# Templater user manual

v4.0

9/11/2019

New Generation Software Ltd
Rikard Pavelic

# Content

# About

## New Generation Software Ltd.

N.G.S. is a software company founded in 2005 by Rikard Pavelic in Croatia. It focuses on making software development easier and more productive. Since its early days Templater-like solutions were used for reporting/document generation. Once we realized such an approach would be useful to others, N.G.S. released Templater v1.0 in 2011.

N.G.S. primary focus is on providing consulting around its software products.

## Templater

Templater focuses on binding data with documents. This allows customization of templates by business users/end clients.

Unlike other reporting libraries which focus on document layout through low level API, Templater in comparison only has high level API. This way document layout is not defined in code, but rather provided outside, often by designers, domain experts experienced with Excel or even end users of the software.

While Templater is not a generic reporting solution it can be used to create really complex documents, but often this will require knowledge of Word, Excel and PowerPoint to setup such documents.

Templater is used by wide variety of companies and non-profits around the world, from large banks to small startups.

# Supported documents

## Office Open XML

Templater main focus is to support Microsoft Office formats based on XML. Word, Excel and PowerPoint support new XML based format which is standardized by ISO since 2007.

To support such formats Templater must understand many of the features supported by Word, Excel and PowerPoint. Templater is written in such a way that new Word, Excel and PowerPoint versions work out of the box for most old and new features. Only in specific scenario a new version is required to support some specific feature of the new Microsoft Office tools.

Supported extensions:

- docx - standard Word XML format
- docm - macro-enabled Word format
- xlsx - standard Excel XML format
- xlsm - macro-enabled Excel format
- pptx - standard Presentation XML format
- pptm - macro-enabled Presentation format

Some features require combination of documents/formats, e.g. chart in a Word/PowerPoint requires the use of xlsx embedded within the docx/pptx. Templater supports such features seamlessly.

Use of XML based formats requires a valid license; otherwise a watermark message will be left in the document.

## Text based formats

Unlike XML based formats which require a valid license, text based formats can be used for free without buying a license.

Common use case for text based formats are CSV (with streaming support), simple message generation (such as configurable SMS message) or white labeling specific HTML based outputs.

When passing in extensions to Templater, specific ones will be recognized:

- csv - Comma Separated Values format
- txt - text based format
- utf8 - text based format using UTF-8 encoding

All extensions use same processing method, with the only difference being that utf8 extension uses explicit UTF-8 encoding, while the others use system/input default encoding.

# Supported languages

Source code is written in two different languages for different platforms. C# is used for Microsoft .NET, while Scala/Java is used for JVM. There is feature parity between the languages, as much as languages allow for it. Whenever a new version is released features are built for each language separately.

Since dynamic structures are natively supported, Templater is usable from command line or as JSON endpoint, which makes it easily usable from other languages.

Demo page provides a nice example of Templater support for JSON. While there is no in-built support for JSON, when JSON is transformed into appropriate lists and maps/dictionaries it can be processed by Templater.

## Microsoft .NET

Templater is released for several Microsoft .NET versions:

- .NET v3.5
- .NET v4.0
- .NET standard v2.0

This means Templater works on all relevant versions of .NET:

- legacy Microsft .NET Framework - Windows only
- .NET core - new, cross platform version of Microsoft .NET

While Templater works on Mono, it is not officially supported on that platform. We do encourage bug reporting for Mono, but if a bug requires extensive workaround it's unlikely it will be fixed.

Nuget can be used to add Templater dependency.

## Oracle Java

Templater supports Java 6 and newer versions. There is no special use of internal APIs, so Templater works out-of-the box on new Java versions such as Java 11. Templater for Java is a no dependency jar without any external dependency.

Maven can be used to add Templater dependency.

For JVM there is a separate Scala build for versions: 2.11, 2.12 and 2.13.

When Scala builds are used, Scala specific data types can be used, such as Option and collections.

## Google Android

With minor setup modifications, Templater also works on Android. Both Java and Scala versions can be used, but due to minor differences some initial configuration tweaks are required:

- use of Xalan XML instead of builtin Android one (does not support all required features)
- disable of default awt image conversions (awt images are not available on Android)

## Others

### JSON

Common use case is to pass in JSON to Templater. For this to work JSON must be transformed in appropriate data structures. In Java those are arrays, lists and maps and for .NET their counterparts: arrays, lists and dictionaries.

Maps/Dictionaries must have string as keys, meaning only:

- IDictionary<string, object>
- Map<String, Object>
- IDictionary/HashTable
- Map

with strings as keys are supported.

In .NET default JSON.NET conversion is not supported, but rather an alternative conversion method must be used.

Github example shows how Templater can be used from a command line by passing JSON with a template document to Templater for processing. It also has a .NET implementation for JSON -> Dictionary conversion which works as expected in Templater.

### HTTP server

While there is no build of Templater for Javascript, it's rather easy to consume it through HTTP API. Templater demo page is a small application which provides various other functionalities and can be used as a starting point for building internal applications which use Templater though REST API.

Templater server application also shows how a third party application can be used to complement document generation by doing PDF conversion via LibreOffice.

# Getting started

Only a couple lines of code are required to use Templater API. While the main Templater API is very small, Templater can be configured with custom code which makes it highly customizable and allows support for all kinds of use cases.

Templater can be tested through the browser in an online demo which is just a simple application that shows few basic use cases.

All features of Templater are available for testing without buying a license in which case Templater will inject a watermark message into the document. Templater comes with a license designed for easy integration into third party applications. It is not allowed to remove the watermark message from the generated documents which will be removed once a valid license is used during the initialization.

Many examples are available at Github and customers will often be referred to the example relevant to their question.

## Tags

Templater works by analyzing document and locating tags within the document. Tags can come in 3 different formats:

- [[TAG]]
- {{TAG}}
- <<TAG>>

Tag format can be customized/disabled during library initialization. This is explained in more detail later in the documentation.

## Metadata

Tags can have metadata. Metadata is an additional info put alongside tag which is used by Templater to invoke some specific actions and often combined with custom code registered during library initialization. Metadata is defined by semicolon and a pattern. There can be multiple metadata on a tag. Special characters must be escaped with a backslash (\). Metadata are processed in order of the definition.

Examples of metadata:

- [[tag1]:format]
- {{tag2}:format(YYMMDD):padLeft(10)]
- <<tag3>:empty(value was missing)]

## Minimal API

There are only a handful of methods in Templater:

- Configuring library
  - **Factory** - for default configuration without any plugins. License file: *templater.lic* will be resolved from relevant places (resource in the project and the root folder)
  - **Builder** - for configuring library with various custom behavior
- Opening and closing/flushing the document
  - **Open**(file) - processing file in place
  - **Open**(input stream, output stream, extension) - reading template from input stream and writing it to output stream. Depending on the extension and the usage additional in-memory stream can/will be used, alongside with continuous streaming to output while processing
- High level:
  - ***Process*(**data**) -** accepts various data types and process it according to either build rules or via custom code defined for specific types
- Low level:
  - ***Resize*(**tags, count) - resizes (duplicates) part of the document which contains all specified tags. When count = 0 part of the document will be removed
  - ***Replace***(tag, value) - replaces first matching tag in the document
  - ***Replace***(tag, index, value) - replaces tag at specified position
  - ***GetMetadata***(tag, all) - returns user defined metadata for the tag (either first or for all of them)
  - ***GetMetadata***(tag, index) - provides both user defined and internal metadata for the tag at specified index. Internal metadata is used by the library to detect appropriate parts of the document and relationship between tags
  - ***Tags*** - lists all current tags detected in the document. Once a specific tag is processed it will be removed from this list

Most usage of Templater consists solely from using high level API. Low level API is mostly used by Templater internals or third party plugins.

Builder/Configuration API is explained in more detail later in the documentation.

A short description of each method is available via native documentation. Javadoc can also be browsed online.

## Pros and cons of minimal API

While high level API is deceptively simple, depending on the types of the data passed in and on the plugins (either built-in or custom registered during initialization) Templater can perform various non-trivial operations on the document:

- image - picture will be inserted into the document
- two dimensional array/data table - dynamic resize feature of Templater will be invoked
- XML - raw XML can be inserted into the document

- URL - a link will be added into the document

So while API is rather simple, to fully master the use of Templater various examples should be explored to learn all minor details which can be used to tweak behavior during processing.

Major benefit of minimal API is that once data is designed/defined it is no longer required to change interaction with the library. This simplifies change requests and increases code reuse. When dynamic data types are used, such as maps/dictionaries, often no code changes are required. Examples of this would be:

- ResultSet/Data table processing is independent of the SQL which populates them
- Dictionaries/Maps can be processed without any code changes
- data types used for presentation can be reused for reporting

While benefits heavily outweigh the downsides, there are some and often developers need to unlearn some habits carried from other reporting libraries:

- its non-obvious that Image data type must be used to inject image into the document
- since there is no API for setting color of a font, such customizations require Templater specific way of doing things
- processing collections without for loops and start/stop definitions often require mind-shift for developers used to explicit imperative style of document generation

## Setting up a project

While there are numerous project examples at Github, such as the most simple one it is rather trivial to setup the project.

### .NET project example

1. In a C# project add a reference to Templater via Nuget: ***Install-Package Templater***
2. Prepare a Word file with tag [[tag]] and add it to the project
3. Initialize the library to create reusable factory:
   ```
   var factory = Configuration.Factory;
   ```
4. Open the document for processing with using pattern:
   ```
   using(var doc = factory.Open("template.docx"))
   ```
5. Process the document using high level API:
   ```
   doc.Process(new { tag = "value" });
   ```
6. At the end of using there is an implicit call to finish the processing:
   ```
   doc.Dispose();
   ```

During the call to Dispose Templater will flush the result of processing to the output stream, or in this case to the opened template.docx file.

### Java project example

1. In Java Maven project add a dependency to Templater:
   ```
   <dependency>
       <groupId>hr.ngs.templater</groupId>
   ```

```
        <artifactId>templater</artifactId>
        <version>4.0.0</version>
</dependency>
```

2. Prepare a Word file with tag [[tag]] and add it to project resources
3. Initialize the library to create reusable factory:
   `IDocumentFactory factory = Configuration.factory();`
4. Open the document for processing:
   `ITemplateDocument doc = factory.open("template.docx");`
5. Process the document using high level API:
   `doc.process(new HashMap<>(){{put("tag", "value");}});`
6. Flush the result to finish the processing:
   `doc.flush();`

## Providing license information

Before Templater can be used without a watermark message, valid license info must be specified during initialization. There are multiple ways to specify the license info:

- license can be embedded into the project as *templater.lic* file[1]
  - during initialization Templater will scan the project resources for the file with exact name
- license information can be specified during initialization via **Builder.Build**(customer, license)
- license file can be specified during initialization via **Builder.Build**(path)

## Thread safety

Once factory was initialized it can be reused to open/process/flush templates. Factory can be reused concurrently across threads as it is thread safe. *ITemplateDocument* instance created from the factory is not thread safe and should not be concurrently used from different threads.

Templater is thread aware and will respect thread interrupt/abort and thus cancel its processing. This can be used to guard against memory starvation since XML can be quite memory heavy[2].

## Built-in processors and analysis

Various data types will work out of the box, such as:

- collections (arrays, lists, iterators, ...)
- maps and dictionaries
- result set/data reader
- data table/data set
- objects via reflection

[1] .NET example: https://github.com/ngs-doo/TemplaterExamples/blob/0b21f41fb97163c0895100bc7114d169aa5d4c89/Beginner/WebExample%20(.NET)/TemplaterWeb.csproj#L98

[2] There are certain alternatives in Java which can improve the memory usage of XML with Templater

When data is passed to high level API best match is found for the provided input. Once match is found data is processed by the appropriate processor. During processing Templater will navigate over objects/data and process parts of the object via other appropriate processors.

Data is matched against the tags which were analyzed at the start of processing. Once document is analyzed, result of the analysis is available via various methods (**GetMetadata**) and properties (**Tags**).

Processors will try to use only the relevant tags, which mean that it's fine to call high level **Process** method multiple times which will only affect relevant parts of the document.

Processors can create new tags via **Resize** API or remove them via **Replace** API. Tags created via **Resize** API will be available for new processing. New tags can't be created[3] via the **Replace** API even if value is used which looks like a tag, eg: **Replace("tag", " [[newTag]]")**

Processing of streams can be chained and thus new tags created from the previous processing which is no longer available for processing can be processed in subsequent processing.

Built-in object processor will only use public fields and methods. While classes do not need to be public, in Java it is highly recommended that classes are public since otherwise performance overhead will be incurred or processing can fail due to lack of security permissions.

Java beans standard is supported for method names (which makes templates more readable).

[3] There is a way to create new tags by combining replace with a resize, but that is not a common API usage

# Application Programming Interface

While there are not many methods in Templater API, they can be used in variety of ways and by combining them in specific patterns complex operations can be performed.

The API is small on purpose, to encourage generic data binding instead of programming document layout through code.

## Low-level API

*ITemplater* is often referred as low level API since it works at the lowest level which is just an abstraction over the document format. There are only few methods, but with few overloads:

```
public interface ITemplater
{
        IEnumerable<string> Tags { get; }
        string[] GetMetadata(string tag, bool all);
        string[] GetMetadata(string tag, int index);
        bool Replace(string tag, object value);
        int Replace(string tag, int index, object value);
        bool Resize(IEnumerable<string> tags, int count);
        IEnumerable<ITemplater> Clone(int count);
}
```

While low level API is rarely used there are use cases when it's useful to use it:

- writing custom data type processors
- writing custom handlers (especially for removing region of the documents)
- implementing custom CSV streaming on objects
- analyzing document and rewriting it into a different processing format
- checking if all tags are processed at the end - it is often that templates are provided with typos or designed in some wrong way; in which case it's useful to explain the problem

Some plugins are invoked when calling **Replace** method on the low level API, while some of them are not. Special datatypes are recognized, meaning that call to **ITemplater.Replace**(tag, image) will still inject image into the document.

## Tags

Once *ITemplater* is created, all tags are listed (only once) in this property. Once all occurrences of a tag have been processed this tag will no longer be listed. Since new tags can't be created with **Replace** method once processing has started, new values cannot appear in this property.

### Tag sharing

It is expected that same tag is repeated multiple times. When same tag is defined on multiple places, depending on where the tags are detected they can enter into a special sharing mode. There are different aspects to tag sharing:

- tags repeated in the same row
  - tags share the same initial context
  - low level **Replace** will only replace a single tag; to replace the other tag **Replace** must be called again
- tags repeated in a different row, but part of the same context
  - tags have different initial context, but **Resize** was called in a setup which grouped them together
  - low level **Replace** will only replace a single tag; to replace the other tag **Replace** must be called again
- tags repeated in different tables, but part of the same context
  - when same tag is used in different table, depending on the **Resize** arguments tables can enter into a special sharing arrangement
  - low level **Replace** will only replace a single tag; to replace the other tag **Replace** must be called again
- tags repeated in different sheets/slides, but used in a collection
  - when same tag is used in different sheets or slides, but duplicated via **Resize** they will enter into a special sharing arrangement
  - low level **Replace** will only replace a single tag; to replace the other tag **Replace** must be called again
- tags bound to a custom XML (Word feature only)
  - when tag is bound to a XML, multiple instances of same tag point to the same underlying value
  - low level **Replace** will replace all occurrences of the relevant tag (tag can be repeated inside a collection, in which case only occurrences of the specific row will be replaced)

## GetMetadata

Metadata is additional information defined alongside tag. There can be multiple metadata defined for a tag. They are processed in order of definition.

There are various use cases for metadata in tags:

- simple formatting
  - decimal places in numbers
  - date formatting
- type conversion
  - convert from string to an image (by looking up image from a specified location)
  - currency exchange rate conversion
- complex conversion
  - verbalizing numbers into text

Tag can be repeated in the document and they can have different metadata.

A common use case would be to repeat a DateTime field and show it as a separate date and time columns, e.g.:

| Date | Time | User |
|---|---|---|
| **[[event.on]:format(DMY)]** | [[event.on]:format(HHMM)] | [[event.user]] |

Using GetMetadata method on *event.on* tag will return:

- **GetMetadata**("event.on", false) - return the user defined metadata for the first tag. In this case this is: "format(DMY)"
- **GetMetadata**("event.on", true) - returns all user defined metadata for this tag. In this case this would be both "format(DMY)" and "format(HHMM)"
- **GetMetadata**("event.on", index) - returns both user defined and internal metadata for this tag at specific index. If invalid index was specified (negative or larger than the number of tags) null will be returned.

GetMetadata with an index is required to support advanced replacement scenarios where due to document layout tags are not replaced in order. A common use case would be to have a tag in multiple tables, but when resized only the first tag per table should be replaced.

### Escaping special characters

Depending on which tag format is used, if such a character is used within the metadata is must be escaped with a backslash (\). Also, if semicolon has to be used, it also needs to be escaped with a backslash.

For example, to format a time escape code is required in certain cases: [[event.on]:format(HH\:MM)]

### Internal metadata

When resize is used on set of tags, they become bound together via certain rules. Templater tracks this binding via internal metadata so it can process them appropriately.

Internal metadata have a "_ci:" prefix, which should be avoided for user defined metadata.

## Replace

While **Tags** and **GetMetadata** are read-only operations, **Replace** method mutates the document. The document is mutated in memory[4] until it's flushed (or Resize is called in streaming mode).

Calling a replace will replace only a single tag (except when the tag is bound to XML in Word).

Replace will ignore the metadata specified on the tag and will just replace the specified tag with the provided value. Metadata is only processed when called from a high-level API.

Even if tag format is specified as a value, new tag will not be created without a new analysis of that document region. Analysis is only done at the start (whole document) and after a resize (region only affected by the resize).

While metadata handlers are not called on low level Replace methods, low level API handler are.

[4] For Word and Excel Templater (.NET) uses a specialized stream to avoid LOH issues: https://docs.microsoft.com/en-us/dotnet/standard/garbage-collection/large-object-heap

Specialized data types also behave as "expected", e.g.: an image passed directly to low level API will still be injected[5] into the document.

### Special data types

Some formats use a specialized representation of a value, e.g.: Excel uses different representation for numbers, text and dates. Both Word and Excel support images which is also not just "a value".

Templater has special logic to handle few specific data types in OOXML formats:

- Image - will insert picture into the document at the location of the tag
  - in Java there is a special Templater image type: ImageInfo[6]
    - by default awt images are supported: BufferedImage and ImageInputStream with low-level plugins which should be disabled on Android
  - .NET supported types: Image and Icon
- XML - will insert raw XML into the document
  - this is useful to directly provide values to the underlying format in a way it's not exposed through Templater
  - there are three internal metadata handlers for doing specific operations with the XML
    - replace-xml
    - merge-xml
    - remove-old-xml
  - it's easy to corrupt the document if "invalid" XML is provided
  - .NET supported type: XElement
  - Java supported type: w3c.dom.Element
- Jagged arrays and lists[7] with elements of same dimension - invokes a Dynamic resize feature of the Templater
  - all nested lists must be of the same size
- ResultSet/DataTable - invokes a Dynamic resize feature of the Templater
- URL/URI (in Word and PowerPoint only) - will create a simple hyperlink
  - Both Excel and Word have special hyperlink features which can have separate description and link. This feature is recognized/supported by Templater
- java.util.Date/DateTime (in Excel only) - will convert value into appropriate number (unless the value is before 1900-01-01)
  - This way dates can be formatted via Excel formatting features and used in other formulas as expected values

While there is no special type for HTML, it is possible to convert HTML into equivalent OOXML format (most of the time) via third party libraries.

[5] Inserting an image works only on OOXML formats. It will not be converted to ASCII art if inserted into a text format

[6] It is common to transform the image before passing it to Templater (e.g.: resize, change DPI, etc...). A relevant example is on Github: https://github.com/ngs-doo/TemplaterExamples/tree/master/Intermediate/Pictures

[7] .NET also recognizes two dimensional arrays: https://docs.microsoft.com/en-us/dotnet/csharp/programming-guide/arrays/multidimensional-arrays

### Low level converters

Types not supported by Templater (such as OffsetDateTime or Optional<X>) can be converted into types which are recognized by Templater via plugins.

They are called by low level API before being passed to final replacement. They can be registered during library initialization.

In Java there are two low level converters registered by default - for converting awt images into Templater image data type.

## Resize

Another mutating API in Templater is resize which duplicates (when count > 1) or removes (when count = 0) parts of the document which contains all the specified tags.

Resize relies heavily on context detection - which is Templater specific way of detecting what part of the document should be affected by an operation. Unlike explicit imperative way to manage part of the document via start/stop commands and for loops, eg:

| | | |
|---|---|---|
| <for item in items> *${item.name}* | ${item.price} | ${item.total} |
| **${item.description}** </for> | | |

Templater takes an approach of implied context based on the detected tags. Equivalent table looks in Templater as:

| | | |
|---|---|---|
| *[[items.name]]* | [[items.price]] | [[items.total]] |
| **[[items.description]]** | | |

This makes document much easier to design by non-developers and it reduces the amount of problems due to bad start/stop loop definition, since they are implied by the document structure and cannot be placed at an inappropriate location.

Special case of Resize(tags, 1) which neither duplicates nor removes the content is still useful since it's used to setup the relationship between tags which is used later on resizing only the subset of tags.

Region of the document which is affected by the resize is influenced by various features of the document it operates on, such as:

- lists
- tables
- sections
- named ranges
- merge cells

Resize returns boolean which is true if the tag was matched and resize could be performed (there are cases when resize can't be performed, such as requesting to do a resize on main Word document).

## Clone

While Resize operates on the *best match* region of the document, clone always operates on the full document.

It creates isolated low level *ITemplater* regions of the documents which can be independently modified, since they do not share tags once created.

With the various improvement to context detection Clone is used less and less, but still, sometimes it's useful to work around some current limitation of the Templater.

# High level API

There is only a single high level method and access to low level API. This way developer is encouraged to prepare the data for binding instead of trying to use low level API for manual document manipulation.

**Process** can be called multiple times, which is often the case even for a single argument object, since additional system wide info can be passed into every processing that way.

```
public interface ITemplateDocument : IDisposable
{
        ITemplater Templater { get; }
        ITemplateDocument Process<T>(T data);
}
```

The only difference between Java and .NET version is the implicit Dispose()[8] call instead of explicit flush() call.

## Processors

High level API will analyze the provided object and call into appropriate processors. Additional processor can be registered during library initialization, but there are several built-in ones which cover wide area of use cases:

- object processor - works via reflection
  - will analyze class for public fields and methods without arguments
  - will call into other processors once navigation over property is detected
  - will respect internal **all** metadata
    - it instructs Templater that all tags should be replaced (this sometimes helps context detection which considers them unrelated)
- enumerable object processor - duplicates region of document with matching tags
  - best matching type is extracted from the values inside a collection - meaning signature can be an interface

[8] .NET framework guidelines advise against doing much work in Dispose method, but this way there is no need for a Close method

    - types with known size will be processed as a whole (ICollection in .NET, Collection in Java and Seq in Scala)
    - streaming types will be processed in a streaming mode
        - chunk size can be configured in configuration API
        - streaming will only work on non dictionary/map types. Templater must check if every element is a dictionary before it can processed collection as dictionary
    - will respect internal **clone** and **fixed** metadata
        - fixed metadata avoids call to resize and clears up any remaining tag after the processing
        - clone metadata calls into low level Clone instead of Resize while doing duplication
    - collection level methods (such as size) can be used (as long as they don't conflict with element level methods)
- dictionary processor - works on maps where strings are used as keys
    - can combine both dynamic keys and class fields/methods
    - will call into other processors once navigation over key is detected
    - supports keys with dot - which is not a navigation over keys
- enumerable dictionary processor - duplicates region of the document with matching tags
    - union of all keys is used to define context
    - will respect internal **clone** and **fixed** metadata
        - fixed metadata avoids call to resize and clears up any remaining tags after the processing
        - clone metadata calls into low level Clone instead of Resize
    - collection level methods often conflicts with element level methods, so they are not as useful
- ResultSet/DataReader processor - uses schema information for tag binding
    - works in streaming mode - resize is called in chunks[9] and then processed row by row
    - will leave unprocessed tags as is (instead of calling into OnUnprocessed handling)
    - respects the **fixed** metadata
        - will avoid call to the resize and clear up tags after the processing
    - calls into other processors when navigated over tag
    - supports multiple results sets (.NET only)
- DataTable (.NET only) processor - uses schema info for tag binding
    - respects the **fixed** metadata
        - will avoid call to the resize and clear up tags after the processing
    - only a single resize is performed (when fixed metadata is not used)
    - calls into other processors when navigated over tag
- DataSet (.NET only) processor - uses schema info for tag binding
    - respects the **clone** metadata
        - will use Clone instead of Resize when doing duplication

[9] streaming/chunking size can be configured during library initialization

- supports relationships between tables
- will process tables based on their dependency order

Built-in processors support thread interrupts and will quickly stop the processing if a thread is interrupted.

Processors only have access to low level API. There is no other internal API available to them. This makes them on same playing field as any of the custom processors registered during library initialization.

Object and dictionary processors can be combined: if class has both methods/fields and also implements dictionary (with all keys as strings) it will be processed for all tags (dictionary keys + methods/fields). When processed in such a way conflicting tags will be resolved to dictionary keys (in favor of methods/fields).

If same tag exists on a collection element and as a collection (e.g. Count/size), it will be resolved depending on the processor type:

- typed collection will always give preference to element methods
- dictionary collection will resolve tags in preference order:
  - dictionary keys
  - collection methods
  - element methods

### Metadata formatters

Few built-in processors will iterate over metadata formatting plugins before passing value to low level replace API. This means that while direct call into low level Replace will not invoke certain plugins, call into high level Process will. An example would be:

tag = [[date]:format(YYYY)]

where we expect it to be replaced with a 4 digit year.

Call into **ITemplater.Replace**("date", date) will show the actual date, while the call to high level **ITemplateDocument.Process**(new { date = date }) will invoke the appropriate format plugin before passing it to low level API as a year value (of string).

### Metadata handlers

Few built-in processors will iterate over generic metadata handler plugins before passing value to low level replace API. Unlike metadata handlers, they can stop further processing and instead do an unrelated change, such as removing tags from the document.

Collapse handlers are built into the library, but they can be disabled and/or custom handlers can be registered during initialization.

In practice explicit call to collapse is rarely needed, as Resize(tags, 0) should be called on empty collections.

## Java/.NET differences

Due to Java erasure there are minor differences in behavior between Java and .NET implementation. When a collection is empty, unless the collection is an array Templater is unable to know the signature of the collection and has a hard time matching tags.

When this scenario happens during navigation, Templater will assume that all remaining tags are under current navigation prefix, but if this happens on top level tags, there are two basic approaches to the problem:

- automatic handling by using array instead of list
- adding collapse or some other metadata and handling it via OnUnprocessed API or at the end of processing
- manual handling by calling into the low level resize

In case of manual workaround code would look like:

```
if (collection.isEmpty()) {
	document.templater().resize(new String[]{"first", "last"}, 0);
} else {
	document.process(collection);
}
```

where relevant tags would be specified manually. It's sufficient to pass in minimal number of tags which fully describe the affected area.

## Processing document

Once *ITemplaterFactory* has been created it can be reused to create new *ITemplateDocument* for binding templates with data.

Open method on factory has several overloads:

- **Open**(string file) - will do a replace of the input file at the end of processing. This API is mostly used in some narrow cases and others, stream based APIs should be used instead
- **Open**(Stream stream, string extension) - (.NET only) - can reuse same stream for processing. This is also used in some special cases, eg when stream is sent to processing multiple times
- **Open**(InputStream input, String extension, OutputStream output) - and similar signature for (.NET) should be used most of the time. Templater will not close such streams; it will only flush to output at the end of processing. If CSV streaming is used, it can flush while doing Resize

Templater processing is CPU intensive and should not be done concurrently as *ITemplateDocument* is not concurrency friendly. The only non CPU intensive operation is when ResultSet/DataReader as being streamed/chunked, but even that is mostly CPU intensive (as data preparation will mostly be done in the background before processing starts).

Process method returns *ITemplateDocument* to indicate that operations can be chained one after another. A common pattern in processing is to first process all fixed/static inputs and then send it the large collection, e.g.:

```
ITemplateDocument doc = ...;
doc.Process(new { filter = filter })
   .Process(new { system = new { user = username, at = DateTime.Now } })
   .Process(mainData);
```

## Configuration

While there are various built-in plugins, for Templater to be truly useful in wide set of scenarios there must be a way to user defined behavior to be plugged in and customize the processing.

Therefore Templater has several extensibility points for customizing the behavior and widening the feature set of the library. During library initialization such behaviors can be defined on *IDocumentFactoryBuilder*.

