

注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。

國立清華大學 110 學年度碩士班考試入學試題


系所班組別：生命科學院

丙組(計算生物與人工智慧組)

科目代碼：0604

考試科目：計算機概論(演算法與計算機數學)

—作答注意事項—

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 考試開始後，請於作答前先翻閱整份試題，是否有污損或試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清(含未依範例畫記)致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

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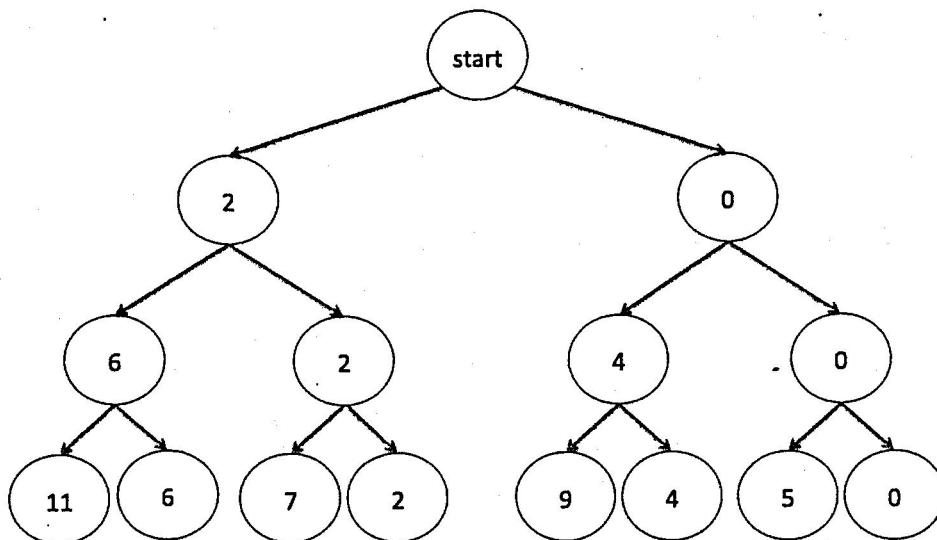
系所班組別：生命科學院丙組

考試科目（代碼）：計算機概論(演算法與計算機數學)(0604)

共 2 頁，第 1 頁

*請在【答案卷】作答

1. (16%) (a) Please explain what a recursive function is. (6%) (b) Write a recursive function $\text{sum}(n)$ to return the summation of the sequence of consecutive integers from 1 to n using any programming language or pseudo-code. (10%)
2. (16%) Please propose an algorithm that can find the intersection between two arrays consisting of m and n integers respectively with time complexity better than $O(mn)$ (8%) and analyze its time complexity. (8%)
3. (16%) Suppose that $n = 3$, $W = 6$, and $w_1 = 2$, $w_2 = 4$, $w_3 = 5$, we can construct a tree as follows:



- (a) This tree can be used to find out all subsets of $\{w_1, w_2, w_3\}$ that sum to W (the sum-of-subsets problem); please explain what this tree represents and how it works to solve this problem. (6%)
- (b) Consider another sum-of-subsets problem with $n = 4$, $W = 13$, and $w_1 = 3$, $w_2 = 4$, $w_3 = 5$, $w_4 = 6$. Use a similar tree as above, give a strategy to avoid searching every possible traversing route in the tree, and show that it can still get to the correct answer. (10%)

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4. (16%)

- (a) Please design a reflection transformation matrix (T) that can map $[x_1 \ x_2]$ to $[x_1 \ -x_2]$. (4%)
- (b) What are the eigenvalues and corresponding eigenvectors of T? (4%)
- (c) What is the inverse of T? (4%)
- (d) Please calculate T^{50} . (4%)

5. (8%) Please convert the following infix expression to postfix expression with a stack. Please illustrate the step-by-step operations.

$$A - (B * (C - D) + E / F + G)$$

6. (28%) Binary search tree.

- (a) Given a sequence of integers: 28, 5, 32, 44, 12, 35, 69, 57, 1, please insert them sequentially (i.e., first inserting 28, then 5, and so on) into an initially empty binary search tree and draw the resulting binary search tree. (12%)
- (b) Suppose there are n numbers in the binary search tree, what is the worst-case time complexity of searching a number in it? Please answer with big-O notation and give an example when such worst case happens. (8%)
- (c) Please draw the resulting binary search tree after deleting 32 from the tree constructed in (a). (8%)