

The `morewrites` package: Always room for a new `\write`

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1 morewrites documentation

This L^AT_EX package is a solution for the error “no room for a new `\write`”, which occurs when a document reserves too many streams to write data to various auxiliary files. It is in principle possible to rewrite other packages so that they are less greedy on resources, but that is often unpractical for the end-user. Instead, `morewrites` hooks at the lowest level (T_EX primitives).

Simply add the line `\usepackage{morewrites}` near the beginning of your L^AT_EX file’s preamble: the “no room for a new `\write`” error should vanish. If it does not, please contact me so that I can correct the problem. This can be done by posting a question on the tex.stackexchange.com question and answers website, logging an issue on GitHub (<https://github.com/blefloch/latex-morewrites>), or emailing me a minimal file showing the problem.

Notes.

- This package loads the `expl3` package, hence the `l3kernel` bundle needs to be up to date.
- This package uses an auxiliary file, `\jobname.mw`, which can safely be deleted. The package only overwrites this auxiliary file if it is empty, and otherwise uses a modified file name, obtained by adding an integer to the name (previously it was obtained by appending additional copies of `.mw` to the name). Such files can be safely deleted. Be careful though to not delete a Maple worksheet by accident when cleaning up your files.
- LuaT_EX allows 128 `\write` streams, so this package does nothing (with a warning) when used with LuaT_EX.

1.1 Commands defined or altered by `morewrites`

<code>\morewritessetup</code>	<code>\morewritessetup {<key-value list>}</code>
New: 2014-07-26	Sets the options described by the <code><key-value list></code> .
<code>allocate</code>	<code>\morewritessetup { allocate = <integer> }</code>
New: 2017-04-10	Sets to (at least) <code><integer></code> the number of <code>\write</code> streams allocated to the inner workings of <code>morewrites</code> . By default this is zero but increasing this value to 10 (or so) may speed up <code>morewrites</code> .
<code>file</code>	<code>\morewritessetup { file = <file name> }</code>
New: 2014-07-26 Updated: 2024-01-05	Sets (globally) the name of the file which will be used by internal processes of <code>morewrites</code> . The file name is <code>\jobname.mw</code> by default (technically, <code>\c_sys_jobname_str.mw</code>). Contrarily to earlier versions of <code>morewrites</code> non-empty files will not be overwritten; this design choice may lead to unwanted <code>.mw</code> files remaining.
<code>verbose</code>	<code>\morewritessetup { verbose }</code>
New: 2024-01-05	This boolean option (<code>false</code> by default) makes the package write to the terminal all of the operations that it performs. This can render <code>morewrites</code> useful for debugging some file-writing operations.

<code>\newwrite</code>	This macro is redefined by <code>morewrites</code> . Since <code>morewrites</code> allows more than 16 write streams, it removes the corresponding restrictions in <code>\newwrite</code> .
Updated: 2015-08-01	
	TeXhackers note: The revised <code>\newwrite</code> allocate stream numbers starting at 129. This might break some code that expects stream numbers to be less than 16.
<code>\immediate</code>	This primitive is altered by <code>morewrites</code> , to detect a following <code>\write</code> or <code>\openout</code> or <code>\closeout</code> and perform the appropriate action.
Updated: 2015-08-01	
<code>\openout</code> <code>\write</code> <code>\closeout</code>	These three primitives are altered by <code>morewrites</code> so that they accept stream numbers outside the normal range $[0, 15]$ and open/write/close files as appropriate.
Updated: 2017-04-20	TeXhackers note: System calls using <code>\write18</code> are detected and forwarded to the engine.
<code>\shipout</code>	This primitive is altered by <code>morewrites</code> to ensure that delayed <code>\openout</code> , <code>\write</code> and <code>\closeout</code> commands are performed at <code>\shipout</code> time, and in the correct order.

1.2 Known deficiencies and open questions

See the bug tracker <https://github.com/blefloch/latex-morewrites/issues/> for a list of issues with `morewrites`.

The package code is not good expl3 code. *Do not take this package as an example of how to code with expl3; go and see Joseph Wright's `siunitx` instead.* It uses `\...:D` primitives directly (the `:D` stands for “do not use”). This is unavoidable in order to hook into the primitives `\immediate`, `\write`, *etc.* and to keep a very strong control on what every command does.

2 morewrites implementation

```
<*package>
1 \RequirePackage {primargs} [2024/01/05]
2 \ProvidesExplPackage
3   {morewrites} {2024/02/02} {} {Always room for a new write}
   Quit early under LuaTeX.
4 \sys_if_engine_luatex:T
5   {
6     \cs_new_protected:Npn \morewritessetup #1 { }
7     \msg_new:nnn { morewrites } { luatex }
8     { The~morewrites~package~is~unnecessary~in~LuaTeX. }
9     \msg_warning:nn { morewrites } { luatex }
10    \tex_endinput:D
11  }%
12 <@@=morewrites>
```

2.1 Overview of relevant T_EX facts

The aim of the `morewrites` package is to lift T_EX’s restriction of only having 16 files open for writing at the same time. This requires patching the primitives `\immediate`, `\openout`, `\write`, `\closeout`, and `\shipout`, and the macro `\newwrite` present in plain T_EX and L^AT_EX 2_ε.

Note that doing the same for `\read` streams is impossible due to the `\ifeof` primitive: that primitive cannot be replaced by a macro without breaking nesting of conditionals.

The `morewrites` package should be loaded as early as possible, so that any package loaded later uses the redefined macros instead of the primitives. However, the format (plain T_EX or L^AT_EX 2_ε) and the `expl3` programming language are always loaded before `morewrites`, and their interaction must be carefully monitored.

Henceforth, “T_EX stream” will refer to stream numbers in the range $[0, 15]$ provided to T_EX’s write primitives, while “user stream” will denote stream numbers in $[0, 15] \cup [129, \infty)$ manipulated by the redefined `\openout`, `\write`, `\closeout`, and `\newwrite`. A user stream in $[0, 15]$ (reserved by L^AT_EX 2_ε or allocated by `expl3`) is mapped to the same T_EX stream number, while a user stream in $[129, \infty)$ is mapped to a T_EX stream according to the property list (with integer keys and values) `\l__morewrites_write_prop`. Stream numbers 16, 17 and 18 are unused because `\write16` is often used to write to the terminal, and `\write18` sends its argument to a shell. The stream number 128 is also often used like 16 to avoid distinguishing LuaT_EX. Rather than special-casing it we skip directly to larger stream numbers.

The primitives `\openout`, `\write`, and `\closeout` expect to be followed by an $\langle integer \rangle$, normally in the range $[0, 15]$, then some further arguments.

```
\openout  $\langle integer \rangle$   $\langle equals \rangle$   $\langle file name \rangle$ 
\write  $\langle integer \rangle$   $\langle filler \rangle$   $\langle general text \rangle$ 
\closeout  $\langle integer \rangle$ 
```

All of the primitives above perform full expansion of all tokens when looking for their operands.

