2D Systems of equations: Row picture

Every of the equations represent a line in 2D,

$$x - 2y = 0$$
$$x + y = 3$$

We can reconstruct the line by given values for x and use the equation for calculating y and viceversa.

For example, for eq1:

```
x = 3
```

```
x = 3
```

```
y = x/2
```

```
y = 1.5000
```

or

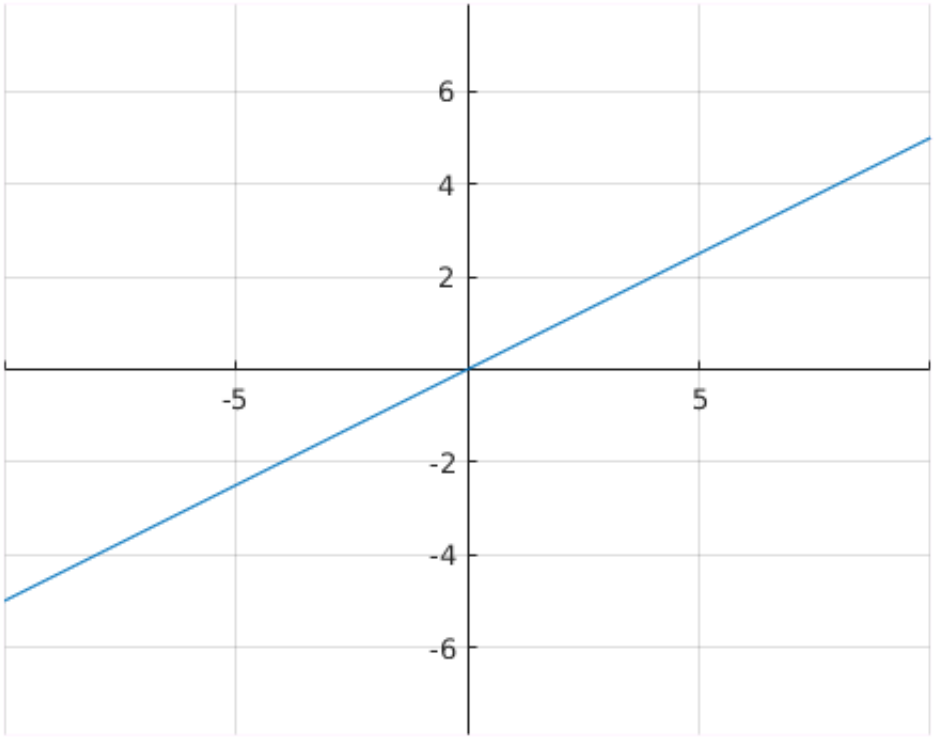
```
y = 3
```

```
y = 3
```

```
x = 2*y;
```

For a bunch of point you can get a segment of the line:

```
x = -10:10;
y = x/2;
plot(x,y)
ax = gca;
ax.XAxisLocation = 'origin';
ax.YAxisLocation = 'origin';
ax.Box = 'off';
axis equal;
grid on;
```



The same happens for the second equation:

```
x = 1
```

```
x = 1
```

```
y = 3-x
```

```
y = 2
```

