Chain Rule

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Derivatives of compositions are products of derivatives!

$$\frac{d}{dx}\Big[\, f\big(\, g(x)\,\big)\,\Big] = f'\big(\, g(x)\,\big)\, g'(x)$$

Iterated Chains

$$\frac{d}{dx}\Big[\, f\Big(\, g\big(\, h(x)\,\big)\,\Big)\,\Big] = f'\Big(\, g\big(\, h(x)\,\big)\,\Big) \cdot g'\big(\, h(x)\,\big) \cdot h'(x)$$

1. Use the chain rule to find $f'(x)$. Compare order of composition!

A1. $f(x) = \big(3\sin x\big)^4$

A2. $f(x) = 3\sin(x^4)$

B1. $f(x) = \sqrt{\cos x}$

B2. $f(x) = \cos\sqrt{x}$

C1. $f(x) = \tan(x^3 + x^2)$

C2. $f(x) = \tan^3 x + x^2$

2. Find $f'(x)$. Compare product rule and chain rule problems!

A1. $f(x) = 5x^3\cos x$

A2. $f(x) = \big(5\cos x\big)^3$

B1. $f(x) = (x^2+1)\sec x$

B2. $f(x) = \sec(x^2+1)$

3. Use the iterated chain rule to compute $f'(x)$.

A. $f(x) = 4\cos\big(5\sin(3x^2+7x)\big)$

B. $f(x) = 2\tan^3\big(4\sin^5 x\big)$

C. $f(x) = \Big(\big(x^2+2x-1\big)^3 - 5x\Big)^2 - 4x$

4. Find the tangent line to $y = \Big(\big(x^2+2x-1\big)^3 - 5x\Big)^2 - 4x$ at $x = 1$.