The \texttt{ltcmdhooks} module\footnote{This file has version v1.0f dated 2021/10/20, © \LaTeX{} Project.}

Frank Mittelbach Phelype Oleinik

July 5, 2022

Contents

1 Introduction 1

2 Restrictions and Operational details 2
  2.1 Patching 2
    2.1.1 Timing 3
  2.2 Commands that look ahead 3

3 Package Author Interface 3

4 The Implementation 4
  4.1 Execution plan 4
  4.2 Variables 5
  4.3 Variants 6
  4.4 Patching or delaying 6
  4.5 Patching commands 8
    4.5.1 Patching by expansion and redefinition 9
    4.5.2 Patching by retokenization 15
  4.6 Messages 19

Index 20

1 Introduction

This file implements generic hooks for (arbitrary) commands. In theory every command \texttt{\langle name \rangle} offers now two associated hooks to which code can be added using \texttt{\AddToHook} or \texttt{\AddToHookNext}.ootnote{In 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.} These are

\texttt{cmd/(name)/before} This hook is executed at the very start of the command execution after its arguments (if any) are parsed. The hook \texttt{\langle code \rangle} is wrapped in the command inside a call to \texttt{\UseHook{cmd/(name)/before}}, so the arguments passed to the command are \textit{not} available in the hook \texttt{\langle code \rangle}.  

This file has version v1.0f dated 2021/10/20, © \LaTeX{} Project.
\texttt{cmd/\langle name\rangle/after} This hook is similar to \texttt{cmd/\langle name\rangle/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 \texttt{\begin{document}} (i.e., using a command in the preamble will never execute them) 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

\begin{verbatim}
\newcommand\foo[2]{{Code #1 for #2!}}
\end{verbatim}

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

\begin{verbatim}
\AddToHook{cmd/foo/before}{<before code>}
\end{verbatim}

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

\begin{verbatim}
\renewcommand\foo[2]{{\UseHook{cmd/foo/before}Code #1 for #2!}}
\end{verbatim}

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

\begin{verbatim}
\renewcommand\foo[2]{{Code #1 for #2!\UseHook{cmd/foo/after}}}
\end{verbatim}

In other words, the mechanism is similar to what \texttt{etoolbox} offers with \texttt{\pretocmd} and \texttt{\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.

2.1 Patching

The code here tries to find out if a command was defined with \texttt{\newcommand} or \texttt{\DeclareRobustCommand} or \texttt{\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 \texttt{\def}, for example), then the code uses an approach similar to \texttt{etoolbox}'s \texttt{\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 \texttt{cmd} hook, say, \texttt{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 \texttt{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 \texttt{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.\footnote{We might change this behavior in the main document slightly after gaining some usage experience.}

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 \texttt{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 \texttt{\section} command. You can add something to the \texttt{cmd/section/before} hook, but if you try to add something to the \texttt{cmd/section/after} hook, \texttt{\section} will no longer work. That happens because the \texttt{\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 \texttt{cmd/section/after} hook, you get in the way of that scanning.

3 Package Author Interface

The \texttt{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 \UseHook calls inside the command in the proper positions, and manually define the hooks with \NewHook or \NewReversedHook. 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:

\begin{verbatim}
\newcommand\fancybox{\@ifnextchar{\@fancybox}{\@fancybox(5cm)}}
\def\@fancybox(#1)#2{\fbox{\parbox{#1}{#2}}}
\end{verbatim}
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 \(\ldots\) 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{\UseHook{cmd/fancybox/before}\parbox{#1}{#2}\UseHook{cmd/fancybox/after}}}
\NewHook{cmd/fancybox/before}
\NewReversedHook{cmd/fancybox/after}

then the hooks will be executed where they should and no patching will be attempted. It is important that the hooks are declared with \NewHook or \NewReversedHook, otherwise the command hook code will try to patch the command. Note also that the call to \UseHook{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 \DisableHook, 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 \LaTeX 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:
\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.