### Formatter plugins

Custom formatter can be registered via

```
IDocumentFactoryBuilder include(IFormatter formatter);
interface IFormatter {
    Object format(Object value, String metadata);
}
```

where built-in plugins will iterate over all registered formatters (first custom, then built-in) and ask them to handle the value and metadata.

If there is no user defined metadata on the tag, this API will not be called. If there are multiple metadata on the tag iteration over them will repeat once for each metadata on the specific tag.

Plugins are expected to match the metadata argument and return the formatted value when appropriate; otherwise they should just return the original argument. An example of the implementation looks like:

```
object Format(object value, string metadata)
{
  var ie = value as IEnumerable;
  if ((value == null || ie != null) && metadata.StartsWith("empty("))
  {
    var str = value as string;
    if (value == null || str != null && str.Length == 0
        || str == null && !ie.Cast<object>().Any())
      return metadata.Substring(6, metadata.Length - 5);
  }
  return value;
}
```

This is a built-in plugin for **:empty**(value is empty) metadata. When provided value is null or empty it will show instead string within the metadata, which in this case is: *value is empty*.

The plugin matches the provided metadata and the type to check if it should be invoked.

Once invoked it checks if the value should be replaced and returns a different value. The returned value goes into next plugin for processing and so until all plugins are iterated over. This way value formatting can be chained across several plugins (in case of some complex transformation).

A common case in financial document creation is showing numbers as text. While it's fine to verbalize specific values in the domain, via a verbalize plugin conversion can be attached to any value by just marking it for verbalization, eg: [[invoice.total]:verbalize]

Instead of writing code for the actual verbalization, it's common to call into third party libraries for such conversion[10].

## Metadata handler plugins

Custom handlers can be registered via

```
IDocumentFactoryBuilder include(IHandler handler);
interface IHandler {
  boolean handle(Object value, String metadata, String property, ITemplater
templater);
}
```

While metadata formatter can transform input value, there are cases when more complex transformation must be performed. One such case is collapse (removal) of region in case of certain condition. There are few such built-in plugins:

- collapse -which will invoke resize 0 for the specified tag when it's null or empty
  - this is often useful to hide part of the document since the object is not available and thus document can't be populated with actual values
- collapse-to(other tag) - which will invoke resize 0 on two tags (original and one in argument)
  - in non-trivial documents a certain region of the document needs to be removed and it's not fully defined with a single tag. In that case specifying two tags for start and end of removal is often sufficient
- collapse-nested - will invoke resize 0 with all tags under specified path
  - most of the times tags which should be removed are nested under the specified path

As with metadata formatter plugins, metadata handler plugins are expected to match the provided metadata and object value before invoking specific actions. Unlike the previous plugins this one can stop further processing of this tag. This is done by returning true. Sometimes it's useful to perform

[10] C# example can be found at: https://github.com/ngs-doo/TemplaterExamples/blob/0b21f41fb97163c0895100bc7114d169aa5d4c89/Intermediate/CollapseRegion/src/Program.cs#L99
Java example can be found at: https://github.com/ngs-doo/TemplaterExamples/blob/0b21f41fb97163c0895100bc7114d169aa5d4c89/Intermediate/CollapseRegion/src/main/java/hr/ngs/templater/example/CollapseExample.java#L113

the actions and return false to continue further processing. Example implementation of the collapse plugins looks like:

```
bool Handle(object value, string metadata, string property, ITemplater templater)
{
  if (metadata.Equals("collapse"))
  {
    var ie = value as IEnumerable;
    if (value == null || ie != null && !ie.Cast<object>().Any()
        || value is bool && (bool)value)
      return templater.Resize(property, 0);
    return false;
  }
  return false;
}
```

The plugin checks if it matches the metadata, in which case it checks for null values, empty collections or true value for boolean property. When either of that is matched it invokes resize 0 on the low level API which returns success when resize was performed causing stoppage of the current tag processing.

## Processor plugin

Custom type processor can be registered via

```
<T> IDocumentFactoryBuilder include(Class<T> manifest, IProcessor<T>
processor);
interface IProcessor<T> {
    boolean tryProcess(String prefix, ITemplater templater, T value);
}
```

In rare cases when built-in processors can't handle specific type (either due to non-public visibility, custom naming rules or some other reason) a custom processor can be registered. All the built-in processors use the same API, to provide complex behavior.

Several examples of custom processor plugin can be found on Github, such as questionnaire example.

## Low level replacer

While formatter plugin requires a metadata to match and is only invoked from high-level API, sometimes it's more useful to always to a type transformation. In that case a plugin for low level API can be registered via

```
IDocumentFactoryBuilder include(ILowLevelReplacer replacer);
interface ILowLevelReplacer {
    Object replace(Object value);
}
```

Low level replacer is invoked on every value sent to **Replace** method. An implementation which adds support for Java 8 Optional would look like:

```
public Object replace(Object value) {
 return value instanceof Optional ? ((Optional)value).orElse(null) : value;
}
```

Replacers will be iterated in a similar way formatters are iterated over; result of previous transformation will be passed to next replacer until the final value is sent to the actual processor for final replacement.

## On unprocessed tags handler

Prior to v3 mismatch between input and template could cause Templater to consume large amounts of memory due to calling resize on a tag which was never processed. Since this could not be resolved in a universal way (removing such tags would hide typing errors) a new API was introduced to finally resolve this issue. Now Templater by default will "process" those tags, by appending **:unprocessed** metadata at their end. This way they will not influence resize anymore and typos will be left in the document (although a new processing will be required to detect them).

If tags with :unprocessed metadata were detected during resize operation, they will be ignored and skipped over.

This issue was amplified in dynamic structures, where JSON often did not have certain attributes at all, so Templater could not handle them consistently (they were sometimes resolved as the value was null).

Unprocessed tags handling can be customized via

```
IDocumentFactoryBuilder onUnprocessed(IUnprocessedTagsHandler handler);
interface IUnprocessedTagsHandler {
    void onUnprocessed(String prefix, ITemplater templater, String[] tags,
Object value);
}
```

In scenario when there are unprocessed tags, Templater will invoke this API with:

- current navigation path
- low level API instance
- all the unprocessed tags
- object value (instance where the tags were mismatched, or the parent instance when the tags were missing due to null value)

A simple implementation which just removes all such tags would look like:

```
void OnUnprocessed(string prefix, ITemplater templater, IEnumerable<string> tags,
object value)
{
        foreach (var t in tags)
                templater.Replace(t, string.Empty);
}
```

It's useful to have validation of templates before they are sent for processing (e.g.: on template upload) in which case it would be useful to either leave the default implementation, or replace it with one which will be aware if there are such tags in the document.

## Resize limit

Prior to OnUnprocessed API one of the main ways to protect against faulty templates was the resize limit (and built-in guards for Excel row limits). Resize limits specify how many times can a tag be resized. This translates to the maximum nesting level. The default is 8.

In practice, even the most complex templates have nesting level up to 4. Nesting level of 4 means that there is a tag nested 4 collections deep. In rare cases when there is more than 8 level of collection nesting, this limit can be increased to the appropriate value via

```
IDocumentFactoryBuilder resizeLimit(int limit);
```

## Streaming size

Templater supports streaming in multiple ways:

- streaming data types (collections without a known size or database readers)
- flushing output during text processing

IDataReader and ResultSet will use streaming size to process rows in chunks of specified size.

If a collection is used which does no implement appropriate interface:

- ICollection in .NET (for Count property)
- Collection/Array in Java (for size method)
- Seq in Scala (for size method)

as long as elements of the collection are not IDictionary or Map they will be processed in chunks.

Default chunk size is 16384. Custom chunk size can be configured via

```
IDocumentFactoryBuilder streaming(int size);
```

## Built-in metadata formatters and handlers

While formatters and handlers are only invoked on matching metadata, if they are not useful they can be disabled via

```
IDocumentFactoryBuilder builtInFormatters(boolean include);
IDocumentFactoryBuilder builtInHandlers(boolean include);
```

While their overhead is not significant, if there is no use for them, they can be turned off.

## Java built-in low-level plugins

In Java due to awt image conversions, two low level plugins are enabled by default. For performance reasons this can be disabled and Templater image type can be used instead

```
IDocumentFactoryBuilder builtInLowLevelPlugins(boolean include);
```

## Tag regex customization

Templater matches tags via regex which can be customized. There are three built-in tag patterns which are recognized:

- [[tag]]
- {{tag}}
- <<tag>>

First format can't be used on some places (such as Excel sheet names), but if Templater detection needs to skip over some tags they can be disabled by modifying tag regex for specific pattern via

```
IDocumentFactoryBuilder withMatcher(String regex, TagPattern pattern);
enum TagPattern {
    BRACKETS("[[", ']'),
    BRACES("{{", '}'),
    CHEVRONS("<<", '>');

    private String startMatch;
    private char endMatch;

    TagPattern(String startMatch, char endMatch) {
        this.startMatch = startMatch;
        this.endMatch = endMatch;
    }
}
```

Default regex pattern is: [-+@\w\s.,!?/]+

To disable a pattern unmatchable regex can be used:

```
builder.withMatcher("[^\\S\\s]", TagPattern.CHEVRONS)
```

There are two similar methods for configuring matchers. Main difference is that one is a convenience API which will specify regex for all formats, while the other is for configuring regex per format. Since by default Templater will recognize only latin (and some extra characters) when a language specific matching is required they can be enabled by providing relevant regex, e.g.:

```
builder.withMatcher("[a-z\u0400-\u04FF]+")
```

## Java bean configuration

By default Java beans are enabled, but if they need to be disabled this can be done via

```
IDocumentFactoryBuilder withJavaBeans(boolean useConvention);
```

Exact method match takes precedence over bean naming, so there is little reason to disable bean naming.

# Word features

Templater has extensive support for various Word features, but there are still few advanced ones missing. Various features are supported out-of-the box without any special code, while some require special handling and are introduced over time.

## Mail merge

On surface Templater looks just like a mail merge solution. You can put tags on specific places in the document and replace them later with actual values. One could wonder why a library would even be required for that, as OOXML is just a ZIP file with a XML files which can be easily edited/manipulated.

But even in such a simple use case there are obstacles, as Word tends to split text into paragraphs so even a simple text such as [[TAG]] often looks like

```
<w:r w:rsidRPr="00A42204">
  <w:rPr>
    <w:lang w:val="en-US"/>
  </w:rPr>
  <w:t>[[</w:t>
</w:r>
<w:proofErr w:type="spellStart"/>
<w:r w:rsidRPr="00A42204">
  <w:rPr>
    <w:lang w:val="en-US"/>
  </w:rPr>
  <w:t>TAG</w:t>
</w:r>
<w:proofErr w:type="spellEnd"/>
<w:r w:rsidRPr="00A42204">
  <w:rPr>
    <w:lang w:val="en-US"/>
  </w:rPr>
  <w:t xml:space="preserve">]] </w:t>
</w:r>
```

which contains various “useless” Word specific information not really relevant for the original [[TAG]] text. There are also various Word specific rules such as **xml:space=”preserve”** which must be respected during processing.

Once tables and lists start to get used, replacing a tag is no longer: “*just locate and replace tag value in XML*”. With the addition of images, special Word objects, such as charts which are implemented as an embedded Excel file within the Word zip changing tags requires extensive knowledge of the Word behavior, format and rules. Therefore a library which copes with those adjustments can be of quite a big help to the developer, even if his is quite familiar with the OOXML format.

## Resizable regions

Templater uses various Word features as indicators for the duplication behavior. The simplest example would be to use row in a table as resizing region - a context. More complicated example would be a list in a table surrounded by section breaks. To understand resizing behavior of Templater few rules must be understood. When Resize(tags, count) is called Templater will

- find the best matching region of the document which encapsulates all specified tags (first occurrences of such tags)
    - regions will be limited to the rows in a table (match for starting and ending row)
        - table region can span multiple rows
    - relevant list levels will be matched
        - list levels can match the hierarchical structure of the model
    - when region includes top level document (there is a tag which is neither in list or a table) sections around the region will be looked up
    - if section is not detected, start/end of the document will be used
- if all tags are inside tables/lists or other resizable elements, instead of duplicating the objects, tables and lists will be resized instead
    - this means when a same collection is repeated both in a table and a list, that those tables and a list will get new rows instead of new tables and lists being created in the document
- when count = 0 indicating removal of the content part of the document will be removed
    - with the exception when tags were detected at the top level and no sections were found - which would result in whole document removal

This way built-in Word features can be used to indicate the expected resizing context for the Templater. Common use cases include:

- use of a table without borders to group elements together
    - table is visible in Word, but not in the printed document
- use of lists without bullet indicators to simulate paragraph duplication
    - Word and Templater will consider it a list, but it will look like a plain paragraph
- nesting list (or tables) inside a table for fine tuning nested elements layout
- using table header repeating (and various other features) for tuning the listing behavior
- using sections (with or without page breaks)

Tags will be detected in almost any part of Word document, such as:

- header or footer
- Word arts
- embedded Excels
- bounded custom XMLs
- hyperlink descriptions
- and various others

## Tables

Most basic resizable object in Word is a table. Table can be with or without header; it can have various options attached to it, such as:

- borders
- spacing
- repeating of header row
- cell/row breaking
- alignments
- automatic resizing
- styles
- cell merging
- text direction

which makes it really useful to design complex layouts.

Resizing a table is quite intuitive in Templater. When table like:

| Column A | Column B |
|---|---|
| **[[collection.columnA]]** | [[collection.columnB]] |

is matched with an appropriate input, e.g.:

```
{
  "collection": [
    {"columnA": "value A1", "columnB": "value B1"},
    {"columnA": "value A2", "columnB": "value B2"}
  ]
}
```

The result will look quite intuitive:

| Column A | Column B |
|---|---|
| **value A1** | value B1 |
| **value A2** | value B2 |

A really important aspect of such transformation is:

- it is implied by the document structure
- there are no loop or start/end constructs in the document
- it matches against the input “intuitively” by using dot (.) for navigation

### Multi-row context

Over the years Templater context detection and manipulation improved significantly[11]. This allowed for context use over multiple rows, such as:

| Product | Price |
|---|---|
| **[[items.name]]** | [[items.price]:format(N2)] |
| *[[items.description]]* | |

when matched with an appropriate input, e.g.:

```
{
  "items": [
    {"name": "Product A", "price": 99.99,"description":"Nice useful tool"},
    {"name": "Product B", "price": 120,"description":"Spans\nmultiple\nrows"}
  ]
}
```

Produces an expected table which looks like:

| Product | Price |
|---|---|
| **Product A** | 99.99 |
| *Nice useful tool* | |
| **Product B** | 120.00 |
| *Spans*<br>*multiple*<br>*rows* | |

and has several non-trivial features:

1. context is no longer a single row, but two rows, since tags were defined across several rows
2. simple number formatting can be used to tweak the output into expected format
3. bolding, italics and other text features were preserved
4. newlines in text input resulted in newlines in cell values

Common use case with displaying collections is that they include information from the parent object. Templater can cope with various setups, even when provided data "is out of order".

| Product | Price |
|---|---|
| **[[items.name]]** | [[currency.signBefore]][[items.price]][[currency.signAfter]] |
| [[item.picture]:image]***[[items.description]]*** | |

when matched with an appropriate input, e.g.:

```
{
```

[11] Various table examples can be found at: https://github.com/ngs-doo/TemplaterExamples/tree/master/Intermediate/WordTables

```
 "items": [
  {"name": "Flashlight", "price": 19.99,"description":"Let there be light","picture":"flashlight.png"},
  {"name": "Helmet", "price": 42.25,"description":"Protects the head","picture":"helmet.png"}
 ],
 "currency": {"signBefore":"", "signAfter":"€"}
}
```

will result in an expected output:

| Product | Price |
|---|---|
| **Flashlight** | 19.99**€** |
|  ***Let there be light*** | |
| **Helmet** | 42.25**€** |
|  ***Protects the head*** | |

This example includes two specific features:

- coping with out of order tags ("currency" was defined after the "items" part)
- inserting the image (via custom images plugin[12])

In this example currency was defined on top level object (as sign which can go in front of the number and as a sign which can go after the number). If "currency" was processed before the "items" it would be a simple case of replacing the tags with **€** and duplicating replaced value per rows. But in this case currency was defined after and it was expected that all rows have the same value, which Templater detected and replaced them accordingly.

Tag for image was defined as [[items.picture]:image] which expects that there exists a plugin which knows how to handle the **image** metadata by loading the image from the appropriate place and putting it at the place of the tag. This way complex interaction between custom code (converting „flashlight.png" into an actual image) and Templater (injecting the image into the document) worked together to produce a complex output.

### Dynamic resize

A special feature of Templater is processing specific input types (two dimensional collections and DataReader/ResultSet) in a specialized way.

A basic use case for Dynamic resize would be to transform table template into a final output, e.g.:

[[table]]

[12] There is no such builtin plugin in Templater, but developer can easily create/add their own

when matched with an appropriate input, e.g.:

```
{
 "table": [
  ["A", "B", "C"],
  ["A-1", "B-1", "C-1"],
  ["A-2", "B-2", "C-2"],
  ["A-3", "B-3", "C-3"]
 ]
}
```

it will be transformed into a table with 3 equal columns and 4 rows:

| A | B | C |
|---|---|---|
| A-1 | B-1 | C-1 |
| A-2 | B-2 | C-2 |
| A-3 | B-3 | C-3 |

While this is useful for some scenarios, usually explicitly defined table templates are used since they allow for more fine-grained tuning.

Dynamic resize can be combined with “standard” table templates which allows for best of both worlds, as most of the table can be predefined, but some specific parts can still allow for dynamicizm:

| [[names.a]] | [[names.b]] | [[columns]] |
|---|---|---|
| **[[row.a]]** | [[row.b]] | [[row.dynamic]] |

when matched with an appropriate input, e.g.:

```
{
 "names": {"a":"Column A", "b": "Column B"},
 "columns": [["Column X", "Column Y"]],
 "row": [
  {"a":"A1", "b":"B1", "dynamic":[["X1","Y1"]]},
  {"a":"A2", "b":"B2", "dynamic":[["X2","Y2"]]}
 ]
}
```

will result in table which is partly dynamic:

| Column A | Column B | Column X | Column Y |
|---|---|---|---|
| **A1** | B1 | X1 | Y1 |
| **A2** | B2 | X2 | Y2 |

## Cell merging

While cells can be merged in the template, there are use cases when they need to be merged during table generation/population. For this reason there are two built-in metadata plugins:

- merge-nulls - invokes horizontal cell merging when cell value is null
- span-nulls - invokes vertical cell merging when cell value is null

Cell merging works both in Dynamic resize and standard table resize. Table such as:

| Column A | Column B | Column C |
|---|---|---|
| **[[nulls.a]:merge-nulls]** | [[nulls.b]:merge-nulls] | [[nulls.c]:merge-nulls] |

when paired with input such as:

```
{
 "nulls": [
  {"a":"A1", "b":null, "c":null},
  {"a":"A2", "b":"B2", "c":null},
  {"a":null, "b":null, "c":null},
  {"a":"A4", "b":null, "c":"C4"}
 ]
}
```

will result in table with merged cells:

| Column A | Column B | Column C |
|---|---|---|
| **A1** | | |
| **A2** | B2 | |
| | | |
| **A4** | | C4 |

### Removing a table

When Resize(tags, 0) is called on a table, relevant rows will be removed. Sometimes this means that entire table will be removed, but often for table with headers which don't have any tags the header remains at the end of the resizing. In case when there is a separate header without tags a common workaround is to add special tag on the header with collapse and hide metadata:

| Product[[items]:collapse:hide] | Price |
|---|---|
| **[[items.name]]** | [[items.price]] |

This way when items collection is empty a separate resize 0 will be called just for the header row. When collection is not empty hide metadata will take care of not showing any text in place of the tag.

There is also a common pattern to show a different table when there are no rows, but this is explored in more detail later in sections part.

## Lists

The second basic resizable elements in Word are lists. All lists types are supported:

- bullets
- numbered

- multi-level

Sometimes it's useful to tweak the layout of the list so it looks like a regular paragraph, because Templater will consider list a resizable element, while paragraph is not[13], e.g.:

[[text]]

matched with an appropriate input:

```
[
  {"text":"first row"},
  {"text":"second row"},
  {"text":"third row"}
]
```

will result in list which looks like an ordinary paragraph (list alignment is moved to the right):

first row
second row
third row

It is common to nest lists inside tables and while it is not common to nest tables within lists, that also works as expected.

### Nesting

Common use case for lists is pairing it with deep nesting or even with recursive structures.

When specialized data structure is used, such as:

```
public class Nest
{
      public String value;
      public Nest[] nested;
}
```

it is rather easy to pair it with nested list by predefining maximum nesting level, eg:

1. [[value]]
   1.1. [[nested.value]]
      1.1.1.[[nested.nested.value]]
         1.1.1.1. [[nested.nested.nested.value]]

Based on the input, resulting list will match the nesting levels and values, eg for input as:

```
[
  { "value":"Level A-1", "nested":[
```

[13] Paragraph can behave as resizable elements if there are continuous sections around it in which case everything between the sections will be duplicated

```
      { "value":"Level A-2a", "nested":[] },
      { "value":"Level A-2b", "nested":[
         { "value":"Level A-3", "nested":[
            { "value":"Level A-4a", "nested":[]},
            { "value":"Level A-4b", "nested":[]}
         ]}
      ]}
   ]},
   { "value":"Level B-1", "nested":[
      { "value":"Level B-2a", "nested":[] },
      { "value":"Level B-2b", "nested":[] }
   ]}
]
```

a matching list will be created:

1. Level A-1
   1.1. Level A-2a
   1.2. Level A-2b
      1.2.1.Level A-3
         1.2.1.1. Level A-4a
         1.2.1.2. Level A-4b
2. Level B-1
   2.1. Level B-2a
   2.2. Level B-2b

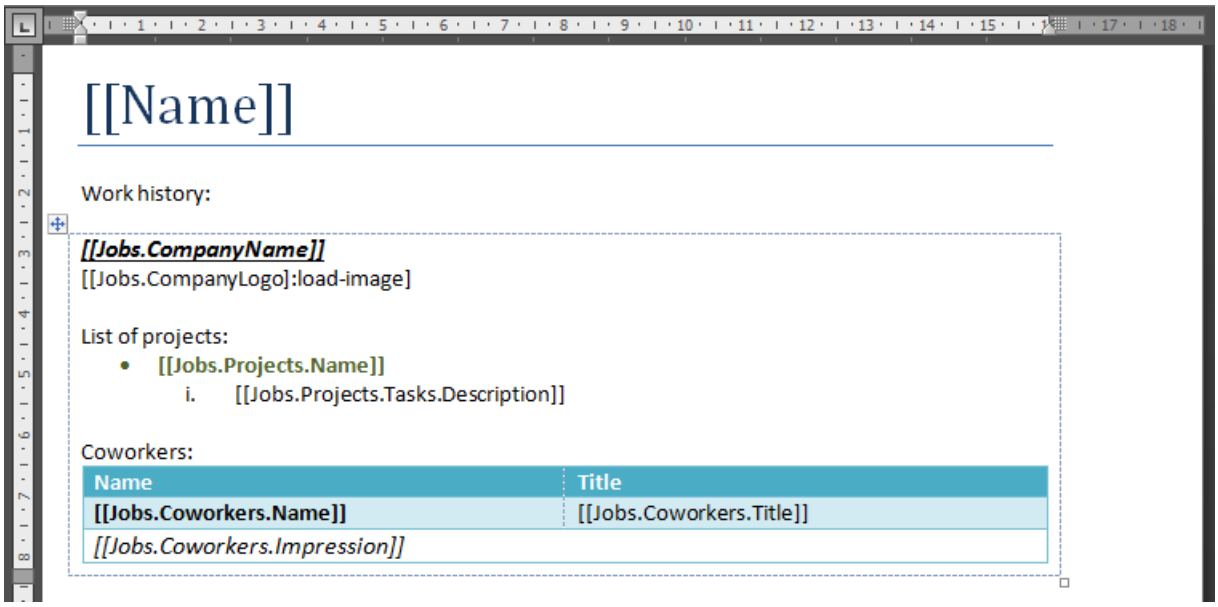
Since style is defined on the list, while Templater only binds the data with the list, complex list representations can be easily constructed.

### Lists in table

A very common use case is to have lists inside a table. The nesting can be arbitrary deep (up to the resize limit configuration option).

Templater will take care of duplicating lists and renumbering them appropriately (when numbered lists are used).

A common “trick” with nesting lists in a table is to use “invisible” tables - tables without border. They will be visible in the editor, but not in the resulting document, e.g.:




### Removing lists

Unlike table which often have special header row, lists are much easier to remove and there is no need for any special workarounds. Calling Resize(tags, 0) on them should remove relevant part of the document (and tweak the document when necessary so it doesn't become corrupted).

## Sections

When choosing a region for the context, Templater will look for sections around the specified tags.

Continuous sections are useful for separating parts of the document without affecting layout. Sections are somewhat counterintuitive at the beginning as they are often applied with the text above.

A common pattern when showing tables is to have different table layouts depending if there is data inside or not. This is easy to implement by combining two tables and a section, such as:

| Name | Description |
|---|---|
| **No results found** | |

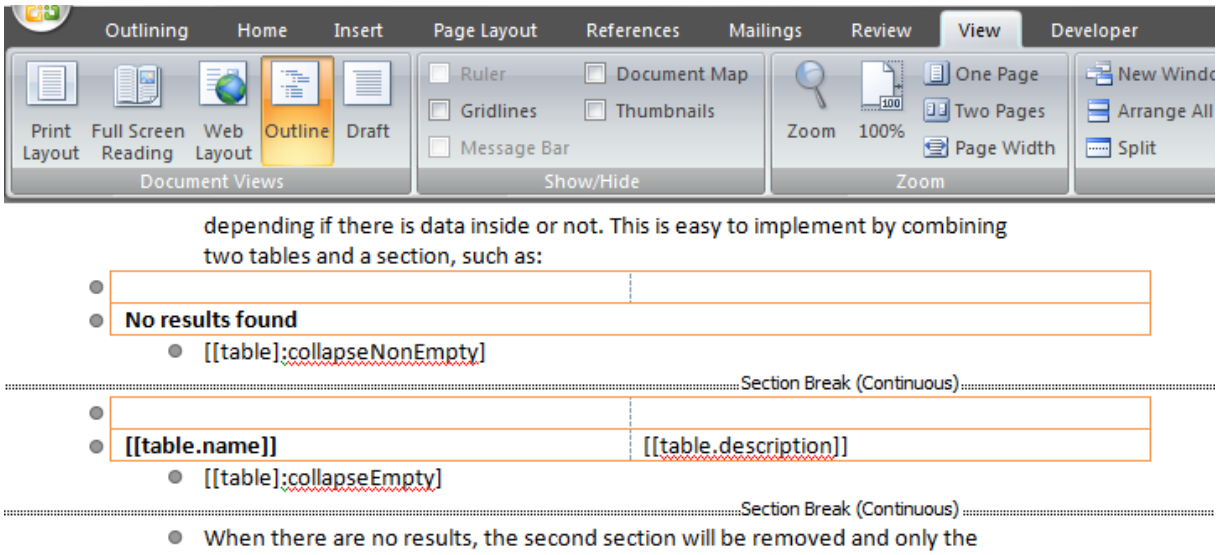
[[table]:collapseNonEmpty]

| Name | Description |
|---|---|
| **[[table.name]]** | [[table.description]] |

[[table]:collapseEmpty]

When there are no results, the second section will be removed and only the table with **No results found** will remain. Otherwise when there is data inside the table collection, the first section will be removed and the second table will be populated with data.

Sections are highly visible in Outline view:




## Charts

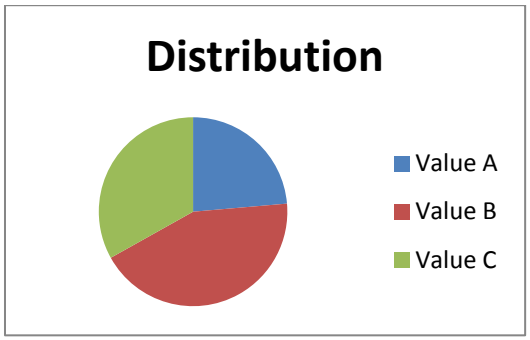
Charts are represented by embedding Excel xlsx inside Word zip docx. Depending on the chart type there is also some aggregation of values within the document XML.

Charts are also considered resizable elements, as the underlying data source is a resizable Excel range.

