Zero Calculator

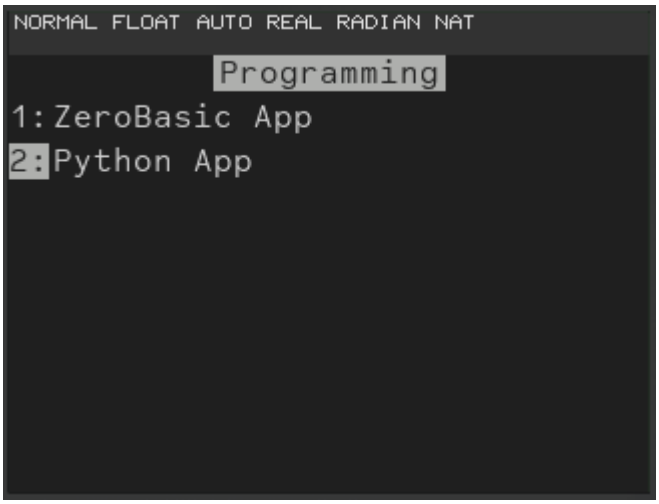
MicroPython User Manual (v2.31.1 dated 07.21.2026)

MicroPython is an implementation of the Python language written in C and designed to run on microcontrollers. More information about the MicroPython project can be found on the project website[1], in the project documentation,[2] and in the project repository[3].
Zero Calculator is able to interpret the MicroPython language. MicroPython is highly platform-dependent. This affects the modules and language features available for this platform. The language functions and features available to the user are described in the MicroPython Specification section.

I. Python app description

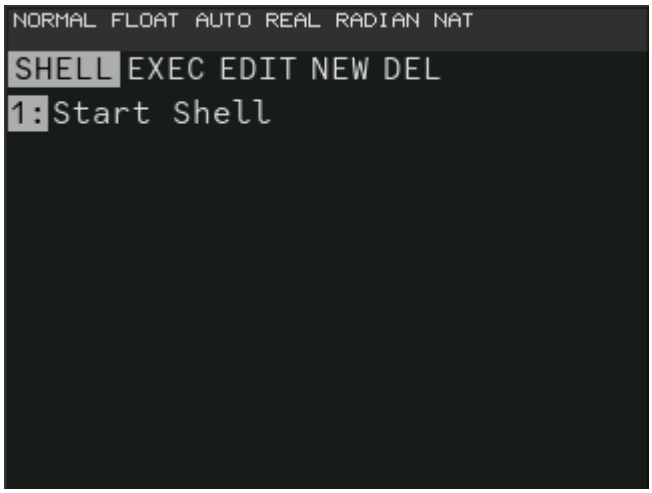
Python app is a separate Zero Calculator mode that contains its own screens and keyboard processing different from other modes.

To enter Python app, press the `prgm` key, then select Python App (`2`).

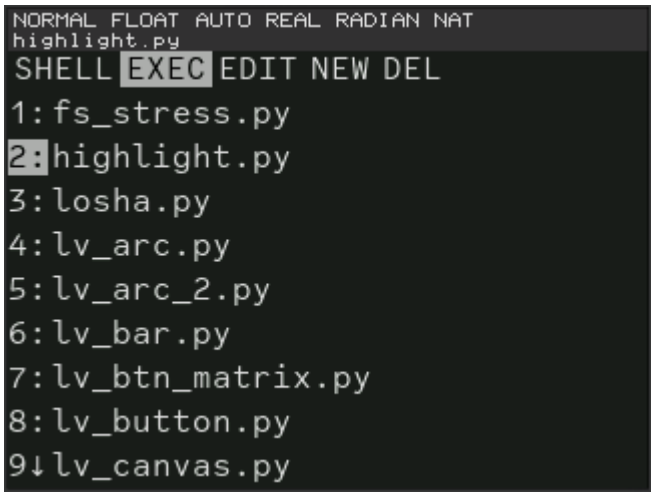


Python app contains five tabs (use `◀` and `▶` to switch between tabs): **SHELL**, **EXEC**, **EDIT**, **NEW**, **DEL**.

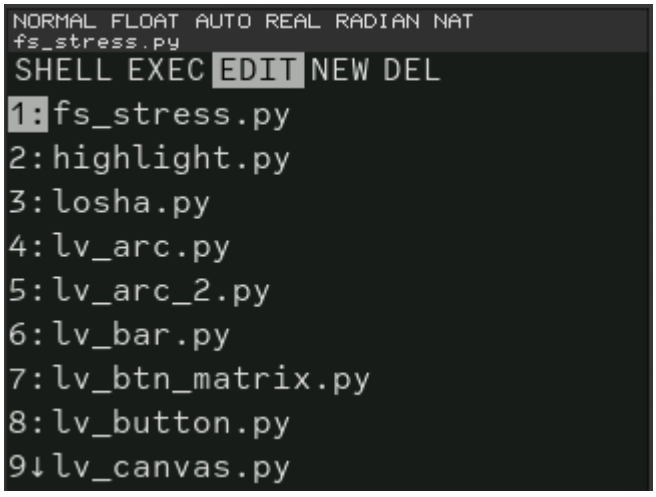
1. The **SHELL** tab. By pressing `enter` in this tab, the user can enter Python Shell window.



2. The **EXEC** tab contains a sorted list of `.py` and `.mpy` files located in the `/exchange` folder (and in subfolders). A file can be selected by using ▲ and ▼. The name of the selected file is displayed in the tooltip in the header of the screen. Pressing `enter` or the button corresponding to the file activates the execution of the selected file in Python Shell window.

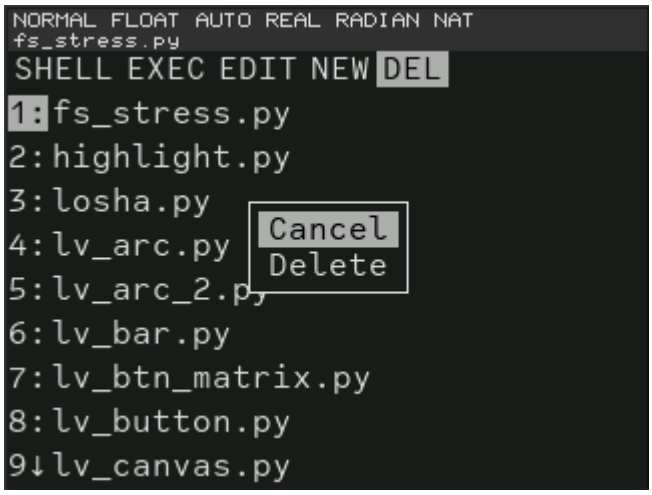


3. The **EDIT** tab contains a sorted list of `.py` files located in the `/exchange` folder (and in subfolders). A file can be selected by using ▲ and ▼. The name of the selected file is displayed in the tooltip in the header of the screen. Pressing `enter` or the button corresponding to the file activates Python Editor for the selected file.



4. The **NEW** tab allows the user to enter a path (which may contain `/`) for a new `.py` file. After the file is created, the Python Editor window is opened for editing the new file.

5. The **DEL** tab contains the same list of files as the **EXEC** tab. File activation in this tab opens the selection confirmation menu: **Cancel** (cancel deletion) and **Delete** (delete the selected file). Use `▲` and `▼` to select an action and `enter` to activate it. Closing the menu (by using `clear`, `quit` or other buttons) is equivalent to activating **Cancel**.

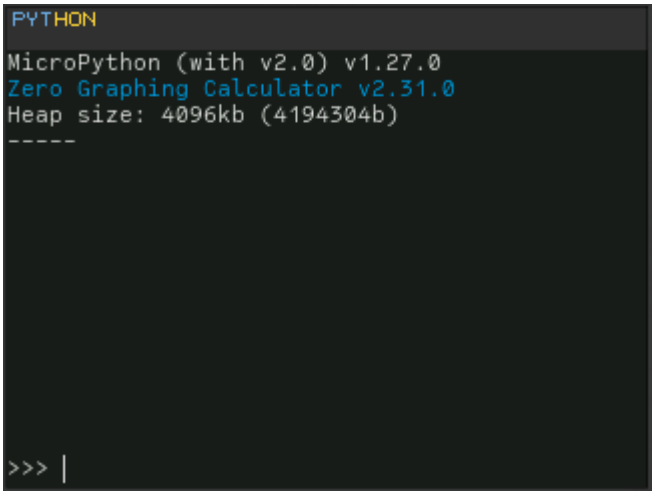


   The same deletion confirmation dialog can be opened by pressing `del` in other tabs.

To exit from Python app, press `clear`, `quit`, or buttons that open other windows (not related to Python app).

II. Python Shell window

Python Shell window contains a history block and a command input block.



Initially, the history block contains a welcome message, which includes MicroPython header with its version, the platform header with its version and size of allocated heap.

The text of the commands entered by the user along with the interpreter's interactive prompt and the text of the command execution result are saved to the history. The history can contain up to **1000** strings. As the history is filled in, older content is truncated. The maximum count of visible lines in the history block is **15**. The maximum count of symbols in one line is **45**. If the string is longer than specified, then its content will be transferred to the following lines.

The history block has vertical scrolling. Scrolling is performed by using alpha + ▲ and alpha + ▼ (The keys can be held down for faster scrolling). The amount of scrolling is 3 lines. Screen header display `Number of first displayed string : Number of last displayed string / Number of history strings count`. Also, adding information to the history block automatically scrolls it to the end.

The command input block is located at the bottom of the screen. It is used to enter commands for the Python interpreter. When entering multi-line expressions (those containing a colon), the input field will automatically add (and remove) an indentation of 2 spaces. Command execution is started after pressing enter. After this, the control over the platform will be passed to the Python interpreter. This means that the calculator screen **will not be updated** (except the `print()`, the `input()` and `flush()`), the keyboard will not respond, and the internal processes of the calculator will stop until the command is interpreted. This implementation is needed to maximize the speed of command interpretation. Interrupting command interpretation can be done with on or physical platform reset (the reset button on the backside of the calculator).

Command execution places its text to the command history (except for an empty command). The command history can contain up to **25** commands. Pressing ▲ extracts the previous command from the command history and places it to the command input block. If there is no previous command, the button is ignored. Pressing ▼ extracts the next command from the command history and places it to the command input block. If there is no next command, then an empty string is placed to the command input block.

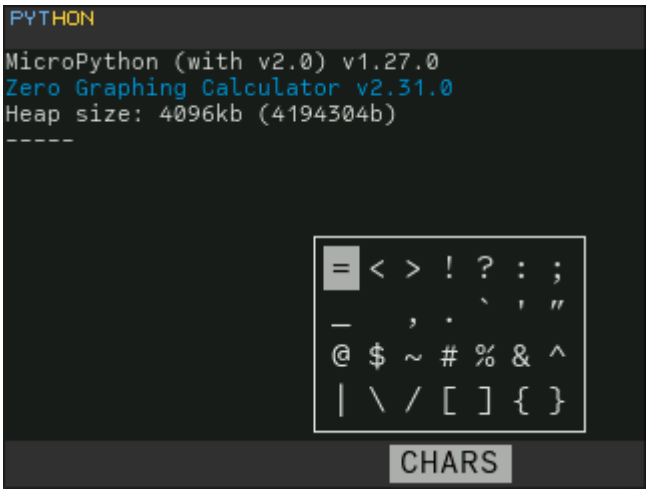
The command input block has horizontal scrolling. Scrolling is done automatically by trying to move the cursor beyond the input field by using ◄ and ►.
Commands entered by the user are executed in the same context of the Python interpreter. The context and the history of commands and results are reset after closing Python Shell window or shutting down the platform.

Keyboard processing in Python Shell window is different from keyboard processing in other modes of Zero Calculator. Below is the list of buttons, symbols, combinations, and the logic of processing thereof:

- 2nd, alpha work similarly to other Zero Calculator modes.
- on throws `KeyboardInterrupt` interruption at the moment of interpreting the command.
- ▲, ►, ▼, ◄ Their work is described above.
- 2nd + ◄, 2nd + ► moves the cursor to the beginning or end of the command input block.
- alpha + ▲, alpha + ▼ scrolls the history block.
- **quit** exits Python Shell window and switches to Python app or interrupts execution of `input()` command.
- **off** switches off Zero Calculator.
- del, alpha + del removes previous symbol.
- clear clears command input block.
- ^, ,, (,), ÷, ×, -, +, ., 0 - 9, **{**, **}**, **]**, **[**, **u**, **v**, **w**, **"**, **?**, **:** insert the corresponding character into the command input block.
- **A - Z** insert the corresponding case-sensitive letter into the command input block.
- sto→ inserts `=` into the command input block.
- (-) inserts `_` into the command input block.
- **π** inserts `pi` into the command input block.
- 2nd + ÷ inserts `\` into the command input block.
- 2nd + + inserts `'` into the command input block.
- 2nd + sto→ inserts `!` into the command input block.
- ␣ inserts space into the command input block.

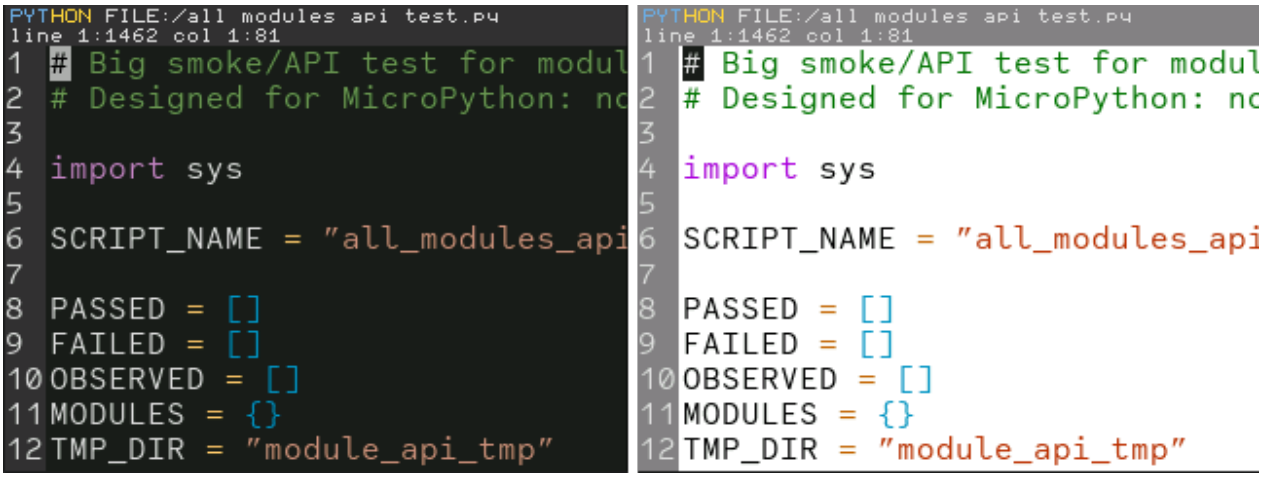
- `θ` inserts `@` into the command input block.
- `prgm` opens the Expression Insertion window.

All other characters can be inserted using the **CHARS** tab in the bottom menu. The bottom menu can be opened using `f4` (`alpha` + `trace`).



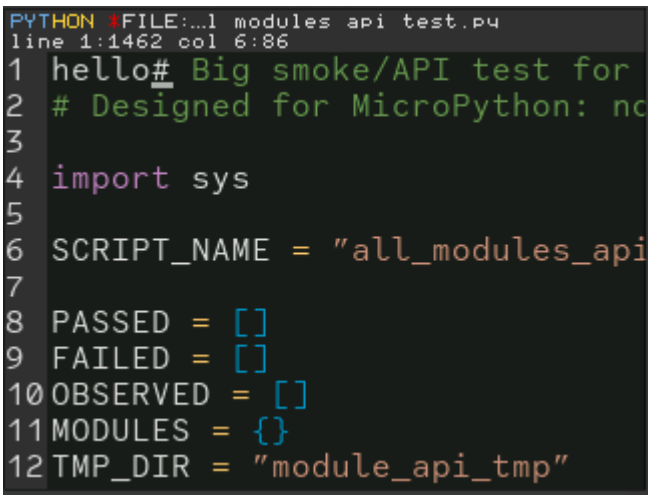
III. Python Editor window

The Python Editor window is designed for convenient editing of `.py` files.



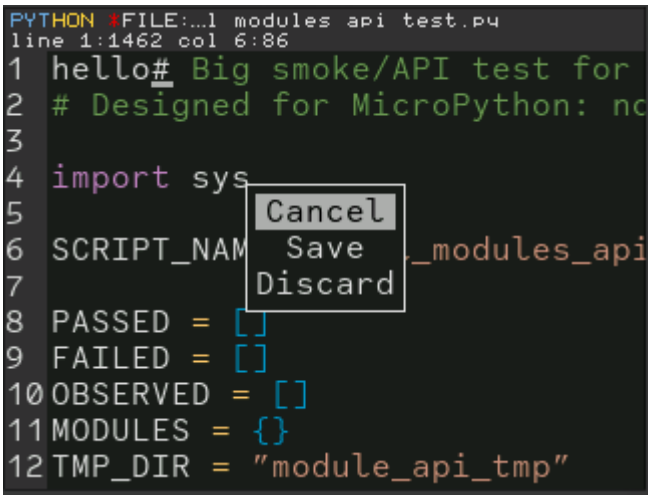
The maximum editable file size is **500 KB** (512000 bytes).

The window header displays the editor mode (PYTHON), the file status (an unsaved file is indicated by a red asterisk), and the full path to the edited file (excluding the `/exchange` directory). The bottom of the header displays the current cursor position, as well as the current line number and the number of characters in the current line (+1).



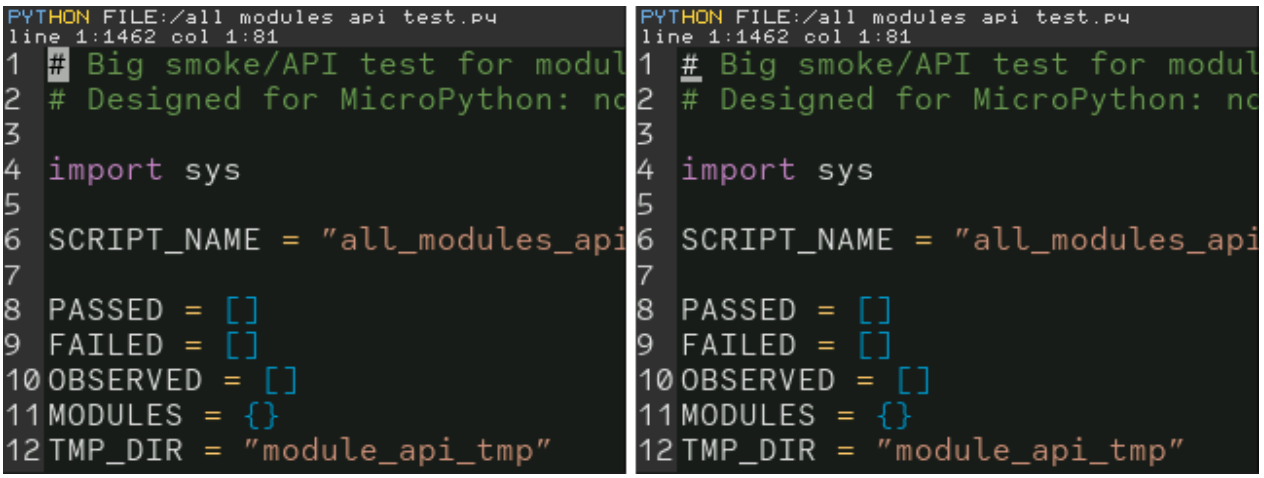
Navigation within the file is performed using ▲, ▶, ▼, and ◀. The key combinations alpha + ▲ and alpha + ▼ are equivalent to Page Up and Page Down, scrolling by all lines currently visible on the screen. These key combinations can be held down for continuous scrolling. The key combinations 2nd + ◀ and 2nd + ▶ are equivalent to Home and End, moving the cursor to the beginning and end of the current line.

You can exit from the editor by pressing `quit`. If the file has not been saved, the editor prompts you to cancel the exit, save the changes, or exit without saving.



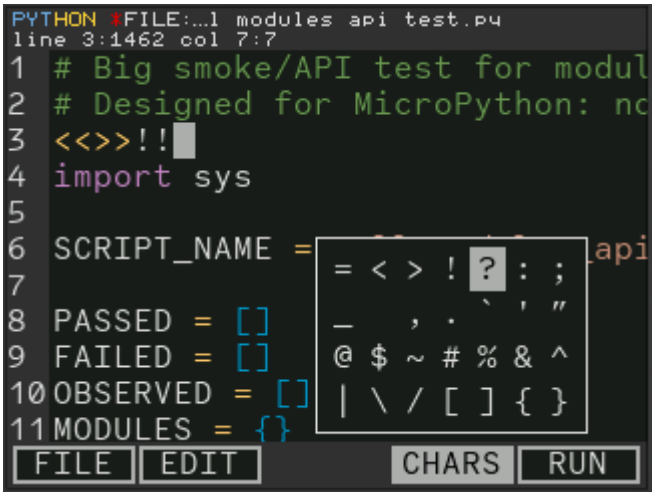
The editor window may also be closed unintentionally (for example, when the calculator is turned off or when switching to a non-inherited window). In this case, a dialog will also be displayed offering to save the changes. If the calculator powers off automatically (after the timeout configured in the **MODE** settings under the *Off Time* option), any **unsaved changes will be lost**.

File (text) editing is performed by entering characters using the keyboard. Entering many characters requires using key combinations with 2nd and alpha. The editor supports two editing modes: *Replace* and *Insert*. Replace mode is enabled by default. Entering a character or expression replaces the character under the cursor (or the selected text). In Insert mode, the entered character or expression is inserted before the cursor (however, selected text is still **replaced**). The editing mode can be switched by pressing `ins`.

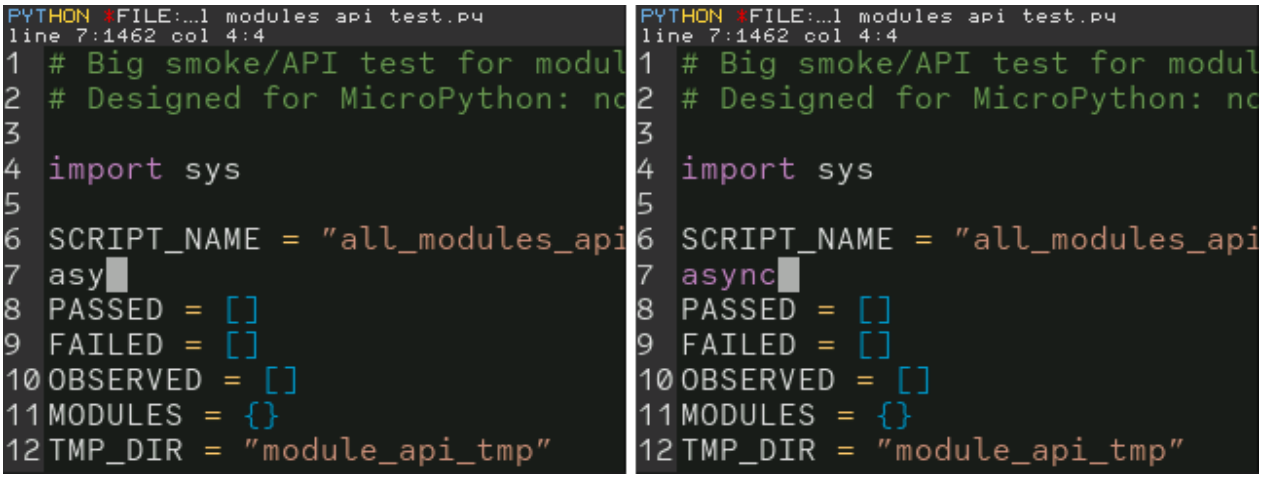


A new line is inserted by pressing `enter`. Characters are deleted using `del` (deletes the current character or selection) and `alpha` + `del` (deletes the previous character or selection).

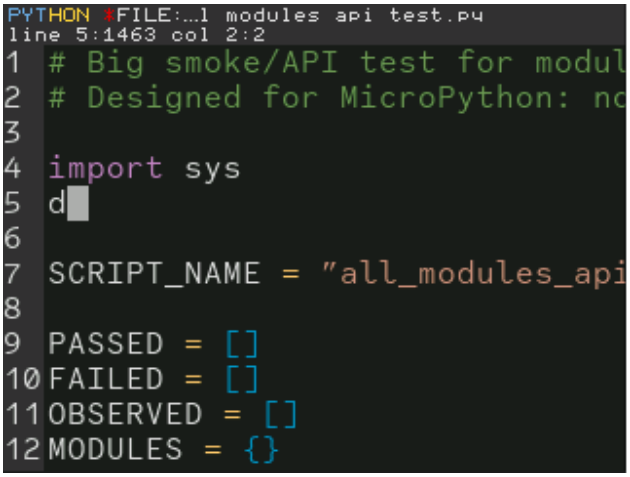
The physical calculator's keyboard cannot directly enter some special characters. These can be inserted using the **CHARS** tab of the bottom menu (`f4`). While the menu is open, the editor still supports character deletion (`del`, `alpha` + `del`) and switching between *Insert* / *Replace* modes.



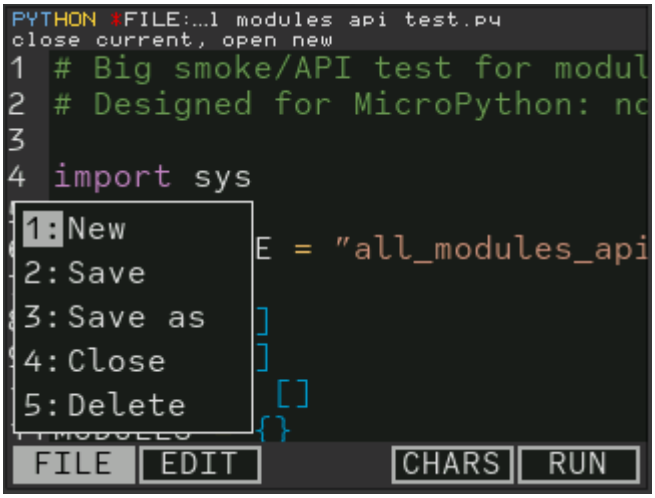
The editor supports code autocompletion. To use it, move the cursor to the end of a word (or to an empty position) and press `entry` (`2nd` + `enter`).



If multiple completion candidates are available, a bottom menu is displayed allowing the desired entry to be selected. This menu supports searching using `a` - `z` . You can exit from the menu by pressing `quit` .

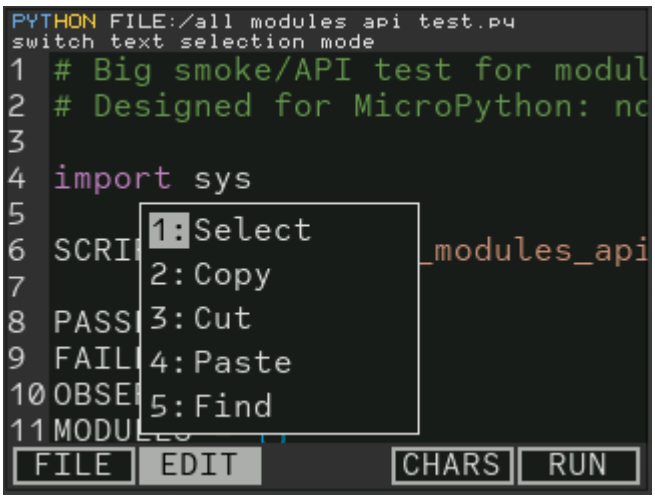


Any modification to the file activates the unsaved changes indicator in the window header. The file can be saved either when closing the editor or from the **FILE** tab of the bottom menu (`f1`).