\section{The Implementation}
\subsection{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 \(\langle\text{parameter text}\rangle\) 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 \#1212 instead of the expected \#112, for example) so we need to resort to \footnote{\textit{Please use} \DisableHook\textit{if at all, only on hooks that you “own”, i.e., for commands that your package or class defines and not second guess whether or not hooks of other packages should get disabled!}}
“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, \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\langle@@=hook\rangle
2\langle∗\2ekernel|latexrelease\rangle
3\ExplSyntaxOn
4\langlelatexrelease\rangle\NewModuleRelease{2021/06/01}{ltcmdhooks}
5\langlelatexrelease\rangle \{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 \l\_\hook\param\text_tl \l\_\hook\replace\text_tl

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

8\tl_new:N \l\_\hook\patch\prefixes_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

A constant token list that contains two parameter tokens.

11\tl_const:Nn \c\_\hook\hash_tl \{ # # \}

(End definition for \c\_\hook\hash_tl.)

\footnote{It’s not always possible to reliably detect this case because a command defined with no optional argument is indistinguishable from a \defed command.}
\__hook_exp_not:NN Two temporary macros that change depending on the macro being patched.
\__hook_def_cmd:w
\cs_new_eq:NN \__hook_exp_not:NN ?
\cs_new_eq:NN \__hook_def_cmd:w ?
(End definition for \__hook_exp_not:NN and \__hook_def_cmd:w.)
\q__hook_recursion_tail\q__hook_recursion_stop Internal quarks for recursion: they can’t appear in any macro being patched.
\quark_new:N \q__hook_recursion_tail
\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.
\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.
\cs_new_protected:Npn \__hook_patch_debug:x #1
{ \__hook_debug:n { \iow_term:x { [lthooks]~#1 } } }
(End definition for \__hook_patch_debug:x.)

4.3 Variants
\tl_rescan:nV exp3 function variants used throughout the code.
\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\__hook_try_put_cmd_hook:w
This function is called from within \AddToHook, when code is first added to a generic cmd hook. If it is called within the preamble, it delays the action until \begin{document}; otherwise it tries to update the hook.
\latexrelease\IncludeInRelease{2021/11/15}{\__hook_try_put_cmd_hook:n}
\latexrelease
{Standardise-generic-hook-names}
\cs_new_protected:Npn \__hook_try_put_cmd_hook:n #1
{ \__hook_patch_cmd_or_delay:Nnn {#1} {#1} {#1} }
\cs_new_protected:Npn \__hook_try_put_cmd_hook:w
#1 / #2 / #3 / #4 \__hook_patch_cmd_or_delay:Nnn #2 #2 #3
{ \__hook_debug:n { \iow_term:n { --Adding-cmd-hook-to-'^#2'-(#3): } } }
\exp_args:Nc \__hook_patch_cmd_or_delay:Nnn #2 #2 #3
(\latexrelease)\EndIncludeInRelease

6
\IncludeInRelease{2021/06/01}{\__hook_put_cmd_hook:n}

\begin{verbatim}
\__hook_put_cmd_hook:n \__hook_put_cmd_hook:w \__hook_put_cmd_hook:w \__hook_put_cmd_hook:w
\end{verbatim}

\cs_new_protected:Npn \__hook_put_cmd_hook:n #1

{ \__hook_put_cmd_hook:w #1 / / / \s__hook_mark {#1} }

\cs_new_protected:Npn \__hook_put_cmd_hook:w #1 / #2 / #3 / #4 \s__hook_mark #5

{ \__hook_debug:n { \iow_term:n { \rightarrow Adding cmd hook to \'#2\'-\#3: } } }

\str_case:nnTF {#3}

{ { before } { } { after } { } }

{ \exp_args:Nc \__hook_patch_cmd_or_delay:Nnn {#2} {#2} {#3} }

\msg_error:nnnn { hooks } { wrong-cmd-hook } {#2} {#3}

\EndIncludeInRelease

\EndDefinitionFor \__hook_put_cmd_hook:n and \__hook_put_cmd_hook:w.

\__hook_put_cmd_or_delay:Nnn \__hook_put_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.

\cs_new_protected:Npn \__hook_patch_cmd_or_delay:Nnn #1 #2 #3

{ \__hook_debug:n { \iow_term:n { \rightarrow Add generic cmd hook for \'#2\'-\#3. } } }

\__hook_debug:n

{ \iow_term:n { ! In the preamble: delaying. } }

\prop_gput:Nnn \g__hook_delayed_patches_prop { #2 / #3 }

\__hook_cmd_try_patch:nn {#2} {#3}

\EndIncludeInRelease

\__hook_patch_cmd_or_delay:Nnn \__hook_patch_cmd_begindocument_code:

\cs_gset_eq:NN \__hook_patch_cmd_or_delay:Nnn \__hook_patch_command:Nnn

\prop_map_function:NN \g__hook_delayed_patches_prop { \use_ii:nn }

\prop_gclear:N \g__hook_delayed_patches_prop

\cs_undefine:N \__hook_patch_cmd_begindocument_code:

\g@addto@macro \@kernel@after@begindocument

{ \__hook_patch_cmd_begindocument_code: }

\EndDefinitionFor \__hook_patch_cmd_or_delay:Nnn and \__hook_patch_cmd_begindocument_code:.

