

Contents

- Define the function & plot it
- Find Root #1
- Find Root #2
- Find Root #3
- Find Root #4
- Find Root #5
- Find Root #6
- Find Root #7
- Find Root #8

```
% HW 3 Problem 3(b)
% Find all the roots of the system

clear
clc
close all
```

Define the function & plot it

```
fm = @(x,y,z) x^2 + y^2 + z^2 - 6;
gm = @(x,y,z) x^2 - y^2 + 2*z^2 - 2;
hm = @(x,y,z) 2*x^2 + y^2 - z^2 - 3;
gradfm = @grad_p3b_f;
gradgm = @grad_p3b_g;
gradhm = @grad_p3b_h;
```

Find Root #1

```
i = 1;
x0 = -2;
y0 = 0.3;
z0 = 0.5;
% Newton's method for multi-variable nonlinear equations
[xm(i,1),ym(i,1),zm(i,1),it3D(i,1),success3D(i,1)] = newton3D_exact(fm,gradfm,gm,gradgm,hm,gradhm,x0,y0,z0,1000,1e-6,true)
% Adding root to the plot
plot3(xm(i,1),ym(i,1),zm(i,1),'bd','MarkerSize',32,'LineWidth',8);
hold on
```

```
iteration: 1; x: -1.250000 + 0.000000 i; y: 5.150000 + 0.000000 i; f: 2.250000, g: 0.000000
iteration: 2.714750e+01; x: -16.835000 + 21.585000 i; y: iteration: 2; x: -1.025000 + 0.000000 i; y: 2.866262 + 0.000000 i; f: 1.569444, g: 0.000000
iteration: 5.729239e+00; x: -4.238522 + 4.853553 i; y: iteration: 3; x: -1.000305 + 0.000000 i; y: 1.956461 + 0.000000 i; f: 1.421890, g: 0.000000
iteration: 8.501207e-01; x: -0.783584 + 0.807186 i; y: iteration: 4; x: -1.000000 + 0.000000 i; y: 1.744921 + 0.000000 i; f: 1.414234, g: 0.000000
iteration: 4.480779e-02; x: -0.044632 + 0.044691 i; y: iteration: 5; x: -1.000000 + 0.000000 i; y: 1.732098 + 0.000000 i; f: 1.414214, g: 0.000000
iteration: 1.644212e-04; x: -0.000164 + 0.000164 i; y: iteration: 6; x: -1.000000 + 0.000000 i; y: 1.732051 + 0.000000 i; f: 1.414214, g: 0.000000
iteration: 2.252726e-09; x: -0.000000 + 0.000000 i; y:

xm =

    -1.0000

ym =

    1.7321

zm =

    1.4142

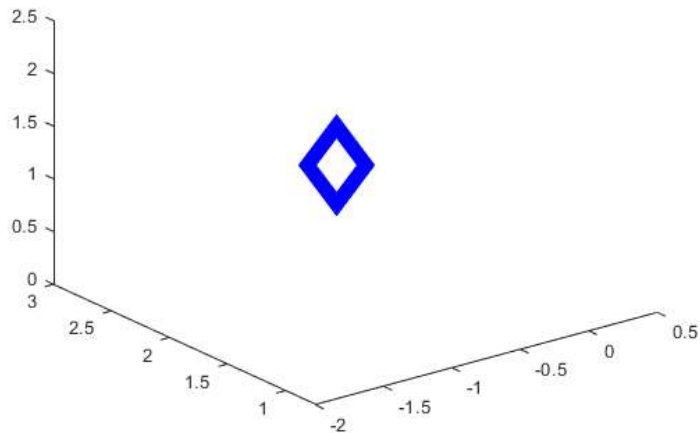
it3D =

     6

success3D =

    logical

     1
```