or

```
y = 2
```

```
y = 2
```

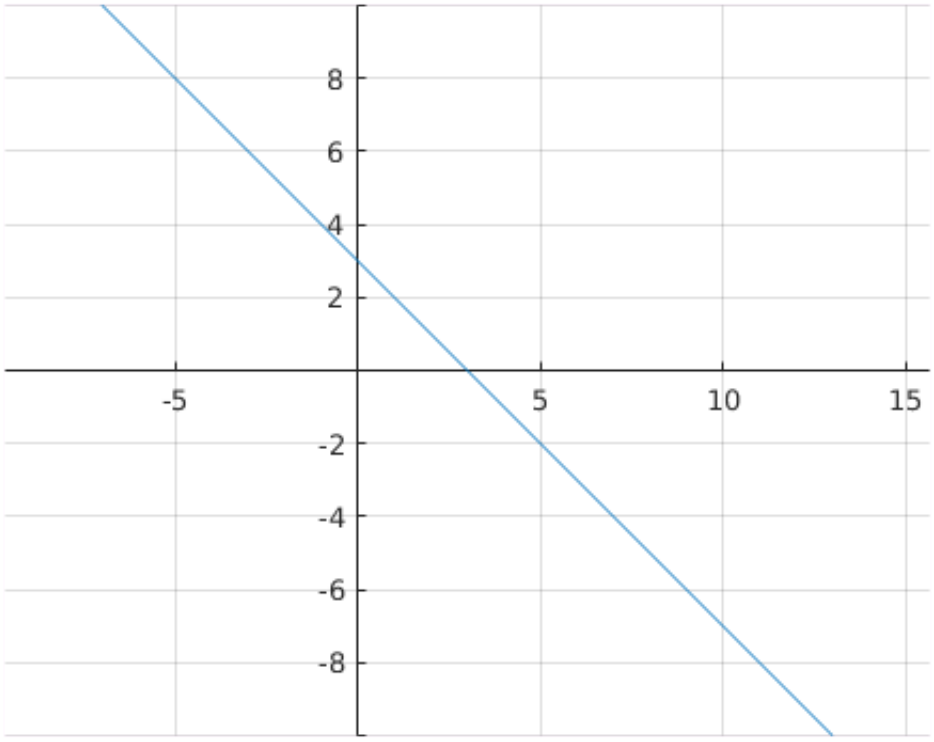
```
x = 3-y
```

```
x = 1
```

And we can draw the line

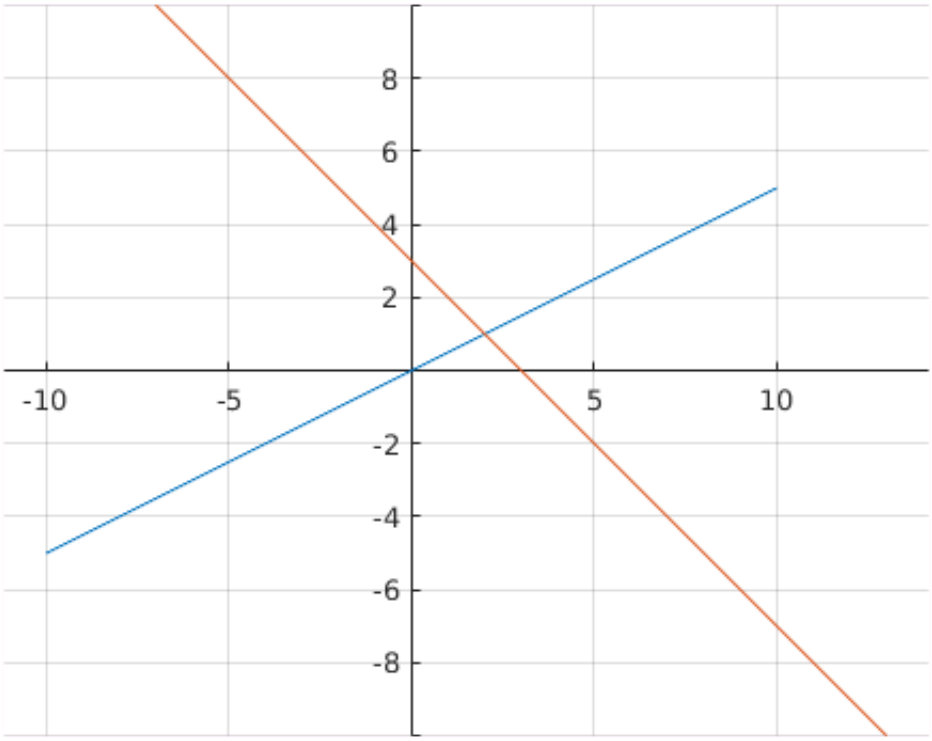
```
y = -10:10;
x = 3-y;
plot(x,y)
ax = gca;
```

```
ax.XAxisLocation = 'origin';
ax.YAxisLocation = 'origin';
ax.Box = 'off';
axis equal;
grid on;
```



