Calculus I

Derivatives involving trigonometry and exponents

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Differentiate:

$$y = \theta e^{\theta} (\tan \theta + \sec \theta).$$

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$$y' = \frac{\mathsf{d}}{\mathsf{d}\theta} \left(\theta e^{\theta} \right) \left(\tan \theta + \sec \theta \right) + \frac{\theta e^{\theta}}{\mathsf{d}\theta} \frac{\mathsf{d}}{\mathsf{d}\theta} (\tan \theta + \sec \theta)$$

Differentiate:

$$y = \theta e^{\theta} (\tan \theta + \sec \theta).$$

$$y' = \frac{\mathsf{d}}{\mathsf{d}\theta} \left(\theta e^{\theta} \right) \left(\tan \theta + \sec \theta \right) + \theta e^{\theta} \frac{\mathsf{d}}{\mathsf{d}\theta} \left(\tan \theta + \sec \theta \right)$$

Differentiate:

$$y = \theta e^{\theta} (\tan \theta + \sec \theta).$$

Product Rule:

$$y' = \frac{\mathsf{d}}{\mathsf{d}\theta} \left(\theta e^{\theta} \right) (\tan \theta + \sec \theta) + \theta e^{\theta} \frac{\mathsf{d}}{\mathsf{d}\theta} (\tan \theta + \sec \theta)$$

$$=$$
 $\left(\mathbf{?} \right) \left(an heta + \sec heta
ight) + heta extbf{e}^{ heta} \left(\mathbf{?} \right)$

Differentiate:

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Product Rule:

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$$= \left(\theta \frac{\mathsf{d}}{\mathsf{d}\theta} \left(\boldsymbol{e}^{\theta}\right) + \frac{\mathsf{d}}{\mathsf{d}\theta} (\theta) \boldsymbol{e}^{\theta}\right) (\tan \theta + \sec \theta) + \theta \boldsymbol{e}^{\theta} \left(\boldsymbol{?}\right)$$

Differentiate:

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Product Rule:

$$y' = \frac{\mathsf{d}}{\mathsf{d}\theta} \left(\theta e^{\theta} \right) \left(\tan \theta + \sec \theta \right) + \theta e^{\theta} \frac{\mathsf{d}}{\mathsf{d}\theta} \left(\tan \theta + \sec \theta \right)$$

$$= \left(\theta \frac{\mathsf{d}}{\mathsf{d}\theta} \left(\boldsymbol{e}^{\theta} \right) + \frac{\mathsf{d}}{\mathsf{d}\theta} (\theta) \boldsymbol{e}^{\theta} \right) \! (\tan \theta + \sec \theta) \! + \! \theta \boldsymbol{e}^{\theta} \left(\boldsymbol{?} \right) \!$$

Differentiate:

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$$= \left(\theta \frac{\mathsf{d}}{\mathsf{d}\theta} \left(e^{\theta} \right) + \frac{\mathsf{d}}{\mathsf{d}\theta} (\theta) e^{\theta} \right) (\tan \theta + \sec \theta) + \theta e^{\theta} \left(\sec^2 \theta + \tan \theta \sec \theta \right)$$

Differentiate:

$$y = \theta e^{\theta} (\tan \theta + \sec \theta).$$

Product Rule:

$$y' = rac{\mathsf{d}}{\mathsf{d} heta} \left(heta e^{ heta}
ight) \left(an heta + \sec heta
ight) + heta e^{ heta} rac{\mathsf{d}}{\mathsf{d} heta} (an heta + \sec heta)$$

$$= \left(\theta \frac{\mathsf{d}}{\mathsf{d}\theta} \left(\mathbf{e}^{\theta}\right) + \frac{\mathsf{d}}{\mathsf{d}\theta} (\theta) \mathbf{e}^{\theta}\right) (\tan \theta + \sec \theta) + \theta \mathbf{e}^{\theta} \left(\sec^{2} \theta + \tan \theta \sec \theta\right)$$
$$= \left(\theta (?) + (?) \mathbf{e}^{\theta}\right) (\tan \theta + \sec \theta) + \theta \mathbf{e}^{\theta} (\sec^{2} \theta + \tan \theta \sec \theta)$$

Differentiate:

$$y = \theta e^{\theta} (\tan \theta + \sec \theta).$$

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ight) \left(an heta + \sec heta
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$$\begin{split} &= \bigg(\theta \frac{\mathsf{d}}{\mathsf{d}\theta} \, \Big(\boldsymbol{e}^{\theta} \Big) + \frac{\mathsf{d}}{\mathsf{d}\theta} (\theta) \boldsymbol{e}^{\theta} \bigg) \big(\tan \theta + \sec \theta \big) + \theta \boldsymbol{e}^{\theta} \, \Big(\sec^2 \theta + \tan \theta \sec \theta \Big) \\ &= \Big(\theta \big(\, \boldsymbol{e}^{\theta} \big) + (\boldsymbol{?}) \boldsymbol{e}^{\theta} \Big) \, \big(\tan \theta + \sec \theta \big) + \theta \boldsymbol{e}^{\theta} \big(\sec^2 \theta + \tan \theta \sec \theta \big) \end{split}$$

