

noromatrix

noromatrix User's Manual
Edition 1.0
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1 茵義膊宴若 noro_matrix.rr

ヤ , asir-contrib 宴若吾 蚊 , 茵義膊宴若 'noromatrix.rr' や 茯 .
宴若吾 篠帥 , 障 'noromatrix.rr' 若.

```
[1831] load("noromatrix.rr");
[2014]
```

宴若吾 醇違若喝冴 , linalg. や.

```
[2014] linalg.random_mat(3,5);
[ 0 -1 -1 ]
[ -1 3 0 ]
[ -2 -2 4 ]
```

ヤ , c 脛莨若水醇違 や 茹 h .

1.1 茵 醇

1.1.1 matrix,vector,linalg.unit_mat

matrix(m,n[,listoflist]) :: m 茵 n .
vector(size[,list]) :: 泣や冴 size .
linalg.unit_mat(size) :: 泣や冴 size 篠茵.
return 茵

size

m

n 罩 f 脛

listoflist 鴻 鴻

list 鴻

- matrix, vector 莨若, linalg.unit_mat 'noromatrix.rr' 臂 .
- matrix, vector , listoflist, list 翫 区, 吟 .
- listoflist [[1,2,3],[3,4,5]] 鴻 鴻 . 綰違 翫, 苟脛 鴻篠帥 c 茵 茵 .
- list [1,2,3] 鴻 . 綰違 翫, 鴻 脛 .

```
[1559] matrix(2,3);
[ 0 0 0 ]
[ 0 0 0 ]
[1560] vector(3);
[ 0 0 0 ]
[1561] linalg.unit_mat(3);
[ 1 0 0 ]
[ 0 1 0 ]
[ 0 0 1 ]
[1559] matrix(2,3,[[1,2,3],[4,5,6]]);
[ 1 2 3 ]
[ 4 5 6 ]
```

1.1.2 linalg.random_mat, linalg.random_rmat, linalg.random_vect

linalg.random_mat(size,bound) :: 罩 f 号 價域 渦.
 linalg.random_rmat(m,n,bound) :: m 茵 n 價域 渦.
 linalg.random_vect(size,bound) :: 價違 渦.

return 價

number 價

- linalg.random_mat(size,bound) , 泣や size, 苟脛 bound 罩 f 号 價域 渦.

•

- linalg.random_rmat(m,n,bound) m 茵 n , 苟脛 bound 價域 渦.

- linalg.random_vect(size,bound) 激 size, 苟脛 bound 價違 渦.

```
[1579] linalg.random_mat(3,4);
[ 2 1 -2 ]
[ 0 -2 1 ]
[ 3 1 -2 ]
[1580] linalg.random_rmat(3,5,2);
[ 0 -1 0 0 0 ]
[ 0 -1 0 1 0 ]
[ -1 0 0 -1 1 ]
[1581] linalg.random_vect(3,6);
[ -3 2 3 ]
```

1.1.3 invmat

invmat(mat)
 :: mat 茵荐膊.

return 鴻

mat 罩 f 壕

- 罩 f 壕 mat 茵荐膊.

- 脛 [invmat,denom] 鴻 . , invmat 茵, denom 罰茵 縷 , invmat/denom 茵茵 .

- mat 價域, 縷茵 翫, invmat 價域, 縷 . 罕, , 縷 荐膊 , 飲帥 翫.

```
[1575] A=linalg.random_mat(4,5);
[ 2 4 3 3 ]
[ 3 0 0 0 ]
[ 0 2 3 -2 ]
[ 2 0 -4 3 ]
[1576] L=invmat(A);
[[ 0 38 0 0 ]
[ -3 -28 63 45 ]
[ 18 16 -36 -42 ]
[ 24 -4 -48 -18 ]],114]
[1577] AI=L[0]/L[1]$ AI*A;
[1578] [ 1 0 0 0 ]
[ 0 1 0 0 ]
```

```

[ 0 0 1 0 ]
[ 0 0 0 1 ]

