Al-Imam Mohammad Ibn Saud Islamic University

Collage of Computer and Information Sciences

Department of Computer Sciences

جامعة الإمام محمد بن سعود الإسلامية

كلية علوم الحاسب والمعلومات

قسم علوم الحاسب

CS 215: Design and Analysis of Algorithms	1440-1441 H, Second semester
Course Project	Due to: Tuesday (April 9th, 2019)

Bridge to Nowhere

A large river runs East/West dividing a country on the north from a country to the south. There are n cities on the north bank of the river and, coincidentally, n cities along the south bank of the river. We call the cities on the north of the river $a_1, a_2, \ldots, a_n$. The cities on the south of the river are $b_1, b_2, \ldots, b_n$. For a number of years, the cities on the north have all been paired with a" sister city" on the south in a cultural exchange program. We now seek to build bridges between each pair of sister cities. Unfortunately, the ordering of the cities on the north does not necessarily correspond to the ordering of their sister cities on the south. Thus, when a city a_i on the north builds a bridge to city b_i on the south, it may prevent other cities from connecting with a bridge (no two bridges may cross).
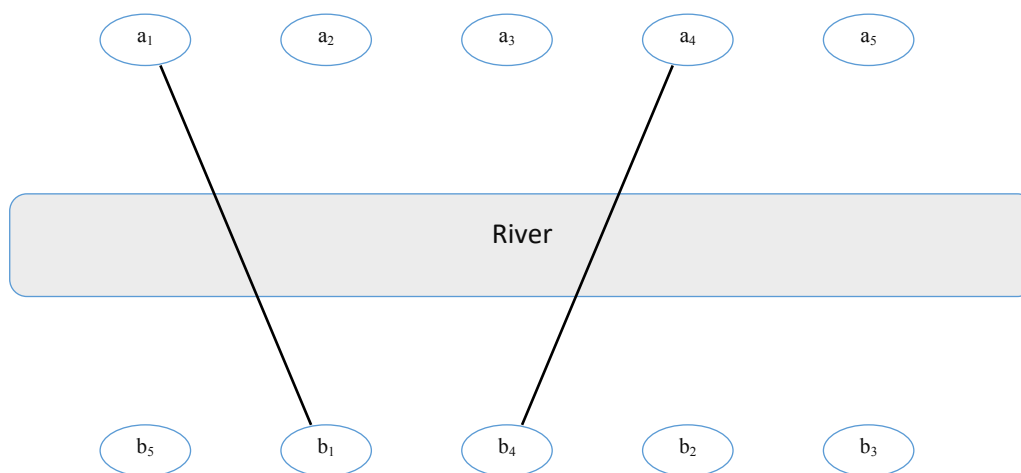
The figure shows an example problem with five cities on each side of the river. The civil engineers have built two bridges, connecting a_1 with b_1 and a_4 with b_4. You point out correctly that if they had forgone the bridge between the "4" cities, they could have built two more bridges between the "2" cities and "3" cities.

Requirements:

Your job is to solve this problem in the general case. Your input will consist of the integer **n ≤ 100** and a permutation of integers *1...n* indicating the ordering of the *"b"* cities on the south side of the river. Your job is to determine the maximum number of bridges that can be build and then also indicate where to build them.

Read data from stdin. Your first input will be integer *n* followed by the integers *1...n* indicating the permutation of cities on the south side of the river (the north cities are in order *1..n*). An example input file is below:

```
6
451362
```

As a bonus task that credits two marks: visualize the bridges between paired sister cities over the river.

Documentation:

Write a report with 5 sections. First section includes proposed algorithm pseudocode and its analysis. Second section presents source code the algorithm. Third section shows screen shots of the output. Fourth section is the conclusion that summarizes what you do to complete this the project, what the benefits you gain, and your suggestions of other optimization problems can use this algorithm as a solution. In last section, list all references and helps you used in completing this project even tools and libraries.