Practice 1

We highly encourage being environment friendly and trying all problems on your own.

1. **Implement exercise 2.3-7.**

2. **Implement priority queue.**

3. Implement Quicksort and answer the following questions. (1) How many comparisons will Quicksort do on a list of n elements that all have the same value? (2) What are the maximum and minimum number of comparisons will Quicksort do on a list of n elements, give an instance for maximum and minimum case respectively.

4. Give a divide and conquer algorithm for the following problem: you are given two sorted lists of size m and n, and are allowed unit time access to the ith element of each list. Give an $O(lg\ m + lgn)$ time algorithm for computing the kth largest element in the union of the two lists. (For simplicity, you can assume that the elements of the two lists are distinct).

Practice 2

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5. **Matrix-chain product. The following are some instances.**
   a) **<3, 5, 2, 1,10>**
   b) **<2, 7, 3, 6, 10>**
   c) **<10, 3, 15, 12, 7, 2>**
   d) **<7, 2, 4, 15, 20, 5>**

6. **Longest Common Subsequence (LCS). The following are some instances.**
   a) **X:** *xzyzzyx* **Y:** *zxyyzxz*
   b) **X:***MAEEEVAKLEKHLMLLRQEYVKLQKKLAETEKRCALLAAQANKESSSESFIS RLLAIVAD*
   Y:*MAEEEVAKLEKHLMLLRQEYVKLQKKLAETEKRCTLLAAQANKENSNESFIS RLLAIVAG*

7. **Longest Common Substring. The following are some instances.**
   a) **X:** *xzyzzyx* **Y:** *zxyyzxz*
   b) **X:***MAEEEVAKLEKHLMLLRQEYVKLQKKLAETEKRCALLAAQANKESSSESFIS RLLAIVAD*
   Y:*MAEEEVAKLEKHLMLLRQEYVKLQKKLAETEKRCTLLAAQANKENSNESFISR*

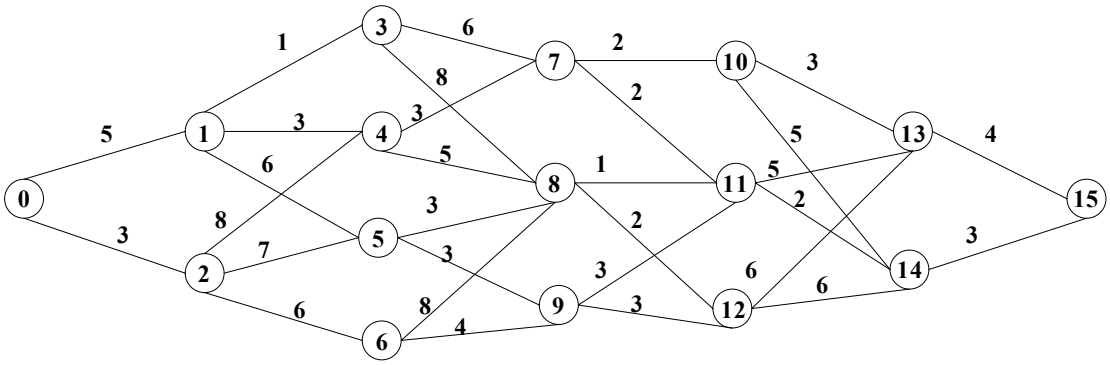
LLAIVAG

8. **Max Sum. The following is an instance.**

a) *(-2, 11, -4, 13, -5, -2)*

9. **Shortest path in multistage graphs. Find the shortest path from *0* to *15* for the following graph.**

A multistage graph is a graph (1) G=(V,E) with V partitioned into K >= 2 disjoint subsets such that if (a,b) is in E, then a is in V_i , and b is in V_{i+1} for some subsets in the partition; and (2) $|V_1| = |V_K| = 1$.



Practice 3

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10. **Knapsack Problem. There are 5 items that have a value and weight list below, the knapsack can contain at most 100 Lbs. Solve the problem both as fractional knapsack and 0/1 knapsack.**

value(SUS)	20	30	65	40	60
weight(Lbs)	10	20	30	40	50
value/weight	2	1.5	2.1	1	1.2

11. **A simple scheduling problem. We are given jobs $j_1, j_2 \ldots j_n$, all with known running times $t_1, t_2 \ldots t_n$, respectively. We have a single processor. What is the best way to schedule these jobs in order to minimize the average completion time. Assume that it is a nonpreemptive scheduling: once a job is started, it must run to completion. The following is an instance.**

a) *$(j_1, j_2, j_3, j_4) : (15, 8, 3, 10)$*

12. **Single-source shortest paths. The following is the adjacency matrix, vertex A is the source.**

A B C D E

A	-1	3		
B		3	2	2
C				
D	1	5		
E			-3	

13 · **All-pairs shortest paths. The adjacency matrix is as same as that of problem 3.(Use Floyd or Johnson's algorithm)**

Practice 4

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14 · **0/1 Knapsack Problem. There are 5 items that have a value and weight list below, the knapsack can contain at most 100 Lbs. Solve the problem using back-tracking algorithm and try to draw the tree generated.**

value(SUS)	20	30	65	40	60
weight(Lbs)	10	20	30	40	50
value/weight	2	1.5	2.1	1	1.2

15 · **Solve the 8-Queen problem using back-tracking algorithm.**