

The `ltxcmdhooks` module*

Frank Mittelbach Phelype Oleinik

May 25, 2023

Contents

1	Introduction	1
2	Restrictions and Operational details	2
2.1	Patching	3
2.1.1	Timing	3
2.2	Commands that look ahead	3
3	Package Author Interface	4
3.1	Arguments and redefining commands	5
4	The Implementation	5
4.1	Execution plan	5
4.2	Variables	6
4.3	Variants	7
4.4	Patching or delaying	7
4.5	Patching commands	9
4.5.1	Patching by expansion and redefinition	10
4.5.2	Patching by retokenization	18
4.6	Messages	24
	Index	25

1 Introduction

This file implements generic hooks for (arbitrary) commands. In theory every command `\<name>` offers now two associated hooks to which code can be added using `\AddToHook`,¹ `\AddToHookNext`, `\AddToHookWithArguments`, and `\AddToHookNextWithArguments`.² These are:

*This file has version v1.0h dated 2023/05/21, © L^AT_EX Project.

¹In this documentation, when something is being said about `\AddToHook`, the same will be valid for `\AddToHookWithArguments`, unless that particular paragraph is highlighting the differences between both. The same is true for the other hook-related functions and their `...WithArguments` counterparts.

²In practice this is not supported for all types of commands, see section 2.2 for the restrictions that apply and what happens if one tries to use this with commands for which this is not supported.

`cmd/⟨name⟩/before` This hook is executed at the very start of the command, right after its arguments (if any) are parsed. The hook `⟨code⟩` runs in the command inside a call to `\UseHookWithArguments`. Any code added to this hook using `\AddToHookWithArguments` or `\AddToHookNextWithArguments` can access the command's arguments using `#1`, `#2`, etc., up to the number of arguments of the command. If `\AddToHook` or `\AddToHookNext` are used, the arguments cannot be accessed (see the `lthooks` documentation³ on hooks with arguments).

`cmd/⟨name⟩/after` This hook is similar to `cmd/⟨name⟩/before`, but it is executed at the very end of the command body. This hook is implemented as a reversed hook.

The hooks are not physically present before `\begin{document}`⁴ (i.e., using a command in the preamble will never execute the hook) and if nobody has declared any code for them, then they are not added to the command code ever. For example, if we have the following definition

```
\newcommand\foo[2]{Code #1 for #2!}
```

then executing `\foo{A}{B}` will simply run `Code_A_for_B!` as it was always the case. However, if somebody, somewhere (e.g., in a package) adds

```
\AddToHook{cmd/foo/before}{<before code>}
```

then, after `\begin{document}` the definition of `\foo` will be:

```
\renewcommand\foo[2]{%
  \UseHookWithArguments{cmd/foo/before}{2}{#1}{#2}%
  Code #1 for #2!}
```

and similarly `\AddToHook{cmd/foo/after}{<after code>}` alters the definition to

```
\renewcommand\foo[2]{%
  Code #1 for #2!%
  \UseHookWithArguments{cmd/foo/after}{2}{#1}{#2}}
```

In other words, the mechanism is similar to what `etoolbox` offers with `\pretocmd` and `\apptocmd` with the important differences

- that code can be prepended or appended (i.e., added to the hooks) even if the command itself is not defined, because the defining package has not yet been loaded;
- and that by using the hook management interface it is now possible to define how the code chunks added in these places are ordered, if different packages want to add code at these points.

2 Restrictions and Operational details

Adding arbitrary material to commands is tricky because most of the time we do not know what the macro expects as arguments when expanding and `TeX` doesn't have a reliable way to see that, so some guesswork has to be employed.

³`texdoc lthooks-doc`

⁴More specifically, they are inserted in the commands after the `begindocument` hook, so they are also not present while `LaTeX` is reading the `.aux` file.

2.1 Patching

The code here tries to find out if a command was defined with `\newcommand` or `\DeclareRobustCommand` or `\NewDocumentCommand`, and if so it *assumes* that the argument specification of the command is as expected (which is not fail-proof, if someone redefines the internals of these commands in devious ways, but is a reasonable assumption).

If the command is one of the defined types, the code here does a sandboxed expansion of the command such that it can be redefined again exactly as before, but with the hook code added.

If however the command is not a known type (it was defined with `\def`, for example), then the code uses an approach similar to `etoolbox`'s `\patchcmd` to retokenize the command with the hook code in place. This procedure, however, is more likely to fail if the catcode settings are not the same as the ones at the time of command's definition, so not always adding a hook to a command will work.

2.1.1 Timing

When `\AddToHook` (or its `expl3` equivalent) is called with a generic `cmd` hook, say, `cmd/foo/before`, for the first time (that is, no code was added to that same hook before), in the preamble of a document, it will store a patch instruction for that command until `\begin{document}`, and only then all the commands which had hooks added will be patched in one go. That means that no command in the preamble will have hooks patched into them.

At `\begin{document}` all the delayed patches will be executed, and if the command doesn't exist the code is still added to the hook, but it will not be executed. After `\begin{document}`, when `\AddToHook` is called with a generic `cmd` hook the first time, the command will be immediately patched to include the hook, and if it doesn't exist or if it can't be patched for any reason, an error is thrown; if `\AddToHook` was already used in the preamble no new patching is attempted.

This has the consequence that a command defined or redefined after `\begin{document}` only uses generic `cmd` hook code if `\AddToHook` is called for the first time after the definition is made, or if the command explicitly uses the generic hook in its definition by declaring it with `\NewHookPair` adding `\UseHook` as part of the code.⁵

2.2 Commands that look ahead

Some commands are defined in different “steps” and they look ahead in the input stream to find more arguments. If you try to add some code to the `cmd/<name>/after` hook of such command, it will not work, and it is not possible to detect that programmatically, so the user has to know (or find out) which commands can or cannot have hooks attached to them.

One good example is the `\section` command. You can add something to the `cmd/section/before` hook, but if you try to add something to the `cmd/section/after` hook, `\section` will no longer work. That happens because the `\section` macro takes no argument, but instead calls a few internal `LATEX` macros to look for the optional and mandatory arguments. By adding code to the `cmd/section/after` hook, you get in the way of that scanning.

⁵We might change this behavior in the main document slightly after gaining some usage experience.

3 Package Author Interface

The `cmd` hooks are, by default, available for all commands that can be patched to add the hooks. For some commands, however, the very beginning or the very end of the code is not the best place to put the hooks, for example, if the command looks ahead for arguments (see section 2.2).

If you are a package author and you want to add the hooks to your own commands in the proper position you can define the command and manually add the `\UseHookWithArguments` calls inside the command in the proper positions, and manually define the hooks with `\NewHookWithArguments` or `\NewReversedHookWithArguments`. When the hooks are explicitly defined, patching is not attempted so you can make sure your command works properly. For example, an (admittedly not really useful) command that typesets its contents in a framed box with width optionally given in parentheses:

```
\newcommand\fancybox{\@ifnextchar({\@fancybox}{\@fancybox(5cm)}}
\def\@fancybox(#1)#2{\fbox{\parbox{#1}{#2}}}
```

If you try that definition, then add some code after it with

```
\AddToHook{cmd/fancybox/after}{<code>}
```

and then use the `\fancybox` command you will see that it will be completely broken, because the hook will get executed in the middle of parsing for optional `(...)` argument.

If, on the other hand, you want to add hooks to your command you can do something like:

```
\newcommand\fancybox{\@ifnextchar({\@fancybox}{\@fancybox(5cm)}}
\def\@fancybox(#1)#2{\fbox{%
    \UseHookWithArguments{cmd/fancybox/before}{2}{#1}{#2}%
    \parbox{#1}{#2}%
    \UseHookWithArguments{cmd/fancybox/after}{2}{#1}{#2}}}
\NewHookWithArguments{cmd/fancybox/before}{2}
\NewReversedHookWithArguments{cmd/fancybox/after}{2}
```

then the hooks will be executed where they should and no patching will be attempted. It is important that the hooks are declared with `\NewHookWithArguments` or `\NewReversedHookWithArguments`, otherwise the command hook code will try to patch the command. Note also that the call to `\UseHookWithArguments{cmd/fancybox/before}` does not need to be in the definition of `\fancybox`, but anywhere it makes sense to insert it (in this case in the internal `\@fancybox`).

Alternatively, if for whatever reason your command does not support the generic hooks provided here, you can disable a hook with `\DisableGenericHook`⁶, so that when someone tries to add code to it they will get an error. Or if you don't want the error, you can simply declare the hook with `\NewHook` and never use it.

The above approach is useful for really complex commands where for one or the other reason the hooks can't be placed at the very beginning and end of the command body and some hand-crafting is needed. However, in the example above the real (and in fact only) issue is the cascading argument parsing in the style developed long ago in L^AT_EX 2.09. Thus, a much simpler solution for this case is to replace it with the modern `\NewDocumentCommand` syntax and define the command as follows:

⁶Please use `\DisableGenericHook` if at all, only on hooks that you “own”, i.e., for commands your package or class defines and not second guess whether or not hooks of other packages should get disabled!

```
\DeclareDocumentCommand\fancybox{D()}{5cm}m}{\fbox{\parbox{#1}{#2}}}
```

If you do that then both hooks automatically work and are patched into the right places.

3.1 Arguments and redefining commands

The code in `ltxcmdhooks` does its best to find out how many arguments a given command has, and to insert the appropriate call to `\UseHookWithArguments`, so that the arguments seen by the hook are exactly those grabbed by the command (the hook, after all, is a macro call, so the arguments have to be placed in the right order, or they won't match).

