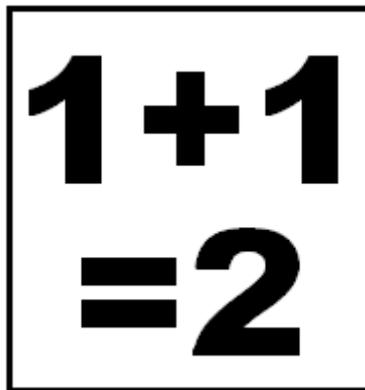


User Guide

For:
Rhyscitlema MFET Calculator

By:
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<http://www.rhyscitlema.com/applications/mfet-calculator>



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1 General Information

Rhyscitlema MFET Calculator is an application to evaluate any mathematical expression, along with user-defined variables and functions. It is derived from the Rhyscitlema computer application.

The software evaluates mathematical expressions expressed in the Math Function Expression Text (MFET) language. MFET enables the representation of mathematical expressions in plain text in very simple and effective ways. Instead of only thinking of a single-value, vector or matrix, the fully general **value-structure** is used: an example is (1,(2,3,4),5).

MFET enables evaluating simple expressions such as $1+1$, to evaluating advanced expressions such as $2*f(3)$; $f(x)=4x$, to evaluating highly complex expressions in an Object-Oriented Programming model (using **inheritance** and **encapsulation**).

Suppose you want to simply evaluate say “ $4*5$ ”, you can do that! Suppose you later notice that you want a few more of the form $4*X$. In that case you simply evaluate say “ $4*(5, 6, 7, 8)$ ”. Suppose you later want to also use 2 and 3 besides 4. In that case you simply evaluate “ $f(2), f(3), f(4)$; $f(x)=x*(5, 6, 7, 8)$ ”. The result will be a 3-by-4 matrix. Suppose you later want to keep the current results but also evaluate with the vector (50, 61, 72, 83). In that case you simply evaluate “

$f(2,a), f(3,a), f(4,a),$
 $f(2,b), f(3,b), f(4,b) ;$
 $f(x,y) = x*y ;$
 $a = (5, 6, 7, 8) ;$
 $b = (50, 61, 72, 83) ;$

”. The result will be a 6-by-4 matrix.

MFET is designed and developed to be USERFOIL:

- **Useful:** can be used to do something important
- **Simple:** has as little different things as possible
- **Efficient:** provides high quantity+quality service
- **Robust:** survives unintended usage
- **Flexible:** gives full control to the user
- **Original:** not a cheap copy of some other
- **Interesting:** definitely worth your time
- **Lasting:** will survive the test of time

For now only technical information is provided.

Rhyscitlema products are provided for free, under the simple usage agreement: **use at your own risk**. In order to encourage improvement as well as release of more content you may please consider donating at <http://rhyscitlema.com/donate>.

2 Math Function Expression Text (MFET)

An MFET is simply a block of text that evaluates to some result.

At the very beginning we have “1+1”, which is a basic math expression that evaluates to 2. The expression can be made slightly more complex:

- $5-6/2+3*4$
- $4*\sin(3+2) + (5-2)^3!^{\wedge-4}!$

Such a basic expression that only makes use of already-defined features along with operators, is called **an MFET statement**.

The MFET block of text can be made even more complex:

1. $5a; a=4$
2. $2*f(3); f(x)=4x$
3. $5a+2*f(3); a=4; f(x)=4x$

1. The 1st case evaluates $5a$ where $a=4$, so the result is $5*4 = 20$.
2. The 2nd case evaluates $2*f(3)$ where $f(x)=4x$, so the result is $2*(4*3) = 24$.
3. The 3rd case evaluates $5a+2*f(3)$ where $a=4$ and $f(x)=4x$, so the result is $20+24 = 44$.

In these cases there are user-defined **variable** and **functions**. Since they are user-defined, there is therefore no more restriction to only using software-defined variables and functions, like $\sin()$.

However, a user-defined variable or function essentially defines a basic math expression. That is for example: $a=4$ evaluates the math expression “4”, while $f(x)=4x$ evaluates the math expression “4x”. Each of these basic expressions, including “ $5a+2*f(3)$ ”, is called *an MFET statement*.

An MFET statement should be terminated by the end-of-statement character, which is the **semi-colon** ';'. However it can still be terminated by the end of a text or the end of a file.

Essentially, both a variable and a function are types of **components**. An MFET block of text is thus a block of **component definitions**, the first of which is directly an MFET statement. This very first statement is *implicitly* assigned to a special variable (or function as shall be seen) called **main**.

The MFET block of text, which is a collection of component definitions, is also called a **container**. A container can be inserted inside another container as an **inner-container** to a **parent-container**. This inner-container will be itself a component sitting besides variables and functions components. As it is given a name, an inner-container can be called just like variables and functions are called.

