PyMuPDF Documentation

Release 1.13.13

Jorj X. McKie

Jul 10, 2018

CONTENTS

CHAPTER

ONE

INTRODUCTION

PyMuPDF is a Python binding for MuPDF - "a lightweight PDF and XPS viewer".

MuPDF can access files in PDF, XPS, OpenXPS, CBZ (comic book archive), FB2 and EPUB (e-book) formats.

These are files with extensions `*.pdf`, `*.xps`, `*.oxps`, `*.cbz`, `*.fb2` or `*.epub` (so in essence, with this binding you can develop **e-book viewers in Python** ...).

PyMuPDF provides access to many important functions of MuPDF from within a Python environment, and we are continuously seeking to expand this function set.

MuPDF stands out among all similar products for its top rendering capability and unsurpassed processing speed. At the same time, its "light weight" makes it an excellent choice for platforms where resources are typically limited, like smartphones.

Check this out yourself and compare the various free PDF-viewers. In terms of speed and rendering quality SumatraPDF ranges at the top (apart from MuPDF's own standalone viewer) - since it has changed its library basis to MuPDF!

While PyMuPDF has been available since several years for an earlier version of MuPDF (v1.2, called **fitz-python** then), it was until only mid May 2015, that its creator and a few co-workers decided to elevate it to support current releases of MuPDF (first v1.7a, up to v1.12.0 as of this writing).

PyMuPDF runs and has been tested on Mac, Linux, Windows XP SP2 and up, Python 2.7 through Python 3.7 (note that Python supports Windows XP only up to v3.4), 32bit and 64bit versions. Other platforms should work too, as long as MuPDF and Python support them.

PyMuPDF is hosted on GitHub. We also are registered on PyPI.

For MS Windows and popular Python versions on Mac OSX and Linux we have created wheels. So installation should be convenient enough for hopefully most of our users: just issue

```
pip install --upgrade pymupdf
```

If your platform is not among those supported with a wheel, your installation consists of two separate steps:

1. Installation of MuPDF: this involves downloading the source from their website and then compiling it on your machine. Adjust `setup.py` to point to the right directories (next step), before you try generating PyMuPDF.
2. Installation of PyMuPDF: this step is normal Python procedure. Usually you will have to adapt the `setup.py` to point to correct `include` and `lib` directories of your generated MuPDF.

For installation details check out the respective chapter.

There exist several demo and example programs in the main repository, ranging from simple code snippets to full-featured utilities, like text extraction, PDF joiners and bookmark maintenance.

Interesting **PDF manipulation and generation** functions have been added over time, including metadata and bookmark maintenance, document restructuring, annotation / link handling and document or page creation.

1.1 Note on the Name fitz

The standard Python import statement for this library is `import fitz`. This has a historical reason:

The original rendering library for MuPDF was called `Libart`.

"After Artifex Software acquired the MuPDF project, the development focus shifted on writing a new modern graphics library called "Fitz". Fitz was originally intended as an R&D project to replace the aging Ghostscript graphics library, but has instead become the rendering engine powering MuPDF." (Quoted from Wikipedia).

1.2 License

PyMuPDF is distributed under GNU GPL V3 (or later, at your choice).

MuPDF is distributed under a separate license, the **GNU AFFERO GPL V3**.

Both licenses apply, when you use PyMuPDF.

Note: Version 3 of the GNU AFFERO GPL is a lot less restrictive than its earlier versions used to be. It basically is an open source freeware license, that obliges your software to also being open source and freeware. Consult this website, if you want to create a commercial product with PyMuPDF.

1.3 Covered Version

This documentation covers PyMuPDF v1.13.13 features as of **2018-07-10 07:30:21**.

Note: The major and minor versions of **PyMuPDF** and **MuPDF** will always be the same. Only the third qualifier (patch level) may be different from that of MuPDF.

CHAPTER

TWO

INSTALLATION

Installation generally encompasses downloading and generating PyMuPDF and MuPDF from sources. This process consists of three steps described below under *Option 1: Install from Sources*.

However, for popular configurations, binary setups via wheels are available, detailed out under *Option 2: Install from Binaries*. This process is **much faster**, less error-prone and requires the download of only one 3 MB file (either `.zip` or `.whl`) - no compiler, no Visual Studio, no download of MuPDF, even no download of PyMuPDF.

2.1 Option 1: Install from Sources

2.1.1 Step 1: Download PyMuPDF

Download this repository and unzip / decompress it. This will give you a folder, let us call it `PyFitz`.

2.1.2 Step 2: Download and Generate MuPDF

Download `mupdf-x.xx-source.tar.gz` from http://mupdf.com/downloads and unzip / decompress it. Call the resulting folder `mupdf`. The latest MuPDF **development sources** are available on https://github.com/ArtifexSoftware/mupdf - this is **not** what you want here.

Make sure you download the (sub-) version for which PyMuPDF has stated its compatibility. The various Linux flavors usually have their own specific ways to support download of packages which we cannot cover here. Do not hesitate posting issues to our web site or sending an e-mail to the authors for getting support.

Put it inside `PyFitz` as a subdirectory for keeping everything in one place.

Controlling the Binary File Size:

Since version 1.9, MuPDF includes support for many dozens of additional, so-called NOTO ("no TOFU") fonts for all sorts of alphabets from all over the world like Chinese, Japanese, Corean, Kyrillic, Indonesian, Chinese etc. If you accept MuPDF's standard here, the resulting binary for PyMuPDF will be very big and easily approach or exceed 20 MB. The features actually needed by PyMuPDF in contrast only represent a fraction of this size: no more than 5 MB currently.

To cut off unneeded stuff from your MuPDF version, modify file `/include/mupdf/config.h` as follows:

```
#ifndef FZ_CONFIG_H

#define FZ_CONFIG_H

/*
Enable the following for spot (and hence overprint/overprint
simulation) capable rendering. This forces FZ_PLOTTERS_N on.
*/
```

(continues on next page)

(continued from previous page)

```
#define FZ_ENABLE_SPOT_RENDERING

/*
Choose which plotters we need.
By default we build all the plotters in. To avoid building
plotters in that aren't needed, define the unwanted
FZ_PLOTTERS_... define to 0.
*/
/* #define FZ_PLOTTERS_G 1 */
/* #define FZ_PLOTTERS_RGB 1 */
/* #define FZ_PLOTTERS_CMYK 1 */
/* #define FZ_PLOTTERS_N 1 */

/*
Choose which document agents to include.
By default all but GPRF are enabled. To avoid building unwanted
ones, define FZ_ENABLE_... to 0.
*/
/* #define FZ_ENABLE_PDF 1 */
/* #define FZ_ENABLE_XPS 1 */
/* #define FZ_ENABLE_SVG 1 */
/* #define FZ_ENABLE_CBZ 1 */
/* #define FZ_ENABLE_IMG 1 */
/* #define FZ_ENABLE_TIFF 1 */
/* #define FZ_ENABLE_HTML 1 */
/* #define FZ_ENABLE_EPUB 1 */
/* #define FZ_ENABLE_GPRF 1 */

/*
Choose whether to enable JPEG2000 decoding.
By default, it is enabled, but due to frequent security
issues with the third party libraries we support disabling
it with this flag.
*/
/* #define FZ_ENABLE_JPX 1 */

/*
Choose whether to enable JavaScript.
By default JavaScript is enabled both for mutool and PDF interactivity.
*/
/* #define FZ_ENABLE_JS 1 */

/*
Choose which fonts to include.
By default we include the base 14 PDF fonts,
DroidSansFallback from Android for CJK, and
Charis SIL from SIL for epub/html.
Enable the following defines to AVOID including
unwanted fonts.
*/
/* To avoid all noto fonts except CJK, enable: */
#define TOFU // PyMuPDF

/* To skip the CJK font, enable: (this implicitly enables TOFU_CJK_EXT and TOFU_
↪CJK_LANG) */
#define TOFU_CJK // PyMuPDF

/* To skip CJK Extension A, enable: (this implicitly enables TOFU_CJK_LANG) */
#define TOFU_CJK_EXT // PyMuPDF

/* To skip CJK language specific fonts, enable: */
```

(continues on next page)

(continued from previous page)

```
#define TOFU_CJK_LANG // PyMuPDF

/* To skip the Emoji font, enable: */
#define TOFU_EMOJI // PyMuPDF

/* To skip the ancient/historic scripts, enable: */
#define TOFU_HISTORIC // PyMuPDF

/* To skip the symbol font, enable: */
#define TOFU_SYMBOL // PyMuPDF

/* To skip the SIL fonts, enable: */
#define TOFU_SIL // PyMuPDF

/* To skip the ICC profiles, enable: */
// #define NO_ICC

/* To skip the Base14 fonts, enable: */
/* #define TOFU_BASE14 */
/* (You probably really don't want to do that except for measurement purposes!) */

/* ---------- DO NOT EDIT ANYTHING UNDER THIS LINE ---------- */

... ... ...

#endif /* FZ_CONFIG_H */
```

The above choice should bring down your binary file size to around 5 MB or less, depending on your bitness.

