

Computing some differentials ... for training!

For every of the following function, you should : find and specify the domain for f , a domain where f is differentiable (by using classic results to quickly justify the differentiation, but without reproving the non-differentiability at the point you choose to remove), and then compute the derivative on this domain.

If one parameter is used in the function ($n \in \mathbb{N}^*$ or $k, a \in \mathbb{R}$ for instance), then your result could depend on the value of this parameter.

$f_1 : x \mapsto \ln(x + \sqrt{x^2 + 1}) + x^\alpha,$	$f_{11} : x \mapsto \frac{1}{4a} \ln\left(\frac{x-a}{x+a}\right) + \frac{1}{2a} \arctan \frac{x}{a},$
$f_2 : x \mapsto \ln(\sqrt{2 \sin x + 1} + \sqrt{2 \sin x - 1}),$	$f_{12} : x \mapsto \arctan 3x - x^3 1 - 3x^2,$
$f_3 : x \mapsto \arctan\left(\frac{\ln(x)}{3}\right),$	$f_{13} : x \mapsto \ln\left(\frac{\sqrt{1+x^2}-1}{\sqrt{1+x^2}+1}\right),$
$f_4 : x \mapsto e^x \arctan(e^x) - \ln(\sqrt{1+e^{2x}}),$	$f_{14} : x \mapsto \ln\left(\frac{\sqrt{1+x^4}-x^2}{\sqrt{1+x^4}+x^2}\right),$
$f_5 : x \mapsto \frac{x}{2} \sqrt{x^2+k} + \frac{k}{2} \ln(x + \sqrt{x^2+k}),$	$f_{15} : x \mapsto \sqrt{x} \arcsin(\sqrt{x}) + \sqrt{1-x},$
$f_6 : x \mapsto \frac{\sin(x)}{\cos^2(x)} + \ln\left(\frac{1+\sin(x)}{\cos(x)}\right),$	$f_{16} : x \mapsto \arcsin\left(\frac{\sin(x)}{\sqrt{1+\sin^2(x)}}\right),$
$f_7 : x \mapsto \arcsin\left(\frac{2x^2}{1+x^4}\right),$	$f_{17} : x \mapsto \arctan\left(\frac{x^x - x^{-x}}{2}\right),$
$f_8 : x \mapsto x^{(x^2)},$	$f_{18} : x \mapsto \frac{x^x}{e^x} (x \ln(x) - x - 1),$
$f_9 : x \mapsto \ln\left(\tan\left(\frac{x}{2}\right)\right) - \frac{x}{\sin(x)},$	$f_{19} : x \mapsto \log_{e^2}(x^n + \sqrt{x^{2n} + 1}),$ with $n \in \mathbb{N}^*,$
$f_{10} : x \mapsto \frac{\arctan(x)}{x} \ln\left(\frac{x}{\sqrt{1+x^2}}\right),$	$f_{20} : x \mapsto \ln(\ln(x((\ln(\ln(x) + \alpha))) - 1))),$