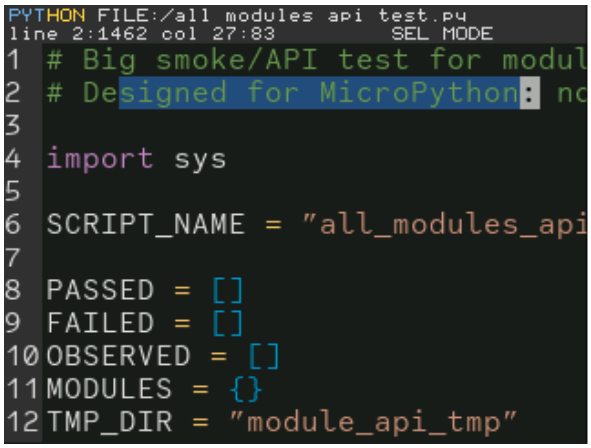


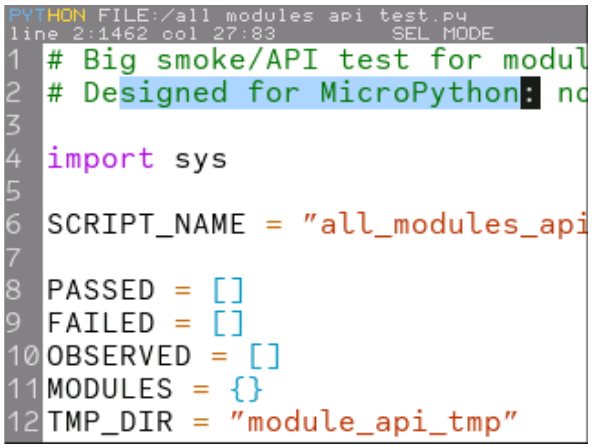
1. **New** - Closes the current file (prompting to save it if necessary), displays the new file creation dialog, and opens the specified file for editing.
2. **Save** - Saves the file and clears the unsaved changes indicator.
3. **Save as** - Opens a dialog for entering the destination path where the current file will be saved. After a successful save, the editor continues editing the file at the new location.
4. **Close** - Closes the current file (prompting to save it if necessary).
5. **Delete** - Prompts the user to delete the currently open file. If confirmed, the file will be deleted.

The **EDIT** tab of the bottom menu (`f2`) contains several operations that simplify editing.

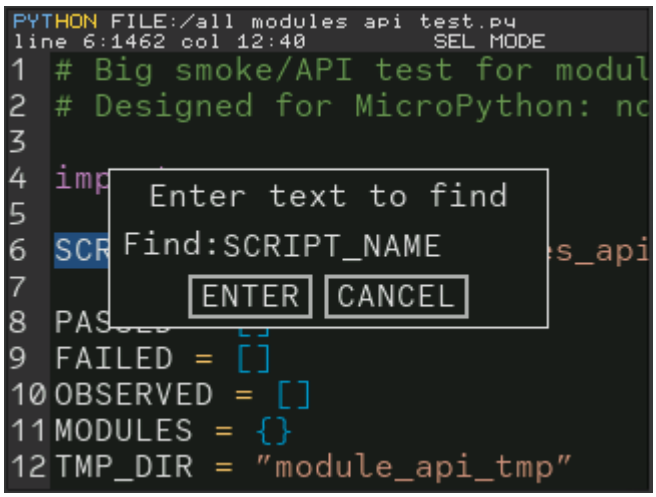


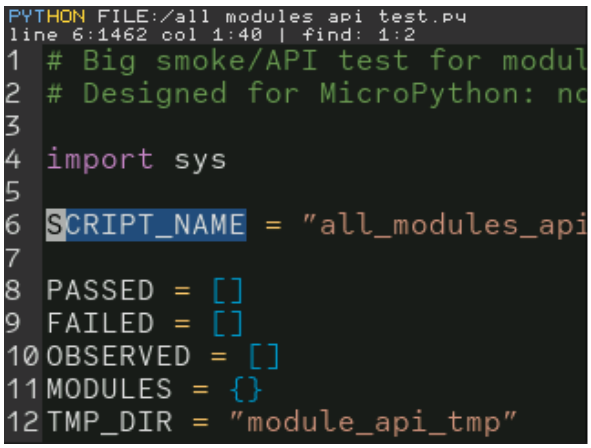
1. **Select** - Enables or disables text selection mode (its status is indicated by an indicator in the editor header). This mode is intended for quick text replacement, searching, and copying. It can also be enabled (and disabled) using `solve` (alpha + enter). You can select text by using the navigation keys and their key combinations. Selection mode can also be exited by pressing `quit` .

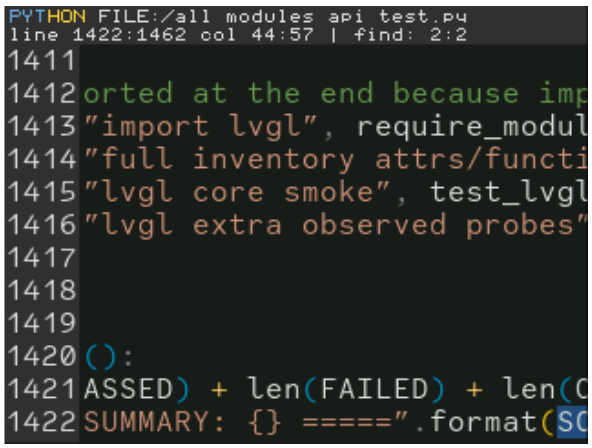




2. **Copy** - Copies the selected text to the clipboard (the clipboard will be cleared when the editor is closed). Selection mode will be disabled.
3. **Cut** - Copies the selected text to the clipboard (the clipboard will be cleared when the editor is closed). The selected text will be removed. Selection mode will be disabled.
4. **Paste** - Replaces or inserts the clipboard contents at the current cursor position. Selected text is always replaced.
5. **Find** - Opens a dialog for entering the search string. If text was selected before starting the search, it is automatically inserted into the search field. When search mode is activated, the header displays the number of matches and the currently selected match. Matches can be navigated using ▲, ◄ and ▼, ►. Search mode is exited by pressing `quit` or `solve` .



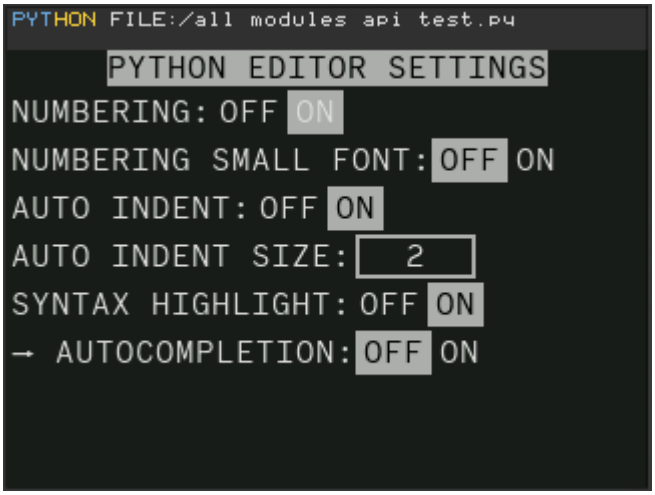




The **RUN** tab of the bottom menu (`f5`) allows the file currently open in the editor to be executed. Before execution, all changes are saved automatically without confirmation.

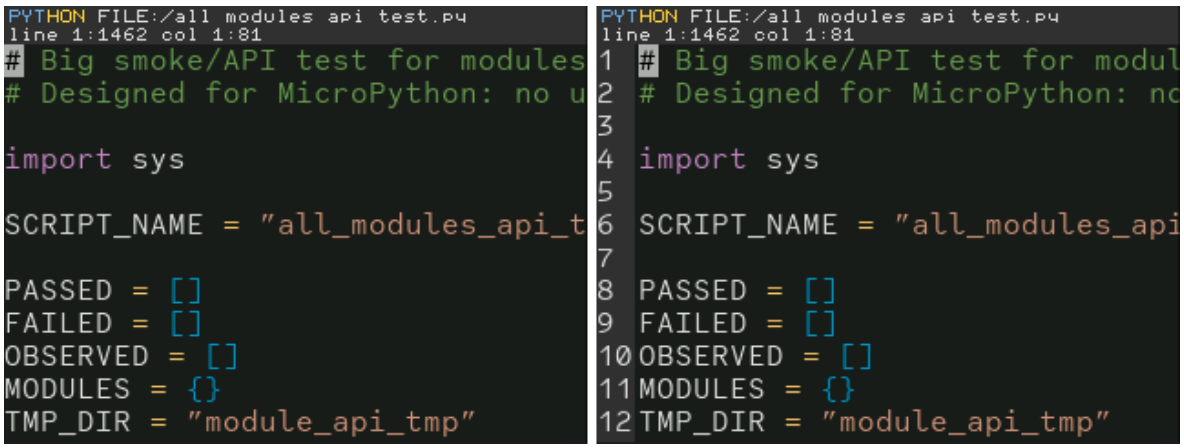
3.1. Python Editor settings

To open the Python Editor settings window, press `mode` while in the Python Editor.

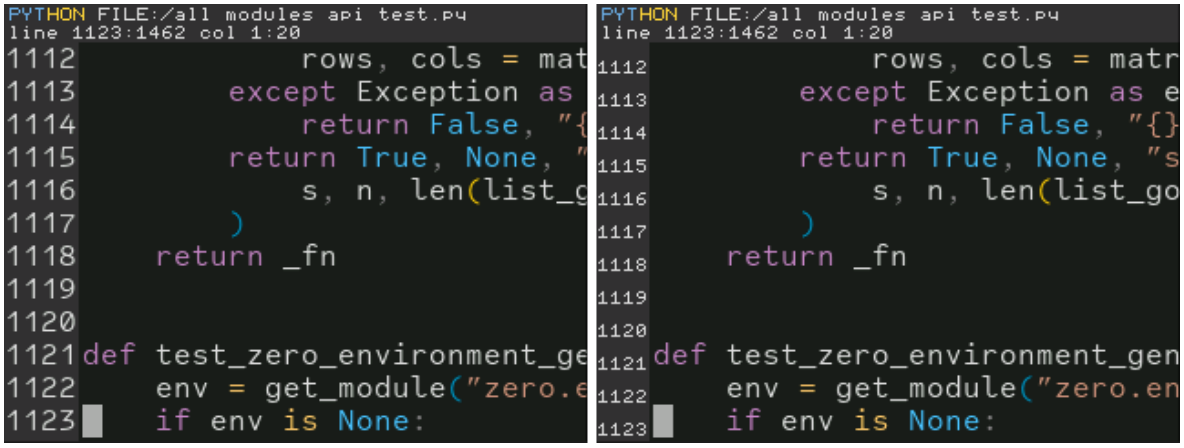


The settings are saved when exiting the settings window.

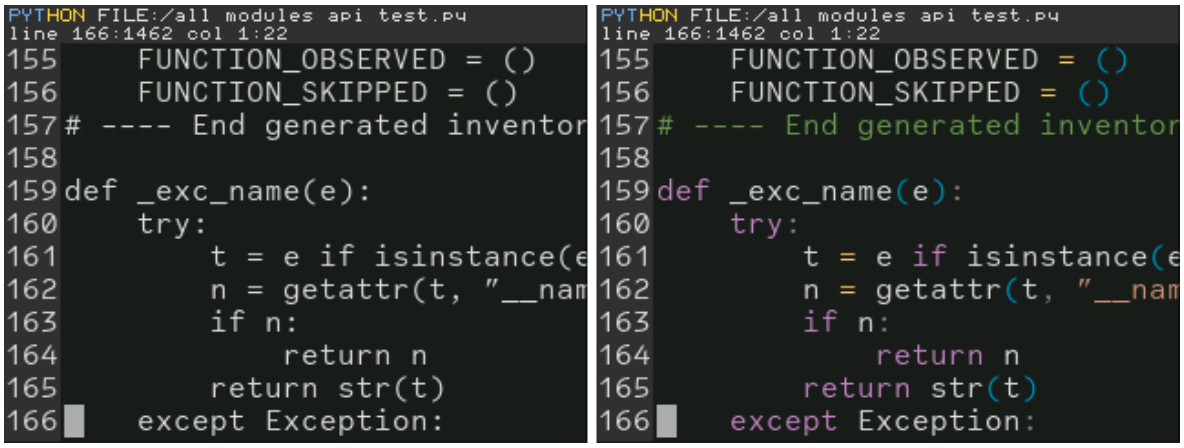
1. **NUMBERING** - Enables line number display.

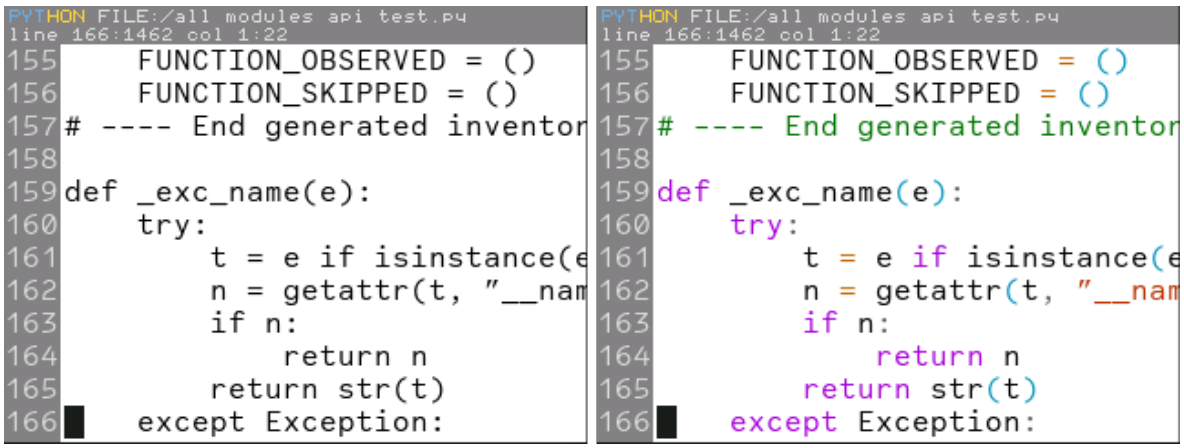


2. **NUMBERING SMALL FONT** - Changes the font size of the line numbers.



3. **AUTO INDENT** - Enables automatic indentation when a new line is inserted.
4. **AUTO INDENT SIZE** - Sets the number of spaces used for a single indentation level.
5. **SYNTAX HIGHLIGHT** - Enables syntax highlighting (reduces editor performance).



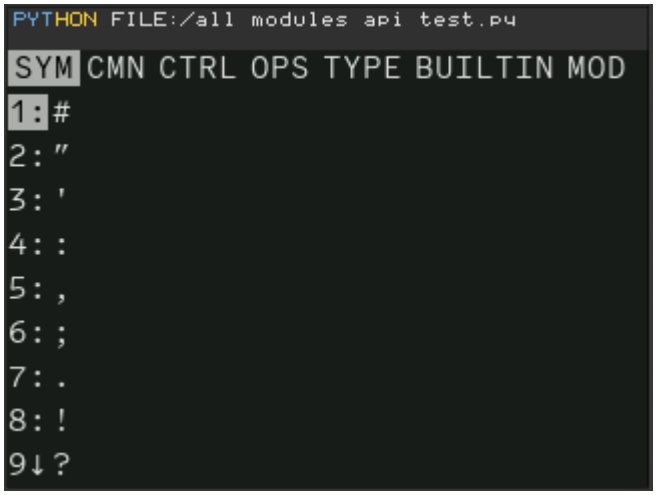


6. → **AUTOCOMPLETION** - Enables autocompletion when ▶ is pressed while the cursor is at the end of a line.

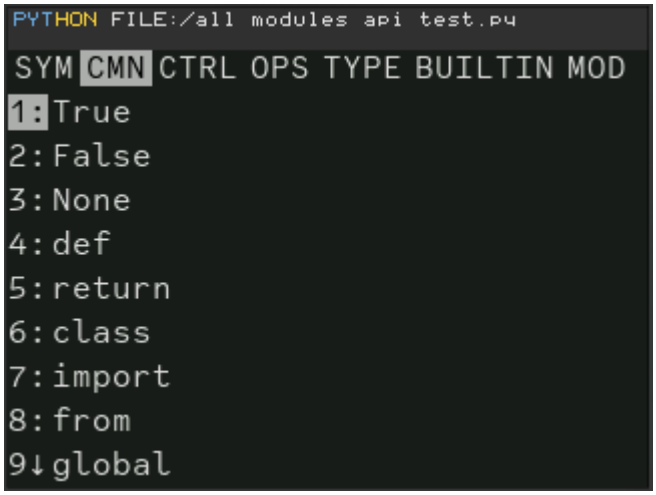
3.2. Expression Insertion window

The Expression Insertion window can be opened by pressing `prgm` while in the Python Editor or the Python Shell. The window contains the following tabs (switch between tabs using ◀ and ▶):

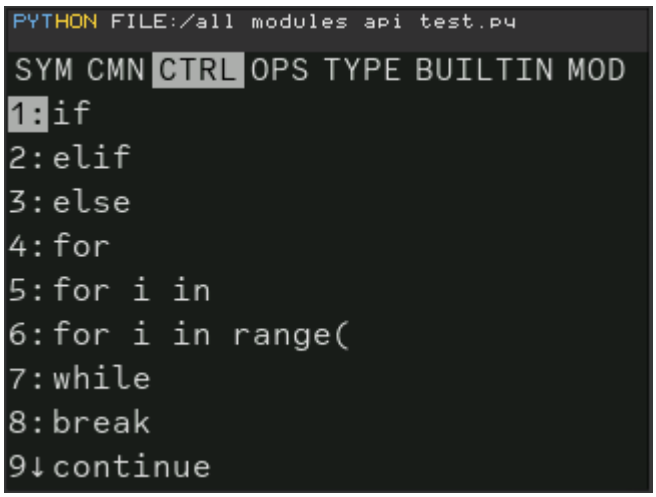
1. **SYM** - Contains symbols that cannot be entered using the calculator's physical keyboard.



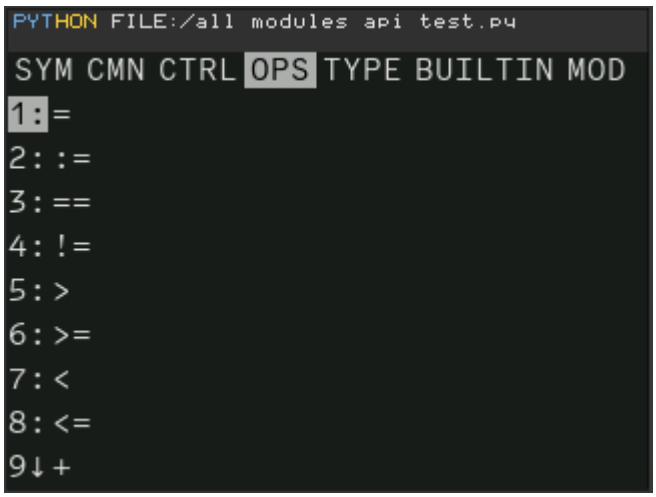
2. **CMN** - Contains keywords.



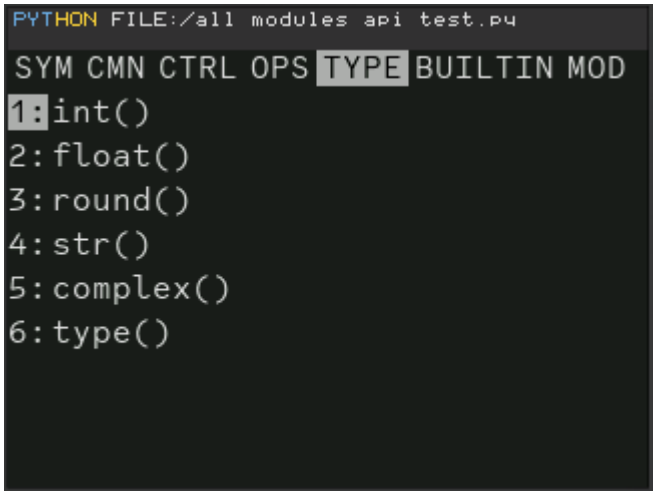
3. **CTRL** - Contains program flow control constructs.



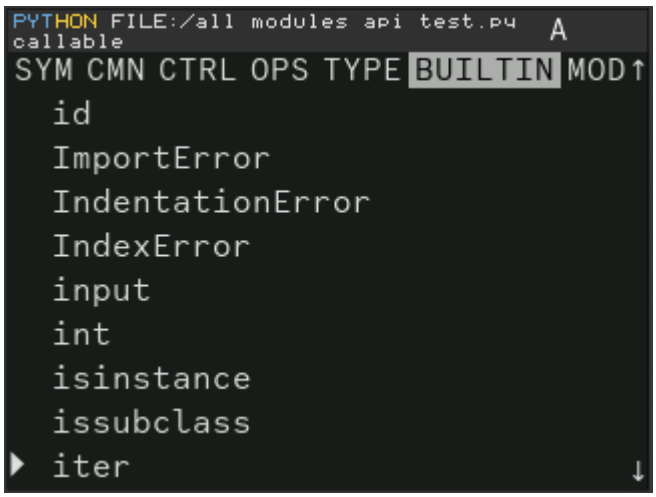
4. **OPS** - Contains operators.



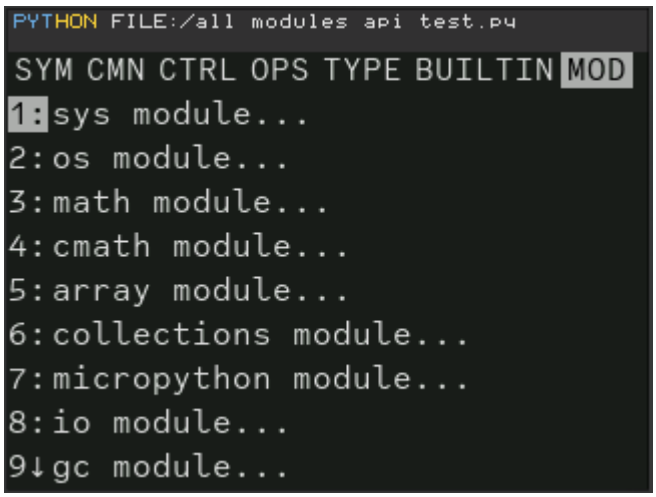
5. **TYPE** - Contains standard data types.

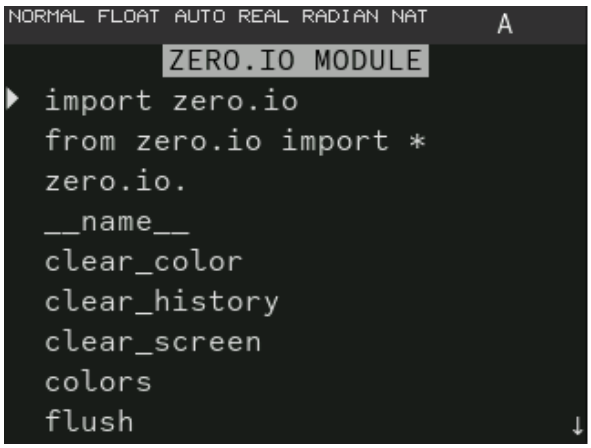


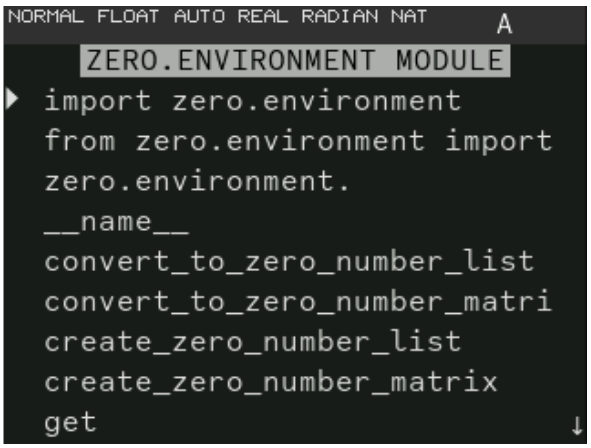
6. **BUILTIN** - Contains built-in functions and types available in the global context. The contents of this tab are sorted alphabetically. Searching and navigation are also available using `a` - `z` .

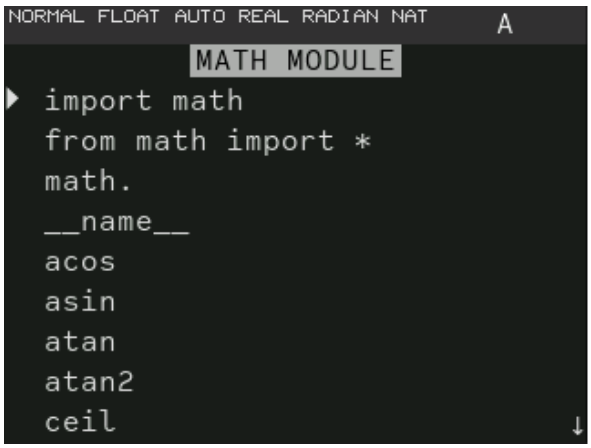


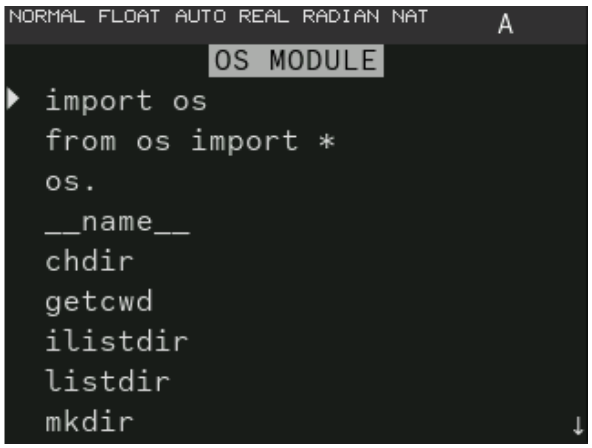
7. **MOD** - Contains a list of importable modules. Selecting a module opens a window displaying its contents. Module contents are sorted alphabetically. Searching and navigation are also available using **a** - **z** .











IV. MicroPython Specification

Zero Calculator includes **MicroPython v1.27.0 dated 09.12.2025** which is built for the ARM Cortex-M4 architecture (without emulators). This build implements Python 3.4 and some featured functions of Python 3.5 and above (comparison[4]). This MicroPython build has the following building options (the options order is set by the configuration file mpconfig.h[5]):

- [Enabled] In-progress/breaking changes slated for the MicroPython 2.x release (`MICROPY_PREVIEW_VERSION_2`).
- Used minimal port with disabling all optional features (`MICROPY_CONFIG_ROM_LEVEL = MICROPY_CONFIG_ROM_LEVEL_MINIMUM`).
- Default allocation memory settings (`MICROPY_ALLOC_...` , `MICROPY_GC_...` , `MICROPY_OBJ_...`).
- [Enabled] Passing allocated memory region size to realloc/free functions (`MICROPY_MALLOC_USES_ALLOCATED_SIZE`).
- 16 bytes allocate initially when creating new chunks to store parse nodes (`MICROPY_ALLOC_PARSE_CHUNK_INIT`).
- Maximum length of a path in the filesystem is 256 symbols (`MICROPY_ALLOC_PATH_MAX`).
- [Enabled] Supporting loading of persistent code (mpy) (`MICROPY_PERSISTENT_CODE_LOAD`).
- [Enabled] Ability to interpret Python commands (`MICROPY_ENABLE_COMPILER`).
- [Disabled] Optimizations and calculations during compilation (minimal port) (`MICROPY_COMP_CONST_FOLDING` , `MICROPY_COMP_CONST_TUPLE` , `MICROPY_COMP_CONST_LITERAL` , `MICROPY_COMP_MODULE_CONST` , `MICROPY_COMP_CONST` , `MICROPY_COMP_CONST_FLOAT` , `MICROPY_COMP_DOUBLE_TUPLE_ASSIGN` , `MICROPY_COMP_TRIPLE_TUPLE_ASSIGN` , `MICROPY_COMP_RETURN_IF_EXPR`).
- [Enabled] Collect memory allocation stats (functions `micropython.mem_total` , `micropython.mem_current` , `micropython.mem_peak`)(`MICROPY_MEM_STATS`).
- [Disabled] Debug settings (default) (`MICROPY_DEBUG_PRINTERS` , `MICROPY_DEBUG_VERBOSE` , `MICROPY_DEBUG_MP_OBJ_SENTINELS` , `MICROPY_DEBUG_PARSE_RULE_NAME` , `MICROPY_DEBUG_VM_STACK_OVERFLOW` , `MICROPY_DEBUG_VALGRIND`).

