**Question 1. Skip List**

Create a Skip list starting with no values and inserting each value one at a time. Result of the coin toss after inserting is also shown below. Based on this information, draw a skip list. How will you characterize the skip list produced?

Insert(10) T

Insert(20) HT

Insert(30) T

Insert(40) HHT

Insert(50) T

Insert(60) HT

Insert(70) T

Insert(80) HHHT

-∞ -----------------------------------------------------------------> 80 ---> +∞

|

-∞ ------------------------------> 40 -----------------------------> 80 ---> +∞

| |

-∞ -------------> 20 -----------> 40 ------------> 60------------> 80 ---> +∞

| | | |

-∞ ---> 10 ---> 20 ---> 30 ---> 40 ---> 50 ---> 60 ---> 70 ---> 80 ---> +∞

**Question 2. Experimenting with lower bound**

Devise an algorithm to sort 4 elements using exactly 5 comparisons in the worst case. Does this violate the theoretical lower bound? Justify your answer.

a b c d

if (a > b) then swap a <-> b -------> b a

if (d < c) then swap d <-> c -------> c d

if (a > c) then temp1 = c

if (d < b) then temp2 = b

if (temp 1 > temp2) --------> d b c a

No violate the theoretical lower bound because the sort algorithm take O(nlogn) = 4log4 = 8. For this algorithm, we just use 5 comparison.

**Question 3. Exploring new ideas: Forward and backward sorted array (FBS array)**

Definition

An array is said to be a FBS array if it satisfies the following three conditions.

(1) Elements in the odd locations are sorted in the ascending order.

(2) Elements in the even locations are sorted in the descending order.

(3) Every element in the even locations are <= every element in the odd locations.

Example: {7, 20, 10, 19, 10, 17, 14, 15, 15}

**Solution:**

1. Sort the Entire Array in ascending order.
2. Rearrange Elements:
   * Rearrange the elements to satisfy the FBS conditions:
     + Place the smallest elements at odd position.
     + Place the largest elements at even position.