

MY-BASIC Quick Reference

1. Introduction

MY-BASIC is a tiny cross-platform easy extendable BASIC interpreter written in pure C with about 6000 lines of source code. Its grammar is similar to structured BASIC in early era, but without line number. It is aimed to be either an embeddable scripting language or a standalone interpreter. The core is pretty light; all in a C source file and an associated header file. You can combine MY-BASIC with an existing C / C++ / Objective-C project easily, that can make them more powerful. This manual is a quick reference on how to program with MY-BASIC, what it can do and what cannot, how to use it and extend it as a scripting programming language.

For the latest info, see https://github.com/paladin-t/my_basic; or contact with author from <mailto:hellotony521@qq.com>.

2. Programming with BASIC

The well-known programming language BASIC is an acronym for Beginner's All-purpose Symbolic Instruction Code; when we mention BASIC today, we often refer to the BASIC family, not a specific one. The BASIC family has a long history since an original BASIC was designed in 1964 by John George Kemeny and Thomas Eugene Kurtz

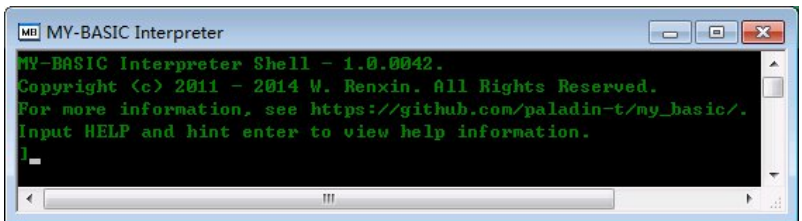
at Dartmouth College in New Hampshire; and BASIC is famous because it is easy to learn and use all the time. Thank you all BASIC dedicators and fanatics.

MY-BASIC has an early structured BASIC like grammar, similar as GW-BASIC but without line number. It would be familiar to you if you ever had programmed with a BASIC dialect.

Getting started

You can download the latest MY-BASIC package from https://github.com/paladin-t/my_basic/archive/master.zip or check out the source use [git clone https://github.com/paladin-t/my_basic.git](https://github.com/paladin-t/my_basic.git) first if you don't have a standalone interpreter yet. It is recommended to get a latest MY-BASIC package and have a quick blast with it.

In this part let's get started using the MY-BASIC command line interpreter which comes as below:

A screenshot of a Windows-style application window titled "MY-BASIC Interpreter". The window has a blue title bar with standard minimize, maximize, and close buttons. The main content area has a black background with green text. The text displayed is: "MY-BASIC Interpreter Shell - 1.0.0042.", "Copyright (c) 2011 - 2014 W. Renxin. All Rights Reserved.", "For more information, see https://github.com/paladin-t/my_basic/.", "Input HELP and hint enter to view help information.", and a single underscore character "_" which serves as the input prompt. A horizontal scrollbar is visible at the bottom of the text area.

The close square bracket is an input prompt. Let's begin rock it by typing a classical 'hello world' tutorial as below:

```
' Hello world tutorial  
a$ = "hello "  
a$ = a$ + "world"  
PRINT a$
```

You would get the response text after giving it a **RUN** command and hinting the enter key. Any text begins with a single quote and end to that line wouldn't be parsed to any interpretable structure but treated as comment; a comment does not perform anything, it's just a short explanation of statements. Like other BASIC dialects, MY-BASIC is case-insensitive; it means **PRINT A\$** or **Print a\$** will perform same behaviors.

Keywords

There are twenty three keywords and twenty four function reserved words in MY-BASIC as below:

Keywords	MOD, AND, OR, NOT, LET, DIM, IF, THEN, ELSE, FOR, TO, STEP, NEXT, WHILE, WEND, DO, UNTIL, EXIT, GOTO, GOSUB, RETURN, MEM, END
Reserved words	ABS, SGN, SQR, FLOOR, ROUND, RND, SIN, COS, TAN, ASIN, ACOS, ATAN, EXP, LOG, ASC, CHR, LEFT, LEN, MID, RIGHT, STR, VAL, PRINT, INPUT

It is not allowed to use these words for user-defined identifier; in addition there are two more **TRUE** and **FALSE** predefined symbols besides these words, which represent Boolean value true and false, you are capable of redefining these two words but it's not

recommended. Meaning of each keyword will be mentioned latter in this manual.

