**ITEC201006 - Introduction to Computer Science & Engineering, Jeonghun Park**

**HW2 – Due date: 4/19**

## Q1. Run-Length Encoding

What is the run-length encoding?

## Q2. Run-Length Encoding

When is the run-length encoding beneficial over the conventional ASCII encoding? For example, considering the following two source sequences, when is the run-length encoding better?

1) *aaaaabbbbbccccccccc*

2) *abcdeefgggghiijklmn*

## Q3. Egg-drop experiment

Assume a N-floor building. If we drop an egg higher than the floor "x," the egg will be broken. We are trying to minimize the number of the eggs to find the floor x. How many eggs do we need to find the floor x?

## Q4. Egg-drop experiment

This problem is continued from Q3. Explain the method to find the floor x with the minimum number of eggs.

## Q5. Egg-drop experiment advance

This problem is continued from Q3. Now assume that we have only two eggs. Obviously, the broken egg will not be used again. Explain your method to find the floor x by using these two eggs, while minimizing the number of dropping experiments.

## Q6. Horse race

Assume that we have 20 horses and we want to arrange them depending on their speed. (For example, starting from the fastest horse to the slowest horse) But we don't have a watch, and only what we have is that a small race course. In this race course, only two horses can race. Explain your method to arrange them how many horse races are required to do that. Of course, we want to use the race course as minimum as possible.

## Q7. Huffman encoding

Assume the following sources: (P[a] = 0.1, P[b] = 0.15, P[c] = 0.15, P[d] = 0.15, P[e] = 0.2, P[f] = 0.25). Construct the Huffman tree and obtain the binary code by using that Huffman tree.

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## Q8. Huffman encoding

This problem is continued from Q7. Calculate the expected code length, and also check that the obtained code achieves the Kraft inequality.

## Q9. Gates

Draw the logic diagram of the gates corresponding to the following Boolean expression:

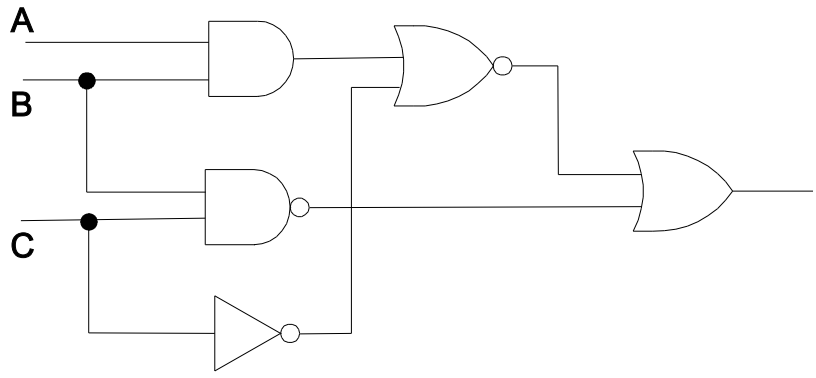
(A+B)(A+D) + (C⊕C')'(D+EFG⊕H)'

## Q10. Gates

This problem is continued from Q9. Draw the equivalent logic diagram with the reduced number of the gates.

## Q11. Gates

Obtain the truth table of the following circuit.




## Q12. Gates

Construct a binary full adder (3 bits + 3 bits) with gates and draw a logic diagram.

## Q13. Gates

Construct a binary multiplier (3 bits x 3 bits) with gates and draw a logic diagram.

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## Q14. Gates

Construct a binary majority rule circuit (3 inputs and each input can be either 1 or 0) with gates and draw a logic diagram.

## Q15. Gates

Construct a XOR gate with other gates and draw a logic diagram.

## Q16. Gates

Construct a S-R latch with NOR gates and provide a truth table.

## Q17. Recursion

Write a pseudocode of the binary search algorithm. Use recursion.

## Q18. Recursion

Write a pseudocode of the quicksort algorithm. Use recursion.