- [Disabled] Optimizations (default, minimal port) (MICROPY_OPT_COMPUTED_GOTO , MICROPY_OPT_LOAD_ATTR_FAST_PATH , MICROPY_OPT_MAP_LOOKUP_CACHE , MICROPY_OPT_MAP_LOOKUP_CACHE_SIZE , MICROPY_OPT_MPZ_BITWISE , MICROPY_OPT_MATH_FACTORIAL).
- [Enabled] Import of external modules (files) (MICROPY_ENABLE_EXTERNAL_IMPORT).
- [Enabled] File reader for importing files (MICROPY_READER_VFS).
- [Enabled] Garbage collector with default settings (MICROPY_ENABLE_GC).
- [Enabled] Calling finalisers in the garbage collector (__del__) (MICROPY_ENABLE_FINALISER).
- [Disabled] Separate allocator for the Python stack (default) (MICROPY_ENABLE_PYSTACK).
- [Enabled] Checking of usage of the C stack (MICROPY_STACK_CHECK) (MICROPY_STACK_CHECK_MARGIN = 1024).
- [Enabled] Emergency exception buffer (MICROPY_ENABLE_EMERGENCY_EXCEPTION_BUF MICROPY_EMERGENCY_EXCEPTION_BUF_SIZE), the initial size is 1024 bytes (the size can be changed by micropython.alloc_emergency_exception_buf()).
- [Enabled] Keyboard interrupt (MICROPY_KBD_EXCEPTION).
- [Enabled] Input helper functions (MICROPY_HELPER_REPL).
- Allow enabling debug prints after each entered command (MICROPY_REPL_INFO).
- [Disabled] Auto indent (MICROPY_REPL_AUTO_INDENT).
- [Enabled] Event-driven input functions (MICROPY_REPL_EVENT_DRIVEN).
- Count of commands keeped in Python history: 0 (MICROPY_READLINE_HISTORY_SIZE).
- [Disabled] Terminal VT100 (MICROPY_HAL_HAS_VT100).
- long int is an arbitrary precision integer type (MICROPY_LONGINT_IMPL = MICROPY_LONGINT_IMPL_MPZ).
- [Enabled] Processing line numbers of the source (MICROPY_ENABLE_SOURCE_LINE).
- [Disabled] Doc strings (__doc__) (default), (MICROPY_ENABLE_DOC_STRING).
- [Enabled] Print basic error and exception details (MICROPY_ERROR_REPORTING = MICROPY_ERROR_REPORTING_NORMAL).
- [Disabled] Warnings (default) (MICROPY_WARNINGS , MICROPY_WARNINGS_CATEGORY).
- float is double (MICROPY_FLOAT_IMPL = MICROPY_FLOAT_IMPL_DOUBLE).
- [Enabled] Complex numbers (MICROPY_PY_BUILTINS_COMPLEX).
- [Disabled] High-quality hash for float and complex numbers (minimal port) (MICROPY_FLOAT_HIGH_QUALITY_HASH).
- [Disabled] Features which improve CPython compatibility (minimal port) (MICROPY_CPYTHON_COMPAT).
- [Disabled] Full checks as done by CPython (minimal port) (MICROPY_FULL_CHECKS).
- [Disabled] POSIX-semantics non-blocking streams (default, minimal port) (MICROPY_STREAMS_NON_BLOCK , MICROPY_STREAMS_POSIX_API).
- [Disabled] Calling __init__ when importing builtin modules for the first time (minimal port) (MICROPY_MODULE_BUILTIN_INIT).
- [Enabled] Built-in modules having sub-packages (MICROPY_MODULE_BUILTIN_SUBPACKAGES).
- [Disabled] Module-level __getattr__ (minimal port) (MICROPY_MODULE_GETATTR).

- [Disabled] Setting `__name__` to `'__main__'` when importing file (default) (`MICROPY_MODULE_OVERRIDE_MAIN_IMPORT`).
- [Disabled] Frozen modules (default) (`MICROPY_MODULE_FROZEN`).
- [Disabled] Overriding builtins in the builtins module (minimal port) (`MICROPY_CAN_OVERRIDE_BUILTINS`).
- [Enabled] Checking that the `self` argument of a builtin method has the correct type (`MICROPY_BUILTIN_METHOD_CHECK_SELF_ARG`).
- [Enabled] Using internally defined errno's (`MICROPY_USE_INTERNAL_ERRNO`).
- [Disabled] Using internally defined `*printf()` functions (`MICROPY_USE_INTERNAL_PRINTF`).
- [Disabled] Asynchronously aborting to the top level (default) (`MICROPY_ENABLE_VM_ABORT` and `MICROPY_PYEXEC_ENABLE_VM_ABORT`).
- [Disabled] Internal scheduler (minimal port) (`MICROPY_ENABLE_SCHEDULER` , `MICROPY_SCHEDULER_STATIC_NODES`).
- [Enabled] Virtual file system (more in Platform features and abilities) (`MICROPY_VFS`).
- [Disabled] Multiple inheritance of Python classes (minimal port) (`MICROPY_MULTIPLE_INHERITANCE`).
- [Enabled] Implementing attributes on functions (`MICROPY_PY_FUNCTION_ATTRS`).
- [Disabled] Implementing code attributes on functions (`MICROPY_PY_FUNCTION_ATTRS_CODE`).
- [Disabled] Descriptors `__get__` , `__set__` , `__delete__` (minimal port) (`MICROPY_PY_DESCRIPTORS`).
- [Disabled] Class `__delattr__` , `__setattr__` methods (minimal port) (`MICROPY_PY_DELATTR_SETATTR`).
- [Disabled] Async/await (minimal port) (`MICROPY_PY_ASYNC_AWAIT`).
- [Enabled] F-strings (`MICROPY_PY_FSTRINGS`).
- [Disabled] Assignment expressions with `:=` (minimal port) (`MICROPY_PY_ASSIGN_EXPR`).
- [Disabled] Non-standard `.pend_throw()` method for generators (minimal port) (`MICROPY_PY_GENERATOR_PEND_THROW`).
- [Disabled] Warning when comparing str and bytes objects (default) (`MICROPY_PY_STR_BYTES_CMP_WARN`).
- [Disabled] Methods `bytes.hex` and `bytes.fromhex` (minimal port) (`MICROPY_PY_BUILTINS_BYTES_HEX`).
- [Disabled] Unicode strings (minimal port) (`MICROPY_PY_BUILTINS_STR_UNICODE`).
- [Disabled] Check for valid UTF-8 when converting bytes to str (minimal port) (`MICROPY_PY_BUILTINS_STR_UNICODE_CHECK`).
- [Enabled] Method `str.count()` (`MICROPY_PY_BUILTINS_STR_COUNT`).
- [Enabled] Operator `str % (...)` (`MICROPY_PY_BUILTINS_STR_OP_MODULO`).
- [Disabled] Methods `str.center()` , `str.partition()` , `str.rpartition()` , `str.splitlines()` (minimal port) (`MICROPY_PY_BUILTINS_STR_CENTER` , `MICROPY_PY_BUILTINS_STR_PARTITION` , `MICROPY_PY_BUILTINS_STR_SPLITLINES`).
- [Enabled] Type `bytearray` (`MICROPY_PY_BUILTINS_BYTEARRAY`).
- [Disabled] Methods `dict.fromkeys()` (minimal port) (`MICROPY_PY_BUILTINS_DICT_FROMKEYS`).
- [Enabled] Type `memoryview` (`MICROPY_PY_BUILTINS_MEMORYVIEW`).

- [Disabled] Property `memoryview.itemsize` (minimal port) (`MICROPY_PY_BUILTINS_MEMORYVIEW_ITEMSIZE`).
- [Enabled] Type `set` (`MICROPY_PY_BUILTINS_SET`).
- [Enabled] `slice` (`[a:b]`) (`MICROPY_PY_BUILTINS_SLICE`).
- [Disabled] Properties `slice.start` , `slice.stop` , `slice.step` (minimal port) (`MICROPY_PY_BUILTINS_SLICE_ATTRS`).
- [Disabled] Methods `slice.indices(len)` (minimal port) (`MICROPY_PY_BUILTINS_SLICE_INDICES`).
- [Disabled] Type `frozenset` (minimal port) (`MICROPY_PY_BUILTINS_FROZENSET`).
- [Disabled] Type `property` (minimal port) (`MICROPY_PY_BUILTINS_PROPERTY`).
- [Disabled] Properties `range.start` , `range.stop` , `range.step` (minimal port) (`MICROPY_PY_BUILTINS_RANGE_ATTRS`).
- [Disabled] Comparing (inequality/equality) `range` objects (minimal port) (`MICROPY_PY_BUILTINS_RANGE_BINOP`).
- [Disabled] Calling `next()` with second argument (minimal port) (`MICROPY_PY_BUILTINS_NEXT2`).
- [Enabled] Function `round(int, int)` (`MICROPY_PY_BUILTINS_ROUND_INT`).
- [Disabled] Supporting complete set of special methods for user classes (minimal port) (`MICROPY_PY_ALL_SPECIAL_METHODS`).
- [Disabled] Supporting all inplace arithmetic operation methods for user classes (`__imul__` and another) (minimal port) (`MICROPY_PY_ALL_INPLACE_SPECIAL_METHODS`).
- [Disabled] Supportingreverse arithmetic operation methods for user classes (`__radd__` and another) (minimal port) (`MICROPY_PY_REVERSE_SPECIAL_METHODS`).
- [Disabled] Function `compile()` (minimal port) (`MICROPY_PY_BUILTINS_COMPILE`).
- [Enabled] Function and type `enumerate()` (`MICROPY_PY_BUILTINS_ENUMERATE`).
- [Enabled] Functions `eval` , `exec` (`MICROPY_PY_BUILTINS_EVAL_EXEC`).
- [Disabled] Python 2 function `execfile()` (minimal port) (`MICROPY_PY_BUILTINS_EXECFILE`).
- [Disabled] Function `filter()` (minimal port) (`MICROPY_PY_BUILTINS_FILTER`).
- [Enabled] Function `reversed()` (`MICROPY_PY_BUILTINS_REVERSED`).
- [Disabled] Constant `"NotImplemented"` (minimal port) (`MICROPY_PY_BUILTINS_NOTIMPLEMENTED`).
- [Enabled] Function `input()` (`MICROPY_PY_BUILTINS_INPUT`).
- [Enabled] Functions `min` , `max` (`MICROPY_PY_BUILTINS_MIN_MAX`).
- [Disabled] Function `pow(int, int, int)` (minimal port) (`MICROPY_PY_BUILTINS_POW3`).
- [Enabled] Function `help()` (`MICROPY_PY_BUILTINS_HELP` , `MICROPY_PY_BUILTINS_HELP_TEXT` , `MICROPY_PY_BUILTINS_HELP_MODULES`).
- [Disabled] Variable `__FILE__` (minimal port) (`MICROPY_PY___FILE__`).
- [Enabled] Functions `micropython.mem_total` , `micropython.mem_current` , `micropython.mem_peak` , `micropython.stack_use` (`MICROPY_PY_MICROPYTHON_MEM_INFO` , `MICROPY_PY_MICROPYTHON_STACK_USE`).
- [Disabled] Function `micropython.heap_locked` (minimal port) (`MICROPY_PY_MICROPYTHON_HEAP_LOCKED`).

- [Disabled] RingIO module (minimal port) (`MICROPY_PY_MICROPYTHON_RINGIO`).
- [Enabled] Module `array` (`MICROPY_PY_ARRAY`).
- [Disabled] Slice assignments for array (`a[0:2] = b`) (minimal port) (`MICROPY_PY_ARRAY_SLICE_ASSIGN`).
- [Enabled] Type `attrtuple` (space-efficient `namedtuple`) (`MICROPY_PY_ATTRTUPLE`).
- [Enabled] Module `collections` (`MICROPY_PY_COLLECTIONS`).
- [Disabled] Types `collections.deque` , `collections.OrderedDict` (minimal port) (`MICROPY_PY_COLLECTIONS_DEQUE` , `MICROPY_PY_COLLECTIONS_ORDEREDDICT`).
- [Disabled] Methods `namedtuple._asdict()` (minimal port) (`MICROPY_PY_COLLECTIONS_NAMEDTUPLE__ASDICT`).
- [Disabled] Module `marshal` (minimal port) (`MICROPY_PY_MARSHAL`).
- [Enabled] Module `math` (`MICROPY_PY_MATH`).
- [Disabled] Addition math module constants without `math.pi` , `math.e` (minimal port) (`MICROPY_PY_MATH_CONSTANTS`).
- [Disabled] Addition math module functions `math.erf` , `math.erfc` , `math.gamma` , `math.lgamma` , `math.factorial` , `math.isclose` (minimal port) (`MICROPY_PY_MATH_SPECIAL_FUNCTIONS` , `MICROPY_PY_MATH_SPECIAL_FUNCTIONS` , `MICROPY_PY_MATH_FACTORIAL` , `MICROPY_PY_MATH_ISCLOSE`).
- [Disabled] Fixes for math module functions `math.atan2` , `math.fmod` , `math.modf` , `math.pow` (default) (`MICROPY_PY_MATH_ATAN2_FIX_INFNAN` , `MICROPY_PY_MATH_FMOD_FIX_INFNAN` , `MICROPY_PY_MATH_MODF_FIX_NEGZERO` , `MICROPY_PY_MATH_POW_FIX_NAN` , `MICROPY_PY_MATH_GAMMA_FIX_NEGINF`).
- [Enabled] Module `cmath` (`MICROPY_PY_CMATH`).
- [Enabled] Module `micropython` (`MICROPY_PY_MICROPYTHON`).
- [Enabled] Module `gc` (`MICROPY_PY_GC`).
- [Enabled] Module `io` (`MICROPY_PY_IO`).
- [Disabled] Classes `io.IOBase` , `io.BufferedWriter` (minimal port) (`MICROPY_PY_IO_IOBASE` , `MICROPY_PY_IO_BUFFEREDWRITER`).
- [Enabled] Module `struct` (`MICROPY_PY_STRUCT`).
- [Enabled] Unsafe and non-standard typecodes O, P, S for `struct` (`MICROPY_PY_STRUCT_UNSAFE_TYPECODES`).
- [Enabled] Module `sys` (`MICROPY_PY_SYS`).
- [Disabled] Constants, properties and functions `sys.maxsize` , `sys.exc_info` , `sys.executable` , `sys.intern` , `sys.atexit` , `sys.ps1` , `sys.ps2` , `sys.settrace` , `sys.getsizeof` , `sys.stdin` , `sys.stdout` , `sys.stderr` , `sys.tracebacklimit` (default, minimal port) (`MICROPY_PY_SYS_MAXSIZE` , `MICROPY_PY_SYS_EXC_INFO` , `MICROPY_PY_SYS_EXECUTABLE` , `MICROPY_PY_SYS_INTERN` , `MICROPY_PY_SYS_ATEXIT` , `MICROPY_PY_SYS_PS1_PS2` , `MICROPY_PY_SYS_SETTRACE` , `MICROPY_PY_SYS_GETSIZEOF` , `MICROPY_PY_SYS_STDFILES` , `MICROPY_PY_SYS_STDIO_BUFFER` , `MICROPY_PY_SYS_TRACEBACKLIMIT`).
- [Enabled] Dictionary `sys.modules` (default) (`MICROPY_PY_SYS_MODULES`).
- [Enabled] Function `sys.exit` (default) (`MICROPY_PY_SYS_EXIT`).
- [Enabled] Lists `sys.path` , `sys.argv` (`MICROPY_PY_SYS_PATH` , `MICROPY_PY_SYS_ARGV`).

- [Enabled] Module `errno` (`MICROPY_PY_ERRNO`).
- [Enabled] Dictionary `errno.errorcode` (default) (`MICROPY_PY_ERRNO_ERRORCODE`).
- [Disabled] Module `select` (minimal port) (`MICROPY_PY_SELECT`).
- [Enabled] Module `time` (`MICROPY_PY_TIME`).
- [Enabled] Timestamps based on 1970-01-01 (`MICROPY_EPOCH_IS_1970`).
- [Disabled] Support time before 1970 (`MICROPY_TIME_SUPPORT_Y1969_AND_BEFORE`).
- [Disabled] Support time after 2100 (`MICROPY_TIME_SUPPORT_Y2100_AND_BEYOND`).
- [Disabled] Module `_thread` (`MICROPY_PY_THREAD`).
- [Disabled] Module `asyncio` (minimal port) (`MICROPY_PY_ASYNCIO`).
- [Disabled] Module `uctypes` (minimal port) (`MICROPY_PY_UCTYPES`).
- [Disabled] Module `deflate` (minimal port) (`MICROPY_PY_DEFLATE`).
- [Disabled] Module `json` (minimal port) (`MICROPY_PY_JSON`).
- [Enabled] Module `os` (`MICROPY_PY_OS`).
- [Disabled] Function `os.statvfs` (`MICROPY_PY_OS_STATVFS`).
- [Enabled] Function `os.uname` (`MICROPY_PY_OS_UNAME`).
- [Enabled] Constant `os.sep` (`MICROPY_PY_OS_SEP`).
- [Enabled] Function `os.urandom` (`MICROPY_PY_OS_URANDOM`). Used hardware True Random Number Generator.
- [Disabled] Module `re` (minimal port) (`MICROPY_PY_RE`).
- [Disabled] Module `heapq` (minimal port) (`MICROPY_PY_HEAPQ`).
- [Disabled] Module `hashlib` (minimal port) (`MICROPY_PY_HASHLIB`).
- [Disabled] Module `cryptolib` (minimal port) (`MICROPY_PY_CRYPTOLIB`).
- [Disabled] Module `binascii` (minimal port) (`MICROPY_PY_BINASCII`).
- [Enabled] Module `random` (`MICROPY_PY_RANDOM`). A hardware True Random Number Generator is used to create seed value during module import.
- [Disabled] Module `machine` (`MICROPY_PY_MACHINE`).
- [Disabled] Module `lwip` (`MICROPY_PY_LWIP`).
- [Disabled] Module `ssl` (default) (`MICROPY_PY_SSL`).
- [Disabled] Module `vfs` (`MICROPY_PY_VFS`).
- [Disabled] Module `websocket` (default) (`MICROPY_PY_WEBSOCKET`).
- [Disabled] Module `framebuf` (minimal port) (`MICROPY_PY_FRAMEBUF`).
- [Disabled] Module `btree` (default) (`MICROPY_PY_BTREE`).
- [Disabled] Module `_onewire` (default) (`MICROPY_PY_ONEWIRE`).
- [Disabled] Module `platform` (minimal port) (`MICROPY_PY_PLATFORM`).
- [Disabled] Support `__all__` in modules (minimal port) (`MICROPY_MODULE___ALL__`).
- [Disabled] Support `__file__` in modules (minimal port) (`MICROPY_MODULE___FILE__`).

4.1. Platform features and abilities

Regardless of the running of the script file or Python Shell, a heap area is allocated for MicroPython interpreter. The heap area size is equal to half the volume of all free RAM, but no more than **4 MB** (4194304 bytes). The size of the allocated heap is at least **128 kb** (131072 bytes).

The MicroPython interpreter checks C stack usage during its execution. This is required to protect the execution of recursive functions. The amount of stack space currently used can be obtained using the `micropython.stack_use()` function. The stack size is limited to 63 KB (64512 bytes).

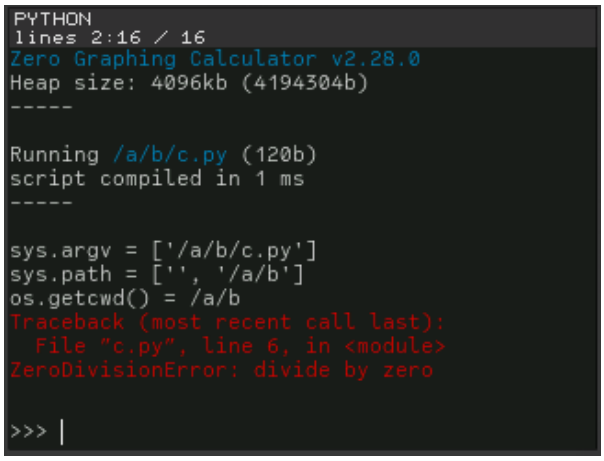
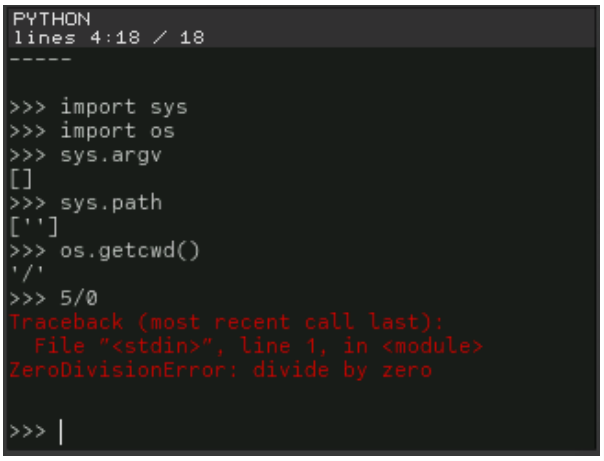
Example:

```
import micropython as mp

def recurse():
    print(mp.stack_use())
    recurse()

recurse()
```

Usage of stack

After executing a command or a script file, the garbage collector `gc.collect()` is called.

MicroPython interpreter can manage a virtual file system. The virtual filesystem root folder (`/`) is at `/exchange` . A recursive script search in **EXEC** tab of Python app is also performed through this path. The `io` and `os` modules can interact with the file system and files. The `input()` function may raise a *RuntimeError* exception if an attempt is made to use it while an LVGL window is open. Execution of the `input()` function can be interrupted using the on key or the **`quit`** combination. Running a script file or Python Shell has some differences:

Running `/a/b/c.py` or `/a/b/c.mpy`	**Running Python Shell**
Welcome message which contain file path, file size and time of reading and compiling/loading.	
`sys.argv = ['/a/b/c.py']` or `sys.argv = ['/a/b/c.mpy']`	`sys.argv = []`
`sys.path = ['','/a/b']`	`sys.path = ['']`
`os.getcwd() = '/a/b'`	`os.getcwd() = '/'`
First traceback level: `c.py`	First traceback level: `<stdin>`
	

Running precompiled `.mpy` files.

In addition to ordinary `.py` files, Zero Calculator can execute precompiled MicroPython bytecode files with the `.mpy` extension.

A `.mpy` file is created on a computer from a `.py` source file using the `mpy-cross` tool from the same MicroPython version as the Zero Calculator firmware.

Example:

```
mpy-cross program.py
```

This command creates:

```
program.mpy
```

The resulting `.mpy` file can be copied to the `/exchange` folder or to one of its subfolders. The **EXEC** tab shows executable `.py` and `.mpy` files. Selecting a `.mpy` file runs it in the same way as selecting a `.py` file.

When a script is executed from a file, the script directory is added to `sys.path`. Therefore, modules located near the executed script can be imported using ordinary `import` statements. MicroPython searches for modules as `.py` or `.mpy` files. If both `module.py` and `module.mpy` exist in the same directory, the `.py` file is used first.

The `.mpy` file format depends on the MicroPython version and build options. If the `.mpy` file was created by an incompatible version of `mpy-cross`, loading it may fail with an exception. Use the `mpy-cross` tool from the same MicroPython source version as the Zero Calculator firmware.

Built-in modules

The implementation of the following modules depends on the current platform:

- `sys` (more[6]), implemented:
  - `argv` <list>
  - `path` <list>
  - `version` <string>
  - `version_info` <tuple>
  - `implementation` <namedtuple>
  - `platform` <string>
  - `byteorder` <string>
  - `exit` <function> (Calling this function will exit Python Shell window and return to the main screen of Zero Calculator. The argument passed to the function will be converted into a string and inserted into the editor.)
  - `modules` <dict>
  - `print_exception` <function>
- `os` (more[7]), implemented:
  - `sep` <string>
  - `uname` <function>
  - `chdir` <function>
  - `getcwd` <function> (current directory may not exist if you delete it after switching to it)

    - `listdir` <function> (if argument is not passed, outputs the contents of the current catalog `.`)
    - `mkdir` <function> (also creates child directories if they don't exist)
    - `remove` <function> (deletes the file if it exists)
    - `rename` <function> (movement is performed only to existing paths)
    - `rmdir` <function> (deletes an empty directory if it exists)
    - `stat` <function> (returns <tuple>, 0th item (`st_mode`): 0x8000 - file, 0x4000 - directory, 6th item (`st_size`): file size in bytes (directory size is 0), 8th item (`st_mtime`): file change timestamp (Zero Calculator uses FAT file system), other items are 0).
    - `statvfs` <function> (throws an exception when used)
    - `unlink` <function> (deletes the file if it exists)
    - `ilistdir` <function>
    - `urandom` <function> (used hardware true random number generator)
- `errno` (more[8]), implemented:
    - `errorcode` <dict>
    - `EPERM` <int> (operation not permitted)
    - `ENOENT` <int> (no such file or directory)
    - `EIO` <int> (i/o error)
    - `EBADF` <int> (bad file number)
    - `EAGAIN` <int> (try again)
    - `ENOMEM` <int> (out of memory)
    - `EACCES` <int> (permission denied)
    - `EEXIST` <int> (file exists)
    - `ENODEV` <int> (no such device)
    - `ENOTDIR` <int> (not a directory)
    - `EISDIR` <int> (is a directory)
    - `EINVAL` <int> (invalid argument)
    - `EROFS` <int> (read-only file system)
    - `EOPNOTSUPP` <int> (operation not supported on transport endpoint)
    - `EADDRINUSE` <int> (address already in use)
    - `ECONNABORTED` <int> (software caused connection abort)
    - `ECONNRESET` <int> (connection reset by peer)
    - `ENOBUFS` <int> (no buffer space available)
    - `ENOTCONN` <int> (transport endpoint is not connected)
    - `ETIMEDOUT` <int> (connection timed out)
    - `ECONNREFUSED` <int> (connection refused)
    - `EHOSTUNREACH` <int> (no route to host)
    - `EALREADY` <int> (operation already in progress)
    - `EINPROGRESS` <int> (operation now in progress)
    - `EFAILED` <int> (Zero Calculator internal error, it is mainly used if the file system cannot process the request)
- `micropython` (more[9]) , implemented:
    - `const` <function>
    - `opt_level` <function>
    - `mem_total` <function>

    - `mem_current` <function>
    - `mem_peak` <function>
    - `mem_info` <function>
    - `qstr_info` <function>
    - `stack_use` <function>
    - `alloc_emergency_exception_buf` <function> (the initial buffer size is 1024 bytes)
    - `heap_lock` <function>
    - `heap_unlock` <function>
    - `kbd_intr` <function> (is not processed because Zero Calculator uses internal processing of keyboard interruption)
- `time` (more[14]), implemented:
    - `gmtime` <function>
    - `localtime` <function>
    - `mktime` <function>
    - `time` <function>
    - `time_ns` <function> (second accuracy)
    - `sleep` <function> (`on` button interrupt handling)
    - `sleep_ms` <function> (`on` button interrupt handling)
    - `sleep_us` <function> (`on` button interrupt handling)
    - `ticks_ms` <function> (30-bit value on real device)
    - `ticks_us` <function> (ms accuracy on emulator, 30-bit value on real device)
    - `ticks_cpu` <function> (ms ticks on emulator, CPU ticks on real device, 30-bit value on real device)
    - `ticks_add` <function>
    - `ticks_diff` <function>
- `random` (more[15]), on import, a seed from the hardware random number generator is used; implemented:
    - `getrandbits` <function>
    - `randint` <function>
    - `randrange` <function>
    - `random` <function>
    - `uniform` <function>
    - `seed` <function> (when `None` is passed, a value obtained from the hardware random number generator is used)
    - `choice` <function>

To get more detailed information about the available data types, functions, methods, and modules, use the function `help()`. Also refer to the online documentation of Python[10] and MicroPython[2] (modules description[11], differences from Python[4]).

V. ZERO Library

The `zero` module is intended for controlling the Zero Calculator, invoking ZeroBasic functions, and reading and setting variables. Most of the functions presented in this module are copies of their corresponding ZeroBasic functions. For detailed information about how these functions work, refer to the ZeroBasic implementation documentation.

For MicroPython, a new exception *ZeroError* has been added (inherited from *Exception*). This exception is generated by internal Zero Calculator functions and contains a short error description, for example: *DOMAIN*, *DIM MISMATCH*, *INCREMENT*, and others. For more detailed information about the cases in which these errors are generated, refer to the ZeroBasic implementation documentation.

Additionally, the `all_zero` module is implemented, which contains all functions of the `zero` module without additional nesting.

5.1. zero.environment module

This module is designed for interacting with the ZeroBasic execution context using MicroPython. It contains the following elements:

get()

```
get(name : str) : any
```

Combines the work of functions get_str, get_number, get_list, get_matrix.

It can raise *ZeroError* exception.

set()

```
set(name : str, value : any) : str
```

Analyzes the type of `value` and calls the appropriate value-setting function (similar to *Assignment* in ZeroBasic).

1. If the type of `value` is a string (or bytes), the set_str function is used. Assigning `Ans` is forbidden. Assigning y-functions is allowed.
2. If the type of `value` is a **non-empty** list whose first element is also a list, the value is checked using is_zero_number_matrix. If the result of the check is negative, an attempt is made to convert the value using create_zero_number_matrix. On success, the value will be set using set_matrix. Assigning `Ans` will create the variable `[Ans]`.
3. If the type of `value` is a list, the value is checked using is_zero_number_list. If the result of the check is negative, an attempt is made to convert the value using create_zero_number_list. On success, the value will be set using set_list. Assigning `Ans` will create the variable `␣Ans`.
4. In all other cases, an attempt is made to set `value` using set_number. Assigning `Ans` is forbidden.

It can raise *ZeroError* exception. For more information, see the *Assignment* section in the ZeroBasic documentation.