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ight) \left(an heta + \sec heta
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$$= \left(\theta \frac{\mathsf{d}}{\mathsf{d}\theta} \left(\mathbf{e}^{\theta}\right) + \frac{\mathsf{d}}{\mathsf{d}\theta} (\theta) \mathbf{e}^{\theta}\right) (\tan \theta + \sec \theta) + \theta \mathbf{e}^{\theta} \left(\sec^{2} \theta + \tan \theta \sec \theta\right)$$
$$= \left(\theta (\mathbf{e}^{\theta}) + (?) \mathbf{e}^{\theta}\right) (\tan \theta + \sec \theta) + \theta \mathbf{e}^{\theta} (\sec^{2} \theta + \tan \theta \sec \theta)$$

Differentiate:

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$$= \left(\theta \frac{d}{d\theta} \left(e^{\theta}\right) + \frac{d}{d\theta} (\theta) e^{\theta}\right) (\tan \theta + \sec \theta) + \theta e^{\theta} \left(\sec^2 \theta + \tan \theta \sec \theta\right)$$
$$= \left(\theta (e^{\theta}) + (1)e^{\theta}\right) (\tan \theta + \sec \theta) + \theta e^{\theta} (\sec^2 \theta + \tan \theta \sec \theta)$$

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$$= \left(\theta \frac{\mathsf{d}}{\mathsf{d}\theta} \left(e^{\theta}\right) + \frac{\mathsf{d}}{\mathsf{d}\theta} (\theta) e^{\theta}\right) (\tan \theta + \sec \theta) + \theta e^{\theta} \left(\sec^2 \theta + \tan \theta \sec \theta\right)$$

$$= \left(\theta (e^{\theta}) + (1)e^{\theta}\right) (\tan \theta + \sec \theta) + \theta e^{\theta} (\sec^2 \theta + \tan \theta \sec \theta)$$

$$= \theta e^{\theta} \sec \theta (\sec \theta + \tan \theta) + e^{\theta} (\theta + 1) (\tan \theta + \sec \theta)$$

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$$\begin{split} &= \left(\theta \frac{\mathsf{d}}{\mathsf{d}\theta} \left(\boldsymbol{e}^{\theta}\right) + \frac{\mathsf{d}}{\mathsf{d}\theta} (\theta) \boldsymbol{e}^{\theta}\right) (\tan \theta + \sec \theta) + \theta \boldsymbol{e}^{\theta} \left(\sec^{2} \theta + \tan \theta \sec \theta\right) \\ &= \left(\theta (\boldsymbol{e}^{\theta}) + (1) \boldsymbol{e}^{\theta}\right) (\tan \theta + \sec \theta) + \theta \boldsymbol{e}^{\theta} (\sec^{2} \theta + \tan \theta \sec \theta) \\ &= \theta \boldsymbol{e}^{\theta} \sec \theta (\sec \theta + \tan \theta) + \boldsymbol{e}^{\theta} (\theta + 1) (\tan \theta + \sec \theta) \end{split}$$

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$$= \left(\theta \frac{d}{d\theta} \left(e^{\theta}\right) + \frac{d}{d\theta} (\theta) e^{\theta}\right) (\tan \theta + \sec \theta) + \theta e^{\theta} \left(\sec^2 \theta + \tan \theta \sec \theta\right)$$

$$= \left(\theta (e^{\theta}) + (1) e^{\theta}\right) (\tan \theta + \sec \theta) + \theta e^{\theta} (\sec^2 \theta + \tan \theta \sec \theta)$$

$$= \theta e^{\theta} \sec \theta (\sec \theta + \tan \theta) + e^{\theta} (\theta + 1) (\tan \theta + \sec \theta)$$

$$= (\theta \sec \theta + \theta + 1) e^{\theta} (\tan \theta + \sec \theta).$$

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$$\begin{split} &= \left(\theta \frac{\mathsf{d}}{\mathsf{d}\theta} \left(e^{\theta}\right) + \frac{\mathsf{d}}{\mathsf{d}\theta} (\theta) e^{\theta}\right) (\tan \theta + \sec \theta) + \theta e^{\theta} \left(\sec^2 \theta + \tan \theta \sec \theta\right) \\ &= \left(\theta (e^{\theta}) + (1) e^{\theta}\right) (\tan \theta + \sec \theta) + \theta e^{\theta} (\sec^2 \theta + \tan \theta \sec \theta) \\ &= \theta e^{\theta} \sec \theta (\sec \theta + \tan \theta) + e^{\theta} (\theta + 1) (\tan \theta + \sec \theta) \\ &= (\theta \sec \theta + \theta + 1) e^{\theta} (\tan \theta + \sec \theta). \end{split}$$