3 MFET Component

Beyond the concept of an MFET statement, such as for example “1+1”, there is the concept of an MFET component. A component can be a variable, a function or an inner-container. Every component has a name. All components inside a *containing container* have unique names.

Consider the following example of two file contents which shows variables, functions, inner-containers and parent-containers:

For file1.mfet

```
1+1;
name = "file1.mfet";

\mfet{variable1;
  name = "container1";
  private variable1 = 10;
  enclosed variable2 = 20;
  protected variable3 = 30 + variable4;
  public variable4 = 40;
}
\mfet{variable2, variable4;
  type = "container1";
  name = "container2";
  public variable4 = 400;
}
```

For file2.mfet

```
2*f(3);
f(x) = 4x;

type = "file1.mfet";
name = "file2.mfet";

\mfet{variable3, "container2".variable3;
  type = "container1";
  name = "container3";
  replace variable4 = 4000;
}
```

3.1 As a variable and as a function

A component as a variable is defined in the form:

- `variable_name = an_MFET_statement`

A component as a function is defined in the form:

- `function_name(parameter) = an_MFET_statement`

The main difference between a variable and a function is that, since a variable does not take parameters, it evaluates to a constant at parsing-time. In future, when sequential execution using loops will be introduced, it will become possible to change the value of a variable at run-time.

3.2 As a container – Parent vs Inner container

An MFET statement, such as for example “1+1”, is the definition of a single component (of some containing container) called the *main* component. Beyond an MFET statement, there are variables and functions, each of which may be thought of as a container having only its *main* component.

An MFET container can be defined as a collection of components definitions, of which there is at least the *main* component’s definition, and optionally the variables, functions and inner-containers.

An inner-container, as itself a component inside a containing container, is defined in the form:

- `\mfet{ the_MFET_container_text }`

The classical components are a variable and a function. The collection of all components defined within the same block forms a container, although this is yet considered to be itself a component (as an inner-container) inside another container (its parent-container). At the top-most level of this hierarchy is **the Root container**. The *Root* container has no variable nor function. It can only have inner-containers, the later which are said to be **top-level containers**.

The example with *file1.mfet* and *file2.mfet* illustrates multiple inner-components and their parent-containers. It should be observed that an MFET statement is always a *main*-component definition.

A file that defines an MFET container is called an *MFET file*. It is typically loaded as a top-level container. It is recommended to not provide a *name* component in an MFET file. The file’s name will be detected and used implicitly upon loading it. If however provided then this *name* component must be equal to the file name.

A container can be called in the same way as a variable/function. The call will call the container’s *main*-component, which is usually a variable, but which can be defined as a function by using:

- `\mfet{(parameter)= rest_of_the_MFET_container_text }`

Parent Container vs Containing Container

It is rather easy to get confused with the difference between a parent container and a containing container. It is all a matter of point of view. For a container *C* that looks at its inner-container *I* as just another one of its contained components, *C* is the containing-container of *I*, and is the parent-container to a variable/function found inside *I*. A variable/function is typically not thought of as being an inner-container itself. But if it was, then its containing-container will be thought of as the parent-container to its *main* component. Notice how the point of view changes. In summary, a parent-container is parent to a containing-container, not to a component definition.

3.3 Base vs Derived container – OOP Inheritance

The Object-Oriented Programming concept of inheritance is achieved using the *type* and *name* components of an MFET container. Both must be provided as direct strings.

Essentially, a derived container can inherit from a base container by setting its type to be equal to the name of that base container. The base container must be a *sibling* to the derived container. Also, the base container must be defined *before* the derived container (this is the only situation in MFET where the order of definition matters).

Containers are considered to be siblings if they have the same parent, or the parent of one inherits from the parent of another. In the example MFET provided, the inner-containers inside the files are all siblings because *file2.mfet* inherits from *file1.mfet*. *container1* is a direct sibling to *container2* because they have the same parent (i.e: *file1.mfet*), meanwhile, these two are indirect siblings to *container3* since *container3* is inside a different parent, *file2.mfet*, which inherits from *file1.mfet*.

If the container *type* is not specified then the container does not inherit anything. If the container *name* is equal to that of an indirect sibling (direct siblings cannot have the same name), and is thereby overriding that indirect sibling, then the *type* must also be equal to that name.

