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sin( ) — Trigonometric and hyperbolic functions

Description Syntax Conformability Diagnostics Also see

Description

`sin(`Z`)`, `cos(`Z`)`, and `tan(`Z`)` return the appropriate trigonometric functions. Angles are measured in radians. All return real if the argument is real and complex if the argument is complex.

`sin(`x`)`, x real, returns the sine of x. `sin()` returns a value between -1 and 1.

`sin(`z`)`, z complex, returns the complex sine of z, mathematically defined as $\{\exp(i*z) - \exp(-i*z)\}/2i$.

`cos(`x`)`, x real, returns the cosine of x. `cos()` returns a value between -1 and 1.

`cos(`z`)`, z complex, returns the complex cosine of z, mathematically defined as $\{\exp(i*z) + \exp(-i*z)\}/2$.

`tan(`x`)`, x real, returns the tangent of x.

`tan(`z`)`, z complex, returns the complex tangent of z, mathematically defined as $\sin(z)/\cos(z)$.

`asin(`Z`)`, `acos(`Z`)`, and `atan(`Z`)` return the appropriate inverse trigonometric functions. Returned results are in radians. All return real if the argument is real and complex if the argument is complex.

`asin(`x`)`, x real, returns arcsine in the range $[-\pi/2, \pi/2]$. If $x < -1$ or $x > 1$, missing (.) is returned.

`asin(`z`)`, z complex, returns the complex arcsine, mathematically defined as $-i * \ln\{i*z + \text{sqrt}(1 - z*z)\}$. Re(asin( )) is chosen to be in the interval $[-\pi/2, \pi/2]$.

`acos(`x`)`, x real, returns arccosine in the range $[0, \pi]$. If $x < -1$ or $x > 1$, missing (.) is returned.

`acos(`z`)`, z complex, returns the complex arccosine, mathematically defined as $-i * \ln\{z + \text{sqrt}(z*z - 1)\}$. Re(acos( )) is chosen to be in the interval $[0, \pi]$.

`atan(`x`)`, x real, returns arctangent in the range $(-\pi/2, \pi/2)$.

`atan(`z`)`, z complex, returns the complex arctangent, mathematically defined as $\ln\{(1 + iz)/(1 - iz)\}/(2i)$. Re(atan( )) is chosen to be in the interval $[0, \pi]$.

`atan2(`X`, `Y`)` returns the radian value in the range $(-\pi, \pi]$ of the angle of the vector determined by (X,Y), the result being in the range $[0, \pi]$ for quadrants 1 and 2 and $[0, -\pi)$ for quadrants 4 and 3. X and Y must be real. `atan2(`X`, `Y`)` is equivalent to `arg(C(`X`, `Y`))`.

`arg(`Z`)` returns the arctangent of Im(Z)/Re(Z) in the correct quadrant, the result being in the range $(-\pi, \pi]$; $[0, \pi]$ in quadrants 1 and 2 and $[0, -\pi)$ in quadrants 4 and 3. `arg(`Z`)` is equivalent to `atan2(Re(`Z`), Im(`Z`))`.

`sinh(`Z`)`, `cosh(`Z`)`, and `tanh(`Z`)` return the hyperbolic sine, cosine, and tangent, respectively. The returned value is real if the argument is real and complex if the argument is complex.

sinh(*x*), *x* real, returns the inverse hyperbolic sine of *x*, mathematically defined as $\{\exp(x) - \exp(-x)\}/2$.

sinh(*z*), *z* complex, returns the complex hyperbolic sine of *z*, mathematically defined as $\{\exp(z) - \exp(-z)\}/2$.

cosh(*x*), *x* real, returns the inverse hyperbolic cosine of *x*, mathematically defined as $\{\exp(x) + \exp(-x)\}/2$.

cosh(*z*), *z* complex, returns the complex hyperbolic cosine of *z*, mathematically defined as $\{\exp(z) + \exp(-z)\}/2$.

tanh(*x*), *x* real, returns the inverse hyperbolic tangent of *x*, mathematically defined as $\sinh(x)/\cosh(x)$.

tanh(*z*), *z* complex, returns the complex hyperbolic tangent of *z*, mathematically defined as $\sinh(z)/\cosh(z)$.

asinh(*Z*), acosh(*Z*), and atanh(*Z*) return the inverse hyperbolic sine, cosine, and tangent, respectively. The returned value is real if the argument is real and complex if the argument is complex.

asinh(*x*), *x* real, returns the inverse hyperbolic sine.

asinh(*z*), *z* complex, returns the complex inverse hyperbolic sine, mathematically defined as $\ln\{z + \text{sqrt}(z * z + 1)\}$. $\text{Im}(\text{asinh}())$ is chosen to be in the interval $[-\pi/2, \pi/2]$.

acosh(*x*), *x* real, returns the inverse hyperbolic cosine. If $x < 1$, missing (.) is returned.

acosh(*z*), *z* complex, returns the complex inverse hyperbolic cosine, mathematically defined as $\ln\{z + \text{sqrt}(z * z - 1)\}$. $\text{Im}(\text{acosh}())$ is chosen to be in the interval $[-\pi, \pi]$; $\text{Re}(\text{acosh}())$ is chosen to be nonnegative.

atanh(*x*), *x* real, returns the inverse hyperbolic tangent. If $|x| > 1$, missing (.) is returned.

atanh(*z*), *z* complex, returns the complex inverse hyperbolic tangent, mathematically defined as $\ln\{(1 + z)/(1 - z)\}/2$. $\text{Im}(\text{atanh}())$ is chosen to be in the interval $[-\pi/2, \pi/2]$.

pi() returns the value of π.

Syntax

numeric matrix `sin(`*numeric matrix Z*`)`

numeric matrix `cos(`*numeric matrix Z*`)`

numeric matrix `tan(`*numeric matrix Z*`)`

numeric matrix `asin(`*numeric matrix Z*`)`

numeric matrix `acos(`*numeric matrix Z*`)`

numeric matrix `atan(`*numeric matrix Z*`)`

real matrix `atan2(`*real matrix X*`,` *real matrix Y*`)`

real matrix `arg(`*complex matrix Z*`)`

numeric matrix `sinh(`*numeric matrix Z*`)`

numeric matrix `cosh(`*numeric matrix Z*`)`

numeric matrix `tanh(`*numeric matrix Z*`)`

numeric matrix `asinh(`*numeric matrix Z*`)`

numeric matrix `acosh(`*numeric matrix Z*`)`

numeric matrix `atanh(`*numeric matrix Z*`)`

real scalar `pi()`

Conformability

`atan2(`*X*`,` *Y*`)`:

X:	$r_1 \times c_1$
Y:	$r_2 \times c_2$, *X* and *Y* r-conformable
result:	`max(`r_1`,`r_2`)` $\times$ max(c_1,c_2)

`pi()` returns a 1×1 scalar.

All other functions return a matrix of the same dimension as input containing element-by-element calculated results.

Diagnostics

All functions return missing for real arguments when the result would be complex. For instance, `acos(2) = .`, whereas `acos(2+0i) = -1.317i`.

Also see

[M-4] **scalar** — Scalar mathematical functions