Generate MuPDF now.

The MuPDF source includes generation procedures / makefiles for numerous platforms. For Windows platforms, Visual Studio solution and project definitions are provided.

Consult additional installation hints on PyMuPDF's main page on Github. Among other things you will find a Wiki pages with details on building the Windows binaries or user provided installation experiences.

2.1.3 Step 3: Build / Setup PyMuPDF

Adjust the setup.py script as necessary. E.g. make sure that

- the include directory is correctly set in sync with your directory structure
- the object code libraries are correctly defined

Now perform a `python setup.py install`.

2.2 Option 2: Install from Binaries

This installation option is available for all MS Windows and popular Mac OS and Linux platforms.

2.2.1 Step 1: Install from PyPI

If you find the wheel for your platform on PyPI, issue

```
pip install [--upgrade] PyMuPDF
```

and you are done. **Continue with next chapter of this manual.**

2.2.2 Step 2: Install from GitHub

This section applies, if you prefer a ZIP file or if you need a special (bug-fix or pre-release) wheel.

Download your Windows, Mac OS or Linux wheel and issue

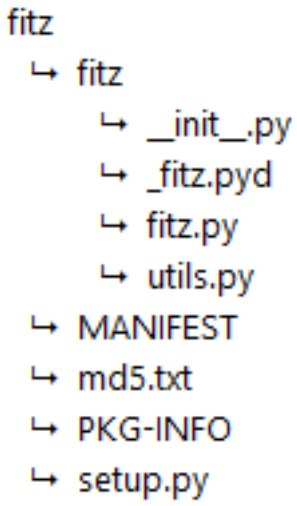
```
pip install [--upgrade] PyMuPDF-<...>.whl
```

If your platform is Windows you can also download a zip file, unzip it to e.g. your `Desktop` and open a command prompt at the unzipped folder's directory, which contains `setup.py`. Enter `python setup.py install` (or `py setup.py install` if you have the Python launcher).

2.2.3 MD5 Checksums

Binary download setup scripts in ZIP format contain an integrity check based on MD5 check sums.

The directory structure of each zip file `pymupdf-<...>.zip` is as follows:



During setup, the MD5 check sum of the four installation files `__init__.py`, `_fitz.pyd`, `utils.py` and `fitz.py` is being calculated and compared against a pre-calculated value in file `md5.txt`. In case of a mismatch the error message

```
md5 mismatch:  probable download error
```

is issued and setup is cancelled. In this case, please check your download for any problems.

If you downloaded a wheel, integrity checks are done by `pip`.

2.2.4 Targeting Parallel Python Installations

Setup scripts for ZIP binary install support the Python launcher `py.exe` introduced with version 3.3.

They contain **shebang lines** that specify the intended Python version, and additional checks for detecting error situations.

This can be used to target the right Python version if you have several installed in parallel (and of course the Python launcher, too). Use the following statement to set up PyMuPDF correctly:

```
py setup.py install
```

The shebang line of `setup.py` will be interpreted by `py.exe` to automatically find the right Python, and the internal checks will make sure that version and bitness are what they sould be.

When using wheels, configuration conflict detection is done by `pip`.

2.3 Using UPX

No matter which option you chose, your PyMuPDF installation will end up with four files: `__init__.py`, `fitz.py`, `utils.py` and the binary file `_fitz<...>.xxx` in the `site-packages` directory. The extension of the binary will be `.pyd` on Windows and `.so` on other platforms.

Depending on your OS, your compiler and your font support choice (see above), this binary can be quite large and range from 5 MB to 20 MB. You can reduce this by applying the compression utility UPX to it, which probably also exists for your operating system. UPX will reduce the size of `_fitz<...>.xxx` by more than 50%. You will end up with 2.5 MB to 9 MB without impacting functionality nor execution speed.

CHAPTER

THREE

TUTORIAL

This tutorial will show you the use of PyMuPDF, MuPDF in Python, step by step.

Because MuPDF supports not only PDF, but also XPS, OpenXPS, CBZ, CBR, FB2 and EPUB formats, so does PyMuPDF[1]. Nevertheless we will only talk about PDF files for the sake of brevity. At places where indeed only PDF files are supported, this will be mentioned explicitely.

3.1 Importing the Bindings

The Python bindings to MuPDF are made available by this import statement:

```
>>> import fitz
```

You can check your version by printing the docstring:

```
>>> print (fitz.__doc__)
PyMuPDF 1.9.1: Python bindings for the MuPDF 1.9a library,
built on 2016-07-01 13:06:02
```

3.2 Opening a Document

To access a supported document, it must be opened with the following statement:

```
>>> doc = fitz.open(filename)      # or fitz.Document(filename)
```

This creates a *Document* object `doc`. `filename` must be a Python string specifying the name of an existing file.

It is also possible to open a document from memory data, or to create a new, empty PDF. See *Document* for details.

A document contains many attributes and functions. Among them are meta information (like "author" or "subject"), number of total pages, outline and encryption information.

[1] PyMuPDF lets you also open several image file types just like normal documents. See section *Supported Input Image Types* in chapter *Pixmap* for more comments.

3.3 Some Document Methods and Attributes

Method / Attribute	Description
Document.pageCount	number of pages (*int*)
Document.metadata	metadata (*dict*)
Document.getToC()	table of contents (*list*)
Document.loadPage()	read a page (*Page*)

3.4 Accessing Meta Data

PyMuPDF fully supports standard metadata. *Document.metadata* is a Python dictionary with the following keys. It is available for **all document types**, though not all entries may always contain data. For details of their meanings and formats consult the respective manuals, e.g. *Adobe PDF Reference 1.7* for PDF. Further information can also be found in chapter *Document*. The meta data fields are strings or `None` if not otherwise indicated. Also be aware that not all of them always contain meaningful data - even if they are not `None`.

Key	Value
producer	producer (producing software)
format	format: 'PDF-1.4', 'EPUB', etc.
encryption	encryption method used
author	author
modDate	date of last modification
keywords	keywords
title	title
creationDate	date of creation
creator	creating application
subject	subject

Note: Apart from these standard metadata, **PDF documents** starting from PDF version 1.4 may also contain so-called *"metadata streams"*. Information in such streams is coded in XML. PyMuPDF deliberately contains no XML components, so we do not directly support access to information contained therein. But you can extract the stream as a whole, inspect or modify it using a package like lxml and then store the result back into the PDF. If you want, you can also delete these data altogether.

Note: There are two utility scripts in the repository that import (PDF only) resp. export metadata from resp. to CSV files.

3.5 Working with Outlines

The easiest way to get all outlines (also called "bookmarks") of a document, is by creating a *table of contents*:

```
>>> toc = doc.getToC()
```

This will return a Python list of lists `[[lvl, title, page, ...], ...]` which looks much like a conventional table of contents found in books.

`lvl` is the hierarchy level of the entry (starting from 1), `title` is the entry's title, and `page` the page number (1-based!). Other parameters describe details of the bookmark target.

Note: There are two utility scripts in the repository that import (PDF only) resp. export table of contents from resp. to CSV files.

3.6 Working with Pages

Page handling is at the core of MuPDF's functionality.

- You can render a page into a raster or vector (SVG) image, optionally zooming, rotating, shifting or shearing it.
- You can extract a page's text and images in many formats and search for text strings.

First, a page object must be created. This is a method of *Document*:

```
>>> page = doc.loadPage(n)          # represents page n of the document (0-based)
>>> page = doc[n]                   # short form
```

`n` may be any positive or negative integer less than `doc.pageCount`. Negative numbers count backwards from the end, so `doc[-1]` is the last page, like with Python lists.

Some typical uses of *Page*s follow:

3.6.1 Inspecting the Links of a Page

Links are shown as "hot areas" when a document is displayed with some software. If you click while your cursor shows a hand symbol, you will usually be taken to the taget that is encoded in that hot area. Here is how to get all links and their types.

```
>>> # get all links on a page
>>> links = page.getLinks()
```

`links` is a Python list of dictionaries. For details see *`Page.getLinks()`*.

3.6.2 Rendering a Page

This example creates a **raster** image of a page's content:

```
>>> pix = page.getPixmap()
```

`pix` is a *Pixmap* object that contains an RGBA image of the page, ready to be used for many purposes. Method *`Page.getPixmap()`* offers lots of variations for controlling the image: resolution, colorspace (e.g. to produce a grayscale image or an image with a subtractive color scheme), transparency, rotation, mirroring, shifting, shearing, etc.