Chart template is defined within Excel by adjusting original template and replacing values with tags, which results in a bit unfriendly chart template:


| | Distribution |
|---|---|
| [[chart.value]] | [[chart.distribution]] |

But once the underlying Excel is populated with data and range, the chart will be updated accordingly:




| | Distribution |
|---|---|
| Value A | 11,2 |
| Value B | 20,5 |
| Value C | 15,7 |

Tags defined within the Excel are visible in the **Tags** property on the *ITemplater* interface of the Word document. This makes them transparent to the application/processing. This means there is no need to unzip the docx file, process the embedded xlsx files, but rather Templater does that behind the scenes.

There are various charts in Word, such as pie charts, graphs and various others. They should all work seamlessly through Templater.

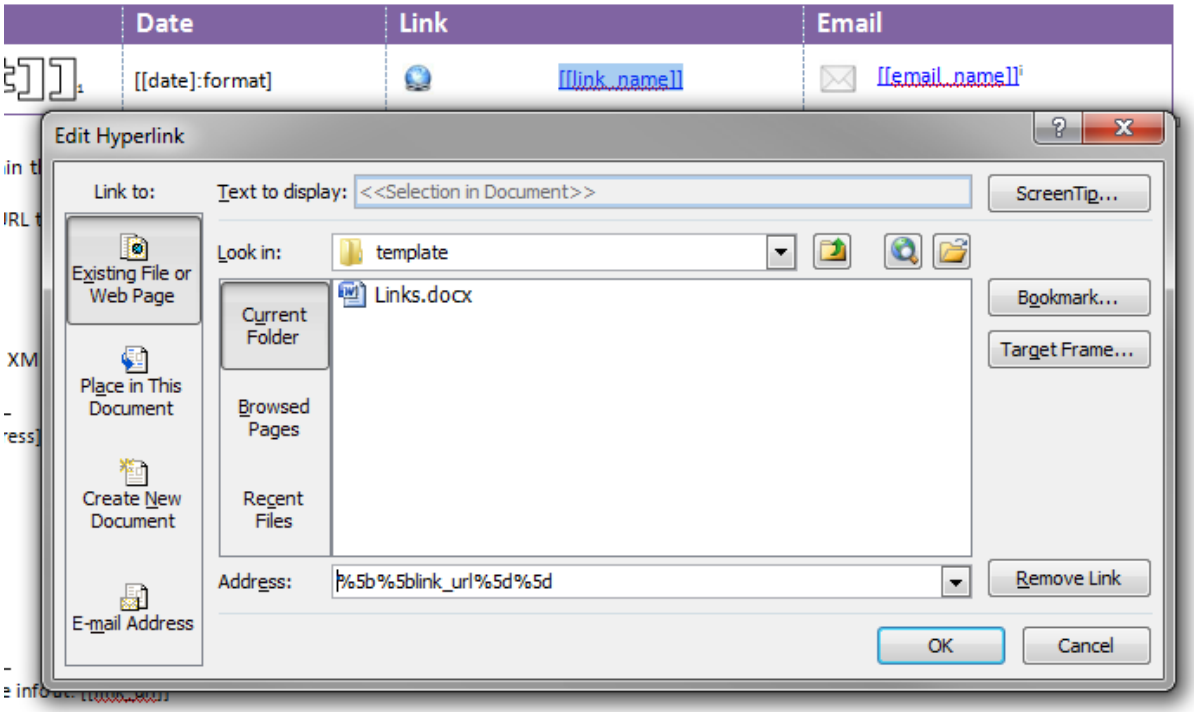
# Word specific features

## Links

Templater analyzes hyperlinks and thus they work as expected. Hyperlink can have multiple tags or tag can be combined with static description, e.g.:

Link to [[description]]

Address is url encoded which means that [[specific_url]] is converted into %5b%5bspecific_url%5d%5d when hyperlink is created, e.g.:

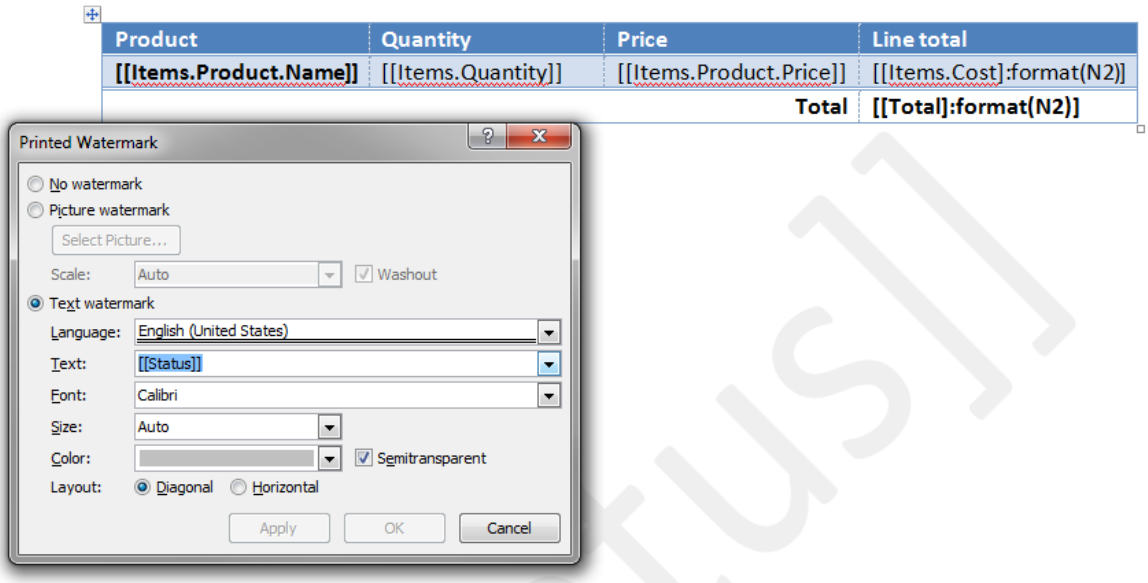



Special data types can also be used to create simple links (just a link, no custom description) when URI/URL is used as datatype.

## Watermark

It is common to have watermarks on documents to indicate special state[14]. Templater will detect and replace tags in watermarks.

Example of watermark on invoice would look like:




## Word ART/Smart ART

Tags can also be used in Word ART, Smart ART and other similar features.

## Footnotes and endnotes

While Templater supports footnotes and endnotes, it should be emphasized that their behavior is non-trivial in a sense that the tags where they are defined is bound to the footnote/endnote location, not the tag itself. This means that when footnotes are used in a table which gets resized, the footnote will also be duplicated. If tag is used multiple times, Templater will take care that all relevant tags are replaced with the expected value.

[14] Invoices often have CANCELED or PAID written over them to emphasize their state, as shown in: https://github.com/ngs-doo/TemplaterExamples/tree/master/Advanced/SalesOrderMVP%20(.NET)

## Header and footer

Tags can be used in header and/or footer along with other places in the document. Header and footer do have some special behaviors, similarly to the tags placed in the top level of the main document.

It's common to use footer to add page numbering to the Word document (as this is a Word feature). Word will recalculate the page numbers once the document is opened.

## Text Box

Tags are recognized within Text Box and other similar features.

## Merge fields

Word and some other libraries only support merge fields for similar features. Templater will also recognize tags within merge fields, although it is much easier to define tags without the use of merge fields.

## Images

Since duplication of context can cause image duplication, Templater will adjust the document accordingly. If new images need to be inserted into the document this can be done via appropriate data type:

- .NET: Image and Icon
- Java: hr.ngs.templater.ImageInfo (with built-in BufferedImage and ImageInputStream conversion)

## Document locking

Word has several document locking features. Some of them are only UI locking which allow for underlying XML manipulation. Since document is not encrypted in that case, Templater is still able to modify the document which appears as locked to the user.

## Font color and styles

Templater will use font and color from the tag definition when replacing it with a provided value. Sometimes color is dynamic and depends on other factors. In that case XML can be injected into the document which can specify color, background color or any other font attribute during the replacement.

For this to work Word format for coloring must be used, meaning appropriate XML must be passed in. By defining appropriate metadata it is easy to define such common cases. XML which would be inserted into the document looks like:

```
<w:tc>
  <w:tcPr>
    <w:shd w:val="clear" w:color="auto" w:fill="COLOR" />
  </w:tcPr>
</w:tc>
```

Such pattern can be encapsulated via a metadata or low level API plugin:

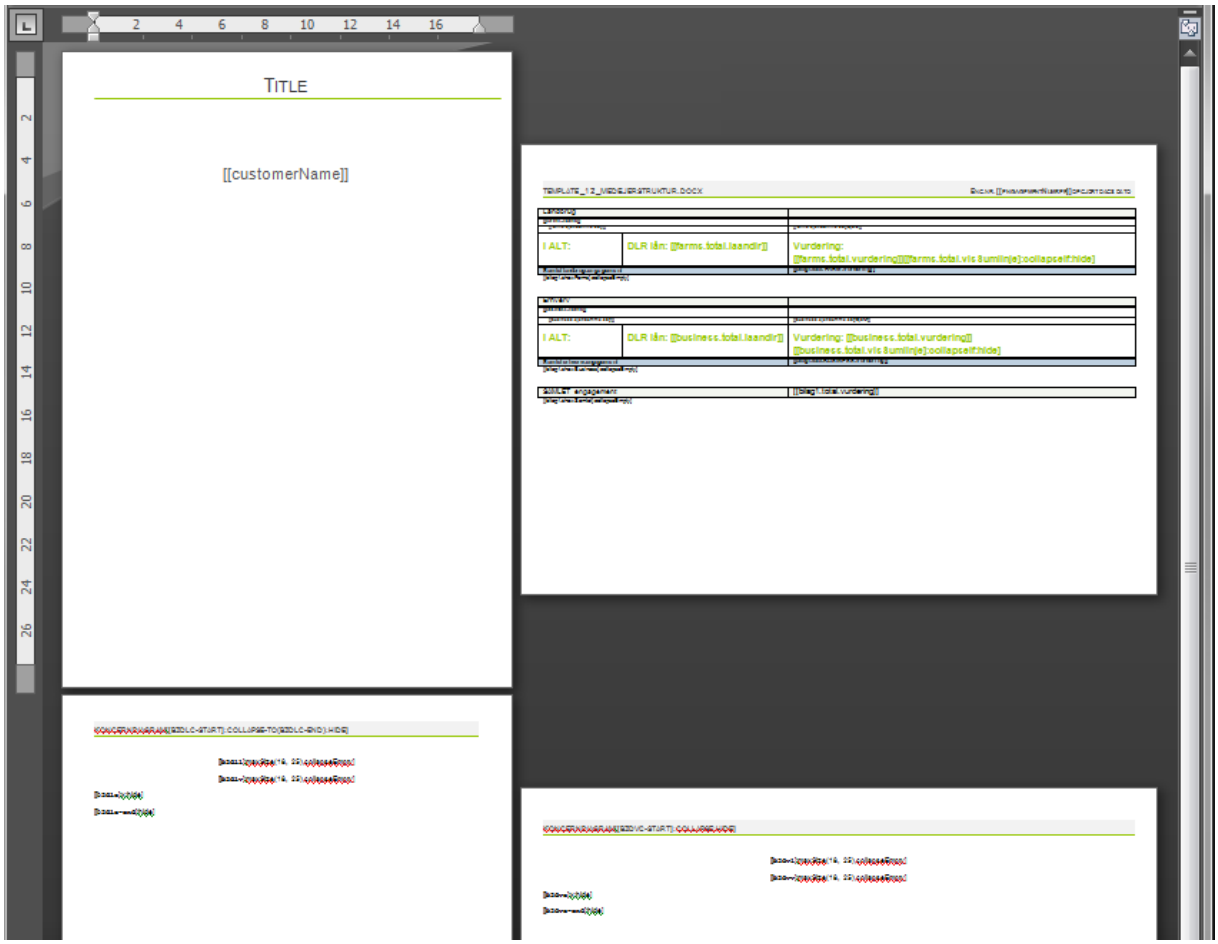
```
private static object ColorConverter(object value)
{
  if (value is Color == false) return value;
  var c = (Color)value;
  var fillValue = c.R.ToString("X2") + c.G.ToString("X2") + c.B.ToString("X2");
  return XElement.Parse(@"
<w:tc xmlns:w=""http://schemas.openxmlformats.org/wordprocessingml/2006/main"">
  <w:tcPr>
    <w:shd w:val=""clear"" w:color=""auto"" w:fill=""" + fillValue + @""" />
  </w:tcPr>
</w:tc>");
}
```

## Page orientation

In Word page orientation can be changed from page to page (or a single orientation can be used per document). While there is nothing special in Templater to support such use cases, when pages are duplicated or removed sometimes special document adjustment is required to avoid empty pages, which Templater does behind the scenes.

Since page orientation can vary from page to page[15], by combining it with collapse (page removal) complex layouts can be defined, e.g.:

[15] A tutorial for page orientation setup can be found here: https://www.officetooltips.com/word_2016/tips/how_to_use_different_page_orientations_inside_one_document.html



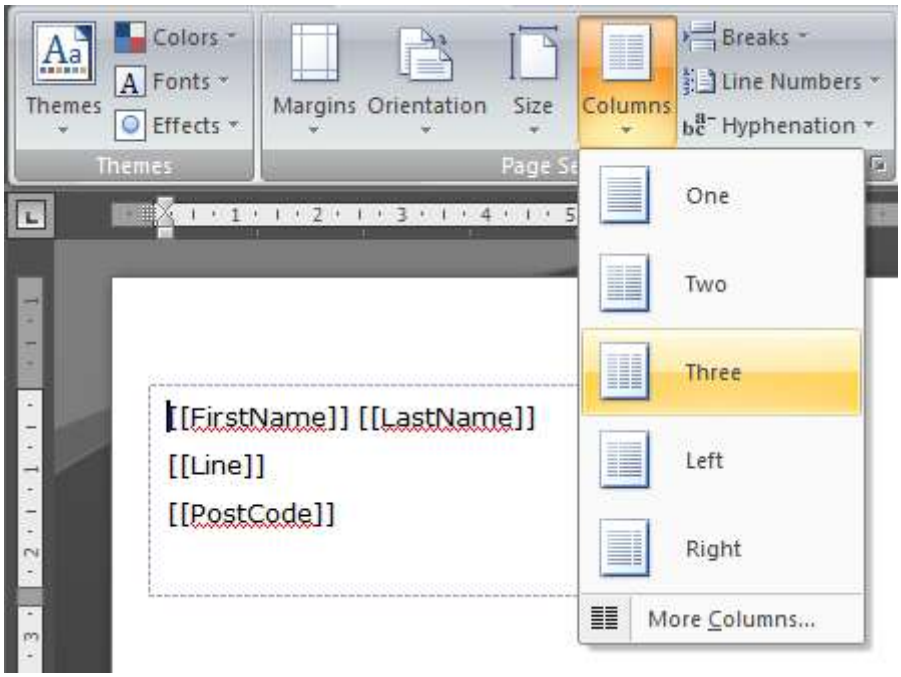

## Object numbering

Various objects have internal ID which must be unique per document. Templater will adjust the numbering so there are no duplicates in the document.

## Multi-columns

Word can have multiple columns per section of the document. This has variety of layout applications. Templater will cope with various scenarios including duplication of multi-column parts of the document.

Common use case is for label printout:




## Content controls

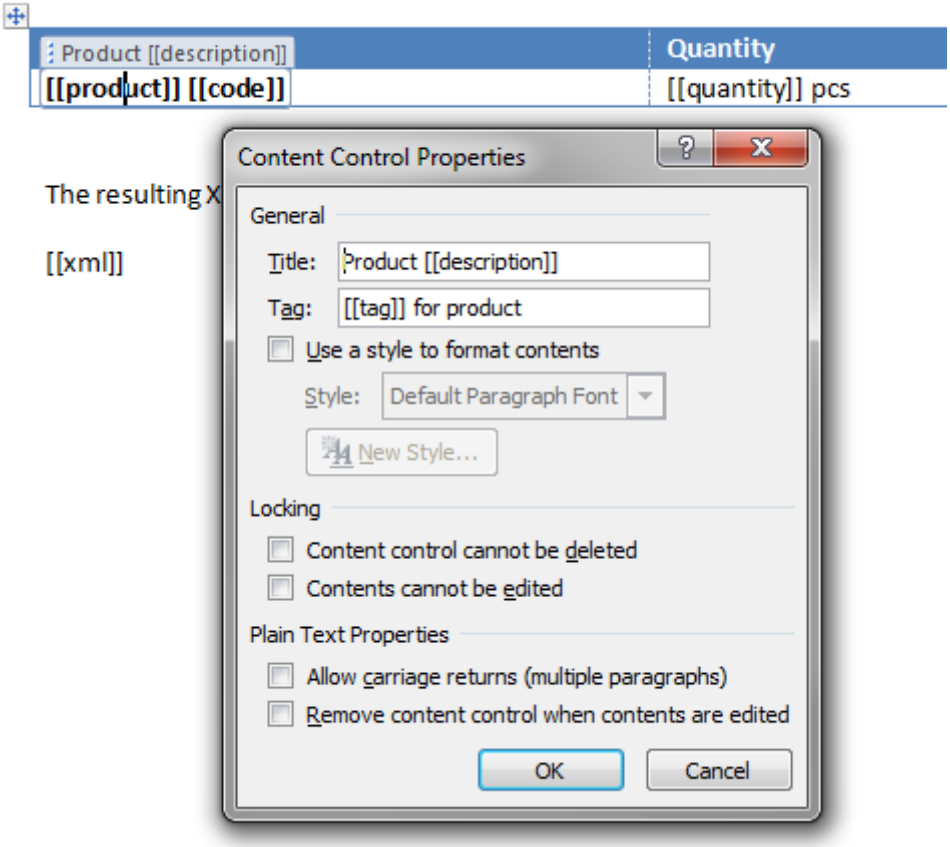
Content controls come in two basic flavors:

- unbounded content controls
- bounded content controls (aka XML binding)

Unbounded controls behave as any other special control with tags.

Bounded controls reference an embedded XML file which must be changed instead of the actual Word document. This requires some special handling and is the only exception where low level Replace can replace “multiple tags” at once - since all tags point to the same underlying value.

Content controls are set-up via appropriate properties window, e.g.:




Bounded controls support resizing in which case XML elements will also be duplicated.

## Known issues

If a specific Word feature is not supported, there are few basic categories it falls into:

- feature requires Word rendering engine and thus it's not supported
  - such features include PDF export, TOC renumbering, etc...
- feature is on the roadmap, but it's not supported yet
  - an example would be support for comments or some special chart
- feature is not behaving as expected due to a bug

## PDF export

A very common use case is to convert Word document into PDF. Unfortunately this requires a Word rendering engine to work correctly.

There are several free and paid libraries which have sufficiently good PDF conversion for simple documents. But non-trivial documents quickly become non pixel-perfect during the conversion.

Whenever user can convert Word document into PDF this should be preferable. If PDF conversion needs to be done on the server and there is no access to Microsoft libraries for PDF conversion[16] the next best thing is to run LibreOffice in headless mode and use it for conversion. For such purpose there is a Dockerfile paired with Templater server.

## Table of Contents

As with PDF export correct updating of Table of Contents page numbers requires rendering engine, as Word does not recalculate them on load (only on print[17]). Alternative way to update TOC on load is to add macro to the document, but requires explicit consent by the user before it can be updated.

## Embedded Excel document

While chart is also an embedded Excel within the Word, when Excel is embedded into the document, only the image of the Excel sheet is shown in the document. If underlying Excel is changed, the picture will not be updated.

[16] SharePoint allows for on demand PDF conversion: https://social.technet.microsoft.com/wiki/contents/articles/15731.sharepoint-2013-new-features-in-word-automation-services.aspx

[17] TOC is a field which are updated only before printing

# Excel features

Templater has extensive support for many Excel features. Several advanced features are supported by Templater just updating their underlying data source and Excel refreshing them on load. Really large Excel files can be created, as long as some best practices are followed.

## Complex non-streaming documents

While Excel is sometimes used just as a single sheet with lots of rows displaying some tabular data, this is often better to do in a plain CSV format which can be opened within Excel. Templater can create huge CSV documents due to support for streaming, while it will keep Excel in memory during processing.

Sometimes it's not clear what benefit does Templater provides to managing Excel, as there are various libraries for specifying cell value and thus it's rather easy to build a simple application for populating Excel with tabular data. But as Templater approach is to bind data with existing templates, instead of programming layout through code, once non-trivial features gets used and managed by Templater it quickly becomes obvious:

- rewriting the formula expressions as cells, ranges and table are copied/moved around
- propagating cell and row styles as regions are pushed around
- adjusting the tables, charts, merge cells and named range sizes during various resize operations
- handling same tag at various places, either as a simple replace or as a part of a collection
- supporting conditional formatting, comments, hyperlinks and various other simple and complex features
- duplicating sheets containing various tables, graphs, charts and other complex Excel features

Templater can be used to create really large Excel files, although they can be quite memory demanding[18]. Since Templater is thread aware processing Excel files can be stopped in case of some problems, such as lack of memory.

## Resizable behavior

In Excel, where cell is the basic element, everything is considered resizable (unlike in Word where use of tables and lists is required to consider a region resizable). Still, some elements affect the decisions Templater will make, such as use of actual tables, named ranges and merge cells.

### Cell range

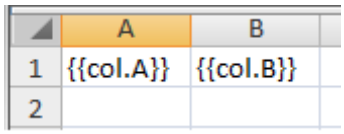
After the initial analysis Templater has information about every tag location. When a resize is called a matching range is being detected. There are different behaviors depending on where the tags were located:

[18] There are certain steps in Java which can alleviate the problem, such as using non-default XML transformer

- all tags within the same sheet - result in range which encapsulates all of them
    - other elements such as named ranges and merge cells can influence the initial minimum spanning range and increase it - this is done so that when resize is performed the object influence by resize doesn't get broken
- tags are on different sheets - behavior depends on location of tags and related metadata
    - most of the time sheets will be processed separately, resulting in separate resize operations per sheet
    - if **sheet** or **page** metadata is used, resizing of relevant sheets (all sheets in between) will be performed
- tag within the sheet name - instructs that full sheet resize should be performed
    - while [[tag]] format will not work without sheet name, both {{tag}} and <<tag>> will

### Simple range

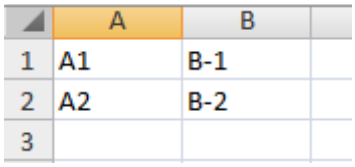
The simplest range consists from a single tag. While that works as expected, usually range is contained from multiple tags:




when paired with matching input:

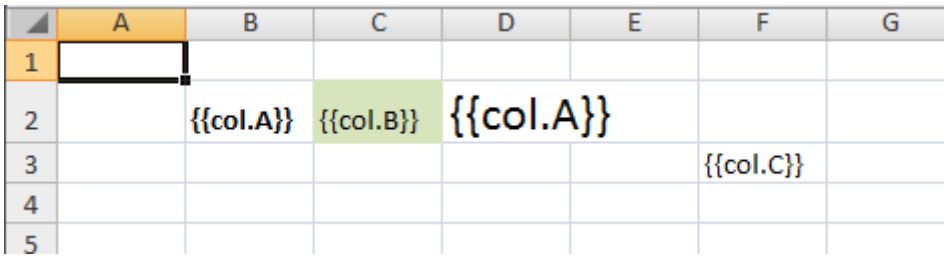
```
{
 "col": [
  {"A": "A1", "B": "B-1"},
  {"A": "A2", "B": "B-2"}
 ]
}
```

will result in appropriate cells




### Matching range within a sheet

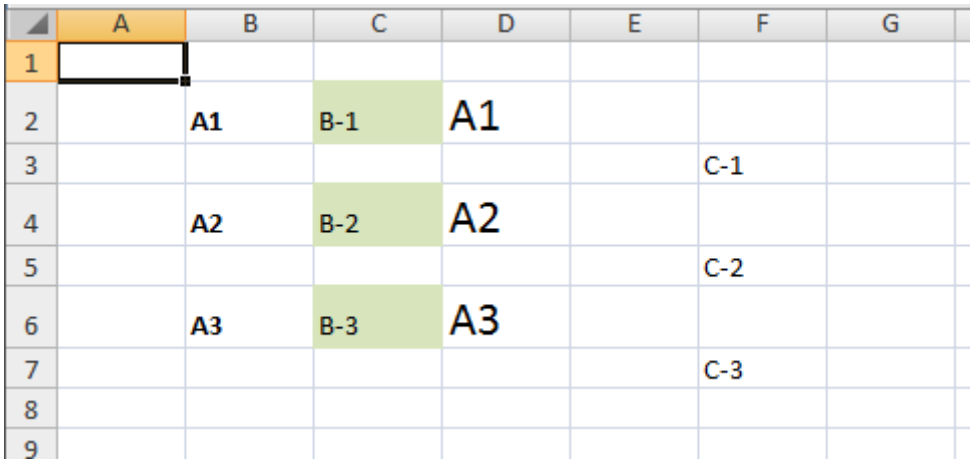
Tags can be repeated multiple times and matching range must include all specified tags. This means that cells can span multiple rows and thus duplication context can be non-trivial. Templater will match tags even if they are somewhat outside of the "expected" place:




when paired with matching input:

```
{
  "col": [
    {"A": "A1", "B":"B-1", "C":"C-1"},
    {"A": "A2", "B":"B-2", "C":"C-2"},
    {"A": "A3", "B":"B-3", "C":"C-3"}
  ]
}
```

will result in appropriate cells




Several non-trivial features are visible in the example above:

- Templater can work with context consisting from multiple rows/columns
- cell style will be replicated (colors, font properties, etc...)
- row style will be replicated (height, etc...)
- tags can be repeated within the context

## Repeating ranges across sheets

Same tag can be repeated across different sheets. It will behave accordingly to the matching input type:

- when input is a simple object, same value will be repeated across all sheets
- when input is a collection, collection within each sheet will be processed separately
- if **page** or **sheet** metadata is used, or a tag is placed within a sheet name, entire sheet will be duplicated, instead of cell range within a sheet

- if **clone** metadata is used, all current sheets will be duplicated

### Finding best range match

Some Excel features influence the behavior of choosing a repeating range, such as:

- named range
- tables
- merge cells

The reason why such features influence context used for duplication is that Templater will try to avoid breaking declared group of items. Thus table is considered a group of items, while just cells which look like a table are not.

### Pushdown

When collection is resized, depending on the chosen context cells bellow the context will be adjusted. If cells are bellow the resizing context they will be **pushed** down. Pushdown will also adjust the relevant formulas so they are still correct after the pushdown.

| | A | B |
|---|---|---|
| 1 | {{col.A}} | {{col.B}} |
| 2 | | |
| 3 | Total: | {{A+B}} |
| 4 | | |

when paired with matching input:

```
{
 "col": [
  {"A": 1, "B": 4},
  {"A": 2, "B": 5},
  {"A": 3, "B": 6}
 ],
 "A+B":21
}
```

will result in appropriate cells

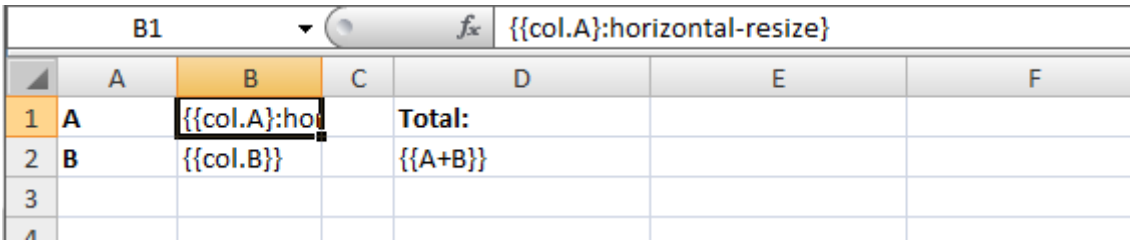
| | A | B |
|---|---|---|
| 1 | 1 | 4 |
| 2 | 2 | 5 |
| 3 | 3 | 6 |
| 4 | | |
| 5 | Total: | 21 |

As shown in the images, row 3 was moved to row 5 as the cells above them pushed them down due to resize.

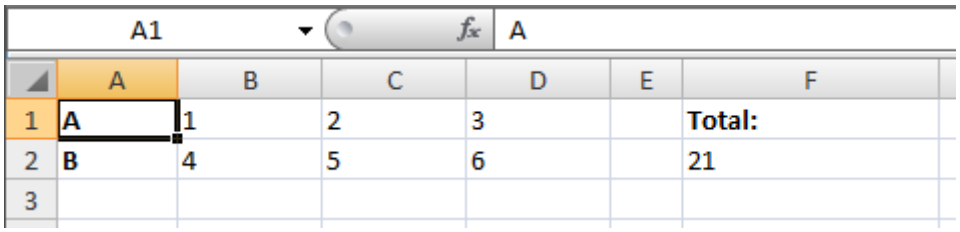
## Horizontal resize

By default calling resize on a set of tags will result in vertical duplication. Sometimes it's useful to do a horizontal duplication (to the right instead of down) with the appropriate push-right instead of pushdown.