Find Root #2

```

i = i + 1;
x0 = -2;
y0 = -0.3;
z0 = 0.5;
% Newton's method for multi-variable nonlinear equations
[xm(i,1),ym(i,1),zm(i,1),it3D(i,1),success3D(i,1)] = newton3D_exact(fm,gradfm,gm,gradgm,hm,gradhm,x0,y0,z0,1000,1e-6,true)
% Adding root to the plot
plot3(xm(i,1),ym(i,1),zm(i,1),'rd','MarkerSize',32,'LineWidth',8);
hold on

iteration: 1; x: -1.250000 + 0.000000 i; y: -5.150000 + 0.000000 i; f: 2.250000, g: 0.000000
iteration: 2.714750e+01; x: -16.835000 + 21.585000 i; y: iteration: 2; x: -1.025000 + 0.000000 i; y: -2.866262 + 0.000000 i; f: 1.569444, g: 0.000000
iteration: 5.729239e+00; x: -4.238522 + 4.853553 i; y: iteration: 3; x: -1.000305 + 0.000000 i; y: -1.956461 + 0.000000 i; f: 1.421890, g: 0.000000
iteration: 8.501207e-01; x: -0.783584 + 0.807186 i; y: iteration: 4; x: -1.000000 + 0.000000 i; y: -1.744921 + 0.000000 i; f: 1.414234, g: 0.000000
iteration: 4.480779e-02; x: -0.044632 + 0.044691 i; y: iteration: 5; x: -1.000000 + 0.000000 i; y: -1.732098 + 0.000000 i; f: 1.414214, g: 0.000000
iteration: 1.644212e-04; x: -0.000164 + 0.000164 i; y: iteration: 6; x: -1.000000 + 0.000000 i; y: -1.732051 + 0.000000 i; f: 1.414214, g: 0.000000
iteration: 2.252726e-09; x: -0.000000 + 0.000000 i; y:

xm =

    -1.0000
    -1.0000

ym =

    1.7321
   -1.7321

zm =

    1.4142
    1.4142

it3D =

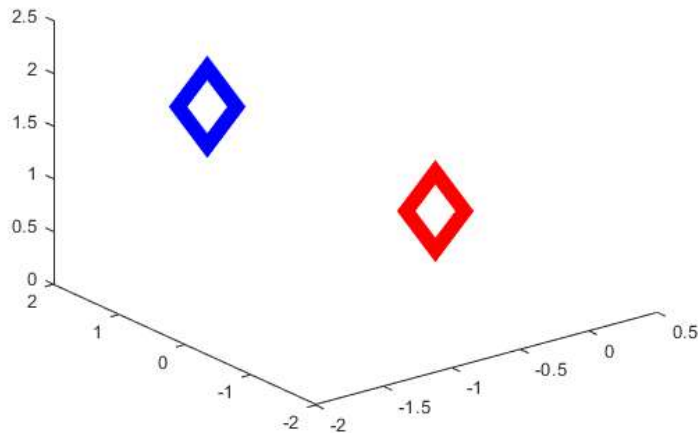
     6
     6

success3D =

    2x1 logical array

     1
     1

```



Find Root #3

```
i = i + 1;
x0 = -2;
y0 = 0.3;
z0 = -0.5;
% Newton's method for multi-variable nonlinear equations
[xm(i,1),ym(i,1),zm(i,1),it3D(i,1),success3D(i,1)] = newton3D_exact(fm,gradfm,gm,gradgm,hm,gradhm,x0,y0,z0,1000,1e-6,true)
% Adding root to the plot
plot3(xm(i,1),ym(i,1),zm(i,1),'md','MarkerSize',32,'LineWidth',8);
hold on

iteration: 1; x: -1.250000 + 0.000000 i; y: 5.150000 + 0.000000 i; f: -2.250000, g: 0.000000
iteration: 2.714750e+01; x: -16.835000 + 21.585000 i; y: iteration: 2; x: -1.025000 + 0.000000 i; y: 2.866262 + 0.000000 i; f: -1.569444, g: 0.000000
iteration: 5.729239e+00; x: -4.238522 + 4.853553 i; y: iteration: 3; x: -1.000305 + 0.000000 i; y: 1.956461 + 0.000000 i; f: -1.421890, g: 0.000000
iteration: 8.501207e-01; x: -0.783584 + 0.807186 i; y: iteration: 4; x: -1.000000 + 0.000000 i; y: 1.744921 + 0.000000 i; f: -1.414234, g: 0.000000
iteration: 4.480779e-02; x: -0.044632 + 0.044691 i; y: iteration: 5; x: -1.000000 + 0.000000 i; y: 1.732098 + 0.000000 i; f: -1.414214, g: 0.000000
iteration: 1.644212e-04; x: -0.000164 + 0.000164 i; y: iteration: 6; x: -1.000000 + 0.000000 i; y: 1.732051 + 0.000000 i; f: -1.414214, g: 0.000000
iteration: 2.252726e-09; x: -0.000000 + 0.000000 i; y:

xm =

-1.0000
-1.0000
-1.0000

ym =

1.7321
-1.7321
1.7321

zm =

1.4142
1.4142
-1.4142

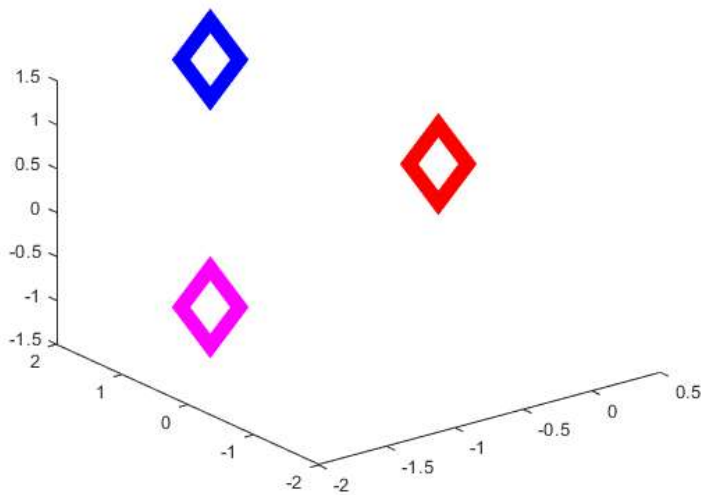
it3D =

6
6
6

success3D =

3x1 logical array

1
1
1
```



