



PEMDAS

User Guide

For PEMDAS, Version 0.2.4

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<http://www.donkeyengineering.com/pemdasapp/>

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PEMDAS Overview

PEMDAS is a simple but powerful calculator for scientists, engineers, students, and other professions to use when working on problems with equations.

PEMDAS stands for Parenthesis, Exponents, Multiplication, Division, Addition, and Subtraction, an acronym sometimes taught to children to help them remember the order of operations.

Keep in mind that this application is still under development. It should be stable, but it may not be feature rich in some areas. If there is a feature you would like to see, or if you find a bug, please provide feedback at <http://www.donkeyengineering.com/pemdasapp/>.

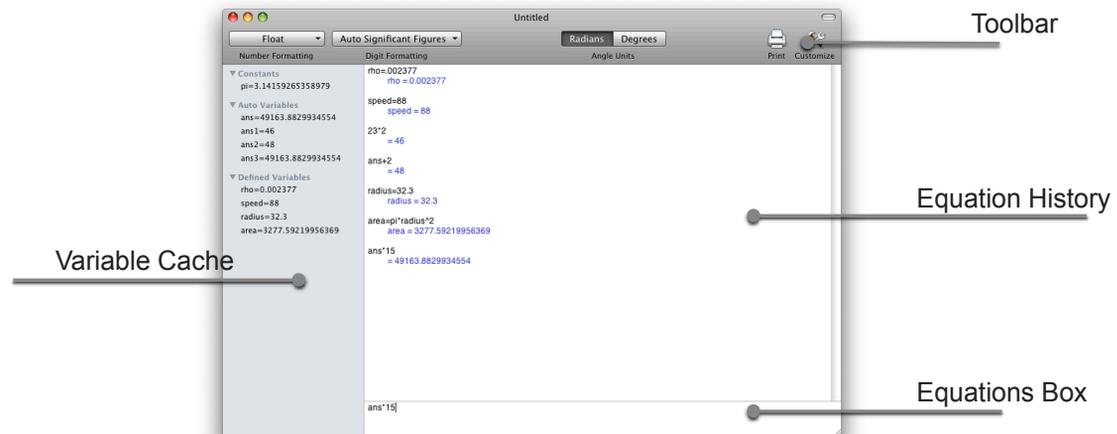
Requirements

To use PEMDAS, you must have:

- a Mac computer with an Intel or PowerPC processor.
- Mac OS X v10.5.6 Leopard or later.
- 5 MB of available disk space.

The User Interface

The PEMDAS interface is relatively simple. Note that the current interface is primarily for development, and will eventually be replaced.



Variable Cache

The variable cache shows all the defined variables in the document.

Equations Box

This text box is where you type your equation. When you want it to be calculated, hit the “return” key on your keyboard. To make the box bigger, drag the line on the top of the box.

Equation History Box

The equation history box shows all the equations you’ve calculated, and their results.

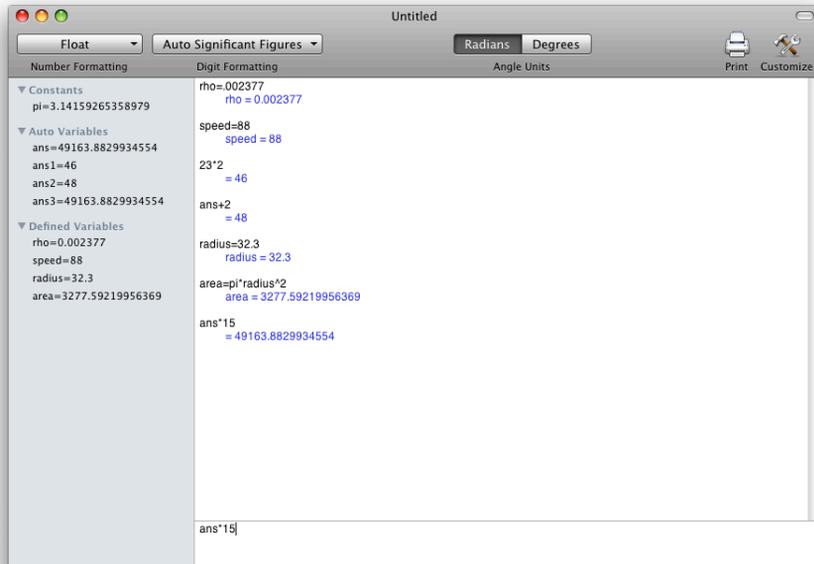
Toolbar

The toolbar contains several useful buttons. You can customize the look of the toolbar by right clicking on it and selecting “Customize Toolbar”.

