Benker Documentation

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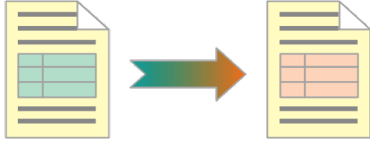
The Benker library can be used to convert tables from one format to another.

Yes, it only converts the tables, not the whole document, but it tries to do it well. The document itself is not changed, and the paragraphs inside the cells, neither. It's your responsibility to do this part of the work.



CHAPTER

ONE

AVAILABLE FORMATS

The Benker library works on XML documents. Currently, it can handle:

OOXML (Office Open XML) is an XML-based format for office documents, including word processing documents, spreadsheets, presentations, as well as charts, diagrams, shapes, and other graphical material. This is the XML format used by Microsoft Word documents: `*.docx`. • Officiel web site: http://officeopenxml.com/. • Wikipedia page: https://en.wikipedia.org/wiki/Office_Open_XML.	
CALS (Continuous Acquisition and Life-cycle Support) table model is a standard for representing tables in SGML/XML. Developed as part of the CALS Department of Defence initiative. The DTD of the CALS table model is available in the OASIS (Organization for the Advancement of Structured Information Standards) web site. • Specification on OASIS web site: https://www.oasis-open.org/specs/tablemodels.php • Wikipedia page: https://en.wikipedia.org/wiki/CALS_Table_Model	OASIS
FORMEX (Formalized Exchange of Electronic Publications) describes the format for the exchange of data between the Publication Office and its contractors. In particular, it defines the logical markup for documents which are published in the different series of the Official Journal of the European Union. Formex v4 is based on the international standard XML. • Official web site: https://op.europa.eu/en/web/eu-vocabularies/formex/	Publications Office

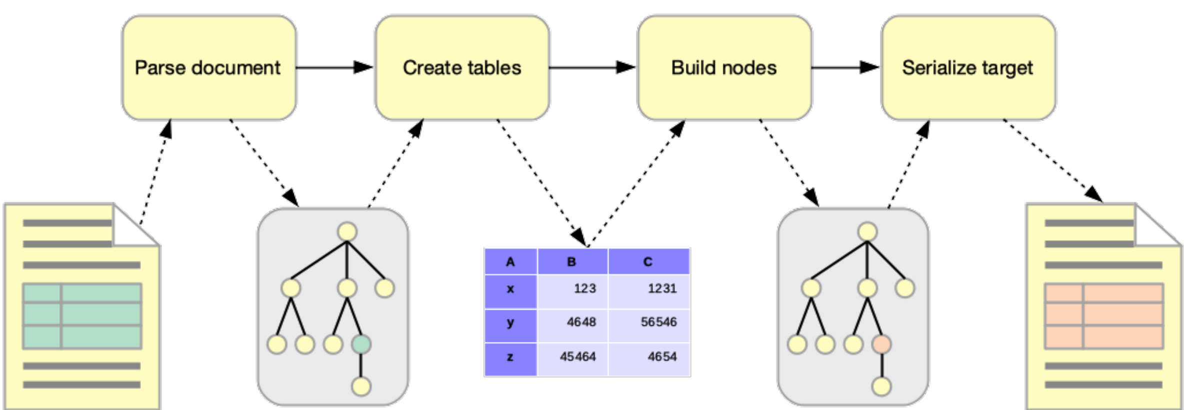
CHAPTER

TWO

CONVERSION STAGES

To convert a document, Benker uses several stages:

1. Parse the source document and construct a nodes tree,
2. Search for table elements and construct the table objects,
3. Build the target nodes tree by replacing table nodes,
4. Serialise the target document.



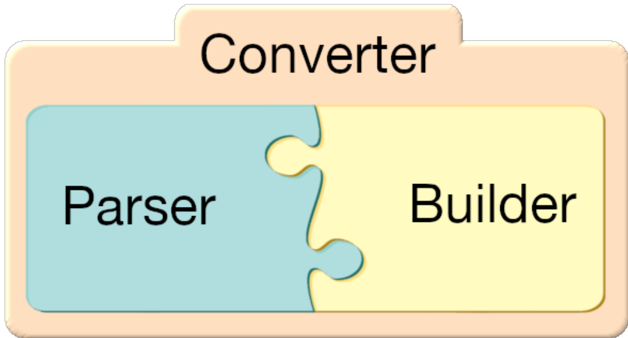
CHAPTER

THREE

CONVERTERS: PARSERS + BUILDERS

The decoupling between parsing, building and final serialization allows a simplified and modular implementation. This decoupling also allows to multiply the combinations: it is easy to change a builder to another one, and to develop its own parser…

The advantage of this approach is that we avoid having a specific document conversion for each format pair (input, output). Instead, you can build a converter by choosing a parser and a builder, as you assemble the pieces of a puzzle.

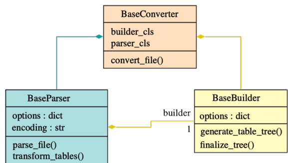


The following table show you the available converters which groups parser and builders by pairs.

Table 1: **Available converters**

\	OOXML	HTML	CALS	Formex4
OOXML	–	*(unavailable)*	`convert_ooxml2cals()`	`convert_ooxml2formex4()`
HTML	*(unavailable)*	–	*(unavailable)*	*(unavailable)*
CALS	*(unavailable)*	*(unavailable)*	–	*(unavailable)*
Formex4	*(unavailable)*	*(unavailable)*	*(unavailable)*	–

You can create your own converter by inheriting the available base classes:



- `BaseConverter`: inherit this class to create your own converter. Set your own parser class to the *parser_cls* class attribute, and your own builder class to the *builder_cls* class attribute.
- `BaseParser`: inherit this class to create your own parser. The method `transform_tables()` is an abstract method, so you need to implement it in your subclass: it must call the method `generate_table_tree()` each time a table node is found and converted to a `Table` object.
- `BaseBuilder`: inherit this class to create your own builder. The method `generate_table_tree()` is an abstract method, so you need to implement it in your subclass: it must convert the `Table` object into a target XML node (the resulting table format). You can also implement the method `finalize_tree()` to do any post-processing to the resulting XML tree.

Hint: Contribution is welcome!

CHAPTER

FOUR

USAGE

For example, to convert the tables of a `.docx` document to Formex4 format, you can process as follow:

```
import os
import zipfile

from benker.converters.ooxml2formex4 import convert_ooxml2formex4

# - Unzip the ``.docx`` in a temporary directory
src_zip = "/path/to/demo.docx"
tmp_dir = "/path/to/tmp/dir/"
with zipfile.ZipFile(src_zip) as zf:
    zf.extractall(tmp_dir)

# - Source paths
src_xml = os.path.join(tmp_dir, "word/document.xml")
styles_xml = os.path.join(tmp_dir, "word/styles.xml")

# - Destination path
dst_xml = "/path/to/demo.xml"

# - Create some options and convert tables
options = {
    'encoding': 'utf-8',
    'styles_path': styles_xml,
}
convert_ooxml2formex4(src_xml, dst_xml, **options)
```

This code produces a table like that:

```
<TBL COLS="7" NO.SEQ="0001">
  <CORPUS>
    <ROW>
      <CELL COL="1" ROWSPAN="2">
        <w:p w:rsidR="00EF2ECA" w:rsidRDefault="00EF2ECA"><w:r><w:t>A</w:t></w:r></w:p>
      </CELL>
      <CELL COL="2" COLSPAN="2">
        <w:p w:rsidR="00EF2ECA" w:rsidRDefault="00EF2ECA"><w:r><w:t>B</w:t></w:r></w:p>
      </CELL>
      <CELL COL="4">
        <IE/>
      </CELL>
```

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```
      <CELL COL="5">
        <IE/>
      </CELL>
      <CELL COL="6">
        <IE/>
      </CELL>
      <CELL COL="7">
        <IE/>
      </CELL>
    </ROW>
    <ROW>
      ...
    </ROW>
  </CORPUS>
</TBL>
```

The content of the cells still contains OOXML fragments. It's your own responsibility to convert them to the target format.

4.1 Benker

Organize your data in a spatial grid system for CALS, HTML, Formex4, Office Open XML tables conversion

4.1.1 Overview

To convert the tables of a `.docx` document to CALS format, you can process as follow:

```
import os
import zipfile

from benker.converters.ooxml2cals import convert_ooxml2cals

# - Unzip the ``.docx`` in a temporary directory
src_zip = "/path/to/demo.docx"
tmp_dir = "/path/to/tmp/dir/"
with zipfile.ZipFile(src_zip) as zf:
    zf.extractall(tmp_dir)

# - Source paths
src_xml = os.path.join(tmp_dir, "word/document.xml")
styles_xml = os.path.join(tmp_dir, "word/styles.xml")

# - Destination path
dst_xml = "/path/to/demo.xml"
```

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```
# - Create some options and convert tables
options = {
    'encoding': 'utf-8',
    'styles_path': styles_xml,
    'width_unit': "mm",
    'table_in_tgroup': True,
}
convert_ooxml2cals(src_xml, dst_xml, **options)
```

4.1.2 Installation

To install this library, you can create and activate a virtualenv, and run:

```
pip install benker
```

Requirements

This library uses lxml library and is tested with the versions 3.8 and 4.*x*.

The following table shows the compatibility between different combinations of Python and lxml versions:

Py \ lxml	3.8	4.0	4.1	4.2	4.3	4.4	4.5	4.6
2.7	✓	✓	✓	✓	✓	✓	✓	✓
3.4	✓!	✓!	✓!	✓!	✓!	×	×	×
3.5	✓	✓	✓	✓	✓	✓	✓	✓
3.6	✓	✓	✓	✓	✓	✓	✓	✓
3.7	×	×	✓	✓	✓	✓	✓	✓
3.8	×	×	×	×	✓	✓	✓	✓
3.9	×	×	×	×	✓	✓	✓	✓

- ✓ lxml is available for this version and unit tests succeed.
- ! installation succeed using “attrs < 21.1”.
- × lxml is not available for this version of Python.

Usage in your library/application

You can use this library in your own library/application.

To do so, add this library in your `setup.py` in your project requirements:

```
setup(
    name="YourApp",
    install_requires=['benker'],
    ...
)
```

To install the dependencies, activate your virtualenv and run:

```
pip install -e .
```

And enjoy!

4.1.3 Licence

This library is distributed according to the MIT licence.

Users have legal right to download, modify, or distribute the library.

4.1.4 Authors

`Benker` was written by Laurent LAPORTE.

4.2 Tutorials

4.2.1 Size

Description

A *`Size`* is a tuple with *width*, *height* coordinates. It represents the width and the height of a cell in a grid.

```
>>> from benker.size import Size

>>> size = Size(4, 5)
```

The representation of a size is "(*width* x *height*)":

```
>>> print(size)
(4 x 5)
```

Operations

You can change the size of a *Size* by adding, subtracting of multiplying values.

You can add two sizes, a size and a tuple (*x*, *y*), a size and a single quantity (integer):

```
>>> Size(2, 3) + Size(3, 4)
Size(width=5, height=7)

>>> Size(2, 3) + (3, 4)
Size(width=5, height=7)

>>> Size(2, 3) + 1
Size(width=3, height=4)
```

You can subtract two sizes, a size and a tuple (*x*, *y*), a size and a single quantity (integer):

```
>>> Size(1, 4) - Size(2, 1)
Size(width=-1, height=3)

>>> Size(1, 4) - (2, 1)
Size(width=-1, height=3)

>>> Size(1, 4) - 1
Size(width=0, height=3)
```

You can multiply a size by an integer. This last ability is useful to reverse a size:

```
>>> Size(3, 4) * 3
Size(width=9, height=12)

>>> Size(3, 4) * -1
Size(width=-3, height=-4)
```

You can also negate a size:

```
>>> -Size(3, 5)
Size(width=-3, height=-5)

>>> +Size(3, 5)
Size(width=3, height=5)
```

All this operations are useful to do mathematical transformation with *Coord — Operations*, for instance, a translation of a coord is done by adding a coord and a size.

4.2.2 Coord

Description

A *Coord* is a tuple with *x*, *y* coordinates. It represents the top-left origin of a cell in a grid.

```
>>> from benker.coord import Coord

>>> coord = Coord(4, 5)
```

We use the Excel convention to represent a *Coord*: columns are represented by letters, rows are represented by numbers.

```
>>> print(Coord(2, 5))
B5
```

Operations

Mathematical operations are an easy way to translate a *Coord* to another locations.