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.

\cs_new_protected:Npn \__hook_cmd_try_patch:nn #1 #2

{ \__hook_debug:n

{ \iow_term:x { \rightarrow string\begin{document}-try-cmd / #1 / #2. } } }

\__hook_if_declared:nTF { cmd / #1 / #2 }

{ \__hook_patch_command:Nnn }
\_\_hook_patch_command:Nnn \_\_hook_patch_check:NNnn \_\_hook_if_public_command:N \_\_hook_if_public_command:w

\_\_hook_patch_command:Nnn \_\_hook_patch_check:NNnn \_\_hook_if_public_command:N \_\_hook_if_public_command:W

\cs_new_protected:Npn \_\_hook_patch_command:Nnn #1 #2 #3
\{ \_\_hook_patch_debug:x { analyzing-'\token_to_str:N #1' } \_\_hook_patch_check:NNnn \cs_if_exist:NTF #1 { undef } \{ \_\_hook_patch_debug:x { ++control-sequence-is-defined } \_\_hook_patch_check:NNnn \token_if_macro:NTF #1 { macro } \{ \_\_hook_patch_debug:x { ++control-sequence-is-a-macro } \_\_hook_patch_check:NNnn \_\_hook_if_public_command:NTF #1 \_\_hook_if_public_command:N \_\_hook_if_public_command:W \robust@command@act \g_hook_patch_action_list_tl #1 \_\_hook_retokenize_patch:Nnn \{ #1 \{#2\} {#3} \} \} \} \}

And here's the auxiliary used above:
\cs_new_protected:Npn \_\_hook_patch_check:NNnn #1 #2 #3 #4
\{ \_\_hook_patch_check:NNnn \token_if_macro:NTF #1 { undef } { \token_to_str:N #2 } {#3} \}

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.
\use:x
\{ \prg_new_protected_conditional:Npnn
4.5.1 Patching by expansion and redefinition

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 ltcmd.

\tl_gset:Nn \g_hook_patch_action_list_tl
\{ \__hook_patch_DeclareRobustCommand:Nnn \}
\{ \__hook_patch_newcommand:Nnn \}
\{ \__kernel_cmd_if_xparse:NTF \__hook_cmd_patch_xparse:Nnn \}
\}

(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.

\cs_new_protected:Npn \__hook_patch_DeclareRobustCommand:NNnn #1
\exp_args:Nc \__hook_patch_DeclareRobustCommand_aux:Nnn
\{ \cs_to_str:N #1 - \}
\}
\cs_new_protected:Npn \__hook_patch_DeclareRobustCommand_aux:Nnn #1
\{ \robust@command@chk@safe #1
\{ \@if@newcommand #1 \}
\{ \use_i:n \}
\{ \__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`.

```latex
\cs_new_protected:Npn \__hook_patch_newcommand:Nnn #1
\exp_args:NNc \__hook_patch_expand_redefine:NNnn \c_true_bool
\{ \cs_to_str:N #1 \}
```

(End definition for `\__hook_patch_newcommand:Nnn`.)

And for commands defined by the `xparse` commands use this for patching:

```latex
\cs_new_protected:Npn \__hook_cmd_patch_xparse:Nnn #1
\exp_args:NNc \__hook_patch_expand_redefine:NNnn \c_false_bool
\{ \cs_to_str:N #1 ~ code \}
```

(End definition for `\__hook_cmd_patch_xparse:Nnn`.)