Find Root #4

```
i = i + 1;
x0 = 2;
y0 = 0.3;
z0 = -0.5;
% Newton's method for multi-variable nonlinear equations
[xm(i,1),ym(i,1),zm(i,1),it3D(i,1),success3D(i,1)] = newton3D_exact(fm,gradfm,gm,gradgm,hm,gradhm,x0,y0,z0,1000,1e-6,true)
% Adding root to the plot
plot3(xm(i,1),ym(i,1),zm(i,1),'gd','MarkerSize',32,'LineWidth',8);
hold on

iteration: 1; x: 1.250000 + 0.000000 i; y: 5.150000 + 0.000000 i; f: -2.250000, g: 0.000000
iteration: 2.714750e+01; x: -16.835000 + 21.585000 i; y: iteration: 2; x: 1.025000 + 0.000000 i; y: 2.866262 + 0.000000 i; f: -1.569444, g: 0.000000
iteration: 5.729239e+00; x: -4.238522 + 4.853553 i; y: iteration: 3; x: 1.000305 + 0.000000 i; y: 1.956461 + 0.000000 i; f: -1.421890, g: 0.000000
iteration: 8.501207e-01; x: -0.783584 + 0.807186 i; y: iteration: 4; x: 1.000000 + 0.000000 i; y: 1.744921 + 0.000000 i; f: -1.414234, g: 0.000000
iteration: 4.480779e-02; x: -0.044632 + 0.044691 i; y: iteration: 5; x: 1.000000 + 0.000000 i; y: 1.732098 + 0.000000 i; f: -1.414214, g: 0.000000
iteration: 1.644212e-04; x: -0.000164 + 0.000164 i; y: iteration: 6; x: 1.000000 + 0.000000 i; y: 1.732051 + 0.000000 i; f: -1.414214, g: 0.000000
iteration: 2.252726e-09; x: -0.000000 + 0.000000 i; y:

xm =

-1.0000
-1.0000
-1.0000
1.0000

ym =

1.7321
-1.7321
1.7321
1.7321

zm =

1.4142
1.4142
-1.4142
-1.4142

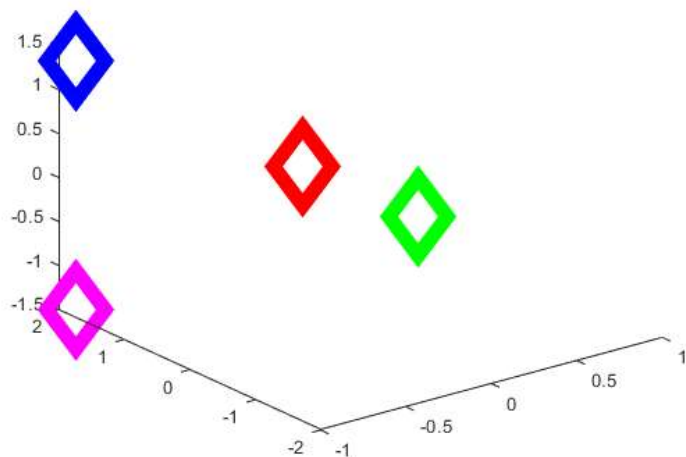
it3D =

6
6
6
6

success3D =

4x1 logical array

1
1
1
```



