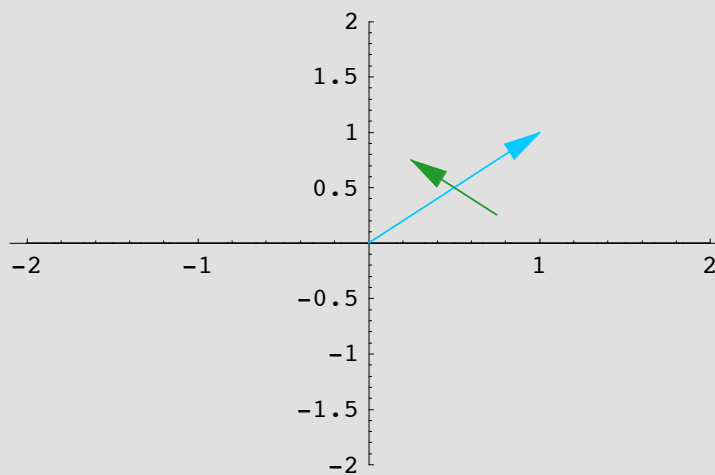

Arrows and Polygons

Arrows

```
<< Graphics`Graphics`  
<< Graphics`Colors`  
<< Graphics`Arrow`
```

```
DisplayTogether[  
  graphPaper = Plot[0, {x, -2, 2},  
    PlotRange -> {-2, 2}],  
  arrows = Show[Graphics[  
    {DeepSkyBlue, Arrow[{0, 0}, {1, 1}],  
    ForestGreen, Arrow[ {.75, .25}, {.25, .75}]}]]];
```



Crystal Lattice of Titanium

The Arrow3D package is available from MathSource at Wolfram Research.

```
<< Arrow3D`Arrow3D`
```

```
showColorful3DVectors[vecs_, shaftColor_, headColor_, opts___] :=  
Module[{o = {0, 0, 0}, i = {1, 0, 0}, j = {0, 1, 0}, k = {0, 0, 1}},  
  Show[Graphics3D[Flatten[{Thickness[.004], shaftColor, Arrow3D[o, i],  
    Arrow3D[o, j], Arrow3D[o, k], Table[Arrow3D[vecs[[i, 1]],  
      vecs[[i, 1]] + vecs[[i, 2]], HeadColor -> headColor],  
    {i, Length[vecs]}]}]]],  
  opts, ViewPoint -> {6, 2, 2}]]
```

Three vectors form a basis for the unit cell in the **crystal lattice of Titanium**.

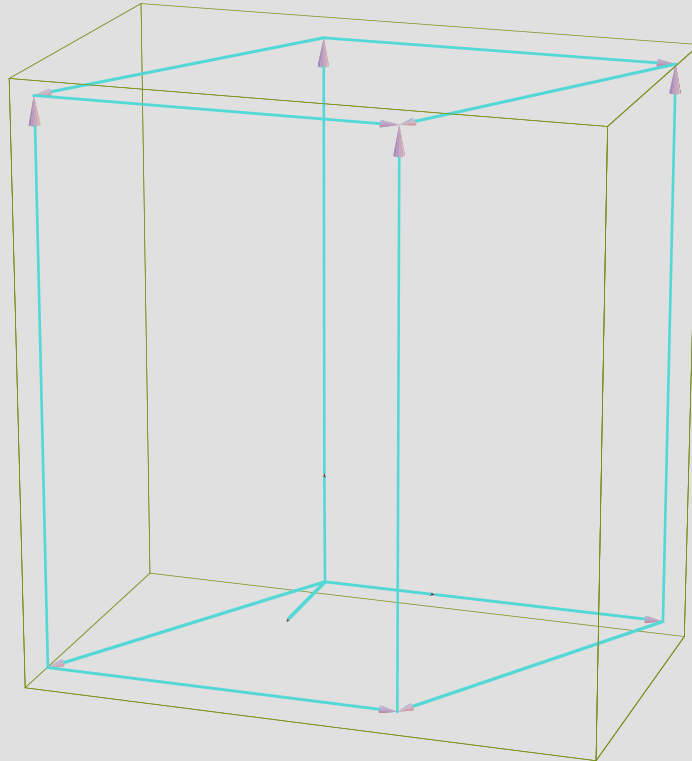
Their coordinates are given in Angstroms.

