The lttemplates.dtx code*

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1 Introduction

There are three broad "layers" between putting down ideas into a source file and ending up with a typeset document. These layers of document writing are

- 1. authoring of the text with mark-up;
- 2. document layout design;
- 3. implementation (with T_EX programming) of the design.

We write the text as an author, and we see the visual output of the design after the document is generated; the TEX implementation in the middle is the glue between the two

If TeX's greatest success has been to standardise a system of mark-up that balances the trade-off between ease of reading and ease of writing to suit almost all forms of technical writing. It's other original strength was a good background in typographical design; while the standard If TeX 2ε classes look somewhat dated now in terms of their visual design, their typography is generally sound (barring the occasional minor faults).

However, \LaTeX 12 has always lacked a standard approach to customising the visual design of a document. Changing the looks of the standard classes involved either:

- Creating a new version of the implementation code of the class and editing it.
- Loading one of the many packages to customise certain elements of the standard classes.
- Loading a completely different document class, such as KOMA-Script or memoir, that allows easy customization.

All three of these approaches have their drawbacks and learning curves.

The idea behind lttemplates is to cleanly separate the three layers introduced at the beginning of this section, so that document authors who are not programmers can easily change the design of their documents. Ittemplates also makes it easier for LATEX programmers to provide their own customizations on top of a pre-existing class.

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2 What is a document?

Besides the textual content of the words themselves, the source file of a document contains mark-up elements that add structure to the document. These elements include sectional divisions, figure/table captions, lists of various sorts, theorems/proofs, and so on. The list will be different for every document that can be written.

Each element can be represented logically without worrying about the formatting, with mark-up such as \section, \caption, \begin{enumerate} and so on. The output of each one of these document elements will be a typeset representation of the information marked up, and the visual arrangement and design of these elements can vary widely in producing a variety of desired outcomes.

For each type of document element, there may be design variations that contain the same sort of information but present it in slightly different ways. For example, the difference between a numbered and an unnumbered section, \section and \section*, or the difference between an itemized list or an enumerated list.

There are three distinct layers in the definition of "a document" at this level

- 1. semantic elements such as the ideas of sections and lists;
- 2. a set of design solutions for representing these elements visually;
- 3. specific variations for these designs that represent the elements in the document.

In the parlance of the template system, these are called types, templates, and instances, and they are discussed below in sections 4, 5, and 7, respectively.

3 Types, templates, and instances

By formally declaring documents to be composed of mark-up elements grouped into types, which are interpreted and typeset with a set of templates, each of which has one or more instances with which to compose each and every semantic unit of the text, we can cleanly separate the components of document construction.

All of the structures provided by the template system are global, and do not respect T_FX grouping.

4 Template types

An template type (sometimes just "type") is an abstract idea of a document element that takes a fixed number of arguments corresponding to the information from the document author that it is representing. A sectioning type, for example, might take three inputs: "title", "short title", and "label".

Any given document class will define which types are to be used in the document, and any template of a given type can be used to generate an instance for the type. (Of course, different templates will produce different typeset representations, but the underlying content will be the same.)

```
\label{lem:lem:lateType} $$\operatorname{VewTemplateType} {\langle template \ type \rangle} \ {\langle no. \ of \ args \rangle}$
```

This function defines an \(\lambda template type \rangle \) taking \(\lambda number of arguments \rangle \), where the \(\text{type}\)\) is an abstraction as discussed above. For example,

```
\NewTemplateType{sectioning}{3}
```

creates a type "sectioning", where each use of that type will need three arguments.

5 Templates

A template is a generalized design solution for representing the information of a specified type. Templates that do the same thing, but in different ways, are grouped together by their type and given separate names. There are two important parts to a template:

- the parameters it takes to vary the design it is producing;
- the implementation of the design.