Now the real action begins. Here we have in #1 a boolean indicating if the command has a leading [ ... ]-delimited argument, in #2 the command control sequence, in #3 the name of the command (note that #1 \neq \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:

```latex
\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 `#`) 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:

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

which obviously fails, because the original input in the definition was `##` but \TeX{} reduced that to a single parameter token `#` when carrying out the definition. That leaves no room for a clever solution with (say) `\unexpanded`, because anything that would double the second `#`, 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 \texttt{tl} variable).

The second case requires looking at the \textit{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.

\begin{verbatim}
\cs_new_protected:Npn \__hook_patch_expand_redefine:NNnn #1 #2 #3 #4
{ \__hook_patch_debug:x { ++~command~can~be~patched~without~rescanning }
  \int_set:Nn \l__hook_patch_num_args_int
  { \exp_args:Nf \str_count:n { \cs_argument_spec:N #2 } / 2
    \bool_if:NT #1 { -1 }
  }
  \tl_set:Nx \l__hook_tmpa_tl { \bool_if:NTF #1 { [ ] } { { } } }
  \int_step_inline:nnn { 2 } { \l__hook_patch_num_args_int }
  \exp_args:NNo \exp_args:No \__hook_if_has_hash:nTF
  { \exp_after:wN #2 \l__hook_tmpa_tl }
  { \cs_set_eq:NN \__hook_exp_not:n \exp_not:n }
}
\end{verbatim}

Now build two token lists:

\texttt{\l__hook_param_text_tl} will contain the \textit{parameter text} to be used when redefining the macro. It should be identical to the \textit{parameter text} used when originally defining that macro.

\texttt{\l__hook_replace_text_tl} will contain braced pairs of \texttt{\c__hook_hash_tl(num)} to feed to the macro when expanded. This token list as well as the previous will have the first item surrounded by \texttt{[ ...]} in the case of an optional argument.

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

\begin{verbatim}
\int_compare:nNnTF { \l__hook_patch_num_args_int } > { \c_zero_int }
{ { \l__hook_patch_num_args_int } > { \c_zero_int }
}
\end{verbatim}

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

\begin{verbatim}
\tl_set:Nx \l__hook_tempa_tl { \bool_if:NTF #1 { [ ] } { { } } }
\int_step_inline:nnn { 2 } { \l__hook_patch_num_args_int }
\tl_put_right:Nn \l__hook_tempa_tl { { } }
\exp_args:NNo \exp_args:No \__hook_if_has_hash:nTF
{ \exp_after:wN #2 \l__hook_tempa_tl }
{ \cs_set_eq:NN \__hook_exp_not:n \exp_not:n }
{ \cs_set_eq:NN \__hook_exp_not:n \use:n }
\end{verbatim}
Here we'll conditionally add [...] around the first parameter:

\bool_if:NTF #1
{ \__hook_tmp:w \tl_set:Nx { [ \c__hook_hash_tl 1 ] } }
{ \__hook_tmp:w \tl_set:Nx { { \c__hook_hash_tl 1 } } }

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

\int_step_inline:nnn { 2 } { \l__hook_patch_num_args_int }
{ \__hook_tmp:w \tl_put_right:Nx { { \c__hook_hash_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_hash_tl by #:

\tl_set:Nx \l__hook_replace_text_tl
{ \exp_not:N #2 \exp_not:V \l__hook_replace_text_tl }
\tl_set:Nx \l__hook_replace_text_tl
{ \token_if_eq_meaning:NNTF \__hook_exp_not:n \exp_not:n
{ \exp_args:NNV \exp_args:No \__hook_double_hashes:n }
{ \exp_args:NV \exp_not:o }
\l__hook_replace_text_tl }

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

\cs_set_eq:NN \__hook_def_cmd:w \tex_gdef:D
\cs_set_eq:NN \__hook_exp_not:NN \prg_do_nothing:
\cs_set_eq:NN \__hook_make_prefixes:w \cs_prefix_spec:N #2 / /

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):

\tl_set:Nx \l__hook_param_text_tl
\tl_set_eq:NN \__hook_def_cmd:w \tex_xdef:D
\cs_set_eq:NN \__hook_exp_not:NN \prg_do_nothing:
\cs_set:Npn \__hook_params:Nn \#1 { \exp_not:N #1 \exp_not:N }

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.

\group_begin:
\int_set:Nn \tex_escapechar:D { ‘/ }
\use:x
{ \group_end:
\tl_set:Nx \exp_not:N \l__hook_patch_prefixes_tl
{ \exp_not:N \__hook_make_prefixes:w \cs_prefix_spec:N #2 / / }

12
Finally, 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 \textit{(replacement text)} of the macro.

\begin{verbatim}
\use:x {
  \__hook_redefine_with_hooks:Nnnn \exp_not:N \#2
  \str_if_eq:nnTF {\#4} { after } {
    \use:nn {
      \__hook_exp_not:NN \exp_not:N \UseHook { cmd / \#3 / \#4 } }
    \{ \}
    \{ \__hook_exp_not:NN \exp_not:N \l__hook_replace_text_tl \}
  }{
    \{ } \__hook_exp_not:NN \exp_not:V \l__hook_replace_text_tl
  }
}
\end{verbatim}

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 \textit{(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 \textit{(replacement text)}, and \#3 which is cmd/#1/after or empty.

\begin{verbatim}
\cs_new_protected:Npn \_\_hook_redefine_with_hooks:Nnnn \#1 \#2 \#3 \#4 {
  \l__hook_patch_prefixes_tl \exp_after:wN \_\_hook_def_cmd:w \exp_after:wN \#1 \l__hook_param_text_tl
  \{ \#2 \#4 \#3 \}
}
\end{verbatim}

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

\begin{verbatim}
\cs_new:Npn \_\_hook_make_prefixes:w \#1 \#2 \#3 \#4 {
  \__hook_make_prefixes:w / \#1 /
  \tl_if_empty:nF {\#1} {
    \exp_not:c { tex_ \tl_trim_spaces:n \#1 :D }
    \__hook_make_prefixes:w / \}
  \__hook_make_prefixes:w / \}
\end{verbatim}

(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.

\begin{verbatim}
\__hook_if_has_hash_p:n \_\_hook_if_has_hash:nTF \_\_hook_if_has_hash:w \_\_hook_if_has_hash_check:w
\end{verbatim}

\__hook_if_has_hash:nTF searches the token list \#1 for a catcode 6 token, and if any is found, it returns \texttt{true}, and \texttt{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.
\__hook_double_hashes:n loops through the token list #1 and duplicates any catcode 6
token, and expands tokens \ifx-equal to \__hook_hash_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.
\__hook_double_hashes:output:N checks for the end of the token list, then checks
if the token is \c__hook_hash_tl, and if so just leaves it.
If \#1 is not \c__hook_hash_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.

\if_catcode:w ## \exp_not:N #1 \exp_after:wN \use_ii:nnnn \fi:
\use_none:n { \exp_not:n { #1 #1 } }

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

\exp_not:N #1 \__hook_double_hashes:w
\cs_new:Npn \__hook_double_hashes_stop:w #1 \q__hook_recursion_stop { \fi: }

Dealing with spaces and grouped tokens is trivial:
\cs_new:Npn \__hook_double_hashes_group:n #1 { { \__hook_double_hashes:n {#1} } \__hook_double_hashes:w }
\exp_last_unbraced:NNo
\cs_new:Npn \__hook_double_hashes_space:w \c_space_tl { ~ \__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.

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.

\cs_new_protected:Npn \__hook_retokenize_patch:Nnn #1 #2 #3
{\__hook_patch_debug:x { ..-command-can-only-be-patched-by-rescanning }
\str_if_eq:eeTF { \cs_argument_spec:N #1 } { } { \__hook_patch_expand_redefine:NNnn \c_false_bool \#1 \#2 \#3 }
}

Otherwise, we start the actual patching by retokenization job. The code calls \__hook_try_patch_with_catcodes:Nnnnn 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).

\begin{verbatim}
l_set:Nx \l__hook_tmpa_tl
{ \int_compare:nNnTF { \char_value_catcode:n {'@' } } = { 12 }
  { \exp_not:N \makeatletter }
  { \exp_not:N \makeatother }
}
l_set:Nx \l__hook_tmpb_tl
{ \bool_if:NTF \l__kernel_expl_bool
  { \ExplSyntaxOff }
  { \ExplSyntaxOn }
}
\use:x
{ \exp_not:N \__hook_try_patch_with_catcodes:Nnnnw
  \exp_not:n { #1 {#2} {#3} }
  { \prg_do_nothing: }
  { \exp_not:V \l__hook_tmpa_tl } % @
