Assignment 3

Bioinformatics (CIS 455)

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Problem 3-1 Jones & Pevzner, Problem 5.1

Correct answer:

$$A(\pi) \geq OPT(\pi)/App_{ratio}$$
$$12 \geq OPT(\pi)/\frac{1}{4}$$
$$OPT(\pi) \leq 3$$

What if A was a minimization algorithm?

$$App_{ratio} \geq A(\pi)/OPT(\pi)$$
$$\frac{1}{4} \geq 12/OPT(\pi)$$
$$OPT(\pi) \geq 48$$

Problem 3-2 Jones & Pevzner, Problem 5.4

1.

We are going to perform *ImprovedBreakpointReversalSort* on π = 3 4 6 5 8 1 7 2.

We start by adding 0 and 9 to the sequence.

0 3 4 6 5 8 1 7 2 9 $b(\pi) = 7$

0 3 4 **6 5** 8 1 7 2 9

0 3 4 5 6 8 1 7 2 9 $b(\pi) = 6$

0 3 4 5 6 **8 1 7** 2 9

0 3 4 5 6 7 1 8 2 9 $b(\pi) = 5$

0 3 4 5 6 7 1 **8 2** 9

0 3 4 5 6 7 1 2 8 9 $b(\pi) = 3$

As there are not any decreasing strips, we flip an increasing one.

$$0\ 3\ 4\ 5\ 6\ 7\ \mathbf{1}\ \mathbf{2}\ 8\ 9$$

$$0\ 3\ 4\ 5\ 6\ 7\ 2\ 1\ 8\ 9\ b(\pi) = 3$$

$$0\ \mathbf{3}\ \mathbf{4}\ \mathbf{5}\ \mathbf{6}\ \mathbf{7}\ \mathbf{2}\ \mathbf{1}\ 8\ 9$$

$$0\ 1\ 2\ 7\ 6\ 5\ 4\ 3\ 8\ 9\ b(\pi) = 2$$

Finally,

$$0\ 1\ 2\ \mathbf{7}\ \mathbf{6}\ \mathbf{5}\ \mathbf{4}\ \mathbf{3}\ 8\ 9$$

$$0\ 1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ b(\pi) = 0$$

2.

The permutation that used the if test was this one:

$$0\ 3\ 4\ 5\ 6\ 7\ 1\ 2\ 8\ 9$$

$$0\ 3\ 4\ 5\ 6\ 7\ \mathbf{1}\ \mathbf{2}\ 8\ 9$$

$$0\ 3\ 4\ 5\ 6\ 7\ 2\ 1\ 8\ 9$$

3.

The sequence shown below uses 4 reversals instead of the 5 reversals used by *ImprovedBreakpointReversalSort*.

$$0\ 3\ 4\ 5\ 6\ 8\ 1\ 7\ 2\ 9$$

$$0\ 3\ 4\ 5\ 6\ \mathbf{8}\ \mathbf{1}\ \mathbf{7}\ \mathbf{2}\ 9$$

$$0\ 3\ 4\ 5\ 6\ 2\ 7\ 1\ 8\ 9$$

$$0\ \mathbf{3}\ \mathbf{4}\ \mathbf{5}\ \mathbf{6}\ 2\ 7\ 1\ 8\ 9$$

$$0\ 6\ 5\ 4\ 3\ 2\ 7\ 1\ 8\ 9$$

$$0\ 6\ 5\ 4\ 3\ 2\ \mathbf{7}\ \mathbf{1}\ 8\ 9$$

0 6 5 4 3 2 1 7 8 9

0 **6 5 4 3 2 1** 7 8 9

0 1 2 3 4 5 6 7 8 9

Problem 3-3 Jones & Pevzner, Problem 5.5

0 1 4 5 2 3 6 $b(\pi) = 3$

We choose the following permutation:

0 1 4 **5 2 3** 6

0 1 4 3 2 5 6 $b(\pi) = 2$

Finally,

0 1 **4 3 2** 5 6

0 1 2 3 4 5 6 $b(\pi) = 0$

Problem 3-4 Jones & Pevzner, Problem 5.13

π_1 and π_2

There are 3 breakpoints between π_1 and π_2: 12, 24, 35.

π_1 and π_3

There are 2 breakpoints between π_1 and π_3: 24, 35.

π_2 and π_3

There are 2 breakpoints between π_2 and π_3: 14, 25.

Problem 3-5 Jones & Pevzner, Problem 6.4

Algorithm 1 Implementation

```
1: function DPCHANGE(M,c,d)
2:     bestNumCoins_0 ← 0
3:     bestCoins_0 ← {}
4:     for m ← 1 to M do
5:         bestNumCoins_M ← ∞
6:         for i ← 1 to d do
7:             if m ≥ c_i then
8:                 if bestNumCoins_{m−c_i} + 1 < bestNumCoins_m then
9:                     bestNumCoins_m ← bestNumCoins_{m−c_i} + 1
10:                    bestCoins_m = {bestCoins_{m−c_i}, c_i}
11:                end if
12:            end if
13:        end for
14:    end for
15:    return bestNumCoins_M
16: end function
```

Problem 3-6 Rosalind

My *Rosalind* username is **jarechalde**.

Problem 3-7 Rosalind

afoster3

What I like about this solution is that is really compact, and in a few lines can implement the whole solution.

dennison_david

What I like about this solution is that rather than using a for loop and going letter by letter, it uses a pointer and a while loop instead, breaking this loop when no more matches are found.

Schavan

What I like about this solution is that it has a really good format, and it is also commented.