Features Overview

Variable Cache

On the side of the application is the variable cache. This lets you easily see all of the variables active in the current document.



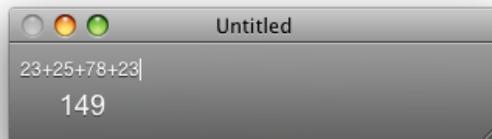
Number Formatting

PEMDAS has several different kinds of number formatting, including float, scientific, engineering, percents, binary, octal, and hexadecimal . It also lets you limit the number of decimals or significant figures to display, and lets you add thousands separators.

See the [Number Formatting](#) section for more information.

Mini Window

PEMDAS can resize into a much smaller window for quick calculations, or for typing in data from other applications. Click on green zoom button in the upper left hand corner of the window to use this feature.



Cocoa Based

PEMDAS is written in Objective-C, and the interface is composed of standard Cocoa controls. This way, you get the benefits of a Cocoa application, such as customizable toolbars, and text areas that behave in a standard fashion. It is also a universal binary, and it has drag and drop installation.

For additional information on how the application is written, see the [Technical Details](#) section.

Equations

Typing Equations

You can type equations in the Equations Box. You can type multiple equations if you separate them with a semicolon. * (see below) When you are finished and want to calculate the equation, hit the enter (or return) key.

Equation Syntax

Following are some syntax examples For information on how equations are calculated, see the [Order of Operations](#) section.

Multiple Equations * (see below)

Multiple equations can be typed on the same line. Simply separate them with a semicolon.

Example:

$3+2;$ $4+5;$

Equals Sign

The equals sign equates one side of an equation to the other.

Example:

$a=27+2$

**Development Note: separating equations with a semicolon is currently disabled while the calculation engine undergoes changes. It will be re-enabled in the next release (Version 0.3).*

Order of Operations

Order of operations is calculated left to right, in the following order:

- 1) Parenthesis
- 2) Exponents ¹
- 3) Multiplication or Division
- 4) Addition or Subtraction

¹ Exponents are calculated right to left. See the [Exponents Calculation](#) section below for an explanation.

Exponents

Exponents are a special case of order of operations – they are evaluated right to left, rather than left to right.

To understand why, take for example if you typed 2^3^2 . This would translate visually to:

$$2^{3^2}$$

When calculating the answer, you would first calculate 3^2 , so it would look like:

$$2^{3^2} = 2^9$$

By doing this, you are calculating from right to left. However, if you started calculating from left to right, you would calculate 2^3 first, which is not correct:

$$2^{3^2} \neq 8^2$$

It should be noted that many other math programs and handheld calculators do not follow this rule, and incorrectly calculate answers.

Typing Binary, Octal, and Hexadecimal Numbers

PEMDAS inputs numbers in base 10. However, you can also enter binary, octal, and hexadecimal numbers by using the following prefixes, which are case insensitive:

- **0b**: Binary number prefix.
- **0o**: Octal number prefix.
- **0x**: Hexadecimal number prefix.

After you input a number, you can also format the outputted number. For more information on how to do this, see the [Number Formatting](#) section.

