Assignment 4

Algorithms & Complexity (CIS 522-01)

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Part A: Read the solved exercises and Practice

Solved excercise #1 in Chapter 6

In this problem, we want to place billboards in a highway to get maximum revenue. The highway will be M miles long, and will have n locations on which we can locate the different billboards, each one of this locations will give us $r_i > 0$ revenue. There is also a regulation that doesn't allow two billboards to be placed closer than 5 miles away from each other.

The goal of this problem is to find the billboard placements that will give us the maximum revenue, while following all the given regulations.

Algorithm Pseudocode

Algorithm 1 Implementation

```
Initiallize M[0] = 0 and M[1] = r_1
for j = 2, 3, ..., n do
    if x_j − x_{j−1} ≥ 5 then
        M[j] = M[j − 1] + r_j
    else Find the closest possible value (x_j − x_i ≥ 5)
        if M[i] + r_j > M[j − 1] then
            M[j] = M[i] + r_j
        else
            M[j] = M[j − 1]
        end if
    end if
end for

return M[n]
```

Solution for problem instance of size 10

The code for a problem instance of size 10 is as follows.

```
x = [1,10,13,14,20,23,28,30,36,40]
r = [10,3,4,20,10,7,6,3,10,20]

n = len(x)

#Initialize M
```

```
M = [0]*(n+1)

#Initializing M[0] and M[1]
M[0] = 0
M[1] = r[0]

for j in range (2,n+1):
 print('j = %i' %j)
 print('Distance to the previous point: %i' %(x[j-1]-x[j-2]))
 if x[j-1]-x[j-2]>=5:
  M[j] = M[j-1]+r[j-1]
  print('M[%i] = %i' %(j,M[j]))
  print('\n')
 else:
  #Look for the eastmost valid
  print('Looking for the eastmost valid value')
  for i in range(j-1,-1,-1):
   print('%i-%i>=5?' %(x[j-1],x[i-1]))
   if x[j-1]-x[i-1]>=5:
    print('YES')
    print('M[%i]+%i>M[%i]?' %(i,r[j-1],j-1))
    if M[i]+r[j-1]>M[j-1]:
     print('YES')
     print('M[%i] = M[%i] + %i' %(j,i,r[j-1]))
     M[j] = M[i]+r[j-1]
     print('M[%i] = %i' %(j,M[j]))
     print('\n')
    else:
     print('NO')
     print('M[%i] = M[%i]' %(j,j-1))
     M[j] = M[j-1]
     print('M[%i] = %i' %(j,M[j]))
     print('\n')
    break
   else:
    print('NO')

print('MAXIMUM REVENUE: %i' %M[n])
```

Time Complexity

Part B: Problem Solving

Consulting Jobs

Problem Model

Pseudocode

Algorithm 2 Implementation

Implementation

Here is the code for the implementation of the *pseudocode* shown below.

Running time

Carrier Selection

Problem Model

Pseudocode

Algorithm 3 Implementation

Running time