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 $\pi = 3\ 4\ 6\ 5\ 8\ 1\ 7\ 2$.

We start by adding 0 and 9 to the sequence.

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

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

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

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

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

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

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*.

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

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

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

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

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

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

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

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

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

Problem 3-3 Jones & Pevzner, Problem 5.5

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

We choose the following permutation:

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

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

Finally,

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

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

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.

3

Problem 3-5 Jones & Pevzner, Problem 6.4

Algorithm 1 Implementation

1: **function** DPCHANGE(M,c,d)
2:     $bestNumCoins_0 \leftarrow 0$
3:     **for** $m \leftarrow 1$ to M **do**
4:         $bestNumCoins_M \leftarrow \infty$
5:         **for** $i \leftarrow 1$ to d **do**
6:             **if** $m \geq c_i$ **then**
7:                 **if** $bestNumCoins_{m-c_i} + 1 < bestNumCoins_m$ **then**
8:                     $bestNumCoins_m \leftarrow bestNumCoins_{m-c_i} + 1$
9:                 **end if**
10:             **end if**
11:         **end for**
12:     **end for**
13:     **return** $bestNumCoins_M$
14: **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.