MA 1024 Lab 1

Daniel Coburn, Aidan Nolde

1)

```
syms f(x,y) z1(x,y) z2(x,y)
f(x,y)= abs(x) + abs(y)
```

f(x, y) = $|x| + |y|$

```
z1(x,y)= 1
```

z1(x, y) = 1

```
z2(x,y)= .4
```

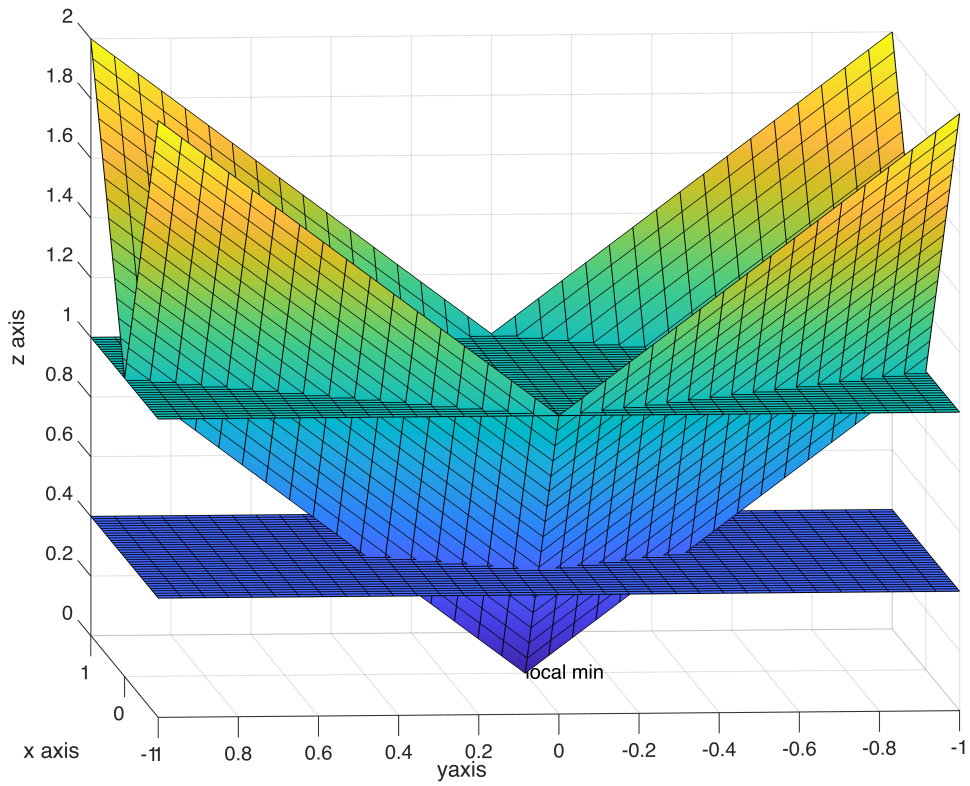
z2(x, y) =

$\frac{2}{5}$

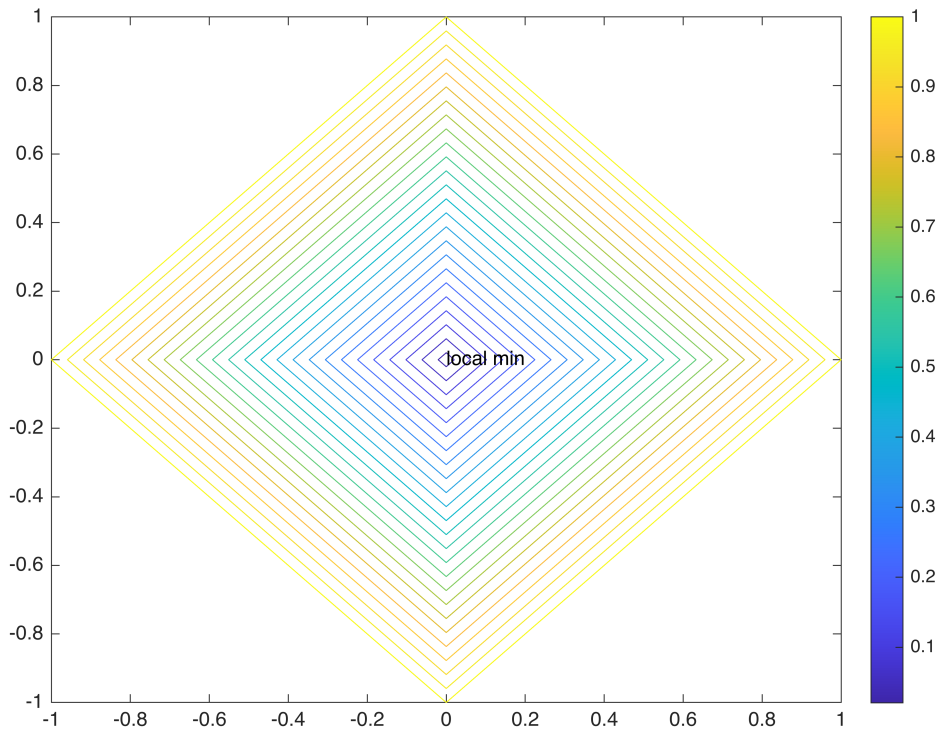
```
%Plane Equations for z=1, z=0.4

fsurf(f,[-1 1 -1 1])
xlabel('x axis'), ylabel('yaxis'), zlabel('z axis')

text(0,0,0, 'local min')
```

There is no local max. The local min is at (0,0,0)

```
hold on
fsurf(z1, [-1 1 -1 1])
fsurf(z2, [-1 1 -1 1])
hold off

view([265.19 7.82])
```




```
