

**(\*Video 1: Chain rule \*)**

In[241]:= **(\*Chain rule: to differentiate a composition,  
take the derivative of outside function computed at the inside  
function and multiply by the derivative of the inside function\*)**

**D[f[g[x]], x]**

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Out[241]=  $f'[g[x]] g'[x]$

Out[242]=  $f'[x] g'[f[x]]$

In[243]:= **(\*Example 1\*)**

**f[x\_] := E^x**

**g[x\_] := x^2 + 3 x + 1**

**f[g[x]]**

**D[f[g[x]], x]**

Out[247]=  $e^{1+3x+x^2}$

Out[248]=  $e^{1+3x+x^2} (3 + 2x)$

In[249]:= **g[f[x]]**

**D[g[f[x]], x]**

Out[249]=  $1 + 3 e^x + e^{2x}$

Out[250]=  $3 e^x + 2 e^{2x}$

In[251]:= **(\*Example 2\*)**

**D[Cos[4 x + 2], x]**

Out[251]=  $-4 \text{Sin}[2 + 4 x]$

**(\*Example 3\*)**

**D[Sin[E^ (7 x)], x]**

Out[235]=  $7 e^{7x} \text{Cos}[e^{7x}]$

In[236]:= **D[e^{7x}, x]**

Out[236]=  $7 e^{7x}$

**(\*More layers, apply rule inductively\*)**

**D[a[f[g[h[x]]]], x]**

Out[239]=  $a'[f[g[h[x]]]] f'[g[h[x]]] g'[h[x]] h'[x]$

**(\*Example 4\*)**

**D[E^ (Sin[2 x^2]), x]**

Out[240]=  $4 e^{\text{Sin}[2x^2]} x \text{Cos}[2x^2]$