MY-BASIC
Quick Reference

https://github.com/paladin-t/my_basic

1. Introduction

MY-BASIC is a lightweight BASIC interpreter written in standard C, with only dual files. Aimed to be embeddable, extendable and portable. It is a dynamic typed programming language. It supports structured grammar; implements a style of OOP called prototype-based programming paradigm; and it offers a functional programming ability with lambda abstraction. The kernel is written with a C source file and an associated header file. It's easy to either embed it or use it as a standalone interpreter. You can get how to use it and how to add new scripting interfaces in five minutes. It's possible to combine MY-BASIC with an existing project in C, C++, Java, Objective-C, Swift, C# and many other languages. Script driven can make your projects configurable, scalable and elegant. It's also possible to learn how to build an interpreter from scratch with MY-BASIC, or build your own dialect based on it.

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 revision or other information, see https://github.com/paladin-t/my_basic; or contact with the author via mailto:hellotony521@qq.com to get support.

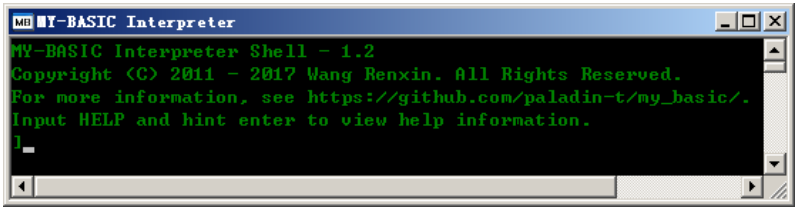
2. Programming with BASIC

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 any 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, your passion affected many people like me, and guided us to the computer science.

MY-BASIC has a structured BASIC syntax, and offers many other retro and modern features. It would be familiar to you if you have ever programmed with another BASIC dialect, or other programming languages.

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 code to make a build manually. You can get the latest revision with *git clone https://github.com/paladin-t/my_basic.git*. It is recommended to get a MY-BASIC executable and have a quick glance. In this part let's get start using the MY-BASIC interpreter, which comes as follow:



The close square bracket is an input prompt. Come alone with a "Hello World" convention in MY-BASIC:

```
' Hello world tutorial
input "What is your name: ", n$
def greeting(a, b)
    return a + " " + b + " by " + n$ + "."
enddef
print greeting("Hello", "world");
```

Like other BASIC dialects, MY-BASIC is case-insensitive; that is to say *PRINT A$* and *Print a$* mean all the same. You would get the response text after giving it a *RUN* command and hinting Enter. Any text begins with a single quote until the end of that line is a comment (or remark) which won't influence the logic of a program; a comment does not perform anything, it's just a short explanation of code. It's also able to use the retro *REM* statement to start a comment as well.

MY-BASIC is configurable with macros, this manual is described with default configuration.

Multi-line comment

MY-BASIC also supports multi-line comment, which is an advantage comparing to other dialects. It's surrounded by "*'[*" and "*']*", for example:

```
print "Begin";
'[
print "This line won't be executed!";
print "This is also ignored";
']
print "End";
```

MY-BASIC will ignores all comment lines between them. The convenience is it's possible to simply modify "*'[*" to "*''[*" to uncomment all lines.

Support for Unicode

Unicode is widely used nowadays for international text representation; MY-BASIC supports both Unicode based identifier and string manipulation. For example:

```
print "你好" + "世界";

日本語 = "こんにちは"
print 日本語, ", ", len(日本語);
```

Keywords

There are some keywords and reserved function words in MY-BASIC as follow:

Keywords		REM, NIL, MOD, AND, OR, NOT, IS, LET, DIM, IF, THEN, ELSEIF, ELSE, ENDIF, FOR, IN, TO, STEP, NEXT, WHILE, WEND, DO, UNTIL, EXIT, GOTO, GOSUB, RETURN, CALL, DEF, ENDDEF, CLASS, ENDCLASS, ME, NEW, VAR, REFLECT, LAMBDA, MEM, TYPE, IMPORT, END
Reserved words	Standard library	ABS, SGN, SQR, FLOOR, CEIL, FIX, ROUND, SRND, RND, SIN, COS, TAN, ASIN, ACOS, ATAN, EXP, LOG, ASC, CHR, LEFT, LEN, MID, RIGHT, STR, VAL, PRINT, INPUT
	Collection library	LIST, DICT, PUSH, POP, BACK, INSERT, SORT, EXISTS, INDEX_OF, GET, SET, REMOVE, CLEAR, CLONE, TO_ARRAY, ITERATOR, MOVE_NEXT

It is not accepted to use these words for user-defined identifiers; in addition there are two more predefined boolean constants, aka. *TRUE* and *FALSE*, which obviously represent boolean value true and false, it's not accepted to reassign these two symbols with other value. Details of keywords and functions will be mentioned latter in this manual.

Operators

All operators in MY-BASIC as follow:

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

All these operators can be used in calculation or comparison expressions. Besides, the keywords *MOD*, *AND*, *OR*, *NOT*, *IS* are also operators. An expression is evaluated from left to right, with top down priorities as follow:

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

MOD stands for modulus, aka. "*%*" in some other programming languages. The caret symbol stands for power operation.

Data types and operations

MY-BASIC is a dynamic programming language, therefore variables don't have types, but values do. The built-in types are: Nil, Integer, Real, String, Type, Array, List, List Iterator, Dictionary, Dictionary Iterator, Prototype (aka. "Class"), and Sub Routine (including Lambda). Besides, MY-BASIC also supports user defined data types (Usertype

and Referenced Usertype) to let you to customize your own data structures.

Nil is a special type which includes only one valid value *NIL*, aka. *null*, *none*, *nothing*, etc. It unreferences the previous value of a variable by assigning it with a nil.

A Type typed value represents the type of a value, it will be explained with the *TYPE* statement.

