Derivatives: Logarithmic Ru

Sometimes given function does not qualify either as exponentia
example consider $f(x) = x^x$. How to find the derivative in this
approaches:

By the Definition of the Logarithm

Remember: logarithm of some b with a base a is such a numbe

$$a^{\log_a b} = b$$

Let us apply the same to the input function:

$$x^x = e^{\ln x^x} = e^{x \ln x}$$

This is manageable since it is simple composition of exponentia
Thus we get:

$$(x^x)' = (e^{x \ln x})' = e^{x \ln x} \cdot (x \ln x)' = x^x \cdot ((x)' \cdot \ln x + x \cdot$$

By logarithmic equation

Consider we have written input as:

$$y(x) = x^x$$

Then we can in advance take a logarithm of both sides:

$$\ln y(x) = x \ln x$$

Since both sides coincide, their derivatives coincide two:

$$(\ln y(x))' = \ln x + 1$$

In the left part we clearly see the composition and thus we appl

$$\frac{1}{y(x)} \cdot y'(x) = \ln x + 1$$