Operators

There are eleven operators in MY-BASIC as below:

Operators	+, -, *, /, ^, =, <, >, <=, >=, <>
-----------	------------------------------------

All these operators could act in calculation or comparison. Besides these operators, keywords **MOD**, **AND**, **OR**, **NOT** can also perform operator behaviors. An operator priority level shown in the table below indicates execution order in an expression:

Level	Operation
1	^
2	*, /, MOD
3	+, - (minus)
4	<, >, <=, >=, <>, = (equal comparison)
5	NOT
6	AND, OR
7	- (negative)
8	= (assignment)

The priority of level 1 is the highest and level 8 is the lowest. Higher level operations are treated before the lower ones. An expression is processed from left to right; operations in a same level are dealt in the same direction. Brackets '(' and ')' are used in pair to process expression between them before operations which are not surrounded by them.

MOD means modulus; it is usually signified by percent symbol '%' in some other programming languages. The caret symbol stands for power operation thus 2^3 results 8.

Data and operation

There are four kinds of built-in data type in MY-BASIC: Integer, Real, Boolean, String.

Integer and Real are defined as **int** and **float** of C types which are 32bit size under most compiler architectures nowadays. And you could redefine them as other types like **long** and **double** by modifying a few lines of code if you wish. Boolean's only instances are **TRUE** and **FALSE**, and can be assigned from a Boolean expression or an Integer. Actually Boolean is implemented and treated the same way as Integer; zero means **FALSE** and non-zero means **TRUE**.

MY-BASIC accepts numbers in HEX and OCT representation. A hexadecimal number begins with a **0x** prefix, and an octadic one begins with a **0**. For instance **0x10**(HEX) equals to **020**(OCT) equals to **16**(DEC).

A variable identifier is formed with alphabet and numbers, but it must begin with a letter. A variable does not require declaration before using, so pay attention to spelling mistakes to avoid strange errors. You don't need to take care of conversion between Integer / Float values, an Integer variable can be changed to a Float automatically if it's assigned with a Float value. Notice that a String variable must end with a dollar character **\$**. An assignment statement consists of a beginning keyword **LET** and a following assignment

expression, practically the word **LET** is always optional. See below:

```
LET a = 1 ' Assignment statement begins with LET  
pi = 3.14 ' Another assignment statement
```

MY-BASIC supports array up to four dimensions by default (defined by a macro), without doubt you can redefine the limit. Array is a kind of regular collection data structure in programming aspect. An array can store a set of data that each element can be accessed via the array name and subscript. A MY-BASIC array can hold either Real or String data. An array must be declared by a **DIM** (short for dimension) statement before using like this:

```
DIM nums(10)  
DIM str$(2, 5)
```

The naming rule for array identifiers is the same as variable naming rule. A dimension definition field followed an array identifier begins with an open bracket and ends with a close. Dimensions are separated by commas. Array indexes begin from zero in MY-BASIC thus **nums(0)** is the first element of array **num**, note for this difference from other BASICs, but it's more common in most modern programming languages. An array index could be a non-negative Integer value formed as a constant, a variable of Integer or an expression which evaluation results Integer; an invalid index would lead to an out of bound error.

MY-BASIC allows you to concatenate two Strings together using

operator plus '+' and get a concatenate String. So be aware of that each String concatenate operation would generate a new String object with memory allocation. Comparison operators can also apply to Strings. These operators start comparing the first character of each String, if they are equal to each other, it continues looking at the following pairs until a difference or a terminating null-character is reached; then return Integer values indicating the relationship between the Strings: a zero value if both Strings are equal, a positive value if the first is greater than the second one, a negative value if the first is less than the second one.