To invoke horizontal resize, internal metadata: **horizontal-resize** must be placed at one of the tags being resized:




when paired with input as in previous example will result in expected output:

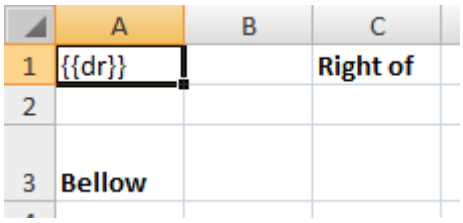



Several relevant things happened during the resize:

- cells were duplicated horizontally instead of vertically
- push to the right instead of push-down was performed on the affected cells right of the context
- column height was preserved during push-right and column duplication
- cell styles were preserved and formulas would be adjusted
- if a special internal metadata **whole-column** was used it would instruct Templater that vertical range used for resizing spans the entire column, instead of just the one matching the tags. This is useful when there is other information in different cells, as it avoids the use of helper tags just for defining appropriate region

## Dynamic resize

Dynamic resize is a Templater specific feature which works in both Word and Excel implementations. Similarly to behavior in Word a tag can be used, which when paired with appropriate input type (jagged array, DataSet/ResultSet,..) will transform a single cell into NxM cells doing both push to the right and pushdown in the process:

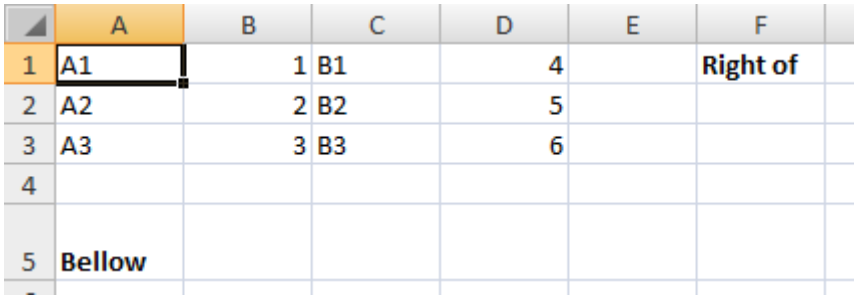


| | A | B | C |
|---|---|---|---|
| 1 | {{dr}} | | Right of |
| 2 | | | |
| 3 | Bellow | | |

when paired with matching input:

```
{
 "dr": [
   ["A1", 1, "B1", 4],
   ["A2", 2, "B2", 5],
   ["A3", 3, "B3", 6]
 ]
}
```

will result in appropriate cells



| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | A1 | 1 | B1 | 4 | | Right of |
| 2 | A2 | 2 | B2 | 5 | | |
| 3 | A3 | 3 | B3 | 6 | | |
| 4 | | | | | | |
| 5 | Bellow | | | | | |

Dynamic resize also recognizes **whole-column** metadata in which case it will duplicate all cells in a column, not just the ones defined by the minimum spanning region over the relevant tags.

### Removing cell range

If **Resize**(tags, 0) is used on a cell range tags will be replaced with an empty string, but there will be no pull down (inverse of pushdown) for the relevant range.

## Tables

Excel can display data set in various ways, either using simple cells range, or using specialized table feature. There are several additional options available when tables are used (and some restrictions) which fit naturally onto certain use cases.

Tables have certain unique properties (compared to plain cells).

- each table has a unique name (across all sheets)
- table maintain their size information
- each column inside a table must have unique name
- formula referencing same row in another column is easier to write/understand and doesn't incur additional overhead due to relative/absolute reference
- merge cells can't be used within table

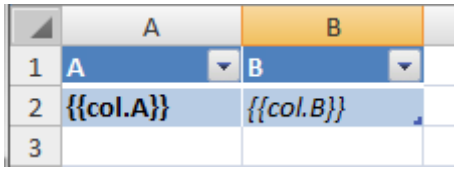
### Single row context

Unlike with cell, where context is defined by minimum spanning range, context in a table is always the full table rows. Most of the time context is just a single row, although tags can be defined outside of the table in which case table will be duplicated.

Usual Templater features apply:

- styles will be replicated
- tags can be repeated multiple times
- if same tags have different metadata, different values can be shown
- major difference from tables in Word is that in Excel every cell can have its own format for displaying the value

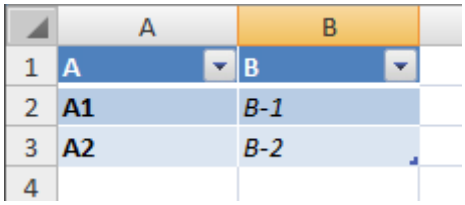
A simple example would look like:




when paired with matching input:

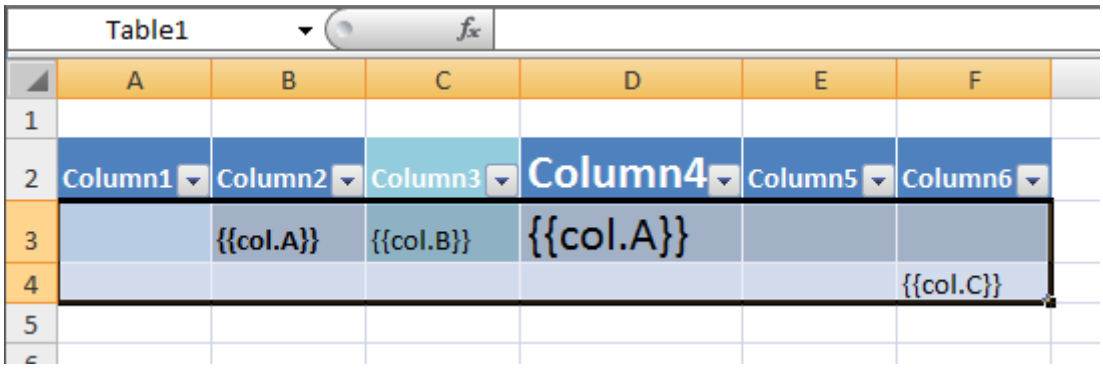
```
{
  "col": [
    {"A": "A1", "B": "B-1"},
    {"A": "A2", "B": "B-2"}
  ]
}
```

will result in resized table




### Multi-row context

Table can also be used in multi-row context, although such usages are not as common. An example would look like:




when paired with matching input:

```
{
 "col": [
   {"A": 1, "B": 4, "C": "X"},
   {"A": 2, "B": 5, "C": "Y"},
   {"A": 3, "B": 6, "C": "Z"}
 ]
}
```

will result in resized table

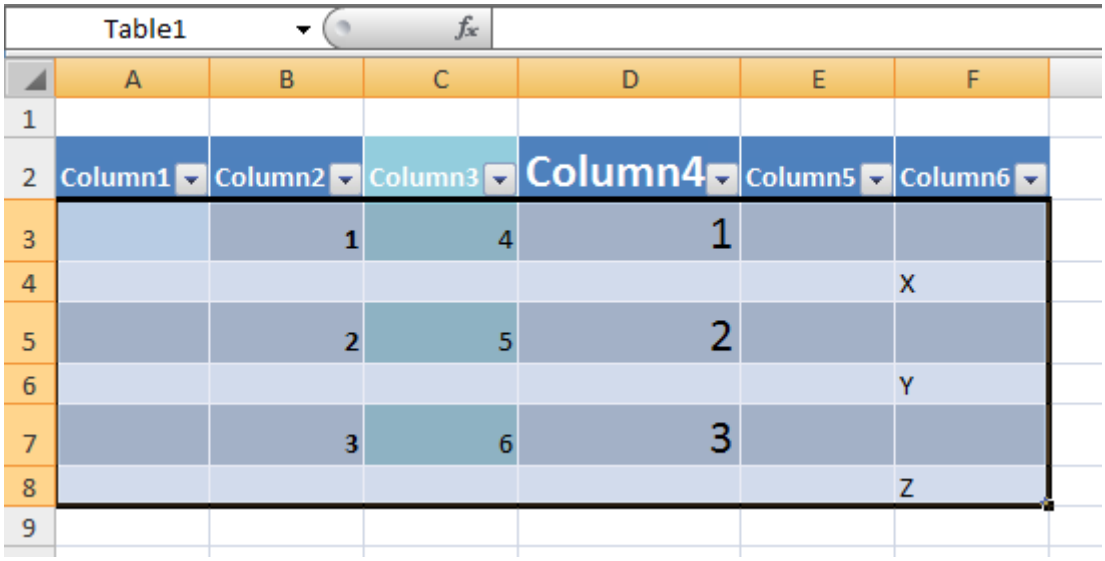



Table resizing behaves almost the same as cell resizing:

- multi-row context is supported
- tags can be repeated
- cell styles will be replicated
- row styles will be replicated

But there are some differences:

- whole table will be used during resize, while cells will find the minimum spanning context

- table size needs to be adjusted

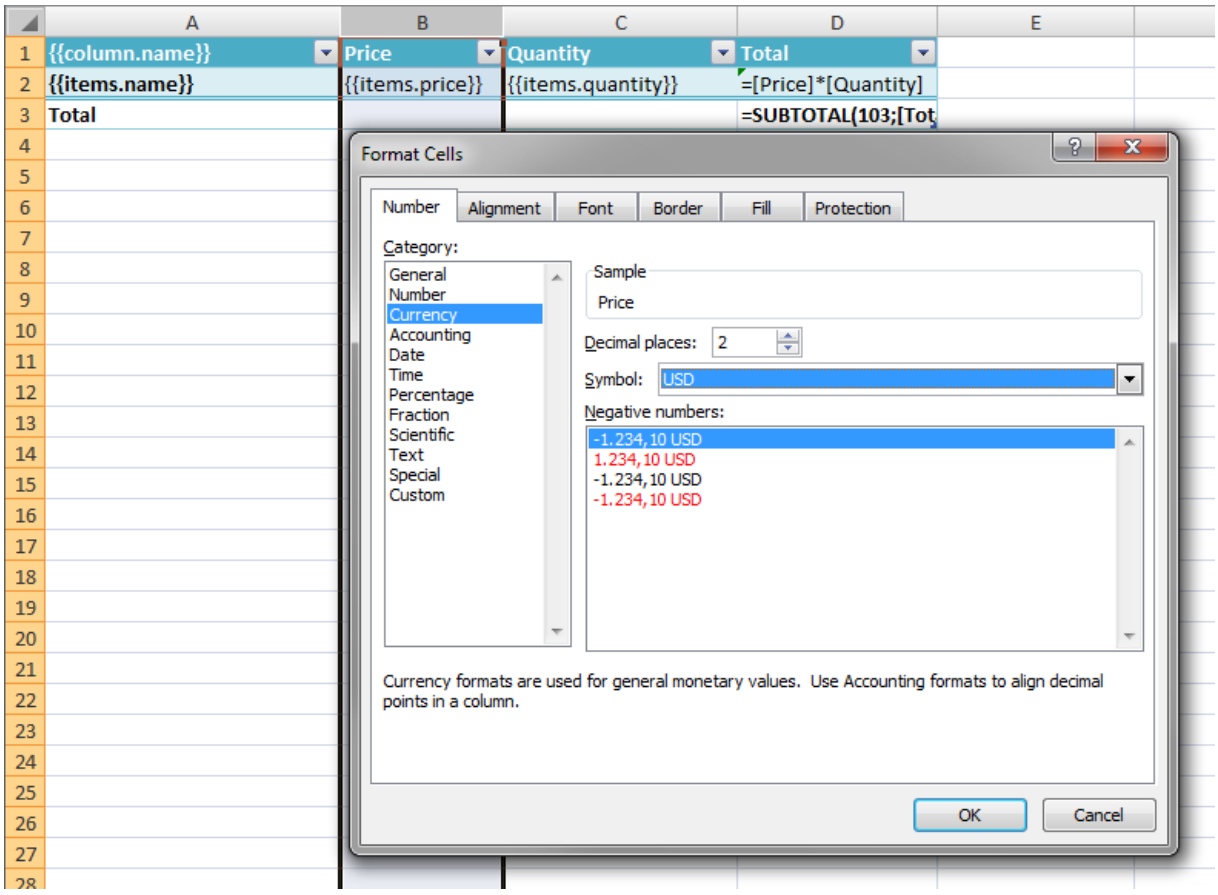
## Setting up tables

While most features which are done within tables can be done with plain cells, use of tables makes them much easier to use:

- it's common to setup cell/column style for formatting purpose
- table style allows for quick/easy visual setup of banded rows/columns
- total row supports various simple formulas for aggregating table data

Tags can be used in table headers, which can also be combined with horizontal-resize (for setting up dynamic columns).

An example of non-trivial table setup could look like:

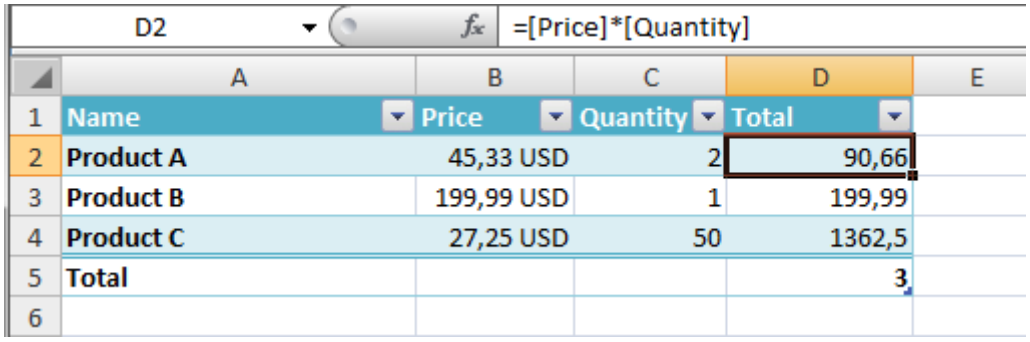



when paired with matching input:

```
{
 "column": {"name": "Name"},
 "items": [
   {"name": "Product A", "price": 45.33, "quantity": 2},
   {"name": "Product B", "price": 199.99, "quantity": 1},
   {"name": "Product C", "price": 27.25, "quantity": 50}
 ]
```

}

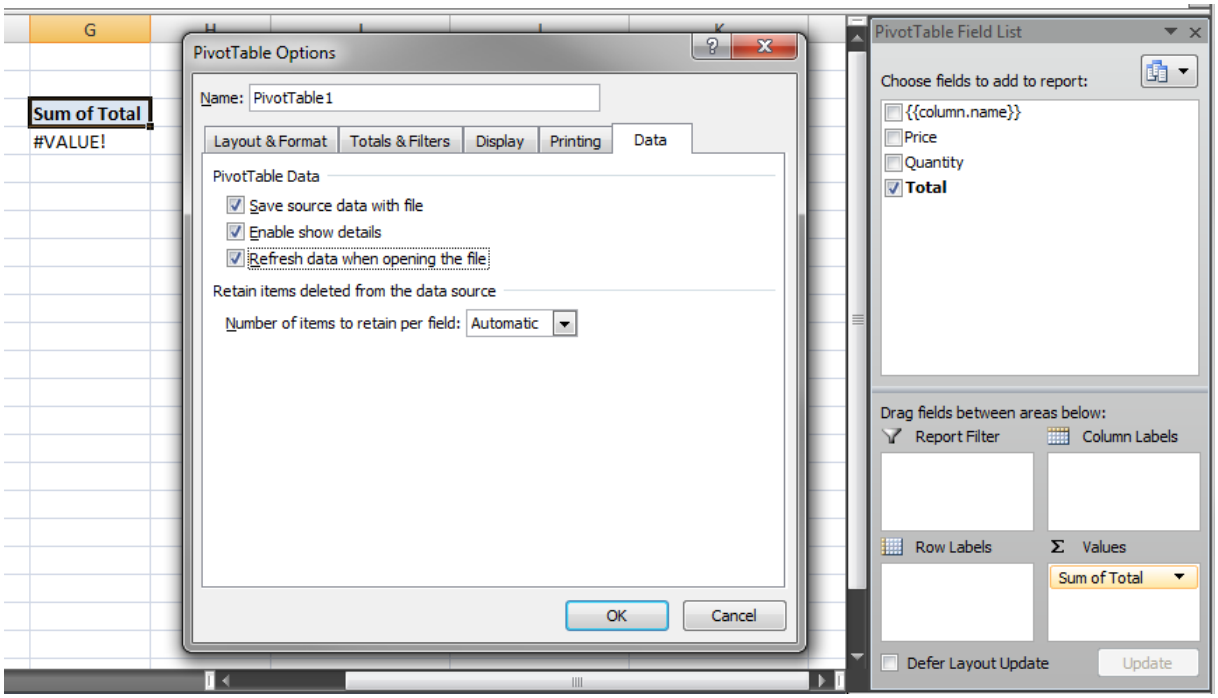
will result in resized table (with Show Formulas disabled under Formulas tab):




Price column was formatted to show extra USD symbol and 2 decimals, unlike the Total column which does not have formatting and thus shows numbers in default format.

Header filters were automatically updated to list all values within the table, while various formulas are showing useful values without extra input data.

For complex reports tables are just the first step, as they are used as data source for various pivots and charts. To create a pivot data source must be defined, which can be just a table name. Pivots can be refreshed on load, which is useful to re-populate them with actual data after Templater finishes with processing. Refresh option can be set on Data tab in PivotTable Options:




## Removing table content

If **Resize**(tags, 0) is called on a table, only the content of the table will be cleared up. Table will still exist with the number of rows as it did in the template. The reason for such behavior is because unlike in Word, in Excel tables must have at least one row.

The way to completely remove a table is to put a named range around it. This way when named range is removed, the table will also be removed.

### Dynamic resize

Similarly to dynamic resize within cells, dynamic resize can be used on a table. When ResultSet/DataReader is used, headers will also be added to table column names. Otherwise generic names will be used for columns.

### Duplicating tables

In several scenarios table can be duplicated. When table is duplicated it will get a new name, since table names must be unique across Excel file.

## Named range

Templater will respect named range and will adjust its context detection to include various Excel features during decision making, such as named range. There are various applications for a named range such as:

- defining outer range used for a resize - instead of letting Templater use minimum range spanning all tags
  - often there are cells outside of tags which ought to be included during the resize. Probably the easiest way to include them is to declare named range which will instruct Templater to use it instead of the underlying range (as long as named range has same tags as the underlying one)
- Templater will avoid breaking cells within certain features (such as tables and named ranges)
  - pushdown after the resize will move all cells within the named range, not just the ones directly below the range being resize
- removing a named range will remove all elements inside
  - this way tables and various others elements can be removed

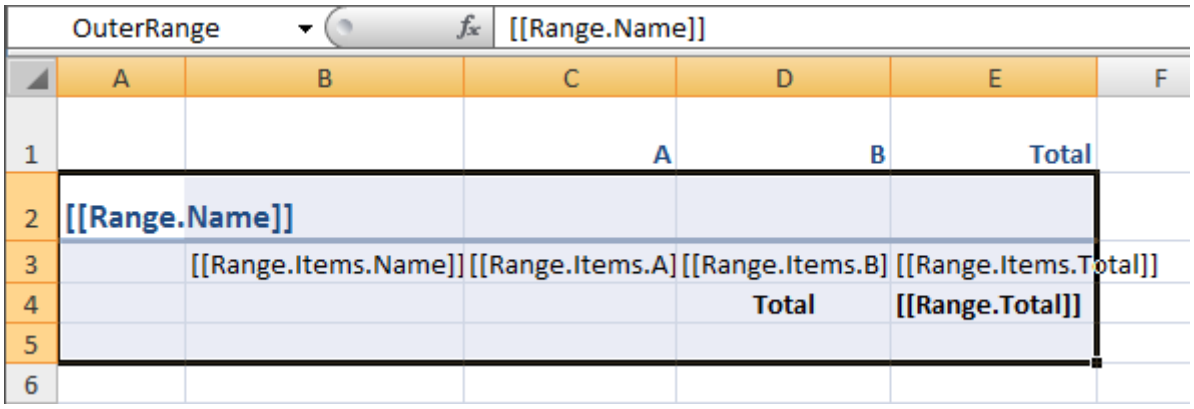
Using named ranges and tables in formula expressions is also more performant and thus recommended over using ranges.

Named ranges can also be hidden (some features such as filters on cells use hidden named ranges).

### Fine tuning resize region

Most common use case for named ranges is to tweak the affected range, without introducing additional tags just for that purpose (along with :hide metadata since they are not really used).

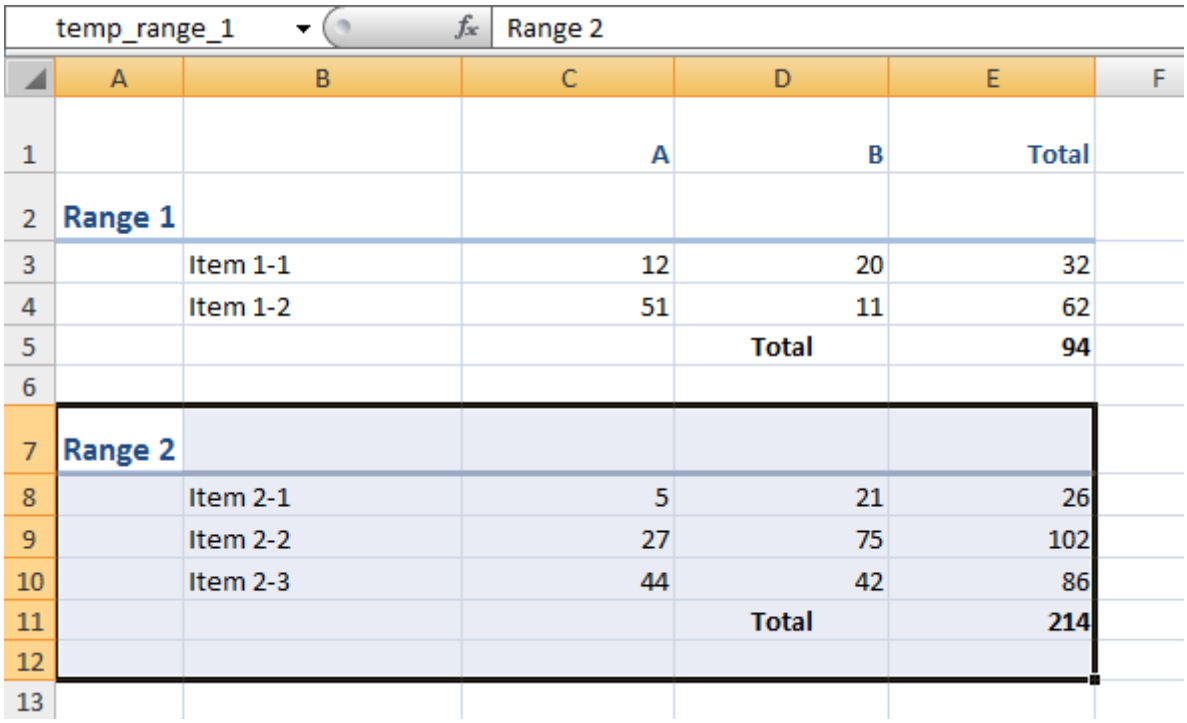
A simple example of fine tuning would look like:




which extends the minimum range from A2:E4 to A2:E5 via an **OuterRange** named range. This example also uses a nested collection which will stretch the named range when the inner collection is resized. When paired with input such as:

```
{
 "Range": [
        { "Name": "Range 1", "Total": 94, "Items": [
                {"Name": "Item 1-1", "A": 12, "B": 20, "Total": 32},
                {"Name": "Item 1-2", "A": 51, "B": 11, "Total": 62}
        ]},
        { "Name": "Range 2", "Total": 214, "Items": [
                {"Name": "Item 2-1", "A": 5, "B": 21, "Total": 26},
                {"Name": "Item 2-2", "A": 27, "B": 75, "Total": 102},
                {"Name": "Item 2-3", "A": 44, "B": 42, "Total": 86}
        ]}
 ]
}
```

will result in output with a new named range:




| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | | A | B | Total | |
| 2 | **Range 1** | | | | | |
| 3 | | Item 1-1 | 12 | 20 | 32 | |
| 4 | | Item 1-2 | 51 | 11 | 62 | |
| 5 | | | | **Total** | **94** | |
| 6 | | | | | | |
| 7 | **Range 2** | | | | | |
| 8 | | Item 2-1 | 5 | 21 | 26 | |
| 9 | | Item 2-2 | 27 | 75 | 102 | |
| 10 | | Item 2-3 | 44 | 42 | 86 | |
| 11 | | | | **Total** | **214** | |
| 12 | | | | | | |
| 13 | | | | | | |

Named range must have a unique name within the Excel file and thus Templater will give it name which starts with **temp_range_**. While Templater could remove such named ranges, they are left within the document for cases when documents are processed multiple times.

Since the named range is larger than minimum range, there will be extra row after each resize, as it was specified by named range.

Both ranges were stretched to accommodate the resized collections within them.

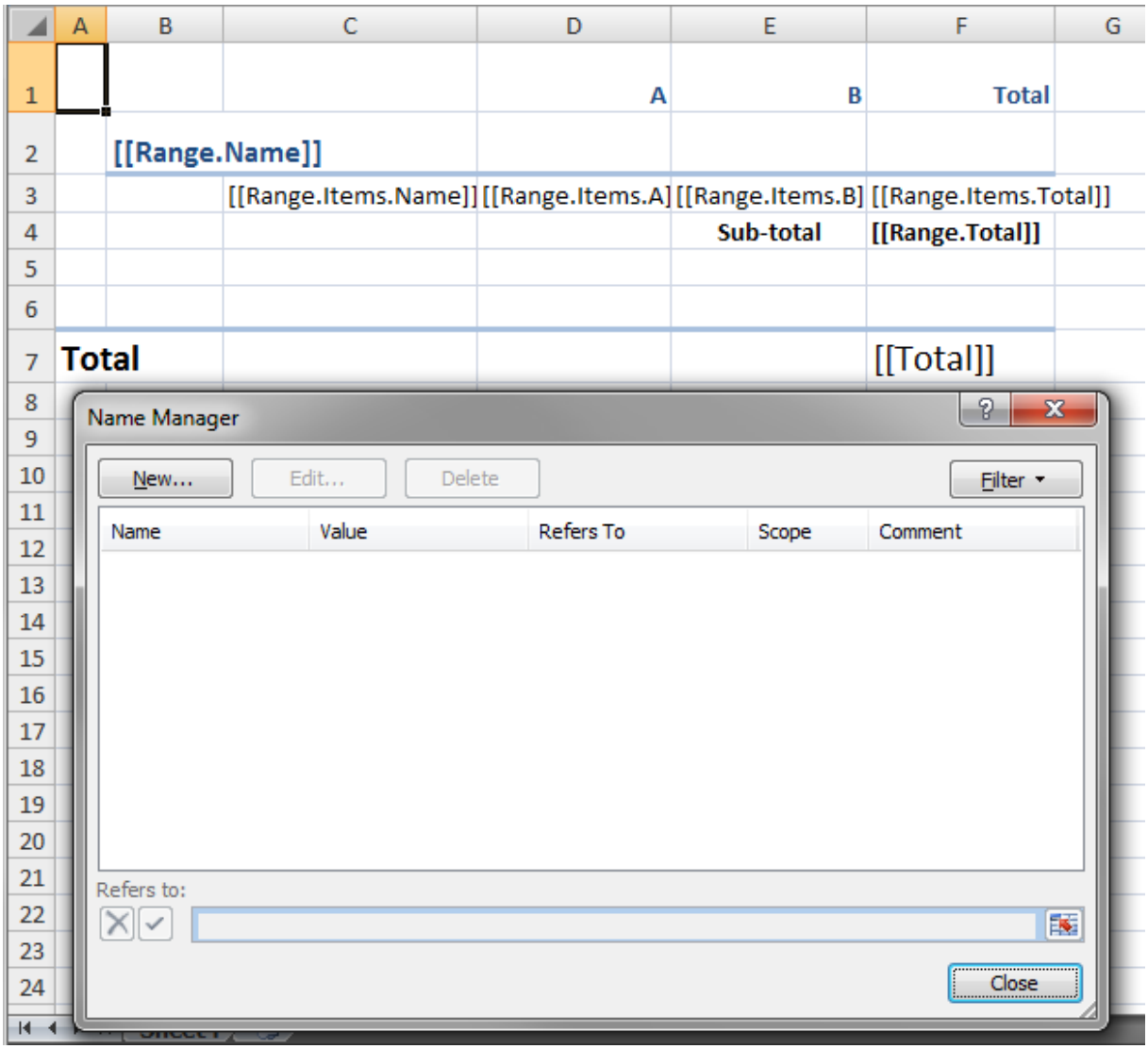
### Preventing range splitting

Another common use case for named ranges is to prevent “unexpected” cell pushdown. Often after the resize a pushdown can break-up totals which were put at the end. There are several ways to prevent such split:

- use table for totals
- named range around the totals
- merge cells at/above the totals

In all of those cases, the underlying theme is that pushdown will try to push only cells directly bellow itself. To prevent this named range can be put at the place where we want range to behave as a unit and thus by giving it a name we will prevent “unexpected” behavior.