3.4 Component Access Control – OOP Encapsulation

The Object-Oriented Programming concept of encapsulation is achieved using a component access control mechanism that controls who can access the inner component of a containing container. This is done by preceding the component's definition by one of the 4 access control identifiers:

1. **private:** accessible only by its containing container (this includes the inner-containers)
2. **enclosed:** accessible only by a container of **same parent** as its containing container
3. **protected:** accessible only by a container of **same grand-parent** as its containing container
4. **public:** accessible by anyone from anywhere

The example with *file1.mfet* and *file2.mfet* illustrates the component access control mechanism. Containers within an MFET file have that file as their containing container. Therefore, a component of one with *enclosed* access will be accessible to a sibling within the file. MFET files are typically loaded as top-level containers, thereby sharing the *Root* container as their parent. Thus, inner-containers from these files will share the same grand parent, thereby having *protected* access level.

The access level of an overridden component cannot be downgraded. That is if a derived container overrides a component of a base container, then the access level of the new component definition (found inside the derived container) must not be less than that found inside the base container.

Important:

1. When not specified, the access type is made ***protected by default***.
2. Top-level containers are always set to have *public* access type.
3. The *name* component is always set to *private* access irrespective of what the user specifies.
4. Upon moving up the hierarchy, that is from inner to parent container, the access level does not change. So the call "`..|..|..|..`".**var** will access *var* even if *var* has private access.
5. Upon moving down the hierarchy, that is from parent to inner container, the access level increases by 1, and increases no more when it becomes *public* access. So a parent container can access its inner-container component only if the later has at least *enclosed* access type.

A certain feature that acts like an access control, although it is technically not one, is the ***replace*** component identifier. A component inside a derived container, is marked as *replace* provided that it **overrides** an existing component found inside a base container and which it can access.

The purpose of the *replace* identifier is for a derived container to tell the target base container that

any usage of that replaced component must be made using the replaced component definition. In the example MFET provided, *container3* evaluates *variable3* while haven replaced *variable4*. So the result will be $30+4000 = 4030$. It could not have used *variable2* because it cannot access it.

The *replace* identifier behaves as an access control with access level 5, which is higher than *public*. This is so that a component marked as *replace* cannot be overridden by a derived container into a component not marked with as *replace*. This aim certainly can be achieved in a different way...!

3.5 Calling a Component – Relative vs Absolute path

A useful feature is the ability to call a component inside an MFET statement. This is done using:

- "path".name

path is the path to the container that contains the component of name *name*.

A path that starts:

- with '|', implying an **absolute path**, starts the search from the *Root* container, and with *public* access level.
- with '.', which denotes **current**, starts the search from the *containing* container, and with *private* access level.
- with '..', which denotes **parent**, starts the search from the *parent* container, and with *enclosed* access level.
- else, the search **defaults** to starting at the *parent* container, again and with *enclosed* access level.

In the example MFET provided, the call "*container2*".*variable3* starts the search from the parent container, which is the container with name "file2.mfet". If the call was ".|*container2*".*variable3* then the search would have started from the containing container, which has name "container3".

Note that the call "*path*".**main** is always valid even for variables and functions, since every component is a container containing at least this *main*-component. So even the call "*path|var|main|main*".*main* is valid, and will resolve to the exact same as doing "*path*".*var* .

Note: the call "|*filename*".*component* will automatically load the MFET file if not already loaded.

3.6 GLOBAL.MFET components

Software-defined variables and functions (such as *sin()*, *cos()* and *pi*) are characterised by the property that they can be called from anywhere. There is no concept of inheritance involved.

In order to provide this same property to user-defined variables and functions, the concept of globally accessible components is used. Basically, all global-scope user-defined components must be defined inside a *top-level* container with name "GLOBAL.MFET".

For example, evaluating the below will make *my_cos* to become globally accessible for future use:

```
0;  
name = "GLOBAL.MFET" ;  
my_cos(x) = cos(2*x) ;
```

One may consider it convenient to define globally accessible components inside an MFET file, then load the file directly after launching the software.

3.7 Evaluating the given example

The example MFET provided can be loaded by evaluating the first file content (which will result to 2, due to “1+1”) and then evaluating the second file content (which will result to 24). The MFET file contents will load as top-level containers. Everything will load properly, except that there will be no useful result to observe and play with! Below is a single container that takes in the two file contents as inner-containers. Evaluating it will produce useful results to observe and play with.

```
".file1.mfet".container1 ,  
".file1.mfet".container2 ,  
".file2.mfet".container3 ,  
".file2.mfet".main ,  
".file1.mfet".main ;
```

```
\mfet{  
  1+1;  
  name = "file1.mfet";  
  
  \mfet{variable1;  
    name = "container1";  
    private variable1 = 10;  
    enclosed variable2 = 20;  
    protected variable3 = 30 + variable4;  
    public variable4 = 40;  
  }  
  \mfet{variable2, variable4;  
    type = "container1";  
    name = "container2";  
    public variable4 = 400;  
  }  
}  
\mfet{  
  2*f(3);  
  f(x) = 4x;  
  
  type = "file1.mfet" ;  
  name = "file2.mfet" ;  
  
  \mfet{variable3 , "container2".variable3 ;  
    type = "container1" ;  
    name = "container3" ;  
    replace variable4 = 4000 ;  
  }  
}
```

The result of evaluation is:

```
(10,  
(20, 400),  
(4030, 70),  
24,  
2)
```

4 MFET Statement – syntax

The concept of an MFET component has been discussed. A variable or function is defined using an MFET statement. The following sub-sections discuss the syntax of an MFET statement in details.