We are interested in the points that fulfill both equations, it is the points shared by the two lines.

```
x1 = -10:10;
y1 = x1/2;

y2 = -10:10;
x2 = (3-y2);

plot(x1,y1,x2,y2)
ax = gca;
ax.XAxisLocation = 'origin';
ax.YAxisLocation = 'origin';
ax.Box = 'off';
axis equal;
grid on;
```



The spolution of the system can be found on the plot as

$$x = 2$$
$$y = 1$$

Systems of equations: Column picture

The same system of equations

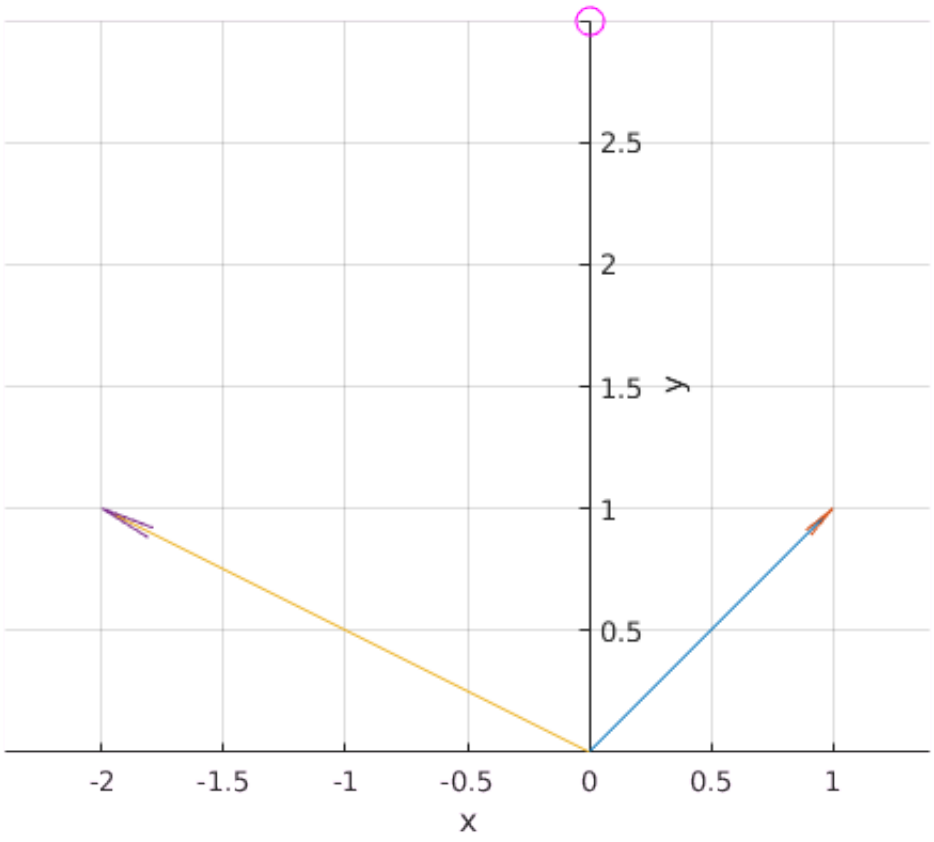
$$x - 2y = 0$$
$$x + y = 3$$

can be thinked as a vectorial equation

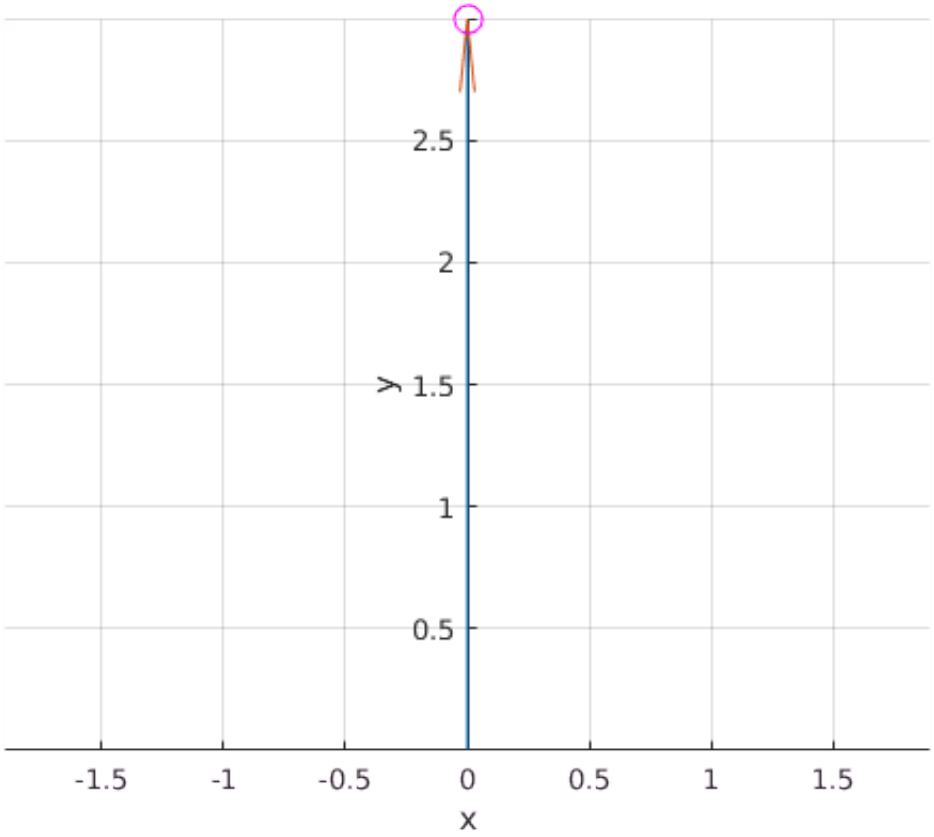
$$x\begin{pmatrix}1\\1\end{pmatrix} + y\begin{pmatrix}-2\\1\end{pmatrix} = \begin{pmatrix}0\\3\end{pmatrix}$$

if we tink in $\begin{pmatrix}1\\1\end{pmatrix}$ and $\begin{pmatrix}-2\\1\end{pmatrix}$ as vectors the problem is solved by finding the values of x and y such that the linear combination of the two past vectorsequals the right hand side.

```
figure;
vectarrow([0;0],[1;1]);
hold on;
vectarrow([0;0],[-2;1]);
hold on;
plot(0,3,'o','MarkerSize',10,'Color','m')
ax = gca;
ax.XAxisLocation = 'origin';
ax.YAxisLocation = 'origin';
ax.Box = 'off';
axis equal;
grid on;
```




```
figure;
vectarrow([0;0],2*[1;1]+[-2;1]);
hold on;
plot(0,3,'o','MarkerSize',10,'Color','m');
ax = gca;
ax.XAxisLocation = 'origin';
ax.YAxisLocation = 'origin';
ax.Box = 'off';
axis equal;
grid on;
```

