UIT2201: CS & the IT Revolution
Tutorial Set 9 (Fall 2016)

(D-Problems discussed on Friday, 14-Oct-2016)
(Q-Problems due on Tuesday, 18-Oct-2016)

Practice Problems: (not graded)
These are practice problems for you to try out. (Not graded or discussed.)

T9-PP1: (Binary Representations) Problems 1, 2, 5 of Section 4.2.1, p.142 of [SG3].

Discussion Problems: -- Prepare (individually) for tutorial discussion.

T9-D0: Read Ch. 4.1--4.2 of [SG3]

T9-D1: (Binary Representations)
Problem 1(b), 3(a)(c), 4(c), 5(c), 8(a), 9(a) on p.184 of [SG3]-Ch4.

T9-D2: (ASCII and UNICODE encoding)
How many binary digits (or *bits*) would it take to represent the following phrase
  `"What are you doing up so early in Cinnamon?"` (Do not include the surrounding "" marks.)
(a) in ASCII code, and
(b) in UNICODE?

T9-D3: [Boolean Logic Laws]
Using truth tables, prove the following logical law (DeMorgan's Law).

    ~(P + Q) = (~P) * (~Q)

T9-D4: (Simple Logic Circuit Design)
Design a circuit using AND, OR and NOT gates to
implement the following truth table for the following logic
function with two inputs a and b.

a	b	Output
0	0	1
0	1	0
1	0	1
1	1	1

T9-D5: (Advertising War)
There are two *pricy* restaurants next to each other. One has a signboard that says,

> "Good food is not cheap."   *meaning*   ("Food is Good" implies *not* ("Food is Cheap"))

and the other has a signboard that says,

> "Cheap food is not good."   *meaning*   ("Food is Cheap" implies *not* ("Food is Good"))

(a) Formulate the statements given in the signboards as logic formulae.
(b) Are the signboards saying the same thing?
[*Hint:* (P --> Q) == (~P + Q), namely, "P implies Q" is equivalent to (~P + Q)]

Problems to be Handed in for Grading by the Deadline:

(**Note:** Please submit *hard copy* to me. Not just soft copy via email.)

T9-Q1: (10 points) (Binary Representations)
Problem 1(a)(c), 3(b)(d), 4(b), 5(b)(d), 8(b), 9(b)(c) on p.184 of [SG3]-Ch4.

T9-Q2: (5 points) (Storing Images) [First read Ch4.2.2 of [SG]]
(a) (Adapted from Practice Prob. 2 of Ch4.2.2 of [SG].)
How many bits / bytes are needed to store a single *uncompressed* RGB image from a 25 megapixel digital camera? How many such images can be stored in a 32GB (Giga-Byte) memory-card?
(b) Answer part (a) again, but now assume that the information is first compressed with a compression ratio of 20:1?

T9-Q3: (5 points) (Storing Sound)
[First read Ch4.2.2 of [SG]] about MP3 format
(a) Using MP3, how many bits / bytes are required to store a 4-minute song in *uncompressed* format? How many such songs can be stored in a 32GB memory-card?
(b) Answer part (a) again, but assume that the information is compressed with a ratio of 15:1?

T9-Q4: (5 points) [Creative, Interesting Interpretations]
Give more interesting and creative interpretations of

    G = A + (B*(~C))

T9-Q5: (10 points) [Boolean Logic Laws]
Using truth tables, prove the following logical laws.
1. `X*(X+Y) = X`   [Absorption Law]
2. `~(X*Y) = (~X) + (~Y)`   [de Morgan's Law]
3. `X+(Y*Z) = (X+Y)*(X+Z)`   [Distributive Law]

A-Problems: OPTIONAL Challenging Problems for Further Exploration

A7-2013: (Limits of Floating Point Numbers) For 64-bit computers, if we use 53 bits to represent the mantissa (sign/magnitude) and 11 bits to represent the exponent (also sign/magnitude), we know that we can only represent a small subset of the real numbers. The *gap* (i.e., difference in absolute value) between two "consecutive" representable real numbers also varies.
(a) What is the largest number (and smallest number) that can be represented.
(b) What is the *smallest gap* between two consecutive real numbers? What is the *largest gap* between any two consecutive real numbers?
[For some details on floating points, you can see http://en.wikipedia.org/wiki/Floating_point]

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