binary — **16** / 16 pts

2.1 **(no title)** — **6** / 6 pts

✓ **+ 6 pts** Correct (1110 0101)

+ 0 pts Incorrect

2.2 **(no title)** — **6** / 6 pts

✓ **+ 6 pts** Correct (-53)

+ 0 pts Incorrect

2.3 **(no title)** — **4** / 4 pts

✓ **+ 4 pts** Correct (5.375)

+ 0 pts Incorrect

Question 3

Hexadecimal ↔ Binary — **12** / 12 pts

3.1 **(no title)** — **6** / 6 pts

✓ **+ 6 pts** Correct (0xFFFA)

+ 0 pts Incorrect

3.2 **(no title)** — **6** / 6 pts

✓ **+ 6 pts** Correct (0010 1100 0111 0011)

+ 0 pts Incorrect

Question 4

2's Complement

24 / 24 pts

4.1 (no title)

6 / 6 pts

✓ **+ 6 pts** Correct (1000 1100, No)

+ 3 pts 1/2 correct

+ 0 pts Incorrect

4.2 (no title)

6 / 6 pts

✓ **+ 6 pts** Correct (0100 1110, Yes)

+ 3 pts correct addition, wrong overflow

+ 0 pts Incorrect

4.3 (no title)

6 / 6 pts

✓ **+ 6 pts** Correct - Mentions that any hexadecimal number x8 or above will be considered negative

+ 0 pts Incorrect

4.4 (no title)

6 / 6 pts

✓ **+ 6 pts** Correct, explains one of below reasons or provides another form of valid reasoning:

1. there are two representation for zero in signed magnitude
2. makes arithmetic difficult when there are sign bits
3. no new hardware for subtraction vs. addition

+ 3 pts Partially correct - reasoning incomplete or slightly incorrect

+ 0 pts Incorrect

Question 5

Octal **16** / 16 pts

5.1 Hexadecimal to Octal **2** / 2 pts

✓ **+ 2 pts** Correct (0o3, 0o10, 0o13, 0o17)

+ 1.5 pts 3/4 correct

+ 1 pt 2/4 correct

+ 0.5 pts 1/4 correct

+ 0 pts Incorrect

5.2 Octal to Binary **4** / 4 pts

✓ **+ 4 pts** Correct (111 011 010 101)

+ 0 pts Incorrect

5.3 Binary to Octal **4** / 4 pts

✓ **+ 4 pts** Correct (0o1726)

+ 0 pts Incorrect

5.4 (no title) **6** / 6 pts

✓ **+ 6 pts** Correct - explains shortcut that includes grouping into 3 bits for one octal numeral

+ 3 pts Partially correct - incorrect or incomplete explanation

+ 0 pts Incorrect

Question 6

ASCII Conversion **10** / 10 pts

6.1 (no title) **5** / 5 pts

✓ **+ 5 pts** Correct (Code)

+ 0 pts Incorrect

6.2 (no title) **5** / 5 pts

✓ **+ 5 pts** Correct (2110fun!)

+ 0 pts Incorrect

Question 7

Decimal ↔ IEEE Floating Point **12** / 12 pts

7.1 (no title) **6** / 6 pts

✓ **+ 6 pts** Correct (3.625)

+ 0 pts Incorrect

7.2 (no title) **6** / 6 pts

✓ **+ 6 pts** Correct (0xC0B80000)

+ 0 pts Incorrect

Question 8

Bitwise Operators **10** / 10 pts

8.1 (no title) **6** / 6 pts

+ 0 pts Incorrect

✓ **+ 6 pts** Correct (19)

8.2 (no title) **4** / 4 pts

+ 0 pts Incorrect

✓ **+ 4 pts** Correct (^)

Question 9

[OPTIONAL] Tell us a joke! **0** / 0 pts

✓ **+ 0 pts** Click here to replace this description.

Q1 Overview
0 Points

This homework is worth a total of 100 points.

Try not to use calculators or any other computer aides in working these problems, except to double-check your responses. Why? The quizzes will not allow either of these.

Formatting

Binary

No subscript or prefix. That is, if you're trying to write 8 as a binary number, write `1000`, instead of `1000_2` or `0b1000`.

Put a space between every *four* bits.

Examples: `0000 0000`, `0101 1110`

Hexadecimal

Use the `0x` prefix, but no subscripts. Do not put any spaces.

Capitalize all letters.

Examples: `0xBEEF`, `0xFEED`

Decimal

No subscript or prefix. Do not put any spaces.

Examples: `-1003`, `45`

Strings

Do not include any quotation marks.

Q2 Decimal ↔ Binary
16 Points

For each of the problems below, you will be asked to convert a **decimal** number to its 2's complement representation and vice versa. You should use eight bits for all conversions to **binary**.