Examples

Binary numbers (note the answers are shown in base 10):

$$\begin{aligned} &0b0101 \\ &= 5 \end{aligned}$$

$$\begin{aligned} &0b1111 \\ &= 15 \end{aligned}$$

Octal numbers (note the answers are shown in base 10):

$$\begin{aligned} &0o77 \\ &= 63 \end{aligned}$$

$$\begin{aligned} &0o100 \\ &= 64 \end{aligned}$$

Hexadecimal numbers (note the answers are shown in base 10, and also note that the hexadecimal number itself is case insensitive):

$$\begin{aligned} &0xFF \\ &= 255 \end{aligned}$$

$$\begin{aligned} &0x1a \\ &= 26 \end{aligned}$$

Note that you can use different bases in the same equation:

$$\begin{aligned} &0xFF - 0b10100110 \\ &= 89 \end{aligned}$$

$$\begin{aligned} &0o27 * 0x1B + 0b10 \\ &= 623 \end{aligned}$$

Supported Functions

Trigonometric Functions

For trigonometric functions, you can set whether you want to work in Radians or Degrees. Setting the working mode to radians or degrees can be done in the toolbar, and it can also be set within the PEMDAS Preferences.



Be careful, radians is selected by default.

Available functions:

- **sin**(*x*) = Sine of *x*.
- **cos**(*x*) = Cosine of *x*.
- **tan**(*x*) = Tangent ($\sin(x)/\cos(x)$) of *x*.
- **csc**(*x*) = Cosecant ($1/\sin(x)$) of *x*.
- **sec**(*x*) = Secant ($1/\cos(x)$) of *x*.
- **cot**(*x*) = Cotangent ($1/\tan(x)$) of *x*.
- **asin**(*x*) = Arcsin of *x*.
- **acos**(*x*) = Arccos of *x*.
- **atan**(*x*) = Arctan of *x*.
- **atan2**(*y*, *x*) = Arctan of *y* and *x*, where *y* and *x* are coordinates of the angle vector. This bypasses the quadrant limitations of **atan**(), and returns an angle from $-\pi$ to π (-180° to 180°).

Hyperbolic Functions

Note: if you are working in degrees, *x* will be converted to radians before calculation. i.e., in degree mode, $\sinh(90)$ will be evaluated as $\sinh(\pi/2)$.

- **sinh**(*x*) = Hyperbolic sine of *x*.
- **cosh**(*x*) = Hyperbolic cosine of *x*.
- **tanh**(*x*) = Hyperbolic tangent of *x*.
- **csch**(*x*) = Hyperbolic cosecant ($1/\sinh(x)$) of *x*.

- **sech**(x) = Hyperbolic secant ($1/\cosh(x)$) of x .
- **coth**(x) = Hyperbolic cotangent ($1/\tanh(x)$) of x .

Exponential & Logarithmic Functions

Depending on PEMDAS preferences, these functions may change.

- **exp**(x) = Notation for raising e to the x .
- **ln**(x) = Natural log of x .
- **log**(x) = Log base 10 of x .

Other Functions

- **sqrt**(x) = Takes the square root of x .

Variables

PEMDAS has support for variables. You can assign the result of any equation to a variable.

Defining a Variable

You can set a variable using the equals operator; anything to the left of the equals is the variable, to the right of the variable is what the variable is assigned. So typing:

```
myVariable=3+5  
myVariable = 8
```

will set the variable `myVariable` to 8. You can then use `myVariable` in any equation as follows:

```
myVariable*2  
= 16
```

All variables you define will show up in the [variable cache](#).

Auto-Cached Variables

If you calculate an equation, and you do not assign the result to a variable, PEMDAS will automatically assign the result to a variable.

All the auto-cached variables are named `ans1`, `ans2`, `ans3`, etc., and will show up in the variable cache. Note that if you assign a variable 'ans3' to a number before PEMDAS is at 'ans3', PEMDAS will skip over it and go to the next available variable name in the auto-cache format.

The 'ans' Variable

The 'ans' variable is not actually a variable. Instead, it acts like a shortcut to typing the previous result. For example, if you calculate :

```
3+2  
= 5
```

PEMDAS will automatically assign the result of 5 to an auto-cached variable (in this example, assume the auto-cached variable is `ans1`). Now, if you were to calculate another equation, since the last result is `ans1`, typing something like `ans*2` is exactly

equivalent to typing `ans1*2`. In fact, PEMDAS will automatically replace the `ans` variable with the `ans1` variable when listing the equation in the equation history field.

This feature will also work when assigning a variable. So if you calculated:

```
myVariable=7*5  
= 35
```

Now typing `ans*3` would be equivalent to typing `myVariable*3`.

