Mathematical Interpreting

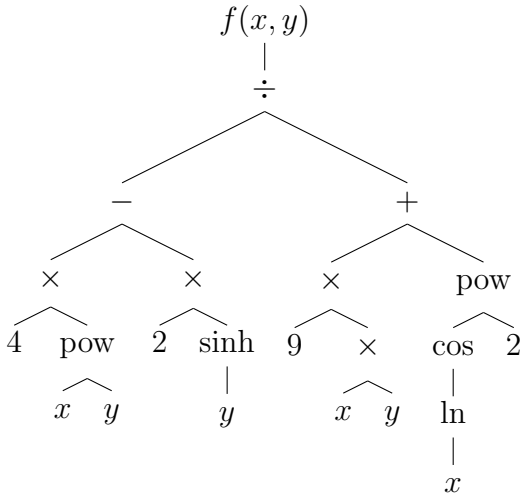
Project Summary

1 Functions

Functions are converted in tree form for manipulation and evaluation, consider the function f,

$$f(x, y) = \frac{4x^y - 2\sinh y}{9xy + \cos^2 \ln x}$$

the equivalent function tree is,



2 Parsing

3 Differentiation

For differentiable function f, g, h, with derivatives f', g', h', we can derive patterns for the differentials of our operations of addition, subtraction, multiplication, division and exponentiation.

3.1 Addition/Subtraction

$$f = g \pm h \implies f' = g' \pm h'$$

3.2 Multiplication

$$f = gh$$
$$\therefore f' = g'h + gh'$$

3.3 Division

$$
\begin{aligned}
f &= \frac{g}{h} \\
&= gh^{-1} \\
\therefore f' &= g'h^{-1} - gh'h^{-2} \\
&= \frac{g'h - gh'}{h^2}
\end{aligned}
$$

3.4 Exponentiation

$$
\begin{aligned}
f &= g^h \\
\therefore \ln f &= h \ln g \\
\frac{f'}{f} &= h' \ln g + h\frac{g'}{g} \\
f' &= g^h\Big(h' \ln g + h\frac{g'}{g}\Big)
\end{aligned}
$$

4 Simplification

$$
\begin{aligned}
0 \times f &= f \times 0 = 0 \\
1 \times f &= f \times 1 = f \\
0 + f &= f + 0 = f \\
f - 0 &= f \\
0 - f &= -1 \times f \\
\frac{f}{1} &= f
\end{aligned}
$$