Homework 2

ECE2504 CRN:82729

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Question 1: (4 pts) Represent the decimal number 5293 in BCD, excess-3 code, ASCII, and hex.

Hex: $5293 = (1 \times 16^3) + (4 \times 16^2) + (10 \times 16^1) + (13 \times 16^0) = 14AD$
BCD: $5293 = (5)0101\ (2)0010\ (9)1001\ (3)0011 = 0101\ 0010\ 1001\ 0011$
Excess-3: $5293 = 1000\ 0101\ 1100\ 0110$

$$\begin{aligned} 5293 &= (5+3)\ (2+3)\ (9+3)\ (3+3) \\ &= (8)1000\ (5)0101\ (12)1100\ (6)0110 \\ &= 1000\ 0101\ 1100\ 0110 \end{aligned}$$

ASCII: $5293 = 0110101\ 0110010\ 0111001\ 0110011$

$$\begin{aligned} 5293 &= (5)011\ 0101\ (2)011\ 0010\ (9)011\ 1001\ (3)011\ 0011 \\ &= 0110101\ 0110010\ 0111001\ 0110011 \end{aligned}$$

Question 2: (8 pts) Write your name in ASCII using an 8-bit code. Use uppercase and lowercase letters appropriately. Include a space between names. Give your final answers in hex.

a) With the leftmost bit always 0.

$$\begin{aligned} Jacob\ Abel &= (J)(a)(c)(o)(b)(\ )(A)(b)(e)(l) \\ &= (10_{10} + 40_{16})(1_{10} + 60_{16})(3_{10} + 60_{16})(15_{10} + 60_{16})(2_{10} + 60_{16}) \\ &\quad (20_{16})(1_{10} + 40_{16})(2_{10} + 60_{16})(_{10}{+}60_{16})(12_{10} + 60_{16}) \\ &= 4A\ 61\ 63\ 6F\ 62\ 20\ 41\ 62\ 65\ 6C \end{aligned}$$

b) With the leftmost bit assigned to produce odd parity

$$\begin{aligned} Jacob\ Abel &= (J)(a)(c)(o)(b)(\ )(A)(b)(e)(l) \\ &= (4A)01001010\ (61)01100001\ (63)01100011\ (6F)01101111\ (62)01100010 \\ &\quad (20)00100000\ (41)01000001\ (62)01100010\ (65)01100101\ (6C)01101100 \\ &= (03)01001010\ (03)01100001\ (04)01100011\ (06)01101111\ (03)01100010 \\ &\quad (01)00100000\ (02)01000001\ (03)01100010\ (04)01100101\ (04)01101100 \\ &= (03)01001010\ (03)01100001\ (04)11100011\ (06)11101111\ (03)01100010 \\ &\quad (01)00100000\ (02)11000001\ (03)01100010\ (04)11100101\ (04)11101100 \\ &= (4A)01001010\ (61)01100001\ (73)11100011\ (7F)11101111\ (62)01100010 \\ &\quad (20)00100000\ (51)11000001\ (62)01100010\ (75)11100101\ (7C)11101100 \\ &= 4A\ 61\ 73\ 7F\ 62\ 20\ 51\ 62\ 75\ 7C \end{aligned}$$

Question 3: (6 pts) Internally in the computer, with few exceptions, all numerical computation is done using binary numbers. Input, however, often uses ASCII, which is formed by appending 011 to the left of a BCD code. Thus, an algorithm that directly converts a BCD integer to a binary integer is very useful. Here is one such algorithm:

1. Draw lines between the 4-bit decades in the BCD number.
2. Move the BCD number one bit to the right.
3. Subtract 011 from each BCD decade containing a binary value > 0111.
4. Repeat Steps 2-3 until the leftmost 1 in the BCD number has been moved out of the least significant decade position.
5. Read the binary result to the right of the least significant decade position.

a) Execute the algorithm for the BCD number 0111 0101.

Start	0111	0101	
» 1	0011	1010	1
		-011	
	0011	0111	1
» 1	0001	1011	11
		-011	
	0001	1000	11
» 1	0000	1100	011
		-011	
	0000	1001	011
» 1	0000	0100	1011
» 3	0000	0000	1001011

b) Execute the algorithm for the BCD number 0011 0110 1000.

Start	0011	0110	1000	
» 1	0001	1011	0100	0
		-011		
	0001	1000	0100	0
» 1	0000	1100	0010	00
		-011		
	0000	1001	0010	00
» 1	0000	0100	1001	000
			-011	
	0000	0100	0110	000
» 1	0000	0010	0011	0000
» 2	0000	0000	1000	110000
			-011	
	0000	0000	0101	110000
» 3	0000	0000	0000	101110000

Question 4: (8 pts) Encode the following Unicode code points in UTF-8. Show both the binary and hex value for each encoding. Hint: Table 1-6 in the textbook will be useful.

a) U+0042
= 0xxxxxxx
= 01000010
= 0x42

b) U+00C6
= 110xxxxx 10xxxxxx
= 11000011 10000110
= 0xC286

c) U+429B
= 1110xxxx 10xxxxxx 10xxxxxx
= 11100100 10001010 10011011
= 0xE48A9B

d) U+1C5F3
= 11110xxx 10xxxxxx 10xxxxxx 10xxxxxx
= 11110000 10011100 10010111 10110011
= 0xF09C97B3

Question 5: Textbook Problem 1-30: What is the percentage of power consumed for continuous counting (either up or down but not both) at the outputs of a binary Gray code counter (with all 2^n code words used) compared to a binary counter as a function of the number of bits, n, in the two counters?

$$efficiency(n) = \frac{\Delta gray(n)}{\Delta binary(n)} \times 100\%$$
$$efficiency(3) = \frac{8}{14} \times 100\% = 57\%$$

GRADING SCALE
Total: 31 pts

Pts	0	4	8	11	15	19	23	27
Letter Grade	D-	D	C-	C	B-	B	A-	A