Sub program

It is recommended to break a program into small sub programs. Sub programs can reduce duplicate and complicity code. A label is used to define the entry point of a sub program. You can use a **GOSUB** statement wherever in the program to call a labeled sub program and transfer control to it. A **RETURN** statement is used to exit a sub program and transfer control back to its caller.

Control structures

There are three kinds of control structure in common structured programming languages, and MY-BASIC is of no exception.

Serial structure that executes statements one by one is a basic fundamental structure. MY-BASIC supports **GOTO** statement that provides unconditional control transfer ability. You can execute it like **GOSUB** as **GOTO label**, but that control proprietary cannot be returned back from a callee. An **END** statement can be placed

anywhere in source code to terminate the whole execution of a program.

Conditional structure consists of some condition jump statements (like **IF**, **THEN**, **ELSE**). These statements check condition expressions then perform an action under the case of true condition branch and in the case of false it performs something else as specified by you. You can write multi statements in a single line by separating them with colons.

Loop structure statements check a loop condition and do the loop body in the case of true until it comes to the false case.

The **FOR TO STEP NEXT** loop statement is deemed as fixed step loop. See below that prints number one to ten:

```
FOR i = 1 TO 10 STEP 1  
    PRINT i  
NEXT i
```

The **STEP** segment is optional if the increment is one. The loop variable after **NEXT** is optional if it should continue the closest **FOR** segment.

Sometimes, we don't know how many steps a loop would repeat. For this reason, variable step loops are quite essential. There are two kinds of variable loops in MY-BASIC, **WHILE WEND** and **DO UNTIL** loop. See the code below:


```
a = 1
WHILE a <= 10
    PRINT a
WEND
```

```
b = 1
DO
    PRINT b
UNTIL a > 10
```

Just as their names imply, **WHILE WEND** loop do the loop body while the condition is true, and **DO UNTIL** loop do that until the condition is false. A key difference is **WHILE WEND** checks the condition first before executing the loop body, however, **DO UNTIL** checks the condition after the loop body has been executed once.

EXIT statement in MY-BASIC is used to interrupt current loop and continue to execute the program after it. It is the same as **break** statement in some other programming languages.

3. Core and Standard Libraries

MY-BASIC supplies a set of frequently used function libraries which provides some fundamental numeric and string functions. These function names couldn't be used as a user-defined variable identifier either. For details of these functions, see the figure bellow:

Type	Name	Description
Numeric	ABS	Returns the absolute value of a number
	SGN	Returns the sign of a number
	SQR	Returns the arithmetic square root of a number
	FLOOR	Returns the greatest integer not greater than a number
	CEIL	Returns the least integer not less than a number
	FIX	Returns the integer trimmed format of a number
	ROUND	Returns the specified value to the nearest integer of a number
	RND	Returns a random float number between 0.0 and 1.0
	SIN	Returns the sine of a number
	COS	Returns the cosine of a number
	TAN	Returns the tangent of a number
	ASIN	Returns the arcsine of a number
	ACOS	Returns the arccosine of a number
	ATAN	Returns the arctangent of a number
	EXP	Returns the base-e exponential of a number
	LOG	Returns the base-e logarithm of a number

String	ASC	Returns the integer ASCII code of a character
	CHR	Returns the character of an integer ASCII code
	LEFT	Returns a given number of characters from the left of a string
	LEN	Returns the length of a string
	MID	Returns a given number of characters from a given position of a string
	RIGHT	Returns a given number of characters from the right of a string
	STR	Returns the string type value of a number
	VAL	Returns the number type value of a string
Input & Output	PRINT	Outputs number or string to the standard output stream, user redirectable
	INPUT	Inputs number or string from the standard input stream, user redirectable

Be aware that all those functions besides **PRINT** and **INPUT** require a pair of brackets to surround arguments.

4. Application Programming Interface

There are a few but adequate exposed MY-BASIC APIs (Application Programming Interface) for C / C++ / Objective-C programmers.