- $\langle integer \rangle$ denotes an integer in any form that T_EX accepts as the right-hand side of a primitive integer assignment of the form `\count0= $\langle integer \rangle$` ;
- $\langle equals \rangle$ is an arbitrary (optional) number of explicit or implicit space characters, an optional explicit equal sign of category other, and further (optional) explicit or implicit space characters;
- $\langle file name \rangle$ is an arbitrary sequence of explicit or implicit characters with arbitrary category codes (except active characters, which are expanded before reaching T_EX’s mouth), ending either with a space character (character code 32, arbitrary non-active category code, explicit or implicit), which is removed, or with a non-expandable token, with some care needed for the case of a `\notexpanded:` expandable token;
- $\langle filler \rangle$ is an arbitrary combination of tokens whose meaning is `\relax` or whose category code is 10;
- $\langle general text \rangle$ is formed of braced tokens, starting with an explicit or implicit begin-group character, and ending with the matching explicit end-group character (both

with any character code), with an equal number of explicit begin-group and end-group characters in between: this is precisely the right-hand side of an assignment of the form `\toks0=\langle general text \rangle`.

The `morewrites` package redefines these three control sequences to expect a user stream number rather than a $\text{\TeX}$ stream number as the $\langle integer \rangle$, then map such a user stream to a $\text{\TeX}$ stream to call the primitive with the appropriate argument. The primitive `\immediate` must also be redefined to detect `\openout`, `\write`, and `\closeout` and make them immediate, while still working with other primitives that can be made immediate. Finally, `\newwrite` must be patched to allocate stream numbers beyond 15.

A few comments on the behaviour of primitives concerning the $\langle integer \rangle$ ($\text{\TeX}$ stream). The `\openout` primitive trigger errors if the $\langle integer \rangle$ is not in $[0, 15]$. The primitive `\write` outputs to the log if the $\langle integer \rangle$ is negative, and to the terminal if the $\text{\TeX}$ stream is closed or greater than 15, with the exception of `\write18` which runs code in a shell. The `\closeout` primitive triggers an error if the $\langle integer \rangle$ is not in $[0, 15]$ and silently do nothing if the $\text{\TeX}$ stream is not open, with the exception of `\closeout18` which causes a segfault at least in some versions.

By default, `\openout`, `\write` and `\closeout` are recorded in a whatsit node in the current list, and will be performed when the box containing the whatsit node is sent to the final pdf, *i.e.*, at “shipout” time. In particular, the $\langle general text \rangle$ for the `\write` primitive is expanded at shipout time. This behaviour may be modified by putting `\immediate` before any of these three primitives to force $\text{\TeX}$ to perform the action immediately instead of recording it in a whatsit node.

Since the `\openout`, `\write`, and `\closeout` primitives operate at `\shipout` time, we will have to hook into this primitive too. It expects to be followed by a box specification, for instance `\box\langle integer \rangle` or `\hbox{\langle material to typeset \rangle}`.

Finally, the `\newwrite` macro expects one token as its argument, and defines this token (with `\chardef`) to be an integer corresponding to the first available ($\text{\TeX}$) write stream. This must be extended to allocate higher (user) streams.

2.2 Preliminaries

2.2.1 Copying some commands

```

\__morewrites_tex_immediate:w
\__morewrites_tex_openout:w
\__morewrites_tex_write:w
\__morewrites_tex_closeout:w
13 \cs_new_eq:NN \__morewrites_tex_immediate:w \tex_immediate:D
14 \cs_new_eq:NN \__morewrites_tex_openout:w \tex_openout:D
15 \cs_new_eq:NN \__morewrites_tex_write:w \tex_write:D
16 \cs_new_eq:NN \__morewrites_tex_closeout:w \tex_closeout:D

(End of definition for \__morewrites_tex_immediate:w and others.)

\__morewrites_tex_newwrite:N Copy \newwrite but making sure that it is not \outer. This copy will not be affected
by redefinitions of \newwrite later on.
17 \exp_args:NNf \cs_new_protected:Npn \__morewrites_tex_newwrite:N
18 { \exp_args:NNc \exp_after:wN \exp_stop_f: { newwrite } }

(End of definition for \__morewrites_tex_newwrite:N.)

```

2.2.2 Variants

We need these variants.

```

19 \cs_generate_variant:Nn \prop_gpop:NnNT { NV }
20 \cs_generate_variant:Nn \prop_gput:Nnn { NVx }
21 \cs_generate_variant:Nn \tl_gput_right:Nn { Nv }

```

2.2.3 Variables

<code>\l_morewrites_internal_tl</code>	Used for temporary scratch purposes.
<code>\l_morewrites_internal_seq</code>	<pre> 22 \tl_new:N \l_morewrites_internal_tl 23 \seq_new:N \l_morewrites_internal_seq </pre> (End of definition for <code>\l_morewrites_internal_tl</code> and <code>\l_morewrites_internal_seq</code>.)
<code>_morewrites_tmp:w</code>	Used for temporary definitions.
	<pre> 24 \cs_new_eq:NN _morewrites_tmp:w ? </pre> (End of definition for <code>_morewrites_tmp:w</code>.)
<code>\l_morewrites_verbose_bool</code>	When this boolean is set true, morewrites will print to the terminal all of the operations that it does.
	<pre> 25 \bool_new:N \l_morewrites_verbose_bool </pre> (End of definition for <code>\l_morewrites_verbose_bool</code>.)
<code>\g_morewrites_later_int</code>	The integer <code>\g_morewrites_later_int</code> labels the various non-immediate operations in the order in which they appear in the source. We can never reuse a number because there is no way to know if a whatsit was recorded in a box register, which could be reused in a shipped-out box:
	<pre> \ vbox_set:Nn \l_my_box { \ iow_shipout_x:Nn \c_term_iow {<text>} } \shipout \copy \l_my_box \shipout \copy \l_my_box </pre> will print <code><text></code> to the terminal twice. <pre> 26 \int_new:N \g_morewrites_later_int </pre> (End of definition for <code>\g_morewrites_later_int</code>.)
<code>\g_morewrites_write_seq</code>	Keep track of T _E X stream numbers managed by morewrites that are currently not in use as user streams.
	<pre> 27 \seq_new:N \g_morewrites_write_seq </pre> (End of definition for <code>\g_morewrites_write_seq</code>.)
<code>\g_morewrites_write_prop</code>	Map user streams to T _E X streams.
	<pre> 28 \prop_new:N \g_morewrites_write_prop </pre> (End of definition for <code>\g_morewrites_write_prop</code>.)
<code>\g_morewrites_write_file_prop</code>	Map user streams with no associated T _E X streams to file names.
	<pre> 29 \prop_new:N \g_morewrites_write_file_prop </pre> (End of definition for <code>\g_morewrites_write_file_prop</code>.)