Integer and real are defined as *int* and *float* of C types which are 32bit size under common compilers. You could redefine them with other types such as *long*, *long long*, *double* and *long double* by modifying a few lines of code. Since there is no dedicated boolean type, it's defined as integer, and can be assigned from any expression. It results false in a boolean condition with *NIL*, *FALSE*, and *0*; it results true with all other values including a blank string *""*.

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

A variable identifier is formed with letters, numbers, underline and an optional dollar postfix, but it must begin with a letter or an underline. It's not accepted to use type specifier for variable, and you don't need to declare it before accessing it neither. You don't need to manage conversion between integer and float values manually, generally MY-BASIC stores numbers with proper data type automatically. The dollar sigil *$* is reserved from traditional BASIC dialects as a valid postfix of a variable identifier. Representing for

different identifiers respectively with or without it. But it doesn't denote for type of string in most cases. However, there are special cases that *$* does mean something with the *DIM* and *INPUT* statements. An assignment statement consists of a beginning keyword *LET* and a following assignment expression, the word *LET* is optional. For example:

```
let a = 1 ' Assignment statement begins with LET
pi = 3.14 ' Another assignment statement without LET
```

MY-BASIC supports array up to four dimensions by default, which is defined by a macro. 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 by the array name and subscript. An array must be declared by a *DIM* (short for dimension) statement before using, for example:

```
dim nums(10)
dim strs$(2, 5)
```

The common naming rules for an array are the same as naming a variable, actually all user identifiers in MY-BASIC obey the same rules. An array can be a collection of either real or string, depends on whether the identifier ends up with a *$* sigil. Dimensions are separated by commas. Array indexes begin from zero in MY-BASIC therefore *nums(0)* is the first element of array *nums*, it is a little different from other BASIC, but more common in 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 results an integer; an invalid index may cause an out of bound error.

It is possible to concatenate two Strings together using the plus operator "*+*". Each string concatenating generates a new string object with memory allocation. It is also possible to apply comparison operators to Strings, which starts comparing the first character of both string, if they are equal to each other, it continues checking the following ones until a difference occurs or reaching the end of a string; then return an integer value indicating the relationship.

Structured routine

It is possible to extract reusable code blocks with sub routines. MY-BASIC supports both structured routine with the *CALL*/*DEF*/*ENDDEF* statements and instructional routine with the *GOSUB*/*RETURN* statements, but they can't be mixed together in one program.

A structured routine begins with a *DEF* statement and ends with *ENDDEF*, you can define routines with any arity. It's similar to call a sub routine with calling a native scripting interface. It requires an explicit *CALL* statement, if a routine is lexically defined after calling. A routine returns the value of the last expression back to its caller, or returns explicitly with the *RETURN* statement. For example:

```
a = 1
b = 0
def fun(d)
    d = call bar(d)
    sin(10)
    return d ' Try comment this line
enddef
def foo(b)
    a = 2
    return a + b
enddef
def bar(c)
    return foo(c)
enddef
r = fun(2 * 5)
print r; a; b; c;
```

Each routine has its own scope for variable lookup.
Furthermore, the *CALL* statement is used to get an invokable value as:

```
routine = call(fun) ' Get an invokable value
routine() ' Invoke an invokable value
```

Be aware it requires a pair of brackets to get the value, or it's a calling execution.

Instructional routine

Traditional instructional routine is reserved as well. A label is used to tag the start point of an instructional routine. You can use a *GOSUB* statement wherever in the program to call a routine label. The *RETURN* statement is used to exit a routine and transfer control back to its caller.

Control structures

There are three kinds of execution flows in MY-BASIC.

Serial structure, which executes statements line by line, is the most basic structure. MY-BASIC supports the *GOTO* statement which provides unconditional control transfer ability. You can execute it like *GOSUB* as *GOTO label*. An instructional routine can return back from a callee, but unconditional *GOTO* cannot. The *END* statement can be placed anywhere in source code to terminate the whole execution of a program.

Conditional structures consist of some condition jump statements: *IF*/*THEN*/*ELSEIF*/*ELSE*/*ENDIF*. These statements check condition expressions then perform an action in a case of true condition branch, otherwise in a case of false it performs something else as you write.

You can write conditional *IF* statements in a single line:

```
if n mod 2 then print "Odd"; else print "Even";
```

Or multiple lines:

```
input n
if n = 1 then
    print "One";
elseif n = 2 then
    print "Two";
elseif n = 3 then
    print "Three";
else
    print "More than that";
endif
```

It supports nested *IF* with multi-line conditional statements.

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

Use the *FOR*/*TO*/*STEP*/*NEXT* statements to loop through certain steps. For example:

```
for i = 1 to 10 step 1
    print i;
next i
```

The *STEP* part is optional if it increases with *1*. The loop variable after *NEXT* is also optional if it is associated with a corresponding *FOR*.

MY-BASIC also supports loop on collections with the *FOR*/*IN*/*NEXT* statements. It's possible to iterate list, dictionary, iterable class and usertypes. The loop variable is assigned with the value of the element

which an iterator is currently pointing to. For example, this counts from one to five:

```
for i in list(1 to 5)
    print i;
next
```

The *WHILE*/*WEND* and *DO*/*UNTIL* loops are used to loop through uncertain steps, or to wait for certain conditions. For example:

```
a = 1
while a <= 10
    print a;
    a = a + 1
wend
```

```
a = 1
do
    print a;
    a = a + 1
until a > 10
```

Just as their names imply, the *WHILE*/*WEND* statements do the loop body while the condition is true, and the *DO*/*UNTIL* statements do it until the condition is false. The *WHILE*/*WEND* statements check condition before executing loop body, while the *DO*/*UNTIL* statements check condition after loop body has been executed once.

The *EXIT* statement interrupts current loop and continues to execute the program after loop.

