

CSCI 406

Final Programming Project: ALGOWARS

1 Problem Description

You are given a set of n circuit modules (e.g., AND gates, flip-flops, etc) and an $n \times n$ connectivity matrix which specifies the number of wires between each pair of modules. The problem is to place the n circuit modules in a row so that the total wire length is minimized. Adjacent modules in a row are separated by one unit.

The input format is as follows (I've only included the comments so that you understand the input. Comments will not be included in the actual inputs):

```
3 // n
0 2 1 // first row of connectivity matrix
2 0 0 // second row
1 0 0 // third row
```

Let's assume that the modules are named A, B and C so that the first row/column corresponds to A, the second to B, etc. The first row of the matrix indicates that there are 2 wires between A & B and 1 between A & C. Notice that the diagonal elements are all zero (because modules are not connected to themselves) and that the connectivity matrix is symmetric (i.e., the number of wires between A & B is the same as the number of wires between B & A). If we were to place the modules in the order $A B C$, then the total wire length is given by:

$$(d(A, B) \times M_{AB}) + (d(A, C) \times M_{AC}) + (d(B, C) \times M_{BC}) = (1 \times 2) + (2 \times 1) + (1 \times 0) = 4$$

The notation $d(X, Y)$ denotes the distance between modules X and Y and M_{XY} the number of wires between X and Y . If the modules are placed in the order $B A C$, then the total wire length becomes $(1 \times 2) + (2 \times 0) + (1 \times 1) = 3$. This means that $B A C$ is a better configuration than $A B C$. Your task is to find the best possible configuration in a reasonable amount of time. *Design your algorithm on the assumption that no input will contain more than 100 modules and that no element of the connectivity matrix is greater than 500.*

Your output should consist of the configuration of your solution in the first line and the cost of your solution on the second line. To illustrate, if your solution to the example above is $B A C$, then your output would be

```
2 1 3
3
```

2 Deliverables

1. *Overview:* ALGOWARS is 10% of your total grade. Your grade will be based on two things:
 - (1) Does your software work and produce correct solutions in a reasonable amount of time?
 - (2) How do the solutions produced by your algorithm compare to those of other groups? (3) Your effort distribution within the group.

2. *Where/When?*: We will schedule a time for all of the groups to meet in the alamode lab in BB during the last week of class (either on Wed or Thurs) to demo the performance of your algorithm on several inputs. Ideally, all group members will be able to attend.
3. *Inputs*: Each group will post a single input file in the format described above on piazza at least 24 hours in advance of the ALGOWARS meeting.
4. *Showtime*: During ALGOWARS, each group will (1) run its program on each input file (2) output the results to a file and (3) get the output validated (see below).
5. *Validation*: each group will need to get its output *validated* by a member of the group that created the corresponding input file. This means that each group will need to develop validation code which will read the solution and verify that its cost has been reported correctly. One of the group members that provided the input must sign off on your outcomes form (see below).
6. *Written deliverables*: (1) The validated outcomes form that has been posted separately. (2) Print-outs of your results on each input.

Good Luck!!!