Find Root #5

```
i = i + 1;
x0 = 2;
y0 = 0.3;
z0 = 0.5;
% Newton's method for multi-variable nonlinear equations
[xm(i,1),ym(i,1),zm(i,1),it3D(i,1),success3D(i,1)] = newton3D_exact(fm,gradfm,gm,gradgm,hm,gradhm,x0,y0,z0,1000,1e-6,true)
% Adding root to the plot
plot3(xm(i,1),ym(i,1),zm(i,1),'wd','MarkerSize',32,'LineWidth',8);
hold on
```

```
iteration: 1; x: 1.250000 + 0.000000 i; y: 5.150000 + 0.000000 i; f: 2.250000, g: 0.000000
iteration: 2.714750e+01; x: -16.835000 + 21.585000 i; y: iteration: 2; x: 1.025000 + 0.000000 i; y: 2.866262 + 0.000000 i; f: 1.569444, g: 0.000000
iteration: 5.729239e+00; x: -4.238522 + 4.853553 i; y: iteration: 3; x: 1.000305 + 0.000000 i; y: 1.956461 + 0.000000 i; f: 1.421890, g: 0.000000
iteration: 8.501207e-01; x: -0.783584 + 0.807186 i; y: iteration: 4; x: 1.000000 + 0.000000 i; y: 1.744921 + 0.000000 i; f: 1.414234, g: 0.000000
iteration: 4.480779e-02; x: -0.044632 + 0.044691 i; y: iteration: 5; x: 1.000000 + 0.000000 i; y: 1.732098 + 0.000000 i; f: 1.414214, g: 0.000000
iteration: 1.644212e-04; x: -0.000164 + 0.000164 i; y: iteration: 6; x: 1.000000 + 0.000000 i; y: 1.732051 + 0.000000 i; f: 1.414214, g: 0.000000
iteration: 2.252726e-09; x: -0.000000 + 0.000000 i; y:
```

xm =

```
-1.0000
-1.0000
-1.0000
1.0000
1.0000
```

ym =

```
1.7321
-1.7321
1.7321
1.7321
1.7321
```

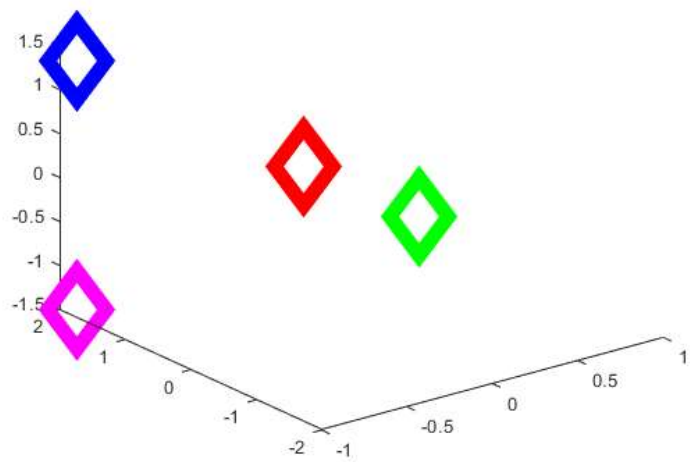
zm =

```
1.4142
1.4142
-1.4142
-1.4142
1.4142
```

it3D =

```
6
6
6
6
6
```

```
success3D =  
  
5x1 logical array  
  
1  
1  
1  
1  
1
```