<code>\l__morewrites_code_tl</code>	Stores the code to run after finding a user stream, in <code>__morewrites_get_user:n</code> . <pre> 30 \tl_new:N \l__morewrites_code_tl </pre> <i>(End of definition for \l__morewrites_code_tl.)</i>
<code>\l__morewrites_user_int</code> <code>\l__morewrites_tstr_tl</code>	The user stream number following redefined primitives is stored in <code>\l__morewrites_user_int</code> (see <code>__morewrites_get_user:N</code>). The corresponding TeX stream number is eventually stored in <code>\l__morewrites_tstr_tl</code> (a token list). <pre> 31 \int_new:N \l__morewrites_user_int 32 \tl_new:N \l__morewrites_tstr_tl </pre> <i>(End of definition for \l__morewrites_user_int and \l__morewrites_tstr_tl.)</i>
<code>\l__morewrites_tstr_token</code>	This token is given as an argument to <code>__morewrites_tex_newwrite:N</code> . <pre> 33 \cs_new_eq:NN \l__morewrites_tstr_token ? </pre> <i>(End of definition for \l__morewrites_tstr_token.)</i>
<code>\s__morewrites</code>	A recognizable version of <code>\scan_stop:</code> . This is inspired by ¹ scan marks (see the <code>l3quark</code> module of L ^A T _E X3), but <code>\scan_new:N</code> is not used directly, since it has been made available in L ^A T _E X3 too recently. <pre> 34 \cs_new_eq:NN \s__morewrites \scan_stop: </pre> <i>(End of definition for \s__morewrites.)</i>
<code>\g__morewrites_iow</code> <code>\g__morewrites_ior</code>	The expansion that <code>\write</code> performs is impossible to emulate (in X _Ǝ TeX at least) with anything else than <code>\write</code> . We will write on the stream <code>\g__morewrites_iow</code> to the file <code>\g__morewrites_tmp_file_tl</code> and read back from it in the stream <code>\g__morewrites_ior</code> for things to work properly. Unfortunately, this means that the file is repeatedly opened and closed, leaving a trace of that in the log. <pre> 35 \newwrite \g__morewrites_iow 36 \newread \g__morewrites_ior </pre> <i>(End of definition for \g__morewrites_iow and \g__morewrites_ior.)</i>
<code>\g__morewrites_tmp_file_tl</code> <code>\g__morewrites_tmp_file_bool</code>	Temporary file used to do the correct expansion for each <code>\write</code> . Boolean indicating whether we have already checked that the file can be used by <code>morewrites</code> : before using a file, the <code>morewrites</code> package now checks it is empty, so as to avoid clobbering user data. <pre> 37 \tl_new:N \g__morewrites_tmp_file_tl 38 \bool_new:N \g__morewrites_tmp_file_bool 39 \bool_gset_false:N \g__morewrites_tmp_file_bool </pre> <i>(End of definition for \g__morewrites_tmp_file_tl and \g__morewrites_tmp_file_bool.)</i>
<code>\g__morewrites_group_level_int</code>	The group level when <code>\shipout</code> is called: this is used to distinguish between explicit boxes and box registers. <pre> 40 \int_new:N \g__morewrites_group_level_int </pre> <i>(End of definition for \g__morewrites_group_level_int.)</i>
<code>\g__morewrites_shipout_box</code>	The page to be shipped out. <pre> 41 \box_new:N \g__morewrites_shipout_box </pre> <i>(End of definition for \g__morewrites_shipout_box.)</i>

¹Historically, this might have happened the other way around, since the author of this package is also on the L^AT_EX3 Team.

2.2.4 Verbosity

`\__morewrites_verbose:n` Messages to put in the terminal if the `verbose` option is selected.

```

42 \cs_new_protected:Npn \__morewrites_verbose:n #1
43   { \bool_if:NT \l__morewrites_verbose_bool { \iow_term:e { morewrites:~#1 } } }

(End of definition for \__morewrites_verbose:n.)

```

2.2.5 Helpers for auxiliary file

`\__morewrites_set_file:n` Sets `\g__morewrites_tmp_file_tl` to the given value (initially `\c_sys_jobname_str.mw`). We do not yet expand, delaying that to the time where we start opening/closing the file, in case `#1` contains something that has not yet been fixed. Mark that the file has not been checked.

```

44 \cs_new_protected:Npn \__morewrites_set_file:n #1
45   {
46     \bool_gset_false:N \g__morewrites_tmp_file_bool
47     \tl_gset:Nn \g__morewrites_tmp_file_tl {#1}
48   }

(End of definition for \__morewrites_set_file:n.)

```

`\__morewrites_empty_file:n` Empties a file by opening it and closing it right away. This is used when performing `\immediate \openout`. It is also used to ensure the file used by `morewrites` is left empty. We do this every time the auxiliary file is used, in case that run ends with an error mid-document.

```

49 \cs_new_protected:Npn \__morewrites_empty_file:n #1
50   {
51     \__morewrites_tex_immediate:w \__morewrites_tex_openout:w
52     \g__morewrites_iow = {#1} \scan_stop:
53     \__morewrites_tex_immediate:w \__morewrites_tex_closeout:w
54     \g__morewrites_iow
55   }

(End of definition for \__morewrites_empty_file:n.)

```

`\__morewrites_if_file_trivial:nTF` True if the file does not exist, or if it is empty. Only the TF variant is defined. We set `\__morewrites_tmp:w` to `\prg_return_true:` or `\prg_return_false:` within the group and use it after cleaning up. The first eof test is true if the file does not exist. Then we read one line, the second eof test is true if the file was empty (it is false if the file contained anything, even a single space).

```

56 \prg_new_conditional:Npnn \__morewrites_if_file_trivial:n #1 { TF }
57   {
58     \group_begin:
59     \tex_openin:D \g__morewrites_ior = {#1}
60     \if_eof:w \g__morewrites_ior
61       \cs_gset_eq:NN \__morewrites_tmp:w \prg_return_true:
62     \else:
63       \int_set:Nn \tex_endlinechar:D { -1 }
64       \tex_readline:D \g__morewrites_ior to \l__morewrites_internal_tl
65       \if_eof:w \g__morewrites_ior
66         \cs_gset_eq:NN \__morewrites_tmp:w \prg_return_true:
67       \else:
68         \cs_gset_eq:NN \__morewrites_tmp:w \prg_return_false:

```

```

69     \fi:
70     \fi:
71     \tex_closein:D \g__morewrites_ior
72     \group_end:
73     \__morewrites_tmp:w
74 }

```

(End of definition for __morewrites_if_file_trivial:nTF.)

