JANUARY 01, 2015 | COMMENTS

Advanced Math Calculation in Bash using GNU bc

In this post, we will cover how to do advanced arithmetic and write your own functions with *GNU bc (https://www.gnu.org/software/bc)*.

If you are looking at doing basic arithmetic in a *bash* shell or using *bc*, you should take a look at my older post about Performing Math Calculation in Bash (/2010/06/14/performing-math-calculation-in-bash/).

About GNU bc

bc stand for **b**asic **c**alculator, it was preceded by *dc (http://en.wikipedia.org/wiki/Dc_(computer_program))*, a cross-platform reverse-polish **d**esk **c**alculator one of the oldest Unix utilities.

> bc, for basic calculator, is "an arbitrary precision calculator language" with syntax similar to the C programming language. bc is typically used as either a mathematical scripting language or as an interactive mathematical shell.
>
> — **Wikipedia** Bc (Programming Language) (http://en.wikipedia.org/wiki/Bc_\(programming_language\))

Math Library Functions

Using the *-l* option of the **GNU bc** command line utility will load the Math library and set the default value of scale to 20. The predefined functions that comes with the math library (https://www.gnu.org/software/bc/manual/html_node/bc_18.html#SEC18) are:

`s (x)`
The sine of *x*, *x* is in radians.

`c (x)`
The cosine of *x*, *x* is in radians.

`a (x)`
The arctangent of *x*, arctangent returns radians.

`l (x)`
The natural logarithm of *x*.

`e (x)`
The exponential function of raising *e* to the value *x*.

`j (n,x)`
The bessel function of integer order *n* of *x*.

```
$ bc -l <<< "l(3)"
1.09861228866810969139
```

Special Expressions

GNU bc provide few special expressions (https://www.gnu.org/software/bc/manual/html_node/bc_14.html#SEC14) that make it even more powerful.

`length ( expression )`
The value of the length function is the number of significant digits in the expression.

`read ( )`
The `read` function (an extension) will read a number from the standard input, regardless of where the function occurs. Beware, this can cause problems with the mixing of data and program in the standard input. The best use for this function is in a previously written program that needs input from the user, but never allows program code to be input from the user. The value of the `read` function is the number read from the standard input using the current value of the variable *ibase* for the conversion base.

`scale ( expression )`
The value of the `scale` function is the number of digits after the decimal point in the expression.

`sqrt ( expression )`
The value of the `sqrt` function is the square root of the expression. If the expression is negative, a run time error is generated.

```
$ bc -l <<< "sqrt(5)"
2.23606797749978969640
```

Going further: Write a function

GNU bc allows you to define your own Functions (https://www.gnu.org/software/bc/manual/html_node/bc_17.html#SEC17) and makes the language very powerful.

```
define name ( parameters ) { newline
    auto_list   statement_list }
```

There is a wide list of open source projects with a lot of functions available. You should check all the *X-BC (http://x-bc.sourceforge.net/)* resources.

- extensions.bc (http://x-bc.sourceforge.net/extensions_bc.html): contains functions of trigonometry, exponential functions, functions of number theory and some mathematical constants.
- scientific_constants.bc (http://x-bc.sourceforge.net/scientific_constants_bc.html): contains particle masses, basic constants, such as speed of light in the vacuum and the gravitational constant.

Another amazing resource is the *GNU bc FAQ* on phodd.net (http://phodd.net/gnu-bc/bcfaq.html). You will find a large amount of functions in the file funcs.bc (http://phodd.net/gnu-bc/code/funcs.bc) that can be of a good help and gives you some good examples (include round-up, ceil, floor, etc).

To go further, I highly recommend reading the GNU bc Manual (https://www.gnu.org/software/bc/manual/bc.html).

Posted by Nicolas Brousse January 01, 2015 ShellTips

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It looks new to anyone who wasn't able to undergo this kind of learning. From this, there would truly be some other techniques that can guide them and would help them in solving those topics in mathematics.

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