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Oct. 21

- HW4 / Quiz - Office Hours - Labs.
- Quiz 3 Solutions today
- HW6 Due Monday
- No HW next week
- midterm practice instead

Midterm: Monday Oct. 31
in class (45min.)

Extra office Hours Next Week
- details Monday.

Will entertain Midterm Questions
on Monday. (topics ...)

Chain Rule: (§ 2.4)

Consider $h(x) = (x^2 + 3)^4$.

outside: $f(x) = x^4$, $f'(x) = 4x^3$.

inside: $g(x) = x^2 + 3$, $g'(x) = 2x$.

$$h'(x) = f'(g(x)) \cdot g'(x)$$

$$= \underline{4(x^2 + 3)^3} \cdot 2x$$

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Alternatively let $u = x^2 + 3$.

Then $h(x) = u^4$.

where $u = u(x)$.

↑ function of x .

Chain Rule (in this form says:)

$$\frac{dh}{dx} = \frac{dh}{du} \cdot \frac{du}{dx}$$

Now,

1) $\frac{dh}{du} = 4u^3$.

← derivative of h with respect to u .

u is the variable.

2) $\frac{du}{dx} = 2x$.

So, $\frac{dh}{dx} = \frac{dh}{du} \cdot \frac{du}{dx} = 4u^3 \cdot 2x = \underline{4(x^2 + 3)^3 \cdot 2x}$.

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Example: Let $f(x) = u^2$
where u is some unknown
function of x . ($u = u(x)$)

What is $\frac{df}{dx}$?

Click Q:

A) $2u$

B) $2x$

→ C) $2u \cdot \frac{du}{dx}$

D) $2 \frac{du}{dx}$

$$\frac{df}{dx} = \frac{df}{du} \cdot \frac{du}{dx}$$

$$= 2u \cdot \frac{du}{dx}$$

We didn't know what u was
in this example.

Say $u = 3x + x^3$.

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$$f(x) = (3x + x^3)^2$$

$$f'(x) = \underbrace{2(3x + x^3)}_{2u} \cdot \underbrace{(3 + 3x^2)}_{\frac{du}{dx}}$$

Example: Say we have a function

$$A = \pi r^2$$

a function of

Let's say our area is time, t .

$$\frac{dA}{dt} = \frac{dA}{dr} \cdot \frac{dr}{dt}$$

↑
variable

The radius itself is an unknown function of time, $r = r(t)$.

$$\frac{dA}{dt} = 2\pi r \cdot \frac{dr}{dt}$$