1. (10%) If S is a set of n elements the power set of S is the set of all possible subsets of S. For example, if S = {a, b, c}, then power set(S) = {{}, {a}, {b}, {c}, {a, b}, {a, c}, {b, c}, {a, b, c}}. Write a recursive function to compute power set(S).

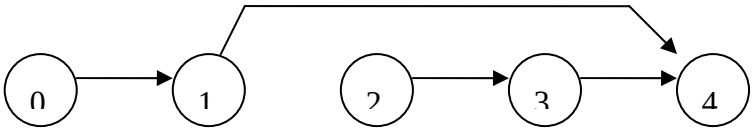
2. (10%) Write the sparse matrix of the following matrix.

$$\begin{bmatrix} 1 & 0 & 3 & 0 \\ 2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 4 \\ 0 & 5 & 0 & 0 \end{bmatrix}$$

3. (10%) How do you check whether a circular queue is full or empty? Write your comments.

4. (10%) The input list is (7, 5, 1, 10, 3, 6, 9). Run heap sort algorithm for the input list. A max heap is adjusted in the first phase of heap sort. Please write the max heap for the input list.

5. (10%) Write the adjacency matrix and transitive closure matrix for the following graph.



6. (15%) Answer Yes or No for the following terms. //Construct the answer table//
   (1) $10n^2 + 5n = O(n)$, (6) $10n^2 + 5n = O(n^2)$, (11) $10n^2 + 5n = O(n^3)$,
   (2) $10n^2 + 5n = \Omega(n)$, (7) $10n^2 + 5n = \Omega(n^2)$, (12) $10n^2 + 5n = \Omega(n^3)$,
   (3) $10n^2 + 5n = \Theta(n)$, (8) $10n^2 + 5n = \Theta(n^2)$, (13) $10n^2 + 5n = \Theta(n^3)$,
   (4) $10n^2 + 5n = o(n)$, (9) $10n^2 + 5n = o(n^2)$, (14) $10n^2 + 5n = o(n^3)$,
   (5) $10n^2 + 5n = \omega(n)$, (10) $10n^2 + 5n = \omega(n^2)$, (15) $10n^2 + 5n = \omega(n^3)$,

7. (10%) Explain the follows. (1) P problems. (2) NP problems. (3) NP-hard problems. (4). NP-complete problems. (5) P = NP problems.

8. (10%) Solve the following recurrence relations.
   $T(n) = 7T(n/2) + n^2$, $T(1) = 1$.

9. (15%) Construct dynamic programming table to find the Longest Common Substring of (1 0 0 1 0 1 0 1) & (0 0 1 0 1 1 0 1 0).