4. Review critical points

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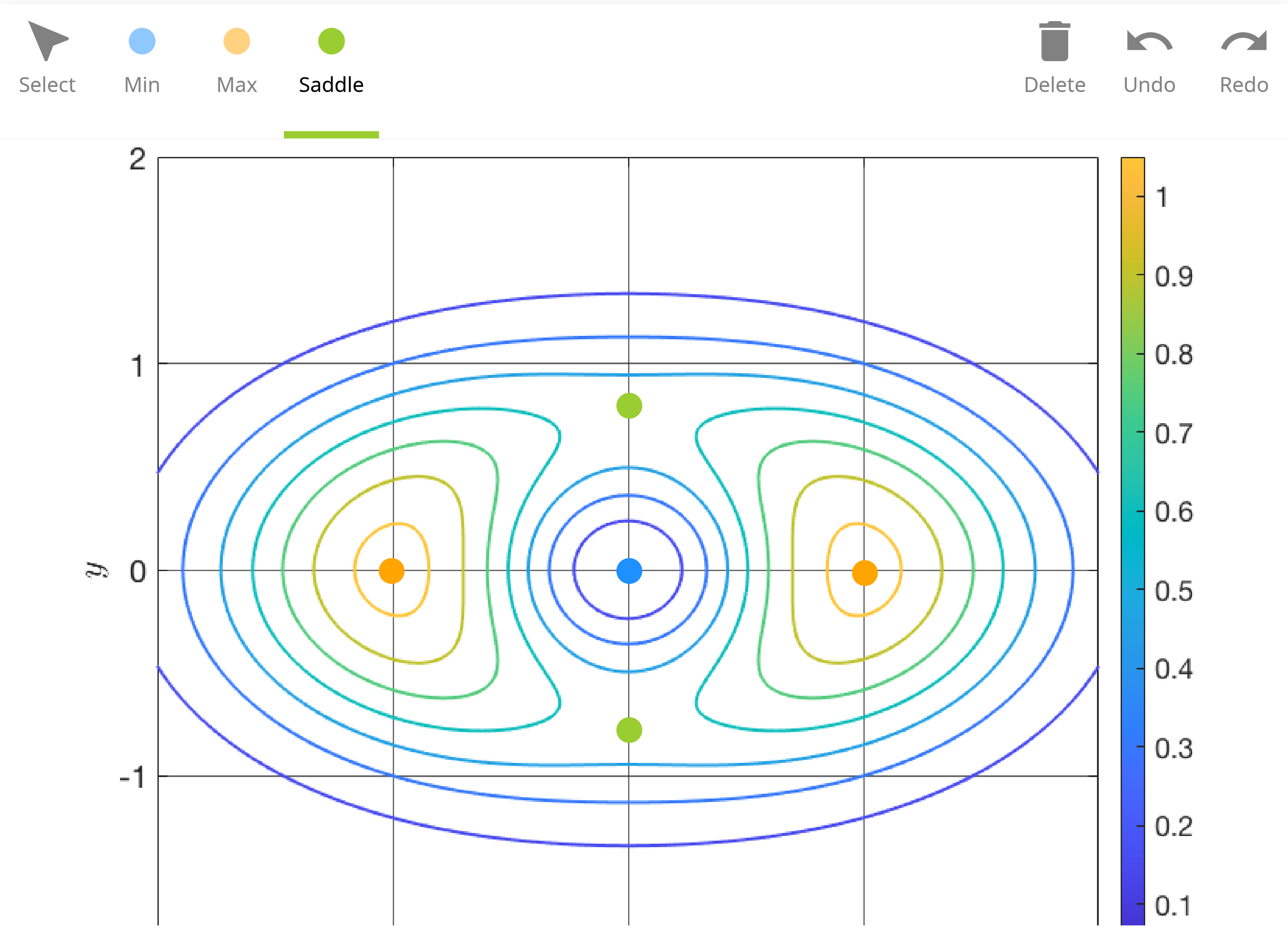
Lecture due Sep 13, 2021 20:30 IST Completed

Review

Identify the types of critical points

1.0/1 point (graded)
Label the critical points in the level curve image below.

(Use the min point tool to label local minima, use the max point tool to label local maxima, and use the saddle point tool to label saddle points.)



