國立成功大學

112學年度碩士班招生考試試題

編　號：175、190、198

系　所：電機工程學系
電腦與通信工程研究所
智慧資訊安全碩士學位學程

科　目：資料結構

日　期：0206

節　次：第 2 節

備　註：不可使用計算機

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※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (10%) Show the asymptotic notations for the following statements.
   (a) n!　(b) $n^3 + 10^6 n^2$
2. (10%) Write the prefix and postfix form of the following expressions:
   (a) (A*B)/D+E*(f*A+D)-C
   (b) !((a && c) || (c > d))　　// assuming C precedence
3. (10%) Let Z( ) be a function that inputs a string and outputs a string, defined as follows:
   Base Case: If the input string X is a single letter L, then Z(X)=L.
   Recursive Case: If the input string X is a string of the form LS, then Z(X)="Z(S)L".
   (a) If X="happy", what is Z(X)?
   (b) What does the function Z( ) actually perform?
4. (15%)(a) Using recursive definition (i.e., having Base case and Recursive case) to define a binary tree. (b) Show the maximum number of nodes in a binary tree on level i.
5. (10%) Landscapes in films are often computer generated. Ever wondered how they do it? Here is an algorithmic drawing example. Draw enough repeating patterns until you can tell what it is. Start by drawing a single straight vertical line as below

   Then execute Draw( ) from this vertical line until you can show how the algorithmic drawing works.

```
Draw( )
{
    Draw 3 shorter lines at an angle in the top two-thirds of the line on its left side.
    Draw 3 shorter lines at an angle in the top two-thirds of the line on its right side.
    Choose a new existing line and Draw( ) from that line again
}
```

6. (15%)　(a) Given a graph G=(V,E), write a **pseudo-code** to generate all pairs shortest paths. (b) Also, you need to define the input, and output of the data structure.
7. (15%) A word-chain automaton is a directed graph with a finite number of vertices V, satisfying the following properties. (i) There is a specified initial node $v_0 \in V$. (ii) There is subset **F** of set V which contains terminal nodes. (iii) Each edge is labeled with a symbol from a finite set **W**. A string $w_1w_2...w_k$ of symbols in **W** is recognized by the automaton if there is a directed path starting at the initial node v_0 and ending at a terminal node $w \in F$ such that the sequence of edges in this directed path is $w_1w_2...w_k$. The set **L** of all strings recognized by the automaton is called the language recognized by the

automaton. A word-chain automaton is a special type of finite-state automaton, which in turn, is a type of finite-sate machine.

(a) Draw a word-chain automaton such that the following five sentences can be recognized: 1. I like his rabbit. 2. They hate his cat. 3. I think that his hamster is cute. 4. I know that his rabbit is soft. 5. They hate to have a hamster.

(b) Explain how the above automaton is used to check whether a sentence is recognized or not.

8. (15%) The following puzzle is called a word ladder: In a word ladder puzzle, you must make the change occur gradually by changing one letter at a time. At each step you must transform one word into another word, you are not allowed to transform a word into a non-word. The following sequence of words shows one possible solution to the problem "Transform the word "FOOL" into the word "SAGE"."

Example: FOOL -> POOL -> POLL -> POLE-> PALE -> SALE -> SAGE

Here, we are interested in figuring out the smallest number of transformations needed to turn the starting word into the ending word.

(a) Construct an example graph by using these words: FOOL, POOL, POLL, POLE, PALE, SALE, SAGE, COOL, FOUL, FOIL, FAIL, FALL, PALL, POLE, POPE, PAGE. Represent the relationships between the words as a word ladder graph. (Hint: Think about the path where we get from the word "FOOL" to the word "SAGE").

(b) Discuss which search algorithm you can use to find an efficient path from the starting word to the ending word, why it is more efficient compared with other. Discuss the complexity.

(c) There is one way to improve efficiency instead of using a graph to show the relationship. Suppose that we have a huge number of **buckets**, each of them with a four-letter word on the outside, except that one of the letters in the label has been replaced by an underscore. The labels on the buckets are the keys in our dictionary. The value stored for that key is a list of words. **Show the data structure and list the buckets using the following words** (don't list the buckets containing only one item): FOOL, POOL, POLL, POLE, PALE, SALE, SAGE, COOL, FOUL, FOIL, FAIL, FALL, PALL, POLE, POPE, PAGE