**Drushti Ganesh Gawade**

**CIS 455 Bioinformatics**

**Assignment No :3**

**ID# 01403907**

**Problem 3-1.** **Suppose you have a maximization algorithm A, that has an approximation ratio of ¼. When run on some input , A() = 12.**

1. **What can you say about the true (correct) answer OPT = OPT()?**

**Solution:**

As A(π ) = 12.

When we take the 12/24 then the ratio is ½ 24 is less than 48 but ½ is greater than ¼.

If we consider 60 instead of 40. So the ratio is 1/5. Here 60 is greater than 48 but the ratio 1/5 is less than ¼.

Here the maximization approximation condition is satisfied so answer is  F. OPT(π) <= 48**.**

1. **What if A is a minimization algorithm?**

**Solution:**

If we assume A is an minimization algorithm then the optimal solution is impossible. And an algorithm with an approximation ratio 1 would be the perfect solution but these algorithms are hard to find. As per book the best known algorithm performance is 1.375

But the given ratio is ¼ = 0.25 so its too less than 1 so the optimal solution of the minimization algorithm A is impossible.

**Problem 3-2.**

**Solution:**

Problem is solved in the attached diagram.

Discussed with: Saurabh Patil.

**Problem 3-3. Find a permutation with no decreasing strips for which there exists a reversal that reduces the number of breakpoints?**

**Solution:** The example of permutation with no decreasing steps is as follows:

0 1 5 6 7 3 4 2

The number of breakpoint in this increasing strip is 3.

While reversing one of the strips (3, 4) we get,

0 1 5 6 7 4 3 2

Here, the permutation consists of a decreasing strip (4, 3, 2). Also the number of breakpoints reduced to 2.

Therefore, there is a permutation with no decreasing strips which there exists a reversal that reduces the number of breakpoints.

**Problem 3-4. Given permutations π1= 124356, π2= 143256 and π3= 123465, compute the number of breakpoints between:**

(1) π1 and π2

(2) π1 and π3

(3) π2 and π3

**Solution:**

**(1) π1 and π2**

When we consider π1 and π2 we will take each pair from π1 and compare with π2. In π1, 1 and 2 are adjacent but in π2, its is not adjacent. So there is a breakpoint. Next in π1, 2 and 4 are adjacent in π2, it is not. So there is one more breakpoint. Next we will compare 4 and 3 which is adjacent in both π1 and π2. So there is no breakpoint. 5 and 6 are adjacent in both π1 and π2, no breakpoint. Hence we get three breakpoint 12, 23 and 35.

**(2) π1 and π3**

1 and 2 are adjacent in both π1 and π3. 2 and 4 are not adjacent in π3 so there is a breakpoint. 4 and 3 are adjacent in both π1 and π3. 3 and 5 are not adjacent in π3. There is one more breakpoint. So there are 2 break points between π1 and π3 for 24 and 25.

**(3)** **π2 and π3**

1 and 4 are adjacent in π2 but not in π3, so there is a breakpoint. 4 and 3 are adjacent in both π2 and π3. Also 3 and 2 are adjacent in both π2 and π3. But 2 and 5 in π2 are not adjacent in π3. So there is another breakpoint. Finally there are 2 breakpoints between π2 and π3 for 14 and 25.

**Problem 3-5. Modify DPChange to return not only the smallest number of coins but also the correct combination of coins?**

**Solution:**

DPChange algorithm: It returns the smallest number of coins.

**DPCHANGE(M, c, d)**

1. bestNumCoins\_0←0
2. for m ←1 to M
3. bestNumCoins\_m←∞
4. for i←1 to d
5. if m≥ci
6. if bestNumCoinsm−ci+ 1< bestNumCoinsm
7. bestNumCoinsm←bestNumCoins\_(m−ci)+ 1
8. return bestNumCoinsM

To return the correct number of coins we should do the following modifications. DPChange algorithm can be modified by using one or more variable to store denomination against the pre computed value of each of M. The variable will return the correct combination of coins and also in smallest numbers.

**Modified: DPCHANGE(M, c, d)**

1. bestNumCoins\_0←0
2. for m ←1 to M
3. bestNumCoins\_m←∞
4. for i←1 to d
5. if m≥ci
6. if bestNumCoinsm−ci+ 1< bestNumCoinsm
7. bestNumCoinsm←bestNumCoins(m−ci)+ 1
8. bestDenomination [A] 🡨 Amount M
9. bestDenomnation [A][B] 🡨 Number of coins of M
10. return best NumCoinsM

This algorithm returns the correctcombinations of coins and also the smallest number of coins.

**Problem 3.6. Two players play the following rock game with two piles of rocks of heights n and m. At every turn a player must take two rocks from one pile (either the first pile or the second pile) and one rock from the other. The player who cannot complete their turn loses.**

If Player A starts playing, by selecting 2 rocks from one pile and 1 rock from another pile, and Player B is following A then B wins.

But if player B does not following player A then at last 3 rocks remains in one pile. And at that time player A wins.

**Attached Image for the same question.**

Discussed with: Saurabh Patil.