LevelCurves1c = linspace(-1,1,50);
fcontour(f, [-1 1 -1 1], 'LevelList', LevelCurves1c)
colorbar

text(0,0,0,'local min')
```



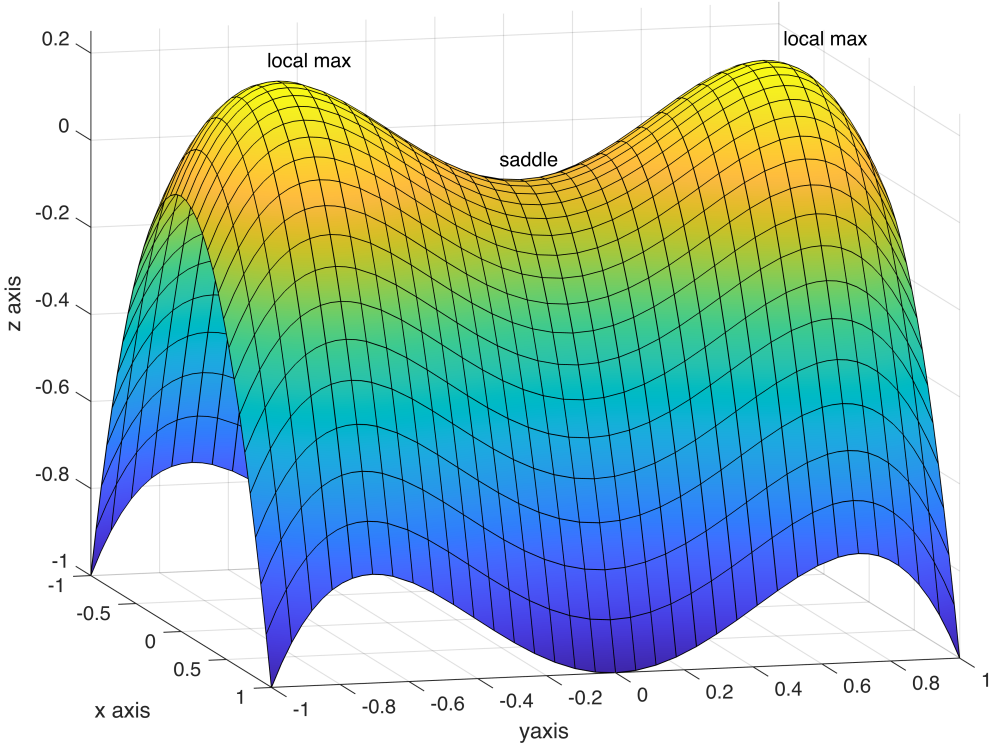
The contour map shows that the point at 0,0,0 is a local min becuase there are no cross sections below it and, it is a point. This indicates that it is the lowest point in the domain and is the only point with the most extreme small color on the contour plot. We know that we do not have any local maximum points, as there are no level curves in the map that do not have any other curve above them, except for the boundary values.