Using class

MY-BASIC supports prototype-based programming paradigm which is a kind of OOP (Object-Oriented Programming). It is also as known as "prototypal", "prototype-oriented", "classless", or "instance-based" programming. Use a pair of *CLASS*/*ENDCLASS* statements to define a prototype object (a class). Use *VAR* to declare a member variable in a class. It's able to define member function (aka. "method") in a prototype with the *DEF*/*ENDDEF* statements as well. Write another prototype surrounding with a pair of parentheses after a declaration statement to inherit from it (which means using it as meta class). Use the *NEW* statement to create a new clone of a prototype. For example:

```
class foo
    var a = 1
    def fun(b)
        return a + b
    enddef
endclass

class bar(foo) ' Use Foo as a meta class (inheriting)
    var a = 2
endclass

inst = new(bar) ' Create a new clone of Bar
print inst.fun(3);
```

"*bar*" will simply link "*foo*" as meta class. But "*inst*" will create a new clone of "*bar*" and keep the "*foo*" meta linkage.

MY-BASIC supports reflection with a prototype with the *REFLECT* statement. It iterates all variable fields and sub routines in a class and its meta class, and stores *name*/*value* pairs of variables and *name*/*type* pairs of sub routines to a dictionary. For example:

```
class base
	var b = "Base"
	def fun()
		print b;
	enddef
endclass
class derived(base)
	var d = "Derived"
	def fun()
		print d;
	enddef
endclass
i = new(derived)
i.fun();
r = reflect(i)
f = iterator(r)
while move_next(f)
	k = get(f)
	v = r(k)
	print k, ": ", v;
wend
g = get(i, “fun”);
g()
```

Using Lambda

A lambda abstraction (aka. “anonymous function” or “function literal”) is a function definition that is not bound to an identifier. Lambda functions are often:

1. Arguments being passed to higher order functions, or
2. Used for constructing the result of a higher-order function that needs to return a function.

A lambda becomes a closure after it captured some values in outer scope.

MY-BASIC offers full support for lambda, including invokable as a value, higher order function, closure and currying, etc.

Lambda abstraction begins with the *LAMBDA* keyword. For example:

```
' Simple invoke
f = lambda (x, y) (return x * x + y * y)
print f(3, 4);
```

```
' Higher order function
def foo()
    y = 1
    return lambda (x, z) (return x + y + z)
enddef
l = foo()
print l(2, 3);
```

```
' Closure
s = 0
def create_lambda()
	v = 0
	return lambda ()
	(
		v = v + 1
		s = s + 1
		print v;
		print s;
	)
enddef
a = create_lambda()
b = create_lambda()
a()
b()
```

```
' Currying
def divide(x, y)
    return x / y
enddef
def divisor(d)
    return lambda (x) (return divide(x, d))
enddef
half = divisor(2)
third = divisor(3)
print half(32); third(32);
```

```
' As return value
def counter()
    c = 0
    return lambda (n)
    (
        c = c + n
        print c;
    )
enddef
acc = counter()
acc(1)
acc(2)
```

Checking the type of a value

The *TYPE* statement tells what the type of a value is, or generates a type information with a predefined type string. For example:

```
print type(123); type("Hi"); ' Get the types of values
print type("INT"); type("REAL"); ' Get the specific types
```

It's also possible to check whether a value match a specific type with the *IS* operator as follow:

```
print 123 is type("INT"); "Hi" is type("STRING");
print inst is type("CLASS");
```

The *IS* statement also tells whether an instance of a prototype is inherited from another prototype:

```
print inst is foo; ' True if foo is inst's prototype
```

Pass a type value to the *STR* statement to get the type name in string.

Importing another BASIC file

It's necessary to separate different parts into multiple reusable files with large programs. The *IMPORT* statement imports another source file just as it was written at where imported. For example assuming we got an "a.bas" as:

```
foo = 1
```

And another "b.bas" as:

```
import a.bas
print foo;
```

You can use everything you've imported. MY-BASIC handles cycle importing properly.

Importing a module

It's possible to put some native scripting interfaces in a module (aka. "namespace") to avoid naming pollution. MY-BASIC doesn't support make modules in BASIC for the moment. Use *IMPORT "@xxx"* to import a native module, all symbols in that module could be used without module prefix.

3. Core and Standard Libraries

MY-BASIC offers a set of frequently used functions which provides some fundamental numeric and string operations. These function names cannot be used for user-defined identifiers as well. For details of these functions, see the figure follow:

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 part of a number
	ROUND	Returns the nearest approximate integer of a number
	SRND	Sets the seed of random number
	RND	Returns a random float number between [0.0, 1.0] by RND, or [0, max] by RND(max), or [MIN, MAX] by RND(min, max)
	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
	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, or format a class instance with the TO_STRING function
Common	VAL	Returns the number type value of a string, or the value of a dictionary iterator, overridable for referenced usertype and class instance
	LEN	Returns the length of a string or an array, or the element count of a LIST or a DICT, overridable for referenced usertype and class instance
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

The *INPUT* statement is followed with an optional input prompt string; and the variable identifier to be filled, which accepts string when a *$* is decorated, otherwise accepts number. Note that all these

functions except *PRINT* and *INPUT* require a pair of brackets to surround arguments; the *RND* statement is a little special, it can come either with or without brackets, see the figure for detail.

