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8. Summary

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Summarize

Big Picture

Theorem

If a function $f(x, y)$ of two variables is differentiable on a closed bounded region R, then $f(x, y)$ attains its absolute maximum (or minimum) on R. Furthermore, either

- the absolute maximum (or minimum) occurs at a critical point, or
- the absolute maximum (or minimum) occurs on the boundary of R.

Mechanics

In order to solve an optimization problem, the first step is to describe the constraint as a closed and bounded region. Next we need to find an equation for the boundary.

In the next lecture, we will apply multivariable calculus techniques to find a more algorithmic procedure to finding maxima along a boundary.

Warning! Constrained optimization is really hard! In the examples of this lecture, we were able to reduce to a single variable calculus problem.

Ask Yourself

If a function has no critical points, can it have a maximum on a bounded region?

Yes! When we constrain our function to a bounded region, it will obtain a maximum value on this region. If there are critical points on the interior, it may occur at the critical point. However, you must always check the boundary even for functions with critical points, as the maximum can occur on the boundary. If there are no critical points, then the maximum (and minimum) must occur along the boundary.

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Can the maximum (or minimum) of a function happen at a critical point that is outside of the bounded region?

Yes! But this isn't a point that is relevant to us in solving our problem. In constrained optimization problems, we are only interested in maxima and minima that occur inside of or along the boundary of a region R.

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8. Summary

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