2)

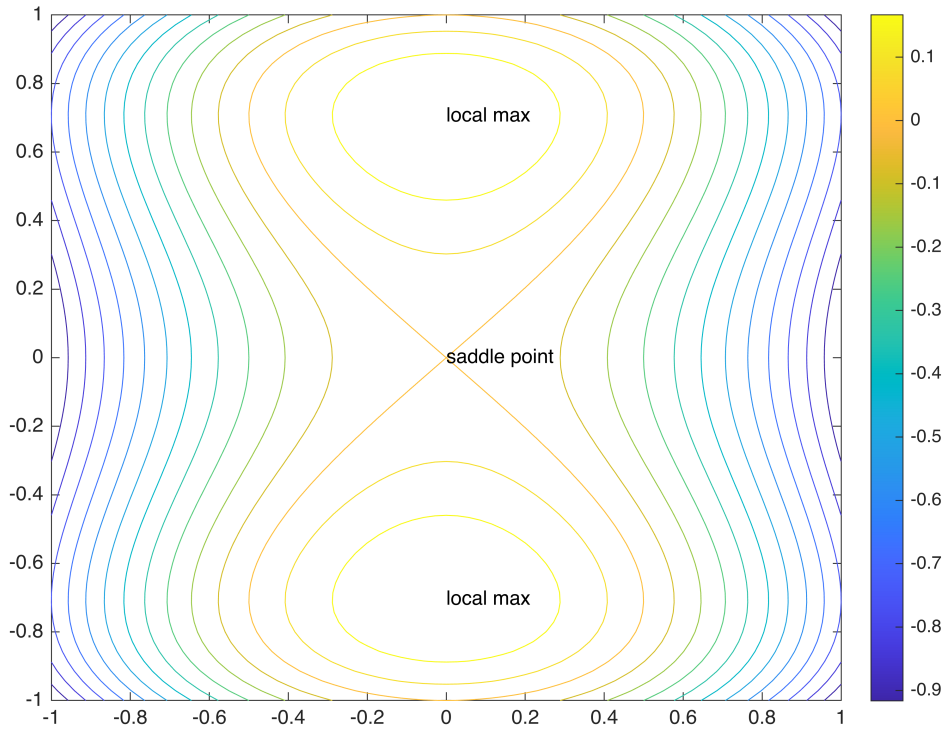
```
syms g(x,y)
g(x,y)= y^2 - y^4 - x^2
```

g(x, y) = $-x^2 - y^4 + y^2$

```
fsurf(g,[-1 1 -1 1])
xlabel('x axis'), ylabel('yaxis'), zlabel('z axis')

% text on 3D graph
text(0, -0.75, 0.3, 'local max')
text(0, 0.75, 0.3, 'local max')
text(0,-0.075,0.05, 'saddle')

view([75.29 12.00])
```




```
LevelCurves1c = linspace(-1,1,25);
fcontour(g, [-1 1 -1 1], 'LevelList', LevelCurves1c)
colorbar

% text on level curve map
text(0,0,'saddle point')
text(0, -0.705, 'local max')
text(0, 0.705,  'local max')
```



