題號： 264　　　　國立臺灣大學 113 學年度碩士班招生考試試題

科目： 資料結構

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When a question asks for pseudocode, you can use a mixture of English and programming notation to describe your solution. Ensure to provide enough details so that a skilled programmer can readily implement your proposed solution.

1. **(10%)** For a **linked list** implementation of a **stack**, what do you think the easiest and most efficient implementation of the **push** (to the front of the linked list or to the end) and **pop** (from the front of the linked list or from the end) operations? Please justify your answer.

2. **(15%)** Compose a pseudocode function designed to accept a 2-dimensional array as input, interpreting it as the **adjacency matrix representation** of a graph. The function's purpose is to transform this matrix into its equivalent **adjacency list representation.** Please clearly specify what the return value of your function is.

3. **a. (15%)** Please write a pseudocode function that takes a **doubly circular linked list** as input, and removes all the duplicate elements. For example, if the content of the **doubly circular linked list** is '1, 3, 3, 2, 4, 2', it becomes '1, 3, 2, 4' after your function is executed. No return values are expected. You have two options to store a set of unique elements: **binary search tree** and **balanced search tree**. You can directly use either of them, without explaining how they are implemented.

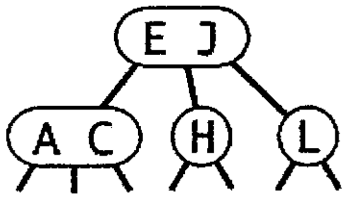
   Note: A node in a **doubly circular linked list** has two pointers, named 'next' and 'prev', respectively, where the 'next' pointer is used to find the next node and the 'prev' pointer is used to find the previous one.

   b. (10%) Please analyze the complexity of your function when **binary search tree** is used to store the set of unique elements.

   c. (5%) Please analyze the complexity of your function when **balanced search tree** is used to store the set of unique elements.

4. **a. (10%)** Given the 2-3 tree below, represent it as a **binary search tree** (BST). In your drawing, please highlight the edges that are within a 3-node.

   b. (10%) Please remove the root of your BST in the question **4a**, and replace it with something from the left subtree. Please draw the BST with the new root and highlight the edges that are within a 3-node.



5. **a. (10%)** Draw the **binary min heap** that emerges from sequentially inserting the elements 11, 9, 12, 14, 3, 15, 7, 8, 1 into an initially empty binary heap. Illustrate the intermediate results as you insert each element, and provide the array representation of the final heap.

   b (15%) Write a pseudocode function that transforms a **min heap** (stored in an array) to a **max heap**. Store the result in the same array. No return values are expected. Please justify the correctness of your function.

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