MY-BASIC is written with pure C, what you need to do before programming with MY-BASIC is just copy and add `my_basic.h` and `my_basic.c` to the target project; all interfaces are declared in `my_basic.h`. Most APIs return an `int` value, they should return `MB_FUNC_OK` if there was no execution error.

Interpreter structure

MY-BASIC uses an interpreter structure to store some necessary data structures during parsing and running period; like local / global function directory, global variable dictionary, abstract syntax tree, parsing / running context, error information etc. An interpreter structure is a unit of MY-BASIC environment. Invoking between MY-BASIC script and host program also works through this structure.

Initializing and disposing

`int mb_init(void);`

This function must and must only be called once before any other operations with MY-BASIC to initialize the entire system.

`int mb_dispose(void);`

This function must and must only be called once after operations with MY-BASIC to dispose the entire system.

`int mb_open(struct mb_interpreter_t** s);`

This function opens an interpreter structure to get ready for parsing and running.

Common usage of this function does like this:

```
struct mb_interpreter_t* bas = 0;  
mb_open(&bas);
```

```
int mb_close(struct mb_interpreter_t** s);
```

This function closes an interpreter structure when it is no longer used.

`mb_open` and `mb_close` must be matched in pair sequentially.

```
int mb_reset(struct mb_interpreter_t** s, bool_t clrf);
```

This function resets an interpreter structure to initialization as it was just opened.

Function registration/unregistration

These functions are called to register or remove extended functions.

```
int mb_register_func(struct mb_interpreter_t* s,  
                    const char* n,  
                    mb_func_t f);
```

This function registers a function pointer into an interpreter structure using a given name. The function to be registered must be a pointer of `int (* mb_func_t)(struct mb_interpreter_t*, void**)`. A registered function can be called in MY-BASIC script.

```
int mb_remove_func(struct mb_interpreter_t* s,  
                  const char* n);
```

This function removes a registered function out of an interpreter structure by a given name the same as it was registered.

```
int mb_remove_reserved_func(struct mb_interpreter_t* s,  
                           const char* n);
```

This function removes a reserved function out of an interpreter

structure by a given name. Do not use this function unless you really need to.

Invoking

These functions are utilities called in extended functions.

```
int mb_attempt_func_begin(struct mb_interpreter_t* s,  
                          void** l);
```

This function checks whether script is invoking an extended function in a legal begin format.

```
int mb_attempt_func_end(struct mb_interpreter_t* s,  
                        void** l);
```

This function checks whether script is invoking an extended function in a legal end format.

```
int mb_attempt_open_bracket(struct mb_interpreter_t* s,  
                            void** l);
```

This function checks whether script is invoking an extended function in a legal format that begins with an open bracket before arguments list.

```
int mb_attempt_close_bracket(struct mb_interpreter_t* s,  
                             void** l);
```

This function checks whether script is invoking an extended function in a legal format that ends with a close bracket after arguments list.

```
int mb_has_arg(struct mb_interpreter_t* s,  
               void** l);
```

This function detects whether there is any more argument at current execution position in an interpreter structure. Use this function to

implement a variable parameters interface function.

```
int mb_pop_int(struct mb_interpreter_t* s,  
              void** l,  
              int_t* val);
```

This function tries to pop an argument of `int_t` from an interpreter structure.

```
int mb_pop_real(struct mb_interpreter_t* s,  
               void** l,  
               real_t* val);
```

This function tries to pop an argument of `real_t` from an interpreter structure.

```
int mb_pop_string(struct mb_interpreter_t* s,  
                 void** l,  
                 char** val);
```

This function tries to pop an argument of `char*` from an interpreter structure.

```
int mb_pop_value(struct mb_interpreter_t* s,  
                void** l,  
                mb_value_t* val);
```

This function tries to pop an argument of `mb_value_t` from an interpreter structure. Use this function instead of `mb_pop_int`, `mb_pop_real` and `mb_pop_string` if an extended function accepts arguments of generics types.

```
int mb_push_int(struct mb_interpreter_t* s,  
               void** l,
```

```
int_t val);
```