4. Collection Libraries

MY-BASIC supplies a set of *LIST*, *DICT* manipulation functions, which provide creation, accessing, iteration, etc. as follow:

Name	Description
LIST	Creates a list
DICT	Creates a dictionary
PUSH	Pushes a value to the tail of a list, overridable for referenced usertype and class instance
POP	Pops a value from the tail of a list, overridable for referenced usertype and class instance
BACK	Peeks the value of a tail of a list, overridable for referenced usertype and class instance
INSERT	Inserts a value at a specific position of a list, overridable for referenced usertype and class instance
SORT	Sorts a list increasingly, overridable for referenced usertype and class instance
EXISTS	Tells whether a list contains a specific **value** (**not index**), or whether a dictionary contains a specific

	key, overridable for referenced usertype and class instance
INDEX_OF	Gets the index of a value in a list, overridable for referenced usertype and class instance
GET	Returns the value of a specific index in a list, or the value of a specific key in a dictionary, or a member of a class instance, overridable for referenced usertype and class instance
SET	Sets the value of a specific index in a list, or the value of a specific key in a dictionary, or a member variable of a class instance, overridable for referenced usertype and class instance
REMOVE	Removes the element of a specific index in a list, or the element of a specific key in a dictionary, overridable for referenced usertype and class instance
CLEAR	Clears a list or a dictionary, overridable for referenced usertype and class instance
CLONE	Clones a collection, or a referenced usertype
TO_ARRAY	Copies all elements from a list to an array
ITERATOR	Gets an iterator of a list or a dictionary, overridable for referenced usertype and class instance
MOVE_NEXT	Moves an iterator to next position for a list or a

	dictionary, overridable for referenced usertype and class instance

For example, showing how to use collections:

```
l = list(1, 2, 3, 4)
set(l, 1, "B")
print exists(l, 2); pop(l); back(l); len(l);

d = dict(1, "One", 2, "Two")
set(d, 3, "Three")
print len(d);
it = iterator(d)
while move_next(it)
    print get(it);
wend
```

MY-BASIC supports accessing elements in a list or dictionary using brackets directly:

```
d = dict()
d(1) = 2
print d(1);
```

A list begins from zero as well as how array does in MY-BASIC.

5. Application Programming Interface

MY-BASIC is written cleanly with standard C, in dual files. What you have to do to embed MY-BASIC with existing projects is just copying *my_basic.h* and *my_basic.c* to the target project, then add them to project build configuration. All interfaces are declared in *my_basic.h*. Most API return *int* values representing for execution states, most of them should return *MB_FUNC_OK* if there is no error, check the *MB_CODES* macro in *my_basic.h* for details. Yet there are some exceptions.

Interpreter structure

MY-BASIC uses an interpreter structure to store necessary data during parsing and running period; like registered function, AST (Abstract Syntax Tree), parsing context, running context, scope, error information, etc. An interpreter structure is a unit of MY-BASIC environment context.

Meta information

unsigned long mb_ver(void);

Returns the version number of current interpreter.

const char* mb_ver_string(void);

Returns the version text of current interpreter.

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 using MY-BASIC to dispose the entire system.

int mb_open(struct mb_interpreter_t** s);

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

It usually comes as:

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

int mb_close(struct mb_interpreter_t** s);

This function closes an interpreter instance after using. *mb_open* and *mb_close* must be matched in pair.

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

This function resets an interpreter instance to initialization as it was just opened. It clears all variables; and also all registered global functions if *tclrf* is *true*.

Forking

These functions are used to fork and join an interpreter.

int mb_fork(struct mb_interpreter_t** s,
struct mb_interpreter_t* r,

bool_t clfk);

This function forks a new interpreter, from *r* to *s*. All forked environments share the same registered functions, parsed code, etc. but uses its own running context. Pass *true* to *clfk* to let the source instance collects and manages data in the forked one.

int mb_join(struct mb_interpreter_t** s);

This function joins a forked interpreter. Use this to close a forked interpreter.

int mb_get_forked_from(struct mb_interpreter_t* s,
struct mb_interpreter_t** src);

This function gets the source interpreter of a forked one.

Function registration/unregistration

These functions are called to register or unregister native scripting 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 with a specific name. The function to be registered must have signature as *int (* mb_func_t)(struct mb_interpreter_t*, void**)*. A registered function can be called in MY-BASIC script. This function returns how many entries have been influenced, thus non-zero means success.

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

This function removes a registered function out of an interpreter with a specific name when it was registered. This function returns how many entries have been influenced, thus non-zero means success.

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

This function removes a reserved function out of an interpreter with a specific name. Do not use this function unless you really need to, for example, remove or replace built-in interfaces. This function returns how many entries have been influenced, thus non-zero means success.

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

This function begins a module with a name. All functions registered after a module began will be put in that module. Module is as known as namespace; use the *IMPORT* statement to get shortcuts.

int mb_end_module(struct mb_interpreter_t* s);

This function ends the current module.

Interacting

These functions are used in extended functions to communicate with the kernel.

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

This function checks whether BASIC is invoking an extended function in a legal beginning format. Call it when beginning an extended function without parameters.

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

This function checks whether BASIC is invoking an extended function in a legal ending format. Call it when ending an extended function without parameters.

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

This function checks whether BASIC is invoking an extended function in a legal format that begins with an open bracket.

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

This function checks whether BASIC is invoking an extended function in a legal format that ends with a close bracket after argument 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. Use this function to implement a variadic function. It returns zero for there's no more argument, non-zero for more.

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

This function tries to pop an argument in *int_t* from an interpreter. Then stores the result to **val*.

int mb_pop_real(struct mb_interpreter_t* s,
void** l,

real_t* val);

This function tries to pop an argument in *real_t* from an interpreter. Then stores the result to **val*.

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

This function tries to pop an argument in *char** (string) from an interpreter. And stores the pointer to **val*. You don't need to know how and when a popped string will be disposed, but note that a popped string may be disposed when popping next string argument, so, just process it or cache it in time.

int mb_pop_usertype(struct mb_interpreter_t* s,
void** l,
void** val);

This function tries to pop an argument in *void** (usertype) from an interpreter. Use *mb_pop_value* if a usertype is larger than *void** in bytes.

