The xtemplate package
Prototype document functions*

The LaTeX3 Project†

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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 TeX 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.

LaTeX'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 LaTeX 2_ε classes look somewhat dated now in terms of their visual design, their typography is generally sound. (Barring the occasional minor faults.)

However, LaTeX 2_ε 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 customisation.

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

The idea behind xtemplate 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. xtemplate also makes it easier for LaTeX programmers to provide their own customisations on top of a pre-existing class.

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1 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 itemised 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 object types, templates, and instances, and they are discussed below in sections 3, 4, and 6, respectively.

2 Objects, templates, and instances

By formally declaring documents to be composed of mark-up elements grouped into objects, 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 TEX grouping.

3 Object types

An *object type* (sometimes just "object") 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 object, for example, might take three inputs: "title", "short title", and "label".

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

\DeclareObjectType

`\DeclareObjectType {⟨object type⟩} {⟨no. of args⟩}`

This function defines an ⟨*object type*⟩ taking ⟨*number of arguments*⟩, where the ⟨*object type*⟩ is an abstraction as discussed above. For example,

```
\DeclareObjectType{sectioning}{3}
```

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

4 Templates

A *template* is a generalised design solution for representing the information of a specified object type. Templates that do the same thing, but in different ways, are grouped together by their object 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`
`{⟨object type⟩} {⟨template⟩} {⟨no. of args⟩}`
`{⟨key list⟩}`

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

⟨*key1*⟩ : ⟨*key type1*⟩ ,
⟨*key2*⟩ : ⟨*key type2*⟩ ,
⟨*key3*⟩ : ⟨*key type3*⟩ = ⟨*default3*⟩ ,
⟨*key4*⟩ : ⟨*key type4*⟩ = ⟨*default4*⟩ ,
...

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 defined the type of input that the ⟨*key*⟩ requires. A full list of key types is given in Table 1. Each key may have a ⟨*default*⟩ value, which will be used in by the template if the ⟨*key*⟩ 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.

Key-type	Description of input
`boolean`	`true` or `false`
`choice{`⟨*choices*⟩`}`	A list of pre-defined ⟨*choices*⟩
`code`	Generalised key type: use `#1` as the input to the key
`commalist`	A comma-separated list
`function{`⟨N⟩`}`	A function definition with N arguments (N from 0 to 9)
`instance{`⟨*name*⟩`}`	An instance of type ⟨*name*⟩
`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`.

`\KeyValue` `\KeyValue {`⟨*key name*⟩`}`

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:

```
\DeclareTemplateInterface { object } { template } { no. of args }
  {
    key-name-1 : key-type = value ,
    key-name-2 : key-type = \KeyValue { key-name-1 },
    ...
  }
```

Key-type	Description of binding
`boolean`	Boolean variable, *e.g.* `\l_tmpa_bool`
`choice`	List of choice implementations (see Section 5)
`code`	⟨*code*⟩ using `#1` as input to the key
`commalist`	Comma list, *e.g.* `\l_tmpa_clist`
`function`	Function taking N arguments, *e.g.* `\use_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.* `\l_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
  {⟨object type⟩} {⟨template⟩} {⟨no. of args⟩}
  {⟨key bindings⟩} {⟨code⟩}
```

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 ⟨*object type*⟩ and ⟨*number of arguments*⟩ required. The ⟨*key bindings*⟩ argument is a key–value list which specifies the relationship between each ⟨*key*⟩ of the template interface with an underlying⟨*variable*⟩.

⟨*key1*⟩ = ⟨*variable1*⟩,
⟨*key2*⟩ = ⟨*variable2*⟩,
⟨*key3*⟩ = global ⟨*variable3*⟩,
⟨*key4*⟩ = global ⟨*variable4*⟩,
...

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 ⟨*code*⟩ 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 object type.

\AssignTemplateKeys

\AssignTemplateKeys

In the final argument of \DeclareTemplateCode the assignment of keys defined by the template is carried out by using the function \AssignTemplateKeys. Thus no keys are assigned if this is missing from the ⟨*code*⟩ used.

\EvaluateNow

\EvaluteNow {⟨*expression*⟩}

The standard method when creating an instance from a template is to evaluate the ⟨*expression*⟩ when the instance is used. However, it may be desirable to calculate the value when declared, which can be forced using \EvaluateNow. Currently, this functionality is regarded as experimental: the team have not found an example where it is actually needed, and so it may be dropped *if* no good examples are suggested!

5 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 }
  { 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 =
      {
```

```
      A       = Code-A ,
      B       = Code-B ,
      C       = 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 favoured, with the choice type reserved for keys which take arbitrary values.

6 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 centred 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 centred 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
  {⟨object type⟩} {⟨instance⟩} {⟨template⟩} {⟨parameters⟩}
```

This function uses a ⟨*template*⟩ for an ⟨*object type*⟩ to create an ⟨*instance*⟩. The ⟨*instance*⟩ will be set up using the ⟨*parameters*⟩, which will set some of the ⟨*keys*⟩ in the ⟨*template*⟩.