  { \exp_not:V \l__hook_tmpb_tl } % _:
}
\q_recursion_tail \q_recursion_stop
\end{verbatim}

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

\begin{verbatim}
\msg_error:nnxx { hooks } { cant-patch }
  { \c_backslash_str #2 } { retok }
\end{verbatim}

(End definition for \__hook_retokenize_patch:Nn.)

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

\begin{verbatim}
\cs_new_protected:Npn \__hook_try_patch_with_catcodes:Nnnnw \#1 \#2 \#3 \#4
{ \quark_if_recursion_tail_stop_do:nn \#4 \{ \use:n \}
  \__hook_patch_debug:x \{ ++-trying-to-patch-by-retokenization \}
  \__hook_cmd_if_scanable:NnTF \#1 \#4
  { \__hook_patch_debug:x \{ ++-macro-can-be-retokenized-cleanly \}
    \__hook_patch_debug:x \{ ===-retokenizing-macro-now \}
  }
\end{verbatim}
This is an oddity required to be safe (as safe as reasonably possible) when patching the command. The entirety of

\(\langle \text{prefixes} \rangle \text{\texttt{\textbackslash def}} \langle cs \rangle \langle \text{parameter text} \rangle \langle \text{replacement text} \rangle\) will go through \texttt{\textbackslash scantokens}. The \langle parameter text \rangle and \langle replacement text \rangle 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 \texttt{expl3}-named macro for \langle cs \rangle, nor the \texttt{expl3} versions of \texttt{\textbackslash def} or the \langle prefixes \rangle. That is why the definitions that will eventually go into \texttt{\textbackslash scantokens} will use the oddly (but hopefully clearly)-named \texttt{\kerneltmpDoNotUse}:

\(\texttt{\cs_new_eq:NN \kerneltmpDoNotUse !}\)

\texttt{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.

\texttt{etoolbox} sets the \texttt{\textbackslash endlinechar} and \texttt{\textbackslash 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. Therefore we can’t use an \texttt{expl3}-named macro for \langle cs \rangle, nor the \texttt{expl3} versions of \texttt{\textbackslash def} or the \langle prefixes \rangle. That is why the definitions that will eventually go into \texttt{\textbackslash scantokens} will use the oddly (but hopefully clearly)-named \texttt{\kerneltmpDoNotUse}:

\texttt{\cs_new_eq:NN \kerneltmpDoNotUse !}

\texttt{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.

\texttt{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.

(End definition for \texttt{\kerneltmpDoNotUse}.)

\texttt{\_\hook_patch_required_catcodes:} Here are the catcode settings that are \textit{mandatory} when retokenizing commands. These are the minimum necessary settings to perform the definitions: they identify control sequences, which must be escaped with \texttt{\textbackslash 0}, delimit the definition with \{1 and \}2, and mark parameters with \#6. Everything else may be changed, but not these.

\texttt{\cs_new_protected:Npn \_\hook_patch_required_catcodes:}

(End definition for \_\hook_patch_required_catcodes.)
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 \texttt{\meaning} to the command;
2. split the \langle\textit{prefixes}\rangle, \langle\textit{parameter text}\rangle and \langle\textit{replacement text}\rangle and arrange them as \langle\textit{prefixes}\rangle\texttt{\def\kernelmpDoNotUse\langle\textit{parameter text}\rangle\{\langle\textit{replacement text}\rangle}\}
3. rescan that with the given catcode settings, and do the definition; then finally
4. compare \texttt{\kernelmpDoNotUse} with the original command.

If both are \texttt{\ifx-equ}, the command can be safely patched.

\begin{verbatim}
\prg_new_protected_conditional:Npn \_\hook_cmd_if_scanable:Nn #1 #2 { TF }
{
\cs_set_eq:NN \kerneltmpDoNotUse \scan_stop:
\cs_set_eq:NN \__hook_tmp:w \scan_stop:
\use:x
{\cs_set:Npn \__hook_tmp:w #1 \tl_to_str:n { \token_to_meaning:N #1 \s__hook_mark }{ #1 \def \kerneltmpDoNotUse #2 {#3} }