Returns name of set variable.

5.1.1. Functions for working with strings

get_string_names()

```
get_string_names() : list[str]
```

Returns a list of string names that have an assigned value in the ZeroBasic context.

get_strings()

```
get_strings() : dict[str, str]
```

Returns a dictionary where the key is the string name, the value is the string content, in the ZeroBasic context.

get_str()

```
get_str(name: str) : str | None
```

Takes a string name and returns its value in the ZeroBasic context. If the string does not exist, returns `None`.

set_str()

```
set_str(name: str, value: str) : None
```

Assigns the value `value` to the string variable named `name` in the ZeroBasic context. It can raise *ZeroError* exception. For more information, see the *Assignment* section in the ZeroBasic documentation.

5.1.2. Functions for working with numbers

get_number_names()

```
get_number_names() : {
    "var":            list[str],
    "const":          list[str],
    "volatile_const":list[str]
}
```

Returns a dictionary consisting of three lists. Each list contains names of numbers that have a value in the ZeroBasic context. List `var` consists of the names of ordinary numeric variables. List `const` consists of the names of constants, their value is not changeable. List `volatile_const` consists of variable names that can only be changed by the calculator when performing certain tasks.

get_option_names()

```
get_option_names() : list[str]
```

Returns a list of names of numeric options that affect the work of the calculator.

get_numbers()

```
get_numbers() : {
    "var":            dict[str, zero_number],
    "const":          dict[str, zero_number],
    "volatile_const":dict[str, zero_number]
}
```

Returns a dictionary consisting of three dictionaries. Each list contains numbers, and their names that have a value in the ZeroBasic context. Dictionary `var` consists of ordinary numeric variables. Dictionary `const` consists of constants, their value is not changeable. Dictionary `volatile_const` consists of variables that can only be changed by the calculator when performing certain tasks.

get_options()

```
get_options() : dict[str, zero_number]
```

Returns a dictionary of numeric options, and their names that affect the work of the calculator.

get_number()

```
get_number(name: str) : zero_number | None
```

Accepts the name of a numeric variable (including options) and returns its value in the context ZeroBasic. If the numeric variable does not exist, it returns `None` .

set_number()

```
set_number(name: str, value: zero_number|float|int|complex) : None
```

Assigns the value `value` to the numeric variable (including options) named `name` in the context of ZeroBasic. It can raise *ZeroError* exception. For more information, see the *Assignment* section in the ZeroBasic documentation.

5.1.3. Functions for working with lists

get_list_names()

```
get_list_names() : list[str]
```

Returns list of names of lists that have an assigned value in the ZeroBasic context.

get_list()

```
get_list(name: str) : list[zero_number] | None
```

Takes a list name and returns its value in the ZeroBasic context. If the list does not exist, returns `None` .

set_list()

```
set_list(name: str, value: list[zero_number]) : str
```

Assigns the value `value` to the list named `name` in the ZeroBasic context. The list name `name` may be modified to conform to the lexical structure of list names. For detailed information, see the *Variables* > *Lists* section in the ZeroBasic documentation. Returns the name of the assigned list.

Before assignment, the value `value` is checked for compliance with the `list[zero_number]` type using the `is_zero_number_list()` function. If the types do not match, a *TypeError* exception will be raised.

The function may raise *ZeroError* exceptions; for detailed information, see the *Assignment* section in the ZeroBasic documentation.

is_zero_number_list()

```
is_zero_number_list(value: any) : bool
```

Checks the value `value` for compliance with the `list[zero_number]` type. Returns `False`, if types are not compliance or `value` is zero-length.

convert_to_zero_number_list()

```
convert_to_zero_number_list(value: list[any]) : value
```

Converts the elements of the list `value` to the `zero_number` type. Raises a *ValueError* exception if the list `value` has zero length. Returns `value`.

```
PYTHON
>>> a
[1, nan, 0.6, (7-0.2j)]
>>> b = convert_to_zero_number_list(a)
>>> b
[<zero_number real=1, imag=0>, <zero_number
real=nan, imag=0>, <zero_number real=0.599999
999999999977795539507496 86, imag=0>, <zero_
number real=7, imag=-0.200000000000000011102
3024625156>]
>>> a
[<zero_number real=1, imag=0>, <zero_number
real=nan, imag=0>, <zero_number real=0.599999
999999999977795539507496 86, imag=0>, <zero_
number real=7, imag=-0.200000000000000011102
3024625156>]
>>> a is b
True
```

create_zero_number_list()

```
create_zero_number_list(value: list[any]) : list[zero_number]
```

Converts the elements of the list `value` to the `zero_number` type. Raises a *ValueError* exception if the list `value` has zero length. Returns new list.

```
PYTHON
>>> a = [1, float('nan'), 0.6, 7-0.2j]
>>> a
[1, nan, 0.6, (7-0.2j)]
>>> b = create_zero_number_list(a)
>>> b
[<zero_number real=1, imag=0>, <zero_number
real=nan, imag=0>, <zero_number real=0.599999
999999999777955395074968 6, imag=0>, <zero_
number real=7, imag=-0.2000000000000000111022
3024625156>]
>>> a
[1, nan, 0.6, (7-0.2j)]
>>> a is b
False

>>>
```

```
PYTHON
>>> a=[zero_number(5)]
>>> a
[<zero_number real=5, imag=0>]
>>> b = create_zero_number_list(a)
>>> b
[<zero_number real=5, imag=0>]
>>> a
[<zero_number real=5, imag=0>]
>>> a is b
False
>>>
```

5.1.4. Functions for working with matrices

get_matrix_names()

```
get_matrix_names() : list[str]
```

Returns list of names of matrices that have an assigned value in the ZeroBasic context.

get_matrix()

```
get_matrix(name: str) : list[list[zero_number]] | None
```

Takes a matrix name and returns its value in the ZeroBasic context. If the matrix does not exist, returns `None` .

set_matrix()

```
set_matrix(name: str, value: list[list[zero_number]]) : str
```

Assigns the value `value` to the matrix named `name` in the ZeroBasic context. The matrix name `name` may be modified to conform to the lexical structure of matrix names. For detailed information, see the *Variables* > *Matrices* section in the ZeroBasic documentation. Returns the name of the assigned matrix.

Before assignment, the value `value` is checked for compliance with the `list[list[zero_number]]` type using the `is_zero_number_matrix()` function. If the types do not match, a *TypeError* exception will be raised.

The function may raise *ZeroError* exceptions; for detailed information, see the *Assignment* section in the ZeroBasic documentation.

is_zero_number_matrix()

```
is_zero_number_matrix(value: any) : bool
```

Checks the value `value` for compliance with the `list[list[zero_number]]` type. Returns `False` if the types do not match, if the matrix width or height is 0, or if the nested lists have different sizes.

convert_to_zero_number_matrix()

```
convert_to_zero_number_matrix(value: list[list[any]]) : value
```

Converts the elements of the matrix `value` to the `zero_number` type. Aligns the matrix width to the maximum length of the nested lists (adds new elements with `zero_number(0)` value). Raises a *ValueError* exception if the matrix `value` has zero width or height. Returns `value`.

```
PYTHON
>>> a = [[1],[0.2,3j]]
>>> a
[[1], [0.2, 3j]]
>>> b = convert_to_zero_number_matrix(a)
>>> b
[[<zero_number real=1, imag=0>, <zero_number
real=0, imag=0>], [<zero_number real=0.200000
00000000001110223024625156, imag=0>, <zero_
number real=0, imag=3>]]
>>> a
[[<zero_number real=1, imag=0>, <zero_number
real=0, imag=0>], [<zero_number real=0.200000
00000000001110223024625156, imag=0>, <zero_
number real=0, imag=3>]]
>>> a is b
True


>>>
```

create_zero_number_matrix()

```
create_zero_number_matrix(value: list[list[any]]) : list[list[zero_number]]
```

Converts the elements of the matrix `value` to the `zero_number` type. Aligns the matrix width to the maximum length of the nested lists (adds new elements with `zero_number(0)` value). Raises a *ValueError* exception if the matrix `value` has zero width or height. Returns new matrix.

```
PYTHON
>>> a
[[1], [0.2, 3j]]
>>> b = create_zero_number_matrix(a)
>>> b
[[<zero_number real=1, imag=0>, <zero_number
real=0, imag=0>], [<zero_number real=0.200000
00000000001110223024625156, imag=0>, <zero_
number real=0, imag=3>]]
>>> a
[[1], [0.2, 3j]]
>>> a is b
False
>>>
```

```
PYTHON
>>> a = [[zero_number(0,5)]]
>>> a
[[<zero_number real=0, imag=5>]]
>>> b = create_zero_number_matrix(a)
>>> b
[[<zero_number real=0, imag=5>]]
>>> a
[[<zero_number real=0, imag=5>]]
>>> a is b
False
>>>
```

5.2. Class zero.environment.zero_number

A complex number representing the type used in ZeroBasic calculations. This number can be an integer, floating-point, or complex value. For more detailed information about this data type, refer to the ZeroBasic documentation.
It contains the following elements:

5.2.1. Attributes

real

```
real : float #<read-only>
```

The real part of the number.

imag

```
imag : float #<read-only>
```

The imaginary part of the number.

5.2.2. Constructor

> Logic type can be converted into `int`. This allows to use next expressions: `zero_number(5 < 8)`, `zero_number(False)`.

```
__new__() : zero_number
```

Default constructor. The value will be set to 0.

```
__new__(real: int|float) : zero_number
```

Constructor that sets the real part.

```
__new__(real: int|float, imag: int|float) : zero_number
```

Constructor that sets both the real and imaginary parts.

```
__new__(number: zero_number|complex) : zero_number
```

Constructor based on another complex number.

5.2.3. Type conversion

__str__()

```
__str__(self) : str
```

Returns a human-readable string representation of the number (the number may have a fractional or polar representation if the corresponding flags are set).

__repr__()

```
__repr__(self) : str
```

Returns the full string representation of the number (including additional flags).

__bool__()

```
__bool__(self) : bool
```

Returns `False` if `self.real == 0` and `self.imag == 0`. Otherwise, returns `True`.

__int__()

```
__int__(self) : int
```

Returns `int(self.real)`, if `self` is real (`self.imag == 0`) and integer number. Otherwise, it throws an exception *TypeError*.

__float__()

```
__float__(self) : float
```

Returns `float(self.real)`, if `self` is real (`self.imag == 0`). Otherwise, it throws an exception *TypeError*.

__complex__()

```
__complex__(self) : complex
```

Returns `complex(self.real, self.imag)`.

5.2.4. Unary operations

__pos__()

```
__pos__(self) : complex
```

Returns `self`.

__neg__()

```
__neg__(self) : complex
```

Returns negative value of `self`.

__abs__()

```
__abs__(self) : complex
```

Returns absolute value of `self`.

5.2.5. Mathematical operations

__add__()

```
__add__(left : zero_number, right : zero_number|float|int|complex) : zero_number
```

Returns the sum `left + right`.

__sub__()

```
__sub__(left : zero_number, right : zero_number|float|int|complex) : zero_number
```

Returns the difference `left - right`.

__mul__()

```
__mul__(left : zero_number, right : zero_number|float|int|complex) : zero_number
```

Returns the product `left * right`.

__truediv__()

```
__truediv__(left : zero_number, right : zero_number|float|int|complex) : zero_number
```

Returns the quotient `left / right`. If `right` equals 0, a *ZeroDivisionError* exception will be raised.

__floordiv__()

```
__floordiv__(left : zero_number, right : zero_number|float|int|complex) : zero_number
```

Returns `left // right`. If `right` equals 0, a *ZeroDivisionError* exception will be raised. If `right` or `left` is a complex number, a *TypeError* exception will be raised.

__mod__()

```
__mod__(left : zero_number, right : zero_number|float|int|complex) : zero_number
```

Returns `left % right`. If `right` equals 0, a *ZeroDivisionError* exception will be raised. If `right` or `left` is a complex number, a *TypeError* exception will be raised.

__pow__()

```
__pow__(left : zero_number, right : zero_number|float|int|complex) : zero_number
```

Returns `left ** right`. If both `right` and `left` are equal to 0, an `ArithmeticError` exception will be raised. If `right` or `left` is a complex number and the `Degree` mode is active, an `ArithmeticError` exception will be raised.

__divmod__()

```
__divmod__(left : zero_number, right : zero_number|float|int|complex) : zero_number
```

Returns `divmod(left, right)`. If `right` equals 0, a *ZeroDivisionError* exception will be raised. If `right` or `left` is a complex number, a *TypeError* exception will be raised.

5.2.6. Comparing operations

__lt__()

```
__lt__(left : zero_number, right : zero_number|float|int|complex) : bool
```

Returns `left < right`. If `right` or `left` is a complex number, a *TypeError* exception will be thrown.

__gt__()

```
__gt__(left : zero_number, right : zero_number|float|int|complex) : bool
```

Returns `left > right`. If `right` or `left` is a complex number, a *TypeError* exception will be thrown.

__le__()

```
__le__(left : zero_number, right : zero_number|float|int|complex) : bool
```

Returns `left <= right`. If `right` or `left` is a complex number, a *TypeError* exception will be thrown.

__ge__()

```
__ge__(left : zero_number, right : zero_number|float|int|complex) : bool
```

Returns `left >= right`. If `right` or `left` is a complex number, a *TypeError* exception will be thrown.

__eq__()

```
__eq__(left : zero_number, right : zero_number|float|int|complex) : bool
```

Returns `left == right`.

__is__()

```
__is__(left : zero_number, right : zero_number) : bool
```

Returns `left is right` (exact matching of objects in memory).

__ne__()

```
__ne__(left : zero_number, right : zero_number|float|int|complex) : bool
```

Returns `left != right`.

5.2.7. Methods

is_complex()

```
is_complex(self) : bool
```

Returns whether `self` is complex (`self.imag != 0`).

is_real()

```
is_real(self) : bool
```

Returns whether `self` is real (`self.imag == 0`).

is_integer()

```
is_integer(self) : bool
```

Returns whether `self.real` and `self.imag` are integers.

is_zero()

```
is_zero(self) : bool
```

Returns whether `self.real` and `self.imag` are equal to zero.

is_inf()

```
is_inf(self) : bool
```

Returns whether `self.real` or `self.imag` is infinite.

is_nan()

```
is_nan(self) : bool
```

Returns whether `self.real` or `self.imag` is `NaN` value.

is_ifrac()

```
is_ifrac(self) : bool
```

Returns whether the mixed fraction flag is set (affects string representation formatting).

is_dfrac()

```
is_dfrac(self) : bool
```

Returns whether the improper fraction flag is set (affects string representation formatting).

is_frac()

```
is_frac(self) : bool
```

Returns whether any fraction flag is set (affects string representation formatting).

is_polar()

```
is_polar(self) : bool
```

Returns whether the polar form flag for a complex number is set (affects string representation formatting).

set_dfrac()

```
set_dfrac(self, value : bool) : self
```

Sets a new state for the improper fraction flag.

set_ifrac()

```
set_ifrac(self, value : bool) : self
```

Sets a new state for the mixed fraction flag.

clear_frac()

```
clear_frac(self) : self
```

Clears the state of any fraction flags.

5.3. zero.io module

This module is designed for interacting with input and output using MicroPython. It contains the following elements:

SCREEN_HEIGHT

```
SCREEN_HEIGHT : int
```

Screen height in characters (15).

SCREEN_WIDTH

```
SCREEN_WIDTH : int
```

Screen width in characters (45).

MAX_HISTORY_SIZE

```
MAX_HISTORY_SIZE : int
```

The maximum size of the screen history in rows (1000).

colors

```
colors : dict[str, int]
```

Represents a dict with named values. Each value is a 24-bit representation of a color in the RGB palette. The value is formed as follows:

```
uint32 color = ((r & 0xff) << 16) |
               ((g & 0xff) <<  8) |
               ((b & 0xff) <<  0)
```

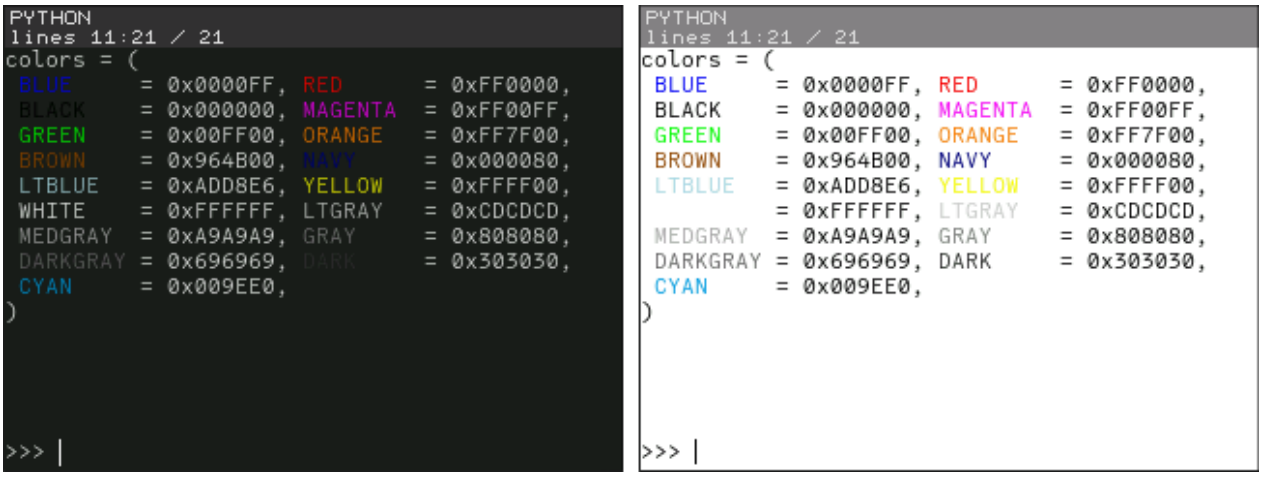
The dict contain next values:

```
(
    BLUE      = 0x0000FF,
    RED       = 0xFF0000,
    BLACK     = 0x000000,
    MAGENTA   = 0xFF00FF,
    GREEN     = 0x00FF00,
    ORANGE    = 0xFF7F00,
    BROWN     = 0x964B00,
    NAVY      = 0x000080,
    LTBLUE    = 0xADD8E6,
    YELLOW    = 0xFFFF00,
    WHITE     = 0xFFFFFF,
    LTGRAY    = 0xCDCDCD,
    MEDGRAY   = 0xA9A9A9,
    GRAY      = 0x808080,
    DARKGRAY  = 0x696969,
    DARK      = 0x303030,
    CYAN      = 0x009EE0
)
```

Example:

```
import zero
from zero.io import *

clear_screen()

print("colors = (")

ind = 0
for c, v in colors.items():
    if ind % 2 == 0:
        print(" ", end="")
    print_color(c, sep="", end="", color=v)
    s = len(c)
    val_str = "0x%0.6X" % v
    s += len(" = ") + len(val_str) + len(", ")
    s = 21 - s
    if s > 0:
        print(" "*s, end="")

    print(" = ", val_str, ", ", sep="", end="")
    if ind % 2 == 1:
        print("\n", end="")
```

```
    ind += 1

print("\n)", end="")
```



flush()

```
flush() : None
```

Forcibly refreshes and redraws the Python Shell window (scrolls the history to the most recent line). The Python Shell window updates automatically in the following cases:

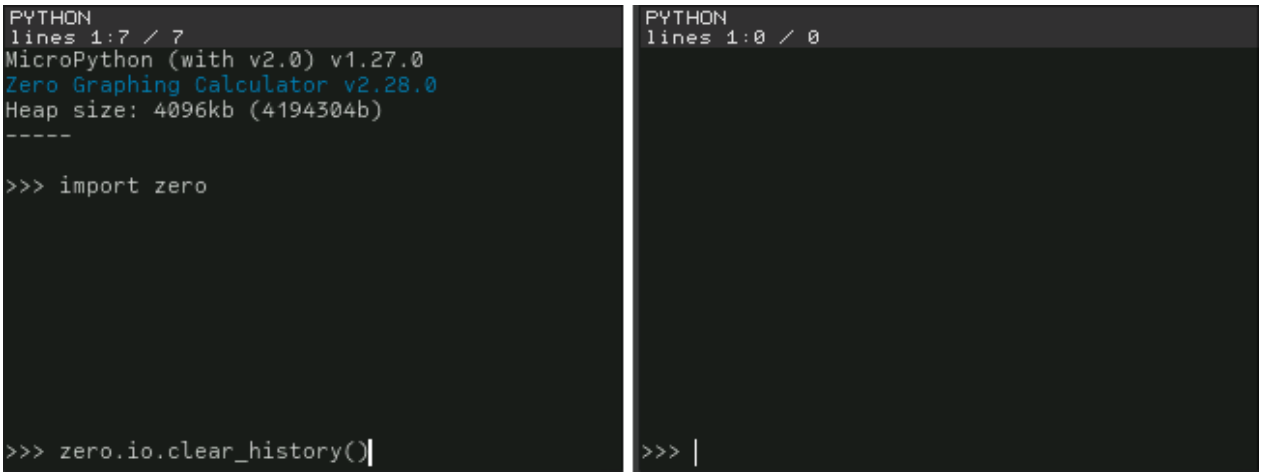
- Script execution has finished
- A command has been entered
- The `print()` function has output text that resulted in a new line being added to the history
- The `input()` function

In all other cases, a manual call to the `flush()` function is required.

clear_history()

```
clear_history() : None
```

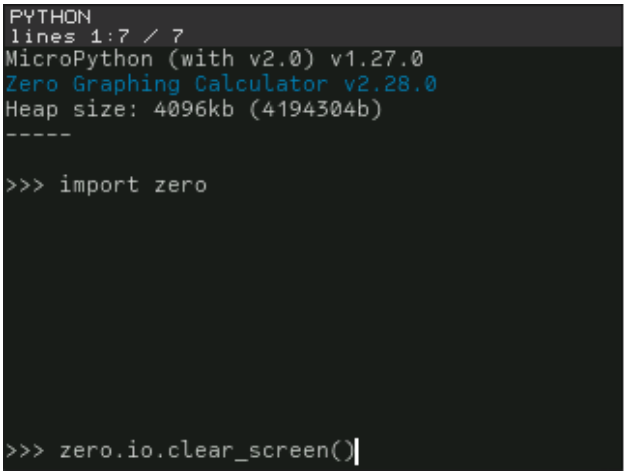
Clears the history. To update the screen during script execution, use the function `flush()`.

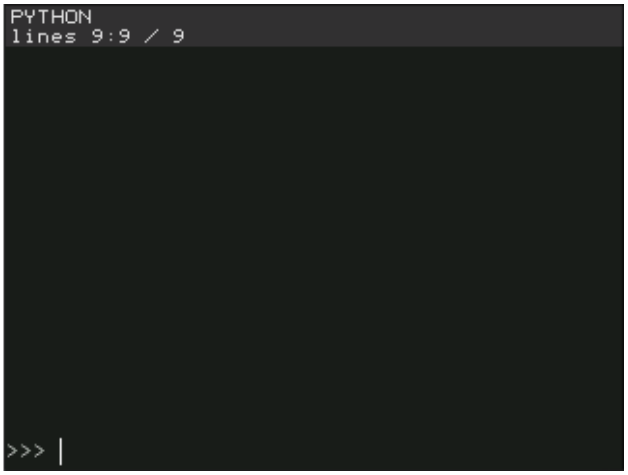


clear_screen()

```
clear_screen() : None
```

Outputs a new empty line to the history (older history entries may be cleared). Scrolls the history to display only the latest empty line. To update the screen during script execution, use the function `flush()` .



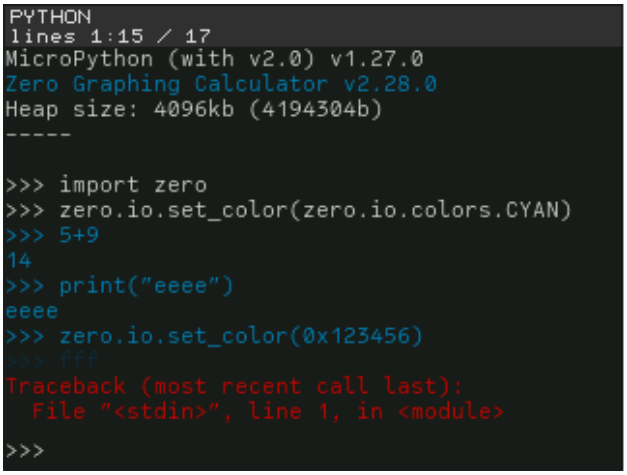


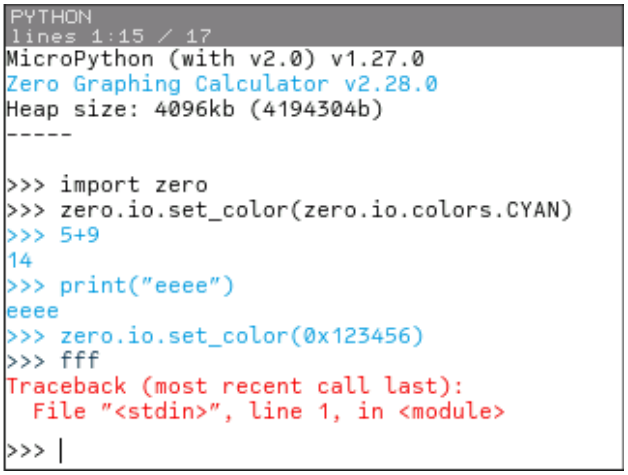
set_color()

```
set_color(color: int) : None
```

Sets the color of the text output to the history. The `color` value must be positive. The value is a 24-bit representation of a color in the RGB palette (for more details, see the section colors). The function is used in conjunction with the `clear_color()` function.

Example:





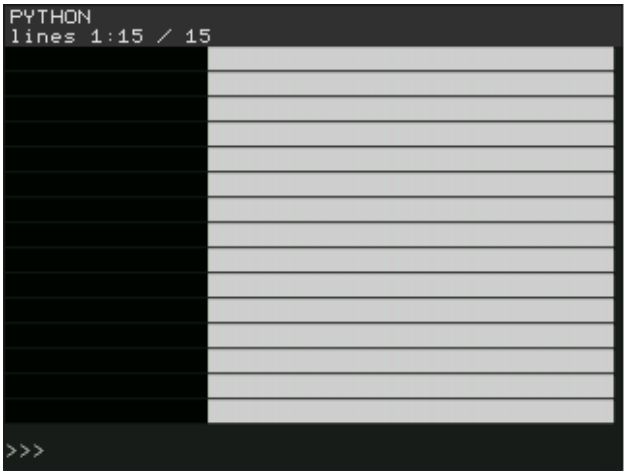
clear_color()

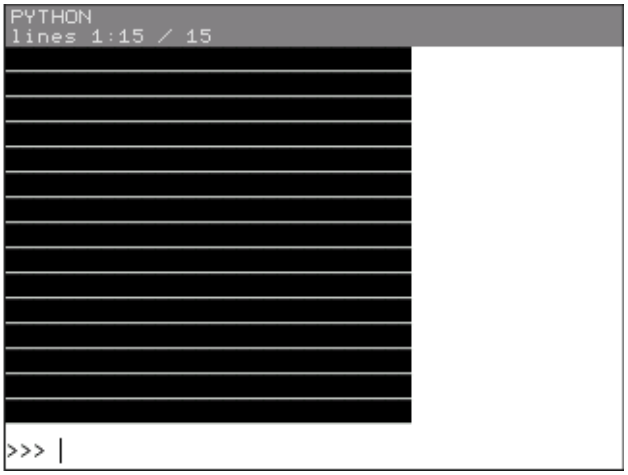
```
clear_color() : None
```

Resets the color of the text output to the history. A feature of the standard output is that the color automatically adjusts to the current color scheme. The function is used in conjunction with the `set_color()` function.

Example:

```
import zero
from zero.io import *

clear_history()
for i in range(SCREEN_HEIGHT):
  set_color(colors.BLACK)
  print("\227"*15,end="")
  clear_color()
  print("\227"*15,end="")
  set_color(colors.WHITE)
  print("\227"*15,end="")
```





print_color()

```
print_color(*objects : any, sep : str = " ", end : str = "\n", color : int | None = None) : None
```

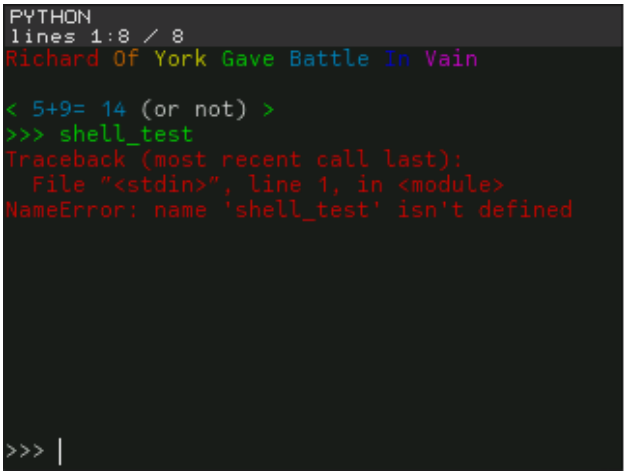
The function is similar to the standard `print()` function, except for the additional **named** parameter `color`.

