DAA Assignment IV

1. **Trace the list with values 10, 20, 10, 20, 10, 5 using following algorithms:**

   A. **Sort by comparison counting and discuss Stable property of the algorithm. Also Workout worst case and best case analysis.**

10	20	10	20	10	5
0	0	0	0	0	0
3	1	0	1	0	0
	1 + 4	0	1	0	0
		2	1 + 1	0	0
			2 + 2	0	0
				1	0
3	5	2	4	1	0

5	10	10	10	20	20
0	1	2	3	4	5

   B. **Sort by Distribution counting and discuss the stable property of the algorithm. Also Workout worst case and best case analysis.**

Values	5	10	20
Frequency	1	3	2
Distribution	1	4	6

5	10	20
1	4	6
0	4	6
0	3	6
0	3	5
0	2	5
0	2	4
0	1	4

5					
			10		
					20
		10			
				20	
	10				

Show the trace in the form of a table showing the intermediate values at each iteration till you get the final sorted array.

2.

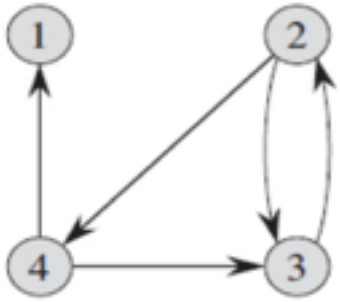
A. Compute C(6, 3) by applying the dynamic programming algorithm.

$C(n, k) = C(n - 1, k) + C(n - 1, k - 1)$

$C(n, n) = C(n, 0) = 1$

n / k	0	1	2	3
0	1			
1	1	1		
2	1	2	1	
3	1	3	3	1
4	1	4	6	4
5	1	5	10	10
6	1	6	15	20

B. Find the transitive closure of the following digraph using Warshall's algorithm.



A_0	1	2	3	4
1	0	0	0	0
2	0	0	1	1
3	0	1	0	0
4	1	0	1	0

A_1	1	2	3	4
1	0	0	0	0
2	0	0	1	1
3	0	1	0	0
4	1	0	1	0

A_2	1	2	3	4
1	0	0	0	0
2	0	0	1	1
3	0	1	**1**	**1**
4	1	0	1	0

A_3	1	2	3	4
1	0	0	0	0
2	0	**1**	1	1
3	0	1	1	1
4	1	**1**	1	**1**

A_4	1	2	3	4
1	0	0	0	0
2	**1**	1	1	1
3	**1**	1	1	1
4	1	1	1	1

3. **Apply Boyer-Moore pattern search algorithm to search a pattern `MAHARAJ` in the text `RAJA–KI–RAJA–MAAHARAJA`. Also find number of character comparisons.**

BAD SYMBOL TABLE							
–	A	H	I	J	K	M	R
7	1	4	7	7	7	6	2

Index:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Text:	R	A	J	A	-	K	I	-	R	A	J	A	-	M	A	A	H	A	R	A	J	A
Pattern:	M	A	H	A	R	A	J															

No match at 0, 1 comparisons so far, using bad character rule to advance by 7.

Index:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Text:	R	A	J	A	-	K	I	-	R	A	J	A	-	M	A	A	H	A	R	A	J	A
Pattern:	M	A	H	A	R	A	J															

No match at 7, 2 comparisons so far, using bad character rule to advance by 6.

Index:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Text:	R	A	J	A	-	K	I	-	R	A	J	A	-	M	A	A	H	A	R	A	J	A
Pattern:								M	A	H	A	R	A	J								

No match at 13, 3 comparisons so far.

Index:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Text:	R	A	J	A	-	K	I	-	R	A	J	A	-	M	A	A	H	A	R	A	J	A
Pattern:														M	A	H	A	R	A	J		

No match at 14, 10 comparisons so far.

Index:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Text:	R	A	J	A	-	K	I	-	R	A	J	A	-	M	A	A	H	A	R	A	J	A
Pattern:															M	A	H	A	R	A	J	

No match at 15, 11 comparisons so far.

Index:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Text:	R	A	J	A	-	K	I	-	R	A	J	A	-	M	A	A	H	A	R	A	J	A
Pattern:																M	A	H	A	R	A	J

Character comparisons = 11
Match(es) = 0 (Word), 6 (Character)

4. **For the input** `12, 8, 30, 20, 56, 75, 31, 19, 90, 33, 80` **and hash function** `h(K) = K mod 9`

   A. **Construct the open hash table.**

0 →	90
1 →	19
2 →	20 → 56
3 →	12 → 27 → 75
4 →	31
5 →	
6 →	33
7 →	
8 →	8 → 80

   B. **Find the largest number of key comparisons in a successful search in this table.**

      3, for key = 75.

   C. **Find the average number of key comparisons in a successful search in this table.**

      a = n/m = 11/9

      = 1 + a/2
      = 1 + (11/9*2)
      = 1.61111

5.

A. Write an algorithm for Heapsort.

```
HEAPSORT(A)
1  BUILD-MAX-HEAP(A)
2  for i = A.length downto 2
3      exchange A[1] with A[i]
4      A.heap-size = A.heap-size − 1
5      MAX-HEAPIFY(A, 1)
```

```
BUILD-MAX-HEAP(A)
1  A.heap-size = A.length
2  for i = ⌊A.length/2⌋ downto 1
3      MAX-HEAPIFY(A, i)
```

```
MAX-HEAPIFY(A, i)
 1  l = LEFT(i)
 2  r = RIGHT(i)
 3  if l ≤ A.heap-size and A[l] > A[i]
 4      largest = l
 5  else largest = i
 6  if r ≤ A.heap-size and A[r] > A[largest]
 7      largest = r
 8  if largest ≠ i
 9      exchange A[i] with A[largest]
10      MAX-HEAPIFY(A, largest)
```

B. The assignment problem can be stated as follows: There are n people who need to be assigned to execute n jobs, one person per job. (That is, each person is assigned to exactly one job and each job is assigned to exactly one person.) The cost that would accrue if the i-th person is assigned to the j-th job is a known quantity C[i, j] for each pair i, j =1,...,n. The problem is to assign the people to the jobs to minimize the total cost of the assignment. Express the assignment problem as a linear programming problem.

Let x_{ij} be a 0-1 variable indicating an assignment of the ith person to the jth job (or, in terms of the cost matrix C, a selection of the matrix element from the ith row and the jth column). The assignment problem can then be posed as the following linear programming problem:

$$
\begin{array}{ll}
\text{minimize} & \sum_{i=1}^{n} \sum_{j=1}^{n} c_{ij} x_{ij} \qquad \text{(the total assignment cost)} \\
\text{subject to} & \sum_{j=1}^{n} x_{ij} = 1 \text{ for } i = 1, \ldots n \text{ (person } i \text{ is assigned to one job)} \\
& \sum_{i=1}^{n} x_{ij} = 1 \text{ for } j = 1, \ldots n \text{ (job } j \text{ is assigned to one person)} \\
& x_{ij} \in \{0, 1\} \quad \text{for } i = 1, \ldots, n \text{ and } j = 1, \ldots, n
\end{array}
$$