UNIVERSITÉ Concordia UNIVERSITY

SOEN 6011 : SOFTWARE ENGINEERING PROCESSES
SUMMER 2021

SUPER CALCULATOR

PROBLEM - 1
Function Description

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Contents

Description of Functions

PROBLEM 1 - F2: $tan(x)$

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Repository address : https://github.com/Dakatsu/SOEN6011Calculator

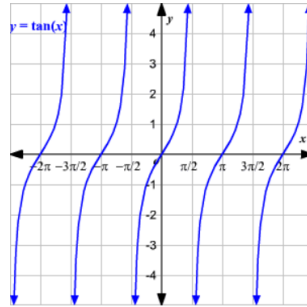## Tangent Function, $tan(x)$

[1] $tan(x)$ is a trigonometric function. There are many uses of tangent function for example, to find the slope of straight lines etc. By using the Unit circle, one can easily understand the tangent function. Moreover, in unit circle, one line is at the positive x-axis and the x coordinate intersects the circle is at $cos(x)$ and y coordinate intersects is at $sin(x)$. so, The tangent function is define as below:

$$tan(x) = \frac{sin(x)}{cos(x)}$$

Graph

Graph of tangent function $(tan(x))$

[1] The tangent function is undefined when $x = \pi\ /\ 2\ +\ n\pi$ (where, n is integer) for which, $cos(x) = 0$. However, Tangent function does not have an amplitude. Inaddition, The graph intercept x-axis at $n\pi$ (where n is integer) and in y-axis at $(0,0)$ point. The period of tangent function is π.

Range

The range of $tan(x)$ is all real number $\mathbb{R}$, $(-\infty, +\infty)$.

Domain and Co-domain

The domain of tangent function is $x \in \mathbb{R}$, $x \neq \pi\ /\ 2 + n\pi$ where, n is an integer. The co-domain of $tan(x)$ is $(-\infty, +\infty)$.

Bibliography

[1] Malambo, Priestly. "Pre-Service Mathematics Teachers' Nature of Understanding of the Tangent Function." Journal of Research and Advances in Mathematics Education 5.2 (2020): 105-118.

PROBLEM 1 - F3: Hyperbolic Sine, $sinh(x)$

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The function $sinh(x)$ is known as the hyperbolic sine, and it has the following formula [1].

$$sinh(x) \equiv \frac{1}{2}(e^x - e^{-x})$$

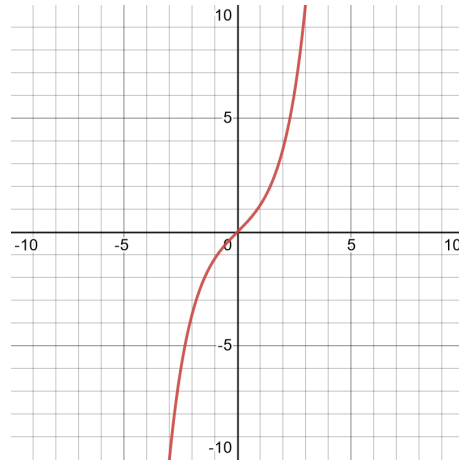The character x is the only variable, as e is a constant roughly equivalent to 2.71828 [4].

Figure 1: A graph of $y = sinh(x)$ generated from Desmos.com

Both the domain and co-domain of $sinh(x)$ is $\mathbb{R}$, i.e. (-∞, +∞). Positive values of x trend toward +∞, negative values of x trend toward -∞, and an input of 0 outputs 0.

Just as the trigonometric functions sine and cosine relate to a unit circle [3], their hyperbolic equivalents relate to the right branch of a unit hyperbola [2]. The x-coordinate of the right branch of the hyperbola at a given hyperbolic angle a can be calculated with $cosh(a)$, and $sinh(a)$ will return the y-coordinate [5].

Bibliography

[1] Hyperbolic Sine, Wolfram MathWorld.
   http://mathworld.wolfram.com/HyperbolicSine.html

[2] Hyperbolic Functions, Wolfram MathWorld.
   http://mathworld.wolfram.com/HyperbolicFunctions.html

[3] Circular Functions, Wolfram MathWorld.
   http://mathworld.wolfram.com/CircularFunctions.html

[4] e, Wolfram MathWorld.
   http://mathworld.wolfram.com/e.html

[5] Rectangular Hyperbola, Wolfram MathWorld.
   https://mathworld.wolfram.com/RectangularHyperbola.html

PROBLEM 1 - F5

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$y = a^x$ is called an exponential function, and it is one of the important basic elementary functions. For $y = ab^x$, a is a real number, b^x is an exponential function, and a can be regarded as a scaling factor of the exponential function.

PROBLEM 1 - F7 : x^y

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Definition of x^y

[1] Exponentiation is a mathematical operation, denoted as x^y, If y is a positive integer and x is any real number, then x^y corresponds to repeated multiplication.

$$x^y = x*x*x*.....*x \text{ of y times}$$

The expression can be called as "x raised to the power of y," "x to the power of y," or simply "x to the y." Here, x is the base and y is the exponent or the power.

Domain

[2] All the real numbers from -infinite to +infinite.($-\infty$ to ∞)

$$(x, y) \in \mathbb{R}^2 : (x \geq 0 \wedge y \neq 0) \vee x > 0$$

Co-domain

A set of all positive real numbers from zero to infinite (0 to ∞) is known as the Exponentiation function

Characteristics

Graph -

[2][3] The **rate of change** increases (or decreases) across the graph in an exponential graph.

- ⋆ The exponential graph crosses the y-axis at (0,1).

- ⋆ The exponential graph increases, when x > 1.

- ⋆ The exponential graph decreases, when 0 < x < 1.

- ⋆ The exponential graph is asymptotic to the x-axis - gets very, very close to the x-axis but, in this case, does not touch it or cross it.
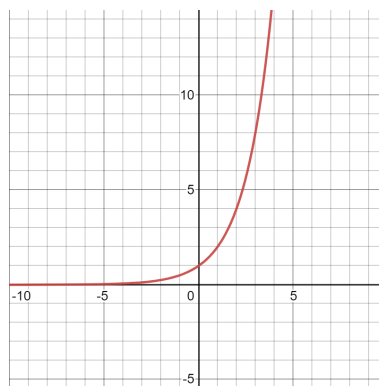
Graph crosses the y-axis at (0,1)

Bibliography

[1] Nykamp DQ: Basic rules for exponentiation
    `https://mathbitsnotebook.com/Algebra2/Exponential/EXExpFunctions.html`

[2] MathBits Teacher: Exponential Functions,
    `https://mathbitsnotebook.com/Algebra2/Exponential/EXExpFunctions.html`

[3] WolframAlpha: Domain of exponentiation function,
    `https://www.wolframalpha.com/input/?i=x%5Ey`

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Context of Use Model

The users of the calculator shall be using it to calculate the result of one of the four functions on a number. This number shall be an integer or decimal, so the digits *0-9* and the decimal point must be enterable by the user. The user shall be able to select the appropriate function they wish to use, and they shall be able to press a key or button to indicate that they have finished inputting the number and wish to have the answer computed.