

考試科目	資料結構及演算法	系所別	資訊科學系	考試時間	2 月 5 日(五) 第二節
<p>1. (10%) Prove or disprove the following statements (n is the size of the input array):</p> <ol style="list-style-type: none"> (5%) The time complexity of any sorting algorithm is $O(n^2)$. (5%) The best-case time complexity of insertion sort is $\theta(n \log n)$. <p>2. (10%) Assume $P \neq NP$. For each of the following statements, answer True or False. No explanation is needed.</p> <ol style="list-style-type: none"> (5%) If a problem is in NP-hard, then the problem is in NP. (5%) If a problem is in NP, then the problem is in NP-complete. <p>3. (15%) Use an example to explain why Dijkstra's shortest path algorithm cannot be applied to graphs with negative edge weights. In your example graph, please highlight the source and the destination.</p> <p>4. (10%) Give two advantages of red black trees over hash tables.</p> <p>5. (15%) An independent set I of an undirected graph $G = (V, E)$ is a subset of V such that for any two vertices u and v in I, u and v are not adjacent, i.e., $(u, v) \notin E$. Design a dynamic program to find the largest independent set in a tree. ***Please explain the high-level idea of your answer in English or Chinese.***</p> <p>6. (15%) Consider an n-node sorted singly linked list L, where the first node (i.e., the head) stores the smallest data, the last node (i.e., the tail) stores the largest data, and the i^{th} node stores the i^{th} smallest data. Given the address of L's head and a key, is it possible to search for the key in L in $O(\log n)$ time? Please explain your answer.</p> <p>7. (15%) Design a polynomial-time algorithm for the following problem. Input: An n-node undirected graph G. Output: "Yes", if there is a cycle of length at most $n/2$ (i.e., a cycle that has at most $n/2$ nodes) in G; "No", otherwise. ***Please give the high-level idea of your algorithm and explain why it has polynomial running time.***</p> <p>8. (10%) Consider a 500-node binary heap, whose array representation is stored in Arr. Let p be a node in the binary heap. Further assume that u is p's child node and u's key is stored at Arr[305].</p> <ol style="list-style-type: none"> (5%) How to find p's key in Arr? (5%) Does u have a left child node in the binary heap? Please explain your answer. 					
備註	<p>一、作答於試題上者，不予計分。 二、試題請隨卷繳交。</p>				