# Question 2

## a.

Applying the Master theorem, in this case, a = 3, b = 2, d = 0.

Since , we can conclude that T(n)=O().

## b.

**i.**

**ii.**

## c.

0->0,R

X->X,R

1->X,R

0->X,L

1->X,L

0->X,R

█->█,R

0->0,L

1->1,L

X->X,L

1->1,R

X->X,R

X->X,R

█->█,N

## d.

step 1: Divide the array into two equal halves: [5,7,12,23], [8,1,2,4]

step 2: Divide each sub-array into two equal halves: [5,7], [12,23], [8,1], [2,4]

step 3: Divide each sub-array into two equal halves, and now they become arrays of unit length:[5], [7], [12], [23], [8], [1], [2], [4]

step 4: merge [5] and [7] to [5, 7] since they are already in the ascending order; merge [12] and [23] to [12, 23] since they are already in the ascending order; merge [8] and [1] to [1, 8] since 1<8; merge [2] and [4] to [2, 4] since they are already in the ascending order.

Step 5: merge [5,7] and [12,23] to [5,7,12,23] since they are already in the ascending order; merge [1,8] and [2,4] to [1,2,4,8] with merge function.

Step 6: merge [5,7,12,23] and [1,2,4,8] to [1,2,4,5,7,8,12,23] with merge function.

## e.

0

00,01,10,11

1,0

1

# Question 3

## a.

**i.**

after one iteration by using bubble sort, we get A= [3,11,12,2,7,4,1,17]

after the second parsing, A= [3,11,2,7,4,1,12,17]

**ii.**

A= [7,5,3,1,2,4,6,8]

Because the pivot happens to be the smallest element in the list for each sort.

**iii.**

A= [1,2,3,4,5,6,7,8]

Because the list is already in the correct order, so it will only take once for each sort.

## b.

**i.**

**ii.**

## c.

1)for f(n)=100n+nlogn+5, the asymptotic function is g(n)= nlogn

there exist c=101, k=100, such that f(x)≦c\*g(x) for all x>k.

Proof: c\*g(x)=101xlogx.

c\*g(x)-f(x)=101xlogx-100x-xlogx-5=100x(logx-1)-5, since logx>2 when x >100, so 100x(logx-1)-5 > 100\*100\*(2-1)-5 =9995 > 0

so we conclude that g(n)=nlogn is the asymptotic function.

2)for f(n)=n0.5+10logn+40, the asymptotic function is g(n)= n0.5

There exist c=11, k=100,such that f(x) ≦c\*g(x) for all x>k.

Proof:c\*g(x)=11 x0.5

c\*g(x)-f(x)= 10x0.5-10logx+40=10(x0.5-logx)+40, since x0.5>10 when x>100,and logx > 2 when x>100,and x0.5 is growing faster than logx, so 10(x0.5-logx)+40>10\*(10-2)+40=120>0

so we conclude that g(n)= n0.5 is the asymptotic function.

## d.

█->█,R

█->█,L

1->1,L

1->X,R

1->X,R

0->0,R

X->X,R

0->X,R

█->█,N

0->0,L

X->X,L

X->X,R

## e.

if there exists zero 0, then the expression should be 1+

if there exists one 0, then the expression should be 1+01\* U 1\*01+

if there exists two 0, then the expression should be 1+01\*01\* U 1\*01+01\* U 1\*01\*01+

In all, the regular expression will be 1+ U 1+01\* U 1\*01+ U 1+01\*01\* U 1\*01+01\* U 1\*01\*01+