Determinant1 (From the library of flanagan)

Determinant1 is from the study[1].

Input：A matrix A.

Output：The determinant of this matrix, i.e., det(A).
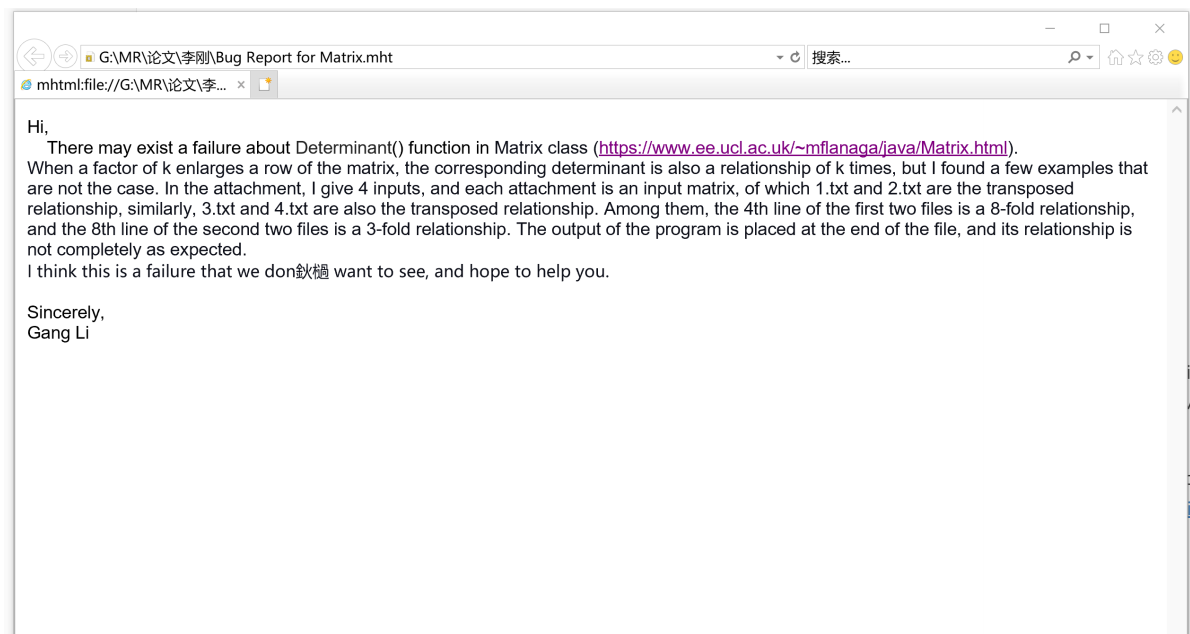
MR1: Transposition: $det(A) = det(A^T)$

MR2: Row Multiplied with Scalar: $\beta det((a_1,...,a_{k-1},a_k,a_{k+1},...,a_n)^T) = det((a_1,...,a_{k-1},\beta a_k,a_{k+1},...,a_n)^T)$ for $k \in \{1, ..., n\}$

Giving two testcases 0.txt and 1.txt：

The second test case input is based on the first test case, multiplying the value of line 20 by 6; However, the output of the first test case multiplied by 6 is not equal to the output of the second test case, which violates the metamorphic relation.

We sent an email on July 16, 2020, to the author to describe the bug we have found, but no reply is received as of now.The email content is as follows：

Hi,

　　There may exist a failure about Determinant() function in Matrix class (https://www.ee.ucl.ac.uk/~mflanaga/java/Matrix.html).
When a factor of k enlarges a row of the matrix, the corresponding determinant is also a relationship of k times, but I found a few examples that are not the case. In the attachment, I give 4 inputs, and each attachment is an input matrix, of which 1.txt and 2.txt are the transposed relationship, similarly, 3.txt and 4.txt are also the transposed relationship. Among them, the 4th line of the first two files is a 8-fold relationship, and the 8th line of the second two files is a 3-fold relationship. The output of the program is placed at the end of the file, and its relationship is not completely as expected.
I think this is a failure that we don鈥檛 want to see, and hope to help you.