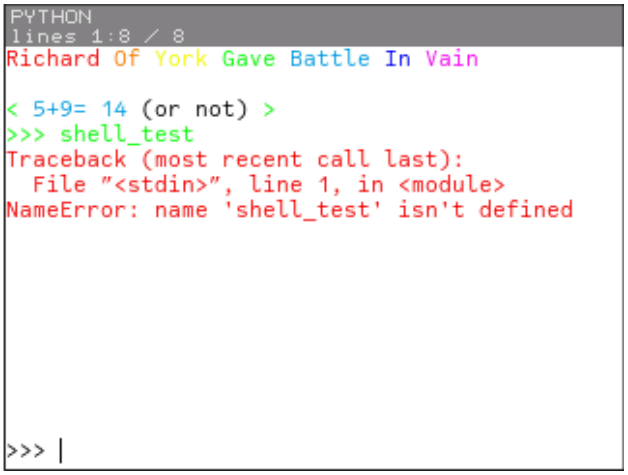
The function outputs text using the color specified in the `color` argument, ignoring the globally set color (for more details, see the section `set_color()`). If the `color` value is set to `None`, the standard color is used for output. (for more details, see the section `clear_color()`). The `color` value must be positive (unless it is `None`). The value is a 24-bit representation of a color in the RGB palette (for more details, see the section colors).

Example:

```
import zero
from zero.io import *

clear_history()

set_color(colors.RED)
print("Richard", end=" ")
set_color(colors.ORANGE)
print("Of", end=" ")
set_color(colors.YELLOW)
print("York", end=" ")
set_color(colors.GREEN)
print("Gave", end=" ")
set_color(colors.CYAN)
print("Battle", end=" ")
set_color(colors.BLUE)
print("In", end=" ")
set_color(colors.MAGENTA)
print("Vain\n")
```

```
clear_color()

set_color(colors.GREEN)
print("<",end=" ")
print_color("5+9=",5+9,end=" ",color=colors.CYAN)
print_color("(or not)",end=" ")
print(">")
```





output()

```
output(x : int, y: int, data : str, color : int | None = None) : None
```

Outputs the text `data` at the specified position in the history, using the specified `color`. The function modifies the history content (it may add new lines and remove old ones). To update the screen during script execution, use the `flush()` function.

Raises a *ValueError* if the value of `x` is less than 0 or greater than or equal to SCREEN_WIDTH. Raises a *ValueError* if the value of `y` is less than 0 or greater than or equal to SCREEN_HEIGHT.

The contents of `data` will be clipped at the edge of the screen (no wrapping is performed). The function outputs text using the color specified in the `color` argument, ignoring the globally set color (for more details, see `set_color()`). If the `color` value is set to `None`, the standard color is used for output (for more details, see `clear_color()`). The `color` value must be positive (unless it is `None`). The value is a 24-bit representation of a color in the RGB palette (for more details, see colors).

Example:

```
import zero
from zero.io import *

clear_screen()

pic = [[4289056159, 4279478543, 4283216705, 4288530333,
        4292006610, 4286962804, 4286434414, 4283273290],
       [4280914726, 4284466521, 4282496822, 4285450597,
        4283208008, 4285586525, 4284857429, 4292006610],
       [4282893622, 4280243223, 4281882673, 4287879052,
        4283930710, 4280176152, 4281882673, 4292664540],
       [4283222845, 4280176152, 4278190080, 4284993365,
        4282888761, 4278190080, 4279712276, 4286107239],
       [4287222402, 4284856151, 4287944590, 4280045332,
        4280110102, 4291023552, 4282944581, 4284403788],
       [4288991898, 4283537230, 4281882673, 4278190080,
```

```
         4278190080, 4280243480, 4284995413, 4290761403],
        [4290962107, 4284981606, 4278190080, 4278190080,
         4278190080, 4278190080, 4284464208, 4283537485],
        [4284995413, 4286766704, 4279712276, 4287877764,
         4289646760, 4280110102, 4282093111, 4285058903]]

for y in range(8):
    for x in range(8):
        output(
            (SCREEN_WIDTH - 16) // 2 + x*2,
            (SCREEN_HEIGHT - 8) // 2 + y,
            "\227\227",
            pic[y][x]
        )

flush()

for i in range(10):
    wait(0.5)
    output(
        (SCREEN_WIDTH - 10) // 2 + i,
        SCREEN_HEIGHT - 2,
        "s"
    )
    flush()
```


```
 # https://www.youtube.com/watch?v=hvxV54jh-tA
base = [
    {'x': 22, 'y': 1, 'ch': 'A',  'color': 0xffffff},
    {'x': 21, 'y': 2, 'ch': '/',  'color': 0xffffff},
    {'x': 22, 'y': 2, 'ch': '|',  'color': 0x313131},
    {'x': 23, 'y': 2, 'ch': '\\', 'color': 0xffffff},
    {'x': 17, 'y': 3, 'ch': '_',  'color': 0xffffff},
    {'x': 20, 'y': 3, 'ch': '|',  'color': 0xffffff},
    {'x': 21, 'y': 3, 'ch': '.',  'color': 0x004e24},
    {'x': 22, 'y': 3, 'ch': '0',  'color': 0xff7125},
    {'x': 23, 'y': 3, 'ch': '.',  'color': 0x004e24},
    {'x': 24, 'y': 3, 'ch': '|',  'color': 0xffffff},
    {'x': 27, 'y': 3, 'ch': '_',  'color': 0xffffff},
    {'x': 13, 'y': 4, 'ch': '_',  'color': 0xffffff},
    {'x': 16, 'y': 4, 'ch': '|',  'color': 0xffffff},
    {'x': 17, 'y': 4, 'ch': '"',  'color': 0x063168},
    {'x': 18, 'y': 4, 'ch': '|',  'color': 0xffffff},
    {'x': 19, 'y': 4, 'ch': '_',  'color': 0x00a0f5},
    {'x': 20, 'y': 4, 'ch': '|',  'color': 0xffffff},
    {'x': 21, 'y': 4, 'ch': '!',  'color': 0x9e1a12},
    {'x': 22, 'y': 4, 'ch': '#',  'color': 0x9e1a12},
    {'x': 23, 'y': 4, 'ch': '!',  'color': 0x9e1a12},
    {'x': 24, 'y': 4, 'ch': '|',  'color': 0xffffff},
```

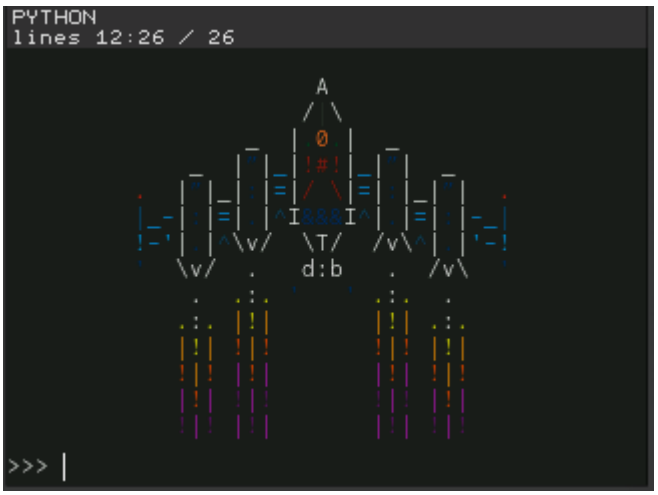
```
    {'x': 25, 'y': 4, 'ch': '_',  'color': 0x00a0f5},
    {'x': 26, 'y': 4, 'ch': '|',  'color': 0xffffff},
    {'x': 27, 'y': 4, 'ch': '"',  'color': 0x063168},
    {'x': 28, 'y': 4, 'ch': '|',  'color': 0xffffff},
    {'x': 31, 'y': 4, 'ch': '_',  'color': 0xffffff},
    {'x': 9,  'y': 5, 'ch': '.',  'color': 0xf62011},
    {'x': 12, 'y': 5, 'ch': '|',  'color': 0xffffff},
    {'x': 13, 'y': 5, 'ch': '"',  'color': 0x063168},
    {'x': 14, 'y': 5, 'ch': '|',  'color': 0xffffff},
    {'x': 15, 'y': 5, 'ch': '_',  'color': 0xffffff},
    {'x': 16, 'y': 5, 'ch': '|',  'color': 0xffffff},
    {'x': 17, 'y': 5, 'ch': ':',  'color': 0x063168},
    {'x': 18, 'y': 5, 'ch': '|',  'color': 0xffffff},
    {'x': 19, 'y': 5, 'ch': '=',  'color': 0x00a0f5},
    {'x': 20, 'y': 5, 'ch': '|',  'color': 0xffffff},
    {'x': 21, 'y': 5, 'ch': '/',  'color': 0x9e1a12},
    {'x': 23, 'y': 5, 'ch': '\\', 'color': 0x9e1a12},
    {'x': 24, 'y': 5, 'ch': '|',  'color': 0xffffff},
    {'x': 25, 'y': 5, 'ch': '=',  'color': 0x00a0f5},
    {'x': 26, 'y': 5, 'ch': '|',  'color': 0xffffff},
    {'x': 27, 'y': 5, 'ch': ':',  'color': 0x063168},
    {'x': 28, 'y': 5, 'ch': '|',  'color': 0xffffff},
    {'x': 29, 'y': 5, 'ch': '_',  'color': 0xffffff},
    {'x': 30, 'y': 5, 'ch': '|',  'color': 0xffffff},
    {'x': 31, 'y': 5, 'ch': '"',  'color': 0x063168},
    {'x': 32, 'y': 5, 'ch': '|',  'color': 0xffffff},
    {'x': 35, 'y': 5, 'ch': '.',  'color': 0xf62011},
    {'x': 9,  'y': 6, 'ch': '|',  'color': 0x005381},
    {'x': 10, 'y': 6, 'ch': '_',  'color': 0x00a0f5},
    {'x': 11, 'y': 6, 'ch': '-',  'color': 0x00a0f5},
    {'x': 12, 'y': 6, 'ch': '|',  'color': 0xffffff},
    {'x': 13, 'y': 6, 'ch': ':',  'color': 0x063168},
    {'x': 14, 'y': 6, 'ch': '|',  'color': 0xffffff},
    {'x': 15, 'y': 6, 'ch': '=',  'color': 0x00a0f5},
    {'x': 16, 'y': 6, 'ch': '|',  'color': 0xffffff},
    {'x': 17, 'y': 6, 'ch': '.',  'color': 0x063168},
    {'x': 18, 'y': 6, 'ch': '|',  'color': 0xffffff},
    {'x': 19, 'y': 6, 'ch': '^',  'color': 0x1d496d},
    {'x': 20, 'y': 6, 'ch': 'I',  'color': 0xffffff},
    {'x': 21, 'y': 6, 'ch': '&',  'color': 0x003270},
    {'x': 22, 'y': 6, 'ch': '&',  'color': 0x003270},
    {'x': 23, 'y': 6, 'ch': '&',  'color': 0x003270},
    {'x': 24, 'y': 6, 'ch': 'I',  'color': 0xffffff},
    {'x': 25, 'y': 6, 'ch': '^',  'color': 0x1d496d},
    {'x': 26, 'y': 6, 'ch': '|',  'color': 0xffffff},
    {'x': 27, 'y': 6, 'ch': '.',  'color': 0x063168},
    {'x': 28, 'y': 6, 'ch': '|',  'color': 0xffffff},
    {'x': 29, 'y': 6, 'ch': '=',  'color': 0x00a0f5},
    {'x': 30, 'y': 6, 'ch': '|',  'color': 0xffffff},
    {'x': 31, 'y': 6, 'ch': ':',  'color': 0x063168},
    {'x': 32, 'y': 6, 'ch': '|',  'color': 0xffffff},
    {'x': 33, 'y': 6, 'ch': '-',  'color': 0x00a0f5},
    {'x': 34, 'y': 6, 'ch': '_',  'color': 0x00a0f5},
    {'x': 35, 'y': 6, 'ch': '|',  'color': 0x005381},
    {'x': 9,  'y': 7, 'ch': '!',  'color': 0x00a0f5},
    {'x': 10, 'y': 7, 'ch': '-',  'color': 0x00a0f5},
    {'x': 11, 'y': 7, 'ch': "'",  'color': 0x00a0f5},
    {'x': 12, 'y': 7, 'ch': '|',  'color': 0xffffff},
    {'x': 13, 'y': 7, 'ch': '.',  'color': 0x063168},
    {'x': 14, 'y': 7, 'ch': '|',  'color': 0xffffff},
    {'x': 15, 'y': 7, 'ch': '^',  'color': 0x1d496d},
    {'x': 16, 'y': 7, 'ch': '\\', 'color': 0xffffff},
    {'x': 17, 'y': 7, 'ch': 'v',  'color': 0xffffff},
    {'x': 18, 'y': 7, 'ch': '/',  'color': 0xffffff},
    {'x': 21, 'y': 7, 'ch': '\\', 'color': 0xffffff},
    {'x': 22, 'y': 7, 'ch': 'T',  'color': 0xffffff},
    {'x': 23, 'y': 7, 'ch': '/',  'color': 0xffffff},
    {'x': 26, 'y': 7, 'ch': '/',  'color': 0xffffff},
```

```
    {'x': 27, 'y': 7, 'ch': 'v',  'color': 0xffffff},
    {'x': 28, 'y': 7, 'ch': '\\', 'color': 0xffffff},
    {'x': 29, 'y': 7, 'ch': '^',  'color': 0x1d496d},
    {'x': 30, 'y': 7, 'ch': '|',  'color': 0xffffff},
    {'x': 31, 'y': 7, 'ch': '.',  'color': 0x063168},
    {'x': 32, 'y': 7, 'ch': '|',  'color': 0xffffff},
    {'x': 33, 'y': 7, 'ch': "'",  'color': 0x00a0f5},
    {'x': 34, 'y': 7, 'ch': '-',  'color': 0x00a0f5},
    {'x': 35, 'y': 7, 'ch': '!',  'color': 0x00a0f5},
    {'x': 9,  'y': 8, 'ch': "'",  'color': 0x063168},
    {'x': 12, 'y': 8, 'ch': '\\', 'color': 0xffffff},
    {'x': 13, 'y': 8, 'ch': 'v',  'color': 0xffffff},
    {'x': 14, 'y': 8, 'ch': '/',  'color': 0xffffff},
    {'x': 17, 'y': 8, 'ch': ':',  'color': 0xffffff},
    {'x': 21, 'y': 8, 'ch': 'd',  'color': 0xffffff},
    {'x': 22, 'y': 8, 'ch': ':',  'color': 0xffffff},
    {'x': 23, 'y': 8, 'ch': 'b',  'color': 0xffffff},
    {'x': 27, 'y': 8, 'ch': ':',  'color': 0xffffff},
    {'x': 30, 'y': 8, 'ch': '/',  'color': 0xffffff},
    {'x': 31, 'y': 8, 'ch': 'v',  'color': 0xffffff},
    {'x': 32, 'y': 8, 'ch': '\\', 'color': 0xffffff},
    {'x': 35, 'y': 8, 'ch': "'",  'color': 0x063168},
    {'x': 13, 'y': 9, 'ch': ':',  'color': 0xffffff},
    {'x': 17, 'y': 9, 'ch': "'",  'color': 0xf0f30d},
    {'x': 20, 'y': 9, 'ch': "'",  'color': 0x063168},
    {'x': 24, 'y': 9, 'ch': "'",  'color': 0x063168},
    {'x': 27, 'y': 9, 'ch': "'",  'color': 0xf0f30d},
    {'x': 31, 'y': 9, 'ch': ':',  'color': 0xffffff},
    {'x': 13, 'y': 10, 'ch': "'", 'color': 0xf0f30d},
    {'x': 16, 'y': 10, 'ch': '!', 'color': 0xff9500},
    {'x': 17, 'y': 10, 'ch': '|', 'color': 0xf0f30d},
    {'x': 18, 'y': 10, 'ch': '!', 'color': 0xff9500},
    {'x': 26, 'y': 10, 'ch': '!', 'color': 0xff9500},
    {'x': 27, 'y': 10, 'ch': '|', 'color': 0xf0f30d},
    {'x': 28, 'y': 10, 'ch': '!', 'color': 0xff9500},
    {'x': 31, 'y': 10, 'ch': "'", 'color': 0xf0f30d},
    {'x': 12, 'y': 11, 'ch': '!', 'color': 0xff9500},
    {'x': 13, 'y': 11, 'ch': '|', 'color': 0xf0f30d},
    {'x': 14, 'y': 11, 'ch': '!', 'color': 0xff9500},
    {'x': 16, 'y': 11, 'ch': '|', 'color': 0xff4d00},
    {'x': 17, 'y': 11, 'ch': '!', 'color': 0xff9500},
    {'x': 18, 'y': 11, 'ch': '|', 'color': 0xff4d00},
    {'x': 26, 'y': 11, 'ch': '|', 'color': 0xff4d00},
    {'x': 27, 'y': 11, 'ch': '!', 'color': 0xff9500},
    {'x': 28, 'y': 11, 'ch': '|', 'color': 0xff4d00},
    {'x': 30, 'y': 11, 'ch': '!', 'color': 0xff9500},
    {'x': 31, 'y': 11, 'ch': '|', 'color': 0xf0f30d},
    {'x': 32, 'y': 11, 'ch': '!', 'color': 0xff9500},
    {'x': 12, 'y': 12, 'ch': '|', 'color': 0xff4d00},
    {'x': 13, 'y': 12, 'ch': '!', 'color': 0xff9500},
    {'x': 14, 'y': 12, 'ch': '|', 'color': 0xff4d00},
    {'x': 16, 'y': 12, 'ch': '!', 'color': 0xba1bb8},
    {'x': 17, 'y': 12, 'ch': '|', 'color': 0xff4d00},
    {'x': 18, 'y': 12, 'ch': '!', 'color': 0xba1bb8},
    {'x': 26, 'y': 12, 'ch': '!', 'color': 0xba1bb8},
    {'x': 27, 'y': 12, 'ch': '|', 'color': 0xff4d00},
    {'x': 28, 'y': 12, 'ch': '!', 'color': 0xba1bb8},
    {'x': 30, 'y': 12, 'ch': '|', 'color': 0xff4d00},
    {'x': 31, 'y': 12, 'ch': '!', 'color': 0xff9500},
    {'x': 32, 'y': 12, 'ch': '|', 'color': 0xff4d00},
    {'x': 12, 'y': 13, 'ch': '!', 'color': 0xba1bb8},
    {'x': 13, 'y': 13, 'ch': '|', 'color': 0xff4d00},
    {'x': 14, 'y': 13, 'ch': '!', 'color': 0xba1bb8},
    {'x': 16, 'y': 13, 'ch': '|', 'color': 0x6c1277},
    {'x': 17, 'y': 13, 'ch': '!', 'color': 0xba1bb8},
    {'x': 18, 'y': 13, 'ch': '|', 'color': 0x6c1277},
    {'x': 26, 'y': 13, 'ch': '|', 'color': 0x6c1277},
    {'x': 27, 'y': 13, 'ch': '!', 'color': 0xba1bb8},
```

```
    {'x': 28, 'y': 13, 'ch': '|', 'color': 0x6c1277},
    {'x': 30, 'y': 13, 'ch': '!', 'color': 0xba1bb8},
    {'x': 31, 'y': 13, 'ch': '|', 'color': 0xff4d00},
    {'x': 32, 'y': 13, 'ch': '!', 'color': 0xba1bb8},
    {'x': 12, 'y': 14, 'ch': '|', 'color': 0x6c1277},
    {'x': 13, 'y': 14, 'ch': '!', 'color': 0xba1bb8},
    {'x': 14, 'y': 14, 'ch': '|', 'color': 0x6c1277},
    {'x': 16, 'y': 14, 'ch': '!', 'color': 0xba1bb8},
    {'x': 17, 'y': 14, 'ch': '|', 'color': 0x6c1277},
    {'x': 18, 'y': 14, 'ch': '!', 'color': 0xba1bb8},
    {'x': 26, 'y': 14, 'ch': '!', 'color': 0xba1bb8},
    {'x': 27, 'y': 14, 'ch': '|', 'color': 0x6c1277},
    {'x': 28, 'y': 14, 'ch': '!', 'color': 0xba1bb8},
    {'x': 30, 'y': 14, 'ch': '|', 'color': 0x6c1277},
    {'x': 31, 'y': 14, 'ch': '!', 'color': 0xba1bb8},
    {'x': 32, 'y': 14, 'ch': '|', 'color': 0x6c1277},
]

frames = [
    [
        {'x': 17, 'y': 8, 'ch': '.', 'color': 0xffffff},
        {'x': 27, 'y': 8, 'ch': '.', 'color': 0xffffff},

        {'x': 13, 'y': 9, 'ch': '.', 'color': 0xffffff},

        {'x': 16, 'y': 9, 'ch': ".", 'color': 0xf0f30d},
        {'x': 17, 'y': 9, 'ch': ":", 'color': 0xffffff},
        {'x': 18, 'y': 9, 'ch': ".", 'color': 0xf0f30d},

        {'x': 26, 'y': 9, 'ch': ".", 'color': 0xf0f30d},
        {'x': 27, 'y': 9, 'ch': ":", 'color': 0xffffff},
        {'x': 28, 'y': 9, 'ch': ".", 'color': 0xf0f30d},

        {'x': 31, 'y': 9, 'ch': '.', 'color': 0xffffff},

        {'x': 12, 'y': 10, 'ch': ".", 'color': 0xf0f30d},
        {'x': 13, 'y': 10, 'ch': ":", 'color': 0xffffff},
        {'x': 14, 'y': 10, 'ch': ".", 'color': 0xf0f30d},

        {'x': 16, 'y': 10, 'ch': '|', 'color': 0xff9500},
        {'x': 17, 'y': 10, 'ch': '!', 'color': 0xf0f30d},
        {'x': 18, 'y': 10, 'ch': '|', 'color': 0xff9500},
        {'x': 26, 'y': 10, 'ch': '|', 'color': 0xff9500},
        {'x': 27, 'y': 10, 'ch': '!', 'color': 0xf0f30d},
        {'x': 28, 'y': 10, 'ch': '|', 'color': 0xff9500},

        {'x': 30, 'y': 10, 'ch': ".", 'color': 0xf0f30d},
        {'x': 31, 'y': 10, 'ch': ":", 'color': 0xffffff},
        {'x': 32, 'y': 10, 'ch': ".", 'color': 0xf0f30d},

        {'x': 12, 'y': 11, 'ch': '|', 'color': 0xff9500},
        {'x': 13, 'y': 11, 'ch': '!', 'color': 0xf0f30d},
        {'x': 14, 'y': 11, 'ch': '|', 'color': 0xff9500},
        {'x': 16, 'y': 11, 'ch': '!', 'color': 0xff4d00},
        {'x': 17, 'y': 11, 'ch': '|', 'color': 0xff9500},
        {'x': 18, 'y': 11, 'ch': '!', 'color': 0xff4d00},
        {'x': 26, 'y': 11, 'ch': '!', 'color': 0xff4d00},
        {'x': 27, 'y': 11, 'ch': '|', 'color': 0xff9500},
        {'x': 28, 'y': 11, 'ch': '!', 'color': 0xff4d00},
        {'x': 30, 'y': 11, 'ch': '|', 'color': 0xff9500},
        {'x': 31, 'y': 11, 'ch': '!', 'color': 0xf0f30d},
        {'x': 32, 'y': 11, 'ch': '|', 'color': 0xff9500},
        {'x': 12, 'y': 12, 'ch': '!', 'color': 0xff4d00},
        {'x': 13, 'y': 12, 'ch': '|', 'color': 0xff9500},
        {'x': 14, 'y': 12, 'ch': '!', 'color': 0xff4d00},
        {'x': 16, 'y': 12, 'ch': '|', 'color': 0xba1bb8},
        {'x': 17, 'y': 12, 'ch': '!', 'color': 0xff4d00},
        {'x': 18, 'y': 12, 'ch': '|', 'color': 0xba1bb8},
```

```
        {'x': 26, 'y': 12, 'ch': '|', 'color': 0xba1bb8},
        {'x': 27, 'y': 12, 'ch': '!', 'color': 0xff4d00},
        {'x': 28, 'y': 12, 'ch': '|', 'color': 0xba1bb8},
        {'x': 30, 'y': 12, 'ch': '!', 'color': 0xff4d00},
        {'x': 31, 'y': 12, 'ch': '|', 'color': 0xff9500},
        {'x': 32, 'y': 12, 'ch': '!', 'color': 0xff4d00},
        {'x': 12, 'y': 13, 'ch': '|', 'color': 0xba1bb8},
        {'x': 13, 'y': 13, 'ch': '!', 'color': 0xff4d00},
        {'x': 14, 'y': 13, 'ch': '|', 'color': 0xba1bb8},
        {'x': 16, 'y': 13, 'ch': '!', 'color': 0x6c1277},
        {'x': 17, 'y': 13, 'ch': '|', 'color': 0xba1bb8},
        {'x': 18, 'y': 13, 'ch': '!', 'color': 0x6c1277},
        {'x': 26, 'y': 13, 'ch': '!', 'color': 0x6c1277},
        {'x': 27, 'y': 13, 'ch': '|', 'color': 0xba1bb8},
        {'x': 28, 'y': 13, 'ch': '!', 'color': 0x6c1277},
        {'x': 30, 'y': 13, 'ch': '|', 'color': 0xba1bb8},
        {'x': 31, 'y': 13, 'ch': '!', 'color': 0xff4d00},
        {'x': 32, 'y': 13, 'ch': '|', 'color': 0xba1bb8},
        {'x': 12, 'y': 14, 'ch': '!', 'color': 0x6c1277},
        {'x': 13, 'y': 14, 'ch': '|', 'color': 0xba1bb8},
        {'x': 14, 'y': 14, 'ch': '!', 'color': 0x6c1277},
        {'x': 16, 'y': 14, 'ch': '|', 'color': 0xba1bb8},
        {'x': 17, 'y': 14, 'ch': '!', 'color': 0x6c1277},
        {'x': 18, 'y': 14, 'ch': '|', 'color': 0xba1bb8},
        {'x': 26, 'y': 14, 'ch': '|', 'color': 0xba1bb8},
        {'x': 27, 'y': 14, 'ch': '!', 'color': 0x6c1277},
        {'x': 28, 'y': 14, 'ch': '|', 'color': 0xba1bb8},
        {'x': 30, 'y': 14, 'ch': '!', 'color': 0x6c1277},
        {'x': 31, 'y': 14, 'ch': '|', 'color': 0xba1bb8},
        {'x': 32, 'y': 14, 'ch': '!', 'color': 0x6c1277},
    ],
    [
        {'x': 17, 'y': 8, 'ch': ':', 'color': 0xffffff},
        {'x': 27, 'y': 8, 'ch': ':', 'color': 0xffffff},

        {'x': 13, 'y': 9, 'ch': ':', 'color': 0xffffff},

        {'x': 16, 'y': 9, 'ch': " ", 'color': 0xf0f30d},
        {'x': 17, 'y': 9, 'ch': "'", 'color': 0xf0f30d},
        {'x': 18, 'y': 9, 'ch': " ", 'color': 0xf0f30d},

        {'x': 26, 'y': 9, 'ch': " ", 'color': 0xf0f30d},
        {'x': 27, 'y': 9, 'ch': "'", 'color': 0xf0f30d},
        {'x': 28, 'y': 9, 'ch': " ", 'color': 0xf0f30d},

        {'x': 31, 'y': 9, 'ch': ':', 'color': 0xffffff},

        {'x': 12, 'y': 10, 'ch': " ", 'color': 0xf0f30d},
        {'x': 13, 'y': 10, 'ch': "'", 'color': 0xf0f30d},
        {'x': 14, 'y': 10, 'ch': " ", 'color': 0xf0f30d},

        {'x': 16, 'y': 10, 'ch': '!', 'color': 0xff9500},
        {'x': 17, 'y': 10, 'ch': '|', 'color': 0xf0f30d},
        {'x': 18, 'y': 10, 'ch': '!', 'color': 0xff9500},
        {'x': 26, 'y': 10, 'ch': '!', 'color': 0xff9500},
        {'x': 27, 'y': 10, 'ch': '|', 'color': 0xf0f30d},
        {'x': 28, 'y': 10, 'ch': '!', 'color': 0xff9500},

        {'x': 30, 'y': 10, 'ch': " ", 'color': 0xf0f30d},
        {'x': 31, 'y': 10, 'ch': "'", 'color': 0xf0f30d},
        {'x': 32, 'y': 10, 'ch': " ", 'color': 0xf0f30d},

        {'x': 12, 'y': 11, 'ch': '!', 'color': 0xff9500},
        {'x': 13, 'y': 11, 'ch': '|', 'color': 0xf0f30d},
        {'x': 14, 'y': 11, 'ch': '!', 'color': 0xff9500},
        {'x': 16, 'y': 11, 'ch': '|', 'color': 0xff4d00},
        {'x': 17, 'y': 11, 'ch': '!', 'color': 0xff9500},
        {'x': 18, 'y': 11, 'ch': '|', 'color': 0xff4d00},
```

```
        {'x': 26, 'y': 11, 'ch': '|', 'color': 0xff4d00},
        {'x': 27, 'y': 11, 'ch': '!', 'color': 0xff9500},
        {'x': 28, 'y': 11, 'ch': '|', 'color': 0xff4d00},
        {'x': 30, 'y': 11, 'ch': '!', 'color': 0xff9500},
        {'x': 31, 'y': 11, 'ch': '|', 'color': 0xf0f30d},
        {'x': 32, 'y': 11, 'ch': '!', 'color': 0xff9500},
        {'x': 12, 'y': 12, 'ch': '|', 'color': 0xff4d00},
        {'x': 13, 'y': 12, 'ch': '!', 'color': 0xff9500},
        {'x': 14, 'y': 12, 'ch': '|', 'color': 0xff4d00},
        {'x': 16, 'y': 12, 'ch': '!', 'color': 0xba1bb8},
        {'x': 17, 'y': 12, 'ch': '|', 'color': 0xff4d00},
        {'x': 18, 'y': 12, 'ch': '!', 'color': 0xba1bb8},
        {'x': 26, 'y': 12, 'ch': '!', 'color': 0xba1bb8},
        {'x': 27, 'y': 12, 'ch': '|', 'color': 0xff4d00},
        {'x': 28, 'y': 12, 'ch': '!', 'color': 0xba1bb8},
        {'x': 30, 'y': 12, 'ch': '|', 'color': 0xff4d00},
        {'x': 31, 'y': 12, 'ch': '!', 'color': 0xff9500},
        {'x': 32, 'y': 12, 'ch': '|', 'color': 0xff4d00},
        {'x': 12, 'y': 13, 'ch': '!', 'color': 0xba1bb8},
        {'x': 13, 'y': 13, 'ch': '|', 'color': 0xff4d00},
        {'x': 14, 'y': 13, 'ch': '!', 'color': 0xba1bb8},
        {'x': 16, 'y': 13, 'ch': '|', 'color': 0x6c1277},
        {'x': 17, 'y': 13, 'ch': '!', 'color': 0xba1bb8},
        {'x': 18, 'y': 13, 'ch': '|', 'color': 0x6c1277},
        {'x': 26, 'y': 13, 'ch': '|', 'color': 0x6c1277},
        {'x': 27, 'y': 13, 'ch': '!', 'color': 0xba1bb8},
        {'x': 28, 'y': 13, 'ch': '|', 'color': 0x6c1277},
        {'x': 30, 'y': 13, 'ch': '!', 'color': 0xba1bb8},
        {'x': 31, 'y': 13, 'ch': '|', 'color': 0xff4d00},
        {'x': 32, 'y': 13, 'ch': '!', 'color': 0xba1bb8},
        {'x': 12, 'y': 14, 'ch': '|', 'color': 0x6c1277},
        {'x': 13, 'y': 14, 'ch': '!', 'color': 0xba1bb8},
        {'x': 14, 'y': 14, 'ch': '|', 'color': 0x6c1277},
        {'x': 16, 'y': 14, 'ch': '!', 'color': 0xba1bb8},
        {'x': 17, 'y': 14, 'ch': '|', 'color': 0x6c1277},
        {'x': 18, 'y': 14, 'ch': '!', 'color': 0xba1bb8},
        {'x': 26, 'y': 14, 'ch': '!', 'color': 0xba1bb8},
        {'x': 27, 'y': 14, 'ch': '|', 'color': 0x6c1277},
        {'x': 28, 'y': 14, 'ch': '!', 'color': 0xba1bb8},
        {'x': 30, 'y': 14, 'ch': '|', 'color': 0x6c1277},
        {'x': 31, 'y': 14, 'ch': '!', 'color': 0xba1bb8},
        {'x': 32, 'y': 14, 'ch': '|', 'color': 0x6c1277},
    ],
]

import zero
from zero.io import *

clear_screen()

for i in base:
    output(i['x'], i['y'], i['ch'], i['color'])

flush()

frame = 0
while 1:
    for i in frames[frame % len(frames)]:
        output(i['x'], i['y'], i['ch'], i['color'])
    frame +=1
    flush()
    wait(0.2)
```