You can use a *Size* to move a coord to another position. You can also use a tuple (*x*, *y*) or a single quantity (integer):

```
>>> from benker.size import Size

>>> Coord(2, 5) + Size(1, 2)
Coord(x=3, y=7)

>>> Coord(2, 5) + (1, 2)
Coord(x=3, y=7)

>>> Coord(2, 5) + 1
Coord(x=3, y=6)
```

The translation can be positive or negative:

```
>>> Coord(2, 5) - Size(1, 2)
Coord(x=1, y=3)

>>> Coord(2, 5) - (1, 2)
Coord(x=1, y=3)

>>> Coord(2, 5) - 1
Coord(x=1, y=4)
```

You cannot add or subtract two coordinates:

```
>>> Coord(2, 5) + Coord(2, 1)
Traceback (most recent call last):
    ...
TypeError: <class 'benker.coord.Coord'>

>>> Coord(2, 5) - Coord(1, 2)
Traceback (most recent call last):
    ...
TypeError: <class 'benker.coord.Coord'>
```

Again, you cannot add a size and a coord:

```
>>> Size(2, 5) + Coord(2, 1)
Traceback (most recent call last):
    ...
TypeError: <class 'benker.coord.Coord'>

>>> Size(2, 5) - Coord(1, 2)
Traceback (most recent call last):
    ...
TypeError: <class 'benker.coord.Coord'>
```

Warning: This constraint must be respected in order to help diagnosing conceptual errors.

4.2.3 Box

Description

A *Box* is a rectangular area defined by two coordinates:

- the top-left corner of the rectangle: the *min* coord,
- the bottom-right corner of the rectangle: the *max* coord.

The default size of a *Box* is (1, 1), so you can create a *box* by only specifying the top-let corner of the rectangle.

```
>>> from benker.box import Box

>>> Box(1, 2, 2, 3)
Box(min=Coord(x=1, y=2), max=Coord(x=2, y=3))
>>> Box(1, 2)
Box(min=Coord(x=1, y=2), max=Coord(x=1, y=2))
```

You can use two coordinates to define a box:

```
>>> from benker.coord import Coord

>>> Box(Coord(5, 6), Coord(7, 8))
Box(min=Coord(x=5, y=6), max=Coord(x=7, y=8))
>>> Box(Coord(5, 6))
Box(min=Coord(x=5, y=6), max=Coord(x=5, y=6))
```

You can specify the size of a box:

```
>>> from benker.size import Size

>>> Box(Coord(5, 6), Size(3, 2))
Box(min=Coord(x=5, y=6), max=Coord(x=7, y=7))
```

We use the Excel convention to represent a *Box*: columns are represented by letters, rows are represented by numbers.

```
>>> print(Box(Coord(2, 5)))
B5
>>> print(Box(Coord(2, 5), Size(3, 2)))
B5:D6
```

Properties

You can use the following properties to extract information from a *box*:

- use *min* to get the top-left corner coordinates,
- use *max* to get the bottom-right corner coordinates,
- use *width* to get the width of the box (number of columns),
- use *height* to get the height of the box (number of rows),
- use *size* to get the size (*width* and *height*) of the box.

```
>>> b1 = Box(Coord(5, 6), Size(3, 2))

>>> b1.min
Coord(x=5, y=6)
>>> b1.max
Coord(x=7, y=7)
>>> b1.width
3
>>> b1.height
2
>>> b1.size
Size(width=3, height=2)
```

Warning: All properties are non-mutable:

```
>>> b1.width = 9
Traceback (most recent call last):
...
AttributeError: can't set attribute
```

Operations

Contains

You can check if a point, defined by its coordinates (tuple (*x*, *y*) or `Coord` instance), is contained in a box:

```
>>> top_left = Coord(5, 6)
>>> top_right = Coord(6, 6)
>>> bottom_left = Coord(5, 8)
>>> bottom_right = Coord(6, 8)

>>> b1 = Box(top_left, bottom_right)

>>> top_left in b1
True
>>> top_right in b1
True
>>> bottom_left in b1
True
>>> bottom_right in b1
True

>>> Coord(7, 6) in b1
False

>>> (5, 7) in b1
True
```

Warning: Even if a *Size* object is a subtype of `tuple`, such an object cannot be "contained" in a *Box*.

```
>>> b1 = Box(Coord(x=5, y=6), Coord(x=6, y=8))
>>> Size(5, 7) in b1
Traceback (most recent call last):
    ...
TypeError: <class 'benker.size.Size'>
```

You can check if a *Box* is contained in another box:

```
>>> b1 = Box(Coord(x=5, y=6), Coord(x=6, y=8))
>>> b2 = Box(Coord(x=5, y=7), Coord(x=6, y=7))
>>> b3 = Box(Coord(x=6, y=6), Coord(x=7, y=6))

>>> b1 in b1
True
>>> b2 in b1
True
>>> b3 in b2
False
```

Intersection and Union

You can find if a *Box* intersects another *Box*:

```
>>> b1 = Box(Coord(x=1, y=1), Coord(x=3, y=3))
>>> b2 = Box(Coord(x=2, y=2), Coord(x=4, y=4))
>>> b3 = Box(Coord(x=4, y=1), Coord(x=5, y=1))

>>> b1.intersect(b2)
True
>>> b1.intersect(b3)
False
```

Two boxes are disjoint if they don't intersect each other:

```
>>> b1.isdisjoint(b2)
False
>>> b1.isdisjoint(b3)
True
```

You can calculate the intersection of two boxes. You can use the "&" operator to do that:

```
>>> b1.intersection(b2)
Box(min=Coord(x=2, y=2), max=Coord(x=3, y=3))
>>> b1 & b2
Box(min=Coord(x=2, y=2), max=Coord(x=3, y=3))
```

Warning: If the two boxes are disjoint, there is no intersection:

```
>>> b1 & b3
Traceback (most recent call last):
  ...
ValueError: (Box(min=Coord(x=1, y=1), max=Coord(x=3, y=3)), Box(min=Coord(x=4, y=1),␣
↪max=Coord(x=5, y=1)))
```

You can calculate the union of two boxes. The union of two boxes is the bounding box: You can use the "|" operator to do that:

```
>>> b1.union(b2)
Box(min=Coord(x=1, y=1), max=Coord(x=4, y=4))
>>> b1 | b2
Box(min=Coord(x=1, y=1), max=Coord(x=4, y=4))
```

Total ordering

A total ordering is defined for the boxes. The aim is to order the cells in a grid sorted from left to right and from top to bottom. This order is useful to group the cells by rows.

You can compare boxes:

```
>>> b1 = Box(Coord(3, 2), Coord(6, 4))
>>> b1 < b1
False
>>> b1 < Box(Coord(3, 2), Coord(6, 5))
True
>>> b1 < Box(Coord(3, 2), Coord(7, 4))
True
>>> b1 < Box(Coord(4, 2), Coord(6, 4))
True
>>> b1 < Box(Coord(3, 3), Coord(6, 4))
True
```

You can sort boxes. The sort order can be defined as below:

- top cells are sorted before bottom cells,
- top-left cells are sorted before top-right cells,
- smaller cells are sorted before bigger.

```
>>> from random import shuffle

>>> boxes = [Box(x, y) for x in range(1, 4) for y in range(1, 3)]
>>> [str(box) for box in boxes]
['A1', 'A2', 'B1', 'B2', 'C1', 'C2']

>>> shuffle(boxes)
>>> [str(box) for box in sorted(boxes)]
['A1', 'B1', 'C1', 'A2', 'B2', 'C2']
```

4.2.4 Styled

Description

A *Styled* object contains a dictionary of styles.

It is mainly used for *Table*, *RowView*, *ColView*, and *Cell*.

```
>>> from benker.styled import Styled

>>> styled = Styled({'text-align': 'justify'}, "body")
```

The representation of a styled is the representation of its dictionary of styles:

```
>>> print(styled)
{'text-align': 'justify'}
```

Attributes

A *Styled* object has the following attribute:

- *styles* is the user-defined styles: a dictionary of key-value pairs. This values are useful to store some HTML-like styles (border-style, border-width, border-color, vertical-align, text-align, etc.). Of course, we are not tied to the HTML-like styles, you can use your own styles list.

  Note: The style dictionary is always copied: in other words, key-value pairs are copied but a shallow copy is done for the values (in general, it is not a problem if you use non-mutable values like `str`).

- *nature*: a way to distinguish the body cells, from the header and the footer. The default value is "body", but you can use "header", "footer" or whatever is suitable for your needs. This kind of information is in general not stored in the styles, even if it is similar.

  Tables can also have a *nature*, similar to HTML `@class` attribute, you can use it do identify the styles to apply to your table. For tables, the default value is `None`.

  Note: In a *Grid*, the *merging* of two natures is done by keeping the first nature and dropping the second one. In other words, the resulting nature is the group of the most top-left nature of the merged cells.

Example of *styles* initialisation and shallow copy:

```
>>> css =  { 'border-style': 'solid', 'border-width': '5px'}

>>> one = Styled(css, "body")
>>> one.styles['border-width'] = '2px 10px 4px 20px'
>>> two = Styled(one.styles, "body")
>>> two.styles['border-width'] = 'medium'

>>> css
{'border-style': 'solid', 'border-width': '5px'}

>>> one.styles
{'border-style': 'solid', 'border-width': '2px 10px 4px 20px'}
```

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```
>>> two.styles
{'border-style': 'solid', 'border-width': 'medium'}
```

4.2.5 Cell

Description

A *Cell* object stores the *content* of a *Grid* cell.

A cell can have *styles*, a dictionary of key-value properties attached to the cell.

A cell has a *type* to distinguish between header, body and footer cells. The default type is “body”, but you can also use “header”, “footer” or whatever…

A cell has top-left coordinates: *x* and *y*. The default coordinates is (1, 1): this is the top-left coordinate of the cell box. The coordinates *x* and *y* cannot be null: grid coordinates are 1-indexed.

A cell has a size: *width* and *height*. The default size is (1, 1), you can increase them to represent horizontal or vertical spanning. The *width* and the *height* cannot be null.

To instantiate a *Cell*, you can do:

```
>>> from benker.cell import Cell

>>> c1 = Cell("c1")
>>> c2 = Cell("c2", styles={'color': 'red'})
>>> c3 = Cell("c3", x=2, y=3, nature="footer")
>>> c4 = Cell("c4", width=2)
>>> c5 = Cell("c5", height=2)
```

The string representation of a cell is the string representation of it’s content:

```
>>> for cell in c1, c2, c3, c4, c5:
...     print(cell)
c1
c2
c3
c4
c5
```

Attributes

A cell has the following attributes:

- *content* is the user-defined cell content. It can be of any type: `None`, `str`, `int`, `float`, a container (`list`), a XML element, etc. The same content can be shared by several cells, it’s your own responsibility to handle the copy (or deep copy) of the *content* reference when needed.

  Note: In a *Grid*, the *merging* of two cell contents is done with the “+” operator (`__add__()`). You can override this by using a *content_appender*, a two-arguments function which will perform the concatenation of the two contents.

- *styles* is the user-defined cell styles: a dictionary of key-value pairs. This values are useful to store some HTML-like styles (border-style, border-width, border-color, vertical-align, text-align, etc.). Of course, we are not tied to the HTML-like styles, you can use your own styles list.

  Note: The style dictionary is always copied: in other words, key-value pairs are copied but a shallow copy is done for the values (in general, it is not a problem if you use non-mutable values like `str`).

- *type* is a way to distinguish the body cells, from the header and the footer. The default value is "body", but you can use "header", "footer" or whatever is suitable for your needs.

  Note: In a *`Grid`*, the *merging* of two cell types is done by keeping the first cell type and dropping the second one. In other words, the resulting cell type is the type of the most top-left cell type of the merged cells.

Using the cell attributes:

```
>>> paragraphs = ["Hello", "How are you?"]
>>> css = {'text-align': 'justify', 'vertical-align': 'top'}

>>> c1 = Cell(paragraphs, styles=css, nature="normal")
>>> c2 = Cell(paragraphs, styles=css, nature="normal")

# this will mutate the referenced *paragraphs* list:
>>> c1.content.append("I am well.")
>>> c2.content
['Hello', 'How are you?', 'I am well.']