4.1 Value-Structure

The value-structure defines the structure of the result of an expression after it has been evaluated. Particularly:

- A value structure is represented using brackets, comma-separators and names.
 - $((w,x,y),z)$, $\{w,x,\{y,z\}\}$
- A single value is the most common value structure
 - x , (x) , $((x))$
- Vectors and matrices are special types of value structures
 - (w,x,y,z)
 - $((w,x), (y,z))$
- The parameter to a function is defined using a value structure
The brackets **()** must be used.
 - $f((x,y),z) = x+y+z$;
- The brackets pairs **{}** and **()** are always interchangeable. The only exception is that **()** is used when specifying a function parameter or a function call argument.

4.2 Supported Operators

All the available operators are listed below. The order in which they are listed is also their **precedence order**. That is what comes lastly is evaluated firstly. For example, because the operator times ***** comes after the operator plus **+**, an expression such as $2+3*4$ will evaluate as $(2+(3*4))$. However some have equal precedence, such as times and divide. Do not rely on these: use brackets wherever possible. The logical operators always evaluate to the integer value 1 or 0. Any single-value operand is considered as *true* if it evaluates to non-zero and as *false* if it evaluates to zero (or null). The concept of *per-value operation* is mentioned here but is explained later.

- open-close brackets **()** and **{}**
- brackets for subscripting **[]**
- comma separator **,**
- mix/combine **.**
- Replacement **:=**
- Conditional **? :**
- Logical OR **or** (does only per-value operation)
- Logical AND **and** (does only per-value operation)
- Logical NOT **not**
- Not equal **!=** (or **!:=** for per-value operation)
- Equal **==** (or **:=** for per-value operation)
- Less than **<** (or **.<** for per-value operation)

- Greater than $>$ (or $.>$ for per-value operation)
- Less than or equal to $<=$ (or $.<=$ for per-value operation)
- Greater than or equal to $>=$ (or $.>=$ for per-value operation)

- Plus $+$ (does only per-value operation)
- Minus $-$ (does only per-value operation)
- Positive $+$
- Negative $-$
- Times $*$ (or $.*$ for per-value operation)
- Divide $/$ (or $./$ for per-value operation)
- To-power $^$ (or $.^$ for per-value operation)
- modulo/remainder **mod** (does only per-value operation)

- Bitwise *right shift* $>>$ (**these** do only per-value operations)
- Bitwise *left shift* $<<$
- Bitwise *xor* $\wedge+$
- Bitwise *or* $|$
- Bitwise *and* $\&$
- Bitwise *not* \sim

- DotProduct \cdot
- factorial $!$ (also possible for a real number x , as *gamma_function(x+1)*)
- Transpose T

4.3 Software-Defined Math-Constants

- e constant **e**
- PI constant **pi**
- square root of -1 **i**

4.4 Software-Defined Math-Functions

- e raised to power **exp()**
- logarithm base 10 **log()**
- logarithm base e **ln()**
- square root **sqrt()**
- ceiling **ceil()**
- floor **floor()**

- complex number magnitude **cabs()**
- complex number argument **carg()**
- complex number real part **real()**
- complex number imaginary part **imag()**
- complex number conjugate **conj()**
- complex number projection **proj()**

- trigonometric sine **sin()**
- trigonometric cosine **cos()**

- trigonometric tangent **tan()**
- trigonometric sine inverse **asin()**
- trigonometric cosine inverse **acos()**
- trigonometric tangent inverse **atan()**
- hyperbolic sine **sinh()**
- hyperbolic cosine **cosh()**
- hyperbolic tangent **tanh()**
- hyperbolic sine inverse **asinh()**
- hyperbolic cosine inverse **acosh()**
- hyperbolic tangent inverse **atanh()**