get_key()

```
get_key(seconds: float | None = None) : int
```

Equivalent to ZeroBasic `getKey`, returns the number of the pressed key. The key press is polled about every 50 ms. If no key was pressed, 0 is returned. You can specify the waiting time in seconds.

pause()

```
pause(msg: str | None = None, seconds: float | None = None) : None
```

Equivalent to ZeroBasic `pause`. Stops program execution until the `enter` key is pressed. If the `msg` argument is provided, this message is printed to the console. If the `seconds` argument is provided, the waiting time is limited.

wait()

```
wait(seconds: float) : None
```

Equivalent to ZeroBasic `wait`. Stops program execution for the specified number of seconds.

5.4. zero.time

The module contains functions for interacting with time, equivalent to ZeroBasic.

start_tmr()

```
start_tmr() : int
```

Equivalent to ZeroBasic `startTmr`, returns the current timer value in seconds.

check_tmr()

```
check_tmr(seconds: int) : int
```

Equivalent to ZeroBasic `checkTmr`, returns the difference between the current timer value and the value from the argument.

get_time()

```
get_time() : tuple[int, int, int]
```

Equivalent to ZeroBasic `getTime`, returns the current time in the format (hour, minute, second).

set_time()

```
set_time(hour: int, minute: int, second: int) : tuple[int, int, int]
```

Equivalent to ZeroBasic `setTime`, sets a new time value and returns it in the format (hour, minute, second).

get_tm_fmt()

```
get_tm_fmt() : int
```

Equivalent to ZeroBasic `getTmFmt`, returns the current time format (12 or 24).

set_tm_fmt()

```
set_tm_fmt(format: int) : int
```

Equivalent to ZeroBasic `setTmFmt`, sets a new time format and returns it (12 or 24).

get_tm_str()

```
get_tm_str(format: int | None = None) : str
```

Equivalent to ZeroBasic `getTmStr`, returns the time of day as a string according to the specified format.

get_date()

```
get_date() : tuple[int, int, int]
```

Equivalent to ZeroBasic `getDate`, returns the current date in the format (year, month, day).

set_date()

```
set_date(year: int, month: int, day: int) : tuple[int, int, int]
```

Equivalent to ZeroBasic `setDate`, sets the date and returns it in the format (year, month, day).

get_dt_fmt()

```
get_dt_fmt() : int
```

Equivalent to ZeroBasic `getDtFmt`, returns the current date format (1, 2, or 3).

set_dt_fmt()

```
set_dt_fmt(format: int) : int
```

Equivalent to ZeroBasic `setDtFmt`, sets a new date format and returns it (1, 2, or 3).

get_dt_str()

```
get_dt_str(format: int | None = None) : str
```

Equivalent to ZeroBasic `getDtStr`, returns the current date as a string according to the specified format.

time_cnv()

```
time_cnv(seconds: int) : tuple[int, int, int]
```

Equivalent to ZeroBasic `timeCnv`, converts the specified duration from seconds into days, hours, and minutes, and returns the result as (day, hour, minute).

day_of_wk()

```
day_of_wk(year: int, month: int, day: int) : int
```

Equivalent to ZeroBasic `dayOfWk`, returns the day of the week (1–7) for the specified date.

dbd()

```
dbd(date1: float | list[float], date2: float | list[float]) : int | list[int]
```

Equivalent to ZeroBasic `dbd`, returns the number of days between the specified dates. Dates can be passed as a list.

VI. LVGL Library

Micropython support using the LVGL (LittlevGV) library version v6.1.2.

LittlevGL is a free and open-source graphics library providing everything you need to create embedded GUI with easy-to-use graphical elements, beautiful visual effects and low memory footprint.

To get more information about the LVGL library refer to the online documentation of LVLG[1][2]

This documentation provides both basic library information and detailed descriptions with examples for each type of graphical object.

6.1. Zero Micropython + LVGL implementation

To work with LVGL library you need to import it by calling the command `import lvgl`. The base (parent) object for drawing is the screen. Access to this object can be obtained by calling the `scr_act` function. This object occupies the entire display excluding the header. It is forbidden to delete this object, change its position or size. However, you can use your own design functions with this object (an example will be given below). This screen is hidden by default and it is possible to use `show` and `hide` functions to show it. When the Python script execution is finished, but the draw screen is still open, it is possible to close it using the **`quit`** key. Interrupting script execution is also available by pressing the `on` key. The rest of the information on LVGL can be found at the provided link to the LVGL documentation and the examples below. The Python examples in the official documentation have a slightly different API, so it is recommended to use the examples in this document. You can also use the `help` function to get information on LVGL.

Because the LVGL memory region is not accessible to MicroPython, the garbage collector may collect live LVGL objects created by a MicroPython script. To prevent garbage collection issues, the garbage collector is disabled when the lvgl library is imported. It can only be re-enabled after restarting the Shell.

6.1.1. Keyboard support from LVGL

To support keyboard input, register an LVGL `indev` device with type `KEYPAD` and read callback `lvgl.keypad_read`. Graphical objects that are to be controlled from the keyboard must be added to a `group`, and the `group` is bound to the `indev`. Below is a table of how the physical calculator buttons are bound to the LVGL input device:

Phisical key	LVGL key	Action
`▲`	`LV_KEY_UP`	Increase value or move upwards
`▼`	`LV_KEY_DOWN`	Decrease value or move downwards
`▶`	`LV_KEY_RIGHT`	Increase value or move the the right
`◀`	`LV_KEY_LEFT`	Decrease value or move the the left
`del`	`LV_KEY_BACKSPACE`	Delete a character on the left
`clear`	`LV_KEY_ESC`	Close or exit

Phisical key	LVGL key	Action
enter	LV_KEY_ENTER	Triggers LV_EVENT_PRESSED/CLICKED events
alpha + ▲	LV_KEY_HOME	Go to the beginning/top (E.g. in a Text area)
alpha + ▼	LV_KEY_END	Go to the end (E.g. in a Text area)
2nd + ◀	LV_KEY_PREV	Focus on the previous object
2nd + ▶	LV_KEY_NEXT	Focus on the next object

Read more information about input devices and LVGL groups in the LVGL documentation[13]

The creation and use of input devices is shown in some examples below.

6.2. Zero Micropython module objects overview

- `keypad_read` -- <mp_keypad_read>
- `show` -- <function>
- `hide` -- <function>
- `get_header_height` -- <function>
- `__name__` -- lvgl
- `obj` -- <class 'obj'>
- `cont` -- <class 'cont'>
- `btn` -- <class 'btn'>
- `imgbtn` -- <class 'imgbtn'>
- `label` -- <class 'label'>
- `img` -- <class 'img'>
- `line` -- <class 'line'>
- `page` -- <class 'page'>
- `list` -- <class 'list'>
- `chart` -- <class 'chart'>
- `table` -- <class 'table'>
- `cb` -- <class 'cb'>
- `cpicker` -- <class 'cpicker'>
- `bar` -- <class 'bar'>
- `slider` -- <class 'slider'>
- `led` -- <class 'led'>
- `btnm` -- <class 'btnm'>
- `ddlist` -- <class 'ddlist'>
- `roller` -- <class 'roller'>
- `ta` -- <class 'ta'>
- `canvas` -- <class 'canvas'>
- `win` -- <class 'win'>
- `tabview` -- <class 'tabview'>
- `tileview` -- <class 'tileview'>
- `mbox` -- <class 'mbox'>

- `lmeter` -- <class 'lmeter'>
- `gauge` -- <class 'gauge'>
- `sw` -- <class 'sw'>
- `arc` -- <class 'arc'>
- `preload` -- <class 'preload'>
- `spinbox` -- <class 'spinbox'>
- `color_make` -- <function>
- `color_hex` -- <function>
- `color_hex3` -- <function>
- `style_anim_set_time` -- <function>
- `style_anim_set_ready_cb` -- <function>
- `style_anim_set_playback` -- <function>
- `style_anim_clear_playback` -- <function>
- `style_anim_set_repeat` -- <function>
- `style_anim_clear_repeat` -- <function>
- `style_anim_create` -- <function>
- `scr_act` -- <function>
- `mem_init` -- <function>
- `mem_deinit` -- <function>
- `mem_alloc` -- <function>
- `mem_free` -- <function>
- `mem_realloc` -- <function>
- `mem_defrag` -- <function>
- `mem_get_size` -- <function>
- `task_core_init` -- <function>
- `task_handler` -- <function>
- `task_create_basic` -- <function>
- `task_create` -- <function>
- `task_enable` -- <function>
- `task_get_idle` -- <function>
- `trigo_sin` -- <function>
- `bezier3` -- <function>
- `atan2` -- <function>
- `sqrt` -- <function>
- `async_call` -- <function>
- `color_hsv_to_rgb` -- <function>
- `color_rgb_to_hsv` -- <function>
- `tick_get` -- <function>
- `tick_elaps` -- <function>
- `anim_core_init` -- <function>
- `anim_del` -- <function>
- `anim_count_running` -- <function>
- `anim_speed_to_time` -- <function>
- `style_init` -- <function>
- `style_anim_init` -- <function>

- `style_anim_set_styles` -- <function>
- `init` -- <function>
- `event_send` -- <function>
- `event_send_func` -- <function>
- `event_get_data` -- <function>
- `signal_send` -- <function>
- `group_init` -- <function>
- `group_create` -- <function>
- `group_remove_obj` -- <function>
- `group_focus_obj` -- <function>
- `indev_init` -- <function>
- `indev_read_task` -- <function>
- `indev_get_act` -- <function>
- `indev_get_obj_act` -- <function>
- `debug_check_null` -- <function>
- `debug_check_obj_type` -- <function>
- `debug_check_obj_valid` -- <function>
- `debug_check_style` -- <function>
- `debug_check_str` -- <function>
- `debug_log_error` -- <function>
- `theme_get_current` -- <function>
- `txt_get_size` -- <function>
- `txt_get_next_line` -- <function>
- `txt_get_width` -- <function>
- `txt_is_cmd` -- <function>
- `txt_ins` -- <function>
- `txt_cut` -- <function>
- `draw_get_buf` -- <function>
- `draw_free_buf` -- <function>
- `draw_aa_get_opa` -- <function>
- `draw_aa_ver_seg` -- <function>
- `draw_aa_hor_seg` -- <function>
- `draw_px` -- <function>
- `draw_fill` -- <function>
- `draw_letter` -- <function>
- `draw_map` -- <function>
- `draw_rect` -- <function>
- `draw_label` -- <function>
- `draw_line` -- <function>
- `draw_triangle` -- <function>
- `draw_polygon` -- <function>
- `draw_arc` -- <function>
- `draw_img` -- <function>
- `RES` -- <class 'LV_RES'>
- `TASK_PRIO` -- <class 'LV_TASK_PRIO'>

- `OPA` -- <class 'LV_OPA'>
- `INDEV_TYPE` -- <class 'LV_INDEV_TYPE'>
- `INDEV_STATE` -- <class 'LV_INDEV_STATE'>
- `FONT_SUBPX` -- <class 'LV_FONT_SUBPX'>
- `ANIM` -- <class 'LV_ANIM'>
- `BORDER` -- <class 'LV_BORDER'>
- `SHADOW` -- <class 'LV_SHADOW'>
- `BIDI_DIR` -- <class 'LV_BIDI_DIR'>
- `DESIGN` -- <class 'LV_DESIGN'>
- `EVENT` -- <class 'LV_EVENT'>
- `SIGNAL` -- <class 'LV_SIGNAL'>
- `ALIGN` -- <class 'LV_ALIGN'>
- `DRAG_DIR` -- <class 'LV_DRAG_DIR'>
- `PROTECT` -- <class 'LV_PROTECT'>
- `KEY` -- <class 'LV_KEY'>
- `GROUP_REFOCUS_POLICY` -- <class 'LV_GROUP_REFOCUS_POLICY'>
- `FONT_FMT_TXT_CMAP` -- <class 'LV_FONT_FMT_TXT_CMAP'>
- `LAYOUT` -- <class 'LV_LAYOUT'>
- `FIT` -- <class 'LV_FIT'>
- `TXT_FLAG` -- <class 'LV_TXT_FLAG'>
- `TXT_CMD_STATE` -- <class 'LV_TXT_CMD_STATE'>
- `SB_MODE` -- <class 'LV_SB_MODE'>
- `CURSOR` -- <class 'LV_CURSOR'>
- `FONT_FMT_TXT` -- <class 'LV_FONT_FMT_TXT'>
- `SYMBOL` -- <class 'LV_SYMBOL'>
- `C_Pointer` -- <class 'C_Pointer'>
- `area_t` -- <class 'lv_area_t'>
- `style_t` -- <class 'lv_style_t'>
- `style_body_t` -- <class 'lv_style_body_t'>
- `color16_t` -- <class 'lv_color16_t'>
- `color16_ch_t` -- <class 'lv_color16_ch_t'>
- `style_body_border_t` -- <class 'lv_style_body_border_t'>
- `style_body_shadow_t` -- <class 'lv_style_body_shadow_t'>
- `style_body_padding_t` -- <class 'lv_style_body_padding_t'>
- `style_text_t` -- <class 'lv_style_text_t'>
- `font_t` -- <class 'lv_font_t'>
- `font_glyph_dsc_t` -- <class 'lv_font_glyph_dsc_t'>
- `style_image_t` -- <class 'lv_style_image_t'>
- `style_line_t` -- <class 'lv_style_line_t'>
- `task_t` -- <class 'lv_task_t'>
- `ll_t` -- <class 'lv_ll_t'>
- `obj_type_t` -- <class 'lv_obj_type_t'>
- `point_t` -- <class 'lv_point_t'>
- `img_header_t` -- <class 'lv_img_header_t'>
- `img_decoder_dsc_t` -- <class 'lv_img_decoder_dsc_t'>

- `img_decoder_t` -- <class 'lv_img_decoder_t'>
- `img_dsc_t` -- <class 'lv_img_dsc_t'>
- `img_cache_entry_t` -- <class 'lv_img_cache_entry_t'>
- `chart_series_t` -- <class 'lv_chart_series_t'>
- `color_hsv_t` -- <class 'lv_color_hsv_t'>
- `_lv_mp_int_wrapper` -- <class '_lv_mp_int_wrapper'>
- `anim_t` -- <class 'lv_anim_t'>
- `mem_monitor_t` -- <class 'lv_mem_monitor_t'>
- `indev_drv_t` -- <class 'lv_indev_drv_t'>
- `indev_data_t` -- <class 'lv_indev_data_t'>
- `indev_t` -- <class 'lv_indev_t'>
- `indev_proc_t` -- <class 'lv_indev_proc_t'>
- `indev_proc_types_t` -- <class 'lv_indev_proc_types_t'>
- `indev_proc_types_pointer_t` -- <class 'lv_indev_proc_types_pointer_t'>
- `indev_proc_types_keypad_t` -- <class 'lv_indev_proc_types_keypad_t'>
- `group_t` -- <class 'lv_group_t'>
- `theme_t` -- <class 'lv_theme_t'>
- `theme_style_t` -- <class 'lv_theme_style_t'>
- `theme_style_btn_t` -- <class 'lv_theme_style_btn_t'>
- `theme_style_imgbtn_t` -- <class 'lv_theme_style_imgbtn_t'>
- `theme_style_label_t` -- <class 'lv_theme_style_label_t'>
- `theme_style_img_t` -- <class 'lv_theme_style_img_t'>
- `theme_style_line_t` -- <class 'lv_theme_style_line_t'>
- `theme_style_bar_t` -- <class 'lv_theme_style_bar_t'>
- `theme_style_slider_t` -- <class 'lv_theme_style_slider_t'>
- `theme_style_sw_t` -- <class 'lv_theme_style_sw_t'>
- `theme_style_cb_t` -- <class 'lv_theme_style_cb_t'>
- `theme_style_cb_box_t` -- <class 'lv_theme_style_cb_box_t'>
- `theme_style_btnm_t` -- <class 'lv_theme_style_btnm_t'>
- `theme_style_btnm_btn_t` -- <class 'lv_theme_style_btnm_btn_t'>
- `theme_style_mbox_t` -- <class 'lv_theme_style_mbox_t'>
- `theme_style_mbox_btn_t` -- <class 'lv_theme_style_mbox_btn_t'>
- `theme_style_page_t` -- <class 'lv_theme_style_page_t'>
- `theme_style_ta_t` -- <class 'lv_theme_style_ta_t'>
- `theme_style_spinbox_t` -- <class 'lv_theme_style_spinbox_t'>
- `theme_style_list_t` -- <class 'lv_theme_style_list_t'>
- `theme_style_list_btn_t` -- <class 'lv_theme_style_list_btn_t'>
- `theme_style_ddlist_t` -- <class 'lv_theme_style_ddlist_t'>
- `theme_style_roller_t` -- <class 'lv_theme_style_roller_t'>
- `theme_style_tabview_t` -- <class 'lv_theme_style_tabview_t'>
- `theme_style_tabview_btn_t` -- <class 'lv_theme_style_tabview_btn_t'>
- `theme_style_tileview_t` -- <class 'lv_theme_style_tileview_t'>
- `theme_style_table_t` -- <class 'lv_theme_style_table_t'>
- `theme_style_win_t` -- <class 'lv_theme_style_win_t'>
- `theme_style_win_btn_t` -- <class 'lv_theme_style_win_btn_t'>

- `theme_group_t` -- <class 'lv_theme_group_t'>
- `draw_label_txt_sel_t` -- <class 'lv_draw_label_txt_sel_t'>
- `draw_label_hint_t` -- <class 'lv_draw_label_hint_t'>
- `color_t` -- <class 'lv_color16_t'>
- `font_code_saver_12` -- struct lv_font_t
- `font_code_saver_16` -- struct lv_font_t
- `font_unscii8_8` -- struct lv_font_t
- `style_scr` -- struct lv_style_t
- `style_transp` -- struct lv_style_t
- `style_transp_fit` -- struct lv_style_t
- `style_transp_tight` -- struct lv_style_t
- `style_plain` -- struct lv_style_t
- `style_plain_color` -- struct lv_style_t
- `style_pretty` -- struct lv_style_t
- `style_pretty_color` -- struct lv_style_t
- `style_btn_rel` -- struct lv_style_t
- `style_btn_pr` -- struct lv_style_t
- `style_btn_tgl_rel` -- struct lv_style_t
- `style_btn_tgl_pr` -- struct lv_style_t
- `style_btn_ina` -- struct lv_style_t
- `_nesting` -- struct _lv_mp_int_wrapper
- `LvReferenceError` -- <class 'LvReferenceError'>

6.3. Zero Micropython + LVGL examples

6.3.1. Importing library and show help

```
import lvgl as lv
help(lv)
```

```
NORMAL FLOAT AUTO REAL RADIAN NAT

  style_transp_fit -- struct lv_style_t
  style_transp_tight -- struct lv_style_t
  style_plain -- struct lv_style_t
  style_plain_color -- struct lv_style_t
  style_pretty -- struct lv_style_t
  style_pretty_color -- struct lv_style_t
  style_btn_rel -- struct lv_style_t
  style_btn_pr -- struct lv_style_t
  style_btn_tgl_rel -- struct lv_style_t
  style_btn_tgl_pr -- struct lv_style_t
  style_btn_ina -- struct lv_style_t
  _nesting -- struct _lv_mp_int_wrapper
  LvReferenceError -- <class 'LvReferenceErro
r'>


>>>
```

6.3.2. Arc

```
import lvgl as lv

# Create style for the Arcs
style = lv.style_t()
style.copy(lv.style_plain)
style.line.color = lv.color_make(0x00, 0xFF, 0xFF) # Arc color
style.line.width = 8                       # Arc width

# Create an Arc
arc = lv.arc(lv.scr_act(), None)
arc.set_style(lv.arc.STYLE.MAIN, style)    # Use the new style
arc.set_angles(90, 60)
arc.set_size(150, 150)
arc.align(None, lv.ALIGN.CENTER, 0, 0)

lv.show()
print("LVGL drawing finished")
```

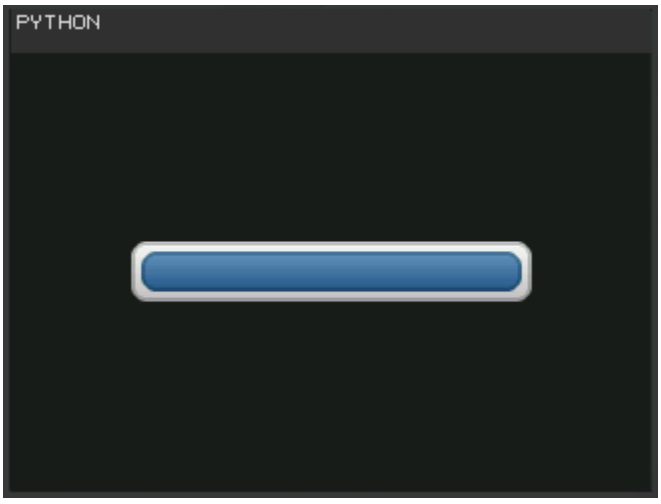
6.3.3. Arc + task

```
import lvgl as lv

# Create an arc which acts as a loader.
class loader_arc(lv.arc):

    def __init__(self, parent, color=lv.color_hex(0x00FF80),
                 width=8, style=lv.style_plain, rate=20):
        super().__init__(parent, None)

        self.a = 0
        self.rate = rate

        # Create style for the Arcs
        self.style = lv.style_t()
        self.style.copy(style)
        self.style.line.color = color
        self.style.line.width = width

        # Create an Arc
        self.set_angles(180, 180)
        self.set_style(self.STYLE.MAIN, self.style)

        # Spin the Arc
        self.spin()
```

```
    def spin(self):
        # Create an `lv_task` to update the arc.
        lv.task_create(self.task_cb, self.rate, lv.TASK_PRIO.LOWEST, {})


    # An `lv_task` to call periodically to set the angles of the arc
    def task_cb(self, task):
        self.a+=5
        if self.a >= 359: self.a = 359

        if self.a < 180: self.set_angles(180-self.a, 180)
        else: self.set_angles(540-self.a, 180)

        if self.a == 359:
            self.a = 0
            task._del()

# Create a loader arc
loader_arc = loader_arc(lv.scr_act())
loader_arc.align(None, lv.ALIGN.CENTER, 0, 0)

lv.show()
print("LVGL drawing finished")
```

6.3.4. Bar

```
import lvgl as lv

bar1 = lv.bar(lv.scr_act(), None)
bar1.set_size(200, 30)
bar1.align(None, lv.ALIGN.CENTER, 0, 0)
bar1.set_anim_time(2500)
bar1.set_value(100, lv.ANIM.ON)

lv.show()
print("LVGL drawing finished")
```



6.3.5. Button matrix

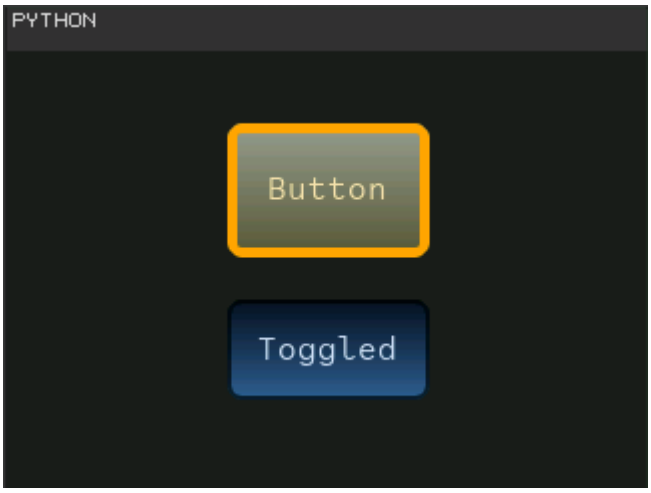
```
import lvgl as lv

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
```

```
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for keyboard handled objects
group = lv.group_create()
keyboard.set_group(group)

def event_handler(obj, event):
    if event == lv.EVENT.VALUE_CHANGED:
        txt = obj.get_active_btn_text()
        print("%s was pressed" % txt)

btnm1 = lv.btnm(lv.scr_act(), None)
btnm1.set_map( ["1", "2", "3", "4", "5", "\n",
            "6", "7", "8", "9", "0", "\n",
            "Action1", "Action2", ""])
btnm1.set_btn_width(10, 2)         # Make "Action1" twice as wide as "Action2"
btnm1.align(None, lv.ALIGN.CENTER, 0, 0)
btnm1.set_event_cb(event_handler)

group.add_obj(btnm1)

lv.show()
print("LVGL drawing finished")
```