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

This function tries to pop an argument in *mb_value_t* from an interpreter. Use this function instead of *mb_pop_int*, *mb_pop_real* and *mb_pop_string* if an extended function accepts arguments of different types. Or popping other advanced data types.

int mb_push_int(struct mb_interpreter_t* s,

***void** l,*

int_t val);

This function pushes a value in *int_t* to an interpreter.

int mb_push_real(struct mb_interpreter_t* s,

***void** l,*

real_t val);

This function pushes a value in *real_t* to an interpreter.

int mb_push_string(struct mb_interpreter_t* s,

***void** l,*

char* val);

This function pushes a value in *char** (string) to an interpreter. The memory of *char* val* must be allocated and disposable by MY-BASIC, use *mb_memdup* to make it before pushing. For example: *mb_push_string(s, l, mb_memdup(str, (unsigned)(strlen(str) + 1));*.

int mb_push_usertype(struct mb_interpreter_t* s,

***void** l,*

void* val);

This function pushes a value in *void** (usertype) to an interpreter. Use *mb_push_value* if a usertype is larger than *void** in bytes.

int mb_push_value(struct mb_interpreter_t* s,

***void** l,*

mb_value_t val);

This function pushes a value in *mb_value_t* to an interpreter. Use this function instead of *mb_push_int*, *mb_push_real* and *mb_push_string* if an extended function returns generics types. Or pushing other

advanced data types.

Class definition

These functions are used to define a class manually at native side.

```
int mb_begin_class(struct mb_interpreter_t* s,
                   void** l,
                   const char* n,
                   mb_value_t** meta,
                   int c,
                   mb_value_t* out);
```

This function begins a class definition with a specific name. *n* is the class name. *meta* is an array of *mb_value_t**, which are meta classes; *c* is the element count of the meta array. The generated class will be returned into **out*.

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

This function ends a class definition.

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

This function gets the userdata of a class instance. The returned data will be stored into **d*.

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

This function sets the userdata of a class instance with data *d*.

Value manipulation

These functions manipulate values.

int mb_get_value_by_name(struct mb_interpreter_t* s,
void** l,
const char* n,
mb_value_t* val);

This function gets the value of an identifier with a specific name. *n* is the expected name text. It returns a value to **val*.

int mb_add_var(struct mb_interpreter_t* s,
void** l,
const char* n,
mb_value_t val,
bool_t force);

This function adds a variable with a specific identifier name and a value to an interpreter. *n* is the name text. *val* is the value of the variable. *force* indicates whether overwrite existing variable.

int mb_get_var(struct mb_interpreter_t* s,
void** l,
void** v,
bool_t redir);

This function gets a token literally, and stores it in the parameter **v* if it's a variable. *redir* indicates whether to redirect result variable to any member variable of a class instance.

int mb_get_var_name(struct mb_interpreter_t* s,
void** v,
char** n);

This function gets the name of a variable, then stores it in the parameter **n*.

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

This function gets the value of a variable into **val*.

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

This function sets the value of a variable from *val*.

int mb_init_array(struct mb_interpreter_t* s,
void** l,
mb_data_e t,
int* d,
int c,
void** a);

This function initializes an array which can be used in BASIC. The parameter *mb_data_e t* stands for the type of elements in the array, it accepts *MB_DT_REAL* or *MB_DT_STRING*; you need to disable the *MB_SIMPLE_ARRAY* macro to use a complex array with passing *MB_DT_NIL*. The *int* d* and *int c* stand for ranks of dimensions and dimension count. The function will put a created array to *void** a*.

int mb_get_array_len(struct mb_interpreter_t* s,
void** l,
void* a,
int r,
int* i);

This function gets the length of an array. *int r* means which dimension you'd like to get.

int mb_get_array_elem(struct mb_interpreter_t* s,
void** l,
void* a,
int* d,
int c,
mb_value_t* val);

This function gets the value of an element in an array.

int mb_set_array_elem(struct mb_interpreter_t* s,
void** l,
void* a,
int* d,
int c,
mb_value_t val);

This function sets the value of an element in an array.

int mb_init_coll(struct mb_interpreter_t* s,
void** l,
mb_value_t* coll);

This function initializes a collection; you need to pass a valid

mb_value_t pointer with a specific collection type you'd like to initialize.

int mb_get_coll(struct mb_interpreter_t* s,
void** l,
mb_value_t coll,
mb_value_t idx,
mb_value_t* val);

This function gets an element in a collection. It accepts *LIST* index or *DICT* key with *mb_value_t idx*.

int mb_set_coll(struct mb_interpreter_t* s,
void** l,
mb_value_t coll,
mb_value_t idx,
mb_value_t val);

This function sets an element in a collection. It accepts *LIST* index or *DICT* key with *mb_value_t idx*.

int mb_remove_coll(struct mb_interpreter_t* s,
void** l,
mb_value_t coll,
mb_value_t idx);

This function removes an element from a collection. It accepts *LIST* index or *DICT* key with *mb_value_t idx*.

int mb_count_coll(struct mb_interpreter_t* s,
void** l,
mb_value_t coll,

int* c);

This function returns the count of elements in a collection.

int mb_keys_of_coll(struct mb_interpreter_t* s,
void** l,
mb_value_t coll,
mb_value_t* keys,
int c);

This function retrieves all keys of a collection. It gets indices of a *LIST* or keys of a *DICT*; and stores them in *mb_value_t* keys*.

int mb_make_ref_value(struct mb_interpreter_t* s,
void* val,
mb_value_t* out,
mb_dtor_func_t un,
mb_clone_func_t cl,
mb_hash_func_t hs,
mb_cmp_func_t cp,
mb_fmt_func_t ft);

This function makes a referenced usertype *mb_value_t* object which holds *void* val* as raw userdata. Note you need to provide some functors for the kernel.

int mb_get_ref_value(struct mb_interpreter_t* s,
void** l,
mb_value_t val,
void** out);

This function gets the raw userdata from a referenced usertype.

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

This function increases the reference count of a referenced value.

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

This function decreases the reference count of a referenced value.

int mb_set_alive_checker(struct mb_interpreter_t s,*
mb_alive_checker_t f);

This function sets an alive object checker globally.

int mb_set_alive_checker_of_value(struct mb_interpreter_t s,*
*void** l,*
mb_value_t val,
mb_alive_value_checker_t f);

This function sets an alive object checker on specific a referenced usertype value.

int mb_override_value(struct mb_interpreter_t s,*
*void** l,*
mb_value_t val,
mb_meta_func_e m,
void f);*

This function overrides a meta function of a specific referenced usertype value.

int mb_dispose_value(struct mb_interpreter_t s,*

mb_value_t val);

This function disposes a value popped from an interpreter. Now used for strings only.