When using the package writer interface, as discussed in section 3, to change the position of the hooks in your commands, you are also free to change how the hook code in your command sees its arguments. When a `cmd` hook is declared with `\NewHook` (or `\NewHookWithArguments` or other variations of that), it loses its “generic” nature and works as a regular hook. This means that you may choose to declare it without arguments regardless if the command takes arguments or not, or declare it with arguments, even if the command takes none.

However, this flexibility should not be abused. When using a nonstandard configuration for the hook arguments, think reasonably: a user will expect that the argument `#1` in the hook corresponds to the argument's first argument, and so on. Any other configuration is likely to cause confusion and, if used, will have to be well documented.

This flexibility, however, allows you to “correct” the arguments for the hooks. For example, L^AT_EX's `\refstepcounter` has a single argument, the name of the counter. The `cleveref` package adds an optional argument to `\refstepcounter`, making the name of the counter argument `#2`. If the author of `cleveref` wanted, for whatever reason, to add hooks to `\refstepcounter`, to preserve compatibility he could write something along the lines of:

```
\NewHookWithArguments{cmd/refstepcounter/before}{1}
\renewcommand\refstepcounter[2][<default>]{%
  \UseHookWithArguments{cmd/refstepcounter/before}{1}{#2}%
  <code for \refstepcounter>}
```

so that the mandatory argument, which is arg `#2` in the definition, would still be seen as `#1` in the hook code.

Another possibility would be to place the optional argument as the second argument for the hook, so that people looking for it would be able to use it. In either case, it would have to be well documented to cause as little confusion as possible.

4 The Implementation

4.1 Execution plan

To add `before` and `after` hooks to a command we will need to peek into the definition of a command, which is always a tricky thing to do. Some cases are easy because we know how the command was defined, so we can assume how its *parameter text* looks like (for example a command defined with `\newcommand` may have an optional argument followed by a run of mandatory arguments), so we can just expand that command and make it grab `#1`, `#2`, etc. as arguments and define it all back with the hooks added.

Life's usually not that easy, so with some commands we can't do that (a `#1` might as well be `#12112` instead of the expected `#6112`, for example) so we need to resort to

“patching” the command: read its `\meaning`, and tokenize it again with `\scantokens` and hope for the best.

So the overall plan is:

1. Check if a command is of a known type (that is, defined with `\newcommand`⁷, `\DeclareRobustCommand`, or `\New(Expandable)DocumentCommand`), and if is, take appropriate action.
2. If the command is not a known type, we’ll check if the command can be patched. Two things will prevent a command from being patched: if it was defined in a nonstandard catcode setting, or if it is an internal expl3 command with `__<module>` in its name, in which case we refuse to patch.
3. If the command was defined in nonstandard catcode settings, we will try a few standard ones to try our best to carry out the patching. If this doesn’t help either, the code will give up and throw an error.

```

1 <@@=hook>
2 <*2kernel | latexrelease>
3 \ExplSyntaxOn
4 <latexrelease> \NewModuleRelease{2021/06/01}{ltxcmdhooks}
5 <latexrelease> {The~hook~management~system~for~commands}
```

4.2 Variables

`\g_hook_patch_action_list_tl` Pairs of `\if<cmd>..\patch<cmd>` to be used with `\robust@command@act` when looking for a known patching rule. This token list is exposed because we see some future applications (with very specialized packages, such as `etoolbox` that may want to extend the pairs processed. It is not meant for general use which is why it is not documented in the interface documentation above.

```
6 \tl_new:N \g_hook_patch_action_list_tl
```

(End definition for `\g_hook_patch_action_list_tl`.)

`\l__hook_patch_num_args_int` The number of arguments in a macro being patched.

```
7 \int_new:N \l__hook_patch_num_args_int
```

(End definition for `\l__hook_patch_num_args_int`.)

`\l__hook_patch_prefixes_tl` The prefixes and parameters of the definition for the macro being patched.

```
\l__hook_param_text_tl 8 \tl_new:N \l__hook_patch_prefixes_tl
```

```
\l__hook_replace_text_tl 9 \tl_new:N \l__hook_param_text_tl
```

```
10 \tl_new:N \l__hook_replace_text_tl
```

(End definition for `\l__hook_patch_prefixes_tl`, `\l__hook_param_text_tl`, and `\l__hook_replace_text_tl`.)

`\c__hook_hash_tl` Two constant token lists that contain one and two parameter tokens.

```
\c__hook_hashes_tl 11 \tl_const:Nn \c__hook_hash_tl { # }
```

```
12 \tl_const:Nn \c__hook_hashes_tl { # # }
```

⁷It’s not always possible to reliably detect this case because a command defined with no optional argument is indistinguishable from a `\defed` command.

(End definition for `\c__hook_hash_tl` and `\c__hook_hashes_tl`.)

`__hook_exp_not:NN` Two temporary macros that change depending on the macro being patched.

`__hook_def_cmd:w` 13 `\cs_new_eq:NN __hook_exp_not:NN ?`
 14 `\cs_new_eq:NN __hook_def_cmd:w ?`

(End definition for `__hook_exp_not:NN` and `__hook_def_cmd:w`.)

`\q__hook_recursion_tail` Internal quarks for recursion: they can't appear in any macro being patched.

`\q__hook_recursion_stop` 15 `\quark_new:N \q__hook_recursion_tail`
 16 `\quark_new:N \q__hook_recursion_stop`

(End definition for `\q__hook_recursion_tail` and `\q__hook_recursion_stop`.)

`\g__hook_delayed_patches_prop` A list containing the patches delayed to `\begin{document}`, so that patching is not attempted twice.

17 `\prop_new:N \g__hook_delayed_patches_prop`

(End definition for `\g__hook_delayed_patches_prop`.)

`__hook_patch_debug:x` A helper for patching debug info.

18 `\cs_new_protected:Npn __hook_patch_debug:x #1`
 19 `{ __hook_debug:n { \iow_term:x { [lthooks]~#1 } } }`

(End definition for `__hook_patch_debug:x`.)

4.3 Variants

`\tl_rescan:nV` `expl3` function variants used throughout the code.

20 `\cs_generate_variant:Nn \tl_rescan:nn { nV }`

(End definition for `\tl_rescan:nV`.)

4.4 Patching or delaying

Before `\begin{document}` all patching is delayed.

`__hook_try_put_cmd_hook:n` This function is called from within `\AddToHook`, when code is first added to a generic `cmd`
`__hook_try_put_cmd_hook:w` hook. If it is called within in the preamble, it delays the action until `\begin{document}`; otherwise it tries to update the hook.

21 `\<latexrelease>\IncludeInRelease{2021/11/15}{__hook_try_put_cmd_hook:n}%`
 22 `\<latexrelease> {Standardise-generic-hook-names}`
 23 `\cs_new_protected:Npn __hook_try_put_cmd_hook:n #1`
 24 `{ __hook_try_put_cmd_hook:w #1 / / / \s__hook_mark {#1} }`
 25 `\cs_new_protected:Npn __hook_try_put_cmd_hook:w`
 26 `#1 / #2 / #3 / #4 \s__hook_mark #5`
 27 `{`
 28 `__hook_debug:n { \iow_term:n { ->~Adding~cmd~hook~to~'#2'~(#{3}): } }`
 29 `\exp_args:Nc __hook_patch_cmd_or_delay:Nnn {#2} {#2} {#3}`
 30 `}`
 31 `\<latexrelease>\EndIncludeInRelease`

```

32 <latexrelease>\IncludeInRelease{2021/06/01}{\__hook_try_put_cmd_hook:n}%
33 <latexrelease>{Standardise-generic-hook-names}
34 <latexrelease>\cs_new_protected:Npn \__hook_try_put_cmd_hook:n #1
35 <latexrelease> { \__hook_try_put_cmd_hook:w #1 / / / \s__hook_mark {#1} }
36 <latexrelease>\cs_new_protected:Npn \__hook_try_put_cmd_hook:w
37 <latexrelease> #1 / #2 / #3 / #4 \s__hook_mark #5
38 <latexrelease> {
39 <latexrelease> \__hook_debug:n { \iow_term:n { ->~Adding~cmd~hook~to~'~#2'~(#{3}): } }
40 <latexrelease> \str_case:nnTF {#3}
41 <latexrelease> { { before } } { { after } } { } }
42 <latexrelease> { \exp_args:Nc \__hook_patch_cmd_or_delay:Nnn {#2} {#2} {#3} }
43 <latexrelease> { \msg_error:nnnn { hooks } { wrong-cmd-hook } {#2} {#3} }
44 <latexrelease> }
45 <latexrelease>\EndIncludeInRelease

```

(End definition for __hook_try_put_cmd_hook:n and __hook_try_put_cmd_hook:w.)

__hook_patch_cmd_or_delay:Nnn
__hook_cmd_begindocument_code:

In the preamble, __hook_patch_cmd_or_delay:Nnn just adds the patch instruction to a property list to be executed later.

```

46 \cs_new_protected:Npn \__hook_patch_cmd_or_delay:Nnn #1 #2 #3
47 {
48 \__hook_debug:n { \iow_term:n { ->~Add~generic~cmd~hook~for~#2~(#{3}). } }
49 \__hook_debug:n
50 { \iow_term:n { !~In~the~preamble:~delaying. } }
51 \prop_gput:Nnn \g__hook_delayed_patches_prop { #2 / #3 }
52 { \__hook_cmd_try_patch:nn {#2} {#3} }
53 }

```

The delayed patches are added to a property list to prevent duplication, and the code stored in the property list for each key is executed. The function __hook_patch_cmd_or_delay:Nnn is also redefined to be __hook_patch_command:Nnn so that no further delaying is attempted.

```

54 \cs_new_protected:Npn \__hook_cmd_begindocument_code:
55 {
56 \cs_gset_eq:NN \__hook_patch_cmd_or_delay:Nnn \__hook_patch_command:Nnn
57 \prop_map_function:NN \g__hook_delayed_patches_prop { \use_i:nn }
58 \prop_gclear:N \g__hook_delayed_patches_prop
59 \cs_undefine:N \__hook_cmd_begindocument_code:
60 }
61 \g@addto@macro \@kernel@after@begin@document
62 { \__hook_cmd_begindocument_code: }

```

(End definition for __hook_patch_cmd_or_delay:Nnn and __hook_cmd_begindocument_code:.)