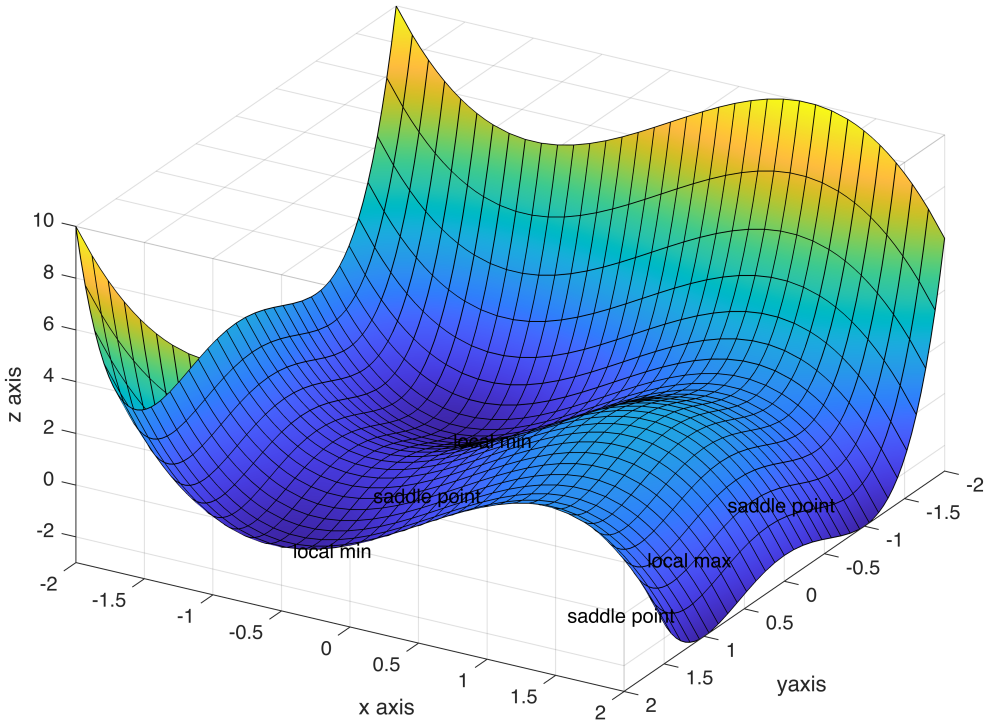
The level curve of a saddle point is a cross becyase this is where the graph is going to "pivot". If we where to make an aproximate graph of the function with segmnets of planes, this cross is where the direction of the planes is going to change, and the plane segment at the cross location is going to be parallel to the z-azis.

3)

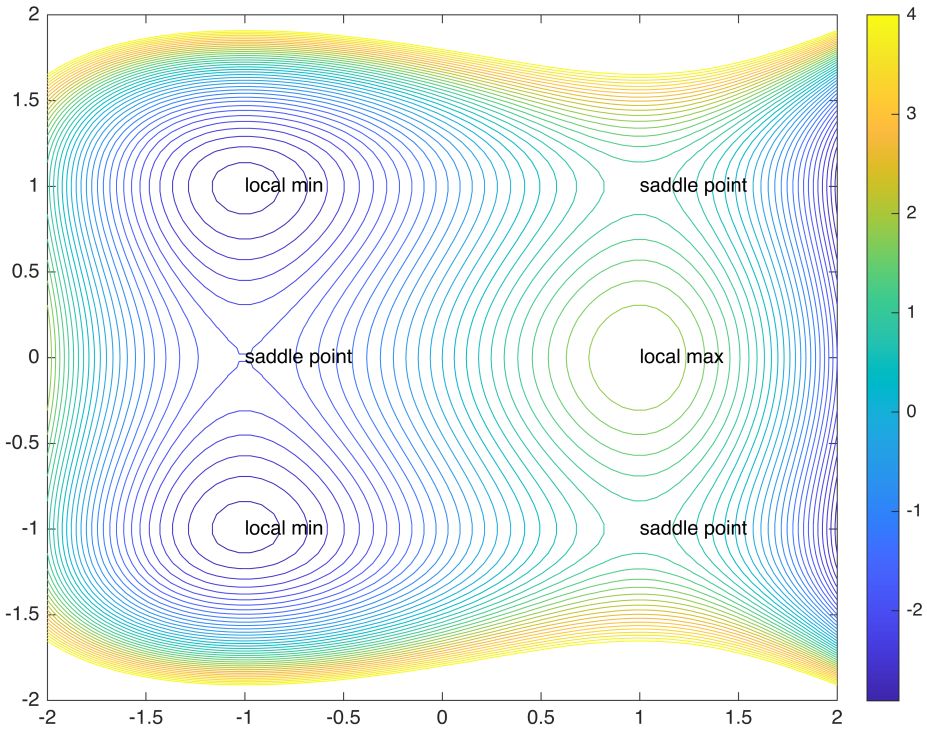
```
syms i(x, y)
i(x,y) = 3*x - x^3 - 2*y^2 + y^4
```

