Precalculus
A useful inverse hyperbolic function identity

Todor Milev

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The inverse hyperbolic function $\operatorname{arcsinh} = \ln\left(x + \sqrt{1 + x^2}\right)$ is used when studying hyperbolas (types of curves in the plane).

Example

Demonstrate that $-\ln\left(\sqrt{1 + x^2} - x\right) = \ln\left(x + \sqrt{1 + x^2}\right)$.

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$$
\begin{aligned}
-\ln\left(\sqrt{1+x^2}-x\right) &= \ln\left(\frac{1}{\sqrt{x^2+1}-x}\right) && \Big|\ \text{rationalize}\\
&= \ln\left(\frac{\left(\sqrt{x^2+1}+x\right)}{\left(\sqrt{x^2+1}-x\right)\left(\sqrt{x^2+1}+x\right)}\right)\\
&= \ln\left(\frac{\sqrt{x^2+1}+x}{x^2+1-x^2}\right)\\
&= \ln\left(\sqrt{x^2+1}+x\right) \quad .
\end{aligned}
$$