## 5. Connection to the gradient

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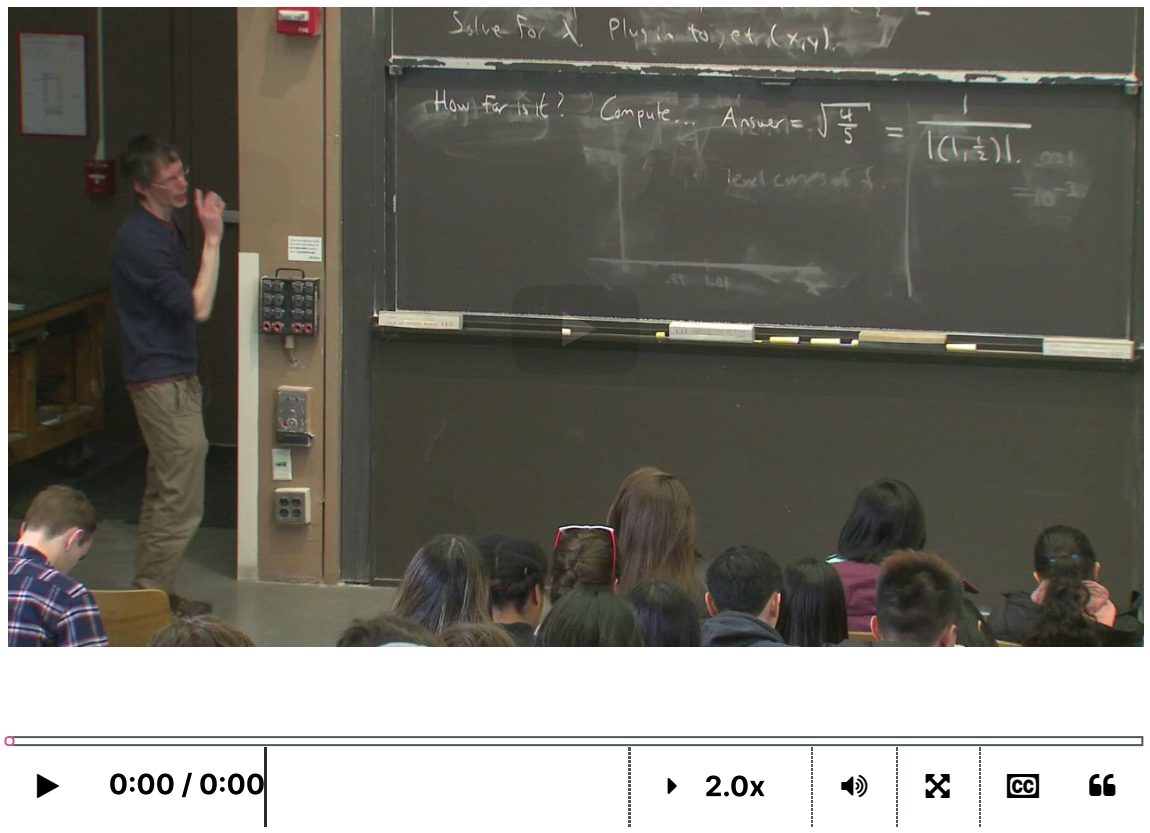
## Connection to the gradient

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PROFESSOR: Cool, so I did this problem for two reasons.

One, is to practice thinking about vectors

and how to set up problems involving vectors

and be able to think through something like this.

But the other reason I did this problem

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How is the answer related to what we know about the gradient?

$$f(x,y) = x + y/2 \tag{7.23}$$

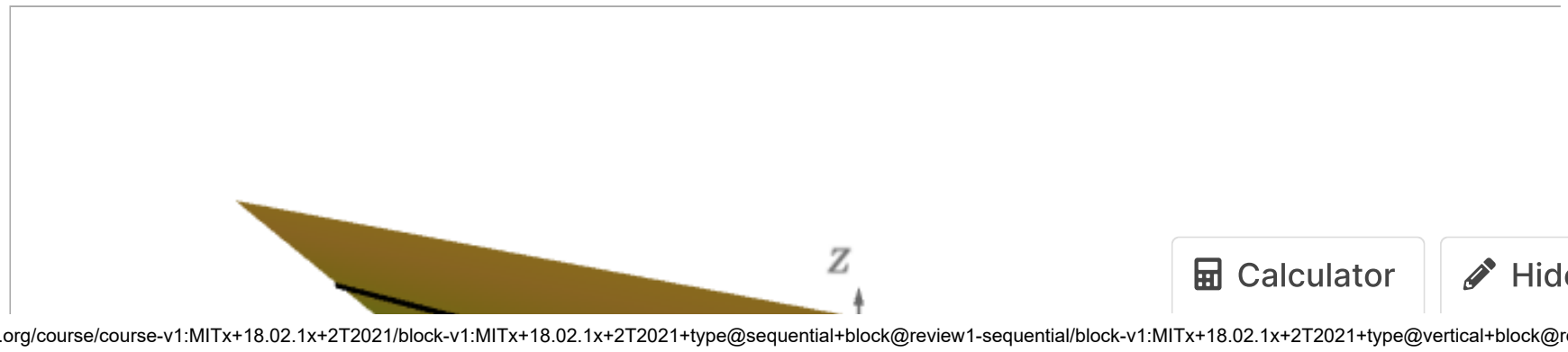
$$\nabla f(x,y) = \langle 1, 1/2 \rangle \tag{7.24}$$

We started at the point $(1,0)$ on the level curve of height $1$. We found a point $(x,y)$ on the level curve of height $2$ in the direction of the gradient.