# this will change only the cell styles:
>>> c1.styles['vertical-align'] = 'middle'
>>> c2.styles == {'text-align': 'justify', 'vertical-align': 'top'}
True
```

Properties

You can use the following properties to extract information from a *cell*:

- use *min* to get the top-left corner coordinates,
- use *max* to get the bottom-right corner coordinates,
- use *width* to get the width of the box (number of columns),
- use *height* to get the height of the box (number of rows),
- use *size* to get the size (*width* and *height*) of the box.

```
>>> c1 = Cell("Hi", x=5, y=6, width=3, height=2)

>>> c1.min
Coord(x=5, y=6)
>>> c1.max
Coord(x=7, y=7)
>>> c1.width
3
```

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```
>>> c1.height
2
>>> c1.size
Size(width=3, height=2)
```

Warning: All properties are non-mutable:

```
>>> c1.width = 9
Traceback (most recent call last):
...
AttributeError: can't set attribute
```

Operations

Contains

You can check if a point, defined by its coordinates (tuple (*x*, *y*) or `Coord` instance), is contained in a `Cell`.

A cell contains a point if it is in its `Box`. This rule is explained in detail in the section *Box – Contains*.

```
>>> c1 = Cell("A", x=2, y=3, width=2, height=1)

>>> (3, 3) in c1
True
>>> (7, 9) in c1
False
```

Total ordering

A total ordering is defined for the cells. The aim is to order the cells in a grid sorted from left to right and from top to bottom. This order is useful to group the cells by rows.

The total ordering is base on the `Box` *Total ordering*.

```
>>> c1 = Cell("one")
>>> c2 = Cell("two", x=2)
>>> c3 = Cell("three", y=2)

>>> c1 < c2 < c3
True
```

This total ordering allow us to sort the cells:

```
>>> from random import shuffle

>>> cells = [c1, c2, c3]
>>> shuffle(cells)
>>> [str(cell) for cell in sorted(cells)]
['one', 'two', 'three']
```

Transformations

It is possible to change the cell position and size by using two kind of transformations:

- Move a cell to a different coordinates,
- Resize a cell.

```
>>> from benker.coord import Coord
>>> from benker.size import Size

>>> c1 = Cell("A")
>>> c1
<Cell('A', styles={}, nature=None, x=1, y=1, width=1, height=1)>

>>> c1.move_to(Coord(2, 3))
<Cell('A', styles={}, nature=None, x=2, y=3, width=1, height=1)>

>>> c1.resize(Size(3, 4))
<Cell('A', styles={}, nature=None, x=1, y=1, width=3, height=4)>

>>> c1.transform(Coord(2, 3), Size(3, 4))
<Cell('A', styles={}, nature=None, x=2, y=3, width=3, height=4)>
```

The transformation functions don't change the current cell but produce a new one with new coordinates/size.

4.2.6 Grid

Description

A *Grid* is a collection of *Cell* objects ordered in a grid of rows and columns.

You can define a empty grid like this:

```
>>> from benker.grid import Grid

>>> Grid()
Grid([])
```

You can also define a grid from a collection (`list`, `set`...) of cells. Cells are ordered according to the total ordering of the cell boxes:

```
>>> from benker.cell import Cell

>>> red = Cell('red', x=1, y=1, height=2)
>>> pink = Cell('pink', x=2, y=1, width=2)
>>> blue = Cell('blue', x=2, y=2)

>>> grid = Grid([red, blue, pink])
>>> for cell in grid:
...     print(cell)
red
pink
blue
```

Warning: If at least one cell intersect another one, an exception is raised:

```
>>> Grid([Cell("one"), Cell("two")])
Traceback (most recent call last):
    ...
KeyError: Coord(x=1, y=1)
```

So, it is important to define the coordinates of the cells.

It's easy to copy the cells of another grid.

Remember that:

- cells are copied (not shared between grids),
- cell contents are shared: two different cells share the same content,
- cell styles are copied (but not deeply).

```
>>> grid1 = Grid([red, blue, pink])
>>> grid2 = Grid(grid1)

>>> tuple(id(cell) for cell in grid1) != tuple(id(cell) for cell in grid2)
True
>>> tuple(id(cell.content) for cell in grid1) == tuple(id(cell.content) for cell in␣
↪grid2)
True
>>> tuple(id(cell.styles) for cell in grid1) != tuple(id(cell.styles) for cell in grid2)
True
```

You can pretty print a grid:

```
>>> grid = Grid([red, blue, pink])
>>> print(grid)
+-----------+-----------------------+
|    red    |   pink                |
|           +-----------+-----------+
|           |   blue    |           |
+-----------+-----------+-----------+
```

Properties

The bounding box of a grid is the bounding box of all cells:

```
>>> grid = Grid()
>>> grid[1, 1] = Cell("red", height=2)
>>> grid[2, 1] = Cell("pink", width=2)
>>> grid[3, 2] = Cell("gray")
>>> print(grid)
+-----------+-----------------------+
|    red    |   pink                |
|           +-----------+-----------+
|           |           |   gray    |
+-----------+-----------+-----------+
```

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```
>>> grid.bounding_box
Box(min=Coord(x=1, y=1), max=Coord(x=3, y=2))
```

Important: The bounding box is not defined for an empty grid, so `None` is returned in that case (this behavior is preferable to raising an exception, in order to simplify interactive debugging).

```
>>> grid = Grid()
>>> grid.bounding_box is None
True
```

Operations

Contains

You can check if a point, defined by its coordinates (tuple (*x*, *y*) or *Coord* instance), is contained in a *Grid*.

The rule is simple: a grid contains a point if it exists a *Cell* of the grid which contains that point. In other words, a point may be contained in the bounding box of a grid but not in any cell if there are some gaps in the grid.

```
>>> from benker.coord import Coord

>>> red = Cell('red', x=1, y=1, height=2)
>>> pink = Cell('pink', x=2, y=1, width=2)
>>> blue = Cell('blue', x=2, y=2)
>>> grid = Grid([red, blue, pink])

>>> (1, 1) in grid
True
>>> (3, 1) in grid
True
>>> (4, 1) in grid
False
>>> (3, 2) in grid
False

>>> Coord(1, 2) in grid
True
```

Set, Get, Delete cells

A grid is a `MutableMapping`, it works like a dictionary of cells. Keys of the dictionary are coordinates (tuple (*x*, *y*) or *Coord* instance). The coordinates are the top-left coordinates of the cells.

```
>>> grid = Grid()
>>> grid[1, 1] = Cell("red", height=2)
>>> grid[2, 1] = Cell("pink", width=2)
>>> grid[2, 2] = Cell("blue")
```

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```
>>> grid[3, 2] = Cell("gray")

>>> print(grid)
+-----------+-----------------------+
|    red    |   pink                |
|           +-----------+-----------+
|           |   blue    |   gray    |
+-----------+-----------+-----------+
```

Warning: Unlike a `dict`, you cannot set a cell to a given location if a cell already exist in that location, an exception is raised in that case.

```
>>> grid[3, 1] = Cell("purple")
Traceback (most recent call last):
    ...
KeyError: Coord(x=3, y=1)
```

You can get a cell at a given location:

```
>>> grid[1, 1]
<Cell('red', styles={}, nature=None, x=1, y=1, width=1, height=2)>
>>> grid[3, 1]
<Cell('pink', styles={}, nature=None, x=2, y=1, width=2, height=1)>
```

You can delete a cell at a given location:

```
>>> del grid[3, 1]
>>> print(grid)
+-----------+-----------+-----------+
|    red    |           |           |
|           +-----------+-----------+
|           |   blue    |   gray    |
+-----------+-----------+-----------+
```

Merging/expanding

It is possible to merge several cells in the grid. The merging takes the *start* coordinates and the *end* coordinates of the cells to merge.

We can define a *content_appender* to give the content merging operation to use to merge several cell contents.

```
>>> grid = Grid()
>>> grid[1, 1] = Cell("red", height=2)
>>> grid[2, 1] = Cell("pink")
>>> grid[3, 1] = Cell("blue")
>>> print(grid)
+-----------+-----------+-----------+
|    red    |   pink    |   blue    |
|           +-----------+-----------+
|           |           |           |
```

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```
+-----------+-----------+-----------+

>>> grid.merge((2, 1), (3, 1), content_appender=lambda a, b: "/".join([a, b]))
<Cell('pink/blue', styles={}, nature=None, x=2, y=1, width=2, height=1)>
>>> print(grid)
+-----------+-----------------------+
|    red    | pink/blue             |
|           +-----------+-----------+
|           |           |           |
+-----------+-----------+-----------+
```

Warning: All cells in the bounding box of the merging must be inside of the bounding box. In other words, the bounding box of the merging must not intersect any cell in the grid.

```
>>> grid.merge((1, 2), (2, 2))
Traceback (most recent call last):
  ...
ValueError: ((1, 2), (2, 2))
```

Similar to the merging, you can expand the size of a cell;

```
>>> grid = Grid()
>>> grid[1, 1] = Cell("red", height=2)
>>> grid[2, 1] = Cell("pink")
>>> grid[3, 1] = Cell("blue")
>>> print(grid)
+-----------+-----------+-----------+
|    red    |   pink    |   blue    |
|           +-----------+-----------+
|           |           |           |
+-----------+-----------+-----------+

>>> grid.expand((2, 1), height=1)
<Cell('pink', styles={}, nature=None, x=2, y=1, width=1, height=2)>
>>> print(grid)
+-----------+-----------+-----------+
|    red    |   pink    |   blue    |
|           |           +-----------+
|           |           |           |
+-----------+-----------+-----------+
```

Iterators

You can iterate the cells of a grid:

```
>>> grid = Grid()
>>> grid[1, 1] = Cell("red", height=2)
>>> grid[2, 1] = Cell("hot", width=2)
>>> grid[2, 2] = Cell("chili")
>>> grid[3, 2] = Cell("peppers")
>>> grid[1, 3] = Cell("Californication", width=3)

>>> print(grid)
+-----------+-----------------------+
|    red    |    hot                |
|           +-----------+-----------+
|           |   chili   |  peppers  |
+-----------------------------------+
|             Californi             |
+-----------------------------------+

>>> for cell in grid:
...     print(cell)
red
hot
chili
peppers
Californication
```

You can iterate over the grid rows with the method *iter_rows()*. Each row is a `tuple` of cells:

```
>>> for row in grid.iter_rows():
...     print(" / ".join(cell.content for cell in row))
red / hot
chili / peppers
Californication
```

4.2.7 Table

Description

A *Table* is a data structure used to represent Office Open XML tables, CALS tables or HTML tables.

A *Table* is a *Styled* object, so you can attach a dictionary of styles and a nature ("body" by default). The nature is used to give a default value to the the row/column views.

```
>>> from benker.table import Table

>>> Table(styles={'frame': 'all'})
<Table({'frame': 'all'}, None)>
```

A table can be initialize with a collection of cells. Make sure all cells are disjoints.

```
>>> from benker.cell import Cell

>>> red = Cell('red', x=1, y=1, height=2)
>>> pink = Cell('pink', x=2, y=1, width=2)
>>> blue = Cell('blue', x=2, y=2)

>>> table = Table([red, pink, blue], nature='header')
>>> table
<Table({}, 'header')>

>>> print(table)
+-----------+-----------------------+
|    red    |   pink                |
|           +-----------+-----------+
|           |   blue    |           |
+-----------+-----------+-----------+
```

Warning: Make sure all cells are disjoints:

```
>>> red = Cell('overlap', x=1, y=1, width=2)
>>> pink = Cell('oops!', x=2, y=1)
>>> Table([red, pink])
Traceback (most recent call last):
    ...
KeyError: Coord(x=2, y=1)
```

Properties

You can use the following properties to extract information from a *table*:

The bounding box of a table is the bounding box of all cells in the grid:

```
>>> red = Cell('red', x=1, y=1, height=2)
>>> pink = Cell('pink', x=2, y=1, width=2)
>>> blue = Cell('blue', x=2, y=2)
>>> table = Table([red, pink, blue])

>>> table.bounding_box
Box(min=Coord(x=1, y=1), max=Coord(x=3, y=2))
```

Important: The bounding box is not defined for an empty table, so `None` is returned in that case (this behavior is preferable to raising an exception, in order to simplify interactive debugging).