Variable Names

Variable names are case sensitive, must be alphanumeric (A-Z, a-z, 0-9), and cannot start with numbers.

Locked Variables

Some variables, like 'ans' and 'pi', are locked, so you can't assign them anything. All function names (sin, exp, etc.) are also locked.

Number Formatting

In PEMDAS, there are several different ways to format numbers and answers. Note that formatting does not change the actual number, it only changes what appears on the screen. In other words, if you have the significant figure precision set to 2, the number 5.4321 will be displayed as 5.4. However, all calculations will use the 5.4321 value.

Formatting Types

There are several different ways that PEMDAS can format answers:

- **Float:** Leaves the number alone.
- **Scientific:** Puts the number in scientific notation.
- **Engineering:** Puts the number in engineering notation, which is similar to scientific except the exponents are shown in multiples of 3. This is very convenient when working in Metric.
- **Percent:** Puts the number into “percent” form, which is similar to Float, except the number has been multiplied by 100.
- **Binary:** Puts the number into binary (base 2) form. The number is prefixed with 0b. ¹
- **Octal:** Puts the number into octal (base 8) form. The number is prefixed with 0o. ¹
- **Hexadecimal:** Puts the number into hexadecimal (base 16) form. The number is prefixed with 0x. ¹

¹ Note that when Binary, Octal, or the Hexadecimal formatting is applied to a non-integer number, it will be floored prior to formatting. When this happens, a (Floored) notice will appear after the number. See [below](#) for examples.

Examples

Using the Float preference:

```
123456.78  
= 123456.78
```

```
0.012345  
= 0.012345
```

Using the Scientific preference:

```
123456.78  
= 1.2345678e5
```

$$0.012345 \\ = 1.2345e-2$$

Using the Scientific preference, with decimal places limited to 4 (see the [Decimal Places](#) below for more information on limiting decimal places):

$$123456.78 \\ = 1.235e5$$

$$0.012345 \\ = 1.235e-2$$

Using the Engineering preference.

$$123456.78 \\ = 123.45678e3$$

$$0.012345 \\ = 12.345e-3$$

Using the Engineering preference, with decimal places limited to 4, and the “Add Zeros To Show Exactly This Amount” not selected (see the [Decimal Places](#) section for more information on limiting decimal places):

$$123456.78 \\ = 123.4568e3$$

$$0.012345 \\ = 12.345e-2$$

Using the Percentage preference, and [Thousands Separators](#) enabled:

$$123456.78 \\ = 12,345,678\%$$

$$0.012345 \\ = 1.2345\%$$

Using the Binary preference:

123456.78
= 0b0001 1110 0010 0100 0000 (Floored)

0.012345
= 0b0 (Floored)

255
= 0b1111 1111

64
= 0b0100 0000

Using the Octal preference:

123456.78
= 0o361100 (Floored)

0.012345
= 0o0 (Floored)

255
= 0o377

64
= 0o100

Using the Hexadecimal preference:

123456.78
= 0x1E240 (Floored)

0.012345
= 0x0 (Floored)

255
= 0xFF

64
= 0x40

Significant Figures

You can limit the amount of significant figures that are displayed. If the number has fewer significant figures than the amount you specify, PEMDAS will leave the number alone.

Example

With significant figures being limited to 4 significant figures:

$$123456.78 \\ = 123500$$

$$0.012345 \\ = 0.01235$$

$$0.012 \\ = 0.012$$

Decimal Places

You can limit the amount of decimals to be displayed. With the “Add Zeros To Show Exactly This Amount” preference selected, PEMDAS will add additional zeros to the number to show exactly that amount of zeros. This preference can be useful when dealing with things like money.

Examples

With decimal places being limited to 4 decimal places, and the “Add Zeros To Show Exactly This Amount” option selected:

$$123456.78 \\ = 123456.7800$$

$$0.012345 \\ = 0.0123$$

$$0.012 \\ = 0.0120$$

$$0.000012 \\ = 0.0000$$

With decimal places being limited to 4 decimal places, and the “Add Zeros To Show Exactly This Amount” option not selected:

123456.78
= 123456.78

0.012345
= 0.0123

0.012
= 0.012

0.000012
= 0

Thousands Separators

Thousand separators are only available when the number is formatted as a Float or a Percent. Currently, only commas are available as a thousands separator.