6.3.6. Buttons

```
import lvgl as lv

def event_handler(obj, event):
    if event == lv.EVENT.CLICKED:
        print("Button clicked")

btn1 = lv.btn(lv.scr_act(), None)
btn1.align(None, lv.ALIGN.CENTER, 0, -40)
btn1.set_event_cb(event_handler)
label = lv.label(btn1, None)
label.set_text("Button")

btn2 = lv.btn(lv.scr_act(), None)
# callback can be lambda:
btn2.set_event_cb(lambda obj, event: print("Toggled") if event == lv.EVENT.VALUE_CHANGED else None)
btn2.align(None, lv.ALIGN.CENTER, 0, 40)
btn2.set_toggle(True)
btn2.toggle()
btn2.set_fit2(lv.FIT.NONE, lv.FIT.TIGHT)
```

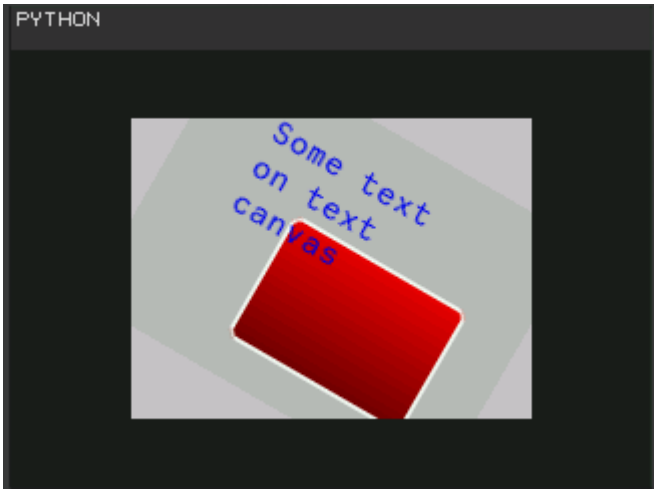
```
label = lv.label(btn2, None)
label.set_text("Toggled")

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for buttons
group = lv.group_create()
group.add_obj(btn1)
group.add_obj(btn2)
keyboard.set_group(group)

lv.show()
print("LVGL drawing finished")
```



6.3.7. Canvas

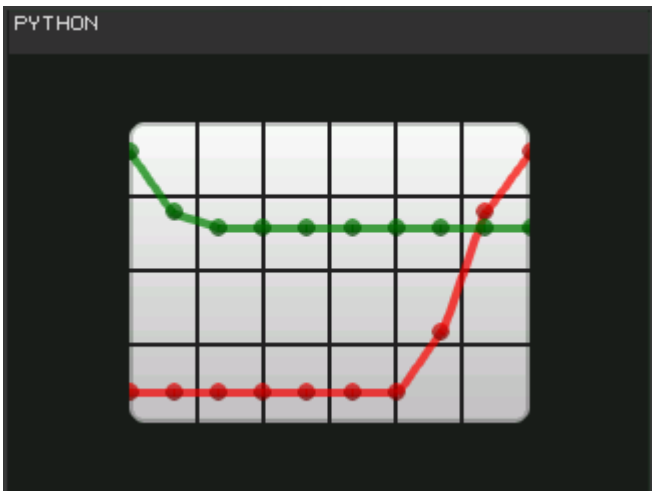
```
import lvgl as lv

CANVAS_WIDTH  = 200
CANVAS_HEIGHT = 150

style = lv.style_t()
style.copy(lv.style_plain)
style.body.main_color = lv.color_make(0xFF,0,0)
style.body.grad_color = lv.color_make(0x80,0,0)
style.body.radius = 4
style.body.border.width = 2
style.body.border.color = lv.color_make(0xFF,0xFF,0xFF)
style.body.shadow.color = lv.color_make(0xFF,0xFF,0xFF)
style.body.shadow.width = 4
style.line.width = 2
style.line.color = lv.color_make(0,0,0)
style.text.color = lv.color_make(0,0,0xFF)

# CF.TRUE_COLOR requires 4 bytes per pixel
cbuf = bytearray(CANVAS_WIDTH * CANVAS_HEIGHT * 4)

canvas = lv.canvas(lv.scr_act(), None)
canvas.set_buffer(cbuf, CANVAS_WIDTH, CANVAS_HEIGHT, lv.img.CF.TRUE_COLOR)
canvas.align(None, lv.ALIGN.CENTER, 0, 0)
canvas.fill_bg(lv.color_make(0xC0, 0xC0, 0xC0))
```

```
canvas.draw_rect(70, 60, 100, 70, style)

canvas.draw_text(40, 20, 100, style, "Some text on text canvas", lv.label.ALIGN.LEFT)

# Test the rotation. It requires an other buffer where the original image is stored.
# So copy the current image to buffer and rotate it to the canvas
img = lv.img_dsc_t()
img.data = cbuf[:]
img.header.cf = lv.img.CF.TRUE_COLOR
img.header.w = CANVAS_WIDTH
img.header.h = CANVAS_HEIGHT

canvas.fill_bg(lv.color_make(0xC0, 0xC0, 0xC0))
canvas.rotate(img, 30, 0, 0, CANVAS_WIDTH // 2, CANVAS_HEIGHT // 2)

lv.show()
```



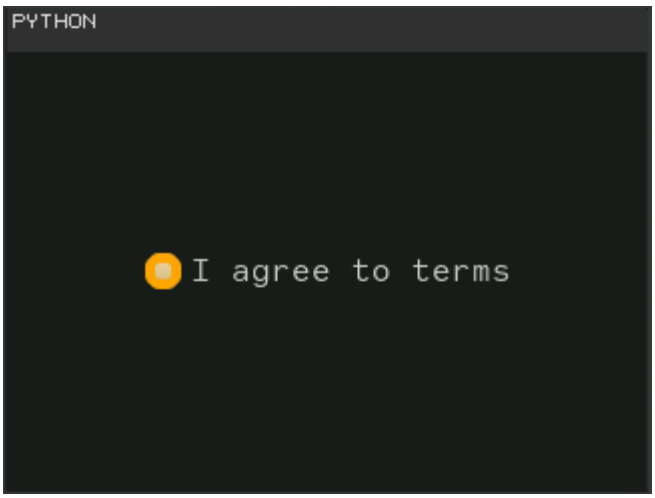
6.3.8. Chart

```
import lvgl as lv

# Create a chart
chart = lv.chart(lv.scr_act(), None)
chart.set_size(200, 150)
chart.align(None, lv.ALIGN.CENTER, 0, 0)
chart.set_type(lv.chart.TYPE.POINT | lv.chart.TYPE.LINE)    # Show lines and points too
chart.set_series_opa(lv.OPA._70)                            # Opacity of the data series
chart.set_series_width(4)                                   # Line width and point radious

chart.set_range(0, 100)

# Add two data series
ser1 = chart.add_series(lv.color_make(0xFF, 0x00, 0x00))
ser2 = chart.add_series(lv.color_make(0x00, 0x80, 0x00))

# Set points on 'dl1'
chart.set_points(ser1, [10, 10, 10, 10, 10, 10, 10, 30, 70, 90])

# Set points on 'dl2'
chart.set_points(ser2, [90, 70, 65, 65, 65, 65, 65, 65, 65, 65])

lv.show()
print("LVGL drawing finished")
```



6.3.9. Checkbox

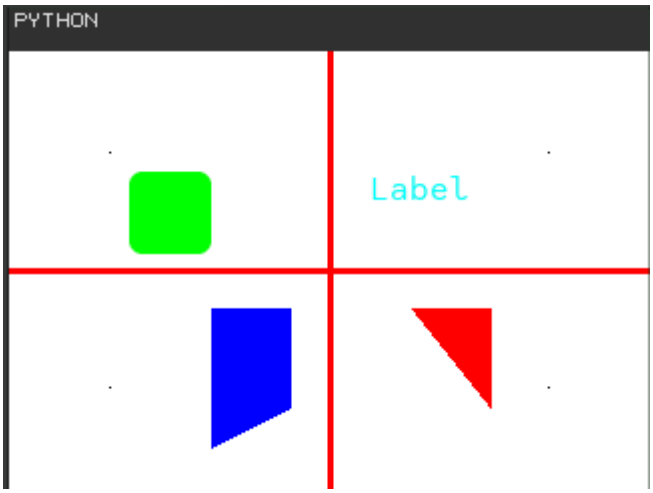
```
import lvgl as lv

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for keyboard handled objects
group = lv.group_create()
keyboard.set_group(group)

def event_handler(obj, event):
    if event == lv.EVENT.VALUE_CHANGED:
        print("State: %s" % ("Checked" if obj.is_checked() else "Unchecked"))

cb = lv.cb(lv.scr_act(), None)
cb.set_text("I agree to terms")
cb.align(None, lv.ALIGN.CENTER, 0, 0)
cb.set_event_cb(event_handler)

group.add_obj(cb)

lv.show()
print("LVGL drawing finished")
```



6.3.10. Manual drawing

```
import lvgl as lv

scr = lv.scr_act()

# Height of persistent header on screen
header_height = lv.get_header_height()

print("Screen width: ", scr.get_width())
print("Screen height: ", scr.get_height())
print("Header height: ", header_height)

def draw_cb(obj, mask, mode):
    if mode == lv.DESIGN.DRAW_MAIN:
        objArea = lv.area_t()
        obj.get_coords(objArea)

        # Fill bg
        bgColor = lv.color_make(0xFF, 0xFF, 0xFF)
        lv.draw_fill(objArea, mask, bgColor, lv.OPA._100)

        styleLine = lv.style_t()
        styleLine.copy(lv.style_plain)
        styleLine.line.color = lv.color_make(0xFF, 0x00, 0x00)
        styleLine.line.width = 3
        styleLine.line.rounded = 1

        # Draw hor line (in coordinates of display (320x240))
        horLinePoint1 = { "x": objArea.x1, "y": objArea.y1 + int(objArea.get_height() / 2) }
        horLinePoint2 = { "x": objArea.x2, "y": objArea.y1 + int(objArea.get_height() / 2) }
        lv.draw_line(horLinePoint1, horLinePoint2, mask, styleLine, lv.OPA._100)

        # Draw ver line (in coordinates of display (320x240))
        verLinePoint1 = { "x": objArea.x1 + int(objArea.get_width() / 2), "y": objArea.y1 }
        verLinePoint2 = { "x": objArea.x1 + int(objArea.get_width() / 2), "y": objArea.y2 }
        lv.draw_line(verLinePoint1, verLinePoint2, mask, styleLine, lv.OPA._100)

        # Draw four pixels
        pxColor = lv.color_make(0x00, 0x00, 0x00)
        lv.draw_px(objArea.x1 + 50, objArea.y1 + 50, mask, pxColor, lv.OPA._100)
        lv.draw_px(objArea.x1 + 50, objArea.y2 - 50, mask, pxColor, lv.OPA._100)
        lv.draw_px(objArea.x2 - 50, objArea.y1 + 50, mask, pxColor, lv.OPA._100)
        lv.draw_px(objArea.x2 - 50, objArea.y2 - 50, mask, pxColor, lv.OPA._100)

        # Draw rectangle
        styleRect = lv.style_t()
        styleRect.copy(lv.style_plain)
        styleRect.body.main_color = lv.color_make(0x00, 0xFF, 0x00)
        styleRect.body.grad_color = lv.color_make(0x00, 0xFF, 0x00)
        styleRect.body.radius = 5

        rectArea = lv.area_t()
        rectArea.set(objArea.x1 + 60, objArea.y1 + 60, objArea.x1 + 100, objArea.y1 + 100)
        lv.draw_rect(rectArea, mask, styleRect, lv.OPA._100)

        # Draw label
        labelStyle = lv.style_t()
        labelStyle.copy(lv.style_plain)
        labelStyle.text.color = lv.color_make(0x00, 0xFF, 0xFF)

        labelOffset = {"x": 0, "y": 0}

        labelArea = lv.area_t()
        labelArea.set(objArea.x1 + 180, objArea.y1 + 60, objArea.x2, objArea.y1 + 80)
        lv.draw_label(labelArea, mask, labelStyle, lv.OPA._100, "Label", 0, labelOffset, None, None, l
```

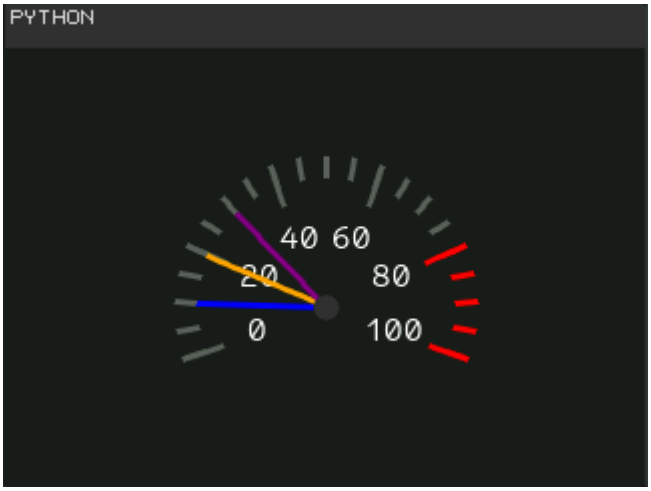
```
v.BIDI_DIR.LTR)

        # Draw triangle
        styleRect.body.main_color = lv.color_make(0xFF, 0x00, 0x00)
        trigPoints = [ {"x":200, "y":150},
                       {"x":240, "y":150},
                       {"x":240, "y":200}]
        lv.draw_triangle(trigPoints, mask, styleRect, lv.OPA._100)

        # Draw polygon
        styleRect.body.main_color = lv.color_make(0x00, 0x00, 0xFF)
        polyPoints = [ {"x":100, "y":150},
                       {"x":140, "y":150},
                       {"x":140, "y":200},
                       {"x":100, "y":220}]
        lv.draw_polygon(polyPoints, len(polyPoints), mask, styleRect, lv.OPA._100)

        return True
    else:
        return False

scr.set_design_cb(draw_cb)

print("Main draw finished")

lv.show()
```



6.3.11. Gauge

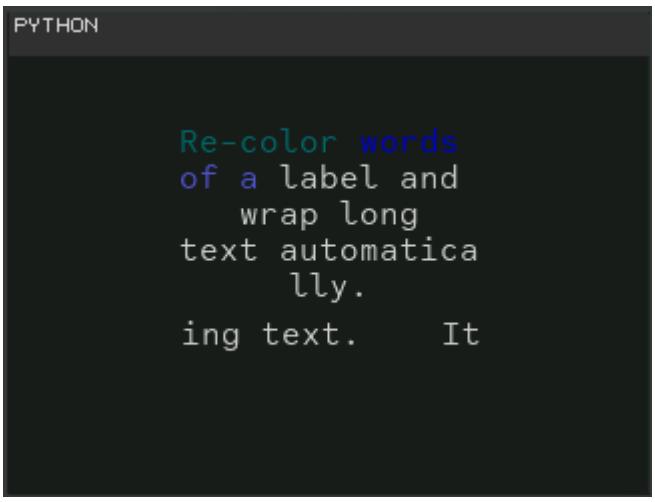
```
import lvgl as lv

# Create a style
style = lv.style_t()
style.copy(lv.style_pretty_color)
style.body.main_color = lv.color_hex3(0x666)      # Line color at the beginning
style.body.grad_color =  lv.color_hex3(0x666)     # Line color at the end
style.body.padding.left = 10                      # Scale line length
style.body.padding.inner = 8                      # Scale label padding
style.body.border.color = lv.color_hex3(0x333)    # Needle middle circle color
style.line.width = 3
style.text.color = lv.color_hex3(0xFFFFFF)
style.line.color = lv.color_hex3(0xF00)           # Line color after the critical value

# Describe the color for the needles
needle_colors = [
    lv.color_make(0x00, 0x00, 0xFF),
    lv.color_make(0xFF, 0xA5, 0x00),
```

```
    lv.color_make(0x80, 0x00, 0x80)
]

# Create a gauge
gauge1 = lv.gauge(lv.scr_act(), None)
gauge1.set_style(lv.gauge.STYLE.MAIN, style)
gauge1.set_needle_count(len(needle_colors), needle_colors)
gauge1.set_size(150, 150)
gauge1.align(None, lv.ALIGN.CENTER, 0, 20)

# Set the values
gauge1.set_value(0, 10)
gauge1.set_value(1, 20)
gauge1.set_value(2, 30)

lv.show()
print("LVGL drawing finished")
```



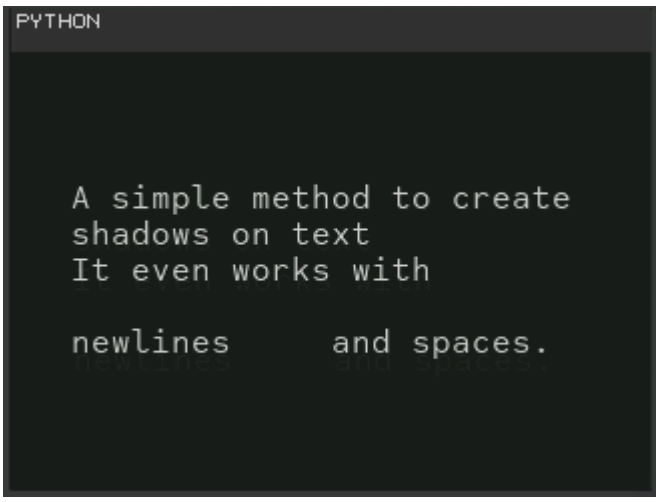
6.3.12. Label

```
import lvgl as lv

label1 = lv.label(lv.scr_act(), None)
label1.set_long_mode(lv.label.LONG.BREAK)     # Break the long lines
label1.set_recolor(True)                      # Enable re-coloring by commands in the text
label1.set_align(lv.label.ALIGN.CENTER)       # Center aligned lines
# Use special symbol \377 to set text color
label1.set_text("\377008080 Re-color\377 \3770000ff words\377 \3776666ff of a\377 label " +
                "and  wrap long text automatically.")
label1.set_width(150)
label1.align(None, lv.ALIGN.CENTER, 0, -30)

label2 = lv.label(lv.scr_act(), None)
label2.set_long_mode(lv.label.LONG.SROLL_CIRC)     # Circular scroll
label2.set_width(150)
label2.set_text("It is a circularly scrolling text. ")
label2.align(None, lv.ALIGN.CENTER, 0, 30)

lv.show()
print("LVGL drawing finished")
```



6.3.13. Label shadow

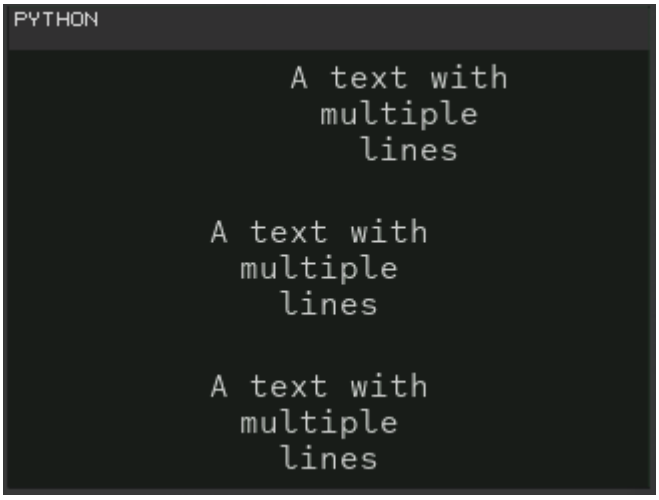
```
import lvgl as lv

# Create a style for the shadow
label_style = lv.style_t()
label_style.copy(lv.style_plain)
label_style.text.opa = lv.OPA._50

# Create a label for the shadow first (it's in the background)
shadow_label = lv.label(lv.scr_act(), None)
shadow_label.set_style(lv.label.STYLE.MAIN, label_style)

# Create the main label
main_label = lv.label(lv.scr_act(), None)
main_label.set_text("A simple method to create\n" +
                    "shadows on text\n" +
                    "It even works with\n\n" +
                    "newlines     and spaces.")

# Set the same text for the shadow label
shadow_label.set_text(main_label.get_text())

# Position the main label
main_label.align(None, lv.ALIGN.CENTER, 0, 0)

# Shift the second label down and to the right by 1 pixel
shadow_label.align(main_label, lv.ALIGN.IN_TOP_LEFT, 1, 1)

lv.show()
print("LVGL drawing finished")
```



6.3.14. Label change

```
import lvgl as lv

# Create three labels to demonstrate the alignments.
labels = []

# `lv_label_set_align` is not required to align the object itslef.
# It's used only when the text has multiple lines

# Create a label on the top.
# No additional alignment so it will be the reference
label = lv.label(lv.scr_act(), None)
label.align(None, lv.ALIGN.IN_TOP_MID, 0, 5)
label.set_align(lv.label.ALIGN.CENTER)
labels.append(label)

# Create a label in the middle.
# `lv_obj_align` will be called every time the text changes
# to keep the middle position
label = lv.label(lv.scr_act(), None)
label.align(None, lv.ALIGN.CENTER, 0, 0)
label.set_align(lv.label.ALIGN.CENTER)
labels.append(label)

# Create a label in the bottom.
# Enable auto realign.
label = lv.label(lv.scr_act(), None)
label.set_auto_realign(True)
label.align(None, lv.ALIGN.IN_BOTTOM_MID, 0, -5)
label.set_align(lv.label.ALIGN.CENTER)
labels.append(label)

class TextChanger:
    """Changes texts of all labels every second"""
    def __init__(self, labels,
                 texts=["Text", "A very long text", "A text with\nmultiple\nlines"],
                 rate=1000):
        self.texts = texts
        self.labels = labels
        self.rate = rate
        self.counter = 0

    def start(self):
        lv.task_create(self.task_cb, self.rate, lv.TASK_PRIO.LOWEST, None)

    def task_cb(self, task):
```

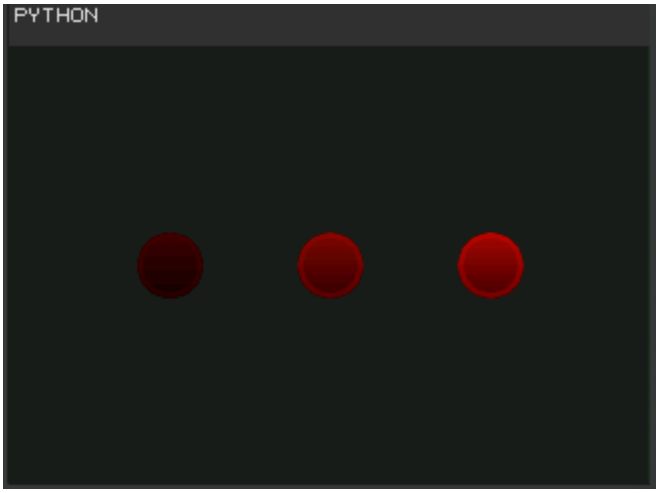
```
        for label in labels:
            label.set_text(self.texts[self.counter])

        # Manually realaign `labels[1]`
        if len(self.labels) > 1:
            self.labels[1].align(None, lv.ALIGN.CENTER, 0, 0)

        self.counter = self.counter + 1
        print("Counter: ", self.counter)
        if self.counter >= len(self.texts):
            task._del()
            print("Task deleted")

text_changer = TextChanger(labels)
text_changer.start()

lv.show()
print("LVGL drawing finished")
```



6.3.15. Led

```
import lvgl as lv

# Create a style for the LED
style_led = lv.style_t()
style_led.copy(lv.style_pretty_color)
style_led.body.radius = 800 # large enough to draw a circle
style_led.body.main_color = lv.color_make(0xb5, 0x0f, 0x04)
style_led.body.grad_color = lv.color_make(0x50, 0x07, 0x02)
style_led.body.border.color = lv.color_make(0xfa, 0x0f, 0x00)
style_led.body.border.width = 3
style_led.body.border.opa = lv.OPA._30
style_led.body.shadow.color = lv.color_make(0xb5, 0x0f, 0x04)
style_led.body.shadow.width = 5

# Create a LED and switch it OFF
led1 = lv.led(lv.scr_act(), None)
led1.set_style(lv.led.STYLE.MAIN, style_led)
led1.align(None, lv.ALIGN.CENTER, -80, 0)
led1.off()

# Copy the previous LED and set a brightness
led2 = lv.led(lv.scr_act(), led1)
led2.align(None, lv.ALIGN.CENTER, 0, 0)
led2.set_bright(190)

# Copy the previous LED and switch it ON
```

```
led3 = lv.led(lv.scr_act(), led1)
led3.align(None, lv.ALIGN.CENTER, 80, 0)
led3.on()

lv.show()
```

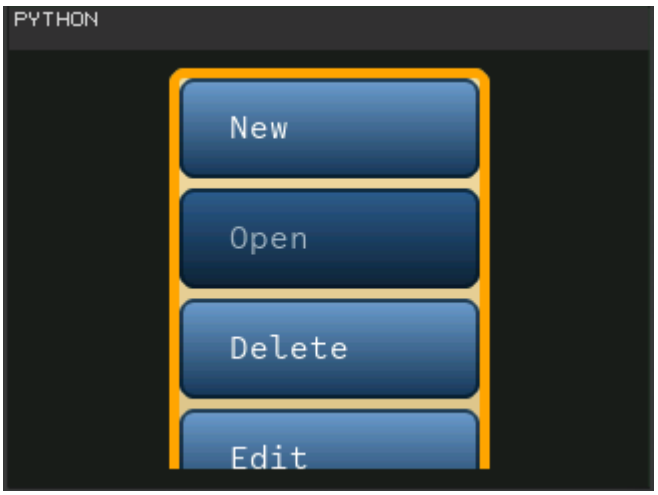


6.3.16. Line

```
import lvgl as lv

# Create an array for the points of the line
line_points = [ {"x":5, "y":5},
                {"x":70, "y":70},
                {"x":120, "y":10},
                {"x":180, "y":60},
                {"x":240, "y":10}]

# Create new style (thick dark blue)
style_line = lv.style_t()
style_line.copy(lv.style_plain)
style_line.line.color = lv.color_make(0x00, 0x3b, 0x75)
style_line.line.width = 3
style_line.line.rounded = 1

# Copy the previous line and apply the new style
line1 = lv.line(lv.scr_act(), None)
line1.set_points(line_points, len(line_points))      # Set the points
line1.set_style(lv.line.STYLE.MAIN, style_line)
line1.align(None, lv.ALIGN.CENTER, 0, 0)

lv.show()
```

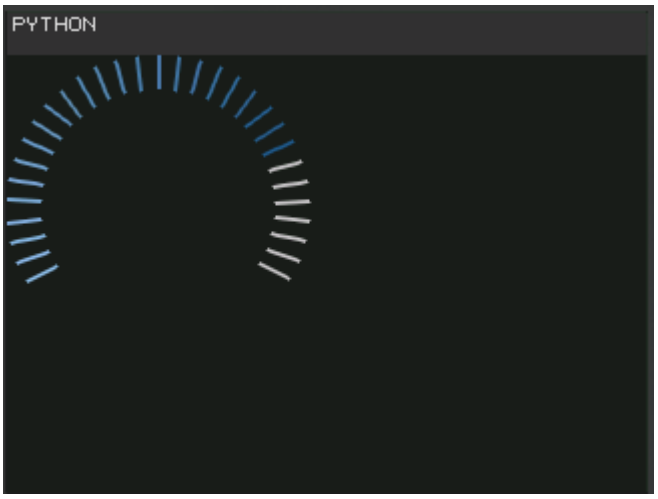
6.3.17. List

```
import lvgl as lv

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for keyboard handled objects
group = lv.group_create()
keyboard.set_group(group)

# Create a list
list1 = lv.list(lv.scr_act(), None)
list1.set_size(160, 200)
list1.align(None, lv.ALIGN.CENTER, 0, 0)

# Add buttons to the list
def event_handler(obj, event):
    if event == lv.EVENT.CLICKED:
        print("Clicked: %s" % list1.get_btn_text(obj))

list_btn = list1.add_btn(None, "New")
list_btn.set_event_cb(event_handler)

list_btn = list1.add_btn(None, "Open")
list_btn.set_event_cb(event_handler)

list_btn = list1.add_btn(None, "Delete")
list_btn.set_event_cb(event_handler)

list_btn = list1.add_btn(None, "Edit")
list_btn.set_event_cb(event_handler)

list_btn = list1.add_btn(None, "Save")
list_btn.set_event_cb(event_handler)

group.add_obj(list1)

lv.show()
```