As a document author or designer does not care about the implementation but rather only the interface to the template, these two aspects of the template definition are split into two independent declarations, \DeclareTemplateInterface and \DeclareTemplateCode.

```
\DeclareTemplateInterface \DeclareTemplateInterface
                                               \{\langle type \rangle\} \{\langle template \rangle\} \{\langle no. of args \rangle\}
                                               \{\langle key \ list \rangle\}
```

A (template) interface is declared for a particular (type), where the (number of arguments) must agree with the type declaration. The interface itself is defined by the (key list), which is itself a key-value list taking a specialized format:

```
\langle \texttt{key1} \rangle : \langle \texttt{key type1} \rangle ,
\langle \texttt{key2} \rangle : \langle \texttt{key type2} \rangle ,
\langle \text{key3} \rangle : \langle \text{key type3} \rangle = \langle \text{default3} \rangle,
\langle \text{key4} \rangle : \langle \text{key type4} \rangle = \langle \text{default4} \rangle,
```

Each (key) name should consist of ASCII characters, with the exception of ,, = and :. The recommended form for key names is to use lower case letters, with dashes to separate out different parts. Spaces are ignored in key names, so they can be included or missed out at will. Each (key) must have a (key type), which defines the type of input that the $\langle \mathbf{key} \rangle$ requires. A full list of key types is given in Table 1. Each key may have a $\langle default \rangle$ value, which will be used in by the template if the $\langle key \rangle$ is not set explicitly. The (default) should be of the correct form to be accepted by the (key type) of the (key): this is not checked by the code. Expressions for numerical values are evaluated when the template is used, thus for example values given in terms of em or ex will be set respecting the prevailing font.

Key-type	Description of input	
boolean	true or false	
$choice\{\langle choices \rangle\}$	A list of pre-defined $\langle choices \rangle$	
commalist	A comma-separated list	
$\mathtt{function}\{\langle N \rangle\}$	A function definition with N arguments (N from 0 to 9)	
$instance\{\langle name \rangle\}$	An instance of type $\langle name \rangle$	
integer	An integer or integer expression	
length	A fixed length	
muskip	A math length with shrink and stretch components	
real	A real (floating point) value	
skip	A length with shrink and stretch components	
tokenlist	A token list: any text or commands	

Table 1: Key-types for defining template interfaces with \DeclareTemplateInterface.

$\verb|\KeyValue \KeyValue {$\langle key\ name \rangle$}|$

There are occasions where the default (or value) for one key should be taken from another. The **\KeyValue** function can be used to transfer this information without needing to know the internal implementation of the key:

Key-type	Description of binding
boolean	Boolean variable, e.g. \l_tmpa_bool
choice	List of choice implementations (see Section 6)
commalist	Comma list, e.g. \l_tmpa_clist
function	Function taking N arguments, $e.g. \sl = i:nn$
instance	
integer	Integer variable, e.g. \l_tmpa_int
length	Dimension variable, e.g. \l_tmpa_dim
muskip	Muskip variable, e.g. \l_tmpa_muskip
real	Floating-point variable, e.g. \l_tmpa_fp
skip	Skip variable, e.g. \1_tmpa_skip
tokenlist	Token list variable, e.g. \l_tmpa_tl

Table 2: Bindings required for different key types when defining template implementations with \DeclareTemplateCode. Apart from code, choice and function all of these accept the key word global to carry out a global assignment.

\DeclareTemplateCode \DeclareTemplateCode

```
\{\langle type \rangle\} \{\langle template \rangle\} \{\langle no. of args \rangle\}
```

 $\{\langle key \ bindings \rangle\} \ \{\langle code \rangle\}$

The relationship between a templates keys and the internal implementation is created using the \DeclareTemplateCode function. As with \DeclareTemplateInterface, the (template) name is given along with the (type) and (number of arguments) required. The (key bindings) argument is a key-value list which specifies the relationship between each $\langle key \rangle$ of the template interface with an underlying $\langle variable \rangle$.

```
\langle key1 \rangle = \langle variable1 \rangle,
\langle \text{key2} \rangle = \langle \text{variable2} \rangle,
\langle key3 \rangle = \text{global } \langle variable3 \rangle,
\langle key4 \rangle = global \langle variable4 \rangle,
. . .
```

With the exception of the choice, code and function key types, the (variable) here should be the name of an existing LATEX3 register. As illustrated, the key word "global" may be included in the listing to indicate that the (variable) should be assigned globally. A full list of variable bindings is given in Table 2.