Q2.1
6 Points

Convert `-27` to eight-bit 2's complement **binary**.

Remember to put a space between every *four* bits.

1110 0101

Q2.2
6 Points

Interpret `1100 1011` as eight-bit 2's complement **binary**, and convert it to **decimal**.

-53

Q2.3
4 Points

Convert the **unsigned binary number** `0101.0110` to decimal.

5.375

Q3 Hexadecimal ↔ Binary

12 Points

For each of the problems below, you will be asked to convert a **binary** number to its **hexadecimal** representation and vice versa. You should use *sixteen bits* for all conversions to **binary** and *four* **hexadecimal** digits for conversion to **hexadecimal**.

Q3.1

6 Points

Take the following 2's complement **binary** number 1010 *sign*-extended to *sixteen* bits, and convert the resulting *sixteen*-bit binary number to **hexadecimal**.

Use the `0x` prefix, but no subscripts. Do not put any spaces. Capitalize all letters.

0xFFFA

Q3.2

6 Points

Convert `0x2C73` to **binary**.

0010 1100 0111 0011

Q4 2's Complement

24 Points

Q4.1

6 Points

Calculate the sum of the following two 8-bit 2's complement binary numbers:
`1001 1101 + 1110 1111`

Write your answer as an *eight-bit* 2's complement **binary** number.

Remember to put a space between every *four* bits.

1000 1100

Was there 2's Complement overflow?

○ Yes

● No

Q4.2

6 Points

Calculate the sum of the following two 8-bit 2's complement binary numbers:
`1000 1001 + 1100 0101`

Write your answer as an *eight-bit* 2's complement **binary** number.

Remember to put a space between every *four* bits.

0100 1110

Was there 2's Complement overflow?

● Yes

○ No

Q4.3
6 Points

Briefly explain a rule for determining whether 2's complement would interpret a single-digit hexadecimal number as encoding a negative integer.

Note: Your rule must refrain from converting the **hexadecimal** digit to **binary**. It must be able to tell if a hexadecimal number is positive or negative, **without intermediate conversion**, i.e., converting hexadecimal to binary followed by checking the most significant bit for a 1 or 0.

In 2's complement a given number is negative when the most significant bit is a 1.

A single hexadecimal digit corresponds to the four binary bits. The most significant bit is the leftmost bit. The negative numbers would therefore be represented as 1000, 1001, 1010, 1011, 1100, 1101, 1110, 1111. These correspond to 8, 9, A, B, C, D, E, F in Hexadecimal. Hence, if the encoded hexadecimal begins with [8,9,A,B,C,D,E or F] then it represents a negative binary number. Based on the above explanation, if the binary bits represent a value greater than or equal to 8 i.e (greater than or equal to 1000 in binary), the encoded number in negative and the corresponding hexadecimal will begin with 8-F.

Q4.4
6 Points

Explain **one** reason why computer scientists prefer to use **2's complement** to represent positive and negative integers in binary rather than with signed-magnitude.

Please use *three sentences or less*.

A benefit of the 2’s Complement number system is that the algorithm and hardware used for addition can also be used for subtraction operations. This is achived by simply adding the additive inverse of that number. Also adding a positive and negative number using 2's complement will never cause an overflow.

Q5 Octal

16 Points

Octal is a base 8 system. For instance, 8 in **decimal** is 10 in **octal**. We use the prefix `0o` (numeral zero, lowercase o) to signal that a number is in **octal format**

Q5.1 Hexadecimal to Octal

2 Points

Answer the questions below by converting the following **hexadecimal** values to their **octal** values using the fewest possible octal digits.

Use the `0o` *prefixes in your answers*.

`0x3`

0o3

`0x8`

0o10

`0xB`

0o13

`0xF`

0o17

Q5.2 Octal to Binary

4 Points

Convert the following **octal** number `0o7325` into **binary**.

*Do not include prefixes in your answer. Use a space between every **three** bits.*

111 011 010 101

Q5.3 Binary to Octal
4 Points

Convert the following **binary** number `001 111 010 110` into **octal**.

Use the `0o` prefix in your answer, but no subscripts. Do not put any spaces.

0o1726

Q5.4
6 Points

Explain a **shortcut** for converting **directly** between octal and binary numbers.

Your explanation should have **no intermediate conversions to decimal**.

Use three sentences or less.