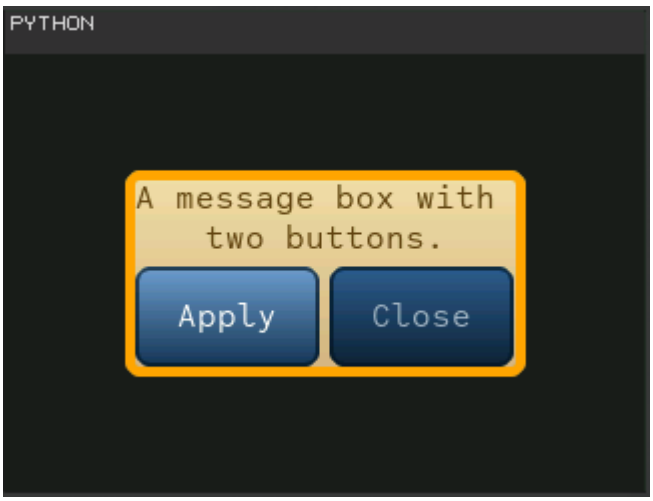
6.3.18. LMeter

```
import lvgl as lv

# Create a style for the line meter
style_lmeter = lv.style_t()
style_lmeter.copy(lv.style_pretty_color)
style_lmeter.line.width = 2
style_lmeter.line.color = lv.color_hex(0xc0c0c0)              # Silver
style_lmeter.body.main_color = lv.color_hex(0x91bfed)         # Light blue
style_lmeter.body.grad_color = lv.color_hex(0x04386c)         # Dark blue
style_lmeter.body.padding.left = 16                           # Line length

# Create a line meter
lmeter = lv.lmeter(lv.scr_act(), None)
lmeter.set_range(0, 100)                    # Set the range
lmeter.set_value(80)                        # Set the current value
lmeter.set_scale(240, 31)                   # Set the angle and number of lines
lmeter.set_style(lv.lmeter.STYLE.MAIN, style_lmeter)          # Apply the new style
lmeter.set_size(150, 150)

lv.show()
```



6.3.19. MessageBox

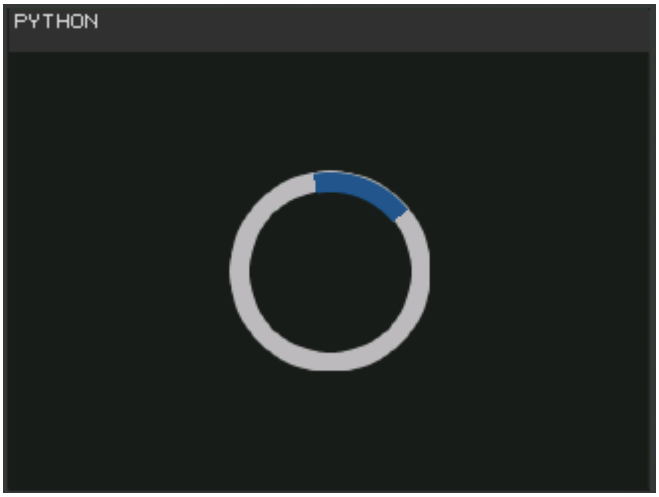
```
import lvgl as lv

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for keyboard handled objects
group = lv.group_create()
keyboard.set_group(group)

def event_handler(obj, event):
    if event == lv.EVENT.VALUE_CHANGED:
        print("Button: %s" % lv.mbox.get_active_btn_text(obj))

mbox1 = lv.mbox(lv.scr_act(), None)
mbox1.set_text("A message box with two buttons.")
mbox1.add_btns(["Apply", "Close", ""])
mbox1.set_width(200)
mbox1.set_event_cb(event_handler)
mbox1.align(None, lv.ALIGN.CENTER, 0, 0)  # Align to the corner

group.add_obj(mbox1)

lv.show()
```



6.3.20. Preloader

```
import lvgl as lv

# Create a style for the Preloader
style = lv.style_t()
style.copy(lv.style_plain)
style.line.width = 10                          # 10 px thick arc
style.line.color = lv.color_hex3(0x258)        # Blueish arc color

style.body.border.color = lv.color_hex3(0xBBB) # Gray background color
style.body.border.width = 10
style.body.padding.left = 0

# Create a Preloader object
preload = lv.preload(lv.scr_act(), None)
```

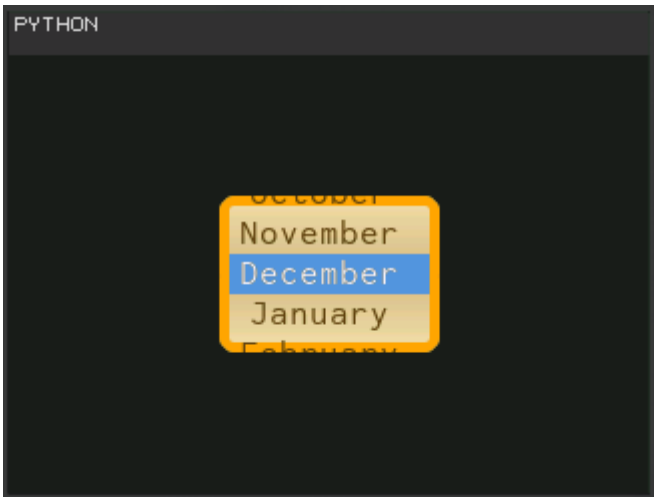
```
preload.set_size(100, 100)
preload.align(None, lv.ALIGN.CENTER, 0, 0)
preload.set_style(lv.preload.STYLE.MAIN, style)

lv.show()
```



6.3.21. Roller

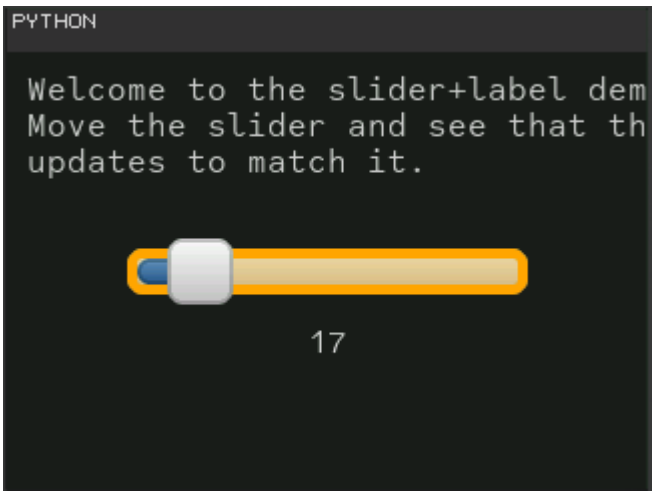
```
import lvgl as lv

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for keyboard handled objects
group = lv.group_create()
keyboard.set_group(group)

def event_handler(obj, event):
    if event == lv.EVENT.VALUE_CHANGED:
        option = " "*10
        obj.get_selected_str(option, len(option))
        print("Selected month: %s" % option.strip())

roller1 = lv.roller(lv.scr_act(), None)
roller1.set_options("\n".join([
                    "January",
                    "February",
                    "March",
                    "April",
                    "May",
                    "June",
                    "July",
                    "August",
                    "September",
                    "October",
                    "November",
                    "December"]), lv.roller.MODE.INIFINITE)

roller1.set_visible_row_count(4)
roller1.align(None, lv.ALIGN.CENTER, 0, 0)
roller1.set_event_cb(event_handler)
```

```
group.add_obj(roller1)

lv.show()
```



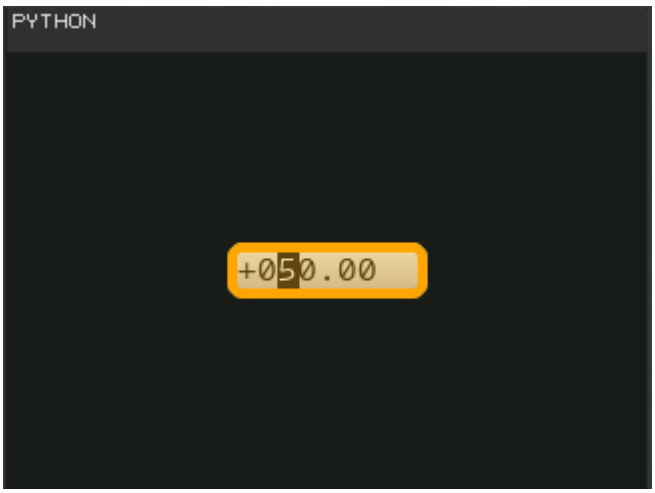
6.3.22. Slider

```
import lvgl as lv

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for keyboard handled objects
group = lv.group_create()
keyboard.set_group(group)

# Create a label below the slider
slider_label = lv.label(lv.scr_act(), None)
slider_label.set_text("0")
slider_label.set_auto_realign(True)

def slider_event_cb(obj, event):
    if event == lv.EVENT.VALUE_CHANGED:
        slider_label.set_text("%u" % obj.get_value())

# Create a slider in the center of the display
slider = lv.slider(lv.scr_act(), None)
slider.set_width(200)
slider.align(None, lv.ALIGN.CENTER, 0, 0)
slider.set_event_cb(slider_event_cb)
slider.set_range(0, 100)

slider_label.align(slider, lv.ALIGN.OUT_BOTTOM_MID, 0, 10)

# Create an informative label
info = lv.label(lv.scr_act(), None)
info.set_text("""Welcome to the slider+label demo!
Move the slider and see that the label
updates to match it.""")
info.align(None, lv.ALIGN.IN_TOP_LEFT, 10, 10)

group.add_obj(slider)

lv.show()
```



6.3.23. Spinbox

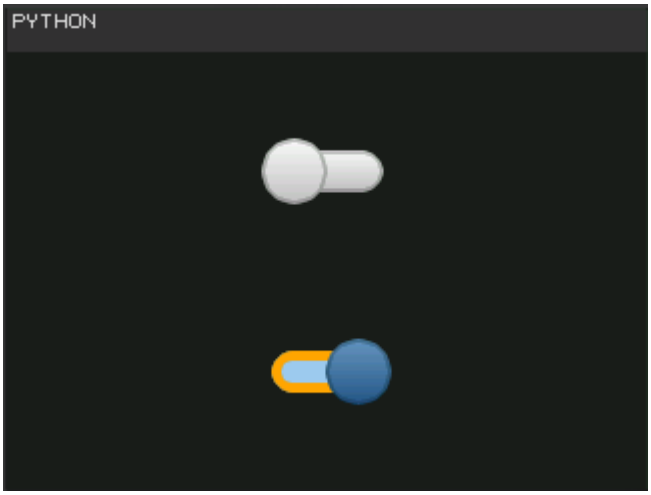
```
import lvgl as lv

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for keyboard handled objects
group = lv.group_create()
keyboard.set_group(group)

def event_handler(obj, event):
    if event == lv.EVENT.VALUE_CHANGED:
        print("Value: %d" % obj.get_value())
    elif event == lv.EVENT.CLICKED:
        # For simple test: Click the spinbox to increment its value
        obj.increment()

spinbox = lv.spinbox(lv.scr_act(), None)
spinbox.set_digit_format(5, 3)
spinbox.step_prev()
spinbox.set_width(100)
spinbox.align(None, lv.ALIGN.CENTER, 0, 0)
spinbox.set_event_cb(event_handler)

group.add_obj(spinbox)

lv.show()
```



6.3.24. Switch

```
import lvgl as lv

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for keyboard handled objects
group = lv.group_create()
keyboard.set_group(group)

def event_handler(obj, event):
    if event == lv.EVENT.VALUE_CHANGED:
        print("State: %s" % ("On" if obj.get_state() else "Off"))

# Create styles for the switch
bg_style = lv.style_t()
indic_style = lv.style_t()
knob_on_style = lv.style_t()
knob_off_style = lv.style_t()

bg_style.copy(lv.style_pretty)
bg_style.body.radius = 800
bg_style.body.padding.top = 6
bg_style.body.padding.bottom = 6

indic_style.copy(lv.style_pretty_color)
indic_style.body.radius = 800
indic_style.body.main_color = lv.color_hex(0x9fc8ef)
indic_style.body.grad_color = lv.color_hex(0x9fc8ef)
indic_style.body.padding.left = 0
indic_style.body.padding.right = 0
indic_style.body.padding.top = 0
indic_style.body.padding.bottom = 0

knob_off_style.copy(lv.style_pretty)
knob_off_style.body.radius = 800
knob_off_style.body.shadow.width = 4
knob_off_style.body.shadow.type = lv.SHADOW.BOTTOM

knob_on_style.copy(lv.style_pretty_color)
knob_on_style.body.radius = 800
knob_on_style.body.shadow.width = 4
```

```
knob_on_style.body.shadow.type = lv.SHADOW.BOTTOM

# Create a switch and apply the styles
sw1 = lv.sw(lv.scr_act(), None)
sw1.set_style(lv.sw.STYLE.BG, bg_style)
sw1.set_style(lv.sw.STYLE.INDIC, indic_style)
sw1.set_style(lv.sw.STYLE.KNOB_ON, knob_on_style)
sw1.set_style(lv.sw.STYLE.KNOB_OFF, knob_off_style)
sw1.align(None, lv.ALIGN.CENTER, 0, -50)
sw1.set_event_cb(event_handler)

# Copy the first switch and turn it ON
sw2 = lv.sw(lv.scr_act(), None)
sw2.set_style(lv.sw.STYLE.BG, bg_style)
sw2.set_style(lv.sw.STYLE.INDIC, indic_style)
sw2.set_style(lv.sw.STYLE.KNOB_ON, knob_on_style)
sw2.set_style(lv.sw.STYLE.KNOB_OFF, knob_off_style)
sw2.on(lv.ANIM.ON)
sw2.align(None, lv.ALIGN.CENTER, 0, 50)
sw2.set_event_cb(lambda o,e: None)

group.add_obj(sw1)
group.add_obj(sw2)

lv.show()
```



6.3.25. Table

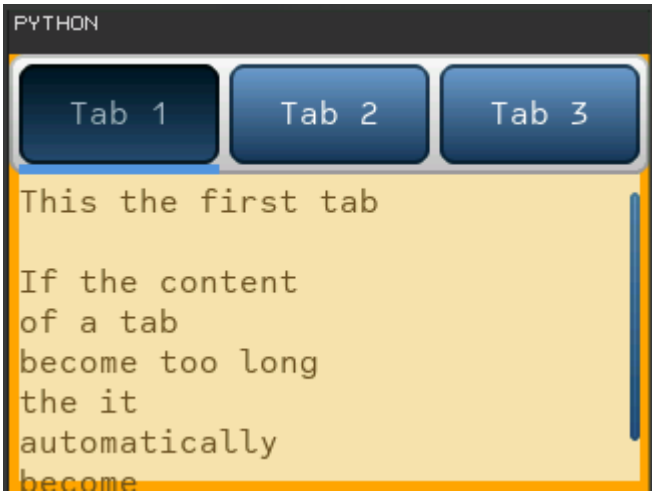
```
import lvgl as lv

# Create a normal cell style
style_cell1 = lv.style_t()
style_cell1.copy(lv.style_plain)
style_cell1.body.border.width = 1
style_cell1.body.border.color = lv.color_make(0,0,0)

# Crealte a header cell style
style_cell2 = lv.style_t()
style_cell2.copy(lv.style_plain)
style_cell2.body.border.width = 1
style_cell2.body.border.color = lv.color_make(0,0,0)
style_cell2.body.main_color = lv.color_make(0xC0, 0xC0, 0xC0)
style_cell2.body.grad_color = lv.color_make(0xC0, 0xC0, 0xC0)

table = lv.table(lv.scr_act(), None)
table.set_style(lv.table.STYLE.CELL1, style_cell1)
table.set_style(lv.table.STYLE.CELL2, style_cell2)
```

```
table.set_style(lv.table.STYLE.BG, lv.style_transp_tight)
table.set_col_cnt(2)
table.set_row_cnt(4)
table.align(None, lv.ALIGN.CENTER, 0, 0)

# Make the cells of the first row center aligned
table.set_cell_align(0, 0, lv.label.ALIGN.CENTER)
table.set_cell_align(0, 1, lv.label.ALIGN.CENTER)

# Make the cells of the first row TYPE = 2 (use `style_cell2`)
table.set_cell_type(0, 0, 2)
table.set_cell_type(0, 1, 2)

# Fill the first column
table.set_cell_value(0, 0, "Name")
table.set_cell_value(1, 0, "Apple")
table.set_cell_value(2, 0, "Banana")
table.set_cell_value(3, 0, "Citron")

# Fill the second column
table.set_cell_value(0, 1, "Price")
table.set_cell_value(1, 1, "$7")
table.set_cell_value(2, 1, "$4")
table.set_cell_value(3, 1, "$6")

lv.show()
```

6.3.26. Tabview

```
import lvgl as lv

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for keyboard handled objects
group = lv.group_create()
keyboard.set_group(group)

# Create a Tab view object
tabview = lv.tabview(lv.scr_act(), None)

# Add 3 tabs (the tabs are page (lv_page) and can be scrolled
tab1 = tabview.add_tab("Tab 1")
```

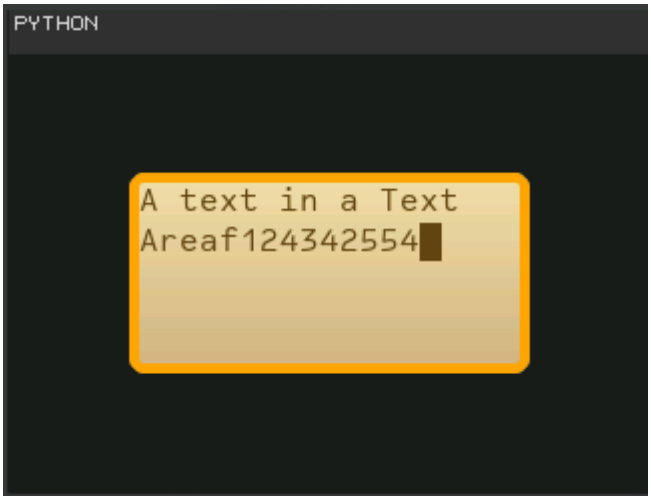
```
tab2 = tabview.add_tab("Tab 2")
tab3 = tabview.add_tab("Tab 3")

# Add content to the tabs
label = lv.label(tab1, None)
label.set_text("""This the first tab

If the content
of a tab
become too long
the it
automatically
become
scrollable.""")

label = lv.label(tab2, None)
label.set_text("Second tab")

label = lv.label(tab3, None)
label.set_text("Third tab")

group.add_obj(tabview)

lv.show()
```



6.3.27. Textarea simple

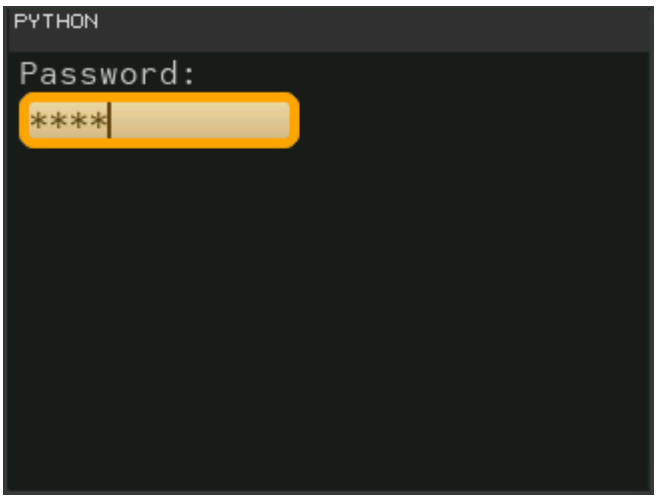
```
import lvgl as lv

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for keyboard handled objects
group = lv.group_create()
keyboard.set_group(group)

def event_handler(obj, event):
    if event == lv.EVENT.VALUE_CHANGED:
        print("Value: %s" % obj.get_text())

ta1 = lv.ta(lv.scr_act(), None)
ta1.set_size(200, 100)
ta1.align(None, lv.ALIGN.CENTER, 0, 0)
```

```
ta1.set_cursor_type(lv.CURSOR.BLOCK)
ta1.set_text("A text in a Text Area")      # Set an initial text
ta1.set_event_cb(event_handler)

group.add_obj(ta1)

lv.show()
print("LVGL drawing finished")
```



6.3.28. Textarea password

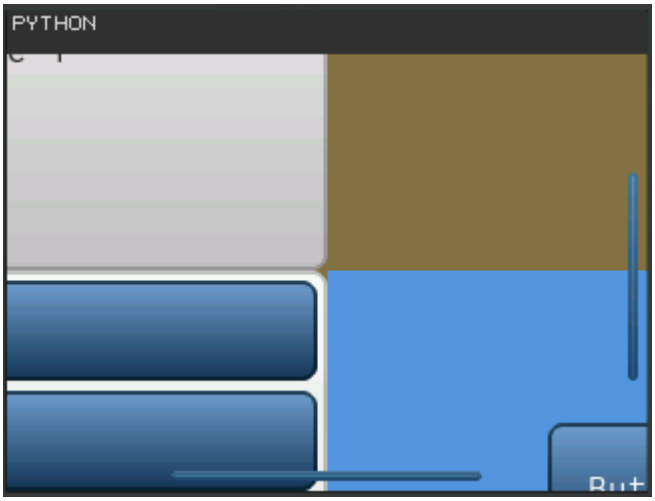
```
import lvgl as lv

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for keyboard handled objects
group = lv.group_create()
keyboard.set_group(group)

HOR_RES = lv.scr_act().get_width()
print("HOR_RES = %d" % HOR_RES)

# Create the password box
pwd_ta = lv.ta(lv.scr_act(), None)
pwd_ta.set_text("")
pwd_ta.set_pwd_mode(True)
pwd_ta.set_one_line(True)
pwd_ta.set_width(HOR_RES // 2 - 20)
pwd_ta.set_pos(5, 20)

# Create a label and position it above the text box
pwd_label = lv.label(lv.scr_act(), None)
pwd_label.set_text("Password:")
pwd_label.align(pwd_ta, lv.ALIGN.OUT_TOP_LEFT, 0, 0)

group.add_obj(pwd_ta)

lv.show()
print("LVGL drawing finished")
```



6.3.29. Tileview

```
import lvgl as lv

# Keyboard register
keyboardDriver = lv.indev_drv_t()
keyboardDriver.init()
keyboardDriver.type = lv.INDEV_TYPE.KEYPAD
keyboardDriver.read_cb = lv.keypad_read
keyboard = keyboardDriver.register()

# Create groupe for keyboard handled objects
group = lv.group_create()
keyboard.set_group(group)

valid_pos = [{"x":0, "y": 0}, {"x": 0, "y": 1}, {"x": 1,"y": 1}]

# resolution of the screen
HOR_RES = lv.scr_act().get_width()
VER_RES = lv.scr_act().get_height()

tileview = lv.tileview(lv.scr_act(), None)
tileview.set_valid_positions(valid_pos, len(valid_pos))
tileview.set_edge_flash(True)

# Tile1: just a label
tile1 = lv.obj(tileview, None)
tile1.set_size(HOR_RES, VER_RES)
tile1.set_style(lv.style_pretty)
tileview.add_element(tile1)

label = lv.label(tile1, None)
label.set_text("Tile 1")
label.align(None, lv.ALIGN.CENTER, 0, 0)

# Tile2: a list
lst = lv.list(tileview, None)
lst.set_size(HOR_RES, VER_RES)
lst.set_pos(0, VER_RES)
lst.set_scroll_propagation(True)
lst.set_sb_mode(lv.SB_MODE.OFF)
tileview.add_element(lst)

list_btn = lst.add_btn(None, "One")
tileview.add_element(list_btn)

list_btn = lst.add_btn(None, "Two")
```

```
tileview.add_element(list_btn)

list_btn = lst.add_btn(None, "Three")
tileview.add_element(list_btn)

list_btn = lst.add_btn(None, "Four")
tileview.add_element(list_btn)

list_btn = lst.add_btn(None, "Five")
tileview.add_element(list_btn)

list_btn = lst.add_btn(None, "Six")
tileview.add_element(list_btn)

list_btn = lst.add_btn(None, "Seven")
tileview.add_element(list_btn)

list_btn = lst.add_btn(None, "Eight")
tileview.add_element(list_btn)

# Tile3: a button
tile3 = lv.obj(tileview, None)
tile3.set_size(HOR_RES, VER_RES)
tile3.set_pos(HOR_RES, VER_RES)
tileview.add_element(tile3)

btn = lv.btn(tile3, None)
btn.align(None, lv.ALIGN.CENTER, 0, 0)

label = lv.label(btn, None)
label.set_text("Button")

group.add_obj(tileview)

lv.show()
```



VII. Documentation changelog

v2.31.1 (2026-07-21)

v2.31.0 (2026-07-03)

- Added section about Python Editor Expression Insertion window.

- Added section about Python Editor settings.
- Added section about Python Editor.
- Added information about autoident in Python Shell.
- Added information about interruption execution of input() command by quit.
- Added information about Alpha+del processing in Python Shell.
- Added information about prgm button processing in Python Shell.
- Added information about additional chars in bottom menu.
- Changed information about Python App menu.
- Updated information about mpy files execution.
- Fixed list of modules in 'Platform features and abilities' section.

v2.30.0 (2026-05-06)

v2.29.1 (2026-04-17)

- Added information about garbage collector behavior with the LVGL library.

v2.29.0 (2026-03-26)

- Activated random module and os.urandom function.

v2.28.1 (2026-02-26)

- Add information of stack usage checking and garbage collector.
- Update min heap size to 128kb.

v2.28.0 (2026-02-20)

- Added information about input function.
- Added zero.io functions output.
- Added zero.io functions set_color, clear_color, print_color and dict of colors.
- Added brackets into headers for functions.
- Added zero.io functions flush, clear_history, clear_screen.
- Moved functions (get_key, pause, wait) of zero module to zero.io module.
- Enabled MICROPY_ENABLE_SOURCE_LINE.
- Updated information about Shell screen, history, welcome message.
- Added information about functions set() and get() for manipulating with ZeroBasic variables.
- Added information about functions for manipulating with ZeroBasic context matrices.
- Added information about functions for manipulating with ZeroBasic context lists.
- Fixed description of zero_number.**pos**().
- Added information about functions for manipulating with ZeroBasic context numbers.
- Changed style of zero library documentation.
- Added information of zero.environment.zero_number.
- Added zero get_key, pause and wait functions.

- Enabled input() function.
- Added zero.time module documentation.
- Added information about MicroPython stack.
- Added zero.environment module, functions for getting and setting ZeroBasic strings.
- Enabled dynamical MICROPY_ENABLE_EMERGENCY_EXCEPTION_BUF.
- Enabled MICROPY_MODULE_BUILTIN_SUBPACKAGES.
- Update for version 1.27.0.
- Add time module information.
- Fix information about shell history size.
- Fix lvgl module objects overview.

v2.27.1 (2025-12-29)

- Added lvgl micropython module objects overview.

v2.27.0 (2025-12-15)

- Enabled functions attributes and enumerate build options.
- Fixed deleting and closing (leak) objects of opened files.
- Fixed memory leaks in functions of os module (chdir, mkdir, remove, unlink, rename, rmdir, stat, ilistdir, open) in case of OSError generation.
- Enabled builtin function reversed(.
- Enabled builtin function help(.

v2.26.0 (2025-10-16)

- Added changelog documentation generating.
- Change styling.
- Added table of content.
- Added f-strings.

v2.25.0 (2025-09-11)

- Fix typo mistakes.

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1. `https://www.micropython.org/` ↩
2. `https://docs.micropython.org/en/latest/` ↩↩
3. `https://github.com/micropython/micropython` ↩
4. `https://docs.micropython.org/en/latest/genrst/index.html` ↩↩
5. `https://github.com/micropython/micropython/blob/master/py/mpconfig.h` ↩
6. `https://docs.micropython.org/en/latest/library/sys.html` ↩
7. `https://docs.micropython.org/en/latest/library/os.html` ↩
8. `https://docs.micropython.org/en/latest/library/errno.html` ↩

9. https://docs.micropython.org/en/latest/library/micropython.html ↩
10. https://docs.python.org/3/index.html ↩
11. https://docs.micropython.org/en/latest/library/index.html ↩
12. https://docs.lvgl.io/6.1 ↩
13. https://docs.lvgl.io/6.1/overview/indev.html#keypad-and-encoder ↩
14. https://docs.micropython.org/en/latest/library/time.html ↩
15. https://docs.micropython.org/en/latest/library/random.html ↩