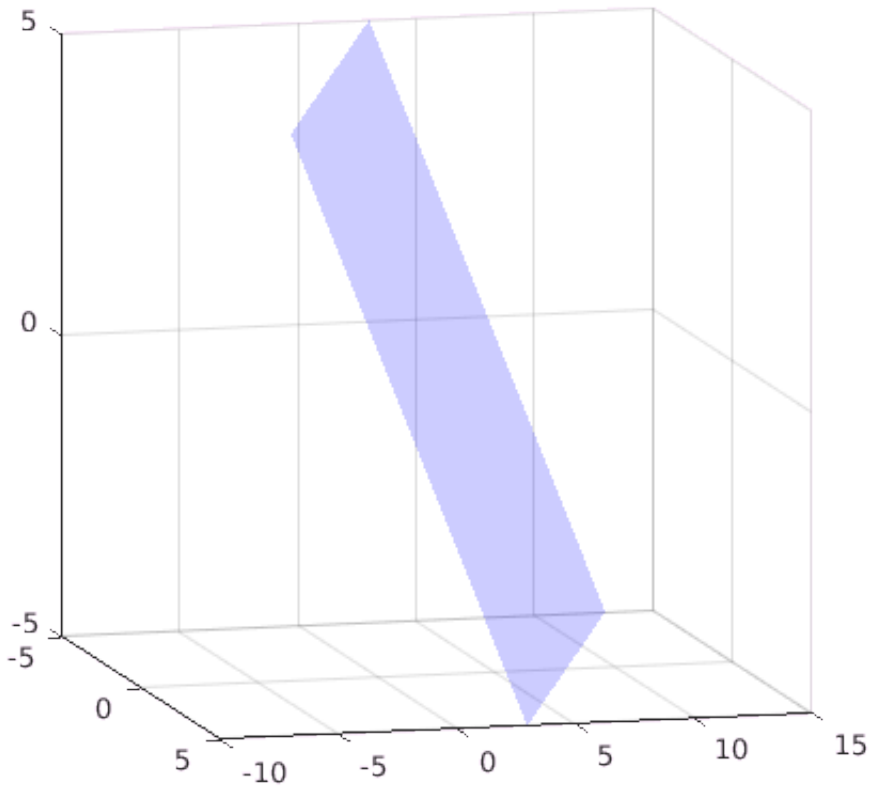


3D systems of equations: Row picture.

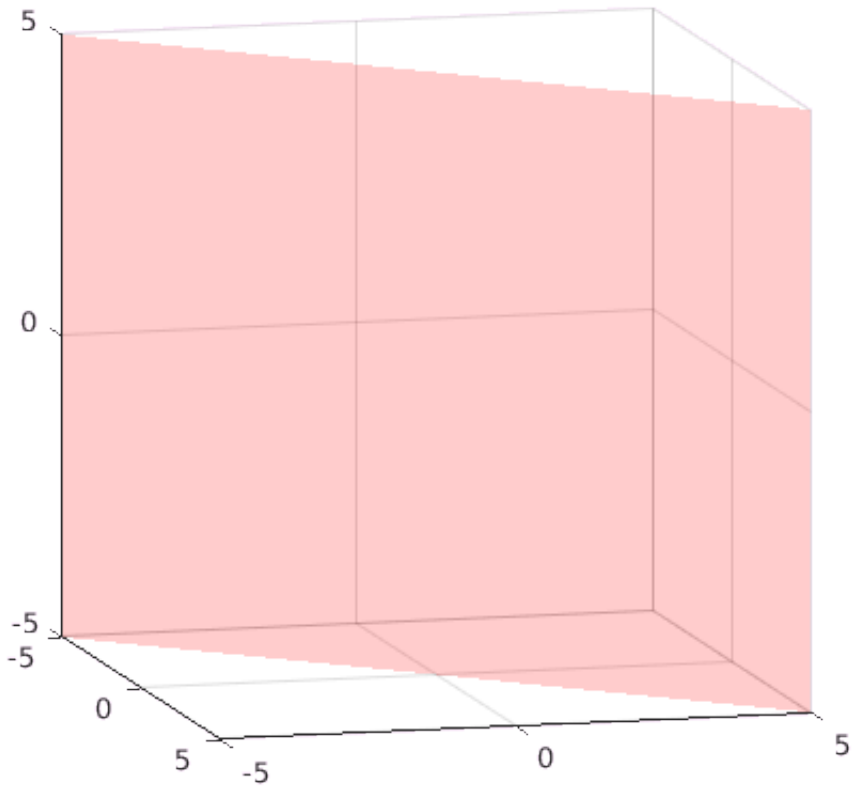
$$x + y + z = 3$$
$$x - y = 0$$
$$x + z = 1$$

In the 3D case, every equation in the system represents the equation of a plane.