The $\langle code \rangle$ argument of \DeclareTemplateCode is used as the replacement text for the template when it is used, either directly or as an instance. This may therefore accept arguments #1, #2, etc. as detailed by the (number of arguments) taken by the type.

\AssignTemplateKeys \AssignTemplateKeys

In the final argument of \DeclareTemplateCode the assignment of keys defined by the template may be delayed by including the command \AssignTemplateKeys. If this is not present, keys are assigned immediately before the template code. If an \AssignTemplateKeys command is present, assignment is delayed until this point. Note that the command must be directly present in the code, not placed within a nested command/macro.

```
\SetKnownTemplateKeys
\SetTemplateKeys
\UnusedTemplateKeys
```

In the final argument of \DeclareTemplateCode one can also overwrite (some of) the current template key value settings by using the command \SetKnownTemplateKeys or \SetTemplateKeys, i.e., they can overwrite the template default values and the values assigned by the instance.

The \SetKnownTemplateKeys and \SetTemplateKeys commands are only supported within the code of a template; using them elsewhere has unpredictable results. If they are used together with \AssignTemplateKeys then the latter command should come first in the template code.

The main use case for these commands is the situation where there is an argument (normally #1) to the template in which a key/value list can be specified that overwrites the normal settings. In that case one could use

```
\SetKnownTemplateKeys{\langle type \rangle} {\langle template \rangle} {\#1}
```

to process this key/value list inside the template.

If \SetKnownTemplateKeys is executed and the \(\keyvals \) argument contains keys not known to the \(\template \) they are simply ignored and stored in the tokenlist \\UnusedTemplateKeys without generating an error. This way it is possible to apply the same key/val list specified by the user on a document-level command or environment to several templates, which is useful, if the command or environment is implemented by calling several different template instances.

As a variation of that, you can use this key/val list the first time, and for the next template instance use what remains in \U nusedTemplateKeys (i.e., the key/val list with only the keys that have not been processed previously). The final processing step could then be \S etTemplateKeys, which unconditionally attempts to set the $\langle keyvals \rangle$ received in its third argument. This command complains if any of them are unknown keys. Alternatively, you could use \S etKnownTemplateKeys and afterwards check whether \U nusedTemplateKeys is empty.

For example, a list, such as enumerate, is made up from a blockenv, block, list, and a para template and in the single user-supplied optional argument of enumerate key/values for any of these templates might be specified.

In fact, in the particular example of list environments, the supplied key/value list is also saved and then applied to each \item which is implemented through an item template. This way, one can specify one-off settings for all the items of a single list (on the environment level), as well as to individual items within that list (by specifying them in the optional argument of an \item). With \SetKnownTemplateKeys and \SetTemplateKeys working together, it is possible to provide this flexibility and still alert the user when one of their keys is misspelled.

On the other hand you may want to allow for "misspellings" without generating an error or a warning. For example, if you define a template that accepts only a few keys, you might just want to ignore anything specified in the source when you use this template in place of a different one, without the need to alter the document source. Or you might

¹Using \SetTemplateKeys exposes the inner structure of the template keys when generating an error. This is something one may want to avoid as it can be confusing to the user, especially if several templates are involved. In that case use \SetKnownTemplateKeys and afterwards check whether \UnusedTemplateKeys is empty; if it is not empty then generate your own error message.

just generate a warning message, which is easy, given that the unused key/values are available in the \UnusedTemplateKeys variable.

```
\DeclareTemplateCopy \DeclareTemplateCopy
                                       \{\langle type \rangle\} \ \{\langle template2 \rangle\} \ \{\langle template1 \rangle\}
```

Copies (template1) of (type) to a new name (template2): the copy can then be edited independent of the original.