\tl_set:Nx \exp_not:N \l__hook_tmpa_tl { \exp_not:N \__hook_tmp:w \token_to_meaning:N #1 \s__hook_mark }}
\tl_rescan:nV \__hook_patch_required_catcodes: \l__hook_tmpa_tl
\token_if_eq_meaning:NNTF #1 \kerneltmpDoNotUse
{ \prg_return_true: }
{ \prg_return_false: }
}\__hook_patch_required_catcodes: \l__hook_tmpa_tl
\end{verbatim}

(End definition for \_\hook_cmd_if_scanable:TNFT.)

Then, if \_\hook_cmd_if_scanable:TNFT returned true, we can go on and patch the command.

\begin{verbatim}
\prg_new_protected:Npn \_\hook_patch_retokenize:Nnnn #1 #2 #3 #4
{
\cs_new_protected:Npn \_\hook_patch_retokenize:Nnnn #1 #2 #3 #4
Start off by making some things \texttt{\relax} to avoid lots of \texttt{\noexpand} below.
\cs_set_eq:NN \kernelmpDoNotUse \scan_stop:
\cs_set_eq:NN \_\hook_tmp:w \scan_stop:
\use:x
{\cs_set:Npn \_\hook_tmp:w \tl_to_str:n { \token_to_meaning:N #1 \s__hook_mark }{ #1 \def \kernelmpDoNotUse #2 {#3} }{ #1 \def \kernelmpDoNotUse #2 {#3} }
\tl_set:Nx \exp_not:N \l__hook_tmpa_tl { \exp_not:N \__hook_tmp:w \token_to_meaning:N #1 \s__hook_mark }{ #1 \def \kernelmpDoNotUse #2 {#3} }
\tl_rescan:nV \__hook_patch_required_catcodes: \l__hook_tmpa_tl
\token_if_eq_meaning:NNTF #1 \kernelmpDoNotUse
{ \prg_return_true: }
{ \prg_return_false: }
\end{verbatim}

(End definition for \_\hook_patch_retokenize:Nnnn.)

Now we’ll define \_\hook_tmp:w such that it splits the \texttt{\meaning} of the macro (#1) into its three parts:

\begin{verbatim}
###1. \langle\textit{prefixes}\rangle
###2. \langle\textit{parameter text}\rangle
###3. \langle\textit{replacement text}\rangle
\end{verbatim}
and arrange that a complete definition, then place the \texttt{before} or \texttt{after} hooks around the \textit{replacement text}: accordingly.

\begin{verbatim}
\cs_set:Npn \_hook_tmp:w
    
####1 \tl_to_str:n { macro: } ####2 \texttt{ \s__hook_mark}
\{
  
####1 \def \kerneltmpDoNotUse ####2
\{
  \str_if_eq:nnNT {#3} { before } }
\str_if_eq:nnNT {#3} { after } }
\token_to_str:N \UseHook { cmd / #2 / #3 }
####3
\}
\}
\end{verbatim}

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

\begin{verbatim}
\tl_set:Nx \exp_not:N \l__hook_tmpa_tl
\{
  \exp_not:N \__hook_tmp:w \token_to_meaning:N #1 \s__hook_mark
\}
\end{verbatim}

Now rescan with the given catcode settings (overridden by the \texttt{\_hook_patch_required_catcodes:}), and implicitly (by using the rescanned token list) carry out the definition from above.

\begin{verbatim}
\tl_rescan:nV \l__hook_ttmpa_tl
\end{verbatim}

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

\begin{verbatim}
\cs_gset_eq:NN #1 \kerneltmpDoNotUse
\end{verbatim}

(\textit{End definition for} \texttt{\_hook_patch_retokenize:Nnnn}.)

\section{Messages}

\begin{verbatim}
\msg_new:nnnn { hooks } { wrong-cmd-hook }
\msg_new:nnnn { hooks } { cant-patch }
\end{verbatim}
You tried to add a hook to ‘#1’, but LaTeX was unable to patch the command because it \_\_hook_unpatchable_cases:n (#2).}
\cs_new:Npn \_\_hook_unpatchable_cases:n #1 #1
{\str_case:nn {#1}
{ { undef } { doesn’t exist }
 { macro } { is not a macro }
 { expl3 } { is a private expl3 macro }
 { retok } { can’t be retokenized cleanly }
}
\langle latexrelease \rangle \IncludeInRelease{0000/00/00}{ltcmdhooks}{The hook management system for commands}
\langle latexrelease \rangle \cs_set_eq:NN \_\_hook_cmd_begindocument_code: \prg_do_nothing:
\langle latexrelease \rangle \EndModuleRelease
\ExplSyntaxOff
\langle /2ekernel \rangle \langle @@= \rangle

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
\# ........................................ 341
\/ ........................................ 199
\\ ........................................ 338, 397
\} ........................................ 339