```
>>> table = Table()
>>> table.bounding_box is None
True
```

Operations

Cells Insertion

You can insert a row to a table. This row is then used to insert cells.

```
>>> table = Table()

>>> row = table.rows[1]
>>> row.nature = "header"
>>> row.insert_cell("Astronomer", width=2)
>>> row.insert_cell("Year")
>>> row.insert_cell("Country")

>>> row = table.rows[2]
>>> row.insert_cell("Nicolaus")
>>> row.insert_cell("Copernicus")
>>> row.insert_cell("1473-1543")
>>> row.insert_cell("Royal Prussia")

>>> row = table.rows[3]
>>> row.insert_cell("Charles")
>>> row.insert_cell("Messier")
>>> row.insert_cell("1730-1817")
>>> row.insert_cell("France", height=2)

>>> row = table.rows[4]
>>> row.insert_cell("Jean-Baptiste")
>>> row.insert_cell("Delambre")
>>> row.insert_cell("1749-1822")

>>> print(table)
+-----------------------+-----------+-----------+
| Astronome             |   Year    |  Country  |
+-----------+-----------+-----------+-----------+
| Nicolaus  | Copernicu | 1473-1543 | Royal Pru |
+-----------+-----------+-----------+-----------+
|  Charles  |  Messier  | 1730-1817 |  France   |
+-----------+-----------+-----------|           |
| Jean-Bapt | Delambre  | 1749-1822 |           |
+-----------+-----------+-----------+-----------+
```

The *nature* of a cell is inherited from its parent's row. The first row contains the header, so the cell nature is "header":

```
>>> table.rows[1].nature
'header'
>>> [cell.nature for cell in table.rows[1].owned_cells]
['header', 'header', 'header']
```

The other rows have no *nature*, so the cell nature is `None`

```
>>> table.rows[2].nature is None
True
```

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```
>>> all(cell.nature is None for cell in table.rows[2].owned_cells)
True
```

Cells Merging

You can merge cells by giving the coordinates of the cells to merge or by extending the size of a given cell.

```
>>> table = Table()
>>> letters = "abcdEFGHijklMNOP"
>>> for index, letter in enumerate(letters):
...     table[(1 + index % 4, 1 + index // 4)] = Cell(letter)
>>> print(table)
+-----------+-----------+-----------+-----------+
|     a     |     b     |     c     |     d     |
+-----------+-----------+-----------+-----------+
|     E     |     F     |     G     |     H     |
+-----------+-----------+-----------+-----------+
|     i     |     j     |     k     |     l     |
+-----------+-----------+-----------+-----------+
|     M     |     N     |     O     |     P     |
+-----------+-----------+-----------+-----------+

>>> table.merge((2, 2), (3, 3))
>>> print(table)
+-----------+-----------+-----------+-----------+
|     a     |     b     |     c     |     d     |
+-----------+-----------------------+-----------+
|     E     |   FGjk                |     H     |
+-----------|                       +-----------+
|     i     |                       |     l     |
+-----------+-----------+-----------+-----------+
|     M     |     N     |     O     |     P     |
+-----------+-----------+-----------+-----------+

>>> table.expand((2, 3), height=1)
>>> print(table)
+-----------+-----------+-----------+-----------+
|     a     |     b     |     c     |     d     |
+-----------+-----------------------+-----------+
|     E     |                       |     H     |
+-----------|                       +-----------+
|     i     |  FGjkNO               |     l     |
+-----------|                       +-----------+
|     M     |                       |     P     |
+-----------+-----------------------+-----------+
```

Owned and caught cells

When a cell is merged into a row group, it is always bound to the top row of this group (the first row). In that case, we say that the first row **owns** the cell and the other rows **catch** the cell.

```
>>> table = Table()

>>> row = table.rows[1]
>>> row.insert_cell("merged", height=2)
>>> row.insert_cell("A")

>>> row = table.rows[2]
>>> row.insert_cell("B")

>>> row = table.rows[3]
>>> row.insert_cell("C")
>>> row.insert_cell("D")
>>> print(table)
+-----------+-----------+
|  merged   |     A     |
|           +-----------+
|           |     B     |
+-----------+-----------+
|     C     |     D     |
+-----------+-----------+
```

Here are the **owned_cells** of this table:

```
>>> for pos, row in enumerate(table.rows, 1):
...     cells = ", ".join("{}".format(cell) for cell in row.owned_cells)
...     print("row #{pos}: {cells}".format(pos=pos, cells=cells))
row #1: merged, A
row #2: B
row #3: C, D
```

Here are the **caught_cells** of this table:

```
>>> for pos, row in enumerate(table.rows, 1):
...     cells = ", ".join("{}".format(cell) for cell in row.caught_cells)
...     print("row #{pos}: {cells}".format(pos=pos, cells=cells))
row #1: merged, A
row #2: merged, B
row #3: C, D
```

The same applies to columns: if a cell is merged into several columns then it belongs to the first column (left) of the merged column group.

```
>>> table = Table()

>>> row = table.rows[1]
>>> row.insert_cell("merged", width=2)
>>> row.insert_cell("A")

>>> row = table.rows[2]
```

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```
>>> row.insert_cell("B")
>>> row.insert_cell("C")
>>> row.insert_cell("D")
>>> print(table)
+-----------------------+-----------+
|  merged               |     A     |
+-----------+-----------+-----------+
|     B     |     C     |     D     |
+-----------+-----------+-----------+
```

Here are the **owned_cells** of this table:

```
>>> for pos, col in enumerate(table.cols, 1):
...     cells = ", ".join("{}".format(cell) for cell in col.owned_cells)
...     print("col #{pos}: {cells}".format(pos=pos, cells=cells))
col #1: merged, merged, B
col #2: C
col #3: A, D
```

Here are the **caught_cells** of this table:

```
>>> for pos, col in enumerate(table.cols, 1):
...     cells = ", ".join("{}".format(cell) for cell in col.caught_cells)
...     print("col #{pos}: {cells}".format(pos=pos, cells=cells))
col #1: merged, merged, B
col #2: merged, merged, C
col #3: A, D
```

4.3 API

Organize your data in a spatial grid system for CALS, HTML, Formex4, Office Open XML tables conversion

4.3.1 Cell Size

A *Size* object is used to represent the *width* and *height* of a *Cell*. The *width* is the number of spanned columns and the *height* is the number of spanned rows. The default cell size is (1, 1).

This module defines the *Size* tuple and give some classic use cases.

class benker.size.**Size**(*width*, *height*)

Bases: *benker.size.SizeTuple*

Size of a cell: *width* is the number of columns and *height* is the number of row.

Usage:

```
>>> from benker.size import Size
```

```
>>> size = Size(2, 1)
>>> size
Size(width=2, height=1)
```

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```
>>> size.width
2
>>> size.height
1
>>> str(size)
'(2 x 1)'
```

You can use the "+" or "-" operators to increase or decrease the size:

```
>>> Size(2, 1) + Size(3, 3)
Size(width=5, height=4)
>>> Size(5, 4) - Size(3, 3)
Size(width=2, height=1)
```

You can expand the *width* and *height* to a given factor using the "*" operator:

```
>>> Size(2, 1) * 2
Size(width=4, height=2)
```

You can have negative or positive sizes using the unary operators "-" and "+":

```
>>> +Size(3, 2)
Size(width=3, height=2)
>>> -Size(3, 2)
Size(width=-3, height=-2)
```

Note: A `Cell` object cannot have a negative or nul sizes, but you can need this values for calculation, for instance when you want to reduce the cell size.

classmethod from_value(*value*)

Convert a value of type `tuple` to a `Size` tuple.

Parameters **value** – tuple of two integers or `Size` tuple.

Returns Newly created object.

Raises `TypeError` – if the value is not a tuple of integers nor a `Size` tuple.

class benker.size.**SizeTuple**(*width*, *height*)

Bases: `tuple`

height

Alias for field number 1

width

Alias for field number 0

4.3.2 Cell Coordinates

A *Coord* object is used to represent the *x* and *y* positions of a *Cell*. The *x* is the left position (column number) and the *y* is the top position (row number). The default cell coordinates is (1, 1).

This module defines the *Coord* tuple and give some classic use cases.

class benker.coord.**Coord**(*x*, *y*)

Bases: *benker.coord.CoordTuple*

Coordinates of a cell in a grid: *x* is the left column, *y* if the top row.

Usage:

```
>>> from benker.coord import Coord

>>> coord = Coord(5, 3)
>>> coord
Coord(x=5, y=3)
>>> coord.x
5
>>> coord.y
3
>>> str(coord)
'E3'
```

You can use the "+" or "-" operators to move the coordinates:

```
>>> from benker.size import Size

>>> Coord(2, 1) + Size(3, 3)
Coord(x=5, y=4)
>>> Coord(5, 4) - Size(3, 3)
Coord(x=2, y=1)
```

Warning: You cannot add or subtract two coordinates, only a coordinate and a size.

```
>>> from benker.coord import Coord

>>> Coord(2, 1) + Coord(3, 3)
Traceback (most recent call last):
    ...
TypeError: <class 'benker.coord.Coord'>
```

classmethod from_value(*value*)

Convert a value of type `tuple` to a *Coord* tuple.

Parameters **value** – tuple of two integers or *Coord* tuple.

Returns Newly created object.

Raises `TypeError` – if the value is not a tuple of integers nor a *Coord* tuple.

class benker.coord.**CoordTuple**(*x*, *y*)

Bases: `tuple`

x

Alias for field number 0

y

Alias for field number 1

4.3.3 Box

A *Box* is a rectangular area defined by two coordinates:

- the top-left corner of the rectangle: the *min* coord,
- the bottom-right corner of the rectangle: the *max* coord.

To instantiate a *Box*, you can do:

```
>>> b1 = Box(Coord(5, 6), Coord(7, 8))
>>> b2 = Box(Coord(5, 6))
>>> b3 = Box(1, 2, 2, 3)
>>> b4 = Box(1, 2)
>>> b5 = Box(b1)
```

Box objects have a string representation à la Excel:

```
>>> for box in b1, b2, b3, b4, b5:
...     print(box)
E6:G8
E6
A2:B3
A2
E6:G8
```

You can calculate the *width* and *height* of boxes:

```
>>> b1 = Box(Coord(5, 6), Coord(6, 8))
>>> b1.width, b1.height
(2, 3)

>>> b2 = Box(Coord(5, 6))
>>> b2.width, b2.height
(1, 1)
```

You can determine if a *Coord* is included in a *Box*:

```
>>> top_left = Coord(5, 6)
>>> top_right = Coord(6, 6)
>>> bottom_left = Coord(5, 8)
>>> bottom_right = Coord(6, 8)

>>> b1 = Box(top_left, bottom_right)

>>> top_left in b1
True
>>> top_right in b1
True
```

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```
>>> bottom_left in b1
True
>>> bottom_right in b1
True

>>> Coord(7, 6) in b1
False

>>> (5, 7) in b1
True
```

You can determine if two boxes intersect each other, or are disjoints:

```
>>> b1 = Box(Coord(5, 6), Coord(6, 8))
>>> b2 = Box(Coord(6, 6), Coord(6, 7))
>>> b3 = Box(Coord(7, 6), Coord(7, 8))
>>> b2.intersect(b3)
False
>>> b1.isdisjoint(b2)
False
>>> b2.isdisjoint(b1)
False
>>> b1.isdisjoint(b3)
True
>>> b3.isdisjoint(b1)
True
```

class benker.box.**Box**(**args*)

Bases: `benker.box.BoxTuple`

A *Box* is a rectangular area defined by two coordinates:

- the top-left corner of the rectangle: the *min* coord,
- the bottom-right corner of the rectangle: the *max* coord.

Usage:

```
>>> from benker.box import Box

>>> box = Box(1, 1, 5, 3)
>>> box
Box(min=Coord(x=1, y=1), max=Coord(x=5, y=3))
```

property height

intersect(*that: benker.box.Box*) → bool

intersection(**others*)

Return the intersection of *self* and all the *boxes*.

Usage:

```
>>> from benker.box import Box
>>> from benker.coord import Coord
```

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```
>>> b1 = Box(Coord(3, 2), Coord(6, 4))
>>> b2 = Box(Coord(4, 3), Coord(5, 7))
>>> b1.intersection(b2)
Box(min=Coord(x=4, y=3), max=Coord(x=5, y=4))

>>> b1 & b2
Box(min=Coord(x=4, y=3), max=Coord(x=5, y=4))
```

Parameters `others` – collections of boxes

Returns The inner box of all the boxes.