Invokable manipulation

int mb_get_routine(struct mb_interpreter_t* s,
void** l,
const char* n,
mb_value_t* val);

This function gets a routine value with its name.

int mb_set_routine(struct mb_interpreter_t* s,
void** l,
const char* n,
mb_routine_func_t f,
bool_t force);

This function sets a routine value with a specific name using a native functor.

int mb_eval_routine(struct mb_interpreter_t* s,
void** l,
mb_value_t val,
mb_value_t* args,
unsigned argc,
mb_value_t* ret);

This function evaluates an invokable value. *mb_value_t* args* is a pointer of an argument array, *unsigned argc* is the count of those

arguments. The last parameter *mb_value_t* ret* is optional; pass *NULL* to it if it's not used.

int mb_get_routine_type(struct mb_interpreter_t* s,
mb_value_t val,
mb_routine_type_e* y);

This function gets the sub type of an invokable value. *mb_value_t val* is a value of an invokable value, and the result will be assigned to *mb_routine_type_e* y*.

Parsing and running

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

This function loads a string into an interpreter; then parses BASIC source code to executable structures and appends them to the AST.

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

This function loads a string into an interpreter; then parses BASIC source code to executable structures and appends them to the AST.

int mb_run(struct mb_interpreter_t* s, bool_t clear_parser);

This function runs a parsed AST in an interpreter.

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

This function suspends and saves current execution point. Call *mb_run* again to resume from a suspended point. This is a reserved

function for compatibility reasons to provide limited suspending (with simple program).

int mb_schedule_suspend(struct mb_interpreter_t* s,
int t);

This function schedules a suspend event, and it will trigger the event after finishing active statements. It's useful to do so when you need to do something else during the whole execution.

A). *mb_schedule_suspend(s, MB_FUNC_SUSPEND);* It's re-enterable which means next *mb_run* will resume execution from where you suspended. B). *mb_schedule_suspend(s, MB_FUNC_END);* Terminate an execution normally, no error message. C). *mb_schedule_suspend(s, MB_EXTENDED_ABORT);* Or pass an argument greater than *MB_EXTENDED_ABORT* to terminate an execution and trigger an error message. You can call *mb_schedule_suspend* either in *_on_stepped* or in a scripting interface function. The difference between *mb_schedule_suspend* and *mb_suspend* is that *mb_suspend* can be called in a scripting interface only, and it cannot trap type B) and C) suspension. This is a reserved function for compatibility reasons to provide limited suspending (with simple program).

Debugging

int mb_debug_get(struct mb_interpreter_t* s,
const char* n,
mb_value_t* val);

This function retrieves the value of a variable with a specific name.

int mb_debug_set(struct mb_interpreter_t* s,
const char* n,
mb_value_t val);

This function sets the value of a variable with a specific name.

int mb_debug_get_stack_trace(struct mb_interpreter_t* s,
void** l,
char** fs,
unsigned fc);

This function traces current call stack. It requires the *MB_ENABLE_STACK_TRACE* macro enabled to use this function.

int mb_debug_set_stepped_handler(struct mb_interpreter_t* s,
mb_debug_stepped h);

This function sets a step handler of an interpreter. The function to be set must be a pointer of *int (* mb_debug_stepped_handler_t)(struct mb_interpreter_t*, void**, const char*, int, unsigned short, unsigned short)*. This function is useful for step by step debugging, or handling extra stuff during excution.

Type handling

const char* mb_get_type_string(mb_data_e t);

This function returns specific type name in string.

Error handling

int mb_raise_error(struct mb_interpreter_t* s,
void** l,

mb_error_e err,
int ret);

This function raises an error manually.

mb_error_e mb_get_last_error(struct mb_interpreter_t* s,
const char** file,
int* pos,
unsigned short* row,
unsigned short* col);

This function returns the latest error information of an interpreter structure, and detail location. It clears the latest error information after return.

const char* mb_get_error_desc(mb_error_e err);

This function returns specific error message in string.

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

This function sets an error handler of an interpreter.

IO redirection

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

This function sets a *PRINT* handler of an interpreter. 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*, ...)*. It defaults to *printf*.

int mb_set_inputer(struct mb_interpreter_t* s,

mb_input_func_t p);

This function sets the *INPUT* handler of an interpreter. 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)(const char*, char*, int)*. It defaults to *mb_gets*. The first parameter is an optional prompt text if you write *INPUT "Some text", A$*. Just ignore it if you don't use it.

Miscellaneous

bool_t mb_get_gc_enabled(struct mb_interpreter_t* s);

This function gets whether garbage collection is enabled.

int mb_set_gc_enabled(struct mb_interpreter_t* s,
bool_t gc);

This function sets whether garbage collection is enabled. Can be used to pause and resume GC.

int mb_gc(struct mb_interpreter_t* s,
int_t* collected);

This function tries to trigger a garbage collection. And gets how much memory has been collected.

int mb_get_userdata(struct mb_interpreter_t* s,
void** d);

This function gets the userdata of an interpreter instance.

int mb_set_userdata(struct mb_interpreter_t* s,
void* d);

This function sets the userdata of an interpreter instance.

int mb_set_import_handler(struct mb_interpreter_t* s,
mb_import_handler_t h);

This function sets a customized importing handler for BASIC code.

int mb_gets(const char* pmt,
char* buf,
int s);

A more safety evolvement of the standard C *gets*. Returns the length of input text.

char* mb_memdup(const char* val,
unsigned size);

This function duplicates a block of memory to a MY-BASIC manageable buffer; use this function before pushing a string argument. Note this function only allocates and copies bytes with a specific *size*, thus you have to add an extra byte to *size* for ending "*\0*". For example:

mb_push_string(s, l, mb_memdup(str, (unsigned)(strlen(str) + 1));.

int mb_set_memory_manager(mb_memory_allocate_func_t a,
mb_memory_free_func_t f);

This function sets a memory allocator and a freer globally to MY-BASIC.