Find Root #6

```
i = i + 1;  
x0 = 2;  
y0 = -0.3;  
z0 = 0.5;  
% Newton's method for multi-variable nonlinear equations  
[xm(i,1),ym(i,1),zm(i,1),it3D(i,1),success3D(i,1)] = newton3D_exact(fm,gradfm,gm,gradgm,hm,gradhm,x0,y0,z0,1000,1e-6,true)  
% Adding root to the plot  
plot3(xm(i,1),ym(i,1),zm(i,1),'kd','MarkerSize',32,'LineWidth',8);  
hold on
```

```
iteration: 1; x: 1.250000 + 0.000000 i; y: -5.150000 + 0.000000 i; f: 2.250000, g: 0.000000  
iteration: 2.714750e+01; x: -16.835000 + 21.585000 i; y: iteration: 2; x: 1.025000 + 0.000000 i; y: -2.866262 + 0.000000 i; f: 1.569444, g: 0.000000  
iteration: 5.729239e+00; x: -4.238522 + 4.853553 i; y: iteration: 3; x: 1.000305 + 0.000000 i; y: -1.956461 + 0.000000 i; f: 1.421890, g: 0.000000  
iteration: 8.501207e-01; x: -0.783584 + 0.807186 i; y: iteration: 4; x: 1.000000 + 0.000000 i; y: -1.744921 + 0.000000 i; f: 1.414234, g: 0.000000  
iteration: 4.480779e-02; x: -0.044632 + 0.044691 i; y: iteration: 5; x: 1.000000 + 0.000000 i; y: -1.732098 + 0.000000 i; f: 1.414214, g: 0.000000  
iteration: 1.644212e-04; x: -0.000164 + 0.000164 i; y: iteration: 6; x: 1.000000 + 0.000000 i; y: -1.732051 + 0.000000 i; f: 1.414214, g: 0.000000  
iteration: 2.252726e-09; x: -0.000000 + 0.000000 i; y:  
  
xm =  
  
-1.0000  
-1.0000  
-1.0000  
1.0000  
1.0000  
1.0000  
  
ym =  
  
1.7321  
-1.7321  
1.7321  
1.7321  
1.7321  
-1.7321  
  
zm =  
  
1.4142  
1.4142  
-1.4142  
-1.4142
```

1.4142
1.4142

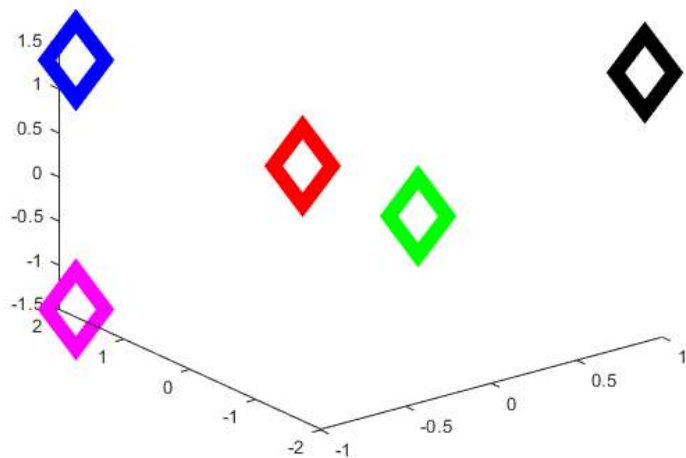
it3D =

6
6
6
6
6
6

success3D =

6×1 logical array

1
1
1
1
1
1



Find Root #7

```
i = i + 1;  
x0 = 2;  
y0 = -0.3;  
z0 = -0.5;  
% Newton's method for multi-variable nonlinear equations  
[xm(i,1),ym(i,1),zm(i,1),it3D(i,1),success3D(i,1)] = newton3D_exact(fm,gradfm,gm,gradgm,hm,gradhm,x0,y0,z0,1000,1e-6,true)  
% Adding root to the plot  
plot3(xm(i,1),ym(i,1),zm(i,1),'yd','MarkerSize',32,'LineWidth',8);  
hold on
```

```
iteration: 1; x: 1.250000 + 0.000000 i; y: -5.150000 + 0.000000 i; f: -2.250000, g: 0.000000  
iteration: 2; x: 1.025000 + 0.000000 i; y: -2.866262 + 0.000000 i; f: -1.569444, g: 0.000000  
iteration: 3; x: 1.000305 + 0.000000 i; y: -1.956461 + 0.000000 i; f: -1.421890, g: 0.000000  
iteration: 4; x: 1.000000 + 0.000000 i; y: -1.744921 + 0.000000 i; f: -1.414234, g: 0.000000  
iteration: 5; x: 1.000000 + 0.000000 i; y: -1.732098 + 0.000000 i; f: -1.414214, g: 0.000000  
iteration: 6; x: 1.000000 + 0.000000 i; y: -1.732051 + 0.000000 i; f: -1.414214, g: 0.000000  
iteration: 2.252726e-09; x: -0.000000 + 0.000000 i; y: -0.000000 + 0.000000 i; f: -1.414214, g: 0.000000  
xm =
```