```

1.1.4 det,nd_det

```

det(mat[,mod])
nd_det(mat[,mod])
    :: mat 絛罷.

return 絛
mat 茵
mod 脰

• det nd_det mat 絛罷.
• 絛 mod , GF(mod) 箏 絛罷.
• 違 号紙 c , 紊紊医絛 茵 茵絛絮 号 祉合翫.
• nd_det 違障 箏箏 絛茵 絛 荐膊絛 . 眼 沔 違 号紙, 若炊割よ
    嚮紊 , 箏 det 蕭 荐膊 .

[91] A=matrix(5,5)$
[92] V=[x,y,z,u,v];
[x,y,z,u,v]
[93] for(I=0;I<5;I++)for(J=0,B=A[I],W=V[I];J<5;J++)B[J]=W^J;
[94] A;
[ 1 x x^2 x^3 x^4 ]
[ 1 y y^2 y^3 y^4 ]
[ 1 z z^2 z^3 z^4 ]
[ 1 u u^2 u^3 u^4 ]
[ 1 v v^2 v^3 v^4 ]
[95] fctr(det(A));
[[1,1],[u-v,1],[-z+v,1],[-z+u,1],[-y+u,1],[y-v,1],[-y+z,1],[-x+u,1],
[-x+z,1],[-x+v,1],[-x+y,1]]

```

1.1.5 generic_gauss_elim

```

generic_gauss_elim(mat)
    :: 膺域膺 .

return 鴻
mat 膺域

• 膺域 mat 亜脰霖球就 (reduced row echelon form; rref) 荐膊, 罕若帥 鴻 .
• 阪 [B,D,J,K] 就 鴻 .  $\sqcup$  mat m 茵 n , 滂 r , B r 茵 n-r . D
    膺, J 激 r, K 激 n-r 膺違 .
• 阪若帥 mat rref 滂滂若 . rref J[l] l 茵 帥 D, 篁  $\sqcup$  0 , rref 膺 K[l] B
    l , 箏 苔違 .
• 就絛 阪宴,  $\sqcup$  茵 滂 紊 翫, rref 0 紊 , < 紊羔莢祉 , 就 鴻,
    違 箏 若帥 .

```

```
[1600] A=linalg.random_rmat(3,5,2);
[ 0 -1 -1 0 -1 ]
[ 1 0 1 -1 0 ]
[ 1 1 0 0 0 ]
[1601] L=generic_gauss_elim(A);
[[ -1 -1 ]
[ 1 1 ]
[ -1 1 ],2,[ 0 1 2 ],[ 3 4 ]]
```

箴, rref 荐膊醇違 吾.

```
def my_rref(A)
{
    S = size(A); M = S[0]; N = S[1];
    L = generic_gauss_elim(A);
    B = L[0]; D = L[1]; J = L[2]; K = L[3];
    R = length(J); NR = N-R;
    A1 = matrix(M,N);
    for ( I = 0; I < R; I++ ) {
        A1[I][J[I]] = D;
        for ( L = 0; L < NR; L++ ) A1[I][K[L]] = B[I][L];
    }
    return A1;
}
```

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1.1.6 linalg.compute_kernel, linalg.compute_image

`linalg.compute_kernel(mat[|rhs=vect])`

:: 域 吾 阪荐膊.

`linalg.compute_image(mat)`

:: 域 阪荐膊.

`return` 鴻

`mat` 域

`vect` 違

- m 茵 n , 窪 n 罨 m 罨 吾 綵 帥 .
- `linalg.compute_kernel` 域 `mat` 吾 阪荐膊.
- `linalg.compute_kernel` 阪 $[[v1, pos1], \dots, [vl, posl]]$ 就 鴻 . , vi 阪 , $posi$, vi 源箴臀, 絨 や渦 鴻ゆ 臀 茵 . $posi$ 違 篆荐若.
- 激 `vect` 紘翫, 脰 $[sol, [[v1, pos1], \dots, [vl, posl]]]$ 鴻 . sol `mat` $sol = vect$ 羣 (号茹), 吾 阪 .
- 茹 c 紘 `vect` 紘 若莎激.
- `linalg.compute_image` 域 `mat` 阪荐膊.
- `linalg.compute_image` 阪, $[v1, pos1, hist1], \dots, [vl, posl, histl]$ 就 鴻 . , vi 阪 , $posi$, vi 源箴臀, 絨 や渦 鴻ゆ 臀 茵 . $posi$ 違 篆荐若. $histi$, vi , `mat` 箴腓冴若帥 . e 綵 ; 障 , 違茵や渦 , 篆違, 箴罨 違茵 . 若 帥 箴 , 紘医 や vi .

```

[1643] A=linalg.random_rmat(3,5,3);
[ 2 1 0 1 -1 ]
[ 2 -2 1 0 1 ]
[ 2 1 -1 -1 -1 ]
[1644] linalg.compute_kernel(A);
[[[ 1 0 -8 4 6 ],0],[[ 0 1 2 -1 0 ],1]]
[1645] linalg.compute_kernel(A|rhs=vector(3,[1,2,3]));
[[ 0 0 8 -5 -6 ],[[[ 1 0 -8 4 6 ],0],[[ 0 1 2 -1 0 ],1]]]
[1646] linalg.compute_image(A);
[[[ 1 1 1 ],0,(1)*<<0>>],[[ 0 -3 0 ],1,(1)*<<1>>+(-1)*<<0>>],
[[ 0 0 3 ],2,(-3)*<<2>>+(-1)*<<1>>+(1)*<<0>>]]