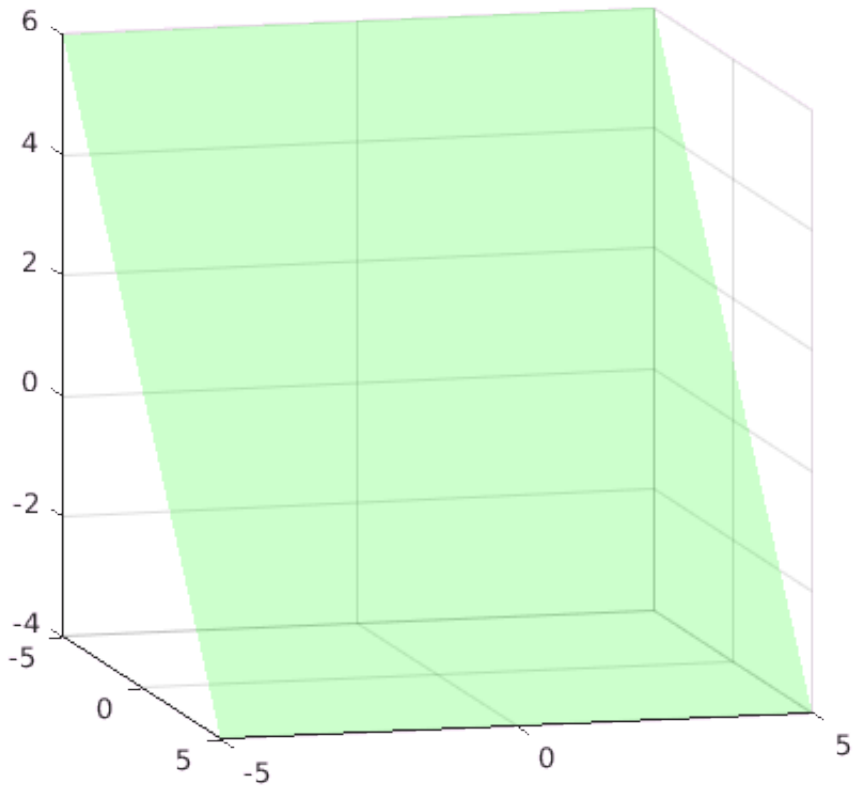
```
figure;
[x, z] = meshgrid(-5:0.5:5);
yv = @(x,z) 3-x-z;
surf(x,yv(x,z),z,'FaceAlpha',0.2,'EdgeAlpha',0.2,...
    'LineStyle','none',...
    'FaceColor','b');

view(gca,[75 10]);
grid(gca,'on');
axis(gca,'square');
hold on;
axis square;
```



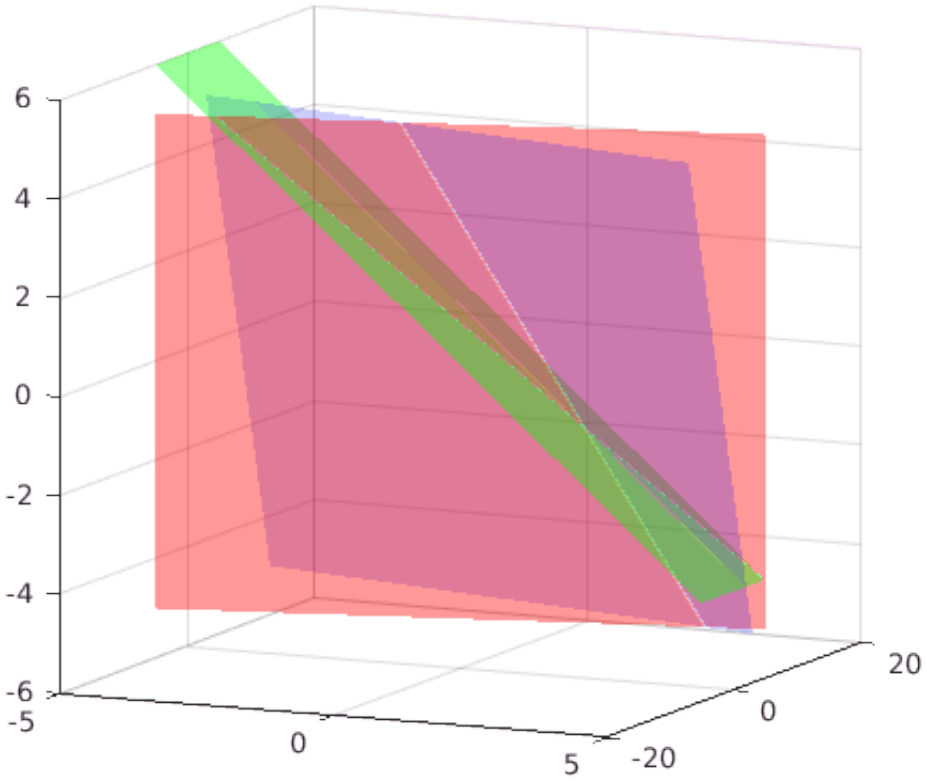

```
figure;

[x, z] = meshgrid(-5:0.5:5);
yv = @(x) x;
surf(x,yv(x),z,'FaceAlpha',0.2,'EdgeAlpha',0.2,...
    'LineStyle','none',...
    'FaceColor','r');

view(gca,[75 10]);
grid(gca,'on');
axis(gca,'square');
hold on;
axis square;
```




```
figure;

[x, y] = meshgrid(-5:0.5:5);
zv = @(x) 1-x;
surf(x,y,zv(x),'FaceAlpha',0.2,'EdgeAlpha',0.2,...
    'LineStyle','none',...
    'FaceColor','g');

view(gca,[75 10]);
grid(gca,'on');
axis(gca,'square');
hold on;
axis square;
```