Raises `ValueError` – if the two boxes are disjoint.

isdisjoint(*that: benker.box.Box*) → bool

move_to(*coord*)

resize(*size*)

property size

transform(*coord=None*, *size=None*)

union(**others*)

Return the union of *self* and all the *boxes*.

Usage:

```
>>> from benker.box import Box
>>> from benker.coord import Coord

>>> b1 = Box(Coord(3, 2), Coord(6, 4))
>>> b2 = Box(Coord(4, 3), Coord(5, 7))
>>> b1.union(b2)
Box(min=Coord(x=3, y=2), max=Coord(x=6, y=7))

>>> b1 | b2
Box(min=Coord(x=3, y=2), max=Coord(x=6, y=7))
```

Parameters `others` – collections of boxes

Returns The bounding box of all the boxes.

property width

class benker.box.**BoxTuple**(*min*, *max*)

Bases: `tuple`

max

Alias for field number 1

min

Alias for field number 0

4.3.4 Styled object

A *Styled* object contains a dictionary of styles.

It is mainly used for *Table*, *RowView*, *ColView*, and *Cell*.

class benker.styled.**Styled**(*styles*, *nature*)

Bases: `object`

Styled object, like Table, Row, Column, or Cell objects.

A styled object stores user-defined styles: a dictionary of key-value pairs. This values are useful to store some HTML-like styles (border-style, border-width, border-color, vertical-align, text-align, etc.). Of course, we are not tied to the HTML-like styles, you can use your own list of styles.

Note: The style dictionary is always copied: in other words, key-value pairs are copied but a shallow copy is done for the values (in general, it is not a problem if you use non-mutable values like `str`).

A styled object stores a nature: a way to distinguish the body cells, from the header and the footer. The default value is `None`, but you can use "body", "header", "footer" or whatever is suitable for your needs. This kind of information is in general not stored in the styles, even if it is similar.

Tables can also have a *nature*, similar to HTML `@class` attribute, you can use it do identify the styles to apply to your table.

Note: In a *Grid*, the *merging* of two natures is done by keeping the first nature and dropping the second one. In other words, the resulting nature is the group of the most top-left nature of the merged cells.

nature

Cell *nature* used to distinguish the body cells, from the header and the footer.

property styles

Dictionary of key-value pairs, where *keys* are the style names.

4.3.5 Grid Cell

A *Cell* object stores the *content* of a *Grid* cell.

A cell can have *styles*, a dictionary of key-value properties attached to the cell.

A cell has a *nature* to distinguish between header, body and footer cells. The default *nature* is `None`, but you can also use "body", "header", "footer" or whatever…

A cell has top-left coordinates: *x* and *y*. The default coordinates is (1, 1): this is the top-left coordinate of the cell box. The coordinates *x* and *y* cannot be null: grid coordinates are 1-indexed.

A cell has a size: *width* and *height*. The default size is (1, 1), you can increase them to represent horizontal or vertical spanning. The *width* and the *height* cannot be null.

To instantiate a *Cell*, you can do:

```
>>> c1 = Cell("c1")
>>> c2 = Cell("c2", styles={'color': 'red'})
>>> c3 = Cell("c3", nature="footer")
>>> c4 = Cell("c4", width=2)
>>> c5 = Cell("c5", height=2)
```

The string representation of a cell is the string representation of it's content:

```
>>> for cell in c1, c2, c3, c4, c5:
...     print(cell)
c1
c2
c3
c4
c5
```

On initialization, the cell min position is always (1, 1), a.k.a. the top-left.

```
>>> c1 = Cell("c1")
>>> c1.min
Coord(x=1, y=1)
>>> c1.size
Size(width=1, height=1)
>>> c1.box
Box(min=Coord(x=1, y=1), max=Coord(x=1, y=1))
```

A cell can be moved to another position:

```
>>> c1 = Cell("c1", width=3, height=2)
>>> c2 = c1.move_to(Coord(5, 3))
>>> c2.min
Coord(x=5, y=3)
>>> c2.size
Size(width=3, height=2)
>>> c2.box
Box(min=Coord(x=5, y=3), max=Coord(x=7, y=4))
```

You can check if a coord is inside the box:

```
>>> c1 = Cell("c1", width=3, height=2)
>>> c2 = c1.move_to(Coord(5, 3))
>>> (7, 4) in c2
True
>>> Coord(6, 3) in c2
True
>>> Box(6, 3, 7, 4) in c2
True
```

class `benker.cell.Cell`(*content*, *styles=None*, *nature=None*, *x=1*, *y=1*, *width=1*, *height=1*)

Bases: *benker.styled.Styled*

Cell of a grid.

Variables

- **content** – user-defined cell content. It can be of any type: `None`, `str`, `int`, `float`, a container (`list`), a XML element, etc. The same content can be shared by several cells, it's your own responsibility to handle the copy (or deep copy) of the *content* reference when needed.

Note: In a *Grid*, the *merging* of two cell contents is done with the "+" operator (`__add__()`). You can override this by using a *content_appender*, a two-arguments function

which will perform the concatenation of the two contents.

- **styles** – user-defined cell styles: a dictionary of key-value pairs. This values are useful to store some HTML-like styles (border-style, border-width, border-color, vertical-align, text-align, etc.). Of course, we are not tied to the HTML-like styles, you can use your own list of styles.

Note: The style dictionary is always copied: in other words, key-value pairs are copied but a shallow copy is done for the values (in general, it is not a problem if you use non-mutable values like `str`).

- **nature** – nature: a way to distinguish the body cells, from the header and the footer. The default value is `None`, but you can use "body", "header", "footer" or whatever is suitable for your needs.

Note: In a *Grid*, the *merging* of two natures is done by keeping the first nature and dropping the second one. In other words, the resulting nature is the group of the most top-left nature of the merged cells.

Changed in version 0.4.2: The default value of *nature* is `None` (instead of "body").

property box
Bounding box of the cell.

content

property height
Height of the cell – rows spanning.

property max
Maximum coordinates of the cell – bottom-right coordinates.

property min
Minimum coordinates of the cell – top-left coordinates.

move_to(*coord*)
Move the cell to the given coordinates.

See: *transform()*.

Parameters **coord** (*tuple[int, int] or* `benker.coord.Coord`) – new top-left coordinates of the cell, by default it is unchanged.

Return type *benker.cell.Cell*

Returns a copy of this cell after transformation.

resize(*size*)
Resize the cell to the given size.

See: *transform()*.

Parameters **size** (*tuple[int, int] or* `benker.size.Size`) – new size of the cell, by default it is unchanged.

Return type *benker.cell.Cell*

Returns a copy of this cell after transformation.

property size
Size of the cell – (*with*, *height*).

transform(*coord=None*, *size=None*)
Transform the bounding box of the cell by making a move and a resize.

Parameters

- **coord** (*tuple[int, int] or* benker.coord.Coord) – new top-left coordinates of the cell, by default it is unchanged.
- **size** (*tuple[int, int] or* benker.size.Size) – new size of the cell, by default it is unchanged.

Return type *benker.cell.Cell*

Returns a copy of this cell after transformation.

property width
Width of the cell – columns spanning.

benker.cell.**get_content_text**(*content*)
Try hard to extract a good string representation of the cell content.

```
>>> from benker.cell import get_content_text
```

```
>>> get_content_text(None) == ''
True
>>> get_content_text('') == ''
True
>>> print(get_content_text('Hi'))
Hi
>>> print(get_content_text(True))
True
>>> print(get_content_text(123))
123
>>> print(get_content_text(3.14))
3.14
>>> get_content_text([None, None]) == ''
True
>>> print(get_content_text(["hello", " ", "world!"]))
hello world!
```

Parameters **content** – Cell content.

Returns

the cell text:

- if the content is None: returns "",
- if the content is a string: return the string unchanged,
- if the content is a number: return the string representation of the number,
- if the content is a list of strings, return the concatenated strings (None is ignored),
- if the content is a list of XML nodes, return the concatenated strings of the elements (the processing-instruction and the comments are ignored),
- else: return a concatenation of the string representation of the content items.

New in version 0.4.1.

4.3.6 Grid

A grid of cells.

Example of grid:

```
.. doctest:: grid_demo
```

```
>>> from benker.grid import Grid
>>> from benker.cell import Cell
```

```
>>> grid = Grid()
>>> grid[1, 1] = Cell("red", height=2)
>>> grid[2, 1] = Cell("pink", width=2)
>>> grid[2, 2] = Cell("blue")
```

```
>>> print(grid)
+-----------+-----------------------+
|    red    |   pink                |
|           +-----------+-----------+
|           |   blue    |           |
+-----------+-----------+-----------+
```

You can retrieve the grid cells as follow:

```
>>> from benker.grid import Grid
>>> from benker.cell import Cell

>>> grid = Grid()
>>> grid[1, 1] = Cell("red", height=2)
>>> grid[2, 1] = Cell("pink", width=2)
>>> grid[2, 2] = Cell("blue")

>>> grid[1, 1]
<Cell('red', styles={}, nature=None, x=1, y=1, width=1, height=2)>
>>> grid[2, 1]
<Cell('pink', styles={}, nature=None, x=2, y=1, width=2, height=1)>
>>> grid[2, 2]
<Cell('blue', styles={}, nature=None, x=2, y=2, width=1, height=1)>
>>> grid[3, 3]
Traceback (most recent call last):
    ...
KeyError: Coord(x=3, y=3)
```

A grid has a bounding box, useful to get the grid sizes:

```
>>> from benker.grid import Grid
>>> from benker.cell import Cell

>>> grid = Grid()
>>> grid[1, 1] = Cell("red", height=2)
```

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```
>>> grid[2, 1] = Cell("pink", width=2)
>>> grid[2, 2] = Cell("blue")

>>> grid.bounding_box
Box(min=Coord(x=1, y=1), max=Coord(x=3, y=2))
>>> grid.bounding_box.size
Size(width=3, height=2)
```

You can expand the cell size horizontally or vertically:

```
>>> from benker.grid import Grid
>>> from benker.cell import Cell

>>> grid = Grid()
>>> grid[1, 1] = Cell("red", height=2)
>>> grid[2, 1] = Cell("pink", width=2)
>>> grid[2, 2] = Cell("blue")

>>> grid.expand((2, 2), width=1)
<Cell('blue', styles={}, nature=None, x=2, y=2, width=2, height=1)>
>>> print(grid)
+-----------+-----------------------+
|    red    |   pink                |
|           +-----------------------+
|           |   blue                |
+-----------+-----------------------+
```

The content of the merged cells is merged too:

```
>>> from benker.grid import Grid
>>> from benker.cell import Cell

>>> grid = Grid()
>>> grid[1, 1] = Cell("red", height=2)
>>> grid[2, 1] = Cell("pink", width=2)
>>> grid[2, 2] = Cell("blue", width=2)