This is quite common in nested ranges which have inner collections and thus partial resize can break the document layout:




In the above example there are no named ranges (or tables or merge cells) in the document. Thus when **Range.*** is resized, only B2:F4 will be used as a range. This will result in moving of B7:F7, while A7 will remain at its original position. Thus the resized document when paired with appropriate input:

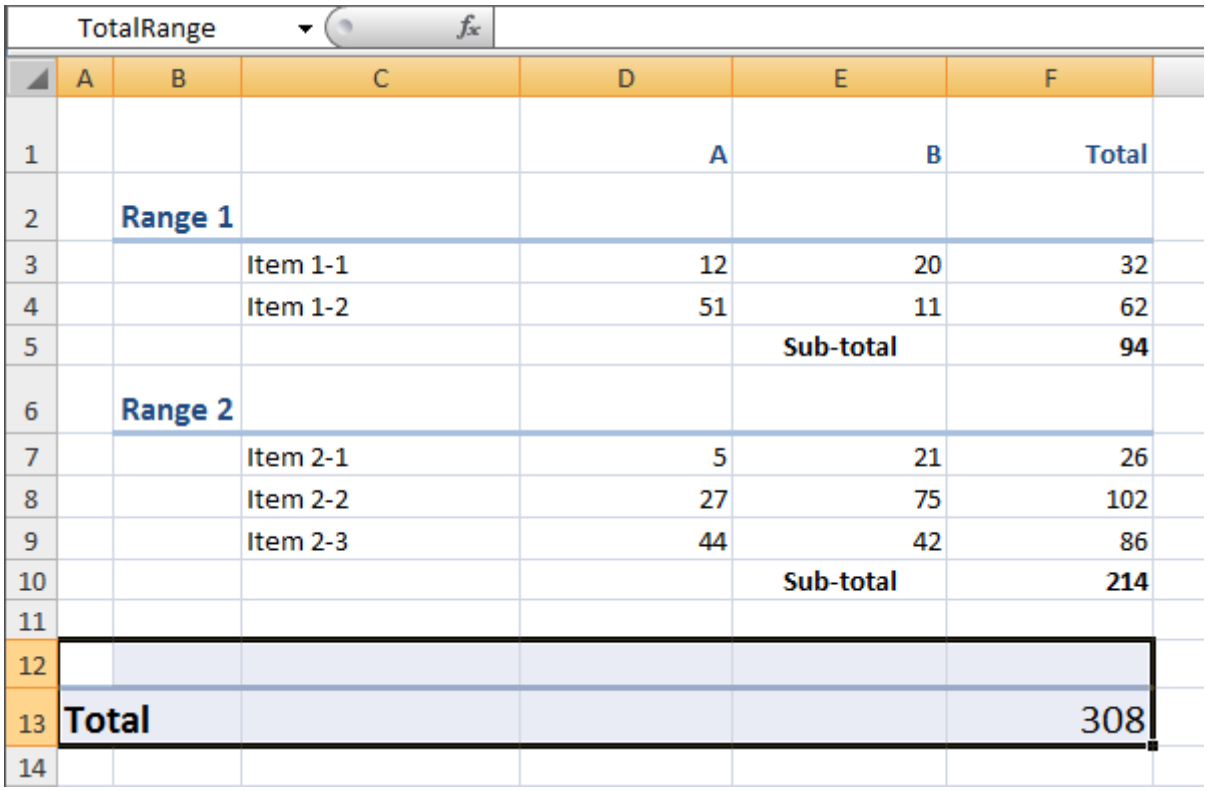
```
{
 "Range": [
        { "Name": "Range 1", "Total": 94, "Items": [
                {"Name": "Item 1-1", "A": 12, "B": 20, "Total": 32},
                {"Name": "Item 1-2", "A": 51, "B": 11, "Total": 62}
        ]},
        { "Name": "Range 2", "Total": 214, "Items": [
                {"Name": "Item 2-1", "A": 5, "B": 21, "Total": 26},
                {"Name": "Item 2-2", "A": 27, "B": 75, "Total": 102},
                {"Name": "Item 2-3", "A": 44, "B": 42, "Total": 86}
        ]}
 ],
 "Total": 308
```

}

will look broken:

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | | | A | B | Total |
| 2 | | Range 1 | | | | |
| 3 | | | Item 1-1 | 12 | 20 | 32 |
| 4 | | | Item 1-2 | 51 | 11 | 62 |
| 5 | | | | | Sub-total | 94 |
| 6 | | Range 2 | | | | |
| 7 | Total | | Item 2-1 | 5 | 21 | 26 |
| 8 | | | Item 2-2 | 27 | 75 | 102 |
| 9 | | | Item 2-3 | 44 | 42 | 86 |
| 10 | | | | | Sub-total | 214 |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | 308 |
| 14 | | | | | | |

To fix this output it's sufficient to define named range as A6:F7 (A6 is used instead of A7 since border was defined in row 6) which will prevent only subset of region to be pushed down. End document will look as expected:



| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | | | A | B | Total |
| 2 | | Range 1 | | | | |
| 3 | | | Item 1-1 | 12 | 20 | 32 |
| 4 | | | Item 1-2 | 51 | 11 | 62 |
| 5 | | | | | Sub-total | 94 |
| 6 | | Range 2 | | | | |
| 7 | | | Item 2-1 | 5 | 21 | 26 |
| 8 | | | Item 2-2 | 27 | 75 | 102 |
| 9 | | | Item 2-3 | 44 | 42 | 86 |
| 10 | | | | | Sub-total | 214 |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | Total | | | | | 308 |
| 14 | | | | | | |

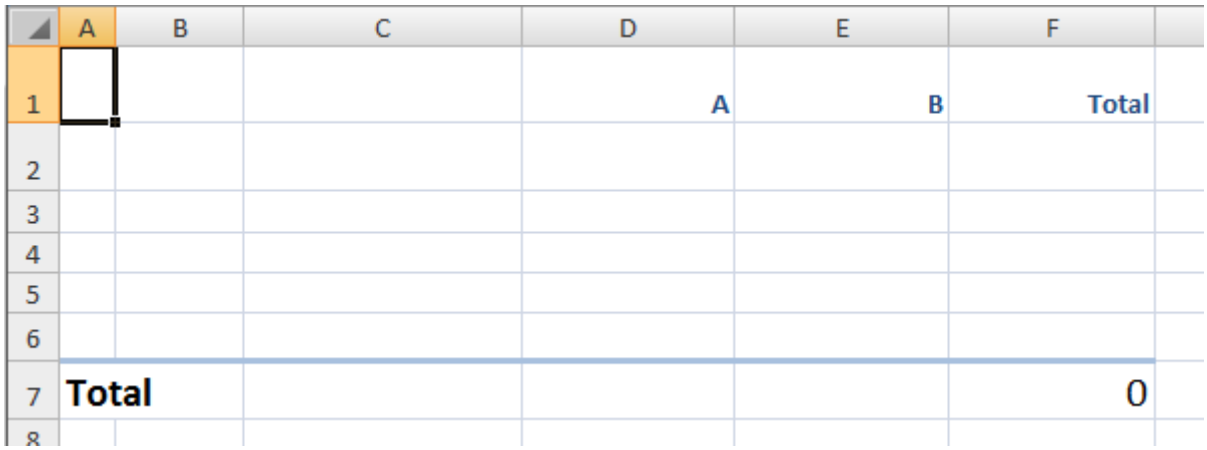
## Removing a named range

Named range will only be removed if all tags are specified during **Resize**(tags, 0) operation. When named range is removed there is no pull down of the cells bellow the range[19].

If previous example was used with a different input:

```
{
  "Range": [],
  "Total": 0
}
```

will have part of rows cleared (instead of deleted):



| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | | | A | B | Total |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | Total | | | | | 0 |
| 8 | | | | | | |

[19] This feature might be introduced in some future version

# Excel specific features

There are various other Excel features Templater recognizes and can manage. Some of them are simple, while others can be quite complex.

## Formulas

Cell in Excel can display a fixed value, or have a formula which in the end display value based on the evaluated formula expression. Formula expression can be quite complicated and contain:

- reference to other cells, ranges, tables or named ranges
- fixed values
- mathematical expressions
- call into functions

Excel will put cached value in the same cell where the formula is defined. Some Excel viewers know how to recalculate/evaluate formulas, but most of them do not and require Excel for evaluating the formulas again.

Templater also does not evaluate formulas[20] but it will adjust them accordingly to the changes being done in the document. Those changes can be from very simple, to highly complex:

- pushdown will adjust the relevant cells which were pushed
- resize can create new formulas or change the existing ones
- new formulas sometime use new tables and/or new named ranges

An example of formula adjustment would look like:

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Conversion factor: | {{exchange.rate}} | | | | |
| 2 | | | | | | |
| 3 | Name | Price | Price (local) | Quantity | Total | Total (local) |
| 4 | {{items.name}} | {{items.price}} | =B4*B7 | {{items.quantity}} | =[Price]*[Quantity] | =E4*B1 |
| 5 | Total | | | | =SUBTOTAL(103;[Total | =SUBTOTAL(105;[Total (I |
| 6 | | | | | | |
| 7 | Conversion factor: | {{exchange.rate}} | | | =SUM(Table2[Total]) | =SUM(F4) |
| 8 | | | | | | |

when paired when relevant info:

```
{
 "exchange": {"rate": 2.7},
 "items": [
   {"name": "Product A", "price": 45.33, "quantity": 2},
   {"name": "Product B", "price": 199.99, "quantity": 1},
   {"name": "Product C", "price": 27.25, "quantity": 50}
 ]
}
```

will result in formulas which were correctly adjusted:

[20] This feature might be introduced in some future version

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Conversion factor: | 2,7 | | | | |
| 2 | | | | | | |
| 3 | Name | Price | Price (local) | Quantity | Total | Total (local) |
| 4 | Product A | 45,33 | =B4*B9 | 2 | =[Price]*[Quantity] | =E4*B1 |
| 5 | Product B | 199,99 | =B5*B9 | 1 | =[Price]*[Quantity] | =E5*B1 |
| 6 | Product C | 27,25 | =B6*B9 | 50 | =[Price]*[Quantity] | =E6*B1 |
| 7 | Total | | | | =SUBTOTAL(103;[Total | =SUBTOTAL(105;[Total (I |
| 8 | | | | | | |
| 9 | Conversion factor: | 2,7 | | | =SUM(Table2[Total]) | =SUM(F4:F6) |

This example has several different cases of formula adjustment:

- new rows copied the formula and pointed to the relevant row[21]
- formulas which referenced cell above the table did not modify that reference
- formulas which referenced cell below the table (which got pushed down) had to modify the reference
- formula which referenced range within a table which stretched due to resize changed their original range from a single cell to a range stretching over all the new cells

As visible in the example above, some formulas did not changed at all; like the **[Price]*[Quantity]** and **SUM(Table2[Total])**; while some had to be changed (at least the visual representation which is saved into the resulting document). Whenever possible formulas which do not change during Templater operations are preferable since they will be processed much faster (this is highly noticeable on large Excel files).

### Formula reference syntax

Templater recognizes the special cell reference syntax (relative and absolute) and will adjust the formulas accordingly:

- D5 - syntax means that cell can move both horizontally and vertically
- $D5 - syntax means that cell can only move vertically, but column is fixed and will not change
- D$5 - syntax means that cell can only move horizontally, but row is fixed and will not change
- $D$5 - syntax means that cell is fixed and will not move (neither horizontally or vertically)

Still, this syntax is only for matching the Excel rules with regards to references. Sometimes Templater still needs to adjust the formula even when it uses a fixed syntax

Formulas are only allowed to reference elements within a single Excel files. References to another file are not supported.

## Images

Templater can insert new images into the document via appropriate data types:

- .NET: Image and Icon

[21] Internally Excel uses non-changing representation of such formulas and thus they are not really changed, but rather just point to a different location

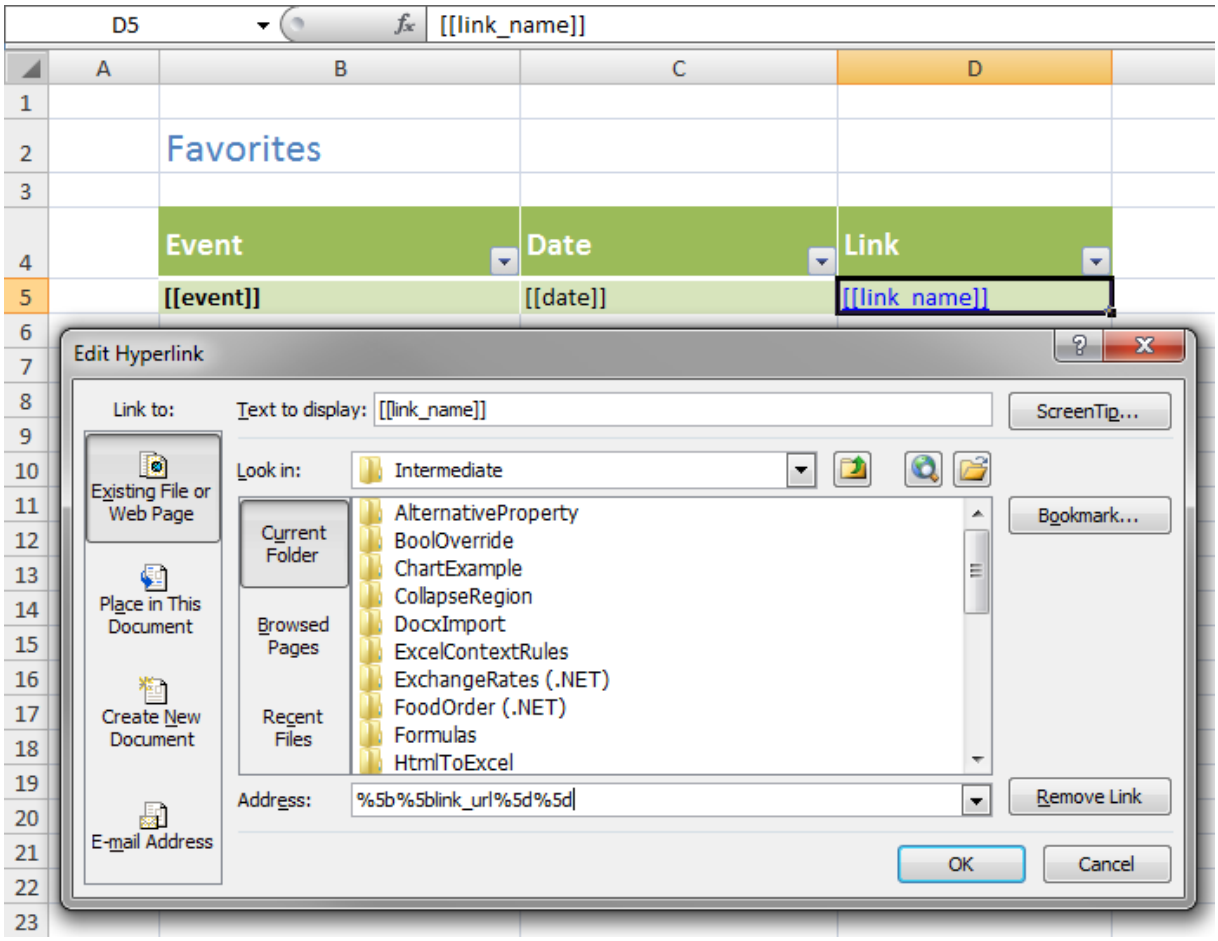
- Java: hr.ngs.templater.ImageInfo (with built-in BufferedImage and ImageInputStream conversion)

The image files will be included in the ZIP file and referenced from the relevant parts.

## Links

Hyperlinks are supported in Excel in the same way as they are supported in Word.

Links have multiple parts, as visible in the example:




## Merged cells

Cell merging has various applications, usually to fine tune the cell display, as cells can have text wrapped. With text wrapping using multiple columns defines how wide a text can look. Templater will duplicate, stretch and move merge cells around when document is changed. But it will also influence regions of document which are pushed down.

Alternative way to void region splitting is to use merge cell instead of named range or a table. Previous example with merge cells:

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | | | | A | B | Total | |
| 2 | | [[Range.Name]] | | | | | |
| 3 | | | [[Range.Items.Name]] | [[Range.Items.A]] | [[Range.Items.B]] | [[Range.Items.Total]] | |
| 4 | | | | | Sub-total | [[Range.Total]] | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | Total | | | | [[Total]] | |
| 8 | | | | | | | |

when resized using same data will look as expected:

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | | | | A | B | Total |
| 2 | | Range 1 | | | | |
| 3 | | | Item 1-1 | 12 | 20 | 32 |
| 4 | | | Item 1-2 | 51 | 11 | 62 |
| 5 | | | | | Sub-total | 94 |
| 6 | | Range 2 | | | | |
| 7 | | | Item 2-1 | 5 | 21 | 26 |
| 8 | | | Item 2-2 | 27 | 75 | 102 |
| 9 | | | Item 2-3 | 44 | 42 | 86 |
| 10 | | | | | Sub-total | 214 |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | Total | | | | 308 |
| 14 | | | | | | |

This works because Templater will avoid breaking up merge cells and thus extending the region which is affected by the pushdown.

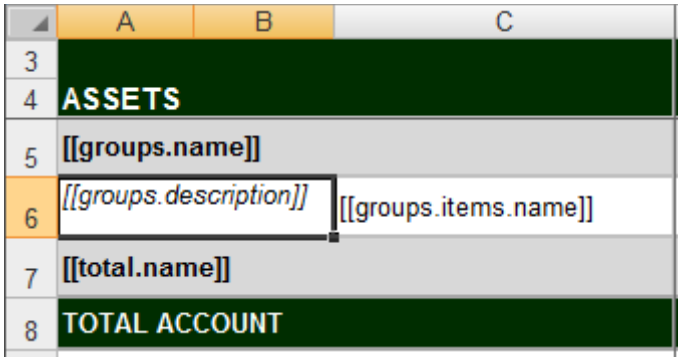
Merged cells also after the behavior of formulas (to some extent):

- formulas can stretch due to merge cell stretching
- formulas intersecting merge cells will behave differently that the ones which do not

Similarly to tables and named ranges, during resize merge cells can be:

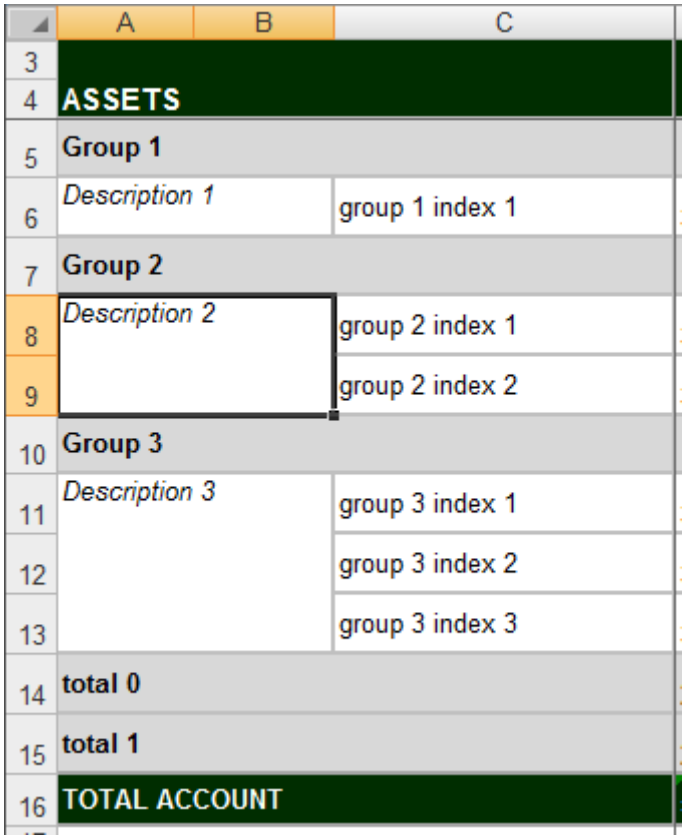
- duplicated
- stretched
- removed

Merge cells requires at least two columns to create a horizontal merge. If merge stretching is required, the easiest way to implement such a feature is to add additional column and setup document accordingly, such as in this example:



| | A | B | C |
|---|---|---|---|
| 3 | | | |
| 4 | **ASSETS** | | |
| 5 | **[[groups.name]]** | | |
| 6 | *[[groups.description]]* | | [[groups.items.name]] |
| 7 | **[[total.name]]** | | |
| 8 | **TOTAL ACCOUNT** | | |

which get's converted into a visible merge cell once rows are duplicate:



| | A | B | C |
|---|---|---|---|
| 3 | | | |
| 4 | **ASSETS** | | |
| 5 | **Group 1** | | |
| 6 | *Description 1* | | group 1 index 1 |
| 7 | **Group 2** | | |
| 8 | *Description 2* | | group 2 index 1 |
| 9 | | | group 2 index 2 |
| 10 | **Group 3** | | |
| 11 | *Description 3* | | group 3 index 1 |
| 12 | | | group 3 index 2 |
| 13 | | | group 3 index 3 |
| 14 | **total 0** | | |
| 15 | **total 1** | | |
| 16 | **TOTAL ACCOUNT** | | |

## Cell styles

Excel has extensive support for cell styling:

- alignment
- text direction
- font/text properties
- colors
- text wrapping

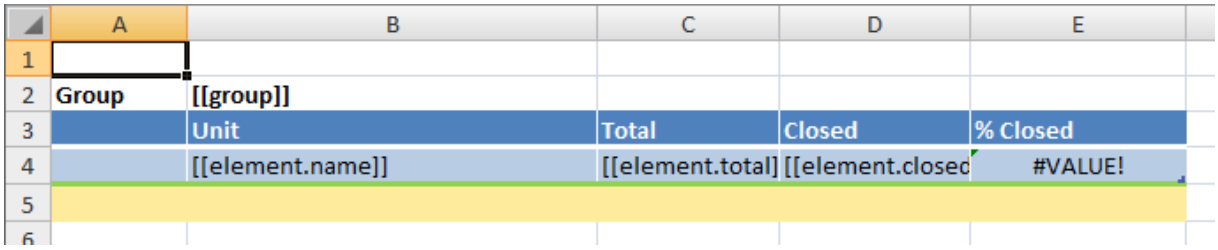
- formatting
- borders
- and few others...

Templater will maintain cell styles during duplication, pushdowns and similar changes. This way style can be easily set-up in Excel, while Templater will maintain those styles across changes.

## Conditional formatting

While cell styles allow for static style setup, sometimes cell style depends on the actual cell value. In those cases it's useful to apply conditional formatting on the relevant cells so they can have custom rules based on their values.

A template example with conditional formatting:



| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | Group | [[group]] | | | |
| 3 | | Unit | Total | Closed | % Closed |
| 4 | | [[element.name]] | [[element.total] | [[element.closed | #VALUE! |
| 5 | | | | | |
| 6 | | | | | |

when paired when relevant data:

```
[
 { "group": "Group 1", "description": "first description", "element": [
   {"name":"element 1","total":20, "closed": 10},
   {"name":"element 2","total":10, "closed": 8},
   {"name":"element 3","total":12, "closed": 1}
 ]},
 { "group": "Group 2", "description": "second description", "element": [
   {"name":"element 2","total":8, "closed": 8},
   {"name":"element 5","total":3, "closed": 0}
 ]}
]
```

will result in two tables with conditional formatting at column E:

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | Group | Group 1 | | | |
| 3 | | Unit | Total | Closed | % Closed |
| 4 | | element 1 | 20 | 10 | 50,0 |
| 5 | | element 2 | 10 | 8 | 80,0 |
| 6 | | element 3 | 12 | 1 | 8,3 |
| 7 | | | | | |
| 8 | | | | | |
| 9 | Group | Group 2 | | | |
| 10 | | Unit | Total | Closed | % Closed |
| 11 | | element 2 | 8 | 8 | 100,0 |
| 12 | | element 5 | 3 | 0 | 0,0 |
| 13 | | | | | |
| 14 | | | | | |

## Comments

Tags can be used even in comments, in which case they will be bound to the cell comment is referencing. Even when there are no tags in comments, when comments reference a cell which gets duplicated, a comment will also be duplicated.

A template with comments could look like:

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | Group | [[group]] | | | |
| 3 | | Unit | Total | | % Closed |
| 4 | | [[element.name]] | [[elemer | | #VALUE! |
| 5 | | | | | |
| 6 | | | | | |

Details about this group [[description]]

when paired with previous example produces:

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | Group | Group 1 | | | |
| 3 | | Unit | Total | Closed | % Closed |
| 4 | | element 1 | 20 | 10 | 50 |
| 5 | | element 2 | 10 | 8 | 80 |
| 6 | | element 3 | 12 | 1 | 8,333333333 |
| 7 | | | | | |
| 8 | | | | | |
| 9 | Group | Group 2 | | | |
| 10 | | Unit | To | | % Closed |
| 11 | | element 2 | | 8 | 100 |
| 12 | | element 5 | 3 | 0 | 0 |
| 13 | | | | | |

Details about this group second description

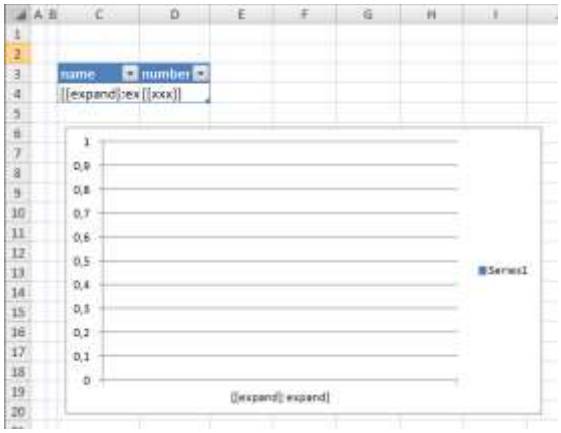
If **Resize**(tags, 0) is invoked on the range which has comments, those specific comments will be removed.

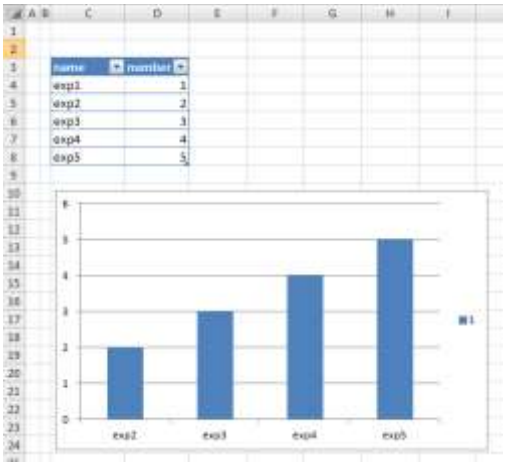
## Drawings

Templater will manage drawings on changes to the documents. Drawings come in various types:

- images
- WordArt
- TextBox
- Charts

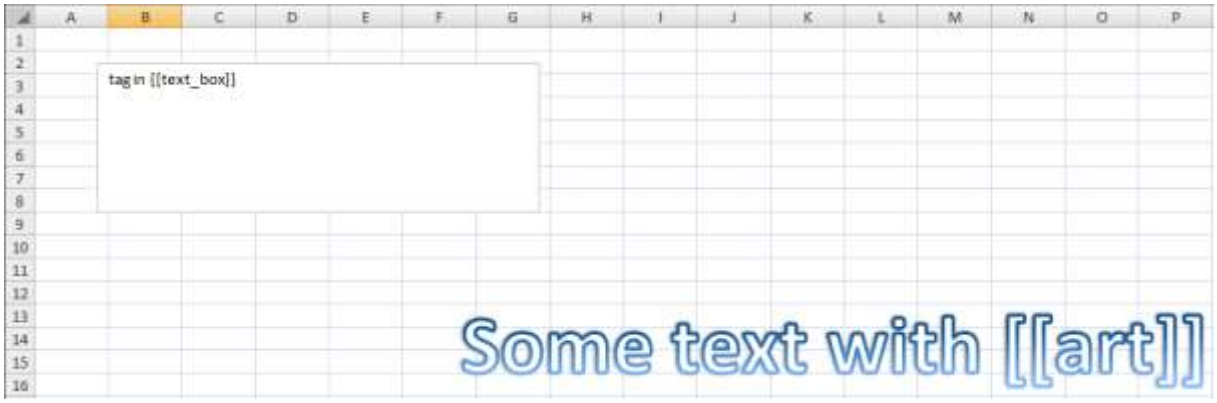
and several others. On resize, pushdown/pushright they will be moved accordingly.