Sincerely,
Gang Li

JAMA (From the library of JAMA)

JAMA is from the study[1].

Input： A matrix A.

Output： The determinant of this matrix, i.e., det(A).

MR1: Transposition: $det(A) = det(A^T)$

MR2: Row Multiplied with Scalar: $\beta det((a_1,...,a_{k-1},a_k,a_{k+1},...,a_n)^T) = det((a_1,...,a_{k-1},\beta a_k,a_{k+1},...,a_n)^T)$ for $k \in \{1, ..., n\}$

Giving two testcases 0.txt and 1.txt：

📄 0.txt - 记事本

文件(F) 编辑(E) 格式(O) 查看(V) 帮助(H)
```
16 16
0 1 -5 5 -10 -10 -2 0 0 6 0 1 0 -5 9 10
0 -1 6 -5 -6 6 6 -10 0 0 0 -1 0 -2 -3 -6
-1 -4 0 -4 1 8 -7 -10 -7 -10 -5 0 -5 3 0 5
-7 4 -8 -5 7 10 -1 0 -4 -8 6 0 -6 3 -5 -4
-1 -6 0 -1 -6 -6 -1 -3 -6 -7 0 -8 -2 0 8 -6
5 -4 0 0 10 1 0 8 -1 -5 0 3 -7 0 -7 4
-5 1 6 0 5 -2 -7 -5 0 -2 -5 8 0 0 0 6
-9 8 0 4 -5 0 0 -8 -2 -10 -6 0 -3 -10 -7 -5
5 2 5 5 -4 9 3 -3 0 -7 -5 0 -10 0 -3 0
-9 -5 -3 -8 0 -10 0 -4 7 0 0 10 0 -2 -7 0
-8 0 4 -8 1 4 0 7 -9 9 -4 -4 9 0 -7 1
6 0 -9 -4 -1 0 -10 -4 10 5 10 10 0 0 -10 5
0 0 -2 -6 0 0 0 -7 1 0 -2 -3 3 -10 1 0
-6 -8 -1 -5 -3 -2 -1 -7 -6 2 -8 10 6 0 0 0
-9 0 -7 -10 0 -3 8 -1 -5 0 -1 -3 8 10 -10 -10
-9 -1 -1 5 0 0 -1 0 0 -5 -8 8 0 -3 0 -7
18644849679849716.00000000
```

📄 1.txt - 记事本

文件(F) 编辑(E) 格式(O) 查看(V) 帮助(H)
```
16 16
0 1 -5 5 -10 -10 -2 0 0 6 0 1 0 -5 9 10
0 -1 6 -5 -6 6 6 -10 0 0 0 -1 0 -2 -3 -6
-1 -4 0 -4 1 8 -7 -10 -7 -10 -5 0 -5 3 0 5
-7 4 -8 -5 7 10 -1 0 -4 -8 6 0 -6 3 -5 -4
-1 -6 0 -1 -6 -6 -1 -3 -6 -7 0 -8 -2 0 8 -6
5 -4 0 0 10 1 0 8 -1 -5 0 3 -7 0 -7 4
-5 1 6 0 5 -2 -7 -5 0 -2 -5 8 0 0 0 6
-9 8 0 4 -5 0 0 -8 -2 -10 -6 0 -3 -10 -7 -5
5 2 5 5 -4 9 3 -3 0 -7 -5 0 -10 0 -3 0
-9 -5 -3 -8 0 -10 0 -4 7 0 0 10 0 -2 -7 0
-8 0 4 -8 1 4 0 7 -9 9 -4 -4 9 0 -7 1
6 0 -9 -4 -1 0 -10 -4 10 5 10 10 0 0 -10 5
0 0 -2 -6 0 0 0 -7 1 0 -2 -3 3 -10 1 0
-6 -8 -1 -5 -3 -2 -1 -7 -6 2 -8 10 6 0 0 0
-45 0 -35 -50 0 -15 40 -5 -25 0 -5 -15 40 50 -50 -50
-9 -1 -1 5 0 0 -1 0 0 -5 -8 8 0 -3 0 -7
93224248399245968.00000000
```

The second test case input is based on the first test case, multiplying the value of line 16 by 5; However, the output of the first test case multiplied by 5 is not equal to the output of the second test case, which violates the metamorphic relation.