Note: You can also create **vector** images of a page using *`Page.getSVGimage()`*. Refer to this Wiki for details.

3.6.3 Saving the Page Image in a File

We can simply store the image in a PNG file:

```
>>> pix.writePNG("page-0.png")
```

3.6.4 Displaying the Image in Dialog Managers

We can also use it in GUI dialog managers. *Pixmap.samples* represents an area of bytes of all the pixels as a Python bytes object. Here are some examples, find more in this directory.

wxPython

```
>>> bitmap = wx.BitmapFromBufferRGBA(pix.width, pix.height, pix.samples)
```

Tkinter

Please also see section 3.19 of the Pillow documentation.

```
>>> from PIL import Image, ImageTk
>>> img = Image.frombytes("RGBA", [pix.width, pix.height], pix.samples)
>>> tkimg = ImageTk.PhotoImage(img)
```

PyQt4, PyQt5, PySide

Please also see section 3.16 of the Pillow documentation.

```
>>> from PIL import Image, ImageQt
>>> img = Image.frombytes("RGBA", [pix.width, pix.height], pix.samples)
>>> qtimg = ImageQt.ImageQt(img)
```

3.6.5 Extracting Text and Images

We can also extract all text, images and other information of a page in many different forms and levels of detail:

```
>>> text = page.getText("type")
```

Use one of the following strings for `"type"` to obtain different formats[2]:

- `"text"`: (default) plain text with line breaks. No formatting, no text position details, no images.
- `"html"`: creates a full visual version of the page including any images. This can be displayed with your internet browser.
- `"dict"`: same information level as HTML, but provided as a Python dictionary. See *TextPage.extractDICT()* for details of its structure.
- `"xhtml"`: text information level as the TEXT version but includes images. Can also be displayed by internet browsers.
- `"xml"`: contains no images, but full position and font information down to each single text character. Use an XML module to interpret.

To give you an idea about the output of these alternatives, we did text example extracts. See *Appendix 2: Details on Text Extraction*.

[2] *Page.getText()* is a convenience wrapper for several methods of another PyMuPDF class, *TextPage*. The names of these methods correspond to the argument string passed to *Page.getText()* : `Page.getText("dict")` is equivalent to `TextPage.extractDICT()` .

3.6.6 Searching for Text

You can find out, exactly where on a page a certain text string appears:

```
>>> areas = page.searchFor("mupdf", hit_max = 16)
```

This delivers a list of up to 16 rectangles (see *Rect*), each of which surrounds one occurrence of the string "mupdf" (case insensitive). You could use this information to e.g. highlight those areas or create a cross reference of the document.

Please also do have a look at chapter *Working together: DisplayList and TextPage* and at demo programs demo.py and demo-lowlevel.py. Among other things they contain details on how the *TextPage*, *Device* and *DisplayList* classes can be used for a more direct control, e.g. when performance considerations suggest it.

3.7 PDF Maintenance

PDFs are the only document type that can be **modified** using PyMuPDF. Other files are read-only.

However, you can convert **any document** (including images) to a PDF and then apply all PyMuPDF features to the conversion outcome. Find out more here *Document.convertToPDF()*, and also look at the demo script xps-converter.py.

Document.save() always stores a PDF in its current (potentially modified) state on disk.

Apart from changes made by you, there are less obvious ways how a PDF may become "modified":

- During open, integrity checks are used to determine the health of the PDF structure. If errors are encountered, the base library goes a long way to correct them and present a readable document. If this is the case, the document is regarded as being modified.
- After a document has been decrypted, the document in memory has changed and also counts as being modified.

In these two cases, *Document.save()* will store a **repaired**, resp. **decrypted** version, and you must specify **a new file**. Otherwise, you have the option to save your changes as update appendices to the original file ("incremental saves" below), which is very much faster in most cases.

The following describes ways how you can manipulate PDF documents. This description is by no means complete: much more can be found in the following chapters.

3.7.1 Modifying, Creating, Re-arranging and Deleting Pages

There are several ways to manipulate the so-called **page tree** (a structure describing all the pages) of a PDF:

Document.deletePage() and *Document.deletePageRange()* delete pages. *Document.copyPage()* and *Document.movePage()* copy or move a page to another location within the same document.

These methods are just wrappers for the following more sophisticated method:

Document.select() shrinks a PDF down to selected pages. Parameter is a list of the page numbers you want to include. These integers must all be in range `0 <= i < pageCount`. When executed, all pages **missing** in this list will be deleted. Remaining pages will occur **in the sequence and as many times (!) as you specify them**.

So you can easily create new PDFs with

- the first or last 10 pages,
- only the odd or only the even pages (for doing double-sided printing),

- pages that **do** or **don't** contain a given text,
- reverse the page sequence, ...

... whatever you may think of.

The saved new document will contain links, annotations and bookmarks that are still valid (i.a.w. either pointing to a selected page or to some external resource).

Document.insertPage() and *Document.newPage()* insert new pages.

Pages themselves can moreover be modified by a range of methods (e.g. page rotation, annotation and link maintenance, text and image insertion).

3.7.2 Joining and Splitting PDF Documents

Method *Document.insertPDF()* copies pages **between different** PDF documents. Here is a simple **joiner** example (`doc1` and `doc2` being openend PDFs):

```
>>> # append complete doc2 to the end of doc1
>>> doc1.insertPDF(doc2)
```

Here is a snippet that **splits** `doc1`. It creates a new document of its first and its last 10 pages:

```
>>> doc2 = fitz.open()                  # new empty PDF
>>> doc2.insertPDF(doc1, to_page = 9)   # first 10 pages
>>> doc2.insertPDF(doc1, from_page = len(doc1) - 10) # last 10 pages
>>> doc2.save("first-and-last-10.pdf")
```

More can be found in the *Document* chapter. Also have a look at PDFjoiner.py.

3.7.3 Embedding Data

PDFs can be used as containers for abitrary data (exeutables, other PDFs, text files, etc.) much like ZIP archives.

PyMuPDF fully supports this feature via *Document* `embeddedFile*` methods and attributes. For some detail read *Appendix 3: Considerations on Embedded Files*, consult the Wiki on embedding files, or the example scripts embedded-copy.py, embedded-export.py, embedded-import.py, and embedded-list.py.

3.7.4 Saving

As mentioned above, *Document.save()* will **always** save the document in its current state.

You can write changes back to the **original PDF** by specifying `incremental = True`. This process is (usually) **extremely fast**, since changes are **appended to the original file** without completely rewriting it.

Document.save() supports all options of MuPDF's command line utility `mutool clean`, see the following table.

Option	mutool	Effect
garbage = 1	g	garbage collect unused objects
garbage = 2	gg	in addition to 1, compact xref tables
garbage = 3	ggg	in addition to 2, merge duplicate objects
garbage = 4	gggg	in addition to 3, skip duplicate streams
clean = 1	c	clean content streams
deflate = 1	z	deflate uncompressed streams
ascii = 1	a	convert binary data to ASCII format
linear = 1	l	create a linearized version
expand = 1	i	decompress images
expand = 2	f	decompress fonts
expand = 255	d	decompress all
incremental = 1	n/a	append changes to the original

For example, `mutool clean -ggggz file.pdf` yields excellent compression results. It corresponds to `doc.save(filename, garbage=4, deflate=1)`.

3.8 Closing

It is often desirable to "close" a document to relinquish control of the underlying file to the OS, while your program continues.

This can be achieved by the *Document.close()* method. Apart from closing the underlying file, buffer areas associated with the document will be freed.

3.9 Example: Dynamically Cleaning up Corrupt PDF Documents

This shows a potential use of PyMuPDF with another Python PDF library (pdfrw).

If a clean, non-corrupt / decompressed / decrypted PDF is needed, one could dynamically invoke PyMuPDF to recover from problems like so:

```
import sys
from pdfrw import PdfReader
import fitz
from io import BytesIO

#---------------------------------------
# 'Tolerant' PDF reader
# Adjust appropriately for decryption
#---------------------------------------
def reader(fname):
    idata = open(fname, "rb").read()
    ibuffer = BytesIO(idata)                # convert to stream
    try:
        return PdfReader(ibuffer)           # try this first
    except:                                 # problem! heal it with PyMuPDF
        # put a repaired version in memory
        c = fitz.open("pdf", idata).write(garbage=4)
        idata = None                        # free some storage
        return PdfReader(BytesIO(c))        # let pdfrw retry
#---------------------------------------
# Main program
#---------------------------------------
pdf = reader("pymupdf.pdf")
```

(continues on next page)

(continued from previous page)

```
print pdf.Info
# do further processing
```

With the command line utility `pdftk` (available for Windows only but it is reported to also run under Wine) a similar result can be achieved, see here. However, you must invoke it as a separate process via `subprocess.Popen`, using stdin and stdout as communication vehicles.

