ELEX 4340 : Data Communications
2013 Fall Session

Assignment 1

Due Thursday, September 19, 2013. Show your work. Hand in your assignment at the lecture or during office hours. Assignments submitted after the solutions are made available will be given a mark of zero.

Question 1

Consider the rightmost four characters of your BCIT ID as a decimal number. Convert this number to:

- a 16-bit binary number (in network order)
- a hexadecimal number (in network order)
- write the numbers above with the two bytes in little-endian order and the bits within each byte also in little-endian order.

Question 2

Find the Unicode code point (the index in the Unicode code table) for the following character: "GREEK CAPITAL LETTER OMEGA" (Hint: `http://unicode.org` -> *The Unicode Standard* -> *Code Charts* -> *Greek*).

Question 3

The two (Traditional) Chinese characters for "New Year" are:

- "年" with Unicode value 0x5E74 and
- "节" with Unicode value 0x8282.

The UTF encoding rules for characters with values between 0x0800 and 0xffff are given in Table 3-6 from version 6.2 of the Unicode standard below.

Each sequence of letters in the Scalar value column represents a sequence of bits that is copied into the bytes in the other columns.

- how many octets does it take to represent each of the two Chinese characters?
- what are the values of these octets in hexadecimal?

One way to check your answer is to copy and paste these characters into Notepad++. Set the encoding to "UTF-8 without BOM" and use the Plugins -> Converter menu item to convert between Unicode characters (incorrectly labelled "ASCII") and hex. Do the conversion manually first and then check your answer (you won't have access to a computer on an exam).

Question 4

A transmitter encodes successive pairs of bits using the following set of waveforms for each pair of bits:

bits (ms first)	waveform
11	$\cos(4000t)$
10	$-\cos(4000t)$
01	$2\cos(4000t)$
00	$-2\cos(4000t)$

where the value of t ranges from 0 to the bit period of 3.1ms (0.0031 seconds) for each bit.

Sketch the waveform that result if following sequence of bits was transmitted (m.s. bit first): 10011100. Label the x-axis in milliseconds and also in bit periods.

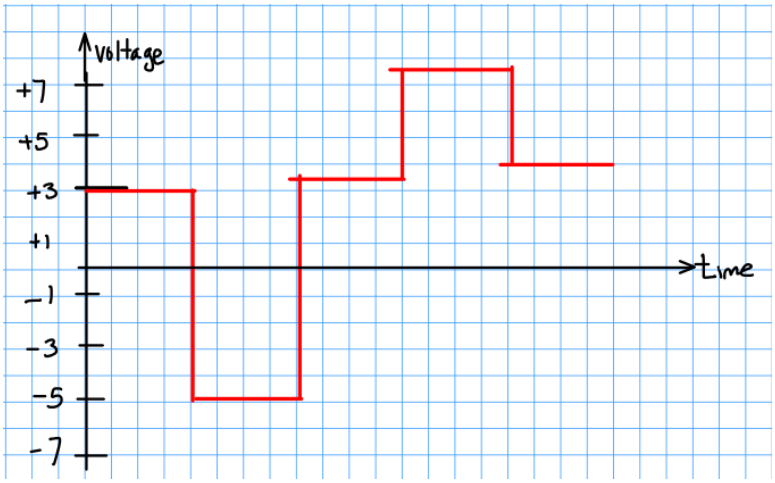
Question 5

A smartphone application transmits status messages giving the phone's location. Each message can be one of three: "Home", "Work", or "Out." Over a period of a month the number of each of these messages were 435, 109 and 56 respectively. Assuming the probabilities of the messages remains constant, how many bits of information does each message contain? The answers need not be integers.

Hint: the information contained by a message is given by: $-\log_2(P)$ where P is the probability of that message being transmitted. A reasonable estimate of

Table 3-6. UTF-8 Bit Distribution

Scalar Value	First Byte	Second Byte	Third Byte	Fourth Byte
00000000 0xxxxxxx	0xxxxxxx			
00000yyy yyxxxxxx	110yyyyy	10xxxxxx		
zzzzyyyy yyxxxxxx	1110zzzz	10yyyyyy	10xxxxxx	
000uuuuu zzzzyyyy yyxxxxxx	11110uuu	10uuzzzz	10yyyyyy	10xxxxxx



the probability of a message being transmitted is the fraction of times it has been transmitted.

What bits were most likely transmitted?

Question 6

A transmitter generates one pulse for each 3 input bits. For every three bits the transmitter generates one of eight equally-spaced pulse levels, from -7 V to +7 V. The level are assigned to bit patterns in increasing numerical order (000 is the lowest voltage, 111 is the highest). Each pulse lasts for 2 μs. The transmitter adds one start pulse and one stop pulse for every eight data pulses (every 24 bits).

Compute the symbol rate, data rate, baud rate and throughput.

Question 7

The corresponding receiver sees the waveform shown above. It consists of 5 pulses. The transmitted waveform was corrupted by noise or distortion.