- The gradient is the direction of steepest increase. So the quickest way to the line of height $2$ is in the direction of the gradient.
- The magnitude of the gradient is the slope in the direction of $\nabla f$. Slope is the rise over the run. The rise is the difference between the heights of the two level curves. The run is exactly the distance we computed, the shortest distance between the level curves.

$$|\nabla f| = \frac{\textbf{rise}}{\textbf{run}} = \frac{2-1}{\frac{1}{|\nabla f|}}$$

▶ **Slope is rise over run**

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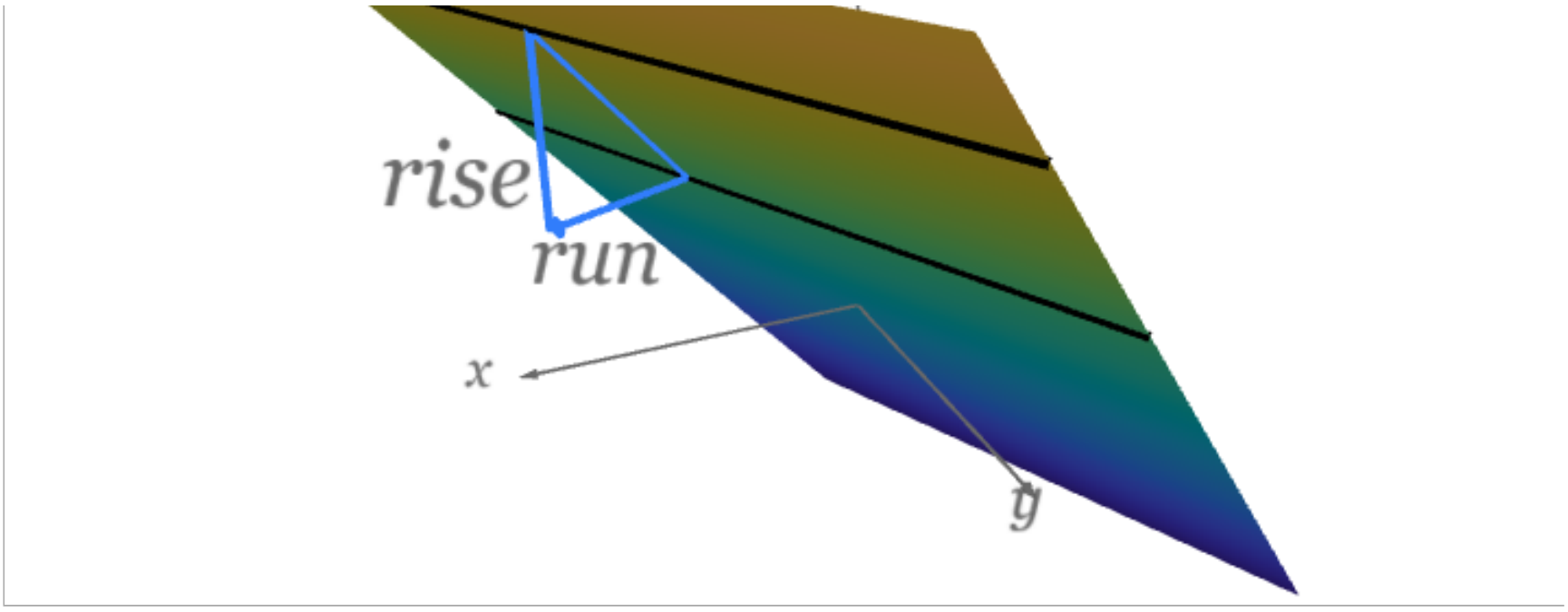


## 5. Connection to the gradient

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### circular definition?

question posted 2 days ago by **pgaldi**

I get the explanation, but something's strange in

$$|\nabla f| = \frac{\textbf{rise}}{\textbf{run}} = \frac{2-1}{\frac{1}{|\nabla f|}}$$

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**sandipan_dey**

less than a minute ago

I think we want to find **run**, i.e., how far is $(x, y)$ from $(1, 0)$ and that can be found using $run = \frac{rise}{|\nabla f|} = \frac{2-1}{|\nabla f|} = \frac{1}{|\nabla f|}$ in this case.

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