__morewrites_chk_file: Expand the file name in \g__morewrites_tmp_file_tl once and for all. Check that the file does not exist or is blank. If not, try another file name obtained as follows: if it ends with .mw pick up any number that lies just before .mw and increment it, and otherwise just add .mw at the end of the file. This avoids clobbering files that the user would not want to lose.

```

75 \cs_new_protected:Npn \__morewrites_chk_file:
76 {
77   \tl_gset:Ne \g__morewrites_tmp_file_tl
78   { \tl_to_str:e { \g__morewrites_tmp_file_tl } }
79   \__morewrites_if_file_trivial:nTF { \g__morewrites_tmp_file_tl }
80   { \bool_gset_true:N \g__morewrites_tmp_file_bool }
81   {
82     \__morewrites_chk_file_aux:
83     \msg_warning:nnxx { morewrites } { file-exists }
84     { \g__morewrites_tmp_file_tl } { \l__morewrites_internal_tl }
85     \tl_gset_eq:NN \g__morewrites_tmp_file_tl \l__morewrites_internal_tl
86     \__morewrites_chk_file:
87   }
88 }
89 \cs_new_protected:Npn \__morewrites_chk_file_aux:
90 {
91   \regex_extract_once:nVNTF
92   { \A (\D*) (\d*) .mw \Z } \g__morewrites_tmp_file_tl \l__morewrites_internal_seq
93   {
94     \tl_set:Ne \l__morewrites_internal_tl
95     {
96       \seq_item:Nn \l__morewrites_internal_seq { 2 }
97       \int_eval:n { \seq_item:Nn \l__morewrites_internal_seq { 3 } + 1 }
98       .mw
99     }
100   }
101   { \tl_set:Ne \l__morewrites_internal_tl { \g__morewrites_tmp_file_tl .mw } }
102 }
103 \msg_new:nnnn { morewrites } { file-exists }
104 { File~'#1'~exists,~using~'#2'~instead. }
105 {
106   The~file~'#1'~exists~and~was~not~created~by~this~version~of~the~
107   'morewrites'~package.~Please~move~or~delete~that~file,~or~provide~
108   another~file~name~by~adding
109   \\ \\
110   \iow_indent:n { \iow_char:N\morewritessetup~{~file~~other~name~} }
111   \\ \\
112   to~your~source~file.~In~the~meantime,~the~file~'#2'~will~be~used.
113 }

```

(End of definition for __morewrites_chk_file:.)

2.2.6 Parsing and other helpers

`\__morewrites_equals_file:N` Most of the parsing for primitive arguments is done using `primargs`, except for one case we care about: after its $\langle number \rangle$ argument, the `\openout` primitive expects an $\langle equals \rangle$ (optional spaces and =) and a $\langle file name \rangle$.

```

114 \cs_new_protected:Npn \__morewrites_equals_file:N #1
115 {
116   \group_begin:
117   \tex_aftergroup:D \primargs_get_input_file_name:N
118   \tex_aftergroup:D #1
119   \primargs_remove_equals:N \group_end:
120 }
```

(End of definition for `\__morewrites_equals_file:N`.)

`\__morewrites_get_user:n` `primargs` commands only take N-type arguments, but we often need to find an integer, save it in `\l__morewrites_user_int`, and run some code `#1`. This is analogous to `\primargs_get_number:N`.

```

121 \cs_new_protected:Npn \__morewrites_get_user:n #1
122 {
123   \tl_set:Nn \l__morewrites_code_tl {#1}
124   \tex_afterassignment:D \l__morewrites_code_tl
125   \l__morewrites_user_int =
126 }
```

(End of definition for `\__morewrites_get_user:n`.)

`\__morewrites_user_to_tstr:NTF` The goal is to go from a user stream `\l__morewrites_user_int` to a TeX stream `\l__morewrites_tstr_tl` (it defaults to the user stream). Streams less than 129 are not managed by `morewrites`: actual TeX streams in $[0, 15]$; negative for writing to `log`; 16, 17, 128 for writing to terminal; 18 for shell escape. Larger stream numbers are looked up in the property list `#1`, namely `\g__morewrites_write_prop`. If present, use the corresponding value as the TeX stream, otherwise run the `false` branch.

```

127 \cs_new_protected:Npn \__morewrites_user_to_tstr:NTF #1
128 {
129   \tl_set:NV \l__morewrites_tstr_tl \l__morewrites_user_int
130   \int_compare:nNnTF { \l__morewrites_user_int } < { 129 }
131   { \use_i:nn }
132   { \prop_get:NVNTF #1 \l__morewrites_user_int \l__morewrites_tstr_tl }
133 }
```

(End of definition for `\__morewrites_user_to_tstr:NTF`.)

`\l__morewrites_collect_next_int` When encountering very large `\write` statements we may need to collect many lines. This can easily become an $O(n^2)$ task, and here we make sure that it remains around $O(n \log n)$, with a large constant unfortunately. Each of the token lists `\l__morewrites_$k$_tl` is empty or contains 2^k lines. As lines accumulate, they move to token lists with larger values of k , and eventually all are combined. The integer `\l__morewrites_collect_next_int` is (one plus) the maximal k among non-empty token lists.

```

134 \int_new:N \l__morewrites_collect_next_int
135 \cs_new_protected:Npn \__morewrites_collect:x #1
136 {
```

```

137 \tl_set:Nx \l__morewrites_internal_tl {#1}
138 \__morewrites_collect_aux:cf { l__morewrites_0_tl } { 1 }
139 }
140 \cs_new_protected:Npn \__morewrites_collect_aux:Nn #1#2
141 {
142   \int_compare:nNnT {#2} > \l__morewrites_collect_next_int
143   {
144     \tl_clear_new:N #1
145     \int_set:Nn \l__morewrites_collect_next_int {#2}
146   }
147   \tl_if_empty:NTF #1
148   { \tl_set_eq:NN #1 \l__morewrites_internal_tl }
149   {
150     \tl_put_left:No \l__morewrites_internal_tl {#1}
151     \tl_clear:N #1
152     \__morewrites_collect_aux:cf { l__morewrites_#2_tl }
153     { \int_eval:n { #2 + 1 } }
154   }
155 }
156 \cs_generate_variant:Nn \__morewrites_collect_aux:Nn { cf }
157 \cs_new_protected:Npn \__morewrites_collect_gput_right:N #1
158 {
159   \int_compare:nNnF \l__morewrites_collect_next_int = 0
160   {
161     \int_decr:N \l__morewrites_collect_next_int
162     \tl_gput_right:Nv #1
163     {
164       l__morewrites_
165       \int_use:N \l__morewrites_collect_next_int
166       _tl
167     }
168     \__morewrites_collect_gput_right:N #1
169   }
170 }
171 \cs_generate_variant:Nn \__morewrites_collect_gput_right:N { c }

```

(End of definition for \l__morewrites_collect_next_int and others.)

`\__morewrites_user_tl_name:n` The name of a global token list variable holding the text of a given user stream.

```

172 \cs_new:Npn \__morewrites_user_tl_name:n #1
173 { g__morewrites_iow_ \int_eval:n {#1} _tl }

```

(End of definition for __morewrites_user_tl_name:n.)

2.3 Writing

We can hold on to material while a file is being written and only write it in one go once the file closes, to avoid using a stream throughout.

At any given time, each user stream may point to an open T_EX stream, given in `\g__morewrites_write_prop`, or may point to a token list that will eventually be written to a file whose file name is stored in `\g__morewrites_write_file_prop`, or may be closed.

When a user stream points to a token list rather than a T_EX stream, any material to be written must be written to our temporary file and read back in to apply the same expansion as `\write` does.

Another difficulty is that users may mix immediate and non-immediate operations. The biggest difficulty comes from the possibility of copying boxes containing delayed actions. If we ever produced a whatsit `\write⟨number⟩{⟨text⟩}` then the T_EX stream `⟨number⟩` would have to be reserved forever, as as copies of the box containing this delayed actions may be shipped out at any later point in the document.

Each delayed action is thus saved in a separate numbered token list and `\write\g__morewrites_iow{⟨number⟩}` is inserted instead of the delayed action. At each `\shipout`, the stream `\g__morewrites_iow` is opened, to catch the `⟨number⟩` of each action that should be performed at this `\shipout`.

