Step 3: Initialize the pivot: Instructions

Help Center

Step 3: Initialize the Pivot

Bundle of unit tests and assignment parts for this step are available online at ZIP or alternatively as a tar.gz file.

The goal of this step is to perform initialization phase simplex. So far, the dictionaries we provided were all pre-initialized for you. Now, we will have to drop that assumption. Therefore, the goal of this assignment is to perform the initialization.

Dictionary

A typical dictionary looks like this:

$$\begin{array}{c|llll} x_{B1} & b_1 & +a_{11}x_{N1} & +\cdots+ & a_{1n}x_{Nn} \\ \vdots & \vdots & & \ddots & \\ x_{Bj} & b_j & +a_{j1}x_{N1} & +\cdots+ & a_{jn}x_{Nn} \\ \vdots & & & & \\ x_{Bm} & b_m & +a_{m1}x_{N1} & +\cdots+ & a_{mn}x_{Nn} \\ z & z_0 & +c_1x_{N1} & +\cdots+ & c_nx_{Nn} \end{array}$$

Steps 1 and 2 guaranteed that $b_1, \ldots, b_m \geq 0$ to start with, so that you did not bother with initialization. This time, we will drop that assumption.

Dictionary Format

Dictionary format will remain the same as it has been in steps 1 and 2. For your convenience it is recalled below. We will store a dictionary as a text file. The text file will have the following format:

```
[Line 1] m n
[Line 2] B1 B2 ... Bm [the list of basic indices m integers]
[Line 3] N1 N2 ... Nn [the list of non-basic indices n integers]
```

```
[Line 4] b1 .. bm (m floating point numbers)
[Line 5] a11 ... a1n (first row coefficients excluding the constant coefficient)
....
[Line m+4] am1 ... amn (mth row coefficients excluding the constant coefficient)
[Line m+5] z0 c1 .. cn (objective coefficients (n+1 floating point numbers))
```

Note: Text shown in black and line numbers are **not** part of the input file.
For example, the dictionary

$$\begin{array}{r|lllll} x_1 & 4 & +2x_3 & -3x_4 & +x_2 & +x_7 \\ x_5 & 5 & -x_3 & +3x_4 & -x_2 & -2x_7 \\ x_6 & -1 & & -x_4 & +x_2 & +3x_7 \\ z & 10 & -x_3 & +x_4 & -x_2 & +0x_7 \end{array}$$

is represented by the file

```
3 4
1 5 6
3 4 2 7
4.0 5.0 -1.0
2.0 -3.0 1.0 1.0
-1.0 3.0 -1.0 -2.0
0.0 -1.0 1.0 3.0
10.0 -1.0 1.0 -1.0 0.0
```

Here is an explanation of the numbers above:

- The first line says " 3 4 " and indicates $m = 3$ and $n = 4$.
- The second line says "1 5 6" and indicates that the basic variables are x_1, x_5, x_6
- The third line says "3 4 2 7" and indicates that the non-basic variables are x_3, x_4, x_2, x_7
- The fourth line says "4.0 5.0 -1.0" and indicates that the $\vec{b}$ coefficients (constant coefficients) are $\vec{b} = \begin{pmatrix} 4 \\ 5 \\ -1 \end{pmatrix}$.
- Lines 5-7 represent the 3×4 matrix A.
- Line 8 (the last line) has two parts: the first entry is $z = 10$ the current objective value and the rest are objective row coefficients.

Assignment

For this step, you are asked to perform the following steps:

- Add a new variable x_0 with index 0 as a non-basic variable, set up the auxiliary problem.
  - Change the objective (make sure you save your original problem objective) to $-x_0$
  - Add an extra column of all 1 to the dictionary corresponding to x_0.
- Perform a so called **magic pivot** where x_0 enters and the basic variable x_j with the least value of b_j leaves.
- Verify that the resulting dictionary is feasible.
- Continue to pivot it by reusing the code you wrote for the optimization phase step 2, previously.
- You can use **any** rule to choose entering variable. But remember the rule that if x_0 is one of the correct choices of leaving variables, it must leave.
  - We suggest that you retain Bland's rule at least initially to get the answers correct and match your answer with ours.
- You will get to a **final dictionary** for the auxiliary problem. You are asked to report the **optimal solution** that you obtained.

Some common pitfalls to watch out:

- Submitting the wrong part
- Printing anything into your output file other than just the auxiliary problem final answer.
- Printing the value of x_0 instead of the optimal solution which is $-x_0$.
- Some students using windows encountered a strange text file format that confuses the grader.
- Some students from Eastern Europe use `,` (comma) instead of the standard decimal point. We remind them that our grader expects decimal point.

Output format

The output is just a single floating point value that will be reported in a text file with just one number in it. For instance, if your solver reports the auxiliary problem optimal value of -3, your output will be a file with just one line that says `-3.0` Nothing else should be in that file. More significantly, **DO NOT** report the number of steps.

Zip Bundle (tar ball)

Bundle of unit tests and assignment parts for this step are available online at ZIP or alternatively as a tar.gz file. The zip bundle consists of a set of unit tests that report the answers and the exact pivoting steps obtained by our solver (we wrote it in python). We follow Bland's rule and hopefully, if you do so as well, you will be able to reproduce our exact answers step by step. The unit tests also have sample output files that you can use to check your answers. The unitTests directory has a printOut.pdf file that provides detailed steps for each unit test case. This is an invaluable tool in

helping compare your detailed answer against ours The **assignmentParts** directory consist of five parts. Once you solve a given part, you are welcome to upload the answer here and get graded.