3.10 Further Reading

Also have a look at PyMuPDF's Wiki pages. Especially those named in the sidebar under title **"Recipies"** cover over 15 topics written in "How-To" style.

CHAPTER

FOUR

CLASSES

4.1 Document

This class represents a document. It can be constructed from a file or from memory.

Since version 1.9.0 there exists the alias `open` for this class.

For addional details on **embedded files** refer to Appendix 3.

Method / Attribute	Short Description
Document.authenticate()	decrypt the document
Document.close()	close the document
Document.copyPage()	PDF only: copy a page to another location
Document.convertToPDF()	write a PDF version to memory
Document.deletePage()	PDF only: delete a page by its number
Document.deletePageRange()	PDF only: delete a range of pages
Document.embeddedFileAdd()	PDF only: add a new embedded file from buffer
Document.embeddedFileDel()	PDF only: delete an embedded file entry
Document.embeddedFileGet()	PDF only: extract an embedded file buffer
Document.embeddedFileInfo()	PDF only: metadata of an embedded file
Document.embeddedFileUpd()	PDF only: change an embedded file
Document.embeddedFileSetInfo()	PDF only: change metadata of an embedded file
Document.getPageFontList()	PDF only: make a list of fonts on a page
Document.getPageImageList()	PDF only: make a list of images on a page
Document.getPagePixmap()	create a pixmap of a page by page number
Document.getPageText()	extract the text of a page by page number
Document.getToC()	create a table of contents
Document.insertPage()	PDF only: insert a new page
Document.insertPDF()	PDF only: insert pages from another PDF
Document.layout()	re-paginate the document (if supported)
Document.loadPage()	read a page
Document.movePage()	PDF only: move a page to another location
Document.newPage()	PDF only: insert a new empty page
Document.save()	PDF only: save the document
Document.saveIncr()	PDF only: save the document incrementally
Document.searchPageFor()	search for a string on a page
Document.select()	PDF only: select a subset of pages
Document.setMetadata()	PDF only: set the metadata
Document.setToC()	PDF only: set the table of contents (TOC)
Document.write()	PDF only: writes the document to memory
Document.embeddedFileCount	number of embedded files
Document.FormFonts	PDF only: list of existing field fonts
Document.isClosed	has document been closed?
Document.isPDF	is this a PDF?

Continued on next page

Table 1 – continued from previous page

Method / Attribute	Short Description
Document.isFormPDF	is this a Form PDF?
Document.isReflowable	is this a reflowable document?
Document.metadata	metadata
Document.name	filename of document
Document.needsPass	require password to access data?
Document.isEncrypted	document (still) encrypted?
Document.openErrCode	> 0 if repair occurred during open
Document.openErrMsg	last error message if openErrCode > 0
Document.outline	first *Outline* item
Document.pageCount	number of pages
Document.permissions	permissions to access the document

Class API

class Document

__init__(*self*, *filename* = *None*, *stream* = *None*, *filetype* = *None*, *rect* = *None*, *fontsize* = *11*)

Creates a `Document` object.

- With default parameters, a **new empty PDF** document will be created.
- If `stream` is given, then the document is created from memory and either `filename` or `filetype` must indicate its type.
- If `stream` is `None`, then a document is created from a file given by `filename`. Its type is inferred from the extension, which can be overruled by specifying `filetype`.

Parameters

- **filename** (*str*) – A UTF-8 string containing a file path or a file type, see below.
- **stream** (*bytes/bytearray*) – A memory area containing a supported document. Its type **must** be specified by either `filename` or `filetype`.
- **filetype** (*str*) – A string specifying the type of document. This may be something looking like a filename (e.g. `"x.pdf"`), in which case MuPDF uses the extension to determine the type, or a mime type like `application/pdf`. Just using strings like `"pdf"` will also work.
- **rect** (*Rect*) – a rectangle specifying the desired page size. This parameter is only meaningful for document types with a variable page layout ("reflowable" documents), like e-books or HTML, and ignored otherwise. If specified, it must be a non-empty, finite rectangle with top-left coordinates (0, 0). Together with parameter `fontsize`, each page will be accordingly laid out and hence also determine the number of pages.
- **fontsize** (*float*) – the default fontsize for reflowable document types. This parameter is ignored if parameter `rect` is not specified. Together with `rect` the page layout is recalculated.

Overview of possible forms (using the `open` synonym of `Document`):

```
>>> # from a file
>>> doc = fitz.open("some.pdf")
>>> doc = fitz.open("some.file", None, "pdf")
>>> doc = fitz.open("some.file", filetype = "pdf")
```

```
>>> # from memory
>>> doc = fitz.open("pdf", mem_area)
>>> doc = fitz.open(None, mem_area, "pdf")
>>> doc = fitz.open(stream = mem_area, filetype = "pdf")
```

```
>>> # new empty PDF
>>> doc = fitz.open()
```

authenticate(*password*)

Decrypts the document with the string `password`. If successful, all of the document's data can be accessed (e.g. for rendering).

Parameters **password** (*str*) – The password to be used.

Return type bool

Returns `True` if decryption with `password` was successful, `False` otherwise. If successful, indicator `isEncrypted` is set to `False`.

loadPage(*pno = 0*)

Load a *Page* for further processing like rendering, text searching, etc.

Parameters **pno** (*int*) – page number, zero-based (0 is default and the first page of the document) and `< doc.pageCount`. If `pno < 0`, then page `pno % pageCount` will be loaded (IAW `pageCount` will be added to `pno` until the result is no longer negative). For example: to load the last page, you can specify `doc.loadPage(-1)`. After this you have `page.number == doc.pageCount - 1`.

Return type *Page*

Note: Conveniently, pages can also be loaded via indexes over the document: `doc.loadPage(n) == doc[n]`. Consequently, a document can also be used as an iterator over its pages, e.g. `for page in doc: ...` and `for page in reversed(doc): ...` will yield the *Page*s of `doc` as `page`.

---

convertToPDF(*from_page = -1*, *to_page = -1*, *rotate = 0*)

Create a PDF version of the current document and write it to memory. All document types are supported. The parameters have the same meaning as in *insertPDF()*. In essence, you can restrict the conversion to a page subset, specify page rotation, and revert page sequence.

Parameters

- **from_page** (*int*) – first page to copy (0-based). Default is first page.
- **to_page** (*int*) – last page to copy (0-based). Default is last page.
- **rotate** (*int*) – rotation angle. Default is 0 (no rotation). Should be `n * 90` with an integer `n` (not checked).

Return type bytes

Returns a Python `bytes` object containing a PDF file image. It is created by internally using `write(garbage=4, deflate = True)`. See *write()*. You can output it directly to disk or open it as a PDF via `fitz.open("pdf", pdfbytes)`. Here are some examples:

```
>>> # convert an XPS file to PDF
>>> xps = fitz.open("some.xps")
>>> pdfbytes = xps.convertToPDF()
>>>
>>> # either do this --->
```

(continues on next page)

(continued from previous page)

```
>>> pdf = fitz.open("pdf", pdfbytes)
>>> pdf.save("some.pdf")
>>>
>>> # or this --->
>>> pdfout = open("some.pdf", "wb")
>>> pdfout.write(pdfbytes)
>>> pdfout.close()
```

```
>>> # copy image files to PDF pages
>>> # each page will have image dimensions
>>> doc = fitz.open()                       # new PDF
>>> imglist = [ ... image file names ...] # e.g. a directory listing
>>> for img in imglist:
        imgdoc = fitz.open(img)             # open image as a document
        pdfbytes = imgdoc.convertToPDF()  # make a 1-page PDF of it
        imgpdf = fitz.open("pdf", pdfbytes)
        doc.insertPDF(imgpdf)               # insert the image PDF
>>> doc.save("allmyimages.pdf")
```

Note: The method uses the same logic as the `mutool convert` CLI. This works very well in most cases - however, beware of the following limitations.

- Image files: perfect, no issues detected. Apparently however, image transparency is ignored. If you need that (like for a watermark), use *Page.insertImage()* instead.
- XPS: appearance very good. Links work fine, outlines (bookmarks) are lost, but can easily be recovered[2].
- EPUB, CBZ, FB2: similar to XPS.
- SVG: medium. Roughly comparable to svglib.

---

getToC(*simple = True*)

Creates a table of contents out of the document's outline chain.

Parameters **simple** (*bool*) – Indicates whether a simple or a detailed ToC is required. If `simple == False`, each entry of the list also contains a dictionary with *linkDest* details for each outline entry.