2.3.1 Redefining `\immediate`

To accomodate the `\immediate` primitive, our versions of `\openout`, `\write` and `\closeout` will take the form

```
\s__morewrites \use_i:nn  {⟨code for delayed action⟩}
{⟨code for immediate action⟩}
⟨further code⟩
```

The leading `\s__morewrites` allows the redefined `\immediate` to detect these redefined primitives, and to run the `⟨code for immediate action⟩` instead of the `⟨code for delayed action⟩` which is run by default. In both cases, any `⟨further code⟩` is run.

T_EX's `\immediate` primitive raises a flag which is cancelled after T_EX sees a non-expandable token. We use `\primargs_read_x_token:N` to find the next non-expandable token then test for `\openout`, `\write`, and `\closeout`. More precisely we test for the marker `\s__morewrites` and run the appropriate code as described above. Otherwise we call the primitive, for cases where the next token is `\pdfobj` or similar. In contrived situations involving nonsensical uses of `\noexpand` after `\immediate`, this code does not perfectly match how T_EX expands.

```
174 \cs_new_protected:Npn \__morewrites_immediate:w
175   { \primargs_read_x_token:N \__morewrites_immediate_auxii: }
176 \cs_new_protected:Npn \__morewrites_immediate_auxii:
177   {
178     \token_if_eq_meaning:NNTF \g_primargs_token \s__morewrites
179       { \__morewrites_immediate_auxiii:N }
180     {
181       \__morewrites_verbose:n
182       { \tl_to_str:n { \immediate } \token_to_meaning:N \g_primargs_token }
183       \__morewrites_tex_immediate:w
184     }
185   }
186 \cs_new_protected:Npn \__morewrites_immediate_auxiii:N #1
187   { \str_if_eq:nnTF { #1 } { \s__morewrites } { \use_iii:nnn } { #1 } }
```

(End of definition for `\__morewrites_immediate:w`, `\__morewrites_immediate_auxii:`, and `\__morewrites_immediate_auxiii:N`.)

2.3.2 Immediate actions

The `\openout`, `\write`, and `\closeout` primitive can be either delayed or immediate. In all cases they begin by looking for a user stream. In this subsection we implement the immediate versions only.

`\__morewrites_closeout:w` In the immediate case `\__morewrites_closeout_now:`, there are three cases. The stream may point to a T_EX stream, in which case it is closed, removed from `\g__morewrites_write_prop`, and put back in the list of usable streams. The stream may point to a token list, in which case that token list should be written to the appropriate file. The stream may be closed, in which case nothing happens. The auxiliary `\__morewrites_closeout_now:nn` writes the material collected so far for a given user stream #1 to the file #2. This uses the T_EX stream `\g__morewrites_iow`. The token list consists of multiple `\immediate \write \g__morewrites_iow {<text>}` statements because that is the only safe way to obtain new lines. We do not remove the stream/file pair from `\g__morewrites_write_file_prop`.

```

188 \cs_new_protected:Npn \__morewrites_closeout:w
189 {
190   \s__morewrites
191   \use_i:nn
192   { \__morewrites_get_user:n { \__morewrites_closeout_later: } }
193   { \__morewrites_get_user:n { \__morewrites_closeout_now: } }
194 }
195 \cs_new_protected:Npn \__morewrites_closeout_now:
196 {
197   \__morewrites_verbose:n { \tl_to_str:n { \immediate \closeout } \int_use:N \l__morewrites
198   \__morewrites_closeout_now_silent:
199 }
200 \cs_new_protected:Npn \__morewrites_closeout_now_silent:
201 {
202   \__morewrites_user_to_tstr:NTF \g__morewrites_write_prop
203   {
204     \__morewrites_tex_immediate:w \__morewrites_tex_closeout:w \l__morewrites_tstr_tl \ex
205     \int_compare:nNnF { \l__morewrites_tstr_tl } = { \l__morewrites_user_int }
206     {
207       \prop_gremove:NV \g__morewrites_write_prop \l__morewrites_user_int
208       \seq_gput_left:NV \g__morewrites_write_seq \l__morewrites_tstr_tl
209     }
210   }
211   {
212     \prop_gpop:NVNT \g__morewrites_write_file_prop \l__morewrites_user_int \l__morewrites
213     { \__morewrites_closeout_now:nn { \l__morewrites_user_int } { \l__morewrites_intern
214   }
215 }
216 \cs_new_protected:Npn \__morewrites_closeout_now:nn #1#2
217 {
218   \__morewrites_tex_immediate:w \__morewrites_tex_openout:w \g__morewrites_iow = {#2}
219   \group_begin:
220     \int_set:Nn \tex_newlinechar:D { -1 }
221     \tl_use:c { \__morewrites_user_tl_name:n {#1} }
222     \tl_gclear:c { \__morewrites_user_tl_name:n {#1} }
223   \group_end:
224   \__morewrites_tex_immediate:w \__morewrites_tex_closeout:w \g__morewrites_iow
225 }

```

(End of definition for __morewrites_closeout:w and others.)

`\__morewrites_openout:w` In the immediate case find a file name, then allocate a T_EX stream if possible, and otherwise point the user stream to a token list. In all cases, close the stream to avoid

`\__morewrites_openout_now:n`

`\__morewrites_openout_now_silent:n`

losing any material that T_EX would have written, and empty the file by opening and closing it (actually that's done automatically by the primitive).

```

226 \cs_new_protected:Npn \__morewrites_openout:w
227 {
228   \s__morewrites
229   \use_i:nn
230   { \__morewrites_get_user:n { \__morewrites_openout_later:w } }
231   { \__morewrites_get_user:n { \__morewrites_equals_file:N \__morewrites_openout_now:n } }
232 }
233 \cs_new_protected:Npn \__morewrites_openout_now:n #1
234 {
235   \__morewrites_verbose:n
236   {
237     \tl_to_str:n { \immediate\openout }
238     \int_use:N \l__morewrites_user_int
239     \c_space_tl = ~ {#1}
240   }
241   \__morewrites_openout_now_silent:n {#1}
242 }
243 \cs_new_protected:Npn \__morewrites_openout_now_silent:n #1
244 {
245   \__morewrites_closeout_now_silent:
246   \int_compare:nNnTF { \l__morewrites_user_int } < { 129 }
247   {
248     \__morewrites_tex_immediate:w \__morewrites_tex_openout:w \l__morewrites_user_int
249     = { \tl_to_str:n {#1} }
250   }
251   {
252     \seq_gpop:NNTF \g__morewrites_write_seq \l__morewrites_tstr_tl
253     {
254       \prop_gput:NVV \g__morewrites_write_prop \l__morewrites_user_int \l__morewrites_tstr_tl
255       \__morewrites_tex_immediate:w \__morewrites_tex_openout:w \l__morewrites_tstr_tl
256       = { \tl_to_str:n {#1} }
257     }
258     {
259       \__morewrites_empty_file:n {#1}
260       \prop_gput:NVx \g__morewrites_write_file_prop \l__morewrites_user_int
261       { \tl_to_str:n {#1} }
262       \tl_gc_clear_new:c { \__morewrites_user_tl_name:n { \l__morewrites_user_int } }
263     }
264   }
265 }
266 \sys_if_engine_xetex:T
267 {
268   \cs_new_eq:NN \__morewrites_openout_now_silent_aux:n \__morewrites_openout_now_silent:n
269   \cs_gset_protected:Npn \__morewrites_openout_now_silent:n #1
270   {
271     \tl_set:Nn \l__morewrites_internal_tl {#1}
272     \tl_remove_all:Nn \l__morewrites_internal_tl { " } % { " }
273     \exp_args:No \__morewrites_openout_now_silent_aux:n \l__morewrites_internal_tl
274   }
275 }

```

(End of definition for __morewrites_openout:w, __morewrites_openout_now:n, and __morewrites_

`openout_now_silent:n.)`

`\__morewrites_write:w` In the immediate case we use `\__morewrites_write_now_open:n` if the stream points to a token list, and otherwise use the primitive, with the dummy stream 16 if closed (the text is then written to the terminal).

`\__morewrites_write_now:w`

`\__morewrites_write_now:n`

```

276 \cs_new_protected:Npn \__morewrites_write:w
277 {
278   \s__morewrites
279   \use_i:nn
280   { \__morewrites_get_user:n { \__morewrites_write_later:w } }
281   { \__morewrites_get_user:n { \__morewrites_write_now:w } }
282 }
283 \cs_new_protected:Npn \__morewrites_write_now:w
284 {
285   \__morewrites_user_to_tstr:NTF \g__morewrites_write_prop
286   {
287     \int_compare:nNnT \l__morewrites_user_int = { 18 } { \use_iii:nnn }
288     \int_compare:nT { -1 < \l__morewrites_user_int < 16 }
289     {
290       \__morewrites_verbose:n
291       {
292         \tl_to_str:n { \immediate \write }
293         \int_use:N \l__morewrites_user_int
294       }
295     }
296     \__morewrites_tex_immediate:w \__morewrites_tex_write:w \l__morewrites_tstr_tl \exp_s
297   }
298   { \primargs_get_general_text:N \__morewrites_write_now:n }
299 }
300 \cs_new_protected:Npn \__morewrites_write_now:n #1
301 {
302   \prop_get:NVNTF \g__morewrites_write_file_prop \l__morewrites_user_int \l__morewrites_int
303   {
304     \__morewrites_verbose:n
305     {
306       \tl_to_str:n { \immediate \write }
307       \int_use:N \l__morewrites_user_int
308       \tl_to_str:n { ~ {#1} }
309     }
310     \__morewrites_write_now_open:n {#1}
311   }
312   {
313     \__morewrites_verbose:n
314     {
315       \tl_to_str:n { \immediate \write }
316       \int_use:N \l__morewrites_user_int
317       \tl_to_str:n { ~ (closed) ~ {#1} }
318     }
319     \__morewrites_tex_immediate:w \__morewrites_tex_write:w 16 {#1}
320   }
321 }

```

(End of definition for `\__morewrites_write:w`, `\__morewrites_write_now:w`, and `\__morewrites_write_now:n`.)

`\__morewrites_write_now_open:n` Only `\write` itself can emulate how `\write` expands tokens, because `#` don't have to be doubled, and because the `\newlinechar` has to be changed to new lines. Hence, we start by writing `#1` to a file (after making sure we are allowed to alter it), yielding some lines. The lines are then read one at a time using ϵ -TeX's `\readline` with `\endlinechar` set to `-1` to avoid spurious characters. Each line becomes a `\immediate \write` statement added to a token list whose name is constructed using `\__morewrites_user_tl_name:n`. This token list will be called when it is time to actually write to the file. At that time, `\newlinechar` will be `-1`, so that writing each line will produce no extra line.

```

322 \cs_new_protected:Npn \__morewrites_write_now_open:n #1
323 {
324   \bool_if:NF \g__morewrites_tmp_file_bool { \__morewrites_chk_file: }
325   \__morewrites_tex_immediate:w \__morewrites_tex_openout:w
326   \g__morewrites_iow = { \g__morewrites_tmp_file_tl }
327   \__morewrites_tex_immediate:w \__morewrites_tex_write:w
328   \g__morewrites_iow {#1}
329   \__morewrites_tex_immediate:w \__morewrites_tex_closeout:w
330   \g__morewrites_iow
331   \group_begin:
332     \int_set:Nn \tex_endlinechar:D { -1 }
333     \tex_openin:D \g__morewrites_ior = { \g__morewrites_tmp_file_tl }
334     \__morewrites_write_now_loop:
335     \tex_closein:D \g__morewrites_ior
336     \__morewrites_collect_gput_right:c
337     { \__morewrites_user_tl_name:n { \l__morewrites_user_int } }
338   \group_end:
339   \__morewrites_empty_file:n { \g__morewrites_tmp_file_tl }
340 }
341 \cs_new_protected:Npn \__morewrites_write_now_loop:
342 {
343   \tex_readline:D \g__morewrites_ior to \l__morewrites_internal_tl
344   \ior_if_eof:NF \g__morewrites_ior
345   {
346     \__morewrites_collect:x
347     {
348       \__morewrites_tex_immediate:w \__morewrites_tex_write:w
349       \g__morewrites_iow { \l__morewrites_internal_tl }
350     }
351     \__morewrites_write_now_loop:
352   }
353 }

```

(End of definition for `\__morewrites_write_now_open:n` and `\__morewrites_write_now_loop:.`)

2.3.3 Delayed actions

`\__morewrites_later:n` Store the action to be done at shipout in a token list, and non-immediately write the label `\g__morewrites_later_int` of the output operation to the temporary file.

```

354 \cs_new_protected:Npn \__morewrites_later:n #1
355 {
356   \int_gincr:N \g__morewrites_later_int
357   \tl_const:cx
358   {
359     c__morewrites_later_

```

```

360     \int_use:N \g__morewrites_later_int
361     _tl
362   }
363   {
364     \int_set:Nn \exp_not:N \l__morewrites_user_int
365     { \exp_not:V \l__morewrites_user_int }
366     \exp_not:n {#1}
367   }
368   \exp_args:NNx \__morewrites_tex_write:w \g__morewrites_iow
369   { '( \int_use:N \g__morewrites_later_int ) }
370 }
371 \cs_new_protected:Npn \__morewrites_later_do:n #1
372 { \tl_use:c { c__morewrites_later_ \int_eval:n {#1} _tl } }

```

(End of definition for __morewrites_later:n and __morewrites_later_do:n.)

__morewrites_closeout_later: If the user stream is a T_EX stream, use the primitive, otherwise save __morewrites_closeout_now_silent: for later.

```

373 \cs_new_protected:Npn \__morewrites_closeout_later:
374 {
375   \__morewrites_verbose:n { \tl_to_str:n { \closeout (later) ~ } \int_use:N \l__morewrites_
376   \int_compare:nNnTF \l__morewrites_user_int < { 129 }
377   { \__morewrites_tex_closeout:w \l__morewrites_user_int }
378   { \__morewrites_later:n { \__morewrites_closeout_now_silent: } }
379 }

```

(End of definition for __morewrites_closeout_later:.)

__morewrites_openout_later:w If the user stream is a T_EX stream use the primitive, otherwise find a file name and call __morewrites_openout_now_silent:n later.

```

\__morewrites_openout_later:n
380 \cs_new_protected:Npn \__morewrites_openout_later:w
381 {
382   \int_compare:nNnTF \l__morewrites_user_int < { 129 }
383   {
384     \__morewrites_verbose:n { \tl_to_str:n { \openout (later) ~ } \int_use:N \l__morewrites_
385     \__morewrites_tex_openout:w \l__morewrites_user_int
386   }
387   { \__morewrites_equals_file:N \__morewrites_openout_later:n }
388 }
389 \cs_new_protected:Npn \__morewrites_openout_later:n #1
390 {
391   \__morewrites_verbose:n
392   {
393     \tl_to_str:n { \openout (later)~ }
394     \int_use:N \l__morewrites_user_int
395     \c_space_tl = ~ {#1}
396   }
397   \__morewrites_later:n { \__morewrites_openout_now_silent:n {#1} }
398 }

```

(End of definition for __morewrites_openout_later:w and __morewrites_openout_later:n.)

__morewrites_write_later:w For T_EX streams use the primitive, otherwise find a general text and save it for later; the auxiliary is very similar to __morewrites_write_now:w.

__morewrites_write_later_aux:n

```

399 \cs_new_protected:Npn \__morewrites_write_later:w
400 {
401   \int_compare:nNnTF \l__morewrites_user_int < { 129 }
402   {
403     \__morewrites_verbose:n { \tl_to_str:n { \write (later)~ } \int_use:N \l__morewrites_
404     \__morewrites_tex_write:w \l__morewrites_user_int
405   }
406   { \primargs_get_general_text:N \__morewrites_write_later:n }
407 }
408 \cs_new_protected:Npn \__morewrites_write_later:n #1
409 {
410   \__morewrites_verbose:n
411   {
412     \tl_to_str:n { \write (later)~ }
413     \int_use:N \l__morewrites_user_int
414     \tl_to_str:n { ~ {#1} }
415   }
416   \__morewrites_later:n { \__morewrites_write_later_aux:n {#1} }
417 }
418 \cs_new_protected:Npn \__morewrites_write_later_aux:n
419 {
420   \__morewrites_user_to_tstr:NTF \g__morewrites_write_prop
421   { \__morewrites_tex_immediate:w \__morewrites_tex_write:w \l__morewrites_tstr_tl \exp_s
422   {
423     \prop_get:NVNTF \g__morewrites_write_file_prop \l__morewrites_user_int \l__morewrites
424     { \__morewrites_write_now_open:n }
425     { \__morewrites_tex_immediate:w \__morewrites_tex_write:w 16 \exp_stop_f: }
426   }
427 }

```

(End of definition for __morewrites_write_later:w, __morewrites_write_later:n, and __morewrites_write_later_aux:n.)

2.3.4 Shipout business

In this section, we hook into the \shipout primitive, and redefine it to first build a box with the material to ship out, then perform

```

\__morewrites_before_shipout:
<primitive shipout> <collected box>
\__morewrites_after_shipout:

```

Each delayed output operation has been replaced by \write \g__morewrites_iow {'(<operation number>)}. The delimiters we chose to put around numbers must be at least two distinct characters on the left (then \tex_newlinechar:D cannot be equal to the delimiter), and at least one non-digit character on the right.

__morewrites_before_shipout: Immediately before the shipout, we must open the writing stream \g__morewrites_iow (after making sure we are allowed to alter the auxiliary file).

```

428 \cs_new_protected:Npn \__morewrites_before_shipout:
429 {
430   \bool_if:NF \g__morewrites_tmp_file_bool { \__morewrites_chk_file: }
431   \__morewrites_tex_immediate:w \__morewrites_tex_openout:w
432   \g__morewrites_iow = { \g__morewrites_tmp_file_tl }
433 }

```

(End of definition for `\__morewrites_before_shipout:`)

`\__morewrites_after_shipout:` Immediately after all the `\writes` are performed, close the file, then read the file with `\__morewrites_after_shipout_loop:ww` `\newlinechar` set to `\newlinechar`² to get exactly the original characters that have been written, possibly with extra characters between ‘(. . .)’ groups. The file is then read with all the appropriate category codes set up (no other character can appear in the file). The looping auxiliary `\__morewrites_after_shipout_loop:ww` extracts the *operation* numbers from the file, and makes a token list out of those. This token list is then used in a mapping function to perform the appropriate `\write` operations. Note that those operations may reuse the file, so we have to fully parse the file before moving on.

```

434 \cs_new_protected:Npn \__morewrites_after_shipout:
435 {
436   \__morewrites_tex_immediate:w \__morewrites_tex_closeout:w
437   \g__morewrites_iow
438   \group_begin:
439     \int_set_eq:NN \tex_endlinechar:D \tex_newlinechar:D
440     \char_set_catcode_other:n { \tex_endlinechar:D }
441     \tl_map_inline:nn { '(0123456789) }
442       { \char_set_catcode_other:n {'##1} }
443     \tex_everyeof:D { '() \exp_not:N }
444     \tl_set:Nx \l__morewrites_internal_tl
445       {
446         \exp_after:wN \__morewrites_after_shipout_loop:ww
447         \tex_input:D { \g__morewrites_tmp_file_tl }
448       }
449     \__morewrites_empty_file:n { \g__morewrites_tmp_file_tl }
450     \exp_args:NNo
451     \group_end:
452     \tl_map_function:nN { \l__morewrites_internal_tl } \__morewrites_later_do:n
453   }
454   \cs_new:Npn \__morewrites_after_shipout_loop:ww #1 '( #2 )
455   {
456     \tl_if_empty:nF {#2}
457     {
458       {#2}
459       \__morewrites_after_shipout_loop:ww
460     }
461   }

```

(End of definition for `\__morewrites_after_shipout:` and `\__morewrites_after_shipout_loop:ww:`)

`\__morewrites_shipout:w` Grab the shipped out box using `\setbox` and regain control using `\afterassignment`.
`\__morewrites_shipout_i:` There are two cases: either the box is given as `\box` or `\copy` followed by a number, in which case `\__morewrites_shipout_i:` is inserted afterwards at the same group level, or the box is given as `\hbox` (or `\vtop` and so on) and an additional `\aftergroup` is needed to reach a point where we can use the box saved in `\g__morewrites_shipout_box`.
`\__morewrites_shipout_ii:`

```

462 \cs_new_protected:Npn \__morewrites_shipout:w
463 {
464   \int_gset_eq:NN \g__morewrites_group_level_int \tex_currentgrouplevel:D
465   \tex_afterassignment:D \__morewrites_shipout_i:

```

²Note that the `\newlinechar` used by `\writes` at `\shipout` time are those in effect when the page is shipped out, *i.e.*, just after the closing brace of the `\shipout` construction, which is exactly where we have added this hook.

```

466 \tex_global:D \tex_setbox:D \g__morewrites_shipout_box
467 }
468 \cs_new_protected:Npn \__morewrites_shipout_i:
469 {
470 \int_compare:nNnTF { \g__morewrites_group_level_int }
471 = { \tex_currentgrouplevel:D }
472 { \__morewrites_shipout_ii: }
473 { \tex_aftergroup:D \__morewrites_shipout_ii: }
474 }
475 \cs_new_protected:Npn \__morewrites_shipout_ii:
476 {
477 \__morewrites_before_shipout:
478 \__morewrites_tex_shipout:w \tex_box:D \g__morewrites_shipout_box
479 \__morewrites_after_shipout:
480 }

```

(End of definition for `\__morewrites_shipout:w`, `\__morewrites_shipout_i:`, and `\__morewrites_shipout_ii:`.)

\shipout

`\__morewrites_tex_shipout:w`

The task is now to locate the shipout primitive, which may have been renamed and hooked into by many different packages loaded before `morewrites`. Any of those control sequences which are equal to the primitive are redefined to do `\__morewrites_shipout:w` instead. If the primitive is not located at all, the fallback is to hook into the control sequence `\shipout`.

```

481 \cs_gset_protected:Npn \__morewrites_tmp:w #1
482 {
483 \cs_if_exist:NF \__morewrites_tex_shipout:w
484 { \cs_new_eq:NN \__morewrites_tex_shipout:w #1 }
485 \cs_gset_eq:NN #1 \__morewrites_shipout:w
486 }
487 \tl_map_inline:nn
488 {
489 \xyrealshipout@
490 \org@shipout
491 \PDFSYNCship@ut@ld
492 \CROP@shipout
493 \@soORI
494 \tex_shipout:D
495 \zwpl@Hship
496 \o@shipout@TP
497 \LL@shipout
498 \Shipout
499 \GXTorg@shipout
500 \AtBegShi@OrgShipout
501 \AtBeginShipoutOriginalShipout
502 \minidocument@orig@shipout
503 \shipout
504 }
505 {
506 \str_if_eq:eeT
507 { \cs_meaning:N #1 }
508 { \token_to_str:N \shipout }
509 { \__morewrites_tmp:w #1 }
510 }

```

```

511 \cs_if_exist:NF \__morewrites_tex_shipout:w
512 {
513   \cs_new_eq:NN \__morewrites_tex_shipout:w \shipout
514   \cs_gset_eq:NN \shipout \__morewrites_shipout:w
515 }

```

(End of definition for `\shipout` and `\__morewrites_tex_shipout:w`. This function is documented on page 3.)

2.3.5 Hook at the very end

`\__morewrites_close_all:` At the end of the document, close all the files.

```

516 \cs_new_protected:Npn \__morewrites_close_all:
517 {
518   \prop_map_inline:Nn \g__morewrites_write_prop
519   {
520     \__morewrites_verbose:n { \tl_to_str:n { \immediate \closeout } ##1 ~ (at~end) }
521     \__morewrites_tex_immediate:w \__morewrites_tex_closeout:w ##2 \scan_stop:
522   }
523   \prop_gclear:N \g__morewrites_write_prop
524   \prop_map_function:NN \g__morewrites_write_file_prop
525   \__morewrites_closeout_now:nn
526   \prop_gclear:N \g__morewrites_write_file_prop
527 }

```

(End of definition for `\__morewrites_close_all:.`)

`\__morewrites_close_all_at_end:nw` At the end of the run, we try very hard to put some material at the `\@@end`, just in case some other very late code writes to files that are not yet closed. This is tried at most 5 times, to avoid infinite loops in case two packages compete for that last place. The four `@` become two after `l3docstrip`.

```

528 \cs_new_protected:Npn \__morewrites_close_all_at_end:nw #1#2 \@@end
529 {
530   \int_compare:nNnTF {#1} > 0
531   { #2 \__morewrites_close_all_at_end:nw { #1 - 1 } }
532   { \__morewrites_close_all: #2 }
533   \@@end
534 }
535 \AtEndDocument { \__morewrites_close_all_at_end:nw { 5 } }

```

(End of definition for `\__morewrites_close_all_at_end:nw`.)

2.4 Redefining commands

2.4.1 Modified `\newwrite`

`\g__morewrites_alloc_write_int` Counter to allocate user streams. We used to initialize it to 18 so that the first user stream allocated by `morewrites` was 19. Indeed, 18 is reserved for shell commands and packages may expect 16 or 17 to write to the terminal. This is now changed to start allocation at 129, since some packages that do not want to distinguish Lua_T_E_X from other engines simply use 128 as a never-open stream.

```

536 \int_new:N \g__morewrites_alloc_write_int
537 \int_gset:Nn \g__morewrites_alloc_write_int { 128 }

```

(End of definition for `\g__morewrites_alloc_write_int`.)

```

\__morewrites_newwrite:N Reimplementation of \newwrite but protected and using a counter \g__morewrites_
alloc_write_int instead of what TEX/LATEX 2ε use.
538 \cs_new_protected:Npn \__morewrites_newwrite:N #1
539 {
540   \int_gincr:N \g__morewrites_alloc_write_int
541   \int_set_eq:NN \allocationnumber \g__morewrites_alloc_write_int
542   \cs_undefine:N #1
543   \int_const:Nn #1 { \allocationnumber }
544   \wlog
545   {
546     \token_to_str:N #1
547     = \token_to_str:N \write \int_use:N \allocationnumber
548   }
549 }

```

(End of definition for __morewrites_newwrite:N.)

```

\__morewrites_allocate:n Raise to #1 the number of \write streams allocated to morewrites.
550 \cs_new_protected:Npn \__morewrites_allocate:n #1
551 {
552   \prg_replicate:nn
553   {
554     \int_max:nn { 0 }
555     {
556       (#1) - \seq_count:N \g__morewrites_write_seq
557       - \prop_count:N \g__morewrites_write_prop
558     }
559   }
560   {
561     \__morewrites_tex_newwrite:N \l__morewrites_tstr_token
562     \seq_gput_right:NV \g__morewrites_write_seq \l__morewrites_tstr_token
563   }
564 }

```

(End of definition for __morewrites_allocate:n.)

2.5 User commands and keys

\morewritessetup Set whatever keys the user passes to \morewritessetup.

```

565 \cs_new_protected:Npn \morewritessetup #1
566 { \keys_set:nn { __morewrites } {#1} }

```

(End of definition for \morewritessetup. This function is documented on page 2.)

file Because of our use of .initial:n, this code must appear after __morewrites_set_file:n is defined.

```

567 \keys_define:nn { __morewrites }
568 {
569   allocate .code:n = \__morewrites_allocate:n {#1} ,
570   file .code:n = \__morewrites_set_file:n {#1} ,
571   file .initial:n = \c_sys_jobname_str .mw ,
572   verbose .bool_set:N = \l__morewrites_verbose_bool
573 }

```

(End of definition for file. This function is documented on page 2.)

```
\immediate
\openout 574 \cs_gset_eq:NN \immediate \__morewrites_immediate:w
\write   575 \cs_gset_eq:NN \openout  \__morewrites_openout:w
\closeout 576 \cs_gset_eq:NN \write    \__morewrites_write:w
\newwrite 577 \cs_gset_eq:NN \closeout  \__morewrites_closeout:w
          578 \cs_gset_eq:NN \newwrite  \__morewrites_newwrite:N
```

(End of definition for \immediate and others. These functions are documented on page 3.)
</package>

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