Answer: See solution.

Good job!

Solution:

There are two maxima located at $(1, 0)$ and $(-1, 0)$, a local minimum at $(0, 0)$ and two saddle points at roughly $(0, 0.7)$ and $(0, -0.7)$. We were generous with tolerances for location since it isn't exact and the level curves are sparce.

To see how to use level curves to understand where different types of critical points are, keep reading the review below.

Submit You have used 2 of 2 attempts

Answers are displayed within the problem

Review critical points

Start of transcript. Skip to the end.

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PROFESSOR: Today we are going to continue

looking at critical points and we'll

learn how to actually decide whether a particular point is

a minimum, a maximum, or a saddle point.

So that's my main topic for today.

So remember yesterday we looked at

0:00 / 0:00 2.0x

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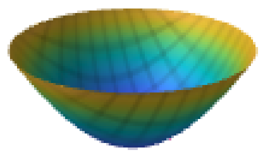
Recall that (a,b) is a critical point of $f(x,y)$ if $\nabla f(a,b) = \langle 0,0\rangle$.

We saw last time that there are three types of critical points.

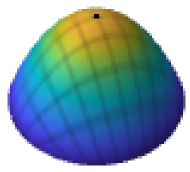
Local minimum

A point whose value is smaller than any nearby point.



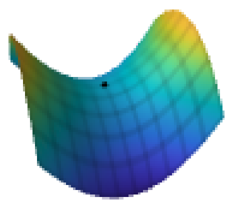
Local maximum

A point whose value is larger than any nearby point.



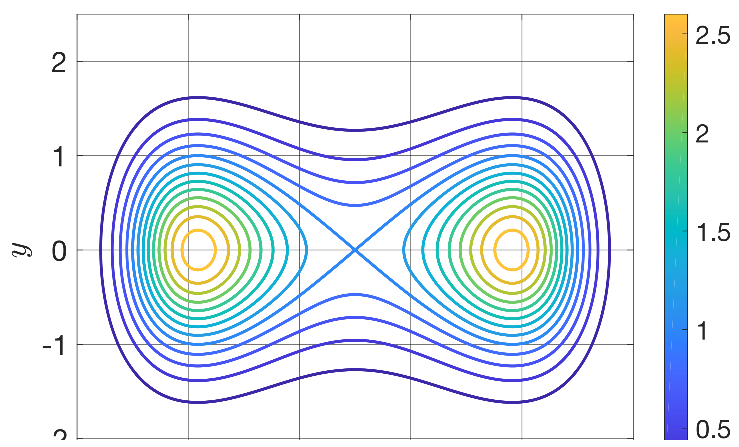
Saddle point

A point that is neither a minimum or a maximum, but can look like either depending on the direction you look at it from.



We were able to determine the type of critical point by using graphical information from the level curves, or even the gradient.

Example 4.1 Given the following level curves of a function, we can see that there are two local minima or maxima where there are nested concentric closed curves. The heights are indicated in this image, and allow us to determine that these are local maxima. There is a saddle point where the level curves cross and change from increasing to decreasing.



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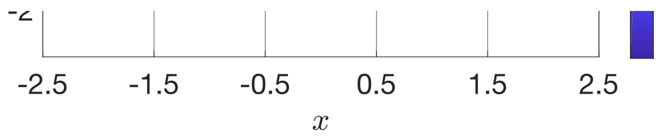
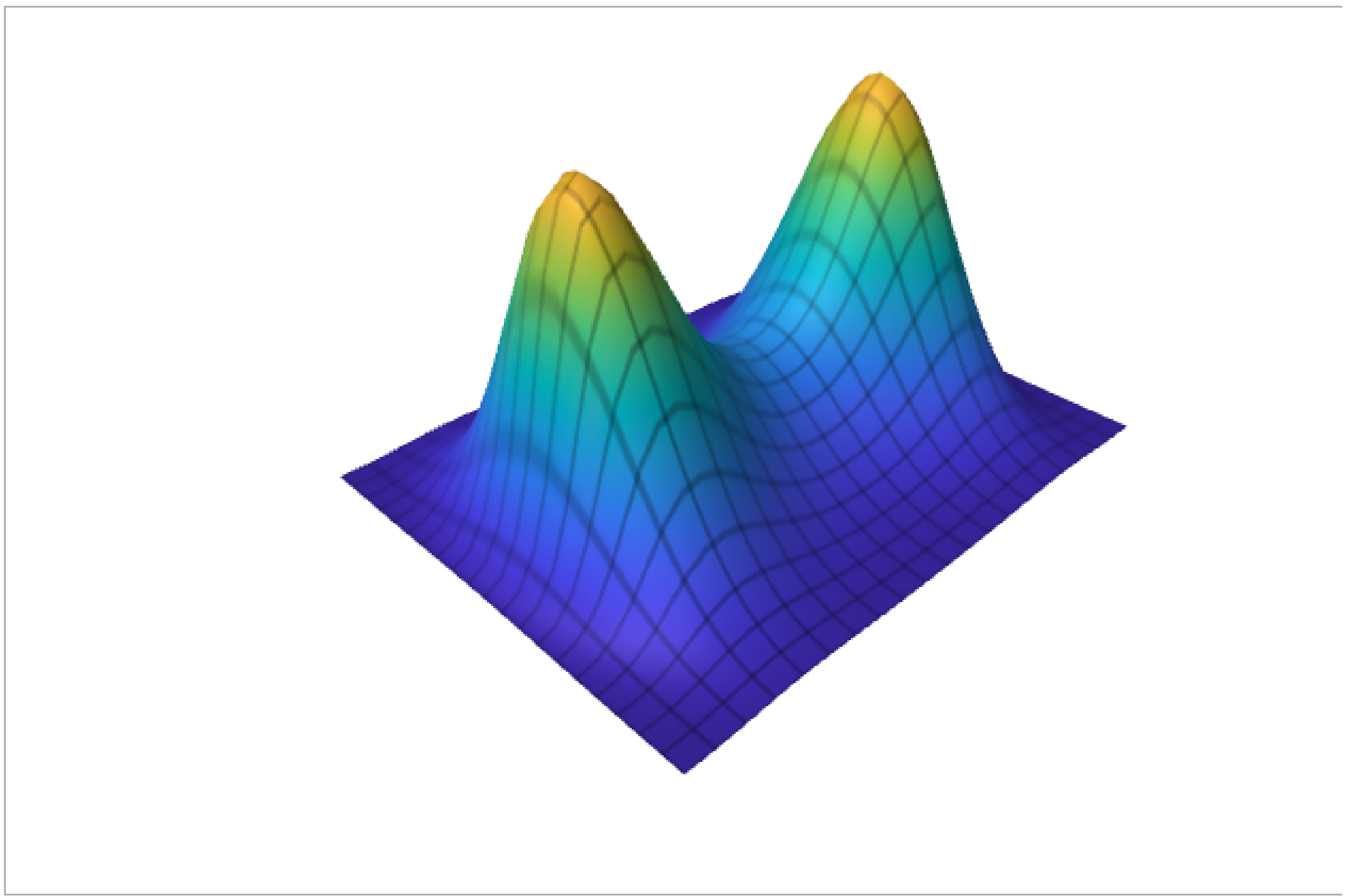


The graph of the multivariable function is shown below in case it is helpful to see the three dimensional graph and connect it to its level curve.

▶ **SURFACE CORRESPONDING TO LEVEL CURVES**



Local vs global extrema

Maxima and minima together are called **extrema** , because they are locations where a function achieves its most "extreme" values.

One distinction we must make is between **local extrema** and **global extrema** .

- **Local extrema** are points at which the function attains a maximum or minimum in a small region about that point.
- **Global extrema** are points at which the function attains a maximum or minimum over its entire domain.

For example, if we find several points at which a function $f(x, y)$ attains a local maximum, we would need to check the value of $f(x, y)$ at each of those points to identify which one is greatest and therefore the global maximum. Sometimes the global maximum or minimum could be “at infinity," which means it is never actually attained. But this means that we must also check the behavior of the function in the limits as $x \to \infty$ and $y \to \infty$. It could also be on the boundary of its domain of definition. We will cover this case in detail in the next lectures. For now, we focus on identifying the type of critical point.

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Level curve graph a bit ambiguous
No criss cross ... how could one know there were saddle point(s) in the graph?
5

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