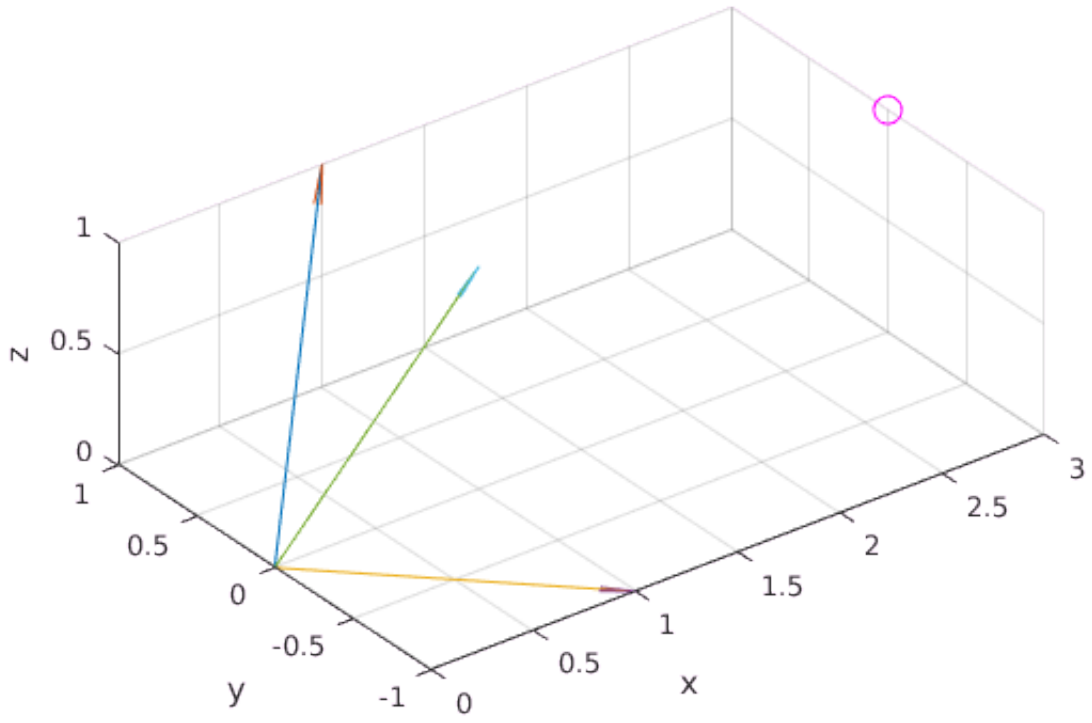

```
figure;
hold on;
[x, z] = meshgrid(-5:0.5:5);
yv = @(x,z) 3-x-z;
surf(x,yv(x,z),z,'FaceAlpha',0.2,'EdgeAlpha',0.2,...
    'LineStyle','none',...
    'FaceColor','b');

[x, z] = meshgrid(-5:0.5:5);
yv = @(x) x;
surf(x,yv(x),z,'FaceAlpha',0.4,'EdgeAlpha',0.4,...
    'LineStyle','none',...
    'FaceColor','r');

[x, y] = meshgrid(-5:0.5:5);
zv = @(x) 1-x;
surf(x,y,zv(x),'FaceAlpha',0.4,'EdgeAlpha',0.4,...
    'LineStyle','none',...
    'FaceColor','g');

view(gca,[25 10]);
grid(gca,'on');
axis(gca,'square');
axis square;
```