6. Scripting with MY-BASIC

The C programming language is most outstanding at source code portability, because C compilers are available on almost every

platform. MY-BASIC is written in standard C, so it can be compiled for different platforms, with none or few porting modifications. It is also not painful at all to embed MY-BASIC in existing projects by just adding the core, with dual files, into the target project.

It should be realized that, which parts in your project are execution speed sensitive, and which parts are flexibility and configurability sensitive. Scripting is appropriate for the volatile parts. MY-BASIC benefits your projects with making it user customizable, extendable and flexible.

7. Customizing MY-BASIC

Redirecting PRINT and INPUT

Include a header file to use variadic:

```
#include <stdarg.h>
```

Customize a print handler for example:

```
int my_print(const char* fmt, ...){
	char buf[128];
	char* ptr = buf;
	size_t len = sizeof(buf);
	int result = 0;
	va_list argptr;
	va_start(argptr, fmt);
	result = vsnprintf(ptr, len, fmt, argptr);
	if(result < 0) {
		fprintf(stderr, "Encoding error.\n");
	} else if(result > (int)len) {
		len = result + 1;
		ptr = (char*)malloc(result + 1);
		result = vsnprintf(ptr, len, fmt, argptr);
	}
	va_end(argptr);
	if(result >= 0)
		printf(ptr); /* Change me */
	if(ptr != buf)
		free(ptr);

	return ret;
}
```

Customize an input handler for example:

```
int my_input(const char* pmt, char* buf, int s) {
	int result = 0;
	if(fgets(buf, s, stdin) == 0) { /* Change me */
		fprintf(stderr, "Error reading.\n");
		exit(1);
	}
	result = (int)strlen(buf);
	if(buf[result - 1] == '\n')
		buf[result - 1] = '\0';

	return result;
}
```

Register these handlers to an interpreter:

```
mb_set_printer(bas, my_print);
mb_set_inputer(bas, my_input);
```

Now your customized printer and inputer will be invoked instead of the standard ones. Use *PRINT* and *INPUT* in BASIC to access to them. See follow for making new functions as BASIC library.

Writing scripting API

You may need more scripting libraries according to your specific requirement, though MY-BASIC already offers some functions.

The first step is defining the function in your native language (often C).

All native callee s which will be invoked from BASIC are pointers of type *int (* mb_func_t)(struct mb_interpreter_t*, void**)*. An interpreter instance is used as the first argument of an extended function, the function can pop variadic 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 should always return *MB_FUNC_OK* for no error nor unexpected things. Let's make a *maximum* function that returns the maximum value of two integers as a tutorial; see the follow code:

```
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;
}
```

The second step is to register this functions as: *mb_reg_fun(bas, maximum);* (assuming we already have *struct mb_interpreter_t* bas* initialized).

After that you can use a registered function as any other BASIC functions in MY-BASIC as:

```
i = maximum(1, 2)
print i;
```

Just return an integer value greater than or equals to the macro *MB_EXTENDED_ABORT* to perform a user defined abort. It is recommended to add an abort value like:

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

Then use *return MB_ABORT_FOO;* in your extended function when something unexpected happened.

Using usertype values

Consider using usertypes, if built-in types in MY-BASIC cannot fit all your requirements. It can accept whatever data you give it. MY-BASIC doesn't know what a usertype really is; it just holds a usertype value, and communicates with BASIC.

There are only two essential interfaces to get or set a usertype: *mb_pop_usertype* and *mb_push_usertype*. You can push a *void** to an interpreter and pop a value as *void** as well.

For more information about using referenced usertype, see the interfaces above, or check the website.

Macros

Some features of MY-BASIC could be configured with macros.

MB_SIMPLE_ARRAY

Enabled by default. An entire array uses a unified type mark, which means there are only two kinds of array: *string* and *real_t*.

Disable this macro if you would like to store generic type values in an array including *int_t*, *real_t*, *usertype*, etc. Besides, array of *string* is still another type. Note non simple array requires extra memory to store type mark of each element.

MB_ENABLE_ARRAY_REF

Enabled by default. Compiles with referenced array if this macro defined, otherwise compiles as value type array.

MB_MAX_DIMENSION_COUNT

Defined as 4 by default. Change this to support arrays of bigger maximum dimensions. Note it cannot be greater than the maximum number which an *unsigned char* precision can hold.

MB_ENABLE_COLLECTION_LIB

Enabled by default. Compiles including *LIST* and *DICT* libraries if this macro is defined.

MB_ENABLE_USERTYPE_REF

Enabled by default. Compiles with referenced usertype support if this macro defined.

MB_ENABLE_ALIVE_CHECKING_ON_USERTYPE_REF

Enabled by default. Compiles with alive object checking functionality

on referenced usertype if this macro defined.

MB_ENABLE_CLASS

Enabled by default. Compiles with class (prototype) support if this macro defined.

MB_ENABLE_LAMBDA

Enabled by default. Compiles with lambda (anonymous function) support if this macro defined.

MB_ENABLE_MODULE

Enabled by default. Compiles with module (namespace) support if this macro defined. Use *IMPORT "@xxx"* to import a module, and all symbols in that module could be used without the module prefix.

MB_ENABLE_UNICODE

Enabled by default. Compiles with UTF8 manipulation ability if this macro defined, to handle UTF8 string properly with functions such as *LEN*, *LEFT*, *RIGHT*, *MID*, etc.

MB_ENABLE_UNICODE_ID

Enabled by default. Compiles with UTF8 token support if this macro defined, this feature requires *MB_ENABLE_UNICODE* enabled.

MB_ENABLE_FORK

Enabled by default. Compiles with fork support if this macro defined.

MB_GC_GARBAGE_THRESHOLD

Defined as 16 by default. It will trigger a sweep-collect GC cycle when such number of deallocation occurred.

