MatrixTools

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Usage

```
python mt.py --input "path/of/input/txt/file" --option "option-name" --output
"path/of/output/txt/file"
```

Example

```
python mt.py --input example.txt --option QR --output qr.txt
```

Alias of arguments

Argument	Alias
`--input`	`-i`
`--option`	`-opt`, `--opt`
`--output`	`-o`

Available options (case free)

Options	Input	Function	Output	Alias
`QR_Gram_Schmidt`	$A(m,n)$	Calculate QR decoposition of A with modified Gram-Schmidt algorithm.	$Q(m,n)$, $R(n,n)$	`QR`, `Gram_Schmidt`
`Householder`	$A(m,n)$	Calculate QR decomposition of A with Householder reduction, such that $A=QR$, where R is the reduced upper-trapezoidal result.	$Q(m,m)$, $R(m,n)$	
`Givens`	$A(m,n)$	Calculate QR decomposition of A with Householder reduction, such that $A=QR$, where R is the reduced upper-trapezoidal result.	$Q(m,m)$, $R(m,n)$	

Options	Input	Function	Output	Alias
`PLU`	$A(n,n)$	Calculate PLU decomposition of A such that $A=PLU$, where P is a permutation matrix, L is lower-triangular, and U is upper-triangular.	$P(n,n)$, $L(n,n)$, $U(n,n)$	`LU`
`determinant`	$A(n,n)$	Calculate the determinant of A.	det of A	`det`
`rank`	$A(m,n)$	Calculate the rank of A.	rank of A	
`URV`	$A(m,n)$	Calculate URV decoposition of A, such that $A=URV^T$.	$U(m,m)$, $R(m,n)$, $V(n,n)$	
`equation`	$C(m,n+1)$, the augmented matrix	Solve $Ax=b$ for a general form solution. The input C is $[A\|b]$. The solution form is $s=ps+\sum_i k_i gs_i$, where ps is a particular solution to $Ax=b$, and gs_i are solutions to $Ax=0$	`ps`, `gs_list`, where each solution has shape $(n,1)$	`eq`
`row_echelon`	$A(m,n)$	Reduce A into row echelon form with partial pivoting.	$R(m,n)$	
`reduced_row_echelon`	$A(m,n)$	Reduce A into reduced row echelon form with partial pivoting and Gauss-Jordan method.	$R(m,n)$	

Attention

- The input for solving equation $Ax=b$ is the augmented matrix $C=[A|b]$.
- A must be square to have determinant and PLU decomposition.
- Difference between `QR_Gram_Schmidt` and `Householder`, `Givens`
  - In `QR_Gram_Schmidt`, you orthogonalize columns of A to get Q, so Q has identical shape to A and R is square.
  - In `Householder` and `Givens`, you reduce A to upper-trapezoidal R with orthogonal reduction, so R has identical shape to A and Q is square.
- The reduced results of `Householder` and `Givens` is upper-trapezoidal, which maybe not in row echelon form.