## TextBox and WordArt

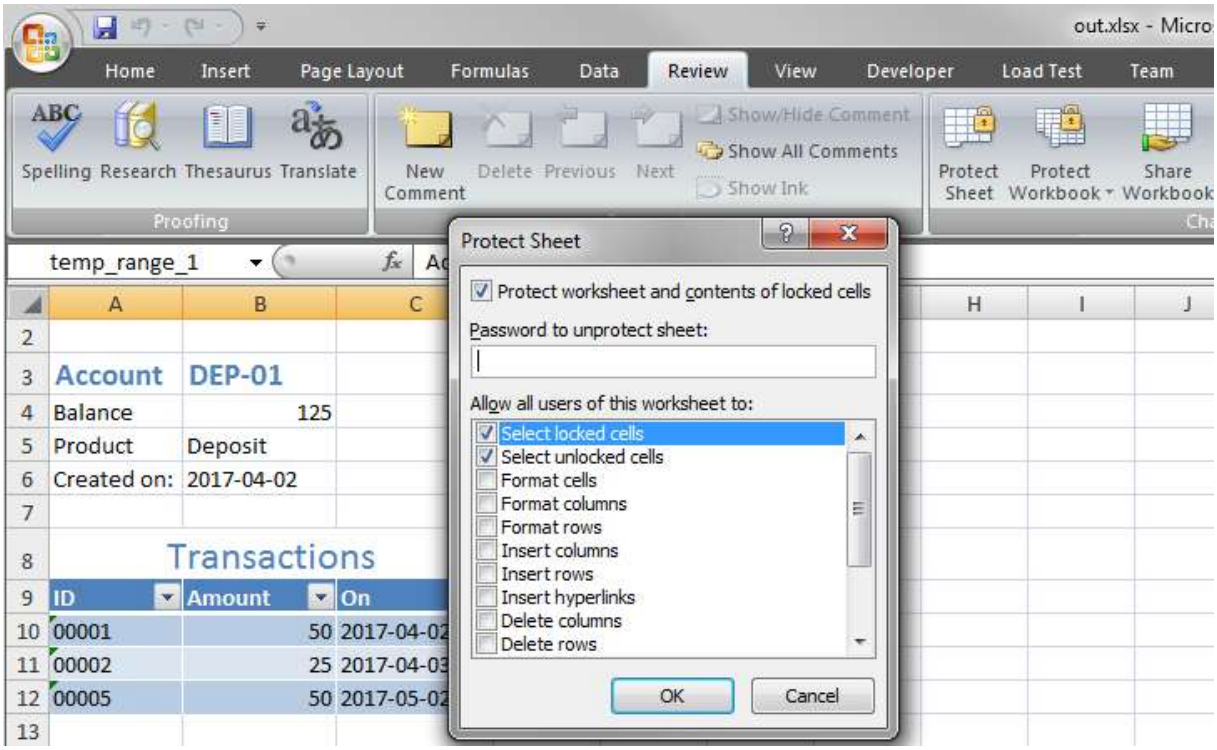
Tags can be used even in TextBox and WordArt, in which case they will be bound to the cell drawing is referencing. As with comments text can be a combination of tags and normal text. A template with could look like:



## Sheet locking

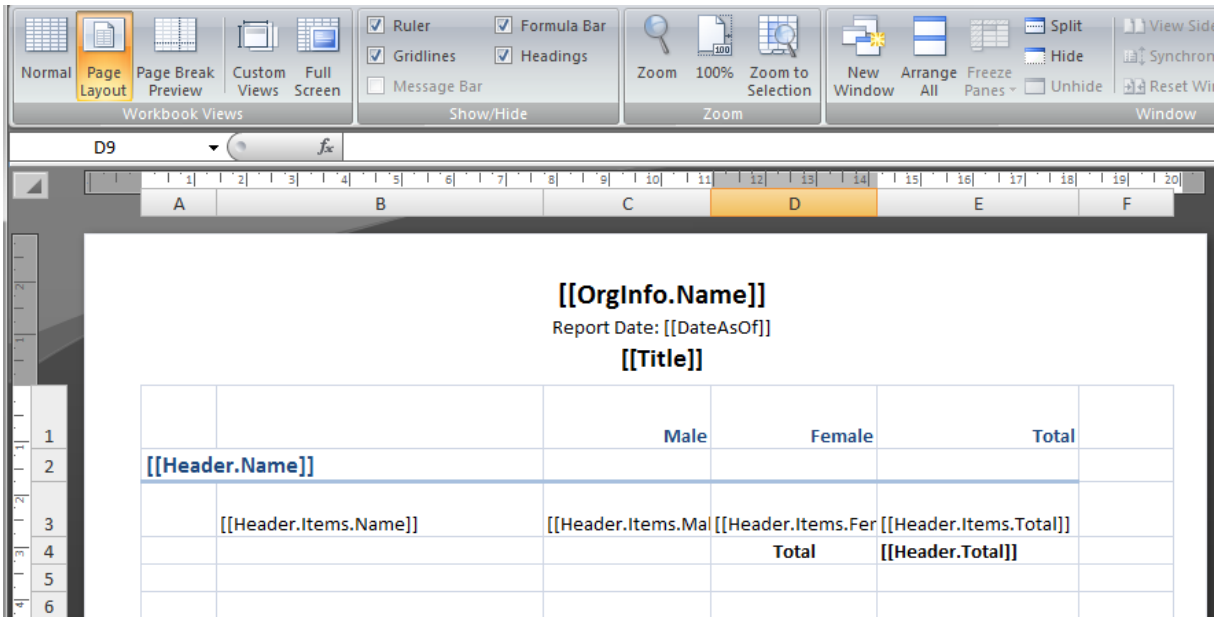
Similarly to locking in Word, a sheet in Excel can be locked. This is a UI feature which doesn't really prevent data manipulation, which means that Templater can still modify the document as usual, but to the user document appears locked (or some parts of it).

It's available through Review -> Protect Sheet menu:




## Headers and footers

Tags can be used in headers and footers, although only a subset of Excel features is available at those places. Headers can be defined in Page layout mode, e.g.:




## Power Query / Get & Transform

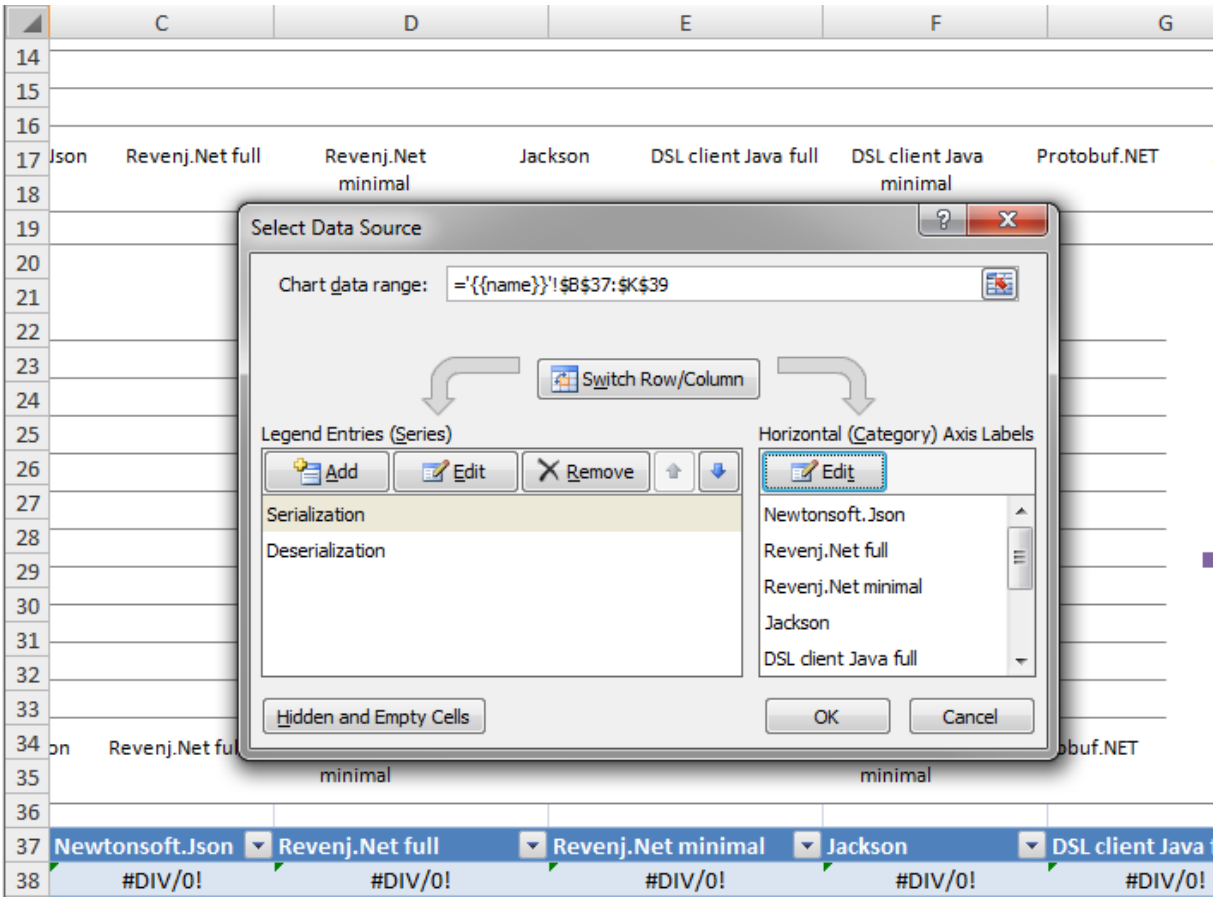
There is basic support for Power Query, as in when underlying data source uses tags, then need a special treatment. This allows usage of complex Power Query use cases. More complicated use case such as use of embedded CSV file within XLSX file which get's processed by Templater and then consumed by Power Query allows for sending complex reports over the network as a single file.

## Pivots and charts

Advanced Excel features usually consume data source(s) (specific range, table or a whole sheet) to present data in various advanced analytics friendly way. As with many other features, Templater can duplicate such pivots and charts which allows for very complex reports.

Most charts (column, line, pie, bar, area...) work the same way and are supported by Templater.

There are usually multiple data source definitions for each specific feature, e.g.:




When charts and pivots are duplicated, data ranges will be adjusted accordingly; even if the sheet name changes (as in the above example).

## Print Area

Templater supports hidden named ranges and will adjust them on document manipulation. This means print area should be correct after processing by Templater.

## Formula conversion

Tags can't be used within formulas. There is a special way to convert cell values into formulas at the end of processing. If a cell starts with [[equals]] tag it will be converted into formula representation.

## Font color and rich text

Similarly to Word XML can be used to inject values into xlsx directly. But unlike in Word, only subset of features can be specified this way, since Excel uses different way to encode cell background information. If background information is required, it's better to use Conditional formatting instead.

Simple rich text can be entered as XML as long as the underlying Excel OOXML format is understood.

## Cell merging via metadata

Internal metadata **merge-nulls** works in Excel also[22].

[22] span-nulls is not currently supported in Excel

# Known issues

If a specific Excel feature is not supported, there are few basic categories it falls into:

- feature requires Excel rendering engine and thus it's not supported
  - such features include PDF export, etc...
- feature is on the roadmap, but it's not supported yet
- feature is not behaving as expected due to a bug

## PDF export

A common use case is to convert Excel document into PDF. Unfortunately this requires an Excel rendering engine to work correctly.

There are several free and paid libraries which have sufficiently good PDF conversion for simple documents. But non-trivial documents quickly become non pixel-perfect during the conversion.

Whenever user can convert Excel document into PDF this should be preferable. Even running LibreOffice in headless mode supports only limited feature set of Excel. For simple documents there is a Dockerfile paired with Templater server which can be used to ease the PDF conversion via LibreOffice.

## Power Query cloning

Templater currently does not support cloning of sheets with Power Query. This restriction might be lifted in some future version.

## Formula values

Templater will remove cached values from formula cells. Also, it will not evaluate formulas at the end of processing. This means that when a document is opened it must be displayed via an application which knows how to evaluate the formulas on load (such as Excel).

# PowerPoint features

Templater has high coverage of various PowerPoint features, although many of them use embedded Excel files within the pptx file. Various features are supported out-of-the box without any special code, while some require special handling and will be introduced over time.

## Ready-to-use presentations

Prior to v4.0 Templater did not support PowerPoint format due to lack of useful use cases. But due to deeper integration of Templater into various applications it became obvious that creating presentations from various in-depth analyses has become a common use case. Therefore most of Templater features work also on PowerPoint format, although common use cases consist from only a few features:

- resizing/populating table to show raw numbers
- populating charts to display numbers in visually informative ways

While both of those can be done in Word or Excel, by automating export into PowerPoint manual step of copy-pasting numbers is avoided.

## Resizable behavior

Processing PowerPoint has its own special rules for detecting how resize behaves. Unlike Word which has a single main document and Excel where the basic element is a cell even if there can be many sheets, in PowerPoint the basic element is a slide. To understand resizing behavior of Templater few rules have to be understood. When Resize(tags, count) is called Templater will

- find the best matching region on the slide or across the slides which encapsulates all specified tags
    - regions will be limited to the rows in a table (matched for starting and ending row)
        - table region can span multiple rows
    - relevant list levels will be matched
        - list levels can match the hierarchical structure of the model
    - when tags are neither in table, embedded Excel (chart) or a list, whole slide will be used
- if all tags are inside tables/lists/chart, instead of duplicating the slides, tables, lists and/or charts will be resized instead
    - this means when a same collection is repeated both in a table and in a chart, that those tables and charts will get new rows instead of slides being duplicated
- when count = 0 indicating removal of the content part of the presentation, slides will be removed
    - all slides can be removed from the presentation
    - this is useful for conditionally presenting only a relevant part of the presentation

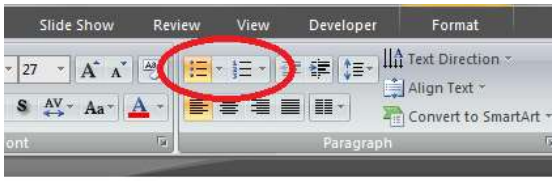
## Lists

Not every element in a slide is considered resizable (like in Excel where each cell can be considered in such a way). Unless text is marked as list within the slide of the presentation the whole slide will be used as context instead of only that list element.

Like in the Word lists can be:

- bullets
- numbered
- multi-level

List can be located even in notes, but they must have special list marker attached to them. Marker is visible in the menu when caret is located on the relevant element:

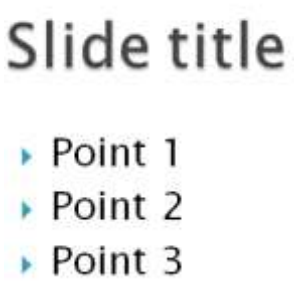




Duplicating list elements will retain all their properties (font style, nesting level, colors, etc...)
Matching above template with appropriate input:

```
[
 {"bullet": "Point 1"},
 {"bullet": "Point 2"},
 {"bullet": "Point 3"}
]
```

will result in multiple list elements:



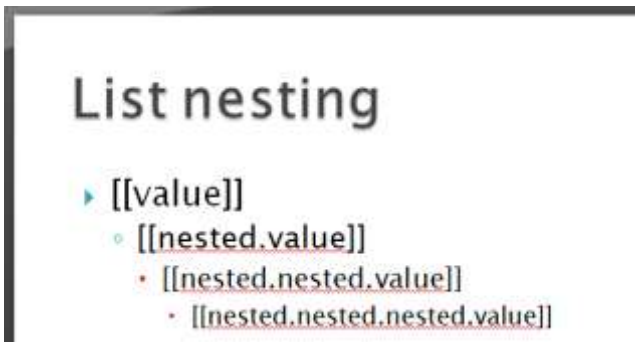
### Nesting

Common use case for lists is pairing it with deep nesting or even with recursive structures.

When specialized data structure is used, such as:

```
public class Nest
{
	public String value;
	public Nest[] nested;
}
```

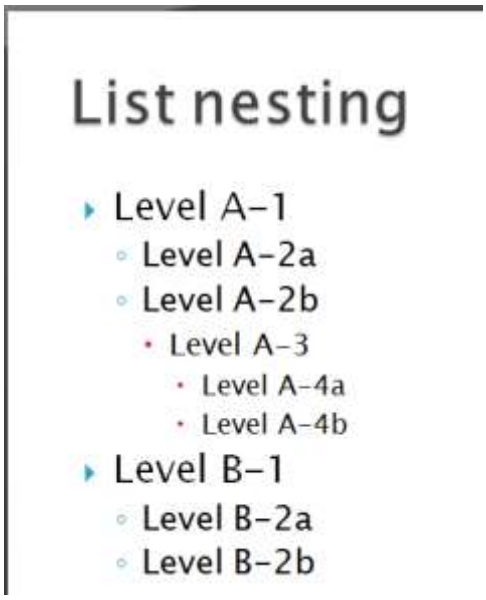
it is rather easy to pair it with nested list by predefining maximum nesting level, e.g.:




Based on the input, resulting list will match the nesting levels and values, e.g. for input as:

```
[
  { "value":"Level A-1", "nested":[
    { "value":"Level A-2a", "nested":[] },
    { "value":"Level A-2b", "nested":[
      { "value":"Level A-3", "nested":[
        { "value":"Level A-4a", "nested":[]},
        { "value":"Level A-4b", "nested":[]}
      ]}
    ]}
  ]},
  { "value":"Level B-1", "nested":[
    { "value":"Level B-2a", "nested":[] },
    { "value":"Level B-2b", "nested":[] }
  ]}
]
```

a matching list will be created:




Since style is defined on the list, while Templater only binds the data with the list, complex list representations can be easily constructed.

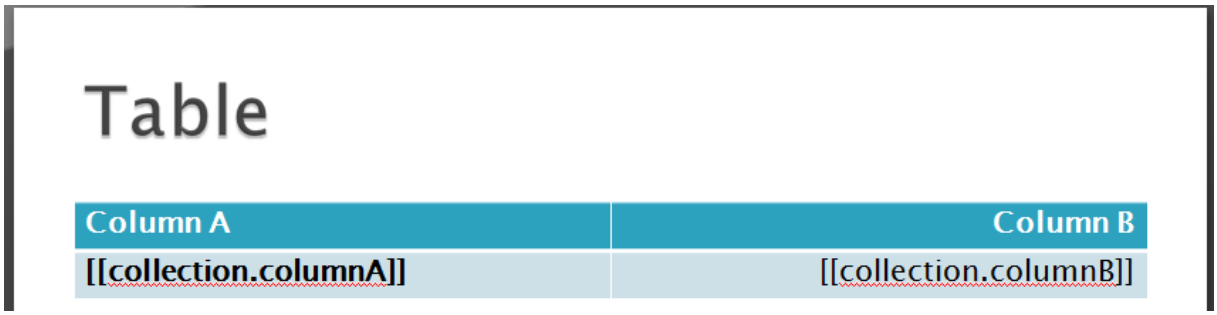
## Tables

While tables in PowerPoint are not as feature rich as the ones in Word, they are still quite useful and used often. Table can have various options attached to it, such as:

- styles
- spacing
- alignments
- borders
- cell merging
- text direction

which allows easy setup of complex layout.

Resizing a table is quite intuitive in Templater. When a table like:

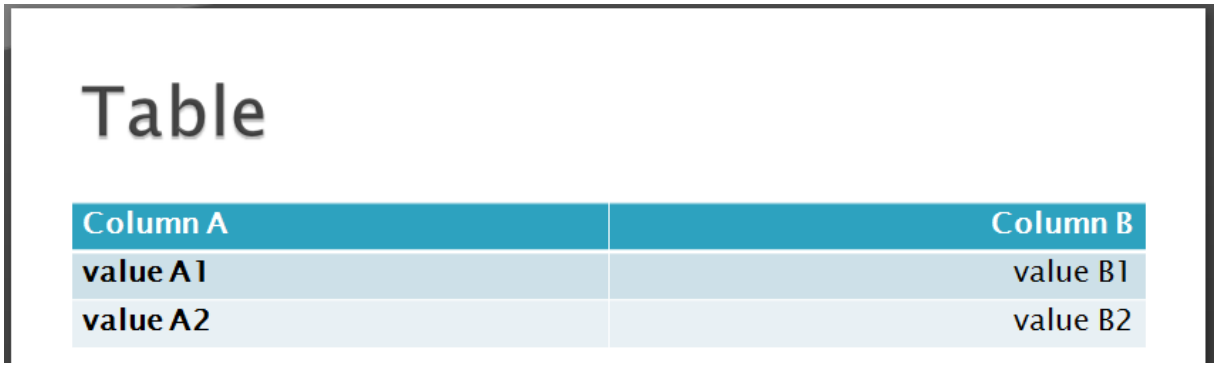



is matched with an appropriate input, e.g.:

```
{
  "collection": [
```

```
  {"columnA": "value A1", "columnB": "value B1"},
  {"columnA": "value A2", "columnB": "value B2"}
 ]
}
```

The result will look as expected:

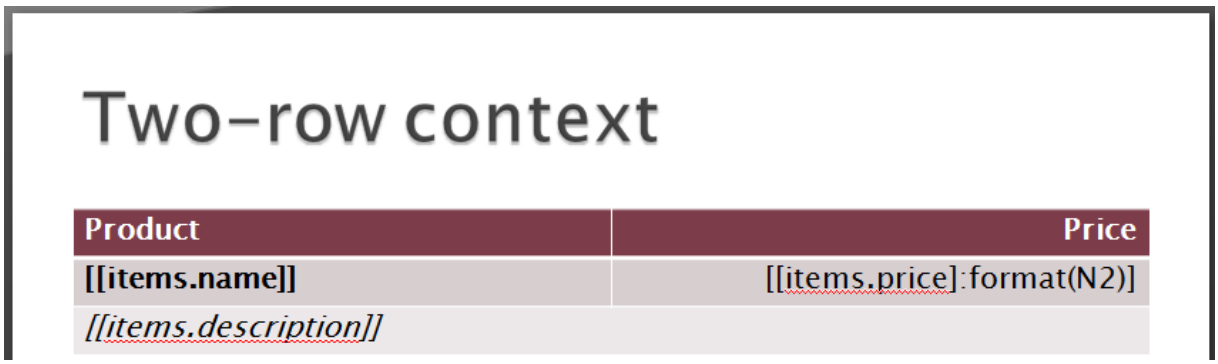



A really important aspect of such transformation is:

- it is implied by the document structure
- there are no loop or start/end constructs in the document
- it matches against the input “intuitively” by using dot (.) for navigation

### Multi-row context

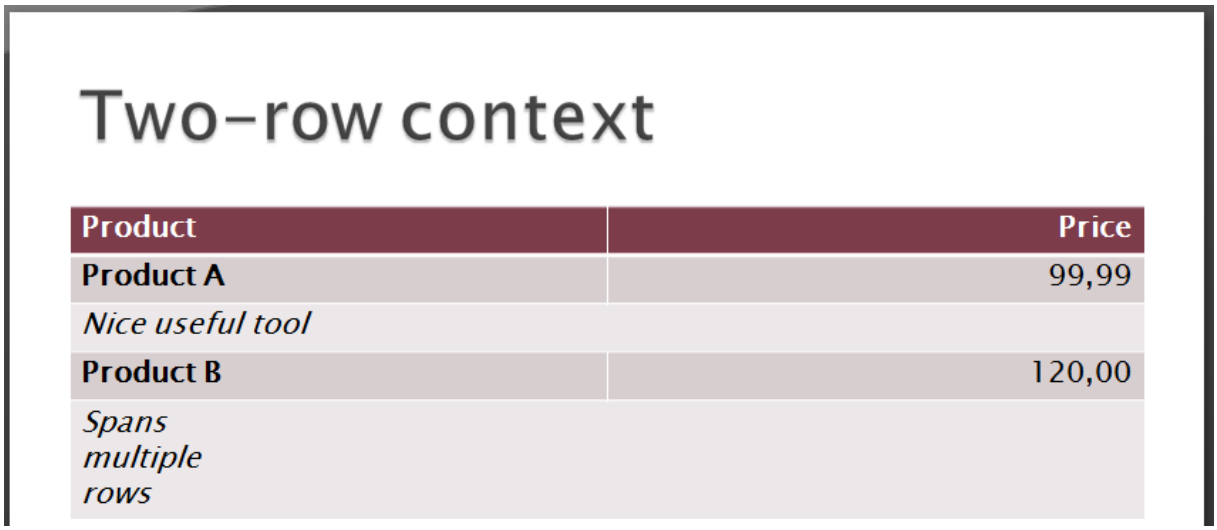
Templater supports context use over multiple rows, such as:




when matched with an appropriate input, e.g.:

```
{
 "items": [
  {"name": "Product A", "price": 99.99,"description":"Nice useful tool"},
  {"name": "Product B", "price": 120,"description":"Spans\nmultiple\nrows"}
 ]
}
```

Produces an expected table which looks like:




and has several non-trivial features:

1. context is no longer a single row, but two rows, since tags were defined across several rows
2. simple number formatting can be used to tweak the output into expected format
3. bolding, italics and other text features were preserved
4. newlines in text input resulted in newlines in cell values

### Dynamic resize

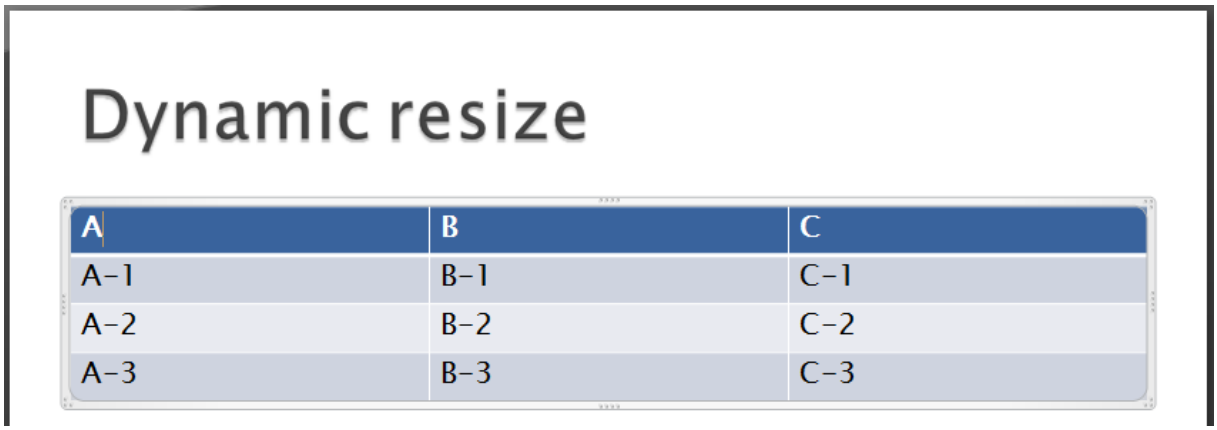
A special feature of Templater is processing specific input types (two dimensional collections and DataReader/ResultSet) in a specialized way.

A basic use case for Dynamic resize would be to transform table template into a final output, e.g.:


when matched with an appropriate input, e.g.:

```
{
  "table": [
    ["A", "B", "C"],
    ["A-1", "B-1", "C-1"],
    ["A-2", "B-2", "C-2"],
    ["A-3", "B-3", "C-3"]
  ]
}
```

it will be transformed into a table with 3 equal columns and 4 rows:



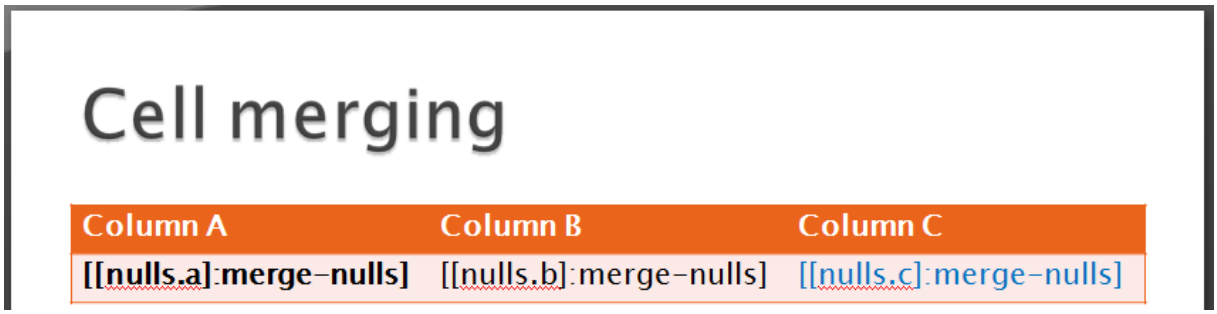

While this is useful for some scenarios, usually explicitly defined table templates are used since they allow for more fine-grained tuning.

