Section 3.1 - Chain Rule

- Chain Rule

din · dout (in)

- New Rules

- $\frac{d}{dx} a^x = a^x \ln a$ → be careful! Exponents other than x will result in a Chain Rule
- can take the power rule of a negative Exp!

- Multipal Composite Functions

1. find inside function & outside functions - inside called u (will have another function inside that - v)
2. rewrite origional function w/ u subed in (New f)
3. Take derivative of u - Write out u & u' ↔ will have to use chain Rule
4. Take derivative of new f
5. plug u & u' back in

Examples: Take the derivative.

- $(2x+5)^3$ $\overset{din}{2} \cdot \overset{dout}{3}\,\overset{in}{(2x+5)}^2 = 6(2x+5)^2$
- $(x^3-2)^5$ $5 \cdot 3x^2\,(x^3-2)^4 = 15x^2(x^3-2)^4$
- $(e^x - x^2)^2$ $2(e^x - 2x)(e^x - x^2)$

- $\sec^3(x) = (\sec(x))^3 \quad 3\sec x \tan x (\sec x)^2 = 3\tan(x)\sec^3 x$
- $\cos(5x) = -5\sin(5x)$
- $e^{\frac{1}{x^2}} = \frac{-2x}{x^4} e^{\frac{1}{x^2}}$
- $3^{\tan x} = \sec^2 x \; 3^{\tan x} \ln(3)$
- $x^3 e^{2x} = 3x^2 e^{2x} + 2e^{2x} x^3$
- $\frac{1}{1+2e^{-x}} = \frac{+2e^{-x}}{(1+2e^{-x})^2}$
- $\frac{3}{x^5+2x^2-3} = \frac{-(5x^4+4x)}{(x^5+2x^2-3)^2}$
- $x^{-5} = -5x^{-6}$
- $\tan(\underbrace{e^{x^2}}_{u})$

$$\tan(u) \qquad u = e^{x^2}$$
$$u' = 2xe^{x^2}$$
$$u' \cdot \sec^2(u) \qquad = 2xe^{x^2}\sec^2(e^{x^2})$$

- $e^{\overbrace{\csc^2(x)}^{u}}$

$$e^u \qquad u = \csc(x)^2$$
$$u' = -2\csc x \cot(x)$$
$$u' e^u \qquad = -2\csc(x)\cot(x)\, e^{\csc^2(x)}$$

- $2\cos^2(x^2) \rightarrow \underbrace{\cos(x^2)}_{u}{}^2$

$$u^2 \qquad u = \cos(x^2)$$
$$u' = -2x\sin(x^2)$$
$$u' \cdot 2u \qquad = -4x\sin(x^2)(\cos(x^2))$$

- $e^{\overbrace{\pi x}^{u}} \tan(\pi x)$

$$e^u \tan(u) \qquad u = \pi x$$
$$u' = \pi$$
$$u' e^u \tan u + u' \sec^2(u) e^u = \pi e^{\pi x} \tan(\pi x) + \pi \sec^2(\pi x) e^{\pi x}$$