i(x, y) = $-x^3 + 3\,x + y^4 - 2\,y^2$

```
fsurf(i,[-2 2 -2 2])
xlabel('x axis'), ylabel('yaxis'), zlabel('z axis')
view([-30.3 -37.2])

% text on 3D graph
text(1, 0, -3.5, 'local max')
text(1, 1, -3.5, 'saddle point')
text(1, -1, -3.5, 'saddle point')
text(-1, 1, -3.5, 'local min')
text(-1, -1, -3.5, 'local min')
text(-1, 0, -3.5, 'saddle point')
```




```
LevelCurves3b = linspace(-4, 4, 45);
fcontour(i, [-2 2 -2 2], 'LevelList', LevelCurves3b)
colorbar

% text on level curve map
text(1, 0, 'local max')
text(1, 1, 'saddle point')
text(1, -1, 'saddle point')
text(-1, 1, 'local min')
text(-1, -1, 'local min')
text(-1, 0, 'saddle point')
```



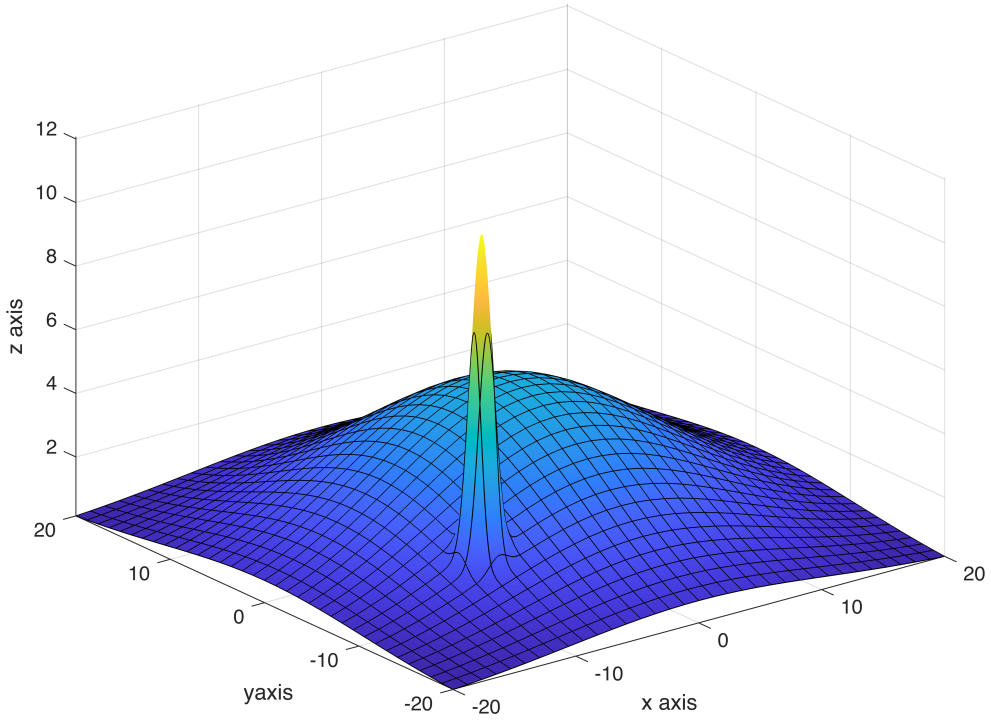
4)

```
syms j(x,y)
j(x, y) = 5*exp(-(x/15)^2 - (y/15)^2) + 10*exp(-(x+10)^2-(y+10)^2)
```