### Cell merging

While cells can be merged in the template, there are use cases when they need to be merged during table generation/population. For this reason there are two built-in metadata plugins:

- merge-nulls - invokes horizontal cell merging when cell value is null
- span-nulls - invokes vertical cell merging when cell value is null

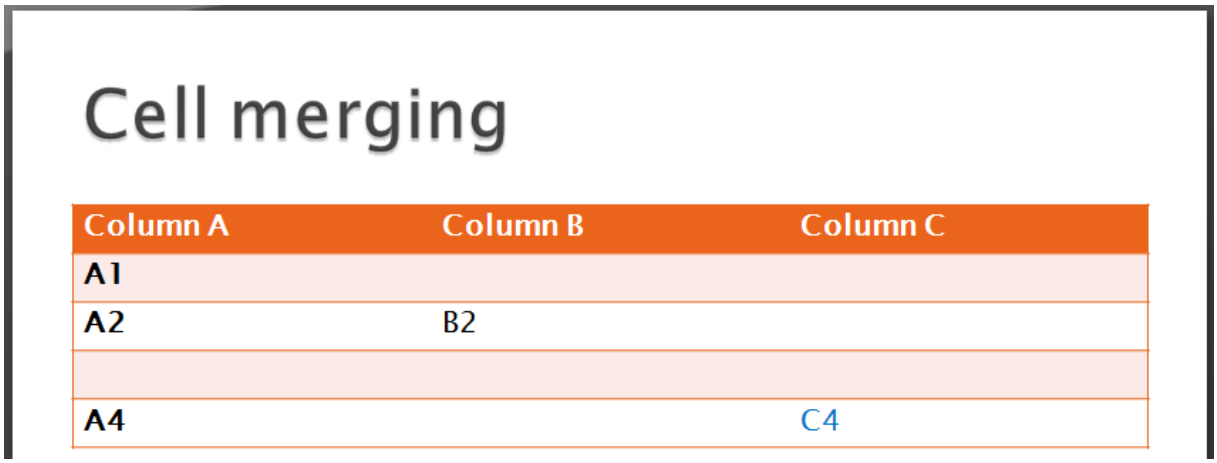
Cell merging works both in Dynamic resize and standard table resize. Table such as:




when paired with input such as:

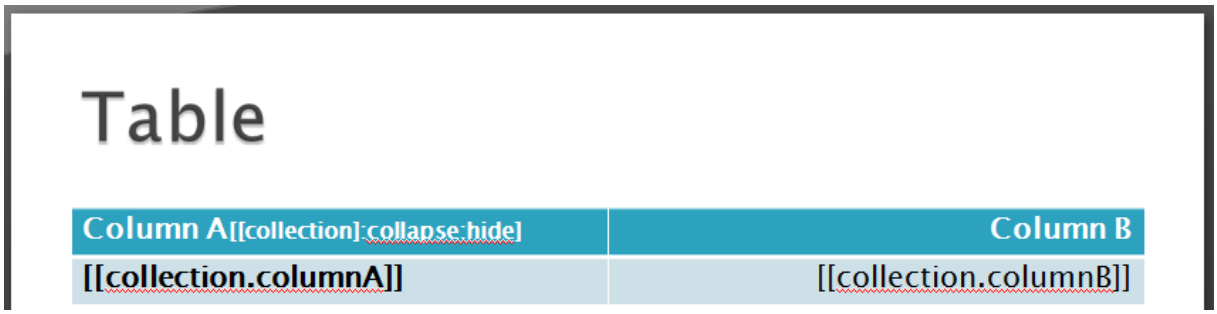
```
{
 "nulls": [
  {"a":"A1", "b":null, "c":null},
  {"a":"A2", "b":"B2", "c":null},
  {"a":null, "b":null, "c":null},
  {"a":"A4", "b":null, "c":"C4"}
 ]
}
```

will result in table with merged cells:




### Removing a table

When Resize(tags, 0) is called on a table, relevant rows will be removed. Sometimes this means that entire table will be removed, but often for the table with headers which don't have any tags the header remains at the end of the resizing. In the case when there is a separate header without tags a common workaround is to add special tag on the header with collapse and hide metadata:



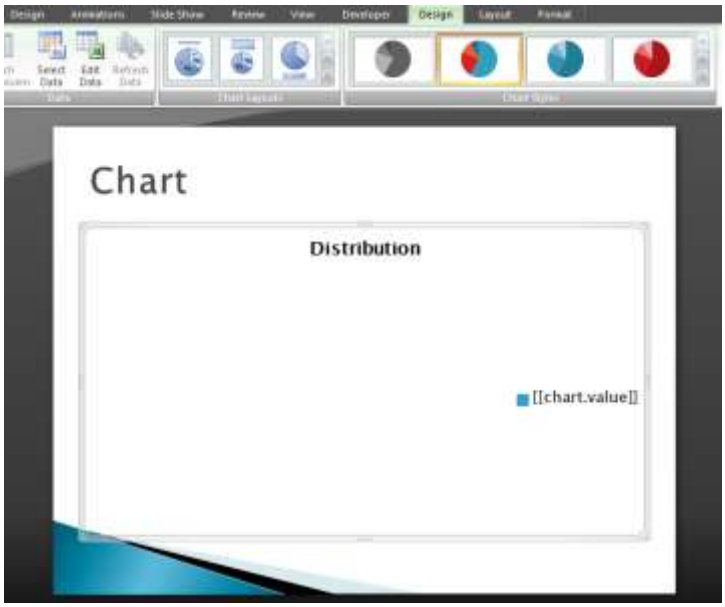

This way when collection is empty a separate resize 0 will be called just for the header row. When collection is not empty hide metadata will take care of not showing any text in place of the tag.

## Charts

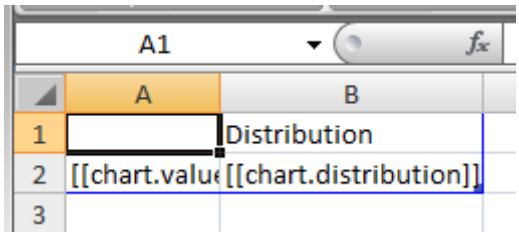
Charts are represented by embedding Excel xlsx inside PowerPoint zip pptx. Depending on the chart type there is also some aggregation of values within the slide XML.

Charts are also considered resizable elements, as the underlying data source is a resizable Excel range.

Chart template is defined within Excel by adjusting original template and replacing values with tags, which results in a bit unfriendly chart template:



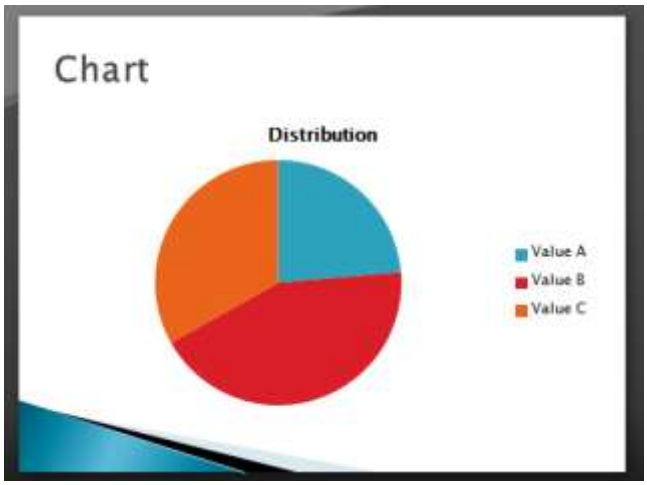

based from the Excel template:

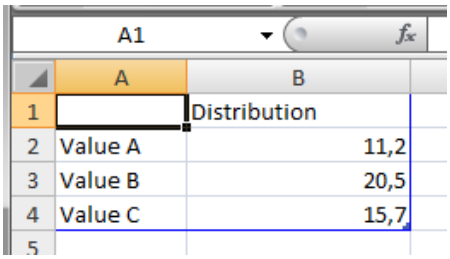



But once the underlying Excel is populated with data, e.g.:

```
{
  "chart": [
    {"value":"Value A","distribution":11.2},
    {"value":"Value B","distribution":20.5},
    {"value":"Value C","distribution":15.7}
  ]
}
```

the chart will be updated accordingly:




Tags defined within the Excel are visible in the **Tags** property on the *ITemplater* interface of the PowerPoint document. This makes them transparent to the application/processing. This means there is no need to unzip the pptx file, process the embedded xlsx files, but rather Templater does that behind the scenes.

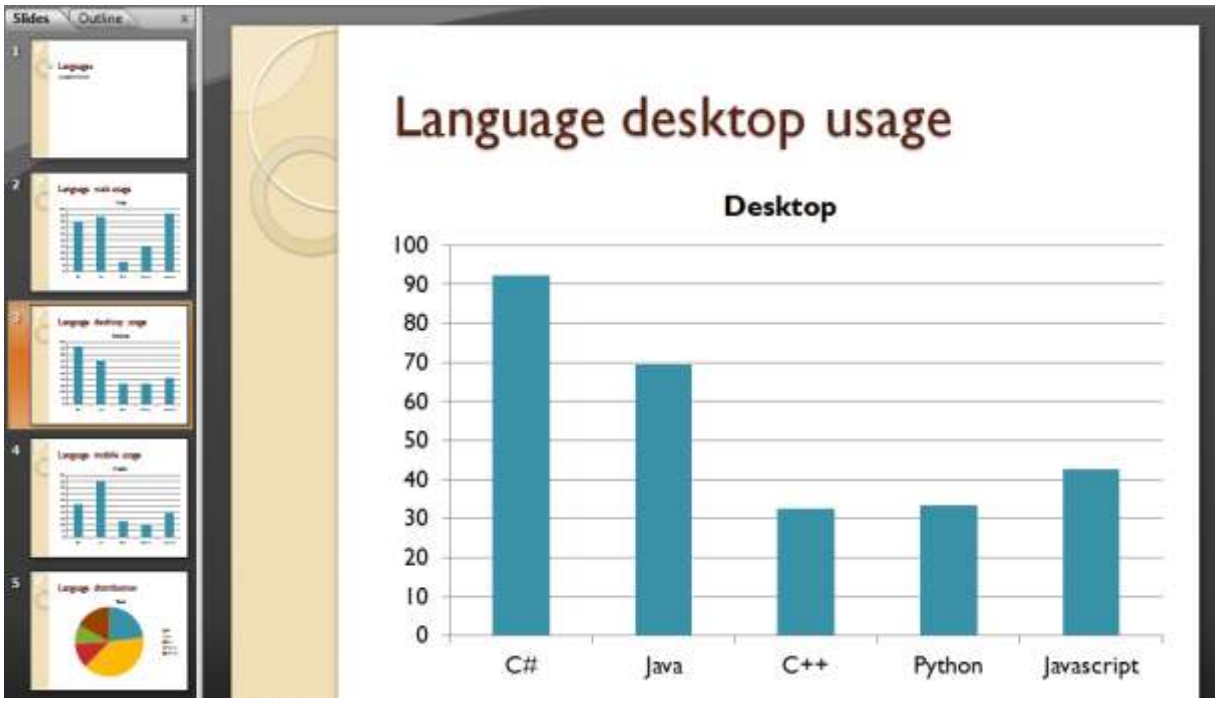
There are various charts in PowerPoint, such as pie charts, graphs and various others. They should all work seamlessly through Templater. Same collection can be used in multiple charts/tables which allows for different representation of the same data.

# PowerPoint specific features

## Slides

Resize behavior of slides is slightly different from the single Word document and from Excel sheets. When a tag is detected in a slide, but not inside list/table or chart the whole slide duplication will be invoked on resize. Resize(tags in a slide, 0) will remove the relevant slide(s). This is similar to the sheet duplication, but will happen more often/easily. Some common use cases for slide duplication/removal are:

- conditional adjustment of presentation
  - by having many possible slide templates and removing non-relevant ones presentation can be adjusted to fit a specific role from a more general template
- repeating of same visualization for different data sources
  - a generic slide can be used to display graph of a relevant specific information; same slide template can be used to display different information in a same way



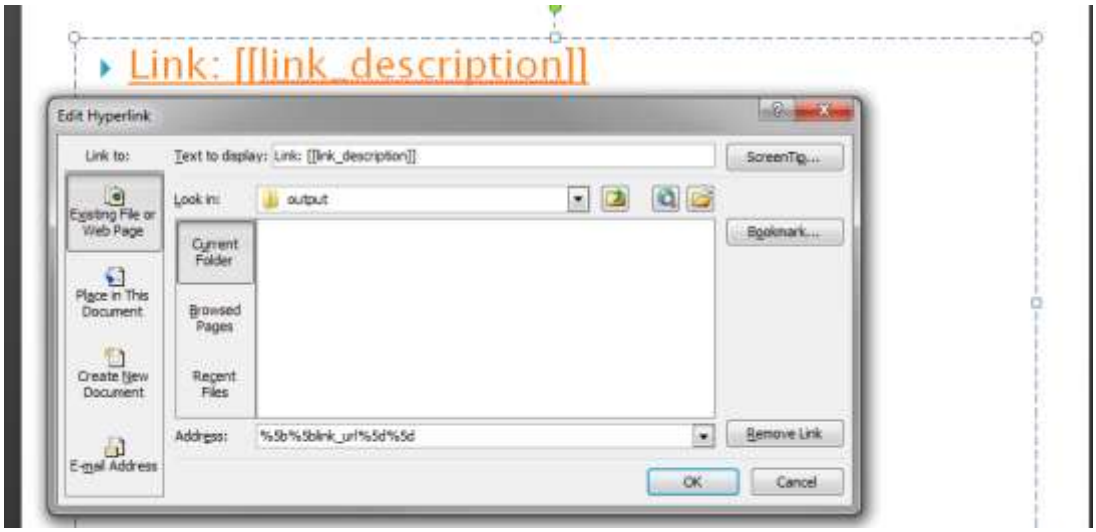

## Notes

Each slide can have notes attached to it. Notes are used to provide contextual information for a slide and have much reduced feature set. If tag is detected within a list inside notes, resizing will only affect the specific list, while otherwise resize will affect the entire slide.

An example of a tag in a list inside notes looks like:

## Links

Templater analyzes hyperlinks and thus they work as expected. Hyperlink can have multiple tags or tag can be combined with static description. Address is url encoded which means that [[specific_url]] is converted into %5b%5bspecific_url%5d%5d when hyperlink is created, e.g.:



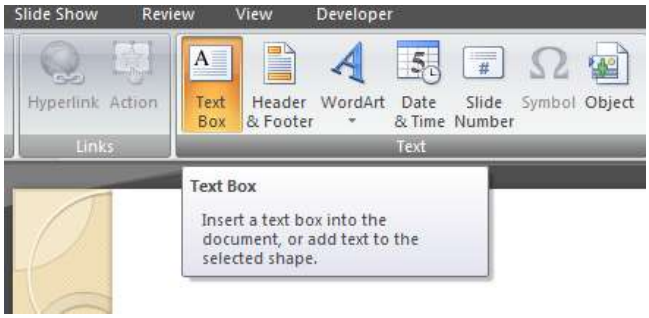

Special data types can also be used to create simple links (just a link, no custom description) when URI/URL is used as datatype.

## Word ART

Tags can also be used in Word ART and other similar features.

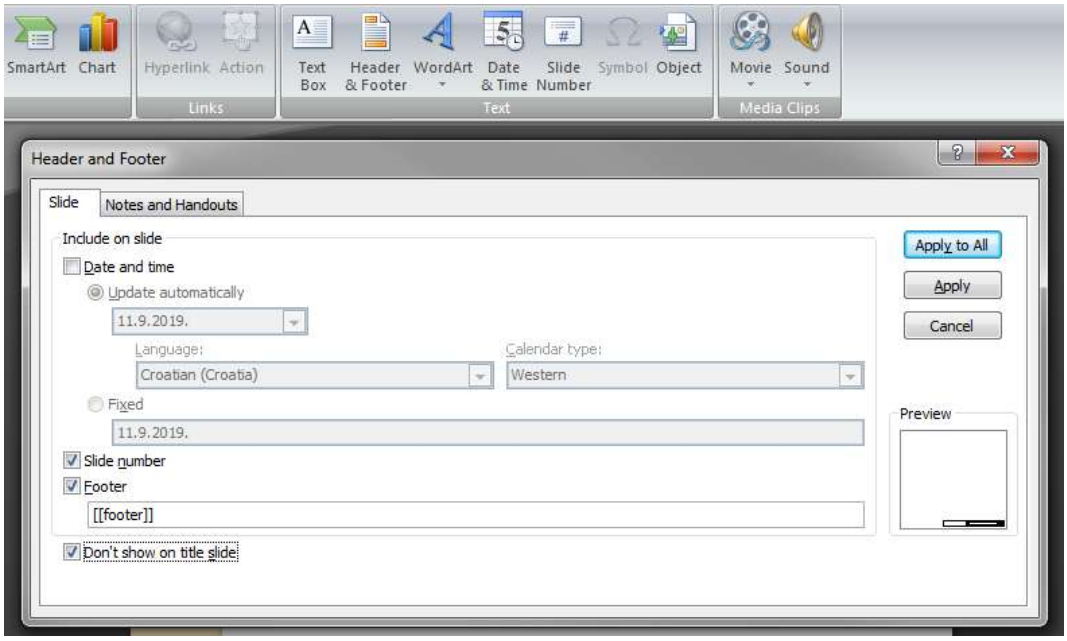

## Text Box

Text box behave like any other region within a slide.




## Header/footer

Slide numbers can be easily injected via Header & Footer functionality. If tags are used in footer they will be repeated automatically on all slides:




# Known issues

PowerPoint is the latest addition to the Templater as of v4.0 so many features are not yet supported. Most of them will be supported over time, unless they require rendering engine.

## PDF export

A very common use case is to convert PowerPoint document into PDF. Unfortunately this requires a PowerPoint rendering engine to work correctly.

There are several free and paid libraries which have sufficiently good PDF conversion for simple documents. But non-trivial documents quickly become non pixel-perfect during the conversion.

## Images

Unlike in Word and Excel, Templater does not support injecting images into the PowerPoint. Since images in PowerPoint are not aligned to a cell or a location in a document it makes little sense to replace a tag with an image.

# CSV/text features

Templater API spans various document formats. While there are various solutions to build text/html/CSV plain text output, there are some advantages if Templater is used for such purpose:

- CSV/text can be user configured (in the same way as Word/Excel/PowerPoint files can)
- same processing can be done on different formats (data structures can be reused to create export for xlsx, docx, pptx or csv without any code changes)
- Templater is heavily optimized and can output text files at high speed
- streaming can be utilized to create huge documents
    - while streaming can be utilized on xlsx (and docx/pptx), not all streaming features can be used as document is optimized for keeping all data structures in memory before the end of processing
- CSV/text will not add watermark message into the document
    - free version can be used without buying a license

## Simple documents

There are various use cases for simple text format usage:

- CSV (comma separated values) export
    - similar to xlsx (can be opened by Excel)
- fixed-width text format export
    - various legacy formats are exchanged between system as a specialized fixed-with format
- simple html/email messages
    - signup email and similar simple messages
- sms/chat messages
    - notification messages (upcoming events, late payments, ...)

Templater is able to process large number of documents, so if user facing customization is required, it's an appropriate choice for such a problem.

Usual Templater features work in text format, although some data types (such as Image or XML which inject XML as-is into the OOXML formats) don't have such meaning in text formats.

When CSV is used, additional low level plugins for quoting string values should be registered, to simplify the conversion without extra metadata information.

## Multi-line context

Templater supports multi-line context even for text processing. This is useful for non-trivial CSV exports which shown single row on two lines.

When **Resize**(tags, 0) is called, rows will be removed (and thus a pull-down will be performed).

## Streaming documents

Unlike xlsx and docx, a text processing will stream to output if certain conditions are met:

- if there are more than streaming size[23] of processed rows
  - streaming will only be invoked on large number of rows
- if there is no tags left before the first tag which is currently resized
  - streaming will only be available if the context which is being processed has special tag setup
- when resized is called multiple times during processing
  - output will be flushed during the resize
  - this can be done manually, or by using a streaming data type such as Iterator/Enumerator

From a pseudocode streaming processing would look like:

1. open document
2. process headers, filters and other non-streaming data
3. repeat until end of data stream
   a. resize to accommodate for the current streaming chunk
      i. naive implementation would call resize(tags, 2) to create extra row
      ii. then call resize(tags, chunk size) for processing the current chunk
   b. process the current chunk
4. remove the extra row if necessary (it's not necessary only in some edge cases for non-trivial implementations)
5. process extra remaining tags (if any) which were dependant on the streaming data (and were located at the end of the template)

A streaming template can look like:

```
Date:;[[filter.date]];;;
User:;[[filter.user]];;;
;;;;
ID;Amount;Date;User;Timestamp
[[data.id]];[[data.amount]];[[data.date]:format];[[data.createdBy]];[[data.createdOn]]
```

when opened in Excel would look like a regular cells (without any styles)

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Date: | [[filter.date]] | | | | |
| 2 | User: | [[filter.user]] | | | | |
| 3 | | | | | | |
| 4 | ID | Amount | Date | User | Timestamp | |
| 5 | [[data.id]] | [[data.amount]] | [[data.date]:forma | [[data.createdBy]] | [[data.createdOn]] | |
| 6 | | | | | | |

[23] Default streaming size is 16k. This can be configured via streaming method in the configuration API

To open CSV within Excel some culture specific requirements must be met:

- number decimal sign should match
  - dot (.) is decimal sign in US countries, while comma (,) is in most EU countries
- comma separator should match
  - comma (,) is separator in US countries, while semicolon (;) is in most EU countries

It's common to stream into a ZIP stream directly (instead of file) and thus further reduce the amount of used memory. Templater will reuse data structures and thus will only consume constant amount of memory, which means if data is iterated over in a streaming fashion (instead of being loaded all into memory) huge documents can be created.

# Best practices

While Templater API is a minimal one, the feature set is quite big and therefore there are various best practices which can be followed when using Templater. Some of them are only applicable for enterprise applications, but it's good to be familiar with them since they will provide deeper understanding of how Templater works and how it should be used.

## Complex documents

On the surface Templater looks just like a mail merge library. But once you scratch the surface all kinds of complex patterns emerge from deceptively simple operations:

- duplicate or remove tag
- replace tag with a value

Some of those emerging patterns are:

- document can consist for parts which are only conditionally shown
    - this way complex document can cover all use cases and then adjusted to fit only the relevant use case for the specific processing
- external code can be used to integrate complex behavior during the replacement
    - using plugins to load image on demand or convert it from argument
    - consuming third party libraries for complex conversions such as verbalizing numbers into text
    - enriching common use cases with appropriate metadata over time
- code can be reused between reporting and other parts of the system
- dynamic types allow for maximum ease of use due to natural matching with tags
- template defined for a single object can work for a collection of objects without any changes
    - this allows for easy bulk export instead of having a separate bulk only export

Still, the most important aspect of complex documents is that they are constructed in rich editor such as Microsoft Office. This provides all kinds of benefits:

- document layout can be prepared/defined much faster and will produce much better looking results - in contrast to defining layout logic in code
    - most of the time, it's not even feasible to create complex layouts which can be done in MS Office through code
- non-developers can take ownership of defining/managing the documents which provides better separation of work
- existing documents can be used as a starting point when some legal document needs to be created
- minor changes to the document are done in fraction of time and minimize the number of involved parties

## Multi-step processing

Complex processing sometimes requires several passes through the template:

- first prepare the tags for second pass
  - using horizontal-resize, dynamic resize or just regular processing which creates new tags
- in the second pass process all tags with the expected values

Common use case for double processing is when multiple columns need to be used to display row information per some subset. While there are multiple solutions to this problem (such as dynamic resize per row) sometimes it's much faster to prepare the layout in first processing and then process the data in second, especially when large number of rows are exported.

A common pattern for such exports is to use a dictionary/map for dynamic part of the schema[24], while reusing existing classes/fields for static part of the schema.

An example of such template

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 5 | **GL Code** | **Account Name** | **Change in Balance** | **Closing Balance** | **[[organization.name]:horizontal-resize:whole-column]** | | |
| 6 | | | **Total** | **Total** | **[[organization.description]]** | | |
| 7 | **[[accs.acco** | **[[accs.accountName** | **[[accs.totalBalance]** | **[[accs.closingBala** | [[organisation.tag]] | | |
| 8 | | | | | | | |

would be converted into:

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 5 | **GL Code** | **Account Name** | **Change in Balance** | **Closing Balance** | **Region A** | **Region B** |
| 6 | | | **Total** | **Total** | **Sub-total** | **Sub-total** |
| 7 | **[[accs.acco** | **[[accs.accountName** | **[[accs.totalBalance]** | **[[accs.closingBala** | [[accs.orgA.subtotal]] | [[accs.orgB.subtotal]] |
| 8 | | | | | | |

Another alternative (for this specific example) would be to instead show the data in raw tabular format and then use the pivot to transform it into another format, but sometimes preparing data before passing it to Excel allows for more user friendly design of various charts and other pivot tables.

When processing templates in such a way, in memory streams should be used between steps; which means even multi-step processing should be fast.

## Hierarchical structures

Templater supports arbitrary deep hierarchies[25]. A common pattern is that once the document is setup for exporting a single instance (such as a single invoice), Templater can support export of multiple instances by just passing in collection instead of a single object instance for processing.

[24] When allowing the use of maps for navigation it's important to prepopulate maps with all possible values for keys, not just the ones which are present in specific rows. This will reduce problems with tags which were left in the document since there was no data in the map.
[25] There is a configurable limit of 8 to prevent bad context detection. This can be changed during initialization

But data structure hierarchy should closely match document hierarchy. That way it will be easy to reason about which regions of the document need to be duplicated and how data translates from the model to the document.

If part of documents needs to be duplicated this means data structure should have an appropriate matching collection.

Sometimes it's useful to transform collection into map, especially when collection has a specific key as identifier. This way only relevant part of the collection can be shown as a column, instead of region of the document being duplicated.

Another common pattern is to have first/last property instead of a collection, as this is the only relevant information most of the time.