>>> grid.merge((2, 1), (3, 2), content_appender=lambda a, b: "/".join([a, b]))
<Cell('pink/blue', styles={}, nature=None, x=2, y=1, width=2, height=2)>
>>> print(grid)
+-----------+-----------------------+
|    red    | pink/blue             |
|           |                       |
|           |                       |
+-----------+-----------------------+
```

class benker.grid.**Grid**(*cells=None*)

Bases: `collections.abc.MutableMapping`

Collection of *Cell* objects ordered in a grid of rows and columns.

property bounding_box

Bounding box of the grid (`None` if the grid is empty).

expand(*coord*, *width=0*, *height=0*, *content_appender=None*)

Expand (or shrink) the *width* and/or *height* of a cell, using the *content_appender* to append cell contents.

See also the method `merge()` to merge a group of cells contained in a bounding box.

Parameters

- **coord** – Coordinates of the cell to expand (or shrink).
- **width** – Number of columns to add to the cell width.
- **height** – Number of rows to add to the cell height.
- **content_appender** – Function to use to append the cell contents. The function must have the following signature: `f(a, b) -> c`, where *a*, *b* anc *c* must be of the same type than the cell content. If not provided, the default function is `operator.__add__()`.

Returns The merged cell.

Raises `ValueError` – If the group of cells is empty or if cells cannot be merged.

iter_rows()

Iterate the cells grouped by rows.

merge(*start*, *end*, *content_appender=None*)

Merge a group of cells contained in a bounding box, using the *content_appender* to append cell contents.

The coordinates *start* and *end* delimit a group of cells to merge.

> **Warning:** All the cells of the group must be included in the group bounding box, no intersection is allowed. If not, `ValueError` is raised.

See also the method `expand()` to expand (or shrink) the width and/or height of a cell.

Parameters

- **start** (`Coord` *or* `tuple[int, int]`) – Top-left coordinates of the group of cells to merge.
- **end** – Bottom-right coordinates of the group of cells to merge (inclusive).
- **content_appender** – Function to use to append the cell contents. The function must have the following signature: `f(a, b) -> c`, where *a*, *b* anc *c* must be of the same type than the cell content. If not provided, the default function is `operator.__add__()`.

Returns The merged cell.

Raises `ValueError` – If the group of cells is empty or if cells cannot be merged.

4.3.7 Table

Generic table structure which simplify the conversion from docx table format to CALS or HTML tables.

class benker.table.**ColView**(*table*, *pos*, *styles=None*, *nature=None*)

Bases: `benker.table.TableView`

A view on the table cells for a given column.

can_catch(*cell*)

Check if a cell can be caught by that view.

Parameters **cell** (`benker.cell.Cell`) – table cell

Returns True if the cell intercept to this view.

can_own(*cell*)
Check if a cell can be stored it that view.

Parameters **cell** (benker.cell.Cell) – table cell

Returns True if the cell belong to this view.

property col_pos
Column position in the table (1-based).

insert_cell(*content*, *styles=None*, *nature=None*, *width=1*, *height=1*)
Insert a new cell in the column at the next free position, or at the end.

Parameters

- **content** – User-defined cell content. It can be of any type: None, str, int, float, a container (list), a XML element, etc. The same content can be shared by several cells, it's your own responsibility to handle the copy (or deep copy) of the *content* reference when needed.
- **styles** (*typing.Dict[str, str]*) – User-defined cell styles: a dictionary of key-value pairs. This values are useful to store some HTML-like styles (border-style, border-width, border-color, vertical-align, text-align, etc.). Of course, we are not tied to the HTML-like styles, you can use your own list of styles.
- **width** (*int*) – Width of the cell (columns spanning), default to 1.
- **height** (*int*) – Height of the cell (rows spanning), default to 1.

Variables **nature** – a way to distinguish the body cells, from the header and the footer. The default value is None, but you can use "body", "header", "footer" or whatever is suitable for your needs. If set to None, the cell nature is inherited from the column nature.

Changed in version 0.4.2: The *nature* of a cell is inherited from its parent's column.

class benker.table.**RowView**(*table*, *pos*, *styles=None*, *nature=None*)
Bases: *benker.table.TableView*

A view on the table cells for a given row.

can_catch(*cell*)
Check if a cell can be caught by that view.

Parameters **cell** (benker.cell.Cell) – table cell

Returns True if the cell intercept to this view.

can_own(*cell*)
Check if a cell can be stored it that view.

Parameters **cell** (benker.cell.Cell) – table cell

Returns True if the cell belong to this view.

insert_cell(*content*, *styles=None*, *nature=None*, *width=1*, *height=1*)
Insert a new cell in the row at the next free position, or at the end.

Parameters

- **content** – User-defined cell content. It can be of any type: None, str, int, float, a container (list), a XML element, etc. The same content can be shared by several cells, it's your own responsibility to handle the copy (or deep copy) of the *content* reference when needed.

- **styles** (*typing.Dict[str, str]*) – User-defined cell styles: a dictionary of key-value pairs. This values are useful to store some HTML-like styles (border-style, border-width, border-color, vertical-align, text-align, etc.). Of course, we are not tied to the HTML-like styles, you can use your own list of styles.
- **width** (*int*) – Width of the cell (columns spanning), default to 1.
- **height** (*int*) – Height of the cell (rows spanning), default to 1.

Variables nature – a way to distinguish the body cells, from the header and the footer. The default value is `None`, but you can use "body", "header", "footer" or whatever is suitable for your needs. If set to `None`, the cell nature is inherited from the row nature.

Changed in version 0.4.2: The *nature* of a cell is inherited from its parent's row.

property row_pos
Row position in the table (1-based).

class benker.table.Table(*cells=None*, *styles=None*, *nature=None*)
Bases: `benker.styled.Styled`, `collections.abc.MutableMapping`

Table data structure used to simplify conversion to CALS or HTML.

Short demonstration:

```
>>> from benker.cell import Cell
>>> from benker.table import Table

>>> table = Table(styles={'frame': 'all'})

>>> table[(1, 1)] = Cell("one")
>>> table.rows[1].insert_cell("two")

>>> table[(2, 1)]
<Cell('two', styles={}, nature=None, x=2, y=1, width=1, height=1)>

>>> table.cols[1].insert_cell("alpha")
>>> table.cols[2].insert_cell("beta")
>>> (1, 2) in table
True

>>> del table[(1, 2)]
>>> (1, 2) in table
False

>>> len(table)
3

>>> for cell in table:
...     print(cell)
one
two
beta

>>> for row in table.rows:
...     print(row)
[one, two]
```

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```
[beta]

>>> table.merge((1, 2), (2, 2))
>>> print(table)
+-----------+-----------+
|    one    |    two    |
+-----------------------+
|   beta                |
+-----------------------+

>>> table.expand((1, 1), width=3)
>>> print(table)
+-----------------------------------------------+
|              onetwo                           |
+-----------------------+-----------+-----------+
|   beta                |           |           |
+-----------------------+-----------+-----------+
```

Variables

- **styles** – User-defined table styles: a dictionary of key-value pairs. This values are useful to store some HTML-like styles (border-style, border-width, border-color, vertical-align, text-align, etc.). Of course, we are not tied to the HTML-like styles, you can use your own list of styles.

  Note: The style dictionary is always copied: in other words, key-value pairs are copied but a shallow copy is done for the values (in general, it is not a problem if you use non-mutable values like `str`).

- **nature** – A table can have a nature: a way to distinguish the body cells, from the header and the footer. The default value is `None`, but you can use "body", "header", "footer" or whatever is suitable for your needs. This kind of information is in general not stored in the styles, even if it is similar.

  Note: In a `Grid`, the *merging* of two natures is done by keeping the first nature and dropping the second one. In other words, the resulting nature is the group of the most top-left nature of the merged cells.

property bounding_box

Bounding box of the table (`None` if the table is empty).

Return type *benker.box.Box*

Returns The bounding box.

cols

List of views of type `ColView`

expand(*coord*, *width=0*, *height=0*, *content_appender=None*)

merge(*start*, *end*, *content_appender=None*)

nature
Cell *nature* used to distinguish the body cells, from the header and the footer.

rows
List of views of type `RowView`

class benker.table.**TableView**(*table*, *pos*, *styles=None*, *nature=None*)
Bases: `benker.styled.Styled`

Base class of `RowView` and `ColView` used to create a view on the table cells for a given row or column.

See also: `TableViewList`

adopt_cell(*cell*)
Event handler called by the system when a cell is about to be inserted in the table.

can_catch(*cell*)
Check if a cell can be caught by that view.

Parameters **cell** (`benker.cell.Cell`) – table cell

Returns `True` if the cell intercept to this view.

can_own(*cell*)
Check if a cell can be stored it that view.

Parameters **cell** (`benker.cell.Cell`) – table cell

Returns `True` if the cell belong to this view.

property caught_cells
List of cells caught (intercepted) by this view.

property owned_cells
List of cells owned by this view.

property table
Non-mutable reference to the table (instance of `Table`).

class benker.table.**TableViewList**(*table*, *view_cls*)
Bases: `object`

This class defined a (simplified) list of views.

Short demonstration:

```
>>> from benker.cell import Cell
>>> from benker.table import Table
>>> from benker.table import ColView
>>> from benker.table import RowView
>>> from benker.table import TableViewList

>>> red = Cell('red', x=1, y=1, height=2)
>>> pink = Cell('pink', x=2, y=1, width=2)
>>> blue = Cell('blue', x=2, y=2)
>>> table = Table([red, pink, blue])
>>> print(table)
+-----------+-----------------------+
|    red    |   pink                |
|           +-----------+-----------+
|           |   blue    |           |
+-----------+-----------+-----------+
```

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```
>>> cols = TableViewList(table, ColView)
>>> len(cols)
3
>>> rows = TableViewList(table, RowView)
>>> len(rows)
2

>>> for pos, col in enumerate(cols, 1):
...     print("col #{pos}: {col}".format(pos=pos, col=str(col)))
col #1: [red]
col #2: [pink, blue]
col #3: []