Return type list

Returns

a list of lists. Each entry has the form `[lvl, title, page, dest]`. Its entries have the following meanings:

- `lvl` - hierarchy level (positive *int*). The first entry is always 1. Entries in a row are either **equal**, **increase** by 1, or **decrease** by any number.
- `title` - title (*str*)
- `page` - 1-based page number (*int*). Page numbers `< 1` either indicate a target outside this document or no target at all (see next entry).
- `dest` - (*dict*) included only if `simple = False`. Contains details of the link destination.

getPagePixmap(*pno*, **args*, ***kwargs*)

Creates a pixmap from page `pno` (zero-based). Invokes *Page.getPixmap()*.

Return type *Pixmap*

[2] However, you **can** use *Document.getToC()* and *Page.getLinks()* (which are available for all document types) and copy this information over to the output PDF. See demo xps-converter.py.

getPageImageList(*pno*)

PDF only: Return a list of all image descriptions referenced by a page.

Parameters **pno** (*int*) – page number, 0-based, any value `< len(doc)`.

Return type list

Returns

a list of images shown on this page. Each entry looks like `[xref, smask, width, height, bpc, colorspace, alt. colorspace, name, filter]`. Where

- `xref` (*int*) is the image object number,
- `smask` (*int* optional) is the object number of its soft-mask image (if present),
- `width` and `height` (*ints*) are the image dimensions,
- `bpc` (*int*) denotes the number of bits per component (a typical value is 8),
- `colorspace` (*str*)a string naming the colorspace (like `DeviceRGB`),
- `alt. colorspace` (*str* optional) is any alternate colorspace depending on the value of `colorspace`,
- `name` (*str*) is the symbolic name by which the **page references the image** in its content stream, and
- `filter` (*str* optional) is the decode filter of the image (*Adobe PDF Reference 1.7*, pp. 65).

See below how this information can be used to extract PDF images as separate files. Another demonstration:

```
>>> doc = fitz.open("pymupdf.pdf")
>>> doc.getPageImageList(0)
[[316, 0, 261, 115, 8, 'DeviceRGB', '', 'Im1', 'DCTDecode']]
>>> pix = fitz.Pixmap(doc, 316)      # 316 is the xref of the image
>>> pix
fitz.Pixmap(DeviceRGB, fitz.IRect(0, 0, 261, 115), 0)
```

Note: This list has no duplicate entries: the combination of `xref` and `name` is unique. But by themselves, each of the two may occur multiple times. The same image may well be referenced under different names within a page. Duplicate `name` entries on the other hand indicate the presence of "Form XObjects" on the page, e.g. generated by *`Page.showPDFpage()`*.

---

getPageFontList(*pno*)

PDF only: Return a list of all fonts referenced by the page.

Parameters **pno** (*int*) – page number, 0-based, any value `< len(doc)`.

Return type list

Returns

a list of fonts referenced by this page. Each entry looks like `[xref, ext, type, basefont, name, encoding]`. Where

- `xref` (*int*) is the font object number (may be zero if the PDF uses one of the builtin fonts directly),
- `ext` (*str*) font file extension (e.g. `ttf`, see *Font File Extensions*),
- `type` (*str*) is the font type (like `Type1` or `TrueType` etc.),
- `basefont` (*str*) is the base font name,

- `name` (*str*) is the reference name (or label), by which **the page references the font** in its contents stream(s), and
- `encoding` (*str* optional) the font's character encoding if different from its built-in encoding (*Adobe PDF Reference 1.7*, p. 414):

```
>>> doc = fitz.open("some.pdf")
>>> for f in doc.getPageFontList(0): print(f)
[24, 'ttf', 'TrueType', 'DOKBTG+Calibri', 'R10', '']
[17, 'ttf', 'TrueType', 'NZNDCL+CourierNewPSMT', 'R14', '']
[32, 'ttf', 'TrueType', 'FNUUTH+Calibri-Bold', 'R8', '']
[28, 'ttf', 'TrueType', 'NOHSJV+Calibri-Light', 'R12', '']
[8, 'ttf', 'Type0', 'ECPLRU+Calibri', 'R23', 'Identity-H']
```

Note: This list has no duplicate entries: the combination of `xref` and `name` is unique. But by themselves, each of the two may occur multiple times. Duplicate `name` entries indicate the presence of "Form XObjects" on the page, e.g. generated by *`Page.showPDFpage()`*.

`getPageText`(*pno*, *output = "text"*)

Extracts the text of a page given its page number `pno` (zero-based). Invokes *`Page.getText()`*.

Parameters

- **`pno`** (*`int`*) – page number, 0-based, any value `< len(doc)`.
- **`output`** (*`str`*) – A string specifying the requested output format: text, html, json or xml. Default is `text`.

Return type str

`layout`(*rect*, *fontsize = 11*)

Re-paginate ("reflow") the document based on the given page dimension and fontsize. This only affects some document types like e-books and HTML. Ignored if not supported. Supported documents have `True` in property *`isReflowable`*.

Parameters

- **`rect`** (*Rect*) – desired page size. Must be finite, not empty and start at point (0, 0).
- **`fontsize`** (*`float`*) – the desired default fontsize.

`select`(*s*)

PDF only: Keeps only those pages of the document whose numbers occur in the list. Empty lists or elements outside the range `0 <= page < doc.pageCount` will cause a `ValueError`. For more details see remarks at the bottom or this chapter.

Parameters **`s`** (*`sequence`*) – A sequence (see *Using Python Sequences as Arguments in PyMuPDF*) of page numbers (zero-based) to be included. Pages not in the sequence will be deleted (from memory) and become unavailable until the document is reopened. **Page numbers can occur multiple times and in any order:** the resulting document will reflect the sequence exactly as specified.

`setMetadata`(*m*)

PDF only: Sets or updates the metadata of the document as specified in `m`, a Python dictionary. As with *`select()`*, these changes become permanent only when you save the document. Incremental save is supported.

Parameters **`m`** (*`dict`*) – A dictionary with the same keys as `metadata` (see below). All keys are optional. A PDF's format and encryption method cannot be set or changed and will be ignored. If any value should not contain data, do not specify its key or set the value to `None`. If you use `m = {}` all metadata information will be cleared to the string `"none"`. If you want to selectively change only some

values, modify a copy of `doc.metadata` and use it as the argument. Arbitrary unicode values are possible if specified as UTF-8-encoded.

setToC(*toc*)

PDF only: Replaces the **complete current outline** tree (table of contents) with the new one provided as the argument. After successful execution, the new outline tree can be accessed as usual via method `getToC()` or via property `outline`. Like with other output-oriented methods, changes become permanent only via `save()` (incremental save supported). Internally, this method consists of the following two steps. For a demonstration see example below.

- Step 1 deletes all existing bookmarks.
- Step 2 creates a new TOC from the entries contained in `toc`.

Parameters **toc** (*sequence*) – A Python nested sequence with **all bookmark entries** that should form the new table of contents. Each entry is a list with the following format. Output variants of method `getToC()` are also acceptable as input.

- `[lvl, title, page, dest]`, where
  - `lvl` is the hierarchy level (int > 0) of the item, starting with `1` and being at most 1 higher than that of the predecessor,
  - `title` (str) is the title to be displayed. It is assumed to be UTF-8-encoded (relevant for multibyte code points only).
  - `page` (int) is the target page number **(attention: 1-based to support getToC()-output)**, must be in valid page range if positive. Set this to `-1` if there is no target, or the target is external.
  - `dest` (optional) is a dictionary or a number. If a number, it will be interpreted as the desired height (in points) this entry should point to on `page` in the current document. Use a dictionary (like the one given as output by `getToC(simple = False)`) if you want to store destinations that are either "named", or reside outside this documennt (other files, internet resources, etc.).

Return type int

Returns `outline` and `getToC()` will be updated upon successful execution. The return code will either equal the number of inserted items (`len(toc)`) or the number of deleted items if `toc` is an empty sequence.

Note: We currently always set the *Outline* attribute `is_open` to `False`. This shows all entries below level 1 as collapsed.

---

save(*outfile*, *garbage=0*, *clean=False*, *deflate=False*, *incremental=False*, *ascii=False*, *expand=0*, *linear=False*, *pretty=False*)

PDF only: Saves the document in its **current state** under the name `outfile`. A document may have changed for a number of reasons: e.g. after a successful `authenticate`, a decrypted copy will be saved, and, in addition (even without optional parameters), some basic cleaning may also have occurred, e.g. broken xref tables may have been repaired and earlier incremental changes may have been resolved. If you executed any modifying methods, their results will also be reflected in the saved version.

Parameters

- **outfile** (*str*) – The file name to save to. Must be different from the original value if `incremental = False`. When saving incrementally, `garbage` and `linear` **must be** `False` and `outfile` **must equal** the original filename (for convenience use `doc.name`).