__hook_cmd_try_patch:nn

At \begin{document} tries patching the command if the hook was not manually created in the meantime. If the document does not exist, no error is raised here as it may hook into a package that wasn't loaded. Hooks added to commands in the document body still raise an error if the command is not defined.

```

63 \cs_new_protected:Npn \__hook_cmd_try_patch:nn #1 #2
64 {
65 \__hook_debug:n
66 { \iow_term:x { ->~\string\begin{document}-try-cmd / #1 / #2. } }
67 \__hook_if_declared:nTF { cmd / #1 / #2 }
68 {

```



```

69     \__hook_debug:n
70     { \iow_term:n { .->~Giving-up:~hook-already-created. } }
71   }
72   {
73     \cs_if_exist:cT {#1}
74     { \exp_args:Nc \__hook_patch_command:Nnn {#1} {#1} {#2} }
75   }
76 }

```

(End definition for __hook_cmd_try_patch:nn.)

4.5 Patching commands

__hook_patch_command:Nnn __hook_patch_command:Nnn will do some sanity checks on the argument to detect if it is possible to add hooks to the command, and raises an error otherwise. If the command can contain hooks, then it uses \robust@command@act to find out what type is the command, and patch it accordingly.

```

77 \cs_new_protected:Npn \__hook_patch_command:Nnn #1 #2 #3
78 {
79   \__hook_patch_debug:x { analyzing~'\token_to_str:N #1' }
80   \__hook_patch_debug:x { \token_to_str:N #1 = \token_to_meaning:N #1 }
81   \__hook_patch_check:NNnn \cs_if_exist:NTF #1 { undef }
82   {
83     \__hook_patch_debug:x { ++~control~sequence~is~defined }
84     \__hook_patch_check:NNnn \token_if_macro:NTF #1 { macro }
85     {
86       \__hook_patch_debug:x { ++~control~sequence~is~a~macro }
87       \__hook_patch_check:NNnn \__hook_if_public_command:NTF #1 { expl3 }
88       {
89         \__hook_patch_debug:x { ++~macro~is~not~private }
90         \robust@command@act
91         \g_hook_patch_action_list_tl #1
92         \__hook_retokenize_patch:Nnn { #1 {#2} {#3} }
93       }
94     }
95   }
96 }

```

And here's the auxiliary used above:

```

97 \cs_new_protected:Npn \__hook_patch_check:NNnn #1 #2 #3 #4
98 {
99   #1 #2 {#4}
100   {
101     \msg_error:nnxx { hooks } { cant-patch }
102     { \token_to_str:N #2 } {#3}
103   }
104 }

```

and a conditional __hook_if_public_command:N to check if a command has __ in its name (no other checking is performed). Primitives with :D in their name could be included here, but they are already discarded in the \token_if_macro:NTF test above.

```

105 \use:x
106 {
107   \prg_new_protected_conditional:Npnn

```

```

108     \exp_not:N \__hook_if_public_command:N ##1 { TF }
109   {
110     \exp_not:N \exp_last_unbraced:Nf
111     \exp_not:N \__hook_if_public_command:w
112     { \exp_not:N \cs_to_str:N ##1 }
113     \tl_to_str:n { _ _ } \s__hook_mark
114   }
115 }
116 \exp_last_unbraced:NNNNo
117 \cs_new_protected:Npn \__hook_if_public_command:w
118   #1 \tl_to_str:n { _ _ } #2 \s__hook_mark
119 {
120   \tl_if_empty:nTF {#2}
121   { \prg_return_true: }
122   { \prg_return_false: }
123 }

```

(End definition for `__hook_patch_command:Nnn` and others.)

4.5.1 Patching by expansion and redefinition

`\g_hook_patch_action_list_tl`

This is the list of known command types and the function that patches the command hooks into them. The conditionals are taken from `\ShowCommand`, `\NewCommandCopy` and `__kernel_cmd_if_xparse:Ntf` defined in `ltxcmd`.

```

124 \tl_gset:Nn \g_hook_patch_action_list_tl
125 {
126   { \@if@DeclareRobustCommand \__hook_patch_DeclareRobustCommand:Nnn }
127   { \@if@newcommand \__hook_patch_newcommand:Nnn }
128   { \__kernel_cmd_if_xparse:Ntf \__hook_cmd_patch_xparse:Nnn }
129 }

```

(End definition for `\g_hook_patch_action_list_tl`.)

`__hook_patch_DeclareRobustCommand:Nnn`

At this point we know that the commands can be patched by expanding then redefining. These are the cases of commands defined with `\newcommand` with an optional argument or with `\DeclareRobustCommand`.

With `__hook_patch_DeclareRobustCommand:Nnn` we check if the command has an optional argument (with a test counter-intuitively called `\@if@newcommand`; also make sure the command doesn't take args by calling `\robust@command@chk@safe`). If so, we pass the patching action to `__hook_patch_newcommand:Nnn`, otherwise we call the patching engine `__hook_patch_expand_redefine:NNnn` with a `\c_false_bool` to indicate that there is no optional argument.

```

130 \cs_new_protected:Npn \__hook_patch_DeclareRobustCommand:Nnn #1
131 {
132   \exp_args:Nc \__hook_patch_DeclareRobustCommand_aux:Nnn
133   { \cs_to_str:N #1 ~ }
134 }
135 \cs_new_protected:Npn \__hook_patch_DeclareRobustCommand_aux:Nnn #1
136 {
137   \robust@command@chk@safe #1
138   { \@if@newcommand #1 }
139   { \use_ii:nn }
140   { \__hook_patch_newcommand:Nnn }

```

```

141         { \_hook_patch_expand_redefine:NNnn \c_false_bool }
142         #1
143     }

```

(End definition for _hook_patch_DeclareRobustCommand:Nnn.)

_hook_patch_newcommand:Nnn If the command was defined with \newcommand and an optional argument, call the patching engine with a \c_true_bool to flag the presence of an optional argument, and with \command to patch the actual code for \command.

```

144 \cs_new_protected:Npn \_hook_patch_newcommand:Nnn #1
145 {
146     \exp_args:NNc \_hook_patch_expand_redefine:NNnn \c_true_bool
147     { \c_backslash_str \cs_to_str:N #1 }
148 }

```

(End definition for _hook_patch_newcommand:Nnn.)

_hook_cmd_patch_xparse:Nnn And for commands defined by the xparse commands use this for patching:

```

149 \cs_new_protected:Npn \_hook_cmd_patch_xparse:Nnn #1
150 {
151     \exp_args:NNc \_hook_patch_expand_redefine:NNnn \c_false_bool
152     { \cs_to_str:N #1 ~ code }
153 }

```

(End definition for _hook_cmd_patch_xparse:Nnn.)

_hook_patch_expand_redefine:NNnn Now the real action begins. Here we have in #1 a boolean indicating if the command
_hook_redefine_with_hooks:Nnn has a leading [...] delimited argument, in #2 the command control sequence, in #3 the
_hook_make_prefixes:w name of the command (note that #1 ≠ \csname#2\endcsname at this point!), and in #4 the hook position, either before or after.

Patching with expansion+redefinition is trickier than it looks like at first glance. Suppose the simple definition:

```
\def\foo#1{#1##2}
```

When defined, its *⟨replacement text⟩* will be a token list containing:

out_param 1, mac_param #, character 2

Then, after expanding \foo{##1} (here ## denotes a single #₆) we end up with a token list with *out_param 1* replaced:

mac_param #, character 1, mac_param #, character 2

that is, the definition would be:

```
\def\foo#1{#1#2}
```

which obviously fails, because the original input in the definition was ## but T_EX reduced that to a single parameter token #₆ when carrying out the definition. That leaves no room for a clever solution with (say) \unexpanded, because anything that would double the second #₆, would also (incorrectly) double the first, so there's not much to do other than a manual solution.

There are three cases we can distinguish to make things hopefully faster on simpler cases:

1. a macro with no parameters;
2. a macro with no parameter tokens in its definition;
3. a macro with parameters *and* parameter tokens.

The first case is trivial: if the macro has no parameters, we can just use `\unexpanded` around it, and if there is a parameter token in it, it is handled correctly (the macro can be treated as a `\tl` variable).

The second case requires looking at the *<replacement text>* of the macro to see if it has a parameter token in there. If it does not, then there is no worry, and the macro can be redefined normally (without `\unexpanded`).

The third case, as usual, is the devious one. Here we'll have to loop through the definition token by token, and double every parameter token, so that this case can be handled like the previous one.

```

154 <latexrelease>\IncludeInRelease{2023/06/01}{\__hook_patch_expand_redefine:NNnn}
155 <latexrelease>{cmd-hooks-with-args}
156 \cs_new_protected:Npn \__hook_patch_expand_redefine:NNnn #1 #2 #3 #4
157 {
158   \__hook_patch_debug:x { ++~command~can~be~patched~without~rescanning }

```

We'll start by counting the number of arguments in the command by counting the number of characters in the `\cs_argument_spec:N` of the macro, divided by two, and subtracting one if the command has an optional argument (that is, an extra `[]` in its *<parameter text>*).

```

159   \int_set:Nn \l__hook_patch_num_args_int
160   {
161     \exp_args:Nf \str_count:n { \cs_argument_spec:N #2 } / 2
162     \bool_if:NT #1 { -1 }
163   }

```

Now build two token lists:

`\l__hook_param_text_tl` will contain the *<parameter text>* to be used when redefining the macro. It should be identical to the *<parameter text>* used when originally defining that macro.