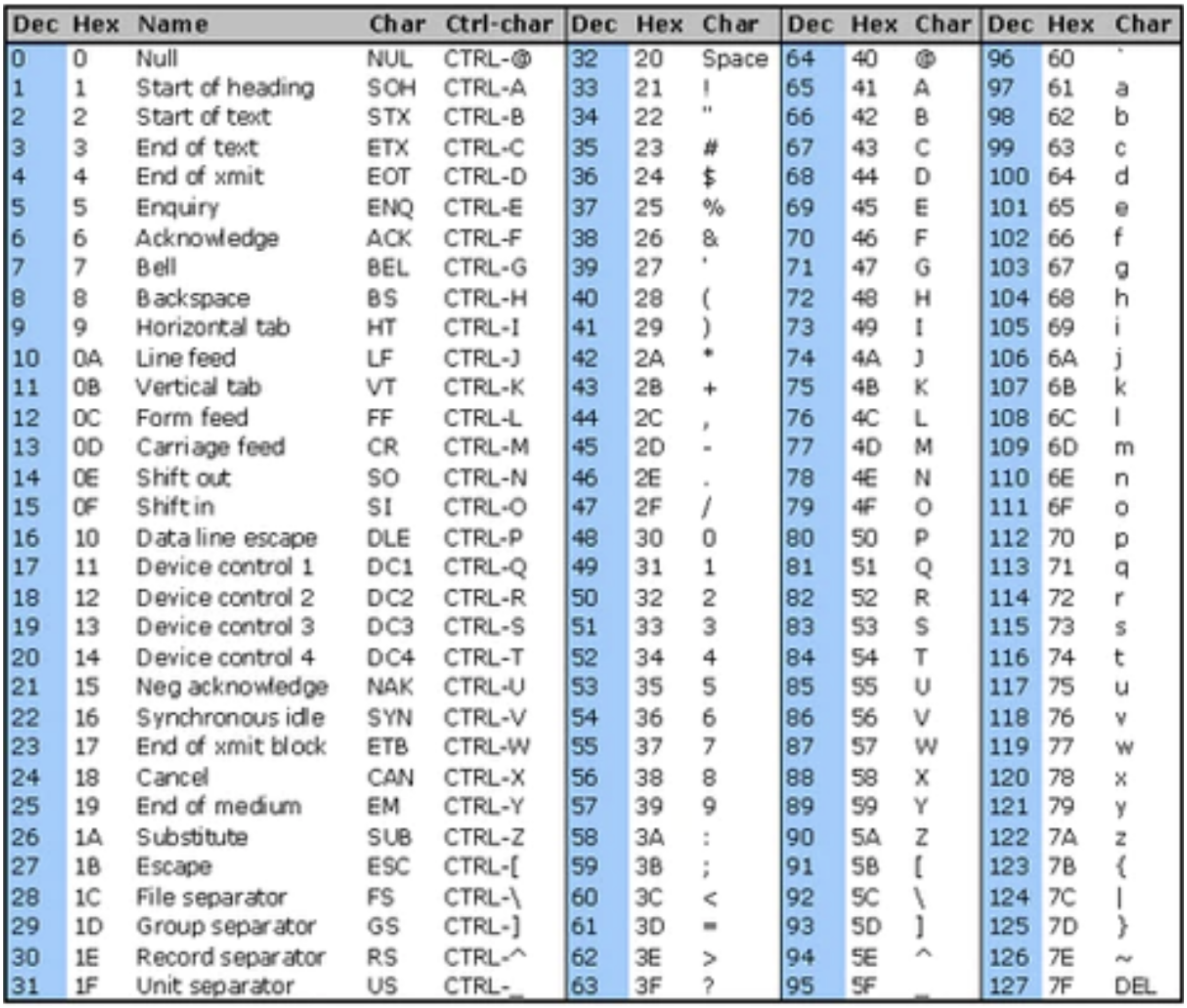
Each octal digit represents three binary digits. Traverse the octal digit by digit, so 0 maps to 000, 1 to 001, 2 to 010, 3 to 011, 4 to 100, 5 to 101, 6 to 110, 7 to 111. Group these together to form the binary equivalent.

Q6 ASCII Conversion

10 Points

In the following problem, you will be given a *thirty-two* bit binary number. You will be asked to interpret it as an ASCII string.

Here is an ASCII Table to help with the conversions:



Dec	Hex	Name	Char	Ctrl-char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	0	Null	NUL	CTRL-@	32	20	Space	64	40	@	96	60	`
1	1	Start of heading	SOH	CTRL-A	33	21	!	65	41	A	97	61	a
2	2	Start of text	STX	CTRL-B	34	22	"	66	42	B	98	62	b
3	3	End of text	ETX	CTRL-C	35	23	#	67	43	C	99	63	c
4	4	End of xmit	EOT	CTRL-D	36	24	$	68	44	D	100	64	d
5	5	Enquiry	ENQ	CTRL-E	37	25	%	69	45	E	101	65	e
6	6	Acknowledge	ACK	CTRL-F	38	26	&	70	46	F	102	66	f
7	7	Bell	BEL	CTRL-G	39	27	'	71	47	G	103	67	g
8	8	Backspace	BS	CTRL-H	40	28	(	72	48	H	104	68	h
9	9	Horizontal tab	HT	CTRL-I	41	29	)	73	49	I	105	69	i
10	0A	Line feed	LF	CTRL-J	42	2A	*	74	4A	J	106	6A	j
11	0B	Vertical tab	VT	CTRL-K	43	2B	+	75	4B	K	107	6B	k
12	0C	Form feed	FF	CTRL-L	44	2C	,	76	4C	L	108	6C	l
13	0D	Carriage feed	CR	CTRL-M	45	2D	-	77	4D	M	109	6D	m
14	0E	Shift out	SO	CTRL-N	46	2E	.	78	4E	N	110	6E	n
15	0F	Shift in	SI	CTRL-O	47	2F	/	79	4F	O	111	6F	o
16	10	Data line escape	DLE	CTRL-P	48	30	0	80	50	P	112	70	p
17	11	Device control 1	DC1	CTRL-Q	49	31	1	81	51	Q	113	71	q
18	12	Device control 2	DC2	CTRL-R	50	32	2	82	52	R	114	72	r
19	13	Device control 3	DC3	CTRL-S	51	33	3	83	53	S	115	73	s
20	14	Device control 4	DC4	CTRL-T	52	34	4	84	54	T	116	74	t
21	15	Neg acknowledge	NAK	CTRL-U	53	35	5	85	55	U	117	75	u
22	16	Synchronous idle	SYN	CTRL-V	54	36	6	86	56	V	118	76	v
23	17	End of xmit block	ETB	CTRL-W	55	37	7	87	57	W	119	77	w
24	18	Cancel	CAN	CTRL-X	56	38	8	88	58	X	120	78	x
25	19	End of medium	EM	CTRL-Y	57	39	9	89	59	Y	121	79	y
26	1A	Substitute	SUB	CTRL-Z	58	3A	:	90	5A	Z	122	7A	z
27	1B	Escape	ESC	CTRL-[	59	3B	;	91	5B	[	123	7B	{
28	1C	File separator	FS	CTRL-\	60	3C	<	92	5C	\	124	7C	|
29	1D	Group separator	GS	CTRL-]	61	3D	=	93	5D	]	125	7D	}
30	1E	Record separator	RS	CTRL-^	62	3E	>	94	5E	^	126	7E	~
31	1F	Unit separator	US	CTRL-_	63	3F	?	95	5F	_	127	7F	DEL

Q6.1

5 Points

Write `0100 0011 0110 1111 0110 0100 0110 0101` as an ASCII string.

Remember to not include any quotation marks.

Code

Q6.2
5 Points

Write `0x3231313066756E21` as an ASCII string.

Remember to not include any quotation marks.

2110fun!

Q7 Decimal ↔ IEEE Floating Point

12 Points

For each of the problems below, you will be asked to convert a decimal to **IEEE-754 floating point** and vice versa.

Q7.1

6 Points

Convert `0 10000000 11010000000000000000000`, which is a *thirty-two* bit IEEE-754 floating point number, into **decimal**.

3.625

Q7.2

6 Points

Convert `-5.75` to *thirty-two* bit IEEE-754 Floating Point representation, then convert the resulting *thirty-two* bit Floating Point number to **hexadecimal**. Your answer should contain *eight* **hexadecimal** symbols.

Use the `0x` prefix, but no subscripts. Do not put any spaces. Capitalize all letters.

0xC0B80000

Q8 Bitwise Operators

10 Points

In each of the following subproblems, you will be asked to evaluate expressions containing bitwise operators.

Bitwise Operator	Character
AND	`&`
OR	`|`
XOR	`^`
NOT	`~`

Q8.1

6 Points

What value results from `(18 | 27) & 23`? Write your answer in **decimal**. Assume these are decimal **unsigned** integers and our answer is **non-negative**.

19

Q8.2

4 Points

Which logical operator will allow you to **toggle** the the bit at index 6 (where the rightmost bit is at index 0) in `1100 0111` using bitmask `0100 0000`?

Enter just the character that denotes this operation.

Terminology:
toggle - flipping a bit (1 becomes 0, 0 becomes 1)
bit 6 - the bit in the bolded position: 0**0**00 0000

^

Q9 [OPTIONAL] Tell us a joke!

0 Points

Your TAs need some cheering up. Tell us your best **school-appropriate** CS-themed joke, or upload a meme.

This question is worth 0 points, but the best jokes/memes will be put up in the Office Hours room!

Some people don't enjoy CS jokes. Not one bit.

No files uploaded