6 Multiple choices

The choice key type implements multiple choice input. At the interface level, only the list of valid choices is needed:

```
\DeclareTemplateInterface { foo } { bar } { 0 }
 { key-name : choice { A, B, C } }
```

where the choices are given as a comma-list (which must therefore be wrapped in braces). A default value can also be given:

```
\DeclareTemplateInterface { foo } { bar } { 0 }
  \{ \text{ key-name : choice } \{ A, B, C \} = A \}
```

At the implementation level, each choice is associated with code, using a nested key-value list.

```
\DeclareTemplateCode { foo } { bar } { 0 }
    key-name =
      {
       A = Code-A ,
       B = Code-B ,
        C = Code-C
      }
   }
   { ... }
```

The two choice lists should match, but in the implementation a special unknown choice is also available. This can be used to ignore values and implement an "else" branch:

```
\DeclareTemplateCode { foo } { bar } { 0 }
    key-name =
      {
        Α
                = Code-A ,
                = Code-B ,
                = Code-C ,
        unknown = Else-code
   { ... }
```

The unknown entry must be the last one given, and should not be listed in the interface part of the template.

For keys which accept the values true and false both the boolean and choice key types can be used. As template interfaces are intended to prompt clarity at the design level, the boolean key type should be favored, with the choice type reserved for keys which take arbitrary values.

7 Instances

After a template is defined it still needs to be put to use. The parameters that it expects need to be defined before it can be used in a document. Every time a template has parameters given to it, an *instance* is created, and this is the code that ends up in the document to perform the typesetting of whatever pieces of information are input into it.

For example, a template might say "here is a section with or without a number that might be centered or left aligned and print its contents in a certain font of a certain size, with a bit of a gap before and after it" whereas an instance declares "this is a section with a number, which is centered and set in 12 pt italic with a 10 pt skip before and a 12 pt skip after it". Therefore, an instance is just a frozen version of a template with specific settings as chosen by the designer.

\DeclareInstance \DeclareInstance

```
\{\langle type \rangle\} \{\langle instance \rangle\} \{\langle template \rangle\} \{\langle parameters \rangle\}
```

This function uses a \(\text{template}\) for an \(\text{type}\) to create an \(\text{instance}\). The \(\text{instance}\) will be set up using the (parameters), which will set some of the (keys) in the $\langle template \rangle$.

As a practical example, consider a type for document sections (which might include chapters, parts, sections, etc.), which is called sectioning. One possible template for this type might be called basic, and one instance of this template would be a numbered section. The instance declaration might read:

```
\DeclareInstance { sectioning } { section-num } { basic }
 {
   numbered
                  = true ,
    justification = center ,
                  =\normalsize\itshape ,
    before-skip
                  = 10pt,
    after-skip
                  = 12pt,
```

Of course, the key names here are entirely imaginary, but illustrate the general idea of fixing some settings.

\IfInstanceExistsT \IfInstanceExistsF \IfInstanceExistsTF

```
\verb| IfInstanceExistsTF {$\langle type \rangle$} {$\langle instance \rangle$} {$\langle true \ code \rangle$} {$\langle false \ code \rangle$}
```

Tests if the named $\langle instance \rangle$ of a $\langle type \rangle$ exists, and then inserts the appropriate code into the input stream.

\DeclareInstanceCopy

```
\DeclareInstanceCopy
```

```
\{\langle type \rangle\} \ \{\langle instance2 \rangle\} \ \{\langle instance1 \rangle\}
Copies the \langle values \rangle for \langle instance1 \rangle for an \langle type \rangle to \langle instance2 \rangle.
```

8 Document interface

After the instances have been chosen, document commands must be declared to use those instances in the document. \UseInstance calls instances directly, and this command should be used internally in document-level mark-up.

