Mathematical Expressions in KiTTy

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Contents

1 Overview

KiTTy supports a beautiful representation of mathematical expressions. Look at the example below.

$$f(r) = \pi r^2$$

You can easily insert mathematical expressions like this into your document.

If you use it inline, use `$\\pi$` as wrapping around an expression by `$` and you can see π in the sentense. Note that a backslash should be double in this case.

If you want to use it in the independent line, use ``` with `math` as below.

````
```math
f(r) = \pi r^2
```
````

By this manner, you can see mathematical expressions as a big size in the independent line.

In fact, KiTTy has KaTeX inside. Thereby, all of mathematical expressions that KaTeX can do is available. To present a beautiful mathematical expression allows for expressive writing.

2 Various Samples of Mathematical Expressions

Let's introduce some of famous expressions and fomulas.

2.1 Pythagorean Theorem

When the length of the hypotenuse of a right triangle is c and the length of other sides are a and b, then the following equation holds.

$$a^2 + b^2 = c^2$$

This is very famous formula, and there are so many ways to prove it on [Wikipedia].

```
a^2 + b^2 = c^2
```

2.2 Euler's Identity

It is a very beautiful mathematical expression containing the Napier number e, the imaginary number i, pi π and the famous constant.

$$e^{i\pi} + 1 = 0$$

You can write it as below.

```
e^{i\pi} + 1 = 0
```

2.3 Euler's Formula

This is a formula that is often used when solving differential equations.

$$e^{i\theta} = \cos\theta + i \sin\theta$$

Trigonometric functions are also supported. If you write `$\\sin\\theta$`, `$\\cos\\theta$`, `$\\tan\\theta$`, it will be represented as $\sin\theta$, $\cos\theta$, $\tan\theta$. Regarding Greek letters such as α, β, γ, etc., capitalized Greek letters are shown like Θ if making the first letter capitalized such as `\Theta`. You can write it as below.

```
e^{i\theta} = \cos\theta + i \sin\theta
```

2.4 Normal Distribution (Gauss Distribution)

A normal distribution with μ as the mean and $\sigma^2 > 0$ as the variance is a probability distribution which probability density function is given by the following formula.

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$

This is an important formula in the field of statistics. This equation is gives a beautiful bel-l-shaped curve on the graph. It is characterized that $\mu \pm \sigma$ is an inflection point.

```
f(x) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}
```

2.5 Gaussian Integral

The Gaussian integral, or the Euler – Poisson integral.

$$\int_{-\infty}^{\infty} f(x)dx = \sqrt{\pi}$$

An integral symbol, it is what you want to write as a mathematical expression. I believe that is why we use LaTeX (just my guess). You can write it as follows.

```
\int_{-\infty}^{\infty} f(x) dx = \sqrt{\pi}
```

2.6 Harmonic Number

The n-th harmonic number is the sum of the reciprocals of the first n natural numbers:

$$\frac{1}{1} + \frac{1}{2} + \frac{1}{3} + \dots = \displaystyle\sum_{i=1}^\infty \frac{1}{n}= \infty$$

Strangely enough, when you add fractions to the limit, they diverge. Like Euler's Identity, many people might be into mathematics by seeing such mysterious properties.

```
\frac{1}{1} + \frac{1}{2} + \frac{1}{3} + \dots
  = \displaystyle\sum_{i=1}^\infty \frac{1}{n}= \infty
```

2.7 Basel Problem

The Basel problem is one of the problems of series, which is how many is the sum of all the reciprocals of a square number.

$$\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots = \displaystyle\sum_{i=1}^\infty \frac{1}{n^2}= \frac{\pi^2}{6}$$

It is similar to the harmonic numbers, but for some reason it converges just by making the denominator a square numer. I wonder why. It is interesting. It can be written as follows.

```
\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots
  = \displaystyle\sum_{i=1}^\infty \frac{1}{n^2}= \frac{\pi^2}{6}
```

2.8 Riemann Zeta Function

It is the general form of the Basel problem, and it is the Basel problem when $s = 2$.

$$\zeta(s) = 1 + \frac{1}{2^s} + \frac{1}{3^s} + \dots = \displaystyle\sum_{i=1}^\infty \frac{1}{n^s}$$

It reached to the famous Riemann hypothesis "The real part of every nontrivial zero of the Riemann zeta function is $\frac{1}{2}$."

```
\zeta(s)
  = 1 + \frac{1}{2^s} + \frac{1}{3^s} + \dots
  = \displaystyle\sum_{i=1}^\infty \frac{1}{n^s}
```

2.9 Matrix

Let's express a Matrix.

$$A = \left(\begin{array}{cccc} a_{11} & a_{12} & \ldots & a_{1n} \\ a_{21} & a_{22} & \ldots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \ldots & a_{mn} \end{array} \right)$$

The dots used in the previous harmonic numbers, etc., can also be arranged horizontally and vertically like this to represent a matrix. It can be written as follows

```
A =
    \left(
    \begin{array}{cccc}
        a_{11} & a_{12} & \ldots & a_{1n} \\
        a_{21} & a_{22} & \ldots & a_{2n} \\
        \vdots & \vdots & \ddots & \vdots \\
        a_{m1} & a_{m2} & \ldots & a_{mn}
    \end{array}
    \right)
```