-1.0000
-1.0000
-1.0000
1.0000
1.0000
1.0000
1.0000

ym =

```

1.7321
-1.7321
1.7321
1.7321
1.7321
-1.7321
-1.7321

```

```
zm =
```

```

1.4142
1.4142
-1.4142
-1.4142
1.4142
1.4142
-1.4142

```

```
it3D =
```

```

6
6
6
6
6
6
6

```

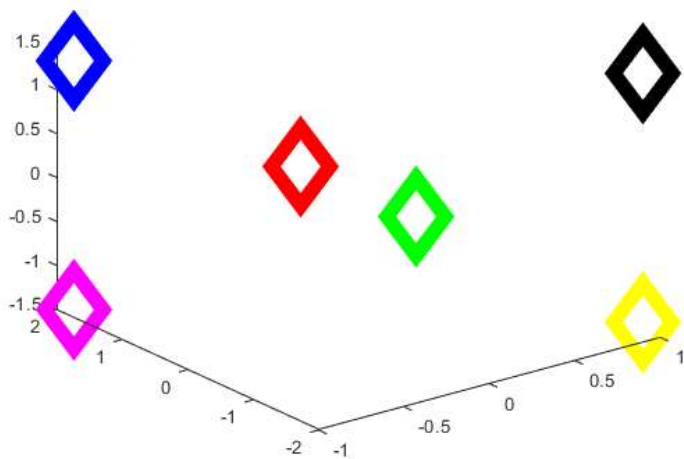
```
success3D =
```

```
7×1 logical array
```

```

1
1
1
1
1
1
1

```



Find Root #8

```

i = i + 1;
x0 = -2;
y0 = -0.3;
z0 = -0.5;
% Newton's method for multi-variable nonlinear equations
[xm(i,1),ym(i,1),zm(i,1),it3D(i,1),success3D(i,1)] = newton3D_exact(fm,gradfm,gm,gradgm,hm,gradhm,x0,y0,z0,1000,1e-6,true);
table(xm,ym,zm,it3D,success3D)
% Adding root to the plot
plot3(xm(i,1),ym(i,1),zm(i,1),'cd','MarkerSize',32,'LineWidth',8);

```


iteration: 1; x: -1.250000 + 0.000000 i; y: -5.150000 + 0.000000 i; f: -2.250000, g: 0.000000
iteration: 2.714750e+01; x: -16.835000 + 21.585000 i; y: iteration: 2; x: -1.025000 + 0.000000 i; y: -2.866262 + 0.000000 i; f: -1.569444, g: 0.000000
iteration: 5.729239e+00; x: -4.238522 + 4.853553 i; y: iteration: 3; x: -1.000305 + 0.000000 i; y: -1.956461 + 0.000000 i; f: -1.421890, g: 0.000000
iteration: 8.501207e-01; x: -0.783584 + 0.807186 i; y: iteration: 4; x: -1.000000 + 0.000000 i; y: -1.744921 + 0.000000 i; f: -1.414234, g: 0.000000
iteration: 4.480779e-02; x: -0.044632 + 0.044691 i; y: iteration: 5; x: -1.000000 + 0.000000 i; y: -1.732098 + 0.000000 i; f: -1.414214, g: 0.000000
iteration: 1.644212e-04; x: -0.000164 + 0.000164 i; y: iteration: 6; x: -1.000000 + 0.000000 i; y: -1.732051 + 0.000000 i; f: -1.414214, g: 0.000000
iteration: 2.252726e-09; x: -0.000000 + 0.000000 i; y:

ans =

8x5 table

xm	ym	zm	it3D	success3D
-1	1.7321	1.4142	6	true
-1	-1.7321	1.4142	6	true
-1	1.7321	-1.4142	6	true
1	1.7321	-1.4142	6	true
1	1.7321	1.4142	6	true
1	-1.7321	1.4142	6	true
1	-1.7321	-1.4142	6	true
-1	-1.7321	-1.4142	6	true