\UseInstance \UseInstance

```
\{\langle type \rangle\} \{\langle instance \rangle\} \langle arguments \rangle
```

Uses an $\langle instance \rangle$ of the $\langle type \rangle$, which will require $\langle arguments \rangle$ as determined by the number specified for the $\langle type \rangle$. The $\langle instance \rangle$ must have been declared before it can be used, otherwise an error is raised.

```
\UseTemplate \UseTemplate \{\langle type \rangle\} \{\langle template \rangle\}
                            \{\langle settings \rangle\} \langle arguments \rangle
```

Uses the $\langle template \rangle$ of the specified $\langle type \rangle$, applying the $\langle settings \rangle$ and absorbing $\langle arguments \rangle$ as detailed by the $\langle type \rangle$ declaration. This in effect is the same as creating an instance using \DeclareInstance and immediately using it with \UseInstance, but without the instance having any further existence. This command is therefore useful when a template needs to be used only once.

This function can also be used as the argument to instance key types:

```
\DeclareInstance { type } { template } { instance }
  {
    instance-key =
      \UseTemplate { type2 } { template2 } { <settings> }
  }
```

9 Changing existing definitions

Template parameters may be assigned specific defaults for instances to use if the instance declaration doesn't explicit set those parameters. In some cases, the document designer will wish to edit these defaults to allow them to "cascade" to the instances. The alternative would be to set each parameter identically for each instance declaration, a tedious and error-prone process.

```
\EditTemplateDefaults \EditTemplateDefaults
```

```
\{\langle type \rangle\} \{\langle template \rangle\} \{\langle new defaults \rangle\}
```

Edits the $\langle defaults \rangle$ for a $\langle template \rangle$ for an $\langle type \rangle$. The $\langle new\ defaults \rangle$, given as a key-value list, replace the existing defaults for the (template). This means that the change will apply to instances declared after the editing, but that instances which have already been created are unaffected.

\EditInstance \EditInstance

```
\{\langle type \rangle\} \{\langle instance \rangle\} \{\langle new \ values \rangle\}
```

Edits the \(\forall values \rangle \) for an \(\lambda instance \rangle \) for an \(\lambda type \rangle \). The \(\lambda new values \rangle \), given as a keyvalue list, replace the existing values for the (instance). This function is complementary to \EditTemplateDefaults: \EditInstance changes a single instance while leaving the template untouched.

9.1 Expanding the values of keys

To allow the user to apply expansion of values when the key is set, key names can be followed by an expansion specifier. This is given by appending: and a single letter specifier to the key name. These letters are the normal argument specifiers for expl3, thus they may be one of n (redundant but supported), o, v, e, n (again redundant) or e. Expansion of a control sequence name is particularly useful when you need to refer to an internal LaTeX 2ε or an L3 programming layer variable, e.g.,

```
key-a:c = @itemdepth , % use \\@itemdepth  as the value key-b:v = @itemdepth % use the current value of \\@itemdepth  as the value
```

10 Getting information about templates and instances

```
| ShowInstanceValues | ShowInstanceValues | ShowInstance| | Shows the | Values| | for an | Values| | for an
```

Shows the (variables) and associated (keys) of a (template) for an (type) in the terminal. Note that code and choice keys do not map directly to variables but to arbitrary code. For choice keys, each valid choice is shown as a separate entry in the list, with the key name and choice separated by a space, for example

```
Template 'example' of type 'example' has variable mapping:
> demo unknown => \def \demo {?}
> demo c => \def \demo {c}
> demo b => \def \demo {b}
> demo a => \def \demo {a}.
```

would be shown for a choice key demo with valid choices a, b and c, plus code for an unknown branch.

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