Math 2150-02
8/20/25

Topic 0 - Calculus Review

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

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

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

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

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

$n \neq -1$

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

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

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

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

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

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

Chain rule

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

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

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

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

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

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:

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

$u = f(x)$

$du = f'(x)\,dx$

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

$$= e^{5x} + C$$

$u = 5x$

$du = 5\,dx$

Ex:

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

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

$u = 10x$

$du = 10\,dx$

$\frac{1}{10}\,du = dx$

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

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

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

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

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

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

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

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

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

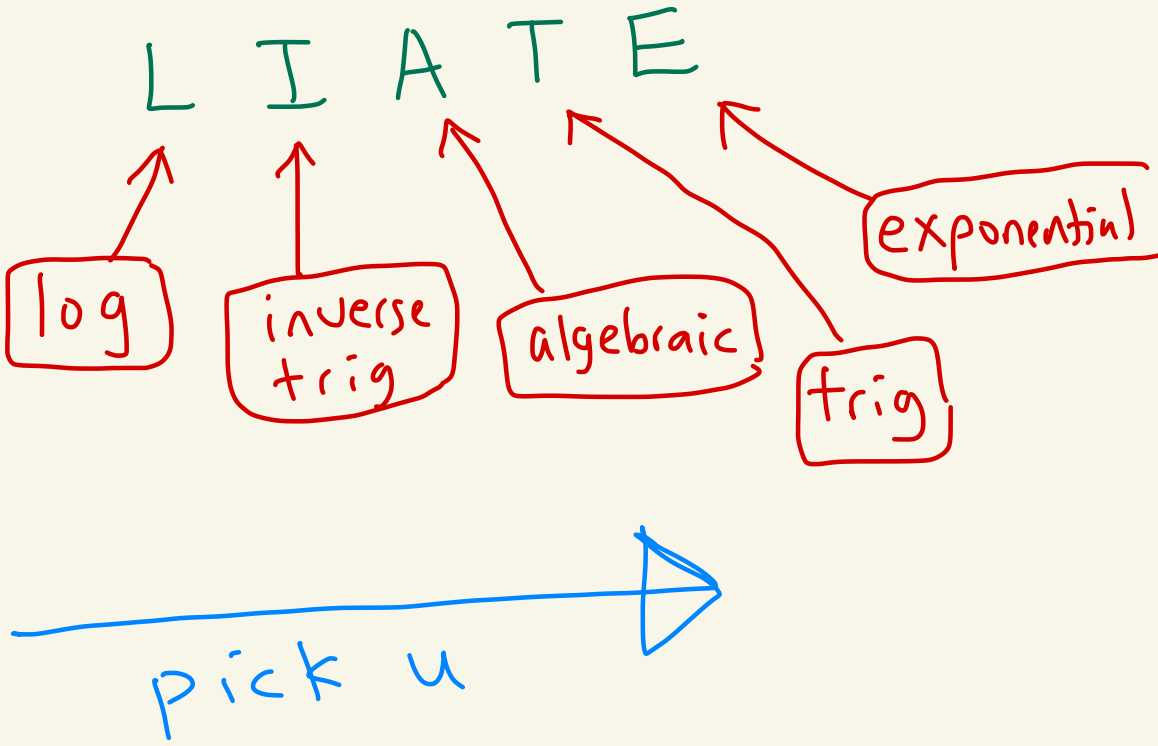
$= -\frac{1}{u} + C$

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

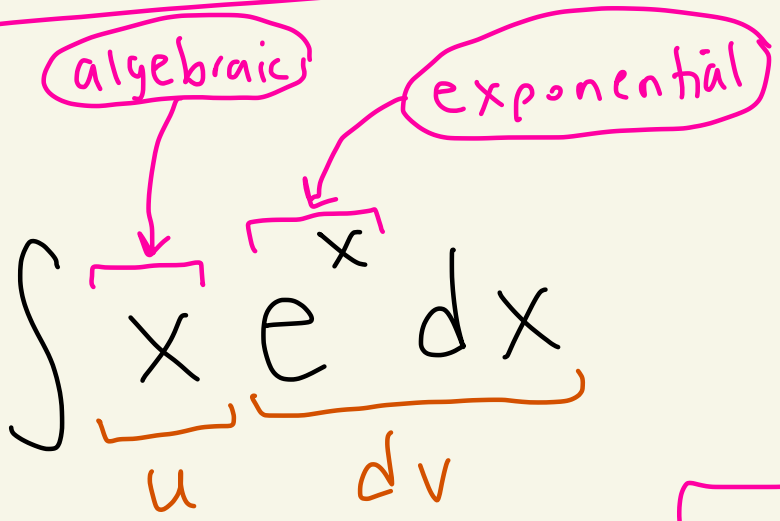
Integration by parts

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

picking u:



Ex:



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

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

$u = x \qquad du = dx$

$dv = e^x dx \qquad v = e^x$

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