Example

123456.78
= 123,456.78

Release Notes

Following are the release notes for each release:

Version 0.2 Series

Version 0.2.4 (March 19, 2009)

- Increased speed of the calculation engine.
- Fixed a bug where nothing would happen after pressing 'enter' with certain equations.
- Changed the way the ans variable works, so now it is just a shortcut to the previous result, rather than an actual variable.
- Added a cube root function, accessible by typing `cbt()`.

Version 0.2.3 (January 30, 2009)

- Renamed the app back to "PEMDAS".
- Added application preferences for the thousands separator character, and exponent character.
- Modified the toolbar preferences, so now they enable and disable automatically, depending on what preference is set.
- Unlocked "e" and "E" to use as variables (note that PEMDAS doesn't support implicit multiplication, so $1.23e24$ still means $1.23 \cdot 10^{24}$).

Version 0.2.2 (January 17, 2009)

- Renamed the app to "Equations", and changed the icon.
- Added support for binary, octal, and hexadecimal numbers:
 - Added ability to input numbers by using the "0b" prefix for binary numbers, "0o" for octal, and "0x" for hexadecimal.
 - Added Binary, Octal, and Hexadecimal output formatting types.
- Revised the decimal place number formatting, to allow either the exact amount of decimal places to be shown by adding zeros, or just to limit the number of decimal places displayed.
- Added a Percentage output formatting type.
- Fixed a bug in the variable cache where it wouldn't scroll vertically.

Version 0.2.1 (December 22, 2008)

- Divided up the variable cache to separate different types of variables.
- Added the ability to scroll previous formulas by pressing option + up/down arrows.
- Added the ability to insert variables from variable cache by clicking on the variable while holding the option key.
- Added a mini mode, accessible by clicking on the green “zoom” button in the upper left corner of the window.
- Changed the formula entering box so it now automatically inserts the ans variable if you just type an operator after calculating a formula.

Version 0.2 (November 18, 2008)

- Finally updated the program.
- Renamed the application from Super PEMDAS to Formulas, updated links to point to the new website, updated the documentation.
- Incorporated latest revision of the Formulas calculation engine (which is faster and has a lot of bug fixes).
- The toolbar now autosaves the configuration it is in.

Version 0.1 Series

Version 0.1 (December 20, 2007)

- Initial release.

Technical Details

Overview

From a development point of view, there are two primary components of PEMDAS: the user interface and the calculation engine. Both portions are written in Objective-C.

The User Interface

The user interface design is based on standard Mac OS X controls, and the design process tries to follow the recommendations of the [Apple Human Interface Guidelines](#).

A lot of time is spent trying to simplify and increase the speed that you spend working on problems, and communicating useful data and feedback on the calculations.

The Calculation Engine

The calculation engine is the portion of the program which handles all the equations, formatting, and variables. It is proprietary and closed-source.

History

Development was started on the engine in early 2006 using Javascript. It went through several releases as part of the PEMDAS Dashboard widget, and in early 2007 it was ported to Objective-C. In mid-2007, to speed up the development process, it was made Leopard-only. In 2008, the calculation engine was fine tuned to run on the iPhone/iPod Touch platform, and was heavily modified to take advantage of Objective C 2.0 features. This increases its speed and allows for for greater expandability in the future.

Design Goals

The goal of the calculation engine is not to be computationally fast (although that is a secondary goal). Instead it is intended to be fast and easy to work with from a user point of view.

Precision

The calculation engine uses double (64 bit) precision, which can hold approximately 16 decimals and has upper/lower bounds of approximately $\pm 10^{309}$.

The User Guide

The PEMDAS User Guide is written in [Pages '08](#) in Word Processing mode. The body font used is Arial, 10 point, 90% black, with 1.1 line spacing. Arial is also used for the various headers, and Courier is used as a code font. An attempt was made to follow the [Apple Publications Style Guide](#).