This function tries to push an argument of `int_t` to an interpreter structure.

```
int mb_push_real(struct mb_interpreter_t* s,  
                void** l,  
                real_t val);
```

This function tries to push an argument of `real_t` to an interpreter structure.

```
int mb_push_string(struct mb_interpreter_t* s,  
                  void** l,  
                  char* val);
```

This function tries to push an argument of `char*` to an interpreter structure.

```
int mb_push_value(struct mb_interpreter_t* s,  
                 void** l,  
                 mb_value_t val);
```

This function tries to push an argument of `mb_value_t` to an interpreter structure. Use this function instead of `mb_push_int`, `mb_push_real` and `mb_push_string` if an extended function returns value of generics types.

Parsing and running

```
int mb_load_string(struct mb_interpreter_t* s,  
                  const char* l);
```

This function loads a string into an interpreter structure; then parses script source to executable structures and appends them to the

abstract syntax tree.

```
int mb_load_file(struct mb_interpreter_t* s,  
                const char* f);
```

This function loads a string into an interpreter structure; then parses script source to executable structures and appends them to the abstract syntax tree.

```
int mb_run(struct mb_interpreter_t* s);
```

This function runs a parsed abstract syntax tree in an interpreter structure.

```
int mb_suspend(struct mb_interpreter_t* s,  
              void** l);
```

This function suspends and saves current execution point. Some extended functions need this ability and resume that point after some other operations. Call `mb_run` as well to resume a suspended point.

Error handling

```
mb_error_e mb_get_last_error(struct mb_interpreter_t* s);
```

This function returns the latest error information of an interpreter structure.

```
const char* mb_get_error_desc(mb_error_e err);
```

This function returns the description string of error information.

```
int mb_set_error_handler(struct mb_interpreter_t* s,  
                        mb_error_handler_t h);
```

This function sets an error callback handler of an interpreter structure.

Stream redirect

```
int mb_set_printer(struct mb_interpreter_t* s,  
                  mb_print_func_t p);
```

This function sets a **PRINT** handler of an interpreter structure. Use this to customize an output handler for the **PRINT** statement. The function to be set must be a pointer of `int (* mb_print_func_t)(const char*, ...)`. `printf` is set by default.

```
int mb_set_inputter(struct mb_interpreter_t* s,  
                   mb_input_func_t p);
```

This function sets the **INPUT** handler of an interpreter structure. Use this to customize an input handler for the **INPUT** statement. The function to be set must be a pointer of `int (* mb_input_func_t)(char*, int)`. `mb_gets` is set by default.

Miscellaneous

```
int mb_gets(char* buf,  
            int s);
```

A more safety evolvement of the standard `gets`.

```
int mb_strdup(char* val,  
              unsigned size);
```

This function duplicates a string to a MY-BASIC manageable string buffer structure; use this to generate an argument for strings to be pushed.

5. Scripting with MY-BASIC

As to source code portability, the C programming language is most outstanding, because C compilers are available on almost every platform; that is why MY-BASIC is written in pure clean C so it can be compiled for PC, Mac, mobile devices, game console, super computers, MCU, smart cards, etc. with none or few porting modifications. It would be pretty easy to bind MY-BASIC in an existing project by just adding the MY-BASIC core which consists of a header declaration file and corresponding C implementation file into the target project.

First of all, you should recognize which parts in your project require execution speed and low level control, and which parts require flexibility and augmentability. It's not wise to code kernel computation-intensive modules in script; script is appropriate for volatile parts of an entire program. There is no one fits all solution; scripting programming languages are not omnipotent.

If it is explicit to you that using a scripting language would benefit your project then you should make and expose some interfaces correctly. More details on how to create your own scripting interfaces will be dealt with in the next chapter. After that you may complete your program with MY-BASIC script, invoking those scripting interfaces and pack them together into a publishable version.

Besides the scripting benefits, play with a scripting language itself is a really enjoyable thing.