- **garbage** (*int*) – Do garbage collection. Positive values exclude `incremental`.
  - 0 = none
  - 1 = remove unused objects
  - 2 = in addition to 1, compact xref table
  - 3 = in addition to 2, merge duplicate objects
  - 4 = in addition to 3, check streams for duplication
- **clean** (*bool*) – Clean content streams[1].
- **deflate** (*bool*) – Deflate (compress) uncompressed streams.
- **incremental** (*bool*) – Only save changed objects. Excludes `garbage` and `linear`. Cannot be used for decrypted files and for files opened in repair mode (`openErrCode > 0`). In these cases saving to a new file is required.
- **ascii** (*bool*) – Where possible convert binary data to ASCII.
- **expand** (*int*) – Decompress objects. Generates versions that can be better read by some other programs.
  - 0 = none
  - 1 = images
  - 2 = fonts
  - 255 = all
- **linear** (*bool*) – Save a linearised version of the document. This option creates a file format for improved performance when read via internet connections. Excludes `incremental`.
- **pretty** (*bool*) – Prettify the document source for better readability.

saveIncr()
PDF only: saves the document incrementally. This is a convenience abbreviation for `doc.save(doc.name, incremental = True)`.

> **Caution:** A PDF may not be encrypted, but still be password protected against changes - see the `permissions` property. Performing incremental saves if `permissions["edit"] == False` can lead to unpredictable results. Save to a new file in such a case. We also consider raising an exception under this condition.

searchPageFor(*pno*, *text*, *hit_ max = 16*)
Search for `text` on page number `pno`. Works exactly like the corresponding *Page.searchFor()*. Any integer `pno < len(doc)` is acceptable.

write(*garbage=0*, *clean=False*, *deflate=False*, *ascii=False*, *expand=0*, *linear=False*, *pretty=False*)
PDF only: Writes the **current content of the document** to a bytes object instead of to a file like `save()`. Obviously, you should be wary about memory requirements. The meanings of the parameters exactly equal those in *Document.save()*. The tutorial contains an example for using this method as a pre-processor to pdfrw.

Return type bytes

Returns a bytes object containing the complete document data.

[1] Content streams describe what (e.g. text or images) appears where and how on a page. PDF uses a specialized mini language similar to PostScript to do this (pp. 985 in *Adobe PDF Reference 1.7*), which gets interpreted when a page is loaded.

insertPDF(*docsrc*, *from_page = -1*, *to_page = -1*, *start_at = -1*, *rotate = -1*, *links = True*)

PDF only: Copy the page range **[from_page, to_page]** (including both) of PDF document `docsrc` into the current one. Inserts will start with page number `start_at`. Negative values can be used to indicate default values. All pages thus copied will be rotated as specified. Links can be excluded in the target, see below. All page numbers are zero-based.

Parameters

- **docsrc** (`Document`) – An opened PDF `Document` which must not be the current document object. However, it may refer to the same underlying file.
- **from_page** (*int*) – First page number in `docsrc`. Default is zero.
- **to_page** (*int*) – Last page number in `docsrc` to copy. Default is the last page.
- **start_at** (*int*) – First copied page will become page number `start_at` in the destination. If omitted, the page range will be appended to current document. If zero, the page range will be inserted before current first page.
- **rotate** (*int*) – All copied pages will be rotated by the provided value (degrees, integer multiple of 90).
- **links** (*bool*) – Choose whether (internal and external) links should be included with the copy. Default is `True`. An **internal** link is always excluded if its destination is outside the copied page range.

Note: If `from_page > to_page`, pages will be **copied in reverse order**. If `0 <= from_page == to_page`, then one page will be copied.

Note: `docsrc` bookmarks **will not be copied**. It is easy however, to recover a table of contents for the resulting document. Look at the examples below and at program PDFjoiner.py in the *examples* directory: it can join PDF documents and at the same time piece together respective parts of the tables of contents.

---

insertPage(*to = -1*, *text = None*, *fontsize = 11*, *width = 595*, *height = 842*, *fontname = "Helvetica"*, *fontfile = None*, *color = (0, 0, 0)*)

PDF only: Insert an new page. Default page dimensions are those of A4 portrait paper format. Optionally, text can also be inserted - provided as a string or as a asequence.

Parameters

- **to** (*int*) – page number (0-based) in front of which to insert. Valid specifications must be in range `-1 <= pno <= len(doc)`. The default `-1` and `pno = len(doc)` indicate end of document, i.e. after the last page.
- **text** (*str or sequence*) – optional text to put on the page. If given, it will start at 72 points (one inch) below top and 50 points from left. Line breaks (`\n`) will be honored, if it is a string. No care will be taken as to whether lines are too wide. However, text output stops when no more lines will fit on the page (discarding any remaining text). If a sequence is specified, its entries must be a of type string. Each entry will be put on one line. Line breaks *within an entry* will be treated as any other white space. If you want to calculate the number of lines fitting on a page beforehand, use this formula: `int((height - 108) / (fontsize * 1.2)`. So, this methods reserves one inch at the top and 1/2 inches at the bottom of the page as free space.
- **fontsize** (*float*) – font size in pixels. Default is 11. If more than one line is provided, a line spacing of `fontsize * 1.2` (fontsize plus 20%) is used.
- **width** (*float*) – width in pixels. Default is 595 (A4 width). Choose 612 for *Letter width*.

- **height** (*float*) – page height in pixels. Default is 842 (A4 height). Choose 792 for *Letter height*.
- **fontname** (*str*) – name of one of the *PDF Base 14 Fonts* (default is "Helvetica") if fontfile is not specified.
- **fontfile** (*str*) – file path of a font existing on the system. If this parameter is specified, specifying `fontname` is **mandatory**. If the font is new to the PDF, it will be embedded. Of the font file, index 0 is used. Be sure to choose a font that supports horizontal, left-to-right spacing.
- **color** (*sequence*) – RGB text color specified as a triple of floats in range 0 to 1. E.g. specify black (default) as `(0, 0, 0)`, red as `(1, 0, 0)`, some gray value as `(0.5, 0.5, 0.5)`, etc.

Return type int

Returns number of text lines put on the page. Use this to check which part of your text did not fit.

Notes:

This method can be used to

1. create a PDF containing only one empty page of a given dimension. The size of such a file is well below 500 bytes and hence close to the theoretical PDF minimum.
2. create a protocol page of which files have been embedded, or separator pages between joined pieces of PDF Documents.
3. convert textfiles to PDF like in the demo script text2pdf.py.
4. For now, the inserted text should restrict itself to one byte character codes.
5. An easy way to create pages with a usual paper format, use a statement like `width, height = fitz.PaperSize("A4-L")`.
6. To simplify color specification, we provide a *Color Database*. This allows you to specify `color = getColor("turquoise")`, without bothering about any more details.

newPage(*to = -1*, *width = 595*, *height = 842*)

PDF only: Convenience method: insert an empty page like `insertPage()` does. Valid parameters have the same meaning. However, no text can be inserted, instead the inserted page object is returned.

If you do not need to insert text with your new page right away, then this method is the more convenient one: it saves you one statement if you need it for subsequent work - see the below example.

Return type *Page*

Returns the page object just inserted.

```
>>> # let the following be a list of image files, from which we
>>> # create a PDF with one image per page:
>>> imglist = [...]   # list of image filenames
>>> doc = fitz.open() # new empty PDF
>>> for img in imglist:
        pix = fitz.Pixmap(img)
        page = doc.newPage(-1, width = pix.width, height = pix.height)
        page.insertImage(page.rect, pixmap = pix)
>>> doc.save("image-file.pdf", deflate = True)
```

deletePage(*pno = -1*)

PDF only: Delete a page given by its 0-based number in range `0 <= pno < len(doc)`.

Parameters **pno** (*int*) – the page to be deleted. For `-1` the last page will be deleted.

deletePageRange(*from_page = -1*, *to_page = -1*)
PDF only: Delete a range of pages specified as 0-based numbers. Any `-1` parameter will first be replaced by `len(doc) - 1`. After that, condition `0 <= from_page <= to_page < len(doc)` must be true. If the parameters are equal, one page will be deleted.

Parameters

- **from_page** (*int*) – the first page to be deleted.
- **to_page** (*int*) – the last page to be deleted.

copyPage(*pno*, *to = -1*)
PDF only: Copy a page within the document.

Parameters

- **pno** (*int*) – the page to be copied. Must be in range `0 <= pno < len(doc)`.
- **to** (*int*) – the page number in front of which to copy. To insert after the last page (default), specify `-1`.

movePage(*pno*, *to = -1*)
PDF only: Move (copy and then delete original) a page within the document.