4.5 Software-Defined Extra-Functions

- convert to string **tostr()**
- convert to number **n/a**
- convert to big number **n/a**
- convert to small number **n/a**
- minimum of all single-value elements **min()**
- maximum of all single-value elements **max()**
- summation of all single-value elements **sum()**
- count of all single-value elements **length()**
- size of a vector or matrix **size()** , the result is a 2-value vector: (rows, columns)
- get a vector in given range **range(start, increment, stop)**
e.g: `vector(1,(4,2),50)` = (1, 5, 7, 11, 13, 17, 19, 23, 25, 29, 31, 35, 37, 41, 43, 47, 49)
- get a vector of given length **vector(start, increment, length)**
e.g: `vector(1,(4,2),17)` = (1, 5, 7, 11, 13, 17, 19, 23, 25, 29, 31, 35, 37, 41, 43, 47, 49)
- get prime factorisation **n/a**
- get prime numbers in range **n/a**
- fullfloor **fullfloor()** , see <http://rhyscitlema.com/algorithms/math-fullfloor-function>
- try expression **try(this, that, ..., catch)**
Evaluate the expression *this*. If no error then return the result to the caller. Else evaluate the expression *that*, if error then keep evaluating the next one up until the last one called *catch*.
- print expression **print()** , evaluate and print the result as an error message.

4.6 Replacement Operator :=

Consider the following expression:

- `2 := current + 1`

The replacement operator `:=` evaluates what is on its right-hand-side (RHS), then replaces what is on its left-hand-side (LHS) with the result. '*current*' is a special variable associated with the replacement operator. It is considered special **only when** there is an associated replacement operator. It simply is the value of the current LHS. This causes the replacement to be an update.

4.7 Conditional Operators “ ? : ”

The pair of conditional operators enables the use of conditional expressions; so it enables piece-wise definition of variables and functions.

The syntax is:

- (condition) ? (on true) : (on false)

which is similar to:

- (on true) if (condition) or
(on false) otherwise

If 'condition' evaluates:

- to non-zero then (on true) is evaluated and (on false) is ignored
- to zero then (on true) is ignored and (on false) is evaluated

For example, consider the expression: $2 + ((5 > 6) ? 1 : -1)$

The result is evaluated as $2 + (-1)$ because the expression $(5 > 6)$ evaluates to zero \rightarrow false.

The two operators have the same precedence level. So an expression like

- $2 + ((5 > 6) ? 1 : (5 < 6) ? 0 : -1)$

which can be rewritten as

- $2 + ((5 > 6) ? 1 : (5 < 6) ? 0 : -1)$

will evaluate as

- $2 + 1$ if $(5 > 6)$ or
 0 if $(5 < 6)$ or
 -1 otherwise

4.8 Per-value Operation

Some operators are described to do **per-value operation**. This means that the operator is applied to each of the corresponding values of the value-structures of the operands, with the output being of the same value-structure as the operands. Typically, the plus + operator does per-value operation.

Ex:

- $(1, 2, 3) + 4$ evaluates as $(1+4, 2+4, 3+4)$
- $(1, 2, 3) + (4, 5, 6)$ evaluates as $(1+4, 2+5, 3+6)$

An operation that can only be performed on a single-value argument (mainly the Math functions) will do a per-value operation when the operand is a value-structure like a vector or a matrix. Ex:

- $\sin(1, 2, 3)$ evaluates as $(\sin(1), \sin(2), \sin(3))$

4.9 String / Text Expression

A string (or a text expression in general) is anything found inside the pair of double quotes " ". It is a type of value, and the only value type that is not a number. On evaluating the expression $(2+3, "text")$ the result will display as $(5, text)$.

Note that operations on text expressions are not yet possible because the design of the Relative Text Expression Format (RTEF) in which they are written is not yet completed.

4.10 Commenting

The character # is used to comment a single line. That is everything from the character up to the encounter of a newline is ignored, except that newline.

#{ and }# are used for *block-commenting*. That is everything from the specific starting point to the specific stopping point is ignored. A }# only closes a matching #{. Therefore **a block-comment can contain another block-comment**.