>>> cols[3].insert_cell("yellow")
>>> print(table)
+-----------+-----------------------+
|    red    |   pink                |
|           +-----------+-----------+
|           |   blue    |  yellow   |
+-----------+-----------+-----------+
```

adopt_cell(*cell*)
Adopt a new cell in the views.

Parameters **cell** (`benker.cell.Cell`) – New cell to adopt

refresh_all()
Cleanup and refresh all the views, taking into account the cells which are in the table grid.

class benker.table.**ViewsProperty**(*view_cls*)
Bases: `object`

Descriptor used to define the rows/cols properties in the class `Table`.

4.3.8 Available Parsers

This package contains a collection of parsers which you can use in conjonction with builders to convert tables from one format to another.

You can pick a builder in the *Available Builders*.

4.3.9 Base Parser

Base class of parsers.

class benker.parsers.base_parser.**BaseParser**(*builder*, *encoding='utf-8'*, ***options*)
Bases: `object`

Abstract base class of the parsers classes.

parse_file(*src_xml*, *dst_xml*)
Parse and convert the tables from one format to another.

Parameters

- **src_xml** (*str*) – Source path of the XML file to convert.
- **dst_xml** (*str*) – Destination path of the XML file to produce.

transform_tables(*tree*)

benker.parsers.base_parser.**value_of**(*element*, *xpath*, *namespaces=None*, *default=None*)
Take the first value of a xpath evaluation.

Parameters

- **element** (*etree._Element*) – Root element used to evaluate the xpath expression.
- **xpath** (*str*) – xpath expression. This expression will be evaluated using the *namespaces* namespaces.
- **namespaces** (*dict[str, str]*) – Namespace map to use for the xpath evaluation.
- **default** – default value used if the xpath evaluation returns no result.

Returns the first result or the *default* value.

4.3.10 Office Open XML parser

This module can parse Office Open XML (OOXML) tables.

Specifications:

- The documentation about OOXML Table is available online at Word Processing - Table Grid/Column Definition.

benker.parsers.ooxml.**NS = {'w': 'http://schemas.openxmlformats.org/wordprocessingml/2006/main'}**
Namespace map used for xpath evaluation in Office Open XML documents

class benker.parsers.ooxml.**OoxmlParser**(*builder*, *styles_path=None*, ***options*)
Bases: *benker.parsers.base_parser.BaseParser*

Office Open XML parser.

parse_grid_col(*w_grid_col*)
Parse a <w:gridCol> element.

See: Table Grid/Column Definition.

Parameters **w_grid_col** (*etree._Element*) – Table element.

parse_table(*w_tbl*)
Convert a Office Open XML <w:tbl> into CALS <table>

Parameters **w_tbl** (*etree._Element*) – Office Open XML element.

Return type etree._Element

Returns CALS element.

parse_tbl(*w_tbl*)
Parse a <w:tbl> element.

See: Table Properties.

Parameters **w_tbl** (*etree._Element*) – Table element.

Changed in version 0.4.0: The section width and height are now stored in the 'x-sect-size' table style (units in 'pt').

parse_tc(*w_tc*)
Parse a <w:tc> element.

See: Table Cell Properties.

Parameters **w_tc** (*etree._Element*) – Table element.

Changed in version 0.4.4: Improved empty cells detection for Formex4 conversion (<IE/> tag management).

parse_tr(*w_tr*)
Parse a <w:tr> element.

See: Table Row Properties.

Parameters **w_tr** (*etree._Element*) – Table element.

transform_tables(*tree*)

benker.parsers.ooxml.**ns_name**(*ns*, *name*)

benker.parsers.ooxml.**w**(*name*)

4.3.11 lxml Iterators

Python alternative to `lxml.etree.iterwalk` for lxml < 4.2.1

4.3.12 Available Builders

This package contains a collection of builders which you can use in conjonction with parsers to convert tables from one format to another.

You can pick a parser in the *Available Parsers*.

4.3.13 Base Builder

Base class of Builders.

class benker.builders.base_builder.**BaseBuilder**(***options*)
Bases: `object`

Base class of Builders.

finalize_tree(*tree*)
Give the opportunity to finalize the resulting tree structure.

Parameters **tree** (*etree._ElementTree*) – The resulting tree.

New in version 0.4.0.

generate_table_tree(*table*)
Build the XML table from the Table instance.

Parameters **table** (`benker.table.Table`) – Table

Returns Table tree

4.3.14 CALS Builder

This module can construct a CALS table from an instance of type *Table*.

Specifications and examples:

- The CALS DTD is available online in the OASIS web site: CALS Table Model Document Type Definition.
- An example of CALS table is available in Wikipedia: CALS Table Model

class benker.builders.cals.**CalsBuilder**(*width_unit='mm'*, *table_in_tgroup=False*, ***options*)

Bases: *benker.builders.base_builder.BaseBuilder*

CALS table builder.

build_cell(*row_elem*, *cell*)

Build the CALS <entry> element.

CALS attributes:

- @colsep is built from the "border-right" style. Default value is "1" (displayed), so, it is better to always define it. This value is only set if different from the table @colsep value.
- @rowsep is built from the "border-bottom" style. Default value is "1" (displayed), so, it is better to always define it. This value is only set if different from the table @rowsep value.
- @valign is built from the "valign" style. Values can be "top", "middle", "bottom" (note: "baseline" is not supported). Default value is "bottom".
- @align is built from the "align" style. Values can be "left", "center", "right", or "justify". Default value is "left". note: paragraphs alignment should be preferred to cells alignment.
- @namest/@nameend are set when the cell is spanned horizontally.
- @morerows is set when the cell is spanned vertically.

Parameters

- **row_elem** (*etree._Element*) – Parent element: <row>.
- **cell** (benker.cell.Cell) – The cell.

build_colspec(*group_elem*, *col*)

Build the CALS <colspec> element.

CALS attributes:

- @colname is the column name. Its format is "c{col_pos}".
- @colwidth width of the column (with its unit). The unit is defined by the *width_unit* options.

Note: The @colnum attribute (number of column) is not generated because this value is usually implied, and can be deduce from the @colname attribute.

Parameters

- **group_elem** (*etree._Element*) – Parent element: <tgroup>.
- **col** (benker.table.ColView) – Columns

build_row(*tbody_elem*, *row*)

Build the CALS <row> element.

CALS attributes:

- `@valign` is built from the "valign" style. Values can be "top", "middle", "bottom" (note: "baseline" is not supported). Default value is "bottom".

Note: A row can be marked as inserted if "x-ins" is defined in the row styles. Revision marks are inserted before and after a <row> using a couple of processing-instructions. We use the <?change-start?> PI to mark the start of the inserted row, and the <?change-end?> PI to mark the end.

Parameters

- **tbody_elem** (*etree._Element*) – Parent element: <tbody>, *<thead>*`, or *<tfoot>*`.
- **row** (benker.table.RowView) – The row.

build_table(*table*)

Build the CALS <table> element.

CALS attributes:

- `@colsep` is built from the "x-cell-border-right" style. Default value is "0" (not displayed).
- `@rowsep` is built from the "x-cell-border-bottom" style. Default value is "0" (not displayed).
- `@tabstyle` is built from the table nature.
- `@orient` is built from the "x-sect-orient" style (orientation of the current section). Possible values are "port" (portrait, the default) or "land" (landscape).
- `@pgwide` is built from the "x-sect-cols" style (column number of the current section). Default value is "0" (width of the current column).

Note: `@colsep`, `@rowsep` and `@tabstyle` attributes are generated only if the *table_in_tgroup* options is `False`.

Attention: According to the CALS specification, the default value for `@colsep` and `@rowsep` should be "1". But, having this value as a default is really problematic for conversions: most of nowadays formats, like Office Open XML and CSS, consider that the default value is "no border" (a.k.a: `border: none`). So, setting "0" as a default value is a better choice.

Parameters **table** (benker.table.Table) – Table

Returns The newly-created <table> element.

build_tbody(*group_elem*, *row_list*, *nature_tag*)

Build the CALS <tbody>, *<thead>*`, or *<tfoot>*` element.

Parameters

- **group_elem** (*etree._Element*) – Parent element: <tgroup>.
- **row_list** – List of rows
- **nature_tag** – name of the tag: 'tbody', 'thead' or 'tfoot'.

build_tgroup(*table_elem*, *table*)

Build the CALS <tgroup> element.

CALS attributes:

- `@cols` is the total number of columns.
- `@colsep` is built from the "x-cell-border-right" style. Default value is "0" (not displayed).
- `@rowsep` is built from the "x-cell-border-bottom" style. Default value is "0" (not displayed).
- `@tgroupstyle` is built from the table nature.

Note: `@colsep`, `@rowsep` and `@tgroupstyle` attributes are generated only if the *table_in_tgroup* options is `True`.

Parameters

- **table_elem** (*etree._Element*) – Parent element: <table>.
- **table** (benker.table.Table) – Table

Returns The newly-created <tgroup> element.

generate_table_tree(*table*)

Build the XML table from the Table instance.

Parameters **table** (benker.table.Table) – Table

Returns Table tree

benker.builders.cals.**revision_mark**(*name*, *attrs*)

4.3.15 Formex4 Builder

This module can construct a Formex4 table from an instance of type *Table*.

FORMEX describes the format for the exchange of data between the Publication Office and its contractors. In particular, it defines the logical markup for documents which are published in the different series of the Official Journal of the European Union.

This builder allow you to convert Word document tables into Formex4 tables using the Formex4 schema (formex-05.59-20170418.xd).

Specifications and examples:

- The Formex4 documentation and schema is available online in the Publication Office: Formex Version 4.
- An example of Formex4 table is available in the Schema documentation: TBL

class benker.builders.formex4.**Formex4Builder**(*detect_titles=False*, ***options*)

Bases: *benker.builders.base_builder.BaseBuilder*

Formex4 builder used to convert tables into `TBL` elements according to the TBL Schema

build_cell(*row_elem*, *cell*, *row*)

Build the Formex4 <CELL> element.

Formex4 attributes:

- `@COL` The mandatory COL attribute is used to specify in which column the cell is located.

- `@COLSPAN` When a cell in a row 'A' must be linked to a group of cells in the same row, the first CELL element of this group has to provide the COLSPAN attribute. The value of the COLSPAN attribute is the number of cells in the group. The COL attribute of the first cell indicates the number of the first column in the group.

  The use of the COLSPAN attribute is only allowed to relate the value of a cell in several columns within the same row. Its value must be at least equal to '2'.

- `@ROWSPAN` When a cell in column 'A' is linked to a cell in row 'B' located just below row 'A', the CELL element of this single cell must provide the ROWSPAN attribute. The value of the ROWSPAN attribute is equal to the number of cells in the group. The CELL element relating to the single cell must be placed within the first ROW element in the group. The ROW elements corresponding to the other rows in the group may not contain any CELL elements for the column containing the single cell 'A'.

  The use of the ROWSPAN attribute is only authorised to relate the value of a cell in several rows. Its value must be at least equal to '2'.

- `@ACCH` If the group of related cells is physically delimited by a horizontal brace, this symbol must be marked up using the ACCH attribute.
- `@ACCV` If the group of related cells is physically delimited by a vertical brace, this symbol must be marked up using the ACCV attribute.
- `@TYPE` The TYPE attribute of the CELL element is used to indicate locally the type of contents of the cells. It overrides the value of the TYPE attribute defined for the row (ROW) which contains the cell.

  Parameters

  - **row_elem** (*etree._Element*) – Parent element: <ROW>.
  - **cell** (benker.cell.Cell) – The cell.
  - **row** (benker.table.RowView) – The parent row.

Changed in version 0.4.4: Modification of the Formex4 builder to better deal with empty cells (management of <IE/> tags).

build_corpus(*tbl_elem*, *table*)

Build the Formex4 <CORPUS> element.

Parameters

- **tbl_elem** (*etree._Element*) – Parent element: <TBL>.
- **table** (benker.table.Table) – Table

Changed in version 0.4.3: If this option *detect_titles* is enable, a title will be generated if the first row contains an unique cell with centered text.

build_row(*corpus_elem*, *row*)

Build the Formex4 <ROW> element.

Formex4 attributes:

- `@TYPE` The TYPE attribute indicates the specific role of the row in the table. The allowed values are:
  - ALIAS: if the row contains aliases. Such references may be used when the table is included on several pages of a publication. The references are associated to column headers on the first page and are repeated on subsequent pages.
  - HEADER: if the row contains cells which may be considered as a column header. This generally occurs for the first row of a table.

- NORMAL: if most of the cells of the row contain 'simple' or 'normal' data. This is the default value.
- NOTCOL: if the cells of the row contain units of measure relating to subsequent rows.
- TOTAL: if the row contains data which could be considered as 'totals'.

Note that this TYPE attribute is also provided for the cells (CELL), which could be used to override the value defined for the row. On the other hand, 'NORMAL' is the default value, so it is necessary to specify the TYPE attribute value in each cell of a row which has a specific type in order to avoid the default overriding (see the first row of the example below).

Parameters

- **corpus_elem** (*etree._Element*) – Parent element: `<CORPUS>`.
- **row** (`benker.table.RowView`) – The row.

build_tbl(*table*)

Build the Formex4 `<TBL>` element.

Formex4 attributes:

- `@NO.SEQ` This mandatory attribute provides a sequence number to the table. This number represents the order in which the table appears in the document.
- `@CLASS` The CLASS attribute is mandatory and is used to specify the type of data contained in the table. The allowed values are:
  - GEN: if the table contains general data (default value),
  - SCHEDULE: if it is a schedule,
  - RECAP: if it is a synoptic table.

  These two last values are only used for documents related to the general budget.
- `@COLS` This mandatory attribute provides the actual number of columns of the table.
- `@PAGE.SIZE` The PAGE.SIZE attribute takes one of these values:
  - DOUBLE.LANDSCAPE: table on two A4 pages forming an A3 landscape page,
  - DOUBLE.PORTRAIT: table on two A4 pages forming an A3 portrait page,
  - SINGLE.LANDSCAPE: table on a single A4 page in landscape,
  - SINGLE.PORTRAIT: table on a single A4 page in portrait (default).

Parameters **table** (`benker.table.Table`) – Table

Returns The newly-created `<TBL>` element.

build_title(*tbl_elem*, *row*)

Build the table title using the `<TITLE>` element.

For instance:

```
<TITLE>
  <TI>
    <P>Table IV</P>
  </TI>
</TITLE>
```

Parameters

- **tbl_elem** (*etree._Element*) – Parent element: <TBL>.
- **row** (benker.table.RowView) – The row which contains the title.

Changed in version 0.4.4: Modification of the Formex4 builder to better deal with empty cells (management of <IE/> tags).

finalize_tree(*tree*)
Finalize the resulting tree structure: calculate the @NO.SEQ values: sequence number of each table.

Parameters **tree** (*etree._ElementTree*) – The resulting tree.

generate_table_tree(*table*)
Build the XML table from the Table instance.

Parameters **table** (benker.table.Table) – Table

Returns Table tree

benker.builders.formex4.**revision_mark**(*name*, *attrs*)

4.3.16 Available Converters

This package contains a collection of converters which you can use to convert tables from one format to another.

To do that, you need to select a **parser** and a **builder**:

- You can pick a parser in the *Available Parsers*.
- You can pick a builder in the *Available Builders*.

4.3.17 Base Converter

Bas class of all converters.

class benker.converters.base_converter.**BaseConverter**
Bases: object

Bas class of all converters.

builder_cls
alias of *benker.builders.base_builder.BaseBuilder*

convert_file(*src_xml*, *dst_xml*, ***options*)
Convert the tables from one format to another.

Parameters

- **src_xml** (*str*) – Source path of the XML file to convert.
- **dst_xml** (*str*) – Destination path of the XML file to produce.
- **options** – Dictionary of parsing/building options.

  Common parsing options:

  encoding (default: "utf-8"): XML encoding of the destination file.

  OOXML parser options:

  styles_path (default: None): Path to the stylesheet to use to resole table styles. In an uncompressed .docx tree structure, the stylesheet path is word/styles.xml.

Common builder options: *(none)*

CALS builder options:

`width_unit` (default: "mm"): Unit to use for column widths. Possible values are: 'cm', 'dm', 'ft', 'in', 'm', 'mm', 'pc', 'pt', 'px'.

`table_in_tgroup` (default: `False`): Where should we put the table properties:

- `False` to insert the attributes `@colsep`, `@rowsep`, and `@tabstyle` in the `<table>` element,
- `True` to insert the attributes `@colsep`, `@rowsep`, and `@tgroupstyle` in the `<tgroup>` element.

Formex4 builder options: *(none)*

`parser_cls`
alias of *`benker.parsers.base_parser.BaseParser`*

4.3.18 Office Open XML to CALS converter

class `benker.converters.ooxml2cals.`**`Ooxml2CalsConverter`**
Bases: *`benker.converters.base_converter.BaseConverter`*

Office Open XML to CALS converter

`builder_cls`
alias of *`benker.builders.cals.CalsBuilder`*

`parser_cls`
alias of *`benker.parsers.ooxml.OoxmlParser`*

`benker.converters.ooxml2cals.`**`convert_ooxml2cals`**(*src_xml*, *dst_xml*, ***options*)
Convert Office Open XML (OOXML) tables to CALS tables.

Parameters

- **`src_xml`** (*`str`*) – Source path of the XML file to convert.

  This must be an XML file, for instance, if you want to convert a Word document (`.docx`), you first need to unzip the `.docx` file, and then, run this function on the file `word/document.xml`. You can also use the *styles_path* option to parse and use the table styles defined in the file `word/styles.xml`.
- **`dst_xml`** (*`str`*) – Destination path of the XML file to produce.
- **`options`** – Extra conversion options. See *`convert_file()`* to have a list of all possible options.

4.3.19 Office Open XML to Formex4 converter

class `benker.converters.ooxml2formex4.`**`Ooxml2Formex4Converter`**
Bases: *`benker.converters.base_converter.BaseConverter`*

Office Open XML to Formex4 converter

`builder_cls`
alias of *`benker.builders.formex4.Formex4Builder`*

parser_cls
alias of *benker.parsers.ooxml.OoxmlParser*

benker.converters.ooxml2formex4.**convert_ooxml2formex4**(*src_xml*, *dst_xml*, ***options*)
Convert Office Open XML (OOXML) tables to Formex4 tables.

Parameters

- **src_xml** (*str*) – Source path of the XML file to convert.

  This must be an XML file, for instance, if you want to convert a Word document (`.docx`), you first need to unzip the `.docx` file, and then, run this function on the file `word/document.xml`. You can also use the *styles_path* option to parse and use the table styles defined in the file `word/styles.xml`.
- **dst_xml** (*str*) – Destination path of the XML file to produce.
- **options** – Extra conversion options. See *convert_file()* to have a list of all possible options.

4.3.20 Alphabet

Utility functions to convert integer into a base-26 "number", and vis versa.

benker.alphabet.**alphabet_to_int**(*letters*, *alphabet='ABCDEFGHIJKLMNOPQRSTUVWXYZ'*)
Convert a base-26 "number" using uppercase ASCII letters into an integer.

```
>>> from benker.alphabet import alphabet_to_int

>>> alphabet_to_int("A")
1
>>> alphabet_to_int("B")
2
>>> alphabet_to_int("AA")
27
>>> alphabet_to_int("AB")
28
>>> alphabet_to_int("ZZZ")
18278
>>> alphabet_to_int("")
0
>>> alphabet_to_int("AA@")
Traceback (most recent call last):
    ...
ValueError: AA@
```

Parameters

- **letters** – string representing a "number" in the base-26.
- **alphabet** – alphabet to use for the conversion.

Returns Integer value of the "number".

benker.alphabet.**int_to_alphabet**(*value*, *alphabet='ABCDEFGHIJKLMNOPQRSTUVWXYZ'*)
Convert a non-nul integer into a base-26 "number" using uppercase ASCII letters.

Usage:

```
>>> from benker.alphabet import int_to_alphabet

>>> int_to_alphabet(1)
'A'
>>> int_to_alphabet(2)
'B'
>>> int_to_alphabet(26)
'Z'
>>> int_to_alphabet(27)
'AA'
>>> int_to_alphabet(28)
'AB'
>>> int_to_alphabet(52)
'AZ'
>>> int_to_alphabet(53)
'BA'
>>> int_to_alphabet(18278)
'ZZZ'
>>> int_to_alphabet(-5)
Traceback (most recent call last):
    ...
ValueError: -5
```

Parameters

- **value** (*int*) – value to convert
- **alphabet** – alphabet to use for the conversion.

Returns string representing this "number" in the base-26.

4.3.21 Drawing

Utility functions used to draw a *Grid*.

`benker.drawing.TILES = {(False, False, False, False): '   \n XXXXXXXXX \n', (False, False, False, True): '   \n XXXXXXXXX \n------------\n', (False, False, True, False): ' |\n XXXXXXXXX |\n', (False, False, True, True): ' |\n XXXXXXXXX |\n------------+\n', (False, True, False, False): '------------\n XXXXXXXXX \n', (False, True, False, True): '------------\n XXXXXXXXX \n------------\n', (False, True, True, False): '------------+\n XXXXXXXXX |\n', (False, True, True, True): '------------+\n XXXXXXXXX |\n------------+\n', (True, False, False, False): '| \n| XXXXXXXXX \n', (True, False, False, True): '| \n| XXXXXXXXX \n+-----------\n', (True, False, True, False): '| |\n| XXXXXXXXX |\n', (True, False, True, True): '| |\n| XXXXXXXXX |\n+-----------+\n', (True, True, False, False): '+-----------\n| XXXXXXXXX \n', (True, True, False, True): '+-----------\n| XXXXXXXXX \n+-----------\n', (True, True, True, False): '+-----------+\n| XXXXXXXXX |\n', (True, True, True, True): '+-----------+\n| XXXXXXXXX |\n+-----------+\n'}`

Default tiles used to draw a *Grid*.

Keys are tuples (*left*, *top*, *right*, *bottom*) : which represent the presence (if `True`) or absence (if `False`) : of the border. Values are the string representation of the tiles, "XXXXXXXXX" will be replaced by the cell content.

`benker.drawing.`**`draw`**`(`*grid*, *tiles=None*`)`

Draw a grid using a collection of tiles.

Parameters

- **grid** (benker.grid.Grid) – Grid to draw.
- **tiles** – Collection of tiles, use *TILES* if not provided.

Returns String representation of the grid.

benker.drawing.**iter_lines**(*grid*, *tiles=None*)

benker.drawing.**iter_tiles**(*grid*, *tiles=None*)

4.3.22 Units

Utility functions to convert values from one unit to another.

benker.units.**UNITS = {'cm': 0.01, 'dm': 0.1, 'ft': 0.3048, 'in': 0.0254, 'm': 1.0, 'mm': 0.001, 'pc': 0.0021166666666666664, 'pt': 0.00035277777777777776, 'px': 0.00035277777777777776}**

Usual units Lengths in meter

benker.units.**convert_value**(*value*, *unit_in*, *unit_out*)

Convert a value from one unit to another.

To convert '1pt' to 'mm', you can do:

```
>>> from benker.units import convert_value

>>> convert_value(1, 'pt', 'mm')
0.353
```

Parameters

- **value** (*int or float*) – Value to convert
- **unit_in** – Current unit of the value.
- **unit_out** – Expected unit of the value.

Return type float

Returns The converted value

4.4 Changelog

All notable changes to this project will be documented in this file.

The format is based on Keep a Changelog and this project adheres to Semantic Versioning.

4.4.1 v0.4.5 (unreleased)

Bug fix release

Fixed

Other

Change in the documentation: fix a broken and redirected links in the documentation.

4.4.2 v0.4.4 (2021-11-10)

Bug fix release

Fixed

Fix #13: ooxml2formex4 conversion – Loss of image calls in table conversion.

- Modification of the OOXML parser to improve empty cells detection for Formex4 conversion (`<IE/>` tags management).
- Modification of the Formex4 builder to better deal with empty cells (management of `<IE/>` tags).

4.4.3 v0.4.3 (2019-10-15)

Bug fix release

Fixed

Fix #5: The title generation should be optional.

- Change in the `Formex4Builder` class: Add the *detect_titles* option: if this option is enable, a title will be generated if the first row contains an unique cell with centered text. The *detect_titles* options is disable by default.

Other

Change in the documentation: update the URL of the Formex documentation, use: https://op.europa.eu/en/web/eu-vocabularies/formex/.

4.4.4 v0.4.2 (2019-06-06)

Bug fix release

Fixed

Fix #1: Cell nature should inherit row nature by default.

- Change in the class *Styled*: The default value of the *nature* parameter is None (instead of "body").
- Change in the methods *insert_cell()* and *insert_cell()* The *nature* of a cell is inherited from its parent's row (or column).

Other

- Change the requirements for Sphinx: add 'requests[security]' for Python 2.7.
- Fix an issue with the AppVeyor build: change the Tox configuration: set `py27,py34,py35: pip >= 9.0.3`.

4.4.5 v0.4.1 (2019-04-24)

Bug fix release

Fixed

- Change in the parser *OoxmlParser*: fix the 'x-sect-cols' value extraction when the `w:sectPr` is missing (use "1" by default).
- Fix the Formex4 builder *Formex4Builder*: Generate a `<IE/>` element if the cell content (the string representation) is empty.

4.4.6 v0.4.0 (2019-04-23)

Feature release

Added

- New converter: *convert_ooxml2formex4()*: Convert Office Open XML (OOXML) tables to Formex4 tables.
- New builder: *Formex4Builder*: Formex4 builder used to convert tables into `TBL` elements.
- Change in the parser *OoxmlParser*:
  - The section width and height are now stored in the 'x-sect-size' table style (units in 'pt').
- Change in the builder *BaseBuilder*: Add the method *finalize_tree()*: Give the opportunity to finalize the resulting tree structure.

4.4.7 v0.3.0 (2019-02-16)

Feature release

Added

- Change in the parser *OoxmlParser*:
  - Parse cell `w:tcPr/w:vAlign` values.
  - Parse paragraph alignments to calculate cell horizontal alignments.
  - Parse cell `w:tcPr/w:tcBorders` values to extract border styles.
- Change in the builder *benker.builders.cals.CalsBuilder*:
  - Generate `entry/@valign` attributes.
  - Generate `entry/@align` attributes.
  - Generate `entry/@colsep` and `entry/@rowsep` attributes.

Changed

- Change in the parser *OoxmlParser*:
  - Add more supported border styles

4.4.8 v0.2.2 (2018-12-15)

Bug fix release

Added

- Add a Python alternative to `lxml.etree.iterwalk` if using lxml < 4.2.1. See lxml changelog v4.2.1.

Fixed

- Fix the implementation of *parse_table()*: use a new implementation of `lxml.etree.iterwalk` if using lxml < 4.2.1.

Other

- Change Tox configuration file to test the library with lxml v3 and v4.
- Add a changelog in the documentation.

4.4.9 v0.2.1 (2018-11-27)

Fixed

- Fix Coverage configuration file.
- Fix and improve configuration for Tox.
- Fix docstring in *ooxml2cals*.
- Fix calculation of the `@frame` attribute in the method *benker.builders.cals.CalsBuilder.build_table()*.

Other

- Change link to PyPi project to "https://pypi.org/project/Benker/".
- Add the README to the documentation.
- Add configuration files for TravisCI and AppVeyor.

4.4.10 v0.2.0 (2018-11-26)

Changed

- Update project configuration
- Add missing `__init__.py` file in `tests` directory: it is required for test modules import.

Fixed

- Fix unit tests (Python 2.7).
- Fix flakes8 problems.
- Fix implementation of the *Grid* class for Python 2.7 (remove annotation). And minor fixes.
- Remove pipenv configuration files.
- Fix project configuration.

4.4.11 v0.1.0 (2018-11-26)

- First version of Benker.

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