Parameters

- **pno** (*int*) – the page to be moved. Must be in range `0 <= pno < len(doc)`.
- **to** (*int*) – the page number in front of which to insert the moved page. To insert after the last page (default), specify `-1`.

embeddedFileAdd(*buffer*, *name*, *filename = None*, *ufilename = None*, *desc = None*)
PDF only: Embed a new file. All string parameters except the name may be unicode (in previous versions, only ASCII worked correctly). File contents will be compressed (where beneficial).

Parameters

- **buffer** (*bytes/bytearray*) – file contents.
- **name** (*str*) – entry identifier, must not already exist.
- **filename** (*str*) – optional filename. Documentation only, will be set to `name` if `None`.
- **ufilename** (*str*) – optional unicode filename. Documentation only, will be set to `filename` if `None`.
- **desc** (*str*) – optional description. Documentation only, will be set to `name` if `None`.

Note: The position of the new entry in the embedded files list can in general not be predicted. Do not assume a specific place (like the end or the beginning), even if the chosen name seems to suggest it. If you add several files, their sequence in that list will probably not be maintained either. In addition, the various PDF viewers each seem to use their own ordering logic when showing the list of embedded files for the same PDF.

---

embeddedFileGet(*n*)
PDF only: Retrieve the content of embedded file by its entry number or name. If the document is not a PDF, or entry cannot be found, an exception is raised.

Parameters **n** (*int/str*) – index or name of entry. For an integer `0 <= n < embeddedFileCount` must be true.

Return type bytes

embeddedFileDel(*name*)

PDF only: Remove an entry from */EmbeddedFiles*. As always, physical deletion of the embedded file content (and file space regain) will occur when the document is saved to a new file with garbage option.

Parameters **name** (*str*) – name of entry. We do not support entry **numbers** for this function yet. If you need to e.g. delete **all** embedded files, scan through embedded files by number, and use the returned dictionary's `name` entry to delete each one.

Return type int

Returns the number of deleted file entries.

Caution: This function will delete **every entry with this name**. Be aware that PDFs not created with PyMuPDF may contain duplicate names, in which case more than one entry may be deleted.

embeddedFileInfo(*n*)

PDF only: Retrieve information of an embedded file given by its number or by its name.

Parameters **n** (*int/str*) – index or name of entry. For an integer `0 <= n < embeddedFileCount` must be true.

Return type dict

Returns

a dictionary with the following keys:

- `name` - (*str*) name under which this entry is stored
- `filename` - (*str*) filename
- `ufilename` - (*unicode*) filename
- `desc` - (*str*) description
- `size` - (*int*) original file size
- `length` - (*int*) compressed file length

embeddedFileUpd(*n*, *buffer = None*, *filename = None*, *ufilename = None*, *desc = None*)

PDF only: Change an embedded file given its entry number or name. All parameters are optional. Letting them default leads to a no-operation.

Parameters

- **n** (*int/str*) – index or name of entry. For an integer `0 <= n < embeddedFileCount` must be true.
- **buffer** (*bytes/bytearray*) – the new file content.
- **filename** (*str*) – the new filename.
- **ufilename** (*str*) – the new unicode filename.
- **desc** (*str*) – the new description.

embeddedFileSetInfo(*n*, *filename = None*, *ufilename = None*, *desc = None*)

PDF only: Change embedded file meta information. All parameters are optional. Letting them default will lead to a no-operation.

Parameters

- **n** (*int/str*) – index or name of entry. For an integer `0 <= n < embeddedFileCount` must be true.
- **filename** (*str*) – sets the filename.

- **ufilename** (*str*) – sets the unicode filename.
- **desc** (*str*) – sets the description.

Note: Deprecated subset of *embeddedFileUpd()*. Will be deleted in next version.

close()
Release objects and space allocations associated with the document. If created from a file, also closes `filename` (releasing control to the OS).

outline
Contains the first *Outline* entry of the document (or `None`). Can be used as a starting point to walk through all outline items. Accessing this property for encrypted, not authenticated documents will raise an `AttributeError`.

Type *Outline*

isClosed
`False` if document is still open. If closed, most other attributes and methods will have been deleted / disabled. In addition, *Page* objects referring to this document (i.e. created with *Document.loadPage()*) and their dependent objects will no longer be usable. For reference purposes, *Document.name* still exists and will contain the filename of the original document (if applicable).

Type bool

isPDF
`True` if this is a PDF document, else `False`.

Type bool

isFormPDF
`True` if this is a Form PDF document with field count greater zero, else `False`.

Type bool

isReflowable
`True` if document has a variable page layout (like e-books or HTML). In this case you can set the desired page dimensions during document creation (open) or via method *layout()*.

Type bool

needsPass
Contains an indicator showing whether the document is encrypted (`True`) or not (`False`). This indicator remains unchanged - **even after the document has been authenticated**. Precludes incremental saves if `True`.

Type bool

isEncrypted
This indicator initially equals `needsPass`. After an authentication, it is set to `False` to reflect the situation.

Type bool

permissions
Shows the permissions to access the document. Contains a dictionary likes this:

```
>>> doc.permissions
{'print': True, 'edit': True, 'note': True, 'copy': True}
```

The keys have the obvious meanings of permissions to print, change, annotate and copy the document, respectively.

Type dict

metadata
Contains the document's meta data as a Python dictionary or `None` (if `isEncrypted = True` and `needPass=True`). Keys are `format`, `encryption`, `title`, `author`, `subject`, `keywords`, `creator`, `producer`, `creationDate`, `modDate`. All item values are strings or `None`.

Except `format` and `encryption`, the key names correspond in an obvious way to the PDF keys `/Creator`, `/Producer`, `/CreationDate`, `/ModDate`, `/Title`, `/Author`, `/Subject`, and `/Keywords` respectively.

- `format` contains the PDF version (e.g. 'PDF-1.6').
- `encryption` either contains `None` (no encryption), or a string naming an encryption method (e.g. `'Standard V4 R4 128-bit RC4'`). Note that an encryption method may be specified **even if** `needsPass = False`. In such cases not all permissions will probably have been granted. Check dictionary `permissions` for details.
- If the date fields contain valid data (which need not be the case at all!), they are strings in the PDF-specific timestamp format "D:<TS><TZ>", where
  - <TS> is the 12 character ISO timestamp `YYYYMMDDhhmmss` (`YYYY` - year, `MM` - month, `DD` - day, `hh` - hour, `mm` - minute, `ss` - second), and
  - <TZ> is a time zone value (time intervall relative to GMT) containing a sign ('+' or '-'), the hour (`hh`), and the minute (`'mm'`, note the apostrophies!).
- A Paraguayan value might hence look like `D:20150415131602-04'00'`, which corresponds to the timestamp April 15, 2015, at 1:16:02 pm local time Asuncion.

Type dict

name
Contains the `filename` or `filetype` value with which `Document` was created.

Type str

pageCount
Contains the number of pages of the document. May return 0 for documents with no pages. Function `len(doc)` will also deliver this result.

Type int

openErrCode
If `openErrCode > 0`, errors have occurred while opening / parsing the document, which usually means damages like document structure issues. In this case **incremental** save cannot be used. The document is available for processing however, potentially with restrictions (depending on damage details).

Type int

openErrMsg
Contains either an empty string or the last open error message if `openErrCode > 0`. Together with any other error messages of MuPDF's C library, it will also appear on `SYSERR`.

Type str

embeddedFileCount
Contains the number of files in the */EmbeddedFiles* list, -1 if the document is not a PDF.

Type int

FormFonts
A list of font resource names. Contains `None` if not a PDF and `[]` if not a Form PDF.

Type int

Note: For methods that change the structure of a PDF (`insertPDF()`, `select()`, `copyPage()`, `deletePage()` and others), be aware that objects or properties in your program may have been invalidated or orphaned. Examples are *Page* objects and their children (links and annotations), variables holding old page counts, tables of content and the like. Remember to keep such variables up to date or delete orphaned objects.

4.1.1 Remarks on `select()`

Page numbers in the list need not be unique nor be in any particular sequence. This makes the method a versatile utility to e.g. select only the even or the odd pages, re-arrange a document from back to front, duplicate it, and so forth. In combination with text search or extraction you can also omit / include pages with no text or containing a certain text, etc.

You can execute several selections in a row. Each time the document structure will be updated.

Any of those changes will become permanent only with a `save()`. If you have de-selected many pages, consider specifying the `garbage` option to eventually reduce the resulting document's size (when saving to a new file).

Also note, that this method **preserves all links, annotations and bookmarks** that are still valid. In other words: deleting pages only deletes references which point to de-selected pages. Page number of bookmarks (outline items) are automatically updated when a TOC is retrieved again with `getToC()`. If a bookmark's destination page happened to be deleted, then its page number will be set to `-1`.

The results of this method can of course also be achieved using combinations of methods `copyPage()`, `deletePage()` etc. While there are many cases, when these methods are more practical, `select()` is easier and safer to use when many pages are involved.