See Lay, Exercises 4.4.37-38, p255.

```
o = {0, 0, 0};  
u = {2.6, -1.5, 0};  
v = {0, 3, 0};  
w = {0, 0, 4.8};
```

The unit cell in the crystal lattice of Titanium is the parallelepiped determined by these three vectors.

```
titaniumUnitCell = {  
  {o, u}, {o, v}, {u, v}, {v, u},  
  {w, u}, {w, v}, {w+u, v}, {w+v, u},  
  {o, w}, {u, w}, {v, w}, {u+v, w}};  
  
cell = showColorful3DVectors [titaniumUnitCell,  
  MediumTurquoise, White,  
  DefaultColor -> ChromeOxideGreen];
```



Polygons

```
o = {0, 0};  
e1 = {1, 0};  
e2 = {0, 1};  
  
vertices = {o, e1, e1 + e2, e2};  
  
unitSquare = Polygon[vertices];
```

```
DisplayTogether[  
  graphPaper = Plot[0, {x, -2, 2},  
    AspectRatio → 1,  
    PlotRange → {-2, 2}],  
  square = Show[Graphics[  
    {Red, unitSquare}]]];
```

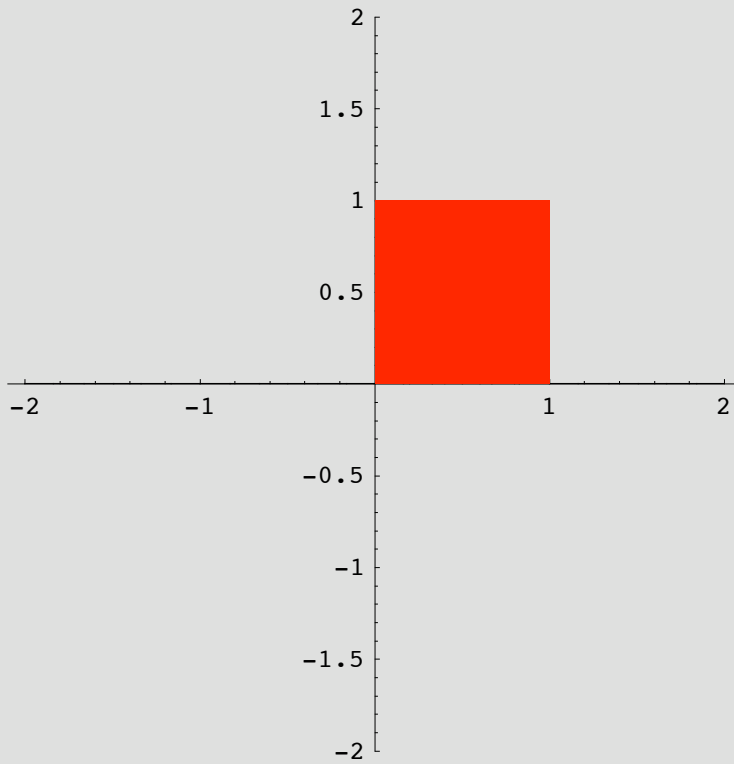


Image of a Polygon Under a Linear Map

$$a = \begin{pmatrix} 1 & 2 \\ 3 & 1 \end{pmatrix};$$

```
L[pt_] := a.pt
```

```
imageL = Polygon[Map[L, vertices]]
```

```
Polygon[{{0, 0}, {1, 3}, {3, 4}, {2, 1}}]
```

```
DisplayTogether[  
  graphPaper = Plot[0, {x, 0, 3},  
    AspectRatio -> 1,  
    PlotRange -> {0, 4}],  
  poly = Show[Graphics[  
    {LightCadmiumYellow, imageL}]]];
```