MB_ENABLE_ALLOC_STAT

Enabled by default. Use *MEM* to tell how much memory in bytes is

allocated by MY-BASIC. Note statistics of each allocation takes *sizeof(intptr_t)* more bytes memory.

MB_ENABLE_SOURCE_TRACE

Enabled by default. MY-BASIC can tell where it goes in source code when an error occurs.

Disable this to reduce some memory occupation. Only do this on memory sensitive platforms.

MB_ENABLE_STACK_TRACE

Enabled by default. MY-BASIC will record stack frames including sub routines and native functions if this macro defined.

MB_ENABLE_FULL_ERROR

Enabled by default. Prompts detailed error message. Otherwise all error types will prompts a uniformed "*Error occurred*" message. However, it's always able to get specific error type by checking error code in the callback.

MB_CONVERT_TO_INT_LEVEL

Describes how to deal with real numbers after an expression is evaluated. Just leave it a real if it's defined as *MB_CONVERT_TO_INT_LEVEL_NONE*; otherwise try to convert it to an integer if it doesn't contains decimal part if it's defined as *MB_CONVERT_TO_INT_LEVEL_ALL*. Also you could use the *mb_convert_to_int_if_posible* macro to deal with an *mb_value_t* in your own scripting interface functions.

MB_PREFER_SPEED

Enabled by default. Prefers running speed over space occupation as

possible. Disable this to reduce memory footprint.

MB_COMPACT_MODE

Enabled by default. C *struct* may use a compact layout.

This might cause some strange pointer accessing bugs with some compilers (for instance, some embedded system compilers). Try disabling this if you met any strange bugs.

_WARNING_AS_ERROR

Defined as 0 by default.

Define this macro as 1 in *my_basic.c* to treat warnings as error, or they will be ignored silently.

Something like divide by zero, wrong typed arguments passed will trigger warnings.

_HT_ARRAY_SIZE_DEFAULT

Defined as 193 by default. Change this in *my_basic.c* to resize the hash tables. Smaller value will reduce some memory occupation, size of hash table will influence tokenization and parsing time during **loading**, won't influence **running** performance most of the time (except cross scope identifier lookup).

_SINGLE_SYMBOL_MAX_LENGTH

Defined as 128 by default. Max length of a lexical symbol.

8. Memory Occupation

Memory footprint is often a sensitive bottleneck, under some memory constrained platforms. MY-BASIC provides a method to

count how much memory an interpreter has allocated. Write script like follow to tell it in bytes:

```
print mem;
```

Note that it will take *sizeof(intptr_t)* bytes more of each allocation if this statistics is enabled, but the extra bytes don't count.

Comment the *MB_ENABLE_SOURCE_TRACE* macro in *my_basic.h* to disable source trace to reduce some memory occupation, but you will reserve error prompting only without source code locating.

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, mostly for parsing mechanisms and dynamic lookup with complex identifiers.

The memory is limited in embedded systems which can run for years and cause a severe waste of memory due to fragmentation. Besides, it's efficient for MY-BASIC to customizing a memory allocator, even on systems with a plenty of memory.

An allocator need to be in form of:

typedef char (* mb_memory_allocate_func_t)(unsigned s);*

And a freer:

typedef void (mb_memory_free_func_t)(char* p);*

Then you can tell MY-BASIC to use them globally instead of standard *malloc* and *free* by calling:

MBAPI int mb_set_memory_manager(mb_memory_allocate_func_t a, mb_memory_free_func_t f);

Note these functors only affect things going inside *my_basic.c*, but *main.c* still uses the standard C library.

There is already a simple memory pool implementation in *main.c*. You need to make sure the *_USE_MEM_POOL* macro is defined as *1* to enable this pool.

There are four functions in this implementation as a tutorial: *_open_mem_pool* opens the pool when setting up an interpreter; *_close_mem_pool* closes the pool when terminating; a pair of *_pop_mem* and *_push_mem* are registered to MY-BASIC. Note *_pop_mem* calls the standard *malloc* if an expected size is not a common size in MY-BASIC; and it will take *sizeof(union _pool_tag_t)* extra bytes to store meta data with each allocation. A typical workflow may looks as follow:

```
_open_mem_pool(); // Open it
mb_set_memory_manager(_pop_mem, _push_mem); // Register them
{
    mb_init();
    mb_open(&bas);
    // Other deals with MY-BASIC
    mb_close(&bas);
    mb_dispose();
}
_close_mem_pool(); // Finish
```

Strictly speaking, the pool doesn't guarantee to allocate memory at continuous spaces, it is an object pool other than a memory pool, which pops a free chunk of memory with an expected size to user, and pushes it to the stack back when user frees it instead of freeing it to system. Replace it with other efficient algorithms to get best performance and balance between space and speed.

9. Using MY-BASIC as a Standalone Interpreter

Execute the binary directly without any argument to launch in the interactive mode. There are some commands for this mode:

Command	Summary	Usage
HELP	Views 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 (modify/insert/remove) a line in current program.	EDIT n, n is line number. EDIT -i n, insert a line before a given line, n is line number. EDIT -r n, remove a line, 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 *.*.
DIR	List all files in a directory.	DIR p, p is a directory path.

Type a command (maybe with several necessary arguments) then hint enter to execute it. Commands are only operations of the interpreter other than keyword, which means it's accepted to use them as identifiers in a BASIC program, for example *LIST* is a reserved word, and a command too. But it's better to avoid using commands as identifiers to prevent reading confusion.

Pass a file path to the binary to load and run that BASIC file instantly.

Pass an option *–e* and an expression to evaluate and print it instantly, for example *–e "2 * (3 + 4)"*, note the double quotation marks are required when an expression contains spacing characters.

Pass an option *–p* and a number to set the threshold size of memory pool, for example *–p 33554432* to set the threshold to 32MB. MY-BASIC will tidy the memory pool when the free list reached this size.