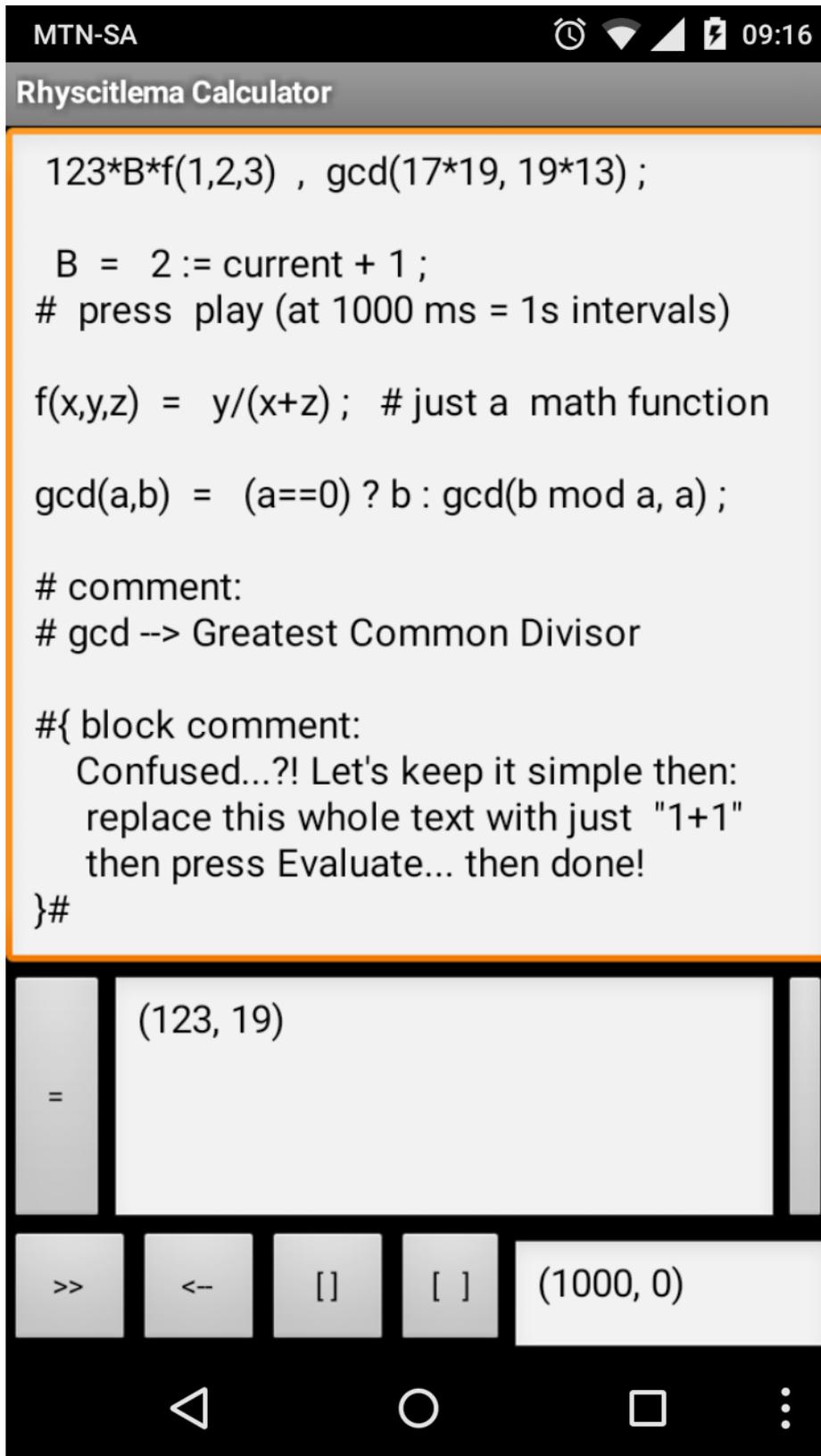
Priority is given to the first encountered commenting. That is for example: #...#{ or #...}# on a single line, is a valid and single-line comment instance – the line is commented. Also #{...#...}# is a valid and single block-comment instance – the block of text is commented.

4.11 More about MFET

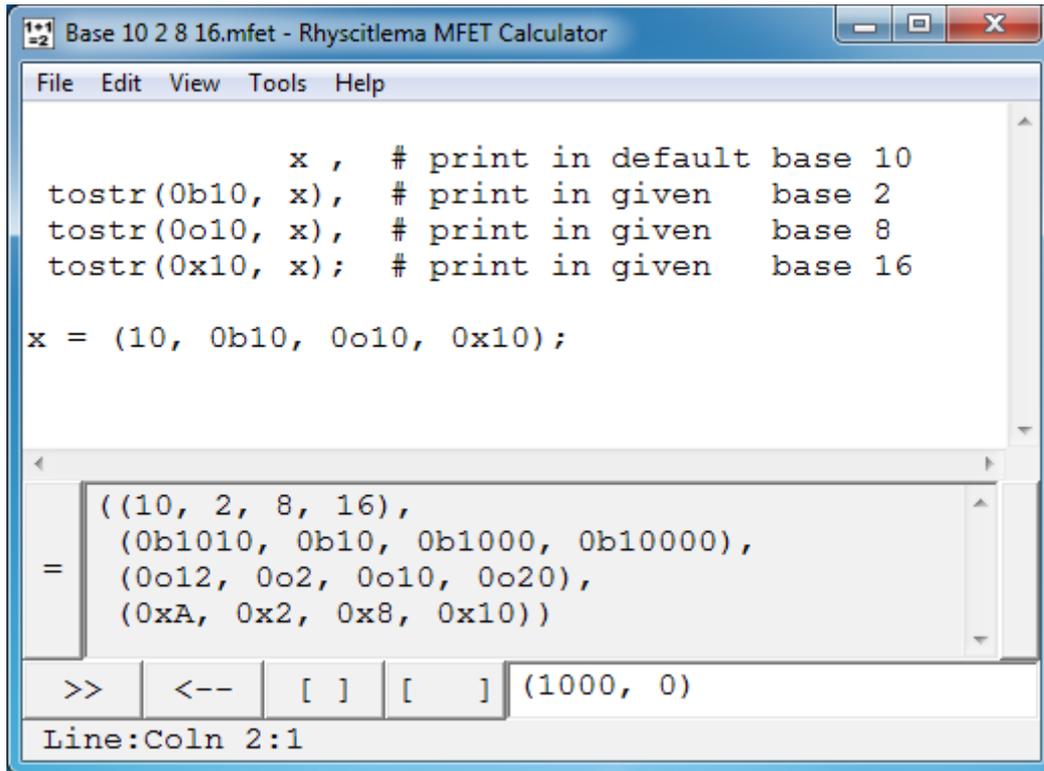
- By default, a given vector (say (0,0,0) for example) is a **column** vector.
- A function parameter overrides any component (that is any user-defined variable or function or container), which in turn overrides any software-defined variable or function.
- Recursive function call is possible.
e.g: “ *fib(10); fib(n) = (n<=1) ? n : fib(n-1) + fib(n-2);* ” = 55
e.g: “ *gcd(35, 65); gcd(a, b) = (a==0) ? b : gcd(b mod a, a);* ” = 5
- The value structure can change during evaluation.
e.g: “ *f(1), f(2,3); f(x) = x+x;* ” = (2, (4,6))
- An example given number in base 2 is **0b**101.01 , in base 8 is **0o**273.14 , in base 16 is **0x**FEA.8D . A number can be given in an arbitrary base B as: **tonum(w,x,B,y,z)** , where w,x,y,z are the digits in the interval [0, B), and B denotes the position of the decimal point.
- **tostr(base, (value structure))** converts the value structure into a string in the given base.
e.g: *tostr(2, (4,5,6)) = (0b100, 0b101, 0b110)*
- Vectored indexing is possible, e.g: (6,7,8,9)[3,2,1] = (9,8,7).
Also, the index can change during evaluation. However for optimization to be possible, it is extremely recommended for all elements of the indexed vector to be of the same value type.
- The *combine/mix* operator **.,** mixes the 1st level values. e.g: (1,2) **.,** (4,5) = (1,2,4,5)
- **Note:** the conversion from a float number to a string, as used when printing the result of evaluation for example, currently has an issue with a float number of magnitude too large to be stored as an integer. This will be a number outside the range $-(2^{63}-1)$ to $+(2^{63}-1)$. It will be considered as infinite. However other operations with the number remain valid.

5 Graphical User Interface

5.1 GUI on Android



5.2 GUI on Windows



The user interface largely does text and file editing. Features that are common to most text file editing software will not be discussed.

When an MFET file is loaded its content is displayed in the large user entry text field. This content is then automatically evaluated and the result is displayed in the small result text field.

5.3 Software-specific Menu features

- Menu → Edit → Go To:
 - Repositions the caret. The provided entry is an MFET.
- Menu → Edit → Convert Text:
 - These are features to choose whether to show a text in its normal character form, partly-code-number form, or fully-code-number form. Refer to the next section for details.
- Menu → Tools → Evaluate:
 - Does the same thing as the evaluate/equal '=' button.

5.4 1st layer buttons and text field

The *Evaluate* (or *Equal*) button, denoted as '=', evaluates the content of the large user entry text field as an MFET entry, then displays the result (of evaluating the *main* component) in the small message text field. Evaluation can also be performed by using the key combination **Shift+Enter**.

The evaluation may commit further changes to the software depending on what has been evaluated.

For example if an MFET container of type User Interface Definition Text (UIDT) is evaluated, then this container will be used to update the GUI of the software.

For example evaluating the below MFET will increase the height of the first layer of the GUI:

```
0;  
type = "User_Interface_Definition_Text" ;  
name = "My Custom GUI" ;  
replace h1 = 100 ;
```

The *Lock* button is used to provide keyboard data to the evaluated MFET. For example consider that the MFET below is evaluated:

```
0 := current + (Key_a or Key_A) - (Key_b or Key_B) ;
```

Then after selecting the *Lock* button, pressing the character ‘a’ or ‘A’ will increment the Left-Hand-Side of the replacement operator, meanwhile pressing the character ‘b’ or ‘B’ will decrement it.

5.5 3rd layer buttons and text field

At the far right of the 3rd layer is a text field that evaluates the MFET: (*TimerPeriod*, *time*). Both are software-defined variables. *TimerPeriod* is the periodic interval in milliseconds, after which the value of *time* is increased by *TimerPeriod/1000* seconds.

The user entry is **re**-evaluated again each time the *time* variable is updated. Pressing the *Play* button ‘>>’ will start the timer. This button will then switch to the *Pause* button ‘||’, the later which when pressed will stop the timer.

Pressing the *Reverse/Forward/Backward* button reverses the sign of the timer period. If *TimerPeriod* is negative then the *time* variable will decrease on every update. Pressing the *Lower* button ‘[]’ will reduce the timer interval by an amount specified in the User Interface Definition Text (UIDT). The default UIDT uses a decrement of 25 milliseconds. Pressing the *Higher* button ‘[]’ will increase the timer interval in the same way (again the default is 25 milliseconds). Note that for all these cases, as the value of *time* does not change, the user entry is not re-evaluated.

The time text field can be updated directly through editing the text. The method of applying the changes made may vary depending on the platform in which the software has been implemented. Most often (as is the case for Android) the *Done/Enter* keyboard button is pressed. For Windows the changes are applied when keyboard focus is moved out of the text field.

5.6 Hidden layers

There are more gui features, such as the 2nd and 4th layers of buttons, which are only discussed in the user guide for the Rhyscitlema Graph Plotter 3D software. They are hidden in the Rhyscitlema MFET Calculator software because of being rarely needed. However the functionalities of the 2nd layer buttons are made available through Menu → Tools:

- *Prev* and *Next* container: are used to scroll through all containers
- *Delete* container: is used to delete the selected container (name shows in the path text field)
- *Clear* container path: is used to clear the path text field, meaning no container is selected.

6 Character vs Partly-Code-Number Text Display

This is a feature for file editing. It is especially useful to:

- Efficiently use the Find-Replace feature
- Provide a character through its code number
- Know the code number associated to a character

A character is stored in a computing device in the form of a number. The displayed character is just the meaning given to that number. For example the character '0' is stored as the hexadecimal number 30 (or 0x30), corresponding to the decimal number $3*16+0 = 48$. This is the *Code Number*.

Here, a character with a 4-digit hexadecimal code number of XXXX is represented as `\uXXXX`. For example the character '0' is represented as `\u0030`. This is described as the fully-code-number representation.

In certain contexts such as software programming, some characters have alternative representations. Particularly:

- The tab character is represented as `\t` (code number `\u0009`)
- The carriage-return character is represented as `\r` (code number `\u000D`)
- The line-feed or newline character is represented as `\n` (code number `\u000A`)

In regard to this feature of the user interface, a character that is said to be displayed as partly-code-number is a character displayed in one of the following forms:

- The **normal character display**
 - The '0' character will display as '0'
 - The newline character will display a new line
- The **alternative representation** if it is available
 - The '0' character will display as '0' (since it has no alternative representation)
 - The newline character will display as `\n` (and there will be no actual new line)
- The **fully-code-number representation**
 - The '0' character will display as `\u0030`
 - The newline character will display as `\u000A`

The feature “Set Partly is Fully Code Number” is a feature to redefine the partly-code-number representation of a character, so that using the feature “Character to Partly Code Number” will keep most characters unchanged while showing the fully-code-number representation of the affected characters only. To use this feature a text is first selected, which contains the targeted characters in their fully-code-number representation.

These features can be applied to any selected text, including texts found in the find-replace text fields – and yes this, is the original reason why these features were developed in the first place!

7 Few Simple Examples

7.1 Basic Example

MFET container:

```
123 * β * f(1,2,3) ;  
β = 2 ; f(x,y,z) = y/(x+z) ;
```

Result of evaluation:

123

7.2 Circles and Spheres

MFET container:

```
Result ;  
  
r = 1 ; # radius  
C = 2*π*r ; # Circumference of a circle  
A = π*r^2 ; # Area of a circle  
S = 4*π*r^2 ; # Surface of a sphere  
V = (4/3)*π*r^3 ; # Volume of a sphere  
π = pi ; # 'pi' is software-defined  
  
Result = (C , A) , (S , V) ;
```

Result of evaluation:

```
((6.283, 3.142),  
(12.566, 4.189))
```

7.3 Quadratic Equation

MFET container:

```
x1 , x2 , f(x1) , f(x2) ;  
  
x1 = ( -b + sqrt(b^2 - 4*a*c) ) / (2a) ;  
x2 = ( -b - sqrt(b^2 - 4*a*c) ) / (2a) ;  
  
f(x) = a x^2 + b x + c ;  
  
a = 2; b = -2; c = 1;  
  
# Solving for x where f(x) = 0  
# Change the coefficients a, b and c
```

Result of evaluation:

```
(0.5+0.5i, 0.5-0.5i, 0, 0)
```