4.1.2 `select()` Examples

In general, any list of integers within the document's page range can be used. Here are some illustrations.

Delete pages with no text:

```
import fitz
doc = fitz.open("any.pdf")
r = list(range(len(doc)))                  # list of page numbers

for page in doc:
    if not page.getText():                 # page contains no text
        r.remove(page.number)              # remove page number from list

if len(r) < len(doc):                      # did we actually delete anything?
    doc.select(r)                          # apply the list
doc.save("out.pdf", garbage = 4)           # save result to new PDF, OR

# update the original document ... *** VERY FAST! ***
doc.saveIncr()
```

Create a sub document with only the odd pages:

```
>>> import fitz
>>> doc = fitz.open("any.pdf")
>>> r = list(range(0, len(doc), 2))
>>> doc.select(r)                                # apply the list
>>> doc.save("oddpages.pdf", garbage = 4)        # save sub-PDF of the odd pages
```

Concatenate a document with itself:

```
>>> import fitz
>>> doc = fitz.open("any.pdf")
>>> r = list(range(len(doc)))
>>> r += r                                  # turn PDF into a copy of itself
>>> doc.select(r)
>>> doc.save("any+any.pdf")                 # contains doubled <any.pdf>
```

Create document copy in reverse page order (well, don't try with a million pages):

```
>>> import fitz
>>> doc = fitz.open("any.pdf")
>>> r = list(range(len(doc)))
>>> r.reverse()
>>> doc.select(r)
>>> doc.save("back-to-front.pdf")
```

4.1.3 `setMetadata()` Example

Clear metadata information. If you do this out of privacy / data protection concerns, make sure you save the document as a new file with `garbage > 0`. Only then the old `/Info` object will also be physically removed from the file. In this case, you may also want to clear any XML metadata inserted by several PDF editors:

```
>>> import fitz
>>> doc=fitz.open("pymupdf.pdf")
>>> doc.metadata             # look at what we currently have
{'producer': 'rst2pdf, reportlab', 'format': 'PDF 1.4', 'encryption': None, 'author
↪':
'Jorj X. McKie', 'modDate': "D:20160611145816-04'00'", 'keywords': 'PDF, XPS, EPUB,
↪ CBZ',
'title': 'The PyMuPDF Documentation', 'creationDate': "D:20160611145816-04'00'",
'creator': 'sphinx', 'subject': 'PyMuPDF 1.9.1'}
>>> doc.setMetadata({})      # clear all fields
>>> doc.metadata             # look again to show what happened
{'producer': 'none', 'format': 'PDF 1.4', 'encryption': None, 'author': 'none',
'modDate': 'none', 'keywords': 'none', 'title': 'none', 'creationDate': 'none',
'creator': 'none', 'subject': 'none'}
>>> doc._delXmlMetadata()    # clear any XML metadata
>>> doc.save("anonymous.pdf", garbage = 4)       # save anonymized doc
```

4.1.4 `setToC()` Demonstration

This shows how to modify or add a table of contents. Also have a look at csv2toc.py and toc2csv.py in the examples directory.

```
>>> import fitz
>>> doc = fitz.open("test.pdf")
>>> toc = doc.getToC()
>>> for t in toc: print(t)                          # show what we have
[1, 'The PyMuPDF Documentation', 1]
[2, 'Introduction', 1]
[3, 'Note on the Name fitz', 1]
[3, 'License', 1]
>>> toc[1][1] += " modified by setToC"              # modify something
>>> doc.setToC(toc)                                 # replace outline tree
3                                                   # number of bookmarks inserted
>>> for t in doc.getToC(): print(t)                 # demonstrate it worked
[1, 'The PyMuPDF Documentation', 1]
```

(continues on next page)

(continued from previous page)

```
[2, 'Introduction modified by setToC', 1]            # <<< this has changed
[3, 'Note on the Name fitz', 1]
[3, 'License', 1]
```

4.1.5 `insertPDF()` Examples

(1) Concatenate two documents including their TOCs:

```
>>> doc1 = fitz.open("file1.pdf")          # must be a PDF
>>> doc2 = fitz.open("file2.pdf")          # must be a PDF
>>> pages1 = len(doc1)                       # save doc1's page count
>>> toc1 = doc1.getToC(simple = False)       # save TOC 1
>>> toc2 = doc2.getToC(simple = False)       # save TOC 2
>>> doc1.insertPDF(doc2)                     # doc2 at end of doc1
>>> for t in toc2:                           # increase toc2 page numbers
        t[2] += pages1                       # by old len(doc1)
>>> doc1.setToC(toc1 + toc2)                 # now result has total TOC
```

Obviously, similar ways can be found in more general situations. Just make sure that hierarchy levels in a row do not increase by more than one. Inserting dummy bookmarks before and after `toc2` segments would heal such cases. A ready-to-use GUI (wxPython) solution can be found in script PDFjoiner.py of the examples directory.

(2) More examples:

```
>>> # insert 5 pages of doc2, where its page 21 becomes page 15 in doc1
>>> doc1.insertPDF(doc2, from_page = 21, to_page = 25, start_at = 15)
```

```
>>> # same example, but pages are rotated and copied in reverse order
>>> doc1.insertPDF(doc2, from_page = 25, to_page = 21, start_at = 15, rotate = 90)
```

```
>>> # put copied pages in front of doc1
>>> doc1.insertPDF(doc2, from_page = 21, to_page = 25, start_at = 0)
```

4.1.6 Other Examples

Extract all page-referenced images of a PDF into separate PNG files:

```
for i in range(len(doc)):
    imglist = doc.getPageImageList(i)
    for img in imglist:
        xref = img[0]                    # xref number
        pix = fitz.Pixmap(doc, xref)    # make pixmap from image
        if pix.n - pix.alpha < 4:        # can be saved as PNG
            pix.writePNG("p%s-%s.png" % (i, xref))
        else:                            # CMYK: must convert first
            pix0 = fitz.Pixmap(fitz.csRGB, pix)
            pix0.writePNG("p%s-%s.png" % (i, xref))
            pix0 = None                  # free Pixmap resources
        pix = None                       # free Pixmap resources
```

Rotate all pages of a PDF:

```
>>> for page in doc: page.setRotation(90)
```

4.2 Outline

`outline` (or "bookmark"), is a property of `Document`. If not `None`, it stands for the first outline item of the document. Its properties in turn define the characteristics of this item and also point to other outline items in "horizontal" or downward direction. The full tree of all outline items for e.g. a conventional table of contents (TOC) can be recovered by following these "pointers".

Method / Attribute	Short Description
Outline.down	next item downwards
Outline.next	next item same level
Outline.page	page number (0-based)
Outline.title	title
Outline.uri	string further specifying the outline target
Outline.isExternal	target is outside this document
Outline.is_open	whether sub-outlines are open or collapsed
Outline.isOpen	whether sub-outlines are open or collapsed
Outline.dest	points to link destination details

Class API

class Outline

down
The next outline item on the next level down. Is `None` if the item has no kids.

Type *Outline*

next
The next outline item at the same level as this item. Is `None` if this is the last one in its level.

Type *Outline*

page
The page number (0-based) this bookmark points to.

Type int

title
The item's title as a string or `None`.

Type str

is_open
Or `isOpen` - an indicator showing whether any sub-outlines should be expanded (`True`) or be collapsed (`False`). This information should be interpreted by PDF display software accordingly.

Type bool

isExternal
A bool specifying whether the target is outside (`True`) of the current document.

Type bool

uri
A string specifying the link target. The meaning of this property should be evaluated in conjunction with `isExternal`. The value may be `None`, in which case `isExternal == False`. If `uri` starts with `file://`, `mailto:`, or an internet resource name, `isExternal` is `True`. In all other cases `isExternal == False` and `uri` points to an internal location. In case of PDF documents, this should either be `#nnnn` to indicate a 1-based (!) page number `nnnn`, or a named location. The format varies for other document types, e.g. `uri = '../FixedDoc.fdoc#PG_21_LNK_84'` for page number 21 (1-based) in an XPS document.

Type str

dest
The link destination details object.

Type *linkDest*

4.3 Page

Class representing a document page. A page object is created by *Document.loadPage()* or, equivalently, via indexing the document like `doc[n]` - it has no independent constructor.

There is a parent-child relationship between a document and its pages. If the document is closed or deleted, all page objects (and their respective children, too) in existence will become unusable. If a page property or method is being used, an exception is raised saying that the page object is "orphaned".

Several page methods have a *Document* counterpart for convenience. At the end of this chapter you will find a synopsis.

4.3.1 Adding Page Content

This is available for PDF documents only. There are basically two groups of methods:

1. Methods making permanent changes. This group contains `insertText()`, `insertTextbox()` and all `draