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10. Worked example

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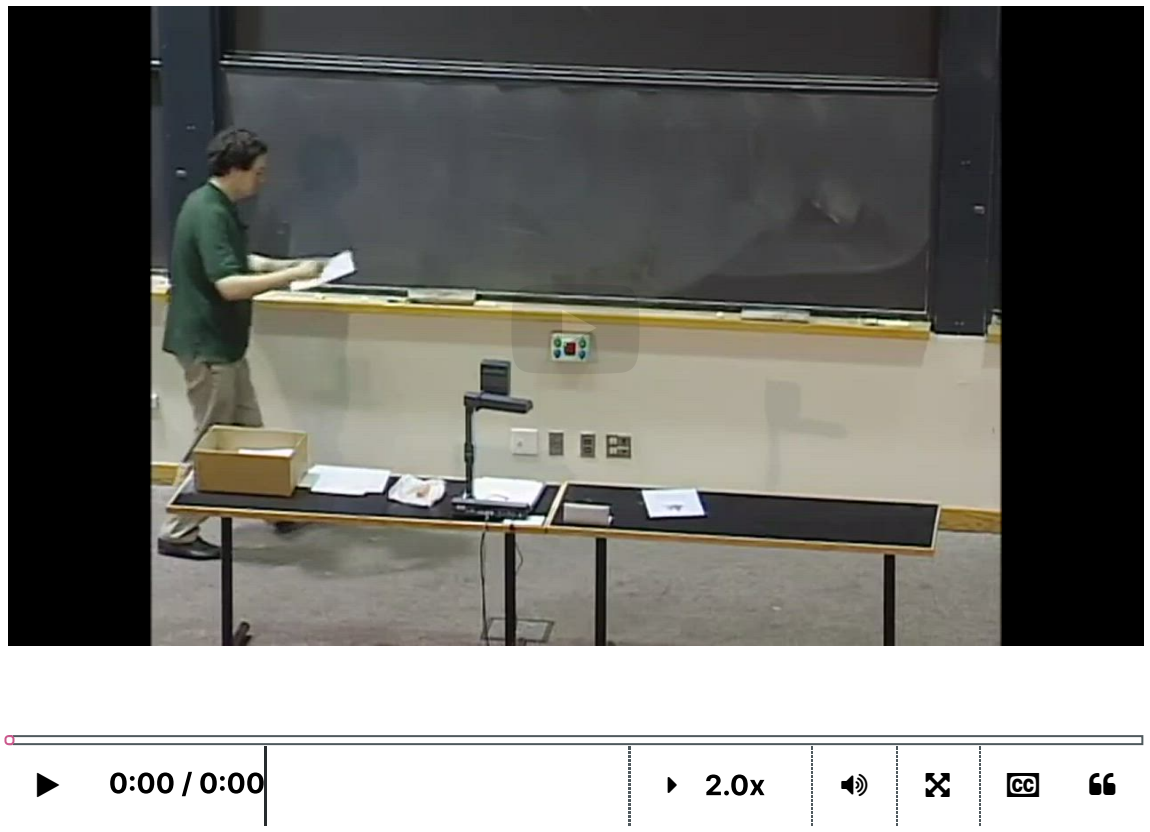
Worked example setup



Start of transcript. Skip to the end.

PROFESSOR: So let's do an example,

let's say I look at f of (x,y) equals x plus y plus 1 over xy,

where x and y are positive.

So I'm looking on there for first point.

I'm doing this because I don't want this denominator

to become 0, so I'm just looking at that situation.

So let's look first for--

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Example 10.1 What are the global maximum and global minimum of the function below?

$$f(x,y) = x + y + \frac{1}{xy}, \qquad x, y > 0$$

(Note we restrict our attention to the domain $x, y > 0$ to avoid the regions where the function is not defined.)

The first step is to find the critical points.

$$f_x(x,y) = 1 - \frac{1}{x^2 y} = 0 \tag{4.87}$$

$$f_y(x,y) = 1 - \frac{1}{xy^2} = 0 \tag{4.88}$$

This tells us that

$$x^2 y = 1 \tag{4.89}$$

$$xy^2 = 1 \tag{4.90}$$

$$\frac{x}{y} = 1 \quad \text{(dividing)} \tag{4.91}$$

$$x = y$$

Calculator Hide Notes

$$y^3 = 1 \quad \text{(substituting)} \tag{4.93}$$

$$\longrightarrow y = 1 \tag{4.94}$$

$$\longrightarrow x = 1 \tag{4.95}$$

Thus there is one critical point at $(1, 1)$.

POLL
What type of critical point is (1,1)?

RESULTS

Local minimum	**61%**
Local maximum	**8%**
Saddle	**12%**
Inconclusive	**12%**
I do not know how to think about this yet	**7%**

Submit

Results gathered from 441 respondents.

FEEDBACK
Your response has been recorded

Worked example conclusion

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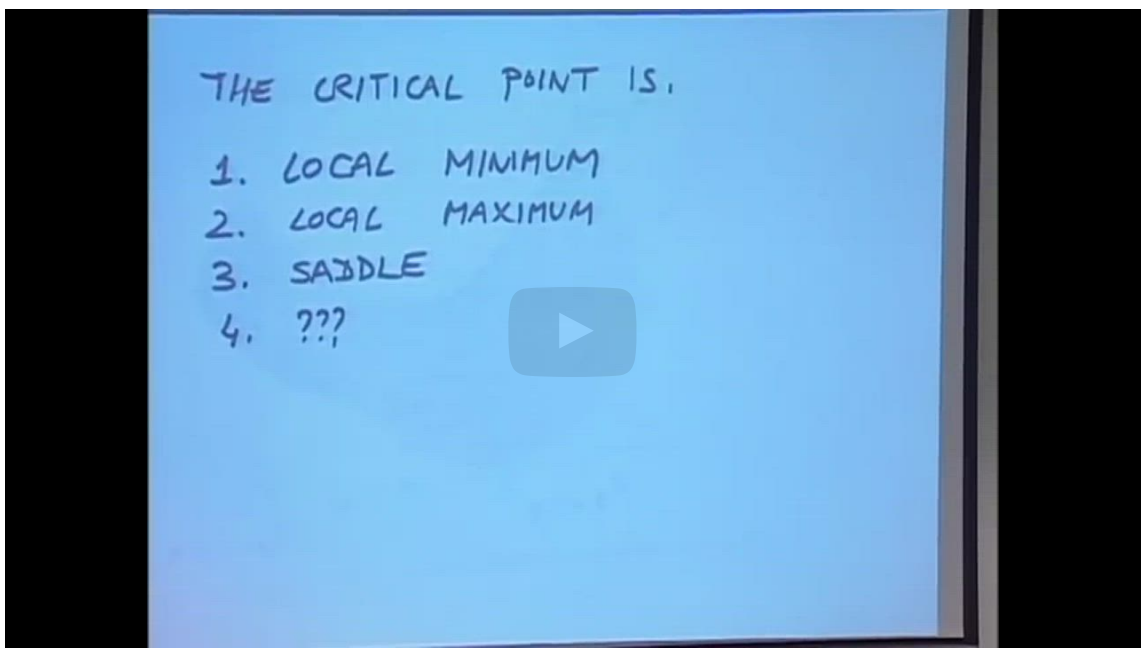

PROFESSOR: So let's see.

To figure out what type of point it is,

we should compute the second partial derivatives.

So f sub xx is--

What do we get when we take the derivative of this

with respect to x?

0:00 / 0:00 2.0x

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Continuing the example above, we must compute the second derivatives to determine the type of critical point.

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$$f_{xx}(x,y) = \frac{2}{x^3 y} \qquad A = f_{xx}(1,1) = 2 \tag{4.96}$$

$$f_{xy}(x,y) = \frac{1}{x^2 y^2} \qquad B = f_{xy}(1,1) = 1 \tag{4.97}$$

$$f_{yy}(x,y) = \frac{2}{x y^3} \qquad C = f_{yy}(1,1) = 2 \tag{4.98}$$

Thus $AC - B^2 = 4 - 1 = 3 > 0$, so we either have a local maximum or local minimum. Since $A > 0$, we have a local minimum. You can check that this is in fact a global minimum, by plotting for example.

The maximum is not attained as f tends to ∞ if $x \to \infty$, $y \to \infty$, $x \to 0$, or $y \to 0$.

10. Worked example

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the only local an global minimum 11

How can we that this is in fact a global minimum, by plotting ?? Can someone help plot this function

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