\} ........................................ 340
\AddToHook .................................. 3, 6
\begin ..................................... 65
bool commands:
\bool_if:NTF .......................... 159, 163, 175, 297
\c_false_bool ......................... 9, 140, 150, 288
\c_true_bool ......................... 10, 145

char commands:
\char_set_catcode_escape:N .... 338
\_hook_patch_newcommand:Nnnn
\_hook_patch_num_args_int
\_hook_patch_prefixes_tl
\_hook_patch_required_catcodes:
\_hook_patch_retokenize:Nnnn
\_hook_patch_required_catcodes_int
\_hook_patch_prefixes_tl
\_hook_patch_required_catcodes:
\_hook_patch_retokenize:Nnnn
\_hook_replace_text_tl
\_hook_retokenize:Nnnn
\_hook_try_patch_with_catcodes:Nnnnw
\_hookTryPutCmdHook:n
\_hookTryPutCmdHook:w
\_hook_unpatchable_cases:n
\if commands:
  \if_catcode:w                  14, 269
  \if_meaning:w                 261, 264
  \ifx                           14
  \IfInRelease                   20, 31, 386, 389, 419
int commands:
  \int_compare:nNnTF            161, 292
  \int_new:N                   156, 199, 342, 343
  \int_set:Nn                 164, 178
  \c_zero_int                  161
iow commands:
  \iow_char:N                  397
  \iow_term:n           18, 27, 38, 47, 49, 65, 69
\DisplayProof
I
\NewDocumentCommand
\NewHook
\NewHookPair
\NewModuleRelease
\NewReversedHook
\notexpanded
\prg commands:
  \prg_do_nothing:         190, 304, 422
  \prg_new_conditional:Nnnn 232
  \prg_new_protected_conditional:Nnnn 106, 345
  \prg_return_false:       121, 245, 360
  \prg_return_true:        120, 245, 359
prop commands:
  \prop_gclear:N             57
  \prop_gput:Nnn             50
  \prop_map_function:HN     56
  \prop_new:N               16
\quark commands:
  \quark_if_recursion_tail_stop_-
do:n                321
  \quark_new:N               14, 15
  \q_recursion_stop         312
  \q_recursion_tail         312
quark internal commands:
  \q__hook_recursion_stop       14
  \q__hook_recursion_stop     14
  \q_recursion_stop          247, 248, 257, 278
  \q_recursion_tail          247, 261
S
\scan commands:
  \scan_stop:            347, 348, 364, 365
scan internal commands:
  \s__hook_mark             23, 25, 34, 36
  \s__hook_mark             112, 117, 233, 244, 352, 355, 369, 381
\str commands:
  \c_backslash_str         146, 315
  \str_case:nn             411
  \str_case:nnTF           39
  \str_count:n            158
  \str_if_eq:nnTF         209, 287, 373, 376
\makeatletter                293
\makeatother                 293
msg commands:
  \msg_error:nnnn         42, 100, 314
  \msg_new:nnnn           391, 401
N
\NewDocumentCommand        4
\NewHook                   3, 4
\NewHookPair               3
\NewModuleRelease          4
\NewReversedHook           3, 4
\notexpanded               14
P
prg commands:
  \prg_do_nothing:         190, 304, 422
  \prg_new_conditional:Nnnn 232
  \prg_new_protected_conditional:Nnnn 106, 345
  \prg_return_false:       121, 245, 360
  \prg_return_true:        120, 245, 359
prop commands:
  \prop_gclear:N             57
  \prop_gput:Nnn             50
  \prop_map_function:HN     56
  \prop_new:N               16
Q
quark commands:
  \quark_if_recursion_tail_stop_-
do:n                321
  \quark_new:N               14, 15
  \q_recursion_stop         312
  \q_recursion_tail         312
quark internal commands:
  \q__hook_recursion_stop       14
  \q__hook_recursion_stop     14
  \q_recursion_stop          247, 248, 257, 278
  \q_recursion_tail          247, 261
\string                   65
<table>
<thead>
<tr>
<th>Command</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>\tex_endlinechar:D</td>
<td>342</td>
</tr>
<tr>
<td>\tex_escapechar:D</td>
<td>199</td>
</tr>
<tr>
<td>\tex_gdef:D</td>
<td>13, 189</td>
</tr>
</tbody>
</table>