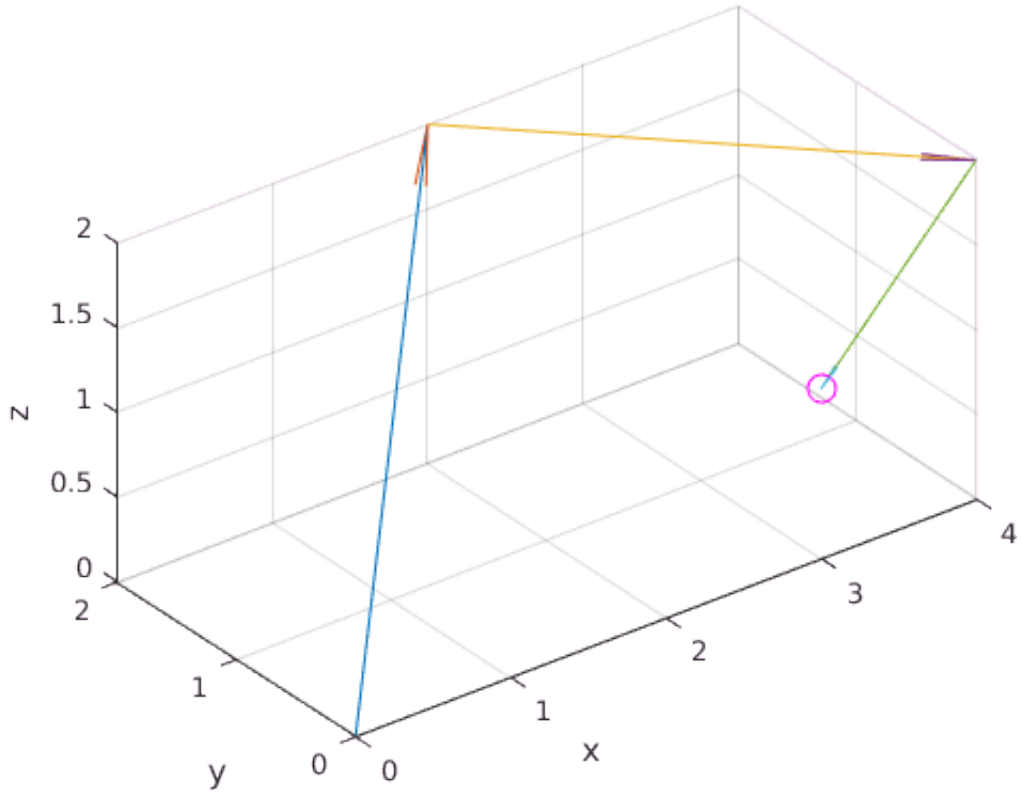
3D system of equations: Column picture

$$x + y + z = 3$$
$$x - y = 0$$
$$x + z = 1$$

```
figure;
vectarrow([0;0;0],[1;1;1]);
hold on;
vectarrow([0;0;0],[1;-1;0]);
hold on;
vectarrow([0;0;0],[1;0;1]);
hold on;
plot3(3,0,1,'o','MarkerSize',10,'Color','m')
ax = gca;
ax.XAxisLocation = 'origin';
ax.YAxisLocation = 'origin';
ax.Box = 'off';
axis equal;
grid on;figure;
```




```
vectarrow([0;0;0],2*[1;1;1]);
hold on;
vectarrow(2*[1;1;1],2*[1;1;1]+2*[1;-1;0]);
hold on;
vectarrow(2*[1;1;1]+2*[1;-1;0],2*[1;1;1]+2*[1;-1;0]-1*[1;0;1]);
hold on;
plot3(3,0,1,'o','MarkerSize',10,'Color','m')
ax = gca;
ax.XAxisLocation = 'origin';
ax.YAxisLocation = 'origin';
ax.Box = 'off';
axis equal;
```


2
1.5
1
0.5
0
z
2
1
0
y
0
1
2
3
4
x