Question 3

b) O(N), it is tail recursive and go over the list one time.

c)

12> hw2:longest_fibm_seq_time().
N = 10 T= 9.108557313059272e-7
N = 100 T= 7.214652990108665e-6
N = 1000 T= 7.120538642836788e-5
N = 10000 T= 7.166747585959873e-4
N = 100000 T= 0.007086465204225352
N = 1000000 T= 0.07252146100000001
N = 10000000 T= 0.803624763

Question 4

a)

Process 0 has segment [3, 3];
Process 1 has segment [4, 6, 10];
Process 2 has segment [5, 1];
Process 3 has segment [7, 3, 9].

List = [3, 3, 4, 6, 10, 5, 1, 7, 3, 9]
Starting position , length = {3, 3}

b)

Process 0 has segment [1, 2];
Process 1 has segment [4, 6, 10];
Process 2 has segment [15, 25];
Process 3 has segment [35, 8, 16].

List = [1,2,4,6,10,15,25,35,8,16]
Starting position , length = {2, 4}

c)

Process 0 has segment [4,8,6];
Process 1 has segment [10, 1, 1];
Process 2 has segment [2, 3, 5];
Process 3 has segment [12, 12, 12].
List = [4,8,6,10,1,1,2,3,5,12,12,12]
Starting position , length = {5, 5}

d)

Process 0 has segment [0,1, 1];
Process 1 has segment [2, 3, 5];
Process 2 has segment [8, 13,21];
Process 3 has segment [4, 5, 6].
List = [0,1,1,2,3,5,8,13,21,4,5,6]
Starting position , length = {1, 9}

Question 5

a) [0,1] = {[0, 1], {1, 2}, [0, 1]}
[9, 48, 57, 5, 62] = {[9, 48], {13, 5}, [5, 62]}

Question 9

a)

```
N_Data =     100, SeqTime =    7.02e-6, SeqValue = {1,100}
             ParTime =    1.06e-4, ParValue = {1,100}
             N_Procs =        32, SpeedUp =  0.066, ValueMatch=true
N_Data =    1000, SeqTime =    6.32e-5, SeqValue = {159,842}
             ParTime =    1.22e-4, ParValue = {159,842}
             N_Procs =        32, SpeedUp =  0.516, ValueMatch=true
N_Data =   10000, SeqTime =    5.93e-4, SeqValue = {4820,1126}
             ParTime =    1.89e-4, ParValue = {4820,1126}
             N_Procs =        32, SpeedUp =  3.139, ValueMatch=true
N_Data =  100000, SeqTime =    6.50e-3, SeqValue = {14962,1066}
             ParTime =    5.34e-4, ParValue = {14962,1066}
             N_Procs =        32, SpeedUp = 12.181, ValueMatch=true
N_Data = 1000000, SeqTime =    1.06e-1, SeqValue = {442479,1501}
             ParTime =    4.26e-3, ParValue = {442479,1501}
             N_Procs =        32, SpeedUp = 24.982, ValueMatch=true
```

b)

```
N_Data = 1000000, SeqTime =    7.30e-2, SeqValue = {631007,2058}
             ParTime =    7.97e-2, ParValue = {631007,2058}
             N_Procs =         1, SpeedUp =  0.916, ValueMatch=true
N_Data = 1000000, SeqTime =    7.26e-2, SeqValue = {861483,2055}
             ParTime =    3.34e-2, ParValue = {861483,2055}
             N_Procs =         2, SpeedUp =  2.170, ValueMatch=true
N_Data = 1000000, SeqTime =    7.30e-2, SeqValue = {284517,1631}
             ParTime =    1.78e-2, ParValue = {284517,1631}
             N_Procs =         4, SpeedUp =  4.098, ValueMatch=true
N_Data = 1000000, SeqTime =    1.57e-1, SeqValue = {432706,1880}
             ParTime =    1.50e-2, ParValue = {432706,1880}
             N_Procs =         8, SpeedUp = 10.451, ValueMatch=true
N_Data = 1000000, SeqTime =    7.38e-2, SeqValue = {899263,1748}
             ParTime =    6.92e-3, ParValue = {899263,1748}
             N_Procs =        16, SpeedUp = 10.664, ValueMatch=true
N_Data = 1000000, SeqTime =    7.44e-2, SeqValue = {201740,1633}
             ParTime =    4.65e-3, ParValue = {201740,1633}
             N_Procs =        32, SpeedUp = 15.986, ValueMatch=true
```

```
N_Data =  1000000, SeqTime =    7.37e-2, SeqValue = {253268,1522}
          ParTime =    3.04e-3, ParValue = {253268,1522}
          N_Procs =       64, SpeedUp = 24.243, ValueMatch=true
N_Data =  1000000, SeqTime =    1.45e-1, SeqValue = {993787,1786}
          ParTime =    3.11e-3, ParValue = {993787,1786}
          N_Procs =      128, SpeedUp = 46.543, ValueMatch=true
N_Data =  1000000, SeqTime =    7.39e-2, SeqValue = {589160,1634}
          ParTime =    2.64e-3, ParValue = {589160,1634}
          N_Procs =      256, SpeedUp = 27.933, ValueMatch=true
```

c) The speed-up increases as we increases the data sizes because the computation cost dominates the communication cost. When we fixed the data sizes and increase the processors, the speed up first increases at an increasing rate, but as we continue to increase the amount of the processor. The speed up will start to increase at a decreasing rate and eventually the speedup will decrease as the number of processors reach 256 , because the communication cost will increase again.