Orthogonal Vectors

```
u = [-2; 3; 1; 4]; v = [1; 2; 0; -1];  % Define the vectors
dot_product = dot(u, v);     % Calculate the dot product

% Check if the dot product is zero (orthogonal)
if dot_product == 0
   disp('The vectors are orthogonal.');
else
   disp('The vectors are not orthogonal.');
end
```

```
The vectors are orthogonal.
```

☐ Generation of two orthogonal vectors of a given 3D vector.

```
A = [1,2,3];
N = null(A);
OrthVec1 = N(:,1)
```

```
OrthVec1 = 3×1
   -0.5345
    0.7745
   -0.3382
```

```
OrthVec2 = N(:,2)
```

```
OrthVec2 = 3×1
   -0.8018
   -0.3382
    0.4927
```

Orthogonal complement of the space spanned by [1,7,2] and [-2,3,1].

```
V1 = [1,7,2]; V2 = [-2,3,1]; % Define the set of vectors
A = [V1; V2];
% Compute the null space of A to find vectors orthogonal to both v1 and v2.
N = null(A)
```

```
N = 3×1
    0.0563
   -0.2817
    0.9578
```

```
[RR,ic]=rref(A)
```

```
RR = 2×3
    1.0000         0   -0.0588
         0    1.0000    0.2941
ic = 1×2
     1     2
```

```
r=length(ic)
```

```
r =
```

```
2
```

```
R=RR(1:r,:) % gives a matrix, whose row vectors forms the basis of row-space of A.
```

```
R = 2×3
    1.0000         0   -0.0588
         0    1.0000    0.2941
```

```
% To check whether column vectors of null(A) and the space spanned by the two
vectors are orthogonal complement of each other.
for i=1:size(R,1)
    for j=1:size(N,2)
        if round(dot(R(i,:),N(:,j)))==0
            disp('They are orthogonal complements of each other')
        else
            disp('They are not orthogonal complements of each other')
        end
    end
end
```

```
They are orthogonal complements of each other
They are orthogonal complements of each other
```

1

```
A = [3,1,-2];
N = null(A);
OrthVec1 = N(:,1)
```

```
OrthVec1 = 3×1
   -0.2673
    0.9604
    0.0793
```

```
OrthVec2 = N(:,2)
```

```
OrthVec2 = 3×1
    0.5345
    0.0793
    0.8414
```

2

```
V1 = [2,0,-1]; V2 = [1,1,1]; % Define the set of vectors
A = [V1; V2];
% Compute the null space of A to find vectors orthogonal to both v1 and v2.
N = null(A)
```

```
N = 3×1
    0.2673
   -0.8018
    0.5345
```

```
[RR,ic]=rref(A)
```

```
RR = 2×3
    1.0000         0   -0.5000
         0    1.0000    1.5000
ic = 1×2
     1     2
```

```
r=length(ic)
```

```
r =
2
```

```
R=RR(1:r,:) % gives a matrix, whose row vectors forms the basis of row-space of A.
```

```
R = 2×3
    1.0000         0   -0.5000
         0    1.0000    1.5000
```

```
% To check whether column vectors of null(A) and the space spanned by the two
vectors are orthogonal complement of each other.
for i=1:size(R,1);
    for j=1:size(N,2);
        if round(dot(R(i,:),N(:,j)))==0
            disp('They are orthogonal complements of each other')
        else
            disp('They are not orthogonal complements of each other')
        end
    end
end
```

```
They are orthogonal complements of each other
They are orthogonal complements of each other
```

3

```
A=[1 1 3;2 -3 1]
```

```
A = 2×3
     1     1     3
     2    -3     1
```

```
b=[0;0]
```

```
b = 2×1
     0
     0
```

```
A\b
```

```
ans = 3×1
     0
     0
     0
```

```
M=pinv(A)*b
```

```
M = 3×1
     0
```

```
     0
     0
```

```
N = null(M')
```

```
N = 3×3
     1     0     0
     0     1     0
     0     0     1
```

```
[RR,ic]=rref(M')
```

```
RR = 1×3
     0     0     0
ic =

  1×0 empty double row vector
```

```
r=length(ic)
```

```
r =
0
```

```
R=RR(1:r,:) % gives a matrix, whose row vectors forms the basis of row-space of A.
```

```
R =

  0×3 empty double matrix
```

```
% To check whether column vectors of null(A) and the space spanned by the two
vectors are orthogonal complement of each other.
for i=1:size(R,1);
    for j=1:size(N,2);
        if round(dot(R(i,:),N(:,j)))==0
            disp('They are orthogonal complements of each other')
        else
            disp('They are not orthogonal complements of each other')
        end
    end
end
```

