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5. Linear approximation: review

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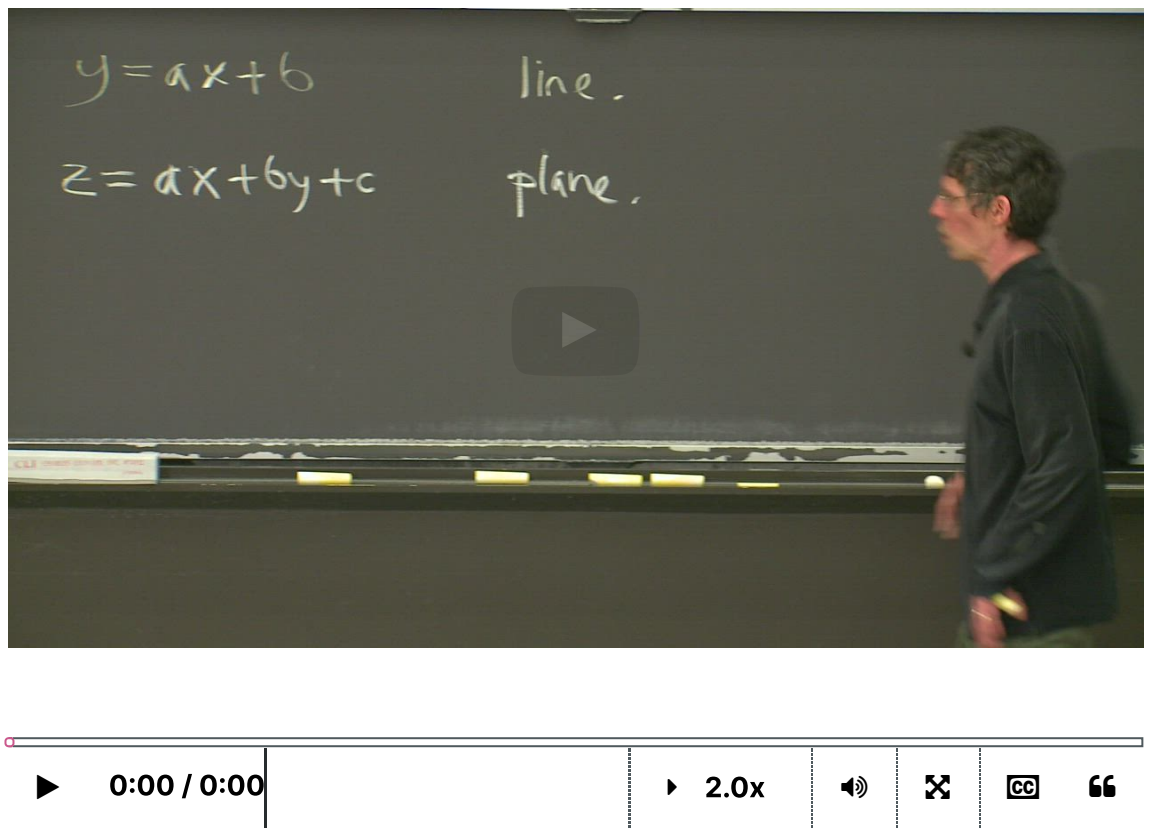
Review

1D linear approximation



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PROFESSOR: So let's remember how it worked in 18.01.

So in 18.01, linear approximation,

we had a function of one variable, say, g of x.

And linear approximation tells us,

how does the function g change if we change x a little bit?

So if we look at g at x0 plus Delta x, that's approximately g

of x0 plus g prime of x0 times Delta

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Recall: The linear approximation of a function $g(x)$ in one variable near $x = x_0$ is

$$g(x_0 + \Delta x) \approx g(x_0) + g'(x_0)\,\Delta x.$$

Example 5.1 Consider $g(x) = x^2$ near $x_0 = 1$.

$$\begin{aligned} g(1) &= 1^2 = 1 \\ g'(x) &= 2x \\ g'(1) &= 2 \end{aligned}$$

Thus

$$g(1 + \Delta x) \approx g(1) + g'(1)\,\Delta x = 1 + 2\Delta x.$$

Another way to write this is that near 1,

$$g(x) \approx g(1) + g'(1)\underbrace{(x-1)}_{\Delta x} = 1 + 2(x-1) = 2x - 1$$

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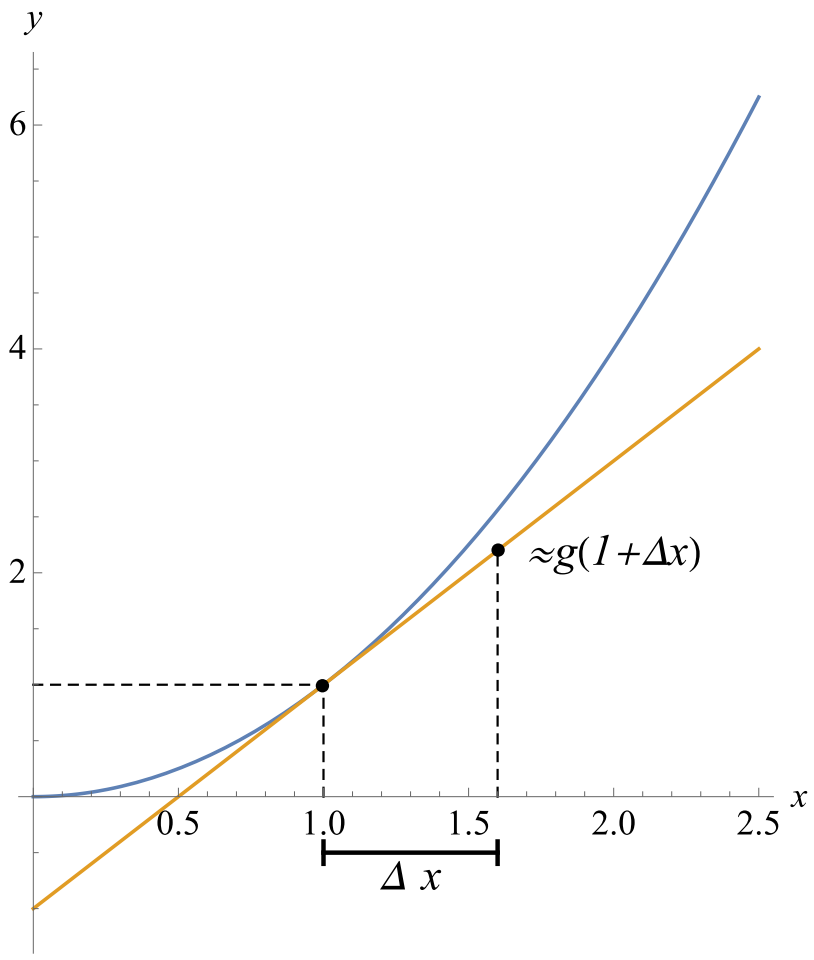

Figure 3: The parabola $y = x^2$ and its tangent line near $x = 1$ given by the line $y = 2x - 1$. The horizontal distance between vertical lines is Δx and the dot represents the linear approximation of $g(1 + \Delta x)$.

Remark 5.2

1. The line $y = 2x - 1$ is the tangent line to the graph of $y = g(x)$ at the point $x = 1$.
2. $2x - 1$ is a good approximation to $g(x)$ when x is near 1.
3. $1 + 2\Delta x$ is a good approximation to $g(1 + \Delta x)$ when Δx is small.

5. Linear approximation: review

Topic: Unit 1: Functions of two variables / 5. Linear approximation: review

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