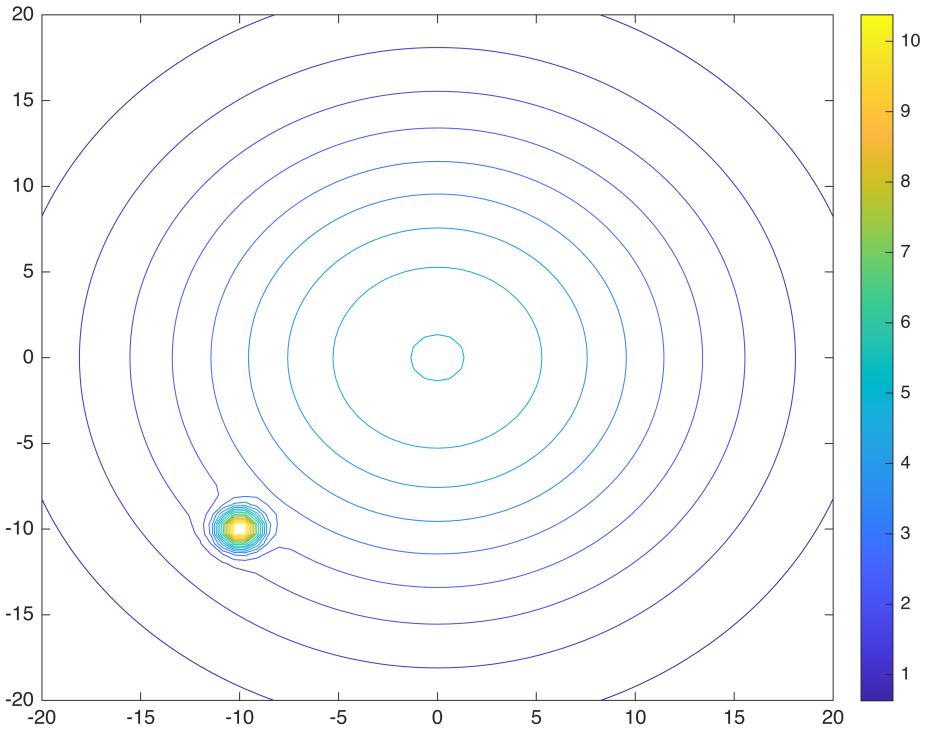
```
j(x, y) =
```

$$5\,\mathrm{e}^{-\frac{x^2}{225}-\frac{y^2}{225}} + 10\,\mathrm{e}^{-(x+10)^2-(y+10)^2}$$

```
fsurf(j, [-20 20 -20 20])
xlabel('x axis'), ylabel('yaxis'), zlabel('z axis')
```




```
LevelCurves4a = linspace(-1, 12, 25);
fcontour(j, [-20 20 -20 20], 'LevelList', LevelCurves4a)
colorbar
```



The smaller the distance between level curves the steeper the slope of the graph is at that point. This is because there is a larger change in the Z axis then there is in the X or Y axis.

This can be seen on the graphs of j(x, y). The taller spike has level curves that are grouped closer together, and the shorter spike has more space between level curves. This happens becase the amount of horizontal distance traveled by the function for a constant vertical distance is less the steeper the graph is.