```

1.1.7 linalg.minipoly_mat

`linalg.minipoly_mat(mat)`
 :: 域 *mat* 絨素絳荐膊.
 return 箏素医絳
mat 域

- 域 *mat* 絨素絳荐膊, 素 *x* 素医絳 菴.

```

[1682] A=linalg.random_mat(3,3);
[ -2 2 -2 ]
[ 0 1 -1 ]
[ 1 -2 -1 ]
[1683] linalg.minipoly_mat(A);
x^3+2*x^2-x-6
[1684] A^3+2*A^2-A-6*linalg.unit_mat(3);
[ 0 0 0 ]
[ 0 0 0 ]
[ 0 0 0 ]

```

1.1.8 linalg.jordan_canonical_form,linalg.sample_mat

`linalg.jordan_canonical_form(mat)`
 :: 井 壕 吾 怡羣綵 荐膊.

`linalg.sample_mat(list)`
 :: 紵吾 怡羣綵 𠂇井 壕.

return 鴻

mat 井 壕

list 吾 鴻 鴻

- `linalg.jordan_canonical_form(mat)` 井 壕 *mat* 吾 怡羣綵 荐膊.
- 阪 $[P, [[e1, s1, n1], \dots, [el, sl, nl]], defideal]$ 綵 鴻 ., *P* 茵, $P^{(-1)}AP$ 吾 岡羣綵 罩 *e* 茵, $[ei, si, ni]$, 堺 *ei*, 泣 *si* 吾 鴻 *ni* 箏 吟 鴻.
- 箏 , 阪 *a0*, ..., *am* 就 <帥 . 紵 , 遺箏 絳 鴻 . 紵臂 合絳 , *defideal* 箏. *defideal* 鴻 鴻 , 苟脰 鴻, 箏脰 怨醜 劫 紵臂 や 茵 . 紵 , 絲上箏素医絳 鴻, 鴻 違 茵 .

```

• linalg.sample_mat(list) 紘吾 恰羣綵 や . list [[e1,s1],...,[el,sl]] 就 鴻
, [ei,sl] 堺 ei, 泣や si 吾 湍 茵 . 泣や冴 吾 湍 や c .
[ 1 -2 0 ]
[ -1 2 1 ]
[ 0 -2 1 ]
[1807] L=linalg.jordan_canonical_form(A);
[[ 2 -2 0 ]
[ -1 0 1 ]
[ 2 -2 -1 ], [[2,1,1],[1,2,1]], []]
[1808] P=L[0]$T=invmat(P)$PI=T[0]/T[1]$
[1809] [1810] [1811] PI*A*P;
[ 2 0 0 ]
[ 0 1 1 ]
[ 0 0 1 ]
[1810] A=linalg.sample_mat([[1,2],[1,1],[2,3],[2,1],[2,1]]);
[ 2 0 2 113 14 678 0 0 ]
[ -1 1 -2 -120 -14 -720 0 0 ]
[ -7 0 -13 -840 -105 -5040 0 0 ]
[ 54 54 0 380 0 2268 -54 0 ]
[ 1 0 2 112 16 672 0 0 ]
[ -9 -9 0 -63 0 -376 9 0 ]
[ 1 1 0 7 0 42 1 0 ]
[ 1 1 0 7 0 42 0 2 ]
[1811] L=linalg.jordan_canonical_form(A);
[[ 0 -6 42 0 0 0 2 2 ]
[ 0 6 0 0 0 0 0 -2 ]
[ 42 -294 0 0 0 0 -1 -1 ]
[ 0 0 0 6 0 108 0 0 ]
[ -6 42 48 0 0 0 0 0 ]
[ 0 0 -1 -1 0 -18 0 0 ]
[ 0 0 0 0 0 2 0 0 ]
[ 0 0 0 0 1 0 -2 0 ], [[2,3,1],[2,1,2],[1,2,1],[1,1,1]], []]

```

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(Index is nonexistent)

(Index is nonexistent)

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