As a practical example, consider an object type for document sections (which might include chapters, parts, sections, *etc.*), which is called `sectioning`. One possible template for this object 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 ,
    font          =\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.

\IfInstanceExist*TF*

```
\IfInstanceExistTF {⟨object type⟩} {⟨instance⟩} {⟨true code⟩} {⟨false code⟩}
```

Tests if the named ⟨*instance*⟩ of a ⟨*object type*⟩ exists, and then inserts the appropriate code into the input stream.

7 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
  {⟨object type⟩} {⟨instance⟩} ⟨arguments⟩
```

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

\UseTemplate

```
\UseTemplate {⟨object type⟩} {⟨template⟩}
  {⟨settings⟩} ⟨arguments⟩
```

Uses the ⟨*template*⟩ of the specified ⟨*object type*⟩, applying the ⟨*settings*⟩ and absorbing ⟨*arguments*⟩ as detailed by the ⟨*object type*⟩ 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. It is therefore useful where a template needs to be used once.

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

```
\DeclareInstance { object } { template } { instance }
  {
    instance-key =
      \UseTemplate { object2 } { template2 } { <settings> }
  }
```

8 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
  {⟨object type⟩} {⟨template⟩} {⟨new defaults⟩}
```

Edits the ⟨*defaults*⟩ for a ⟨*template*⟩ for an ⟨*object type*⟩. The ⟨*new defaults*⟩, 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
  {⟨object type⟩} {⟨instance⟩} {⟨new values⟩}
```

Edits the ⟨*values*⟩ for an ⟨*instance*⟩ for an ⟨*object type*⟩. The ⟨*new values*⟩, given as a key–value 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 When template parameters should be frozen

A class designer may be inheriting templates declared by someone else, either third-party code or the LaTeX kernel itself. Sometimes these templates will be overly general for the purposes of the document. The user should be able to customise parts of the template instances, but otherwise be restricted to only those parameters allowed by the designer.

\DeclareRestrictedTemplate

```
\DeclareRestrictedTemplate
  {⟨object type⟩} {⟨parent template⟩} {⟨new template⟩}
  {⟨parameters⟩}
```

Creates a copy of the ⟨*parent template*⟩ for the ⟨*object type*⟩ called ⟨*new template*⟩. The key–value list of ⟨*parameters*⟩ applies in the ⟨*new template*⟩ and cannot be changed when creating an instance.

10 Getting information about templates and instances

\ShowInstanceValues

```
\ShowInstanceValues {⟨object type⟩} {⟨instance⟩}
```

Shows the ⟨*values*⟩ for an ⟨*instance*⟩ of the given ⟨*object type*⟩ at the terminal.

\ShowTemplateCode

```
\ShowTemplateCode {⟨object type⟩} {⟨template⟩}
```

Shows the ⟨*code*⟩ of a ⟨*template*⟩ for an ⟨*object type*⟩ in the terminal.

\ShowTemplateDefaults

```
\ShowTemplateDefaults {⟨object type⟩} {⟨template⟩}
```

Shows the ⟨*default*⟩ values of a ⟨*template*⟩ for an ⟨*object type*⟩ in the terminal.

\ShowTemplateInterface

```
\ShowTemplateInterface {⟨object type⟩} {⟨template⟩}
```

Shows the ⟨*keys*⟩ and associated ⟨*key types*⟩ of a ⟨*template*⟩ for an ⟨*object type*⟩ in the terminal.

\ShowTemplateVariables

```
\ShowTemplateVariables {⟨object type⟩} {⟨template⟩}
```

Shows the ⟨*variables*⟩ and associated ⟨*keys*⟩ of a ⟨*template*⟩ for an ⟨*object 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 object 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.

11 Collections

The implementation of templates includes a concept termed “collections”. The idea is that by activating a collection, a set of instances can rapidly be set up. An example use case would be collections for `frontmatter`, `mainmatter` and `backmatter` in a book. This

mechanism is currently implemented by the commands `\DeclareCollectionInstance`, `\EditCollectionInstance` and `\UseCollection`. However, while the idea of switchable instances is a useful one, the team feel that collections are not the correct way to achieve this, at least with the current approach. As such, the collection functions should be regarded as deprecated: they remain available to support existing code, but will be removed when a better mechanism is developed.

`\ShowCollectionInstanceValues` `\ShowInstanceValues {⟨collection⟩} {⟨object type⟩} {⟨instance⟩}`

Shows the ⟨*values*⟩ for an ⟨*instance*⟩ within a ⟨*collection*⟩ of the given ⟨*object type*⟩ at the terminal. As for other collection commands, this should be regarded as deprecated.

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