Plotting regions and level sets

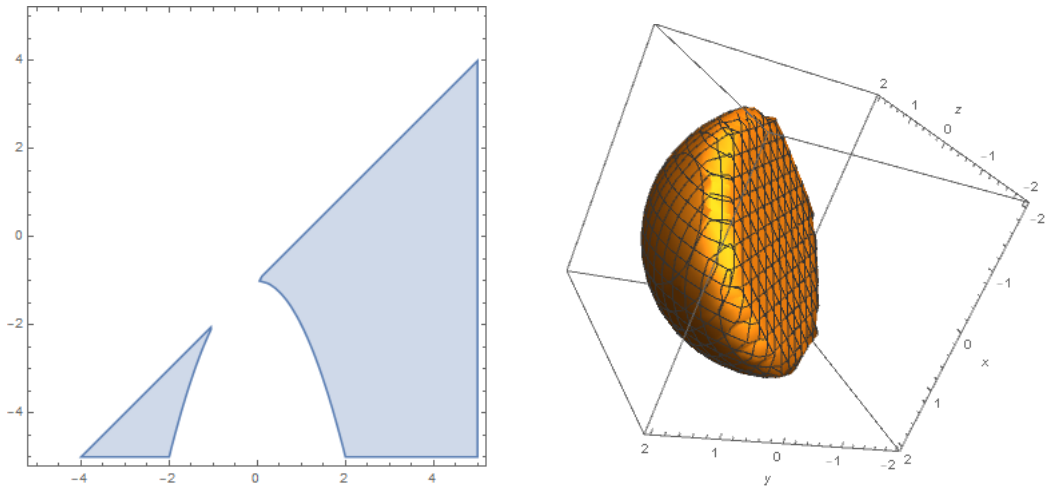
You can use Mathematica to plot regions, for example, the domain of a function using **RegionPlot** or **RegionPlot3D** and level sets of a function using **ContourPlot** or **ContourPlot3D**. To learn more options to each of these command, you can go to Help, choose 'Find Selected Function', and type the command's name.

1. Regions
   The command **RegionPlot** is used to plot a 2D region determined by one or more inequalities. For example, consider the function $f(x,y) = \sqrt{x^2+y+1}\sqrt{x-y-1}$. The domain of this function is the set of points (x,y) such that $x^2+y+1 \geq 0$ and $x-y-1 \geq 0$.

```
(* draw the domain of f, Figure 1a *)
 RegionPlot[x^2 + y + 1 >= 0 && x - y - 1 >= 0, {x, -5, 5}, {y, -5, 5}]
```

   The command **RegionPlot3D** is used to plot a 3D region determined by one or more inequalities. For example, consider the function $g(x,y,z) = \sqrt{x+y+z}\sqrt{4-x^2-y^2-z^2}$. The domain of this function is the set of points (x,y,z) such that $x+y+z \geq 0$ and $x^2+y^2+z^2 \leq 4$.

```
(* draw the domain of g, Figure 1b *)
RegionPlot3D[
 x + y + z >= 0 && x^2 + y^2 + z^2 <= 4, {x, -2, 2}, {y, -2,
  2}, {z, -2, 2}, AxesLabel -> {x, y, z}]
```



(a) (b)

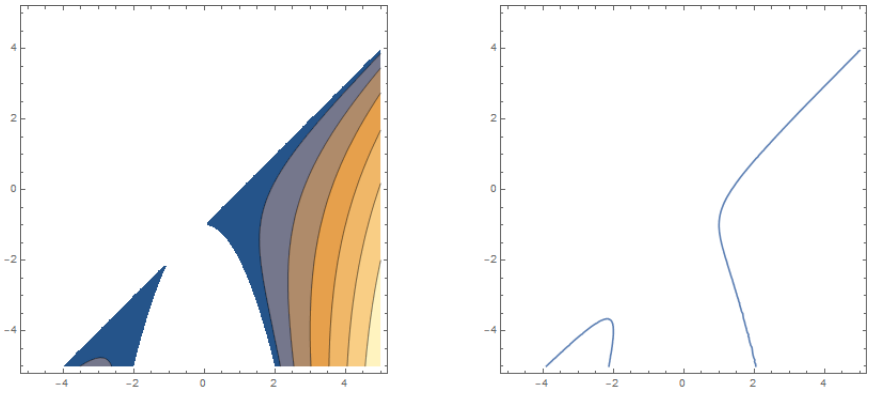
Figure 1

2. Level sets
   The command **ContourPlot** is used to plot the level sets of a function of two variables. The command **ContourPlot3D** is used to plot the level sets of a function of two variables. For example, consider the function $f(x,y)$ and the function $g(x,y,z)$ given above.

```
(* define the function f *)
f[x_, y_] :=  Sqrt[x^2 + y + 1]*Sqrt[x - y - 1]
```

```
(* draw many level sets, Figure 2a *)
 ContourPlot[ f[x, y], {x, -5, 5}, {y, -5, 5}]

(* draw the 0.5-level set, Figure 2b *)
 ContourPlot[ f[x, y] == 0.5, {x, -5, 5}, {y, -5,   5}]
```



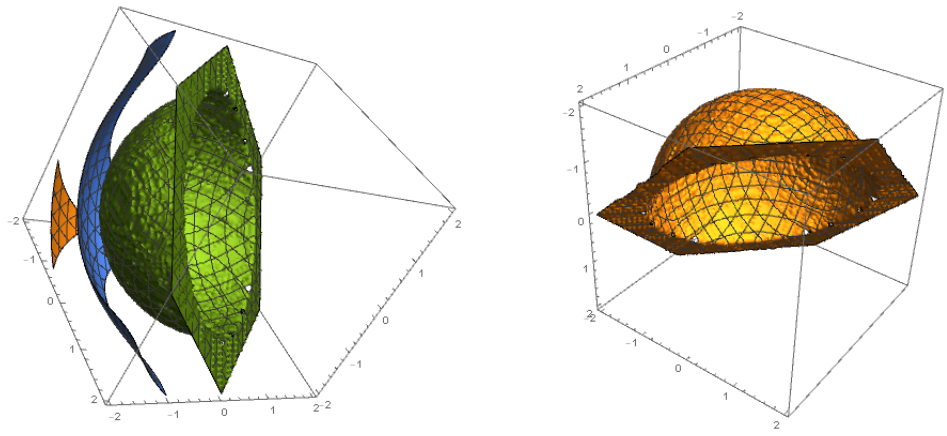
(a) (b)

Figure 2

```
(* define the function g *)
g[x_, y_, z_] := Sqrt[x + y + z]*Sqrt[4 - x^2 - y^2 - z^2]

(* draw many level sets, Figure 3a *)
ContourPlot3D[g[x, y, z], {x, -2, 2}, {y, -2, 2}, {z, -2, 2}]

(* draw the 0.5-level set, Figure 3b *)
ContourPlot3D[g[x, y, z] == 0, {x, -2, 2}, {y, -2, 2}, {z, -2, 2}]
```



(a) (b)

Figure 3