4

```
V1 = [1,0,1]; V2 = [-2,0,0]; V3=[0,0,3]; % Define the set of vectors
A = [V1; V2;V3];
% Compute the null space of A to find vectors orthogonal to v1 v2 and v3.
N = null(A)
```

```
N = 3×1
    0.0000
   -1.0000
   -0.0000
```

```
[RR,ic]=rref(A)
```

```
RR = 3×3
```

```
     1     0     0
     0     0     1
     0     0     0
ic = 1×2
     1     3
```

```
r=length(ic)
```

```
r =
2
```

```
R=RR(1:r,:) % gives a matrix, whose row vectors forms the basis of row-space of A.
```

```
R = 2×3
     1     0     0
     0     0     1
```

```
% To check whether column vectors of null(A) and the space spanned by the three
vectors are orthogonal complement of each other.
for i=1:size(R,1);
    for j=1:size(N,2);
        if round(dot(R(i,:),N(:,j)))==0
            disp('They are orthogonal complements of each other')
        else
            disp('They are not orthogonal complements of each other')
        end
    end
end
```

```
They are orthogonal complements of each other
They are orthogonal complements of each other
```

5

```
V1 = [3,-5,2]; V2 = [2,1,4]; % Define the set of vectors
A = [V1; V2];
% Compute the null space of A to find vectors orthogonal to both v1 and v2.
N = null(A)
```

```
N = 3×1
   -0.8216
   -0.2988
    0.4855
```

```
[RR,ic]=rref(A)
```

```
RR = 2×3
    1.0000         0    1.6923
         0    1.0000    0.6154
ic = 1×2
     1     2
```

```
r=length(ic)
```

```
r =
2
```

```
R=RR(1:r,:) % gives a matrix, whose row vectors forms the basis of row-space of A.
```

```
R = 2×3
    1.0000         0    1.6923
         0    1.0000    0.6154
```

```
% To check whether column vectors of null(A) and the space spanned by the two
vectors are orthogonal complement of each other.
for i=1:size(R,1);
    for j=1:size(N,2);
        if round(dot(R(i,:),N(:,j)))==0
            disp('They are orthogonal complements of each other')
        else
            disp('They are not orthogonal complements of each other')
        end
    end
end
```

```
They are orthogonal complements of each other
They are orthogonal complements of each other
```

6

```
A = [4 1 -2 0;-1 2 -1 1];
N = null(A);
OrthVec1 = N(:,1)
```

```
OrthVec1 = 4×1
    0.2821
    0.4989
    0.8136
    0.0979
```

```
OrthVec2 = N(:,2)
```

```
OrthVec2 = 4×1
    0.1252
   -0.3634
    0.0687
    0.9206
```

7

```
A = [0 1 2; 1 -1 0;3 1 8];
% Compute the null space of A to find orthogonal vectors
N = null(A)
```

```
N = 3×1
   -0.6667
   -0.6667
    0.3333
```

```
[RR,ic]=rref(A)
```

```
RR = 3×3
```

```
     1     0     2
     0     1     2
     0     0     0
ic = 1×2
     1     2
```

```
r=length(ic)
```

```
r =
2
```

```
R=RR(1:r,:) % gives a matrix, whose row vectors forms the basis of row-space of A.
```

```
R = 2×3
     1     0     2
     0     1     2
```

```
% To check whether column vectors of null(A) and the row space spanned by the
vectors are orthogonal complement of each other.
for i=1:size(R,1);
    for j=1:size(N,2);
        if round(dot(R(i,:),N(:,j)))==0
            disp('They are orthogonal complements of each other')
        else
            disp('They are not orthogonal complements of each other')
        end
    end
end
```

```
They are orthogonal complements of each other
They are orthogonal complements of each other
```