We sent an email on July 16, 2020, to the author to describe the bug we have found, but no reply is received as of now.The email content is as follows：
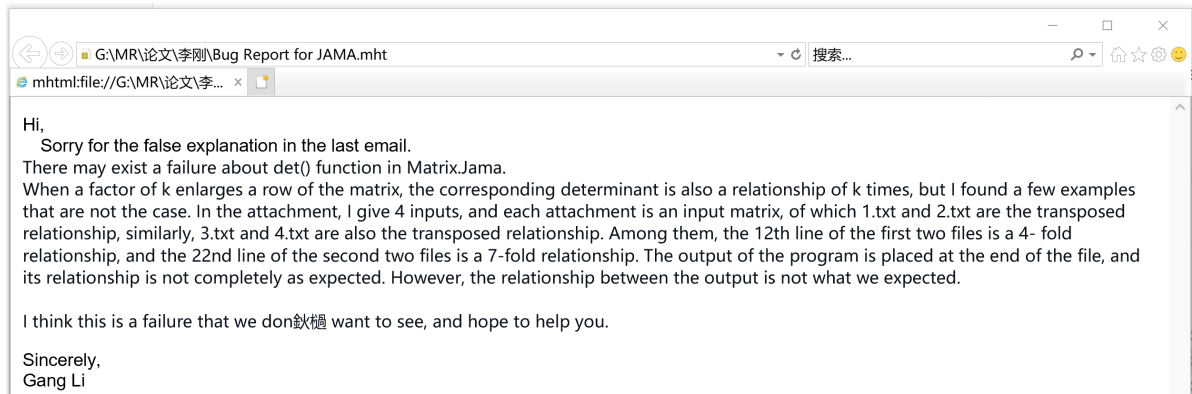
ClosetPair

ClosetPair is a program posted online[2].

Input： A set of points with x-y Cartesian coordinates in a plane.

Output： The distance of two closest points.

MR： Adding one point to this plane, the distance should not be larger than before.

Giving two inputs：

First is [(784832243,700131220), (1696499969,459738083), (1390076221,809277653), (1896548658,14284339220), (355749738,1176386028), (-1540278275,283604219), (-312014611,1004576997), (-137565412,-1210662673), (-939623457,-1306181183), (982263467,-952545436)]，output 9978.34;

Second is [(784832243,700131220), (1696499969,459738083), (1390076221,809277653), (1896548658,14284339220), (355749738,1176386028), (-1540278275,283604219), (-312014611,1004576997), (-137565412,-1210662673), (-939623457,-1306181183), (982263467,-952545436), (1645682438,-1196740735)]，output 16556.7;

The second test case added a point (1645682438,-1196740735) on the basis of the first test case, but the output of the second test case was greater than that of the first test case, which violated the metamorphic relation.

Rotate

Rotate is from the scipy[3].

issue： [BUG: Picture rotated 180 degrees and rotated -180 degrees should be consistent · Issue #12543 · scipy/scipy (github.com)](#)

F_oneway

Foneway is from the scipy[3].

issue： [p-value varies with the order of the data · Issue #11669 · scipy/scipy (github.com)](#)

[1] J. Mayer and R. Guderlei, "An empirical study on the selection of good metamorphic relations," in Proceedings of the 30th Annual International Computer Software and Applications Conference - Volume 01, ser. COMPSAC '06. USA: IEEE Computer Society, 2006, p. 475–484. [Online]. Available: https://doi.org/10.1109/COMPSAC.2006.24

[2] "Closest pair of points O(nlogn) algorithm - problem with some data in c++ implementation," Jul 2020, [Online; accessed 6. Jul. 2020]. [Online]. Available: https://stackoverflow.com/questions/54000950/closest-pair-of-points-onlogn-algorithm-problem-with-some-data-in-c-implem

[3] https://github.com/scipy