6. Customizing MY-BASIC

MY-BASIC is a free and open source software released under the MIT license which allows you to use, modify and extend the software for either commercial or noncommercial uses. You might need more scripting libraries according to your specific requirement though MY-BASIC has already provided some functions. It is not difficult in MY-BASIC to do so.

The first step is to define the function in your host program. All C / C++ / Objective-C callee functions that will be invoked from MY-BASIC script is a pointer of type `int (* mb_func_t)(struct mb_interpreter_t*, void**)`. Since an interpreter structure is used as the first argument of an extended function, the function actually can pop any number of arguments from the interpreter structure and push none or one return value back into the structure. The `int` return value indicates an execution status of an extended function which always returns `MB_FUNC_OK` for no error. Let's make a `maximum` function that returns the maximum value of two integers as a tutorial; see code below:

```
int maximum(struct mb_interpreter_t* s, void** l) {
    int result = MB_FUNC_OK;
    int m = 0;
    int n = 0;
    int r = 0;

    mb_assert(s && l);

    mb_check(mb_attempt_open_bracket(s, l));
    mb_check(mb_pop_int(s, l, &m));
    mb_check(mb_pop_int(s, l, &n));
    mb_check(mb_attempt_close_bracket(s, l));

    r = m > n ? m : n;
    mb_check(mb_push_int(s, l, r));

    return result;
}
```

Quite simple, isn't it.

The second step is to register defined functions like: `mb_reg_fun(bas, maximum)` (supposing we already have `struct mb_interpreter_t* bas` defined).

After that you can use a registered function as any other scripting

interfaces in MY-BASIC like:

```
i = MAXIMUM(1, 2)
PRINT i
```

To perform a user defined abort, just return an integer value greater equal than a macro `MB_EXTENDED_ABORT`. It is recommended to add an abort value like:

```
typedef enum mb_user_abort_e {
    MB_ABORT_FOO = MB_EXTENDED_ABORT + 1,
    /* more... */
};
```

Then write `return MB_ABORT_FOO;` in your customized function when something uncontrollable happened.

7. Memory Occupation

In some memory limited environments, memory occupation is often a sensitive bottleneck. MY-BASIC provides a method to count how much memory has an interpreter context allocated. Define `_MB_ENABLE_ALLOC_STAT` at `my_basic.h` or some place else where `my_basic.c` can include; this macro was already defined if a `_DEBUG` was defined and `NDEBUG` was not. Write script like below to tell how

much memory does MY-BASIC allocated:

PRINT MEM ' The keyword MEM is right for this

Note that it will take `sizeof(intptr_t)` bytes more of each allocation if this statistics is enabled.

Comment the `MB_ENABLE_SOURCE_TRACE` macro in `my_basic.h` to disable source trace to reduce some memory occupation, but you will lost the error locating feature as well.

Redefine the `_HT_ARRAY_SIZE_DEFAULT` macro with a smaller value minimum to `1` in `my_basic.c` to reduce memory occupied by hash tables in MY-BASIC. Value `1` means a linear lookup.

8. Using MY-BASIC as a Standalone Interpreter

You would be familiar with the MY-BASIC interpreter if you have tried the hello world tutorial. There are some useful commands in interpreter mode:

Command	Summary	Usage
HELP	Shows help information.	
CLS	Clears screen.	
NEW	Clears current program.	
RUN	Runs current program.	

BYE	Quits interpreter.	
LIST	Lists current program.	LIST [l [n]], l is start line number, n is line count.
EDIT	Edits a line in current program.	EDIT n, n is line number.
LOAD	Loads a file as current program.	LOAD *.*
SAVE	Saves current program to a file.	SAVE *.*
KILL	Deletes a file.	KILL *.*

Type a command (maybe also with several arguments) and hit enter to execute it. Command is only an aspect of the interpreter other than keyword, that is to say it is valid to use them as variable identifiers in a program; but to avoid reading confusion and conflict, and you may consider different identifier naming.

9. Extra Information

Document version

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