Ideally domain model can combine all of the above and thus allow for customization of documents in various ways. An example could look like:

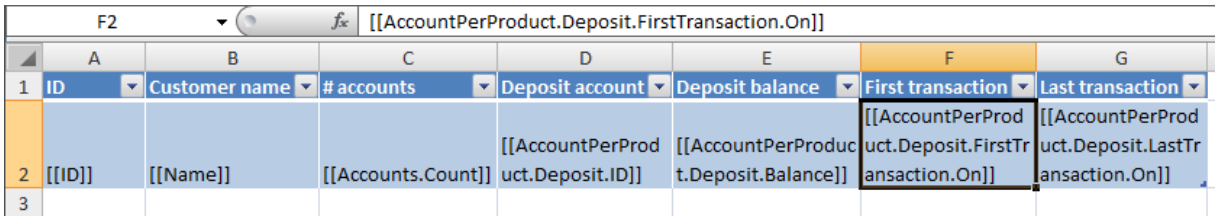
```
public class Customer
{
        public string ID;
        public string Name;
        public List<Account> Accounts;
        public Dictionary<string, Account> AccountPerProduct;
        public Account FirstAccount;
        public Account LastAccount;
}
public class Account
{
        public string ID;
        public decimal Balance;
        public string Product;
        public DateTime CreatedOn;
        public List<Transaction> Transactions;
        public Transaction FirstTransaction;
        public Transaction LastTransaction;
}
public class Transaction
{
        public string ID;
        public decimal Amount;
        public DateTime On;
}
```

Common patterns can be extracted into appropriate properties:

- list of all accounts/transactions is available on customer/account
- accounts are grouped per product into a map
    - this allows use of product id as a key over the dictionary

  - dictionary should be populated for all possible products, with nulls for accounts which do not exists for a product - this way generic template can be designed which will work in all cases, not just when there is a particular product on a client
- first/last account/transaction is available on customer/account
  - depending on business logic and use cases there could be rules which are perfect fit for such a model, as it could allow only a single active account
  - quick info about when the last/first transaction happened can be shown along the customer

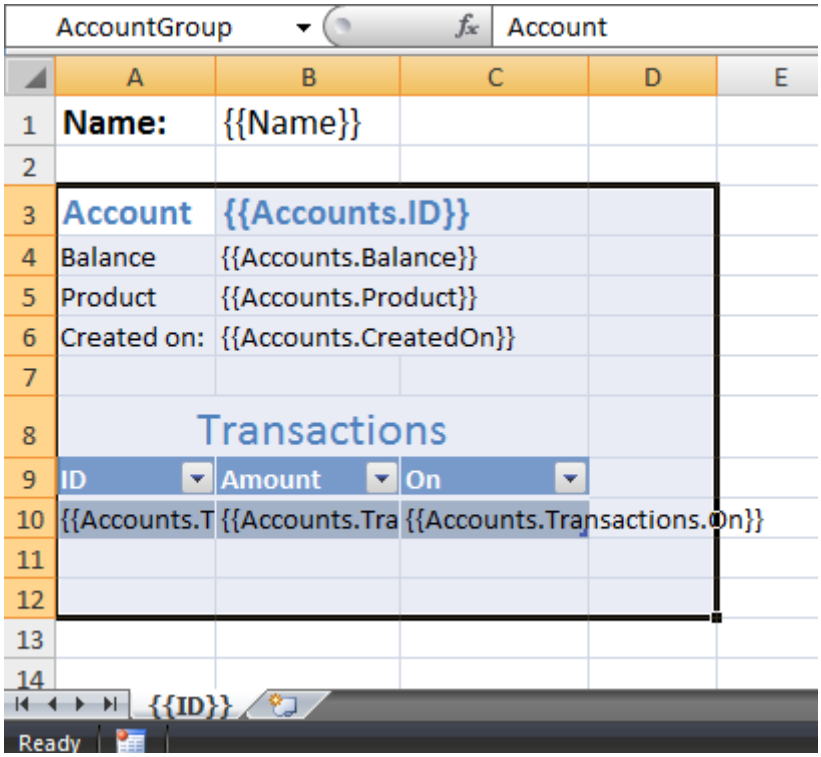
By using this model a rich client row can be displayed, which does not contain any nesting, even though the actual model has 2 level nesting (Customer -> Account -> Transaction). An example:




Common use case for hierarchical structures is to display them in hierarchical way, which for the same model could mean:

- sheet per customer
- accounts repeated in a sheet
- transactions repeated for an account

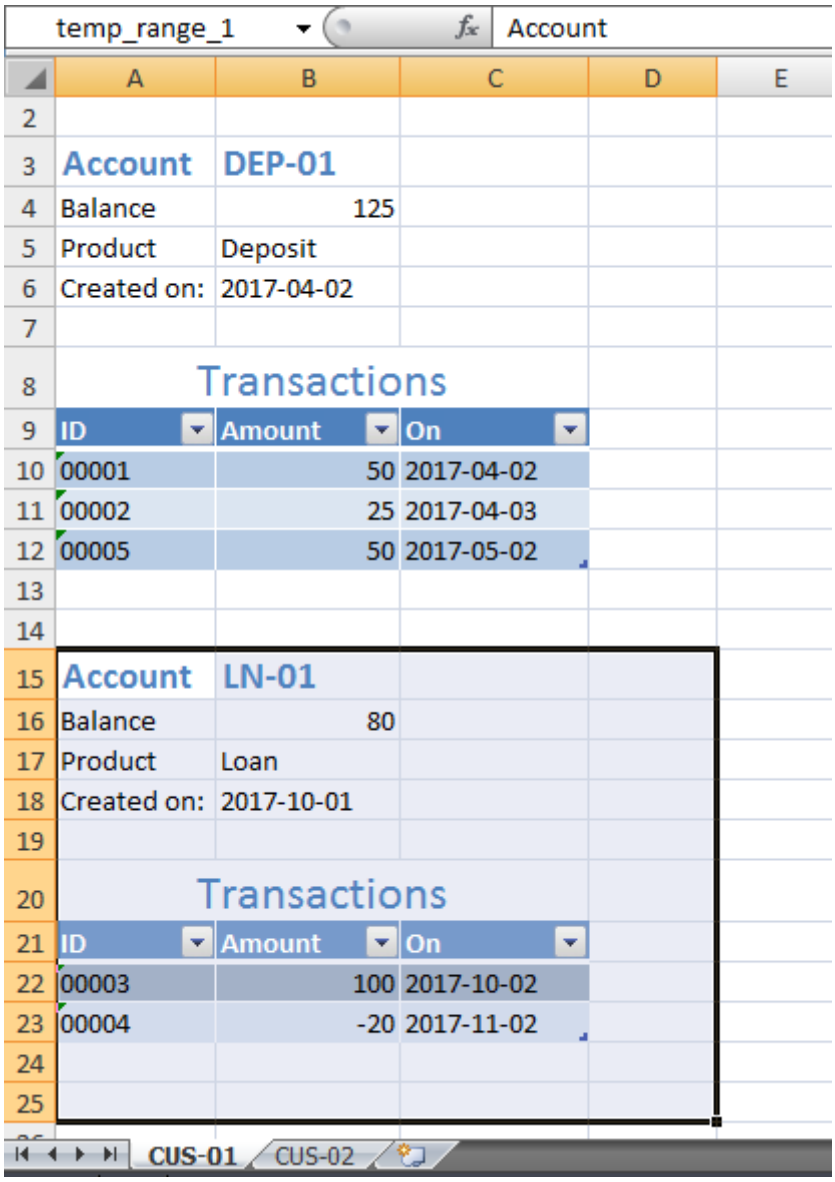
Such a template could look like:



when paired when hierarchical data:


```
[
 {"ID":"CUS-01","Name":"Customer 1","Accounts":[
  {"ID":"DEP-01","Balance":125,"Product":"Deposit","CreatedOn":"2017-04-02","Transactions":[
   {"ID":"00001","Amount":50,"On":"2017-04-02"},
   {"ID":"00002","Amount":25,"On":"2017-04-03"},
   {"ID":"00005","Amount":50,"On":"2017-05-02"}
  ]},
  {"ID":"LN-01","Balance":80,"Product":"Loan","CreatedOn":"2017-10-01","Transactions":[
   {"ID":"00003","Amount":100,"On":"2017-10-02"},
   {"ID":"00004","Amount":-20,"On":"2017-11-02"}
  ]}
 ]},
 {"ID":"CUS-02","Name":"Customer 2","Accounts":[
  {"ID":"DEP-02","Balance":300,"Product":"Deposit","CreatedOn":"2018-01-15","Transactions":[
   {"ID":"00010","Amount":100,"On":"2018-02-12"},
   {"ID":"00011","Amount":200,"On":"2018-03-12"}
  ]}
 ]}
]
```


would be transformed into nested representations:




## Collapse

Most of the time collapse metadata should not be used. Instead data models should indicate what region of the document should be removed during processing. But on more complex documents, especially when there are different display variants for the same part of the data, built-in or custom collapse plugins are required.

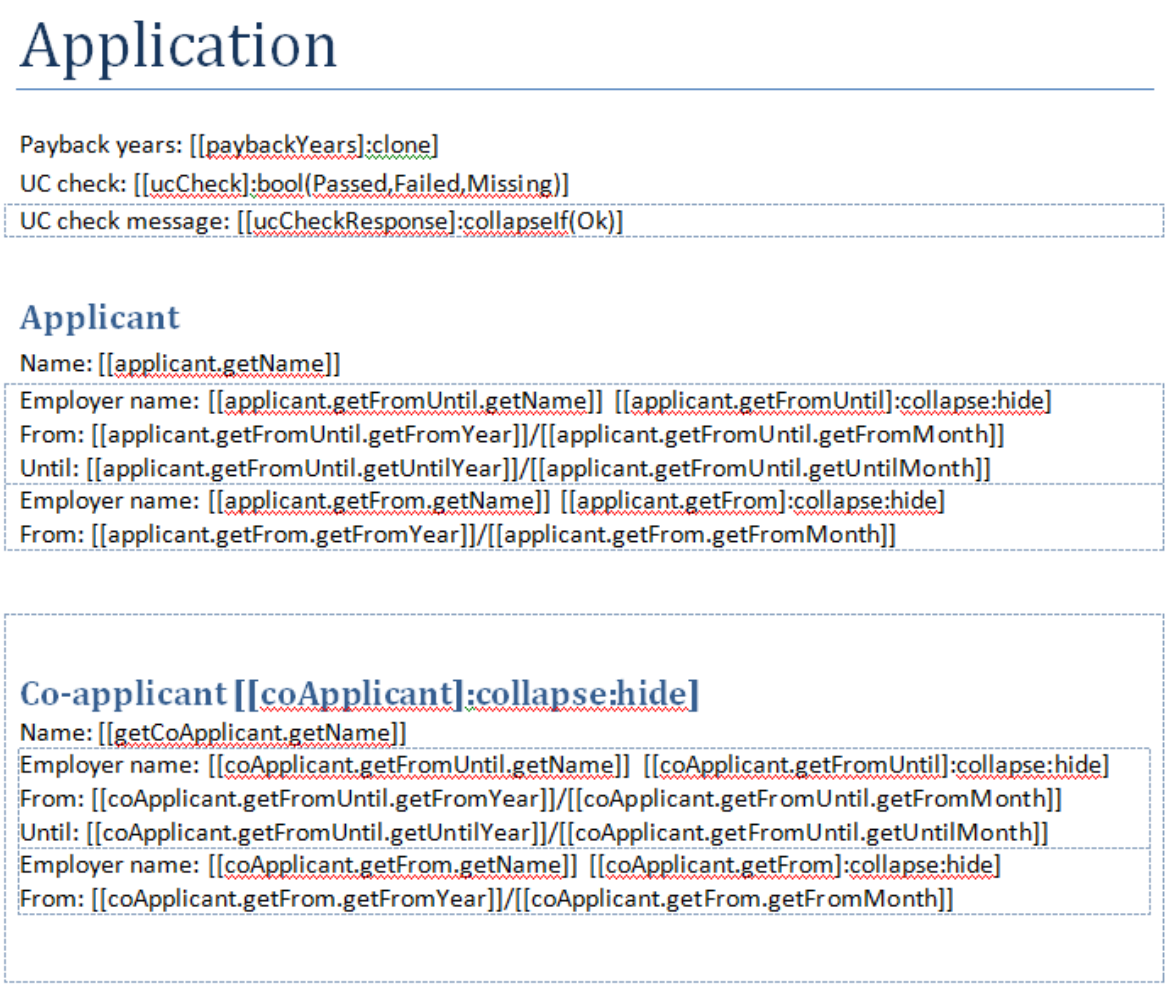
Calling **Resize**(tags, 0) on specific parts of the document can have many applications. Often it's sufficiently good just to remove a single row, instead of providing whole alternative layout for some special input.

For highly complex documents it's also useful to combine collapse and multi-document processing since it will be much easier to reason about how Templater will behave.

Common use case for removal part of the document is when that document part has no values and thus should not be displayed. An example would be a loan application which has an optional co-applicant and thus we want to include relevant part of the document only when co-applicant is used:

```
public class Application
{
        public int paybackYears;
        public bool? ucCheck;
        public string ucCheckResponse;
        public Applicant applicant;
        public Applicant coApplicant;
}
```

paired with template:




will manage the visibility of Co-applicant part of the document through the null value of **coApplicant** property. When collapse is paired with hide metadata this means that when the value is present, instead of being displayed as ToString representation of an instance, it will be hidden instead.

It is sufficient to just specify a single tag if that will remove entire chunk of the document since during removal Templater will inspect which other tags will be removed and remove them also in the process.

Another common use case of collapse is when paired with sections to have two different layouts for same data (or portion of the data). Sections are used to indicate start/stop boundary which will be removed during collapse.

## Performance/memory optimizations

While Templater is quite optimized and high performance for most documents processing it's good to be aware of various minor details which can improve the performance, sometimes quite significantly.

### Tag sharing across sheets

When a same collection is used across different Excel sheets, Templater will process it in a specialized way. This incurs some memory and minor performance overhead[26]. While this is not important for simple documents (with only few thousand rows) it could be noticeable on really large documents. A quick fix which will improve the performance of the processing is to use a different tag for different sheets. An example of such fix would be to expose multiple properties as aliases, e.g.:

```
public class Report
{
        public HeaderInfo Header = ...;
        public List<Item> Items = ...;
        public List<Item> Items1 { get { return Items; } }
        public List<Item> Items2 { get { return Items; } }
        public List<Item> Items3 { get { return Items; } }
}
```

This way Sheet1 can use the **[[Items1.**.. tags, Sheet2 can use the **[[Items2.** tags, etc...

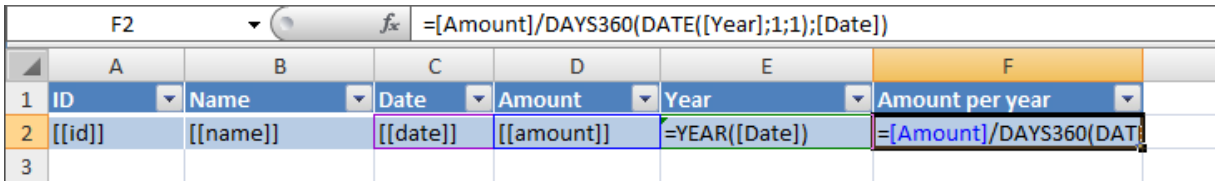
Sometimes even better workaround would be not to use a single report, since it might be better to create multiple variants of a report instead of trying to put multiple variants inside a single Excel file.

### Using formulas without cell references

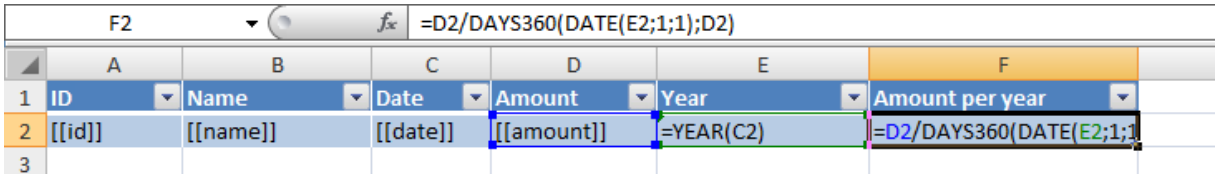
During row duplication Templater needs to parse, rewrite formula so it can be used in a new row. If formulas are defined in such a way that resize will not change their expression Templater will process it much faster.

Optimal formula example:

[26] Performance overhead was minimized in v3.2.0. Prior to that version overhead could be significant




Suboptimal formula example:




The main difference between an optimal and suboptimal formula is that optimal formula will have the same display expression even when pushed around or duplicated.

There are few other basic rules:

- operations can reference named ranges instead of ranges which change
  - SUM([named_range]) vs SUM(E2:T2)
- it's better to put in explicit value than to use formula
  - sometimes formula expressions can be expressed in the domain model
  - this can make complex Excel file much smaller and thus faster to process and open after processing
- property navigation can be used instead of formula expressions
  - [[date.Year]] can produce same value as evaluating =YEAR([date_cell]) in Excel
    - as a bonus it doesn't require evaluation after document is opened
- often tags can be combined instead of complex formulas
  - [[date.Year]] / [[date.Month]] can produce the same result as =YEAR(XX) & "/" & MONTH(XX)

## Unnesting hierarchical models

While Templater encourages deep hierarchies, on large complex documents there are few performance tricks which can yield a significant performance improvements.

One trick to "unnest" a hierarchy is to build a specialized model which looks like a hierarchy, but it's actually flat (at least one level smaller).

E.g., for hierarchy such as:

Client collection -> Account collection

can be flattened into

Account collection (with Client info)

Model such as:

```
public class Client
{
	public string Name;
	public string ID;
	public List<Account> Accounts;
}
public class Account
{
	public string ID;
	public decimal Balance;
	public DateTime OpenedOn;
}
```

can be written as[27]

```
public class Account
{
	public string ID;
	public decimal Balance;
	public DateTime OpenedOn;

	public Client Client; //use for Client on every row
	public Client ClientFirst; //use for Client only on first row
}
public class Client
{
	public string Name;
	public string ID;
}
```

In both cases report can have model such as:

```
public class Report
{
	public List<Client> Clients;
	public List<Account> Accounts;
}
```

For reports which need to list all clients and their accounts instead of having report such as:

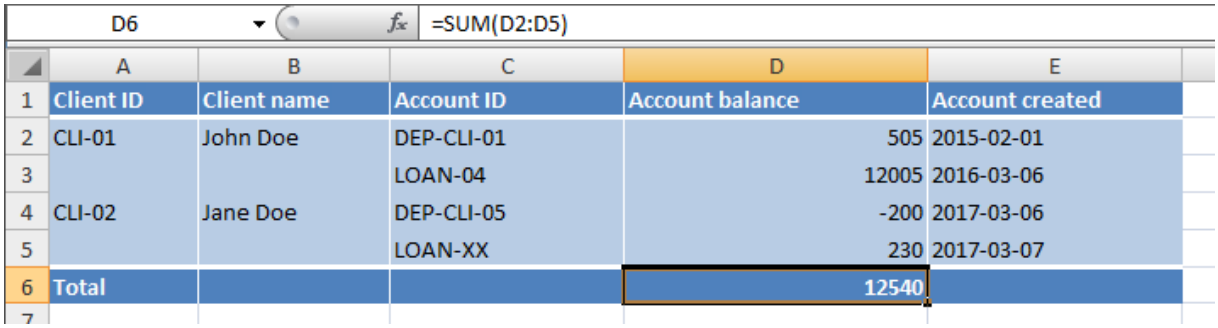
| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Client ID | Client name | Account ID | Account balance | Account created | |
| 2 | [[Clients.ID]] | [[Clients.Name]] | [[Clients.Accounts.ID] | [[Clients.Accounts.Balance]] | [[Clients.Accounts.OpenedOn]] | |
| 3 | Total | | | 0 | | |
| 4 | | | | | | |

[27] If model is written for reporting purpose only, its fine to even have both options in a model, which is what happens anyway on models which are evolved over time for transition purposes

when paired with input such as:

```
{
 "Clients":[
  {"ID":"CLI-01","Name":"John Doe","Accounts":[
   {"ID":"DEP-CLI-01","Balance":505,"OpenedOn":"2015-02-01"},
   {"ID":"LOAN-04","Balance":12005,"OpenedOn":"2016-03-06"}
  ]},
  {"ID":"CLI-02","Name":"Jane Doe","Accounts":[
   {"ID":"DEP-CLI-05","Balance":-200,"OpenedOn":"2017-03-06"},
   {"ID":"LOAN-XX","Balance":230,"OpenedOn":"2017-03-07"}
  ]}
 ]
}
```

will result in output:



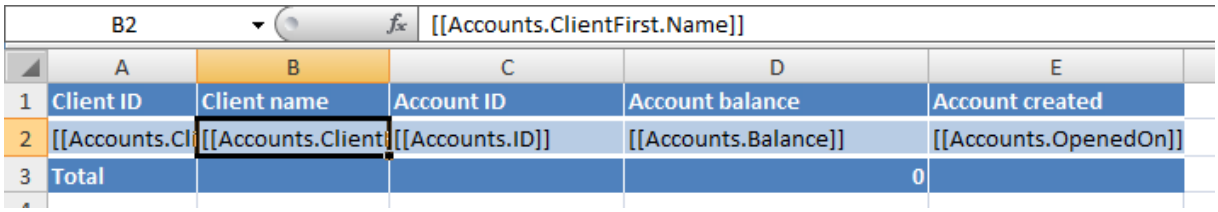

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | Client ID | Client name | Account ID | Account balance | Account created |
| 2 | CLI-01 | John Doe | DEP-CLI-01 | 505 | 2015-02-01 |
| 3 | | | LOAN-04 | 12005 | 2016-03-06 |
| 4 | CLI-02 | Jane Doe | DEP-CLI-05 | -200 | 2017-03-06 |
| 5 | | | LOAN-XX | 230 | 2017-03-07 |
| 6 | Total | | | 12540 | |

Same result can be created with only a single nesting level if the second model is used where ClientFirst is populated only on the first account for a client[28], e.g.:

```
{
 "Accounts":[
  {"ID":"DEP-CLI-01","Balance":505,"OpenedOn":"2015-02-01",
   "ClientFirst":{"ID":"CLI-01","Name":"John Doe"}},
  {"ID":"LOAN-04","Balance":12005,"OpenedOn":"2016-03-06","ClientFirst":null},
  {"ID":"DEP-CLI-05","Balance":-200,"OpenedOn":"2017-03-06",
   "ClientFirst":{"ID":"CLI-01","Name":"John Doe"}},
  {"ID":"LOAN-XX","Balance":230,"OpenedOn":"2017-03-07","ClientFirst":null}
 ]
}
```

by using a different template:

[28] This is much easier to implement when actual data structures are used, rather than JSON which is passed around




## Java XML memory usage

Both Java and .NET heavily rely on XML. Java uses forked version of Xalan library to XML processing and transformation. Templater supports specifying custom version for XML at various stages:

- templater:DocumentBuilderFactory
- templater:TransformerFactory

This way a custom XML library can be used when set in **System.getProperties()**. Some custom Xalan forks significantly improve memory usage[29]

## Factory reuse

When Templater is used to create/process large number of small documents, reusing factory can yield significant gains. Templater will not switch threads during processing, so thread locals and other tricks can be used to further optimize interaction with plugins configured during library initialization.

## Class visibility in Java

While Templater will only work with public methods and fields, non-public classes can be sent for processing in which case Templater will have to change visibility during reflection invocation. Since it restores visibility after the operation to previous state this operation has high overhead. To avoid it used classes should be public which will not require visibility change and thus they will be very performant.

## Thread monitoring

While most parts of Templater are highly optimized, when large documents are being processed, application can run out of memory and go into extra Garbage Collection stage which slows down processing significantly, often resulting in OutOfMemory exception.

To combat such problems in a generic way, Templater processing can be done on a new thread, with an expected timeout for the processing. If processing fails to finish within the specified timeframe, thread can be interrupted which means Templater will stop processing quickly after that[30]. This way if the processing does not require large amount of small documents, it's better to setup processing on a separate thread and monitor thread for timeout/exception/low memory problems.

It's always possible to have multiple document factories prepared and use appropriate processing approach for the relevant use case.

[29] Simple XML optimizations can provide huge gains: https://github.com/zapov/xalan-j. Custom XML transformation can reduce memory usage from 140 -> 20MB for a single large document

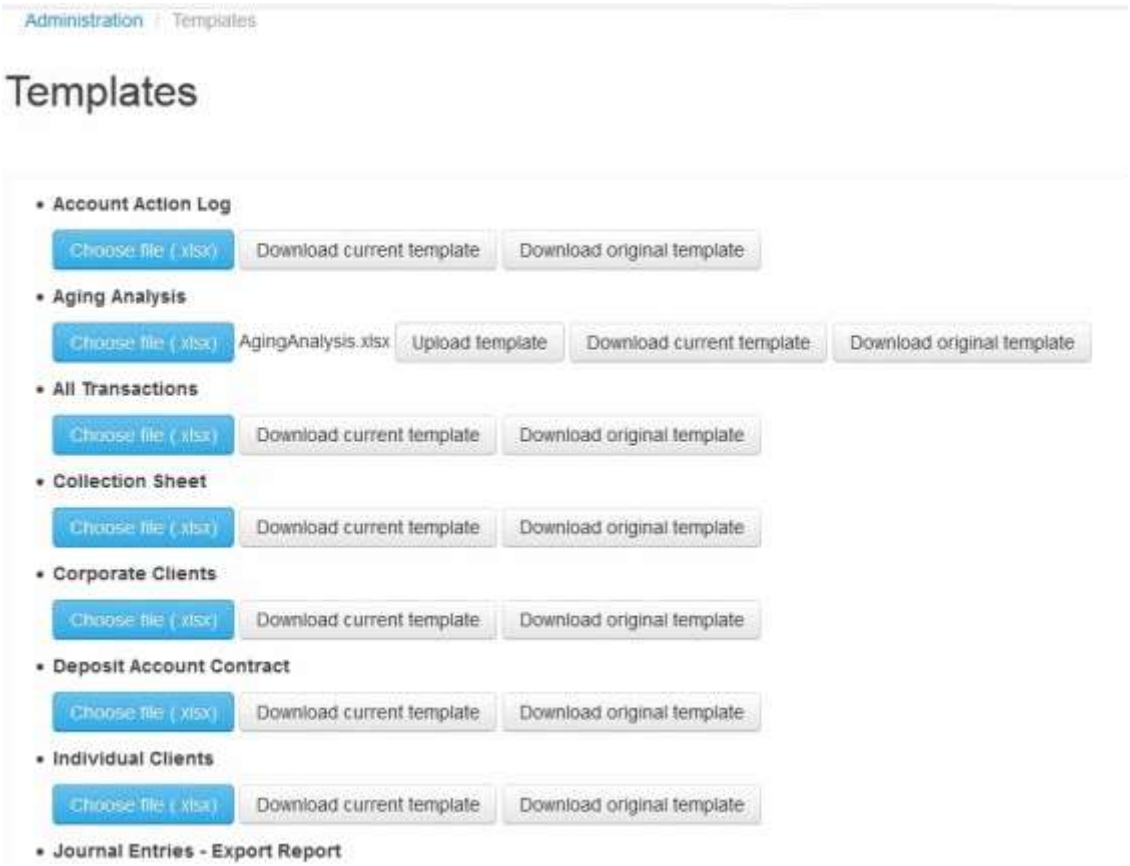
[30] Templater is thread aware in a sense that it often checks whether the thread is still alive; and if it's not will throw InterruptedException/ThreadInterruptedException as a signal to stop further processing

## Tag management

Due to the way tags are defined within the document it's prudent to have some specialized logic around the tag management:

- tag discovery - it should be easily discoverable which tags exists
  - sometimes tag is bound to the actual data on the systems (especially when exposed through maps)
  - this might be more complicated when there is no actual schema in the system
- document validation - before the document is "accepted" by the system, tag validation should be performed on it
  - unless the system restricts how the tags can be bound with the document, it will be quite common to have tag typos
  - in a living systems tag can change from version to version - and thus tags valid in a earlier version can be invalid in a new version

An example of tag management looks like:




where each report has its own specialized validations and example data set.

## User defined plugins

If metadata or low level plugins are used, Templater will call them quite often on large documents. This means plugins should avoid allocations whenever possible, either by caching, thread local variables or similar means.

Normally, it's often not possible to avoid allocations completely, which can be fine most of the time. It's recommended to use a profiler for checking if user defined plugins are causing problems if there is significant memory usage or processing takes a while.

# F.A.Q.

Q: **I'd like to test Templater before buying. How can I get a demo/trial license?**
A: Templater can be tested without buying a license, as all features are available even without a license. In case when license is not provided a watermark message will be added to the document.

Q: **Can I export files to PDF?**
A: Templater does not have a PDF export. All libraries we know of suffer from pixel perfect issues. We suggest using a MS Office for PDF conversion and when this is not possible to run LibreOffice in headless mode for PDF conversion (there will most likely be issues on complex documents, in which case it's often good to adjust the layout until LibreOffice can export it correctly).

Q: **Can I insert image into the document?**
A: Yes. Use of special data type is required to insert an image (.NET: System.Drawing.Image, Java: hr.ngs.templater.ImageInfo with a builtin conversion from BufferedImage or ImageInputStream).

Q: **How can I pass JSON for processing?**
A: Dictionaries/maps and lists/arrays can be used out-of-the-box. Once JSON is converted into maps and lists, it can be passed to Templater for processing.

Q: **I need some help, but my support period has expired. What can I do?**
A: We suggest asking question at Github: https://github.com/ngs-doo/TemplaterExamples/issues. Even when support period expires, license will be valid for new minor version releases. Often just using the latest version might resolve some problem.

Q: **Which license I need to buy for a SaaS product?**
A: Templater license allows for integration into third party apps which add significant other functionality. This means that if your product is a business application you need to buy only one license (even for a solo developer only). If your product is a development oriented platform, such as Low-code platforms or Amazon Web Services, each user of the Templater related feature must buy/have a Templater license.

Q: **Once I try to open document Office complains about corrupted document. How can I fix this?**
A: Most of the time reason for document corruption is use of non MS Office tools to prepare the document. "Corruption" usually means that MS Office tools are unable to recognize some specific feature when loading the file. In those cases just saving the template in MS Office tools will resolve the issue. Sometimes document must be recreated from scratch in MS Office tools. If the error still persists, please send a reproducible for documents which were created in MS Office.

Q: **Document does not look as I expect it to after processing.**
A: If you are within your support period, please send us an email with a reproducible and the expected output. An easy way to create a reproducible is to use JSON builds: https://github.com/ngs-doo/TemplaterExamples/releases/latest.
If your support period has expired, please use the public channels such as Github (https://github.com/ngs-doo/TemplaterExamples/issues) or Stackoverflow for community help