`\l__hook_replace_text_tl` will contain braced pairs of `\c__hook_hashes_tl<num>` to feed to the macro when expanded. This token list as well as the previous will have the first item surrounded by `[...]` in the case of an optional argument.

The use of `\c__hook_hashes_tl` here is to differentiate actual parameters in the macro from parameter tokens in the original definition of the macro. Later on, `\c__hook_hashes_tl` is either replaced by actual parameter tokens, or expanded into them.

```

164   \int_compare:nNnTF { \l__hook_patch_num_args_int } > { \c_zero_int }
165   {

```

We'll first check if the command has any parameter token in its definition (feeding it empty arguments), and set `__hook_exp_not:n` accordingly. `__hook_exp_not:n` will be used later to either leave `\c__hook_hashes_tl` or expand it, and also to remember the result of `__hook_if_has_hash:nTF` to avoid testing twice (the test can be rather slow).

```

166     \tl_set:Nx \l__hook_tmpa_tl { \bool_if:NTF #1 { [ ] } { { } } }
167     \int_step_inline:nnn { 2 } { \l__hook_patch_num_args_int }
168     { \tl_put_right:Nn \l__hook_tmpa_tl { { } } }

```

```

169 \exp_args:NNo \exp_args:No \__hook_if_has_hash:nTF
170 { \exp_after:wN #2 \l__hook_tmpa_tl }
171 { \cs_set_eq:NN \__hook_exp_not:n \exp_not:n }
172 { \cs_set_eq:NN \__hook_exp_not:n \use:n }
173 \cs_set_protected:Npn \__hook_tmp:w ##1 ##2
174 {
175     ##1 \l__hook_param_text_tl { \use:n ##2 }
176     ##1 \l__hook_replace_text_tl { \__hook_exp_not:n {##2} }
177 }

```

Here we'll conditionally add [...] around the first parameter:

```

178 \bool_if:NTF #1
179 { \__hook_tmp:w \tl_set:Nx { [ \c__hook_hashes_tl 1 ] } }
180 { \__hook_tmp:w \tl_set:Nx { { \c__hook_hashes_tl 1 } } }

```

Then, for every parameter from the second, just add it normally:

```

181 \int_step_inline:nnn { 2 } { \l__hook_patch_num_args_int }
182 { \__hook_tmp:w \tl_put_right:Nx { { \c__hook_hashes_tl ##1 } } }

```

Now, if the command has any parameter token in its definition (then `__hook_exp_not:n` is `\exp_not:n`), call `__hook_double_hashes:n` to double them, and replace every `\c__hook_hashes_tl` by #:

```

183 \tl_set:Nx \l__hook_replace_text_tl
184 { \exp_not:N #2 \exp_not:V \l__hook_replace_text_tl }
185 \tl_set:Nx \l__hook_replace_text_tl
186 {
187     \token_if_eq_meaning:NNTF \__hook_exp_not:n \exp_not:n
188     { \exp_args:NNV \exp_args:No \__hook_double_hashes:n }
189     { \exp_args:NV \exp_not:o }
190     \l__hook_replace_text_tl
191 }

```

And now, set a few auxiliaries for the case that the macro has parameters, so it won't be passed through `\unexpanded` (twice):

```

192 \cs_set_eq:NN \__hook_def_cmd:w \tex_gdef:D
193 \cs_set_eq:NN \__hook_exp_not:NN \prg_do_nothing:
194 }
195 {

```

In the case the macro has no parameters, we'll treat it as a token list and things are much simpler (expansion control looks a bit complicated, but it's just a pair of `\exp_not:N` preventing another `\exp_not:n` from expanding):

```

196 \tl_clear:N \l__hook_param_text_tl
197 \tl_set_eq:NN \l__hook_replace_text_tl #2
198 \cs_set_eq:NN \__hook_def_cmd:w \tex_xdef:D
199 \cs_set:Npn \__hook_exp_not:NN ##1 { \exp_not:N ##1 \exp_not:N }
200 }

```

Before redefining, we need to also get the prefixes used when defining the command. Here we ensure that the `\escapechar` is printable, otherwise a macro defined with prefixes `\protected` `\long` will have it `\meaning` printed as `protectedlong`, making life unnecessarily complicated. Here the `\escapechar` is changed to /, then we loop between pairs of /.../ extracting the prefixes.

```

201 \group_begin:
202 \int_set:Nn \tex_escapechar:D { '/' }
203 \use:x

```

```

204     {
205     \group_end:
206     \tl_set:Nx \exp_not:N \l__hook_patch_prefixes_tl
207     { \exp_not:N \__hook_make_prefixes:w \cs_prefix_spec:N #2 / / }
208     }

```

Here we redefine the hook to have the right number of arguments. Disabling the hook, undefining the `parameter` token list then calling `__hook_make_usable:nn` are enough to redefine the hook to the extent we want. Code stored in the hook and other metadata about it are not lost in the process.

```

209     \__hook_disable:n { cmd / #3 / #4 }
210     \cs_undefine:c { c__hook_cmd / #3 / #4_parameter_tl }
211     \__hook_make_usable:nn { cmd / #3 / #4 } { \l__hook_patch_num_args_int }

```

Now call `__hook_redefine_with_hooks:Nnnn` with the macro being redefined in #1, then `\UseHook{cmd/<name>/before}` in #2 or `\UseHook{cmd/<name>/after}` in #3 (one is always empty), and in #4 the *<replacement text>* of the macro.

```

212     \use:e
213     {
214         \__hook_redefine_with_hooks:Nnnn \exp_not:N #2
215         \str_if_eq:nnTF {#4} { after }
216         { \use_ii_i:nn }
217         { \use:nn }
218         { {
219             \__hook_exp_not:NN \exp_not:N \UseHookWithArguments
220             { cmd / #3 / #4 } { \int_use:N \l__hook_patch_num_args_int }
221             \__hook_braced_parameter:n { cmd / #3 / #4 }
222         } }
223         { { } }
224         { \__hook_exp_not:NN \exp_not:N \l__hook_replace_text_tl }
225     }

```

Finally, update the hook code.

```

226     \__hook_update_hook_code:n { cmd / #3 / #4 }
227 }
228 \<latexrelease>\EndIncludeInRelease
229 \<latexrelease>\IncludeInRelease{2021/06/01}{\__hook_patch_expand_redefine:NNnn}
230 \<latexrelease>{cmd~hooks~with~args}
231 \<latexrelease>\cs_gset_protected:Npn \__hook_patch_expand_redefine:NNnn #1 #2 #3 #4
232 \<latexrelease>{
233 \<latexrelease>    \__hook_patch_debug:x { +~command~can~be~patched~without~rescanning }
234 \<latexrelease>    \int_set:Nn \l__hook_patch_num_args_int
235 \<latexrelease>    {
236 \<latexrelease>        \exp_args:Nf \str_count:n { \cs_argument_spec:N #2 } / 2
237 \<latexrelease>        \bool_if:NT #1 { -1 }
238 \<latexrelease>    }
239 \<latexrelease>    \int_compare:nNnTF { \l__hook_patch_num_args_int } > { \c_zero_int }
240 \<latexrelease>    {
241 \<latexrelease>        \tl_set:Nx \l__hook_tmpa_tl { \bool_if:NTF #1 { [ ] } { { } } }
242 \<latexrelease>        \int_step_inline:nnn { 2 } { \l__hook_patch_num_args_int }
243 \<latexrelease>        { \tl_put_right:Nn \l__hook_tmpa_tl { { } } }
244 \<latexrelease>        \exp_args:NNo \exp_args:No \__hook_if_has_hash:nTF
245 \<latexrelease>        { \exp_after:wN #2 \l__hook_tmpa_tl }
246 \<latexrelease>        { \cs_set_eq:NN \__hook_exp_not:n \exp_not:n }
247 \<latexrelease>        { \cs_set_eq:NN \__hook_exp_not:n \use:n }

```

```

248 <latexrelease> \cs_set_protected:Npn \__hook_tmp:w ##1 ##2
249 <latexrelease> {
250 <latexrelease>     ##1 \l__hook_param_text_tl { \use:n ##2 }
251 <latexrelease>     ##1 \l__hook_replace_text_tl { \__hook_exp_not:n {##2} }
252 <latexrelease> }
253 <latexrelease> \bool_if:NTF #1
254 <latexrelease> { \__hook_tmp:w \tl_set:Nx { [ \c__hook_hash_tl 1 ] } }
255 <latexrelease> { \__hook_tmp:w \tl_set:Nx { { \c__hook_hash_tl 1 } } }
256 <latexrelease> \int_step_inline:nnn { 2 } { \l__hook_patch_num_args_int }
257 <latexrelease> { \__hook_tmp:w \tl_put_right:Nx { { \c__hook_hash_tl ##1 } } }
258 <latexrelease> \tl_set:Nx \l__hook_replace_text_tl
259 <latexrelease> { \exp_not:N #2 \exp_not:V \l__hook_replace_text_tl }
260 <latexrelease> \tl_set:Nx \l__hook_replace_text_tl
261 <latexrelease> {
262 <latexrelease>     \token_if_eq_meaning:NNTF \__hook_exp_not:n \exp_not:n
263 <latexrelease>     { \exp_args:NNV \exp_args:No \__hook_double_hashes:n }
264 <latexrelease>     { \exp_args:NV \exp_not:o }
265 <latexrelease>     \l__hook_replace_text_tl
266 <latexrelease> }
267 <latexrelease> \cs_set_eq:NN \__hook_def_cmd:w \tex_gdef:D
268 <latexrelease> \cs_set_eq:NN \__hook_exp_not:NN \prg_do_nothing:
269 <latexrelease> }
270 <latexrelease> {
271 <latexrelease>     \tl_clear:N \l__hook_param_text_tl
272 <latexrelease>     \tl_set_eq:NN \l__hook_replace_text_tl #2
273 <latexrelease>     \cs_set_eq:NN \__hook_def_cmd:w \tex_xdef:D
274 <latexrelease>     \cs_set:Npn \__hook_exp_not:NN ##1 { \exp_not:N ##1 \exp_not:N }
275 <latexrelease> }
276 <latexrelease> \group_begin:
277 <latexrelease>     \int_set:Nn \tex_escapechar:D { ‘\’ }
278 <latexrelease>     \use:x
279 <latexrelease>     {
280 <latexrelease>         \group_end:
281 <latexrelease>         \tl_set:Nx \exp_not:N \l__hook_patch_prefixes_tl
282 <latexrelease>         { \exp_not:N \__hook_make_prefixes:w \cs_prefix_spec:N #2 / / }
283 <latexrelease>         }
284 <latexrelease>     \use:x
285 <latexrelease>     {
286 <latexrelease>         \__hook_redefine_with_hooks:Nnnn \exp_not:N #2
287 <latexrelease>         \str_if_eq:nnTF {#4} { after }
288 <latexrelease>         { \use_ii_i:nn }
289 <latexrelease>         { \use:nn }
290 <latexrelease>         { { \__hook_exp_not:NN \exp_not:N \UseHook { cmd / #3 / #4 } } }
291 <latexrelease>         { { } }
292 <latexrelease>         { \__hook_exp_not:NN \exp_not:V \l__hook_replace_text_tl }
293 <latexrelease>     }
294 <latexrelease> }
295 <latexrelease> \EndIncludeInRelease

```

Now that all the needed tools are ready, without further ado we'll redefine the command. The definition uses the prefixes gathered in `\l__hook_patch_prefixes_tl`, a primitive `__hook_def_cmd:w` (which is `\tex_gdef:D` or `\tex_xdef:D`) to avoid adding extra prefixes, and the *parameter text* from `\l__hook_param_text_tl`.

Then finally, in the body of the definition, we insert `#2`, which is `cmd/#1/before` or

empty, #4 which is the *<replacement text>*, and #3 which is cmd/#1/after or empty.

```

296 \cs_new_protected:Npn \__hook_redefine_with_hooks:Nnnn #1 #2 #3 #4
297 {
298   \l__hook_patch_prefixes_tl
299   \exp_after:wN \__hook_def_cmd:w
300   \exp_after:wN #1 \l__hook_param_text_tl
301   { #2 #4 #3 }
302 }

```

Here's the auxiliary that makes the prefix control sequences for the redefinition. Each item has to be `\tl_trim_spaces:n`'d because the last item (and not any other) has a trailing space.

```

303 \cs_new:Npn \__hook_make_prefixes:w / #1 /
304 {
305   \tl_if_empty:nF {#1}
306   {
307     \exp_not:c { tex_ \tl_trim_spaces:n {#1} :D }
308     \__hook_make_prefixes:w /
309   }
310 }

```

(End definition for `__hook_patch_expand_redefine:Nnnn`, `__hook_redefine_with_hooks:Nnnn`, and `__hook_make_prefixes:w`.)

Here are some auxiliaries for the contraption above.

`__hook_if_has_hash_p:n` `__hook_if_has_hash:nTF` searches the token list #1 for a catcode 6 token, and if any is found, it returns `true`, and `false` otherwise. The searching doesn't care about preserving groups or spaces: we can ignore those safely (braces are removed) so that searching is as fast as possible.

```

311 \prg_new_conditional:Npnn \__hook_if_has_hash:n #1 { TF }
312 { \__hook_if_has_hash:w #1 ## \s_hook_mark }
313 \cs_new:Npn \__hook_if_has_hash:w #1
314 {
315   \tl_if_single_token:nTF {#1}
316   {
317     \token_if_eq_catcode:NNTF ## #1
318     { \__hook_if_has_hash_check:w }
319     { \__hook_if_has_hash:w }
320   }
321   { \__hook_if_has_hash:w #1 }
322 }
323 \cs_new:Npn \__hook_if_has_hash_check:w #1 \s_hook_mark
324 { \tl_if_empty:nTF {#1} { \prg_return_false: } { \prg_return_true: } }

```

(End definition for `__hook_if_has_hash:nTF`, `__hook_if_has_hash:w`, and `__hook_if_has_hash_check:w`.)

`__hook_double_hashes:n` `__hook_double_hashes:w` loops through the token list #1 and duplicates any catcode 6 token, and expands tokens `\ifx-equal` to `\c_hook_hashes_tl`, and leaves all other tokens `\notexpanded` with `\exp_not:N`. Unfortunately pairs of explicit catcode 1 and catcode 2 character tokens are normalised to `{_1` and `}_1` because it's not feasible to expandably detect the character code (*maybe* it could be done using something along the lines of <https://tex.stackexchange.com/a/527538>, but it's far too much work for close to zero benefit).

`__hook_double_hashes:w` is the tail-recursive loop macro, that tests which of the three types of item is in the head of the token list.

```

325 \cs_new:Npn \__hook_double_hashes:n #1
326 { \__hook_double_hashes:w #1 \q__hook_recursion_tail \q__hook_recursion_stop }
327 \cs_new:Npn \__hook_double_hashes:w #1 \q__hook_recursion_stop
328 {
329   \tl_if_head_is_N_type:nTF {#1}
330   { \__hook_double_hashes_output:N }
331   {
332     \tl_if_head_is_group:nTF {#1}
333     { \__hook_double_hashes_group:n }
334     { \__hook_double_hashes_space:w }
335   }
336   #1 \q__hook_recursion_stop
337 }

```

`__hook_double_hashes_output:N` checks for the end of the token list, then checks if the token is `\c__hook_hashes_tl`, and if so just leaves it.

```

338 \cs_new:Npn \__hook_double_hashes_output:N #1
339 {
340   \if_meaning:w \q__hook_recursion_tail #1
341   \__hook_double_hashes_stop:w
342   \fi:
343   \if:w ?
344     \if_meaning:w \c__hook_hashes_tl #1 ! \fi:
345     \if_meaning:w \c__hook_hashes_tl #1 ! \fi:
346     ?
347   \else:

```

(this `\use_i:nnnn` uses `\fi:` and consumes `\use:n`, the whole `\if_catcode:w` block, and the `\exp_not:N`, leaving just `#1` which is `\c__hook_hashes_tl`.)

```

348   \use_i:nnnn
349   \fi:
350   \use:n
351   {

```

If `#1` is not `\c__hook_hashes_tl`, then check if its catcode is 6, and if so, leave it doubled in `\exp_not:n` and consume the following `\exp_not:N #1`.

```

352     \if_catcode:w ## \exp_not:N #1
353     \exp_after:wN \use_ii:nnnn
354     \fi:
355     \use_none:n
356     { \exp_not:n { #1 #1 } }
357   }

```

If both previous tests returned false, then leave the token unexpanded and resume the loop.

```

358   \exp_not:N #1
359   \__hook_double_hashes:w
360 }
361 \cs_new:Npn \__hook_double_hashes_stop:w #1 \q__hook_recursion_stop { \fi: }

```

Dealing with spaces and grouped tokens is trivial:

```

362 \cs_new:Npn \__hook_double_hashes_group:n #1
363 { { \__hook_double_hashes:n {#1} } \__hook_double_hashes:w }

```

```

364 \exp_last_unbraced:NNo
365 \cs_new:Npn \__hook_double_hashes_space:w \c_space_tl
366   { ~ \__hook_double_hashes:w }

```

(End definition for `__hook_double_hashes:n` and others.)

4.5.2 Patching by retokenization

At this point we've drained the possibilities of patching a command by expansion-and-redefinition, so we have to resort to patching by retokenizing the command. Patching by retokenization is done by getting the `\meaning` of the command, doing the necessary manipulations on the generated string, and the retokenizing that again by using `\scantokens`.

Patching by retokenization is definitely a riskier business, because it relies that the tokens printed by `\meaning` produce the exact same tokens as the ones in the original definition. That is, the catcode régime must be exactly(ish) the same, and there is no way of telling except by trial and error.

`__hook_retokenize_patch:Nnn` This is the macro that will control the whole process. First we'll try out one final, rather trivial case, of a command with no arguments; that is, a token list. This case can be patched with the expand-and-redefine routine but it has to be the very last case tested for, because most (all?) robust commands start with a top-level macro with no arguments, so testing this first would short-circuit `\robust@command@act` and the top-level macros would be incorrectly patched. In that case, we just check if the `\cs_argument_spec:N` is empty, and call `__hook_patch_expand_redefine:NNnn`.

```

367 \cs_new_protected:Npn \__hook_retokenize_patch:Nnn #1 #2 #3
368   {
369     \str_if_eq:eeTF { \cs_argument_spec:N #1 } { } {
370       { \__hook_patch_expand_redefine:NNnn \c_false_bool #1 {#2} {#3} }
371       {
372         \__hook_patch_debug:x { ..~command~can~only~be~patched~by~rescanning }

```

Otherwise, we start the actual patching by retokenization job. The code calls `__hook_try_patch_with_catcodes:Nnnnw` with a different catcode setting:

- The current catcode setting;
- Switching the catcode of `@`;
- Switching the `expl3` syntax on or off;
- Both of the above.

If patching succeeds, `__hook_try_patch_with_catcodes:Nnnnw` has the side-effect of patching the macro `#1` (which may be an internal from the command whose name is `#2`).

```

373     \tl_set:Nx \l__hook_tmpa_tl
374     {
375       \int_compare:nNnTF { \char_value_catcode:n {'\@ } } = { 12 }
376       { \exp_not:N \makeatletter } { \exp_not:N \makeatother }
377     }
378     \tl_set:Nx \l__hook_tmpb_tl
379     {
380       \bool_if:NTF \l__kernel_expl_bool
381       { \ExplSyntaxOff } { \ExplSyntaxOn }

```

```

382     }
383     \use:x
384     {
385         \exp_not:N \__hook_try_patch_with_catcodes:Nnnnw
386         \exp_not:n { #1 {#2} {#3} }
387         { \prg_do_nothing: }
388         { \exp_not:V \l__hook_tmpa_tl } % @
389         { \exp_not:V \l__hook_tmpb_tl } % _:
390         {
391             \exp_not:V \l__hook_tmpa_tl % @
392             \exp_not:V \l__hook_tmpb_tl % _:
393         }
394     }
395     \q_recursion_tail \q_recursion_stop

```

If no catcode setting succeeds, give up and raise an error. The command isn't changed in any way in that case.

```

396     {
397         \msg_error:nnxx { hooks } { cant-patch }
398         { \c_backslash_str #2 } { retok }
399     }
400 }
401 }

```

(End definition for __hook_retokenize_patch:Nnn.)

__hook_try_patch_with_catcodes:Nnnnw

This function is a simple wrapper around __hook_cmd_if_scanable:NnTF and __hook_patch_retokenize:Nnnn if the former returns *true*, plus some debug messages.

```

402 <latexrelease>\IncludeInRelease{2023/06/01}{\__hook_try_patch_with_catcodes:Nnnnw}
403 <latexrelease> {cmd-hooks-with-args}
404 \cs_new_protected:Npn \__hook_try_patch_with_catcodes:Nnnnw #1 #2 #3 #4
405 {
406     \quark_if_recursion_tail_stop_do:nn {#4} { \use:n }
407     \__hook_patch_debug:x { +-trying-to-patch-by-retokenization }
408     \__hook_cmd_if_scanable:NnTF {#1} {#4}
409     {
410         \__hook_patch_debug:x { +-macro-can-be-retokenized-cleanly }
411         \__hook_patch_debug:x { ==retokenizing-macro-now }
412         \__hook_patch_retokenize:Nnnn #1 { cmd / #2 / #3 } {#3} {#4}
413         \use_i_delimit_by_q_recursion_stop:nw \use_none:n
414     }
415     {
416         \__hook_patch_debug:x { ---macro-cannot-be-retokenized-cleanly }
417         \__hook_try_patch_with_catcodes:Nnnnw #1 {#2} {#3}
418     }
419 }
420 <latexrelease>\EndIncludeInRelease
421 <latexrelease>\IncludeInRelease{2021/06/01}{\__hook_try_patch_with_catcodes:Nnnnw}
422 <latexrelease> {cmd-hooks-with-args}
423 <latexrelease>\cs_gset_protected:Npn \__hook_try_patch_with_catcodes:Nnnnw #1 #2 #3 #4
424 <latexrelease> {
425 <latexrelease>     \quark_if_recursion_tail_stop_do:nn {#4} { \use:n }
426 <latexrelease>     \__hook_patch_debug:x { +-trying-to-patch-by-retokenization }
427 <latexrelease>     \__hook_cmd_if_scanable:NnTF {#1} {#4}
428 <latexrelease>     {

```

```

429 <latexrelease>      \__hook_patch_debug:x { ++~macro~can~be~retokenized~cleanly }
430 <latexrelease>      \__hook_patch_debug:x { ==~retokenizing~macro~now }
431 <latexrelease>      \__hook_patch_retokenize:Nnnn #1 {#2} {#3} {#4}
432 <latexrelease>      \use_i_delimit_by_q_recursion_stop:nw \use_none:n
433 <latexrelease>      }
434 <latexrelease>      {
435 <latexrelease>      \__hook_patch_debug:x { --~macro~cannot~be~retokenized~cleanly }
436 <latexrelease>      \__hook_try_patch_with_catcodes:Nnnnw #1 {#2} {#3}
437 <latexrelease>      }
438 <latexrelease>      }
439 <latexrelease> \EndIncludeInRelease

```

(End definition for __hook_try_patch_with_catcodes:Nnnnw.)

\kerneltmpDoNotUse This is an oddity required to be safe (as safe as reasonably possible) when patching the command. The entirety of

<prefixes> \def <cs> <parameter text> {<replacement text>}

will go through \scantokens. The *<parameter text>* and *<replacement text>* are what we are trying to retokenize, so not much worry there. The other items, however, should “just work”, so some care is needed to not use too fancy catcode settings. Therefore we can’t use an expl3-named macro for *<cs>*, nor the expl3 versions of \def or the *<prefixes>*. That is why the definitions that will eventually go into \scantokens will use the oddly (but hopefully clearly)-named \kerneltmpDoNotUse:

```

440 \cs_new_eq:NN \kerneltmpDoNotUse !

```

PhO: Maybe this can be avoided by running the <parameter text> and the <replacement text> separately through \scantokens and then putting everything together at the end.

(End definition for \kerneltmpDoNotUse.)

__hook_patch_required_catcodes: Here are the catcode settings that are *mandatory* when retokenizing commands. These are the minimum necessary settings to perform the definitions: they identify control sequences, which must be escaped with _0, delimit the definition with {₁ and }₂, and mark parameters with #₆. Everything else may be changed, but not these.

```

441 \cs_new_protected:Npn \__hook_patch_required_catcodes:
442 {
443   \char_set_catcode_escape:N \_
444   \char_set_catcode_group_begin:N \{
445   \char_set_catcode_group_end:N \}
446   \char_set_catcode_parameter:N \#
447   % \int_set:Nn \tex_endlinechar:D { -1 }
448   % \int_set:Nn \tex_newlinechar:D { -1 }
449 }

```

PhO: etoolbox sets the \endlinechar and \newlinechar when patching, but as far as I tested these didn’t make much of a difference, so I left them out for now. Maybe \newlinechar=-1 avoids a space token being added after the definition.

PhO: If the patching is split by <parameter text> and <replacement text>, then only # will have to stay in that list.

PhO: Actually now that we patch \UseHook{cmd/foo/before}, all the tokens there need to have the right catcodes, so this list now includes all lowercase letters, U and H, the slash, and whatever characters in the command name... sigh...

(End definition for _hook_patch_required_catcodes:.)

_hook_cmd_if_scanable:NnTF Here we'll do a quick test if the command being patched can in fact be retokenized with the specific catcode setting without changing in meaning. The test is straightforward:

1. apply \meaning to the command;
2. split the $\langle prefixes \rangle$, $\langle parameter\ text \rangle$ and $\langle replacement\ text \rangle$ and arrange them as

$$\langle prefixes \rangle \backslash def \backslash kernel tmp Do Not Use \langle parameter\ text \rangle \{ \langle replacement\ text \rangle \}$$
3. rescan that with the given catcode settings, and do the definition; then finally
4. compare \kernel tmp Do Not Use with the original command.

If both are \ifx-equal, the command can be safely patched.

```

450 \prg_new_protected_conditional:Npnn \_hook_cmd_if_scanable:Nn #1 #2 { TF }
451 {
452   \cs_set_eq:NN \kernel tmp Do Not Use \scan_stop:
453   \cs_set_eq:NN \_hook_tmp:w \scan_stop:
454   \use:x
455   {
456     \cs_set:Npn \_hook_tmp:w
457       #####1 \tl_to_str:n { macro: } #####2 -> #####3 \s__hook_mark
458       { #####1 \def \kernel tmp Do Not Use #####2 { #####3 } }
459     \tl_set:Nx \exp_not:N \l__hook_tmpa_tl
460     { \exp_not:N \_hook_tmp:w \token_to_meaning:N #1 \s__hook_mark }
461   }
462   \tl_rescan:nV { #2 \_hook_patch_required_catcodes: } \l__hook_tmpa_tl
463   \token_if_eq_meaning:NNTF #1 \kernel tmp Do Not Use
464   { \prg_return_true: }
465   { \prg_return_false: }
466 }

```

(End definition for _hook_cmd_if_scanable:NnTF.)

_hook_guess_arg_count:NN Looks at the parameter text of a macro, and counts the parameters by looking at the number after a #, and checking if they are sequential. This macro assumes that all parameters are marked with hashes, and not other characters, and that there is no “trick parameter”.

```

467 <latexrelease>\IncludeInRelease{2023/06/01}{\_hook_guess_arg_count:NN}
468 <latexrelease> {cmd~hooks~with~args}
469 \cs_new_protected:Npn \_hook_guess_arg_count:NN #1
470 {
471   \exp_after:wN \_hook_guess_arg_count:wN
472   \token_to_meaning:N #1 \s__hook_mark
473 }
474 \exp_last_unbraced:NNNo
475 \cs_new_protected:Npx \_hook_guess_arg_count:wN
476 #1 { \tl_to_str:n { macro: } } #2 \s__hook_mark #3
477 {
478   \int_set:Nn #3
479   {
480     \exp_not:N \_hook_guess_arg_count:nw { 0 } #2
481     \c_hash_str 0 \s__hook_mark

```

```

482     }
483   }
484   \use:e
485   { \cs_new:Npn \exp_not:N \__hook_guess_arg_count:nw #1 #2 \c_hash_str #3 }
486   {
487     \int_compare:nNnTF { #1 + 1 } = {#3}
488     { \__hook_guess_arg_count:nw {#3} }
489     { #1 \__hook_use_none_delimit_by_s_mark:w }
490   }
491   \<latexrelease>\EndIncludeInRelease
492   \<latexrelease>\IncludeInRelease{2021/06/01}{\__hook_guess_arg_count:NN}
493   \<latexrelease>{cmd~hooks~with~args}
494   \<latexrelease>\cs_undefine:N \__hook_guess_arg_count:NN
495   \<latexrelease>\EndIncludeInRelease

```

(End definition for __hook_guess_arg_count:NN, __hook_guess_arg_count:wN, and __hook_guess_arg_count:nw.)

__hook_patch_retokenize:Nnnn Then, if __hook_cmd_if_scanable:NnTF returned true, we can go on and patch the command.

```

496   \<latexrelease>\IncludeInRelease{2023/06/01}{\__hook_patch_retokenize:Nnnn}
497   \<latexrelease>{cmd~hooks~with~args}
498   \cs_new_protected:Npn \__hook_patch_retokenize:Nnnn #1 #2 #3 #4
499   {
500     % Here, when patching by retokenization, we can only guess the number
501     % of arguments of the macro.
502     % \changes{v1.0h}{2023/05/21}
503     % {Changes to allow support arguments in cmd hooks (cmd-args).}
504     % \begin{macrocode}
505     \__hook_guess_arg_count:NN #1 \l__hook_patch_num_args_int

```

Then we redefine the hook to have the right number of arguments. Disabling the hook, undefining the parameter token list then calling __hook_make_usable:nn are enough to redefine the hook to the extent we want. Code stored in the hook and other metadata about it are not lost in the process.

```

506     \__hook_disable:n {#2}
507     \cs_undefine:c { c__hook_#2_parameter_tl }
508     \__hook_make_usable:nn {#2} { \l__hook_patch_num_args_int }
509     \tl_set:Ne \l__hook_tmpa_tl
510     { \exp_args:Ne \tl_to_str:n { \__hook_braced_parameter:n {#2} } }
511     \use:x
512     {
513       \str_replace_all:Nnn \exp_not:N \l__hook_tmpa_tl
514       { #### } { \c_hash_str }
515     }

```

Then, make make some things \relax to avoid lots of \noexpand below.

```

516     \cs_set_eq:NN \kerneltmpDoNotUse \scan_stop:
517     \cs_set_eq:NN \__hook_tmp:w \scan_stop:
518     \use:x
519     {

```

Now we'll define __hook_tmp:w such that it splits the \meaning of the macro (#1) into its three parts:

####1. *<prefixes>*

####2. \langle parameter text \rangle

####3. \langle replacement text \rangle

and arrange that a complete definition, then place the `before` or `after` hooks around the \langle replacement text \rangle : accordingly.

```

520 \cs_set:Npn \__hook_tmp:w
521   ####1 \tl_to_str:n { macro: } ####2 -> ####3 \s__hook_mark
522   {
523     ####1 \def \kerneltmpDoNotUse ####2
524     {
525       \str_if_eq:nnT {#3} { before }
526       {
527         \token_to_str:N \UseHookWithArguments {#2}
528         { \int_use:N \l__hook_patch_num_args_int }
529         \l__hook_tmpa_tl
530       }
531       ####3
532       \str_if_eq:nnT {#3} { after }
533       {
534         \token_to_str:N \UseHookWithArguments {#2}
535         { \int_use:N \l__hook_patch_num_args_int }
536         \l__hook_tmpa_tl
537       }
538     }
539   }

```

Now we just have to get the `\meaning` of the command being patched and pass it through the meat grinder above.

```

540 \tl_set:Nx \exp_not:N \l__hook_tmpa_tl
541   { \exp_not:N \__hook_tmp:w \token_to_meaning:N #1 \s__hook_mark }
542 }

```

Now rescan with the given catcode settings (overridden by the `__hook_patch_required_catcodes:`), and implicitly (by using the rescanned token list) carry out the definition from above.

```

543 \tl_rescan:nV { #4 \__hook_patch_required_catcodes: } \l__hook_tmpa_tl

```

And to close, copy the newly-defined command into the old name and the patching is finally completed:

```

544 \cs_gset_eq:NN #1 \kerneltmpDoNotUse

```

Finally, update the hook code.

```

545 \__hook_update_hook_code:n {#2}
546 }
547 <latexrelease>\EndIncludeInRelease
548 <latexrelease>\IncludeInRelease{2021/06/01}{\__hook_patch_retokenize:Nnnn}
549 <latexrelease>{cmd~hooks~with~args}
550 <latexrelease>\cs_gset_protected:Npn \__hook_patch_retokenize:Nnnn #1 #2 #3 #4
551 <latexrelease> {
552 <latexrelease>   \cs_set_eq:NN \kerneltmpDoNotUse \scan_stop:
553 <latexrelease>   \cs_set_eq:NN \__hook_tmp:w \scan_stop:
554 <latexrelease>   \use:x
555 <latexrelease>   {
556 <latexrelease>     \cs_set:Npn \__hook_tmp:w

```

```

557 <latexrelease>      #####1 \tl_to_str:n { macro: } #####2 -> #####3 \s__hook_mark
558 <latexrelease>      {
559 <latexrelease>      #####1 \def \kerneltmpDoNotUse #####2
560 <latexrelease>      {
561 <latexrelease>      \str_if_eq:nnT {#3} { before }
562 <latexrelease>      { \token_to_str:N \UseHook { cmd / #2 / #3 } }
563 <latexrelease>      #####3
564 <latexrelease>      \str_if_eq:nnT {#3} { after }
565 <latexrelease>      { \token_to_str:N \UseHook { cmd / #2 / #3 } }
566 <latexrelease>      }
567 <latexrelease>      }
568 <latexrelease>      \tl_set:Nx \exp_not:N \l__hook_tmpa_tl
569 <latexrelease>      { \exp_not:N \__hook_tmp:w \token_to_meaning:N #1 \s__hook_mark }
570 <latexrelease>      }
571 <latexrelease>      \tl_rescan:nV { #4 \__hook_patch_required_catcodes: } \l__hook_tmpa_tl
572 <latexrelease>      \cs_gset_eq:NN #1 \kerneltmpDoNotUse
573 <latexrelease>      }
574 <latexrelease> \EndIncludeInRelease

```

(End definition for __hook_patch_retokenize:Nnnn.)

4.6 Messages

```

575 <latexrelease> \IncludeInRelease{2021/11/15}{wrong-cmd-hook}%
576 <latexrelease>      {Standardise-generic-hook-names}
577 <latexrelease> \EndIncludeInRelease
578 <latexrelease> \IncludeInRelease{2021/11/15}{wrong-cmd-hook}%
579 <latexrelease>      {Standardise-generic-hook-names}
580 <latexrelease> \msg_new:nnnn { hooks } { wrong-cmd-hook }
581 <latexrelease> {
582 <latexrelease>      Generic-hook~‘cmd/#1/#2’~is~invalid.
583 <latexrelease>%      The-hook-should-be-‘cmd/#1/before’~or-‘cmd/#1/after’.
584 <latexrelease> }
585 <latexrelease> {
586 <latexrelease>      You~tried-to~add-a-generic-hook-to-command~\iow_char:N \#1,~but~‘#2’~
587 <latexrelease>      is~an~invalid~component.~Only~‘before’~or~‘after’~are~allowed.
588 <latexrelease> }
589 <latexrelease> \EndIncludeInRelease
590 \msg_new:nnnn { hooks } { cant-patch }
591 {
592      Generic-hooks~cannot-be-added-to~‘#1’.
593 }
594 {
595      You~tried-to~add-a-hook-to~‘#1’,~but~LaTeX~was~unable-to~
596      patch-the-command~because~it~\__hook_unpatchable_cases:n {#2}.
597 }
598 \cs_new:Npn \__hook_unpatchable_cases:n #1
599 {
600      \str_case:nn {#1}
601      {
602          { undef } { doesn’t~exist }
603          { macro } { is~not~a~macro }
604          { expl3 } { is~a~private~expl3~macro }
605          { retok } { can’t~be~retokenized~cleanly }

```



```

606     }
607 }
608 <latexrelease>\IncludeInRelease{0000/00/00}{ltxcmdhooks}%
609 <latexrelease>{The~hook~management~system~for~commands}
610 <latexrelease>

```

The command `__hook_cmd_begindocument_code:` is used in an internal hook, so we need to make sure it has a harmless definition after rollback as that will not remove it from the kernel hook.

```

611 <latexrelease>\cs_set_eq:NN \__hook_cmd_begindocument_code: \prg_do_nothing:
612 <latexrelease>
613 <latexrelease>\EndModuleRelease
614 \ExplSyntaxOff
615 </2ekernel | latexrelease>
616 <@@=>

```

Index

The italic numbers denote the pages where the corresponding entry is described, numbers underlined point to the definition, all others indicate the places where it is used.

Symbols	
<code>\#</code>	446
<code>\/</code>	202, 277
<code>\</code>	443, 586
<code>\{</code>	444
<code>\}</code>	445
A	
<code>\AddToHook</code>	3
B	
<code>\begin</code>	66, 504
bool commands:	
<code>\bool_if:NTF</code>	162, 166, 178, 237, 241, 253, 380
<code>\c_false_bool</code>	141, 151, 370, 10
<code>\c_true_bool</code>	146, 11
C	
<code>\changes</code>	502
char commands:	
<code>\char_set_catcode_escape:N</code>	443
<code>\char_set_catcode_group_begin:N</code>	444
<code>\char_set_catcode_group_end:N</code> ..	445
<code>\char_set_catcode_parameter:N</code> ..	446
<code>\char_value_catcode:n</code>	375
cs commands:	
<code>\cs_argument_spec:N</code> 161, 236, 369, 12	
<code>\cs_generate_variant:Nn</code>	20
<code>\cs_gset_eq:NN</code>	56, 544, 572
<code>\cs_gset_protected:Npn</code> .	231, 423, 550
<code>\cs_if_exist:NTF</code>	73, 81
<code>\cs_new:Npn</code>	303, 313, 323, 325, 327, 338, 361, 362, 365, 485, 598
<code>\cs_new_eq:NN</code>	440, 13, 14
<code>\cs_new_protected:Npn</code>	34, 36, 46, 54, 63, 77, 97, 117, 130, 135, 144, 149, 156, 296, 367, 404, 441, 469, 498, 18, 23, 25
<code>\cs_new_protected:Npx</code>	475
<code>\cs_prefix_spec:N</code>	207, 282
<code>\cs_set:Npn</code> ...	199, 274, 456, 520, 556
<code>\cs_set_eq:NN</code>	171, 172, 192, 193, 198, 246, 247, 267, 268, 273, 452, 453, 516, 517, 552, 553, 611
<code>\cs_set_protected:Npn</code>	173, 248
<code>\cs_to_str:N</code>	112, 133, 147, 152
<code>\cs_undefine:N</code>	59, 210, 494, 507
D	
<code>\def</code>	458, 523, 559
<code>\DisableGenericHook</code>	4
E	
else commands:	
<code>\else:</code>	347
<code>\EndIncludeInRelease</code> 45, 228, 295, 420, 439, 491, 495, 547, 574, 577, 589, 31	
<code>\EndModuleRelease</code>	613

exp commands:

- \exp_after:wN 170, 245, 299, 300, 353, 471
- \exp_args:Nc 42, 74, 132, 29
- \exp_args:Ne 510
- \exp_args:Nf 161, 236
- \exp_args:NNc 146, 151
- \exp_args:NNo 169, 244
- \exp_args:NNV 188, 263
- \exp_args:No 169, 188, 244, 263
- \exp_args:NV 189, 264
- \exp_last_unbraced:Nf 110
- \exp_last_unbraced:NNNo 116, 474
- \exp_last_unbraced:NNo 364
- \exp_not:N 108, 110, 111, 112, 184, 199, 206, 207, 214, 219, 259, 274, 281, 282, 286, 290, 307, 352, 358, 376, 385, 459, 460, 480, 485, 513, 540, 541, 568, 569, 13
- \exp_not:n 171, 184, 187, 189, 224, 246, 259, 262, 264, 292, 356, 386, 388, 389, 391, 392, 13
- \ExplSyntaxOff 381, 614
- \ExplSyntaxOn 381, 3

F

fi commands:

- \fi: ... 342, 344, 345, 349, 354, 361, 17
- \foo 11

G

group commands:

- \group_begin: 201, 276
- \group_end: 205, 280

H

hook commands:

- \g_hook_patch_action_list_tl ... 91, 124, 6

hook internal commands:

- __hook_braced_parameter:n . 221, 510
- __hook_cmd_begindocument_code: . 46, 54, 59, 62, 611, 25
- __hook_cmd_if_scanable:Nn 450
- __hook_cmd_if_scanable:NnTF ... 408, 427, 450, 22
- __hook_cmd_patch_xparse:Nnn ... 128, 149, 149
- __hook_cmd_try_patch:nn .. 52, 63, 63
- __hook_debug:n 39, 48, 49, 65, 69, 19, 28
- __hook_def_cmd:w 192, 198, 267, 273, 299, 13, 14, 15
- \g_hook_delayed_patches_prop ... 51, 57, 58, 17
- __hook_disable:n 209, 506
- __hook_double_hashes:n 188, 263, 325, 325, 363, 16
- __hook_double_hashes:w 325, 326, 327, 359, 363, 366, 17
- __hook_double_hashes_group:n ... 325, 333, 362
- __hook_double_hashes_output:N .. 325, 330, 338, 17
- __hook_double_hashes_space:w ... 325, 334, 365
- __hook_double_hashes_stop:w ... 325, 341, 361
- __hook_exp_not:n 171, 172, 176, 187, 246, 247, 251, 262, 12
- __hook_exp_not:NN 193, 199, 219, 224, 268, 274, 290, 292, 13, 13
- __hook_guess_arg_count:NN 467, 467, 469, 492, 494, 505
- __hook_guess_arg_count:nw 467, 480, 485, 488
- __hook_guess_arg_count:wN 467, 471, 475
- \c_hook_hash_tl 254, 255, 257, 344, 11
- \c_hook_hashes_tl 179, 180, 182, 345, 11, 12
- __hook_if_declared:nTF 67
- __hook_if_has_hash:n 311
- __hook_if_has_hash:nTF 169, 244, 311, 12
- __hook_if_has_hash:w 311, 312, 313, 319, 321
- __hook_if_has_hash_check:w 311, 318, 323
- __hook_if_has_hash_p:n 311
- __hook_if_public_command:N . 108, 9
- __hook_if_public_command:NnTF 77, 87
- __hook_if_public_command:w 77, 111, 117
- __hook_make_prefixes:w 154, 207, 282, 303, 308
- __hook_make_usable:nn .. 211, 508, 14
- \l_hook_param_text_tl 175, 196, 250, 271, 300, 8, 12
- __hook_patch_check:NNnn 77, 81, 84, 87, 97
- __hook_patch_cmd_or_delay:Nnn .. 42, 46, 46, 56, 29, 8
- __hook_patch_command:Nnn 56, 74, 77, 77, 9
- __hook_patch_debug:n ... 79, 80, 83, 86, 89, 158, 233, 372, 407, 410, 411, 416, 426, 429, 430, 435, 18, 18

quark internal commands:		\scantokens 20
\q__hook_recursion_stop		\section 3
. 326, 327, 336, 361, 15		\ShowCommand 10
\q__hook_recursion_tail . . 326, 340, 15	tex commands:	
	\tex_endlinechar:D 447	
	\tex_escapechar:D 202, 277	
	\tex_gdef:D 192, 267, 15	
	\tex_newlinechar:D 448	
	\tex_xdef:D 198, 273, 15	
	tl commands:	
	\c_space_tl 365	
	\tl_clear:N 196, 271	
	\tl_const:Nn 11, 12	
	\tl_gset:Nn 124	
	\tl_if_empty:nTF 120, 305, 324	
	\tl_if_head_is_group:nTF 332	
	\tl_if_head_is_N_type:nTF 329	
	\tl_if_single_token:nTF 315	
	\tl_new:N 6, 8, 9, 10	
	\tl_put_right:Nn . . . 168, 182, 243, 257	
	\tl_rescan:nn . . . 462, 543, 571, 20, 20	
	\tl_set:Nn 166, 179, 180,	
 183, 185, 206, 241, 254, 255, 258,	
 260, 281, 373, 378, 459, 509, 540, 568	
	\tl_set_eq:NN 197, 272	
	\tl_to_str:n	
 113, 118, 457, 476, 510, 521, 557	
	\tl_trim_spaces:n 307, 16	
	token commands:	
	\token_if_eq_catcode:NNTF 317	
	\token_if_eq_meaning:NNTF	
 187, 262, 463	
	\token_if_macro:NNTF 84, 9	
	\token_to_meaning:N	
 80, 460, 472, 541, 569	
	\token_to_str:N	
 79, 80, 102, 527, 534, 562, 565	
	U	
	\unexpanded 12	
	use commands:	
	\use:n 105, 172, 175, 203,	
 212, 247, 250, 278, 284, 350, 383,	
 406, 425, 454, 484, 511, 518, 554, 17	
	\use:nn 217, 289	
	\use_i:nnnn 348, 17	
	\use_i_delimit_by_q_recursion_-	
	stop:nw 413, 432	
	\use_ii:nn 57, 139	
	\use_ii:nnnn 353	
	\use_ii_i:nn 216, 288	
	\use_none:n 355, 413, 432	
	\UseHook 290, 562, 565, 20	
	\UseHookWithArguments . . 219, 527, 534, 4	
quark internal commands:		
\q__hook_recursion_stop		
. 326, 327, 336, 361, 15		
\q__hook_recursion_tail . . 326, 340, 15		
	R	
\refstepcounter 5		
	S	
scan commands:		
\scan_stop: 452, 453, 516, 517, 552, 553		
scan internal commands:		
\s__hook_mark 35, 37,		
. 113, 118, 312, 323, 457, 460, 472,		
. 476, 481, 521, 541, 557, 569, 24, 26		
str commands:		
\c_backslash_str 147, 398		
\c_hash_str 481, 485, 514		
\str_case:nn 600		
\str_case:nnTF 40		
\str_count:n 161, 236		
\str_if_eq:nnTF		
. 215, 287, 369, 525, 532, 561, 564		
\str_replace_all:Nnn 513		
\string 66		
	T	
T _E X and L ^A T _E X 2 _ε commands:		
\@ 375		
\@if@DeclareRobustCommand 126		
\@if@newcommand 127, 138, 10		
\@kernel@after@begindocument . . . 61		
\AddToHook 1		
\AddToHookNext 1		
\AddToHookNextWithArguments 2		
\AddToHookWithArguments 1		
\apptocmd 2		
\DeclareRobustCommand 3		
\def 6		
\endlinechar 20		
\escapechar 13		
\g@addto@macro 61		
\ifx 21		
\meaning 23		
\newcommand 6		
\NewCommandCopy 10		
\NewDocumentCommand 3		
\newlinechar 20		
\noexpand 22		
\patchcmd 3		
\pretocmd 2		
\relax 22		
\robust@command@act 90, 6		
\robust@command@chk@safe 137, 10		