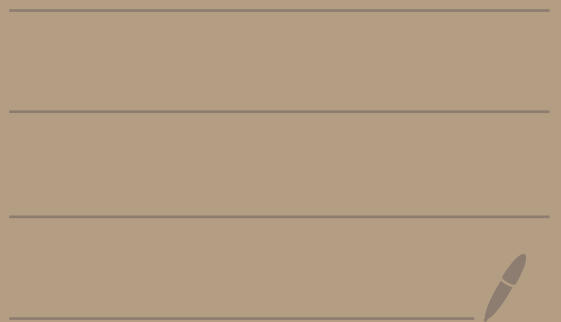


Math 2150-02

8/20/25



Topic 0 - Calculus Review

$$\frac{d}{dx} x^n = nx^{n-1}$$

$$\leftarrow (x^3)' = 3x^2$$

$$\frac{d}{dx} \sin(x) = \cos(x)$$

$$\frac{d}{dx} \cos(x) = -\sin(x)$$

$$\frac{d}{dx} \ln(x) = \frac{1}{x}$$

$$\frac{d}{dx} e^x = e^x$$

$$\int x^n dx = \frac{x^{n+1}}{n+1} + C$$

$\uparrow$
 $n \neq -1$

$$\leftarrow \int x^3 dx = \frac{x^4}{4} + C$$

$$\int \frac{1}{x} dx = \ln|x| + C$$

$$\int \sin(x) dx = -\cos(x) + C$$

$$\int \cos(x) dx = \sin(x) + C$$

$$\int e^x dx = e^x + C$$

$$\int \tan(x) dx = \ln|\sec(x)| + C$$

Chain rule

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

Ex: $\frac{d}{dx} e^{\sin(x)} = e^{\sin(x)} \cdot \cos(x)$

$$= \cos(x) e^{\sin(x)}$$

Ex: $\frac{d}{dx} (\cos(x))^5$

$$= 5(\cos(x))^4 \cdot (-\sin(x))$$

Product rule:

$$(fg)' = f'g + fg'$$

Ex:

$$\frac{d}{dx} \cos(x) \sin(x)$$

$$= (-\sin(x))(\sin(x)) + (\cos(x))(\cos(x))$$

$$= -\sin^2(x) + \cos^2(x)$$

Substitution:

$$\int g(f(x)) \cdot f'(x) dx = \int g(u) du$$

$$\begin{array}{l} u = f(x) \\ du = f'(x) dx \end{array}$$

$$\int 5e^{5x} dx = \int e^u du = e^u + C$$
$$= e^{5x} + C$$

$$\begin{aligned} u &= 5x \\ du &= 5dx \end{aligned}$$

Ex:

$$\int \cos(10x) dx = \frac{1}{10} \sin(10x) + C$$

$$\int \cos(10x) dx = \int \frac{1}{10} \cos(u) du$$

$$\begin{aligned} u &= 10x \\ du &= 10dx \\ \frac{1}{10} du &= dx \end{aligned}$$

$$= \frac{1}{10} \sin(u) + C$$

$$= \frac{1}{10} \sin(10x) + C$$

Ex: $\int e^{7x} dx = \frac{1}{7} e^{7x} + C$

Ex: $\int \frac{1}{x(\ln(x))^2} dx$

$$= \int \frac{1}{x} \cdot \frac{1}{(\ln(x))^2} dx$$

$$= \int \frac{1}{u^2} du = \int u^{-2} du$$

↑
 $u = \ln(x)$
 $du = \frac{1}{x} dx$

$$= \frac{u^{-2+1}}{-2+1} + C$$

$$= -u^{-1} + C$$

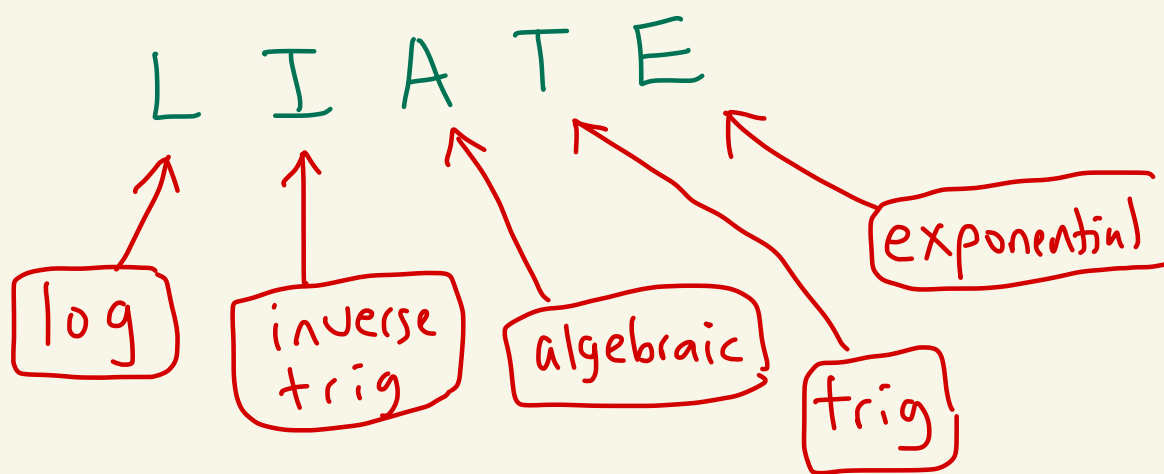
$$= -\frac{1}{u} + C$$

$$= -\frac{1}{\ln(x)} + C$$

Integration by parts

$$\int u dv = uv - \int v du$$

picking u:



pick u

Ex:

An example of integration by parts. The integral $\int x e^x dx$ is shown. The 'x' is underlined in orange and labeled 'u' below it. The 'e^x' is underlined in orange and labeled 'dv' below it. Above the 'x' is a pink oval labeled 'algebraic' with an arrow pointing to it. Above the 'e^x' is a pink oval labeled 'exponential' with an arrow pointing to it.

$$\int u dv = uv - \int v du$$

$$= x e^x - \int e^x dx$$

↑

$$\begin{array}{ll} u = x & du = dx \\ dv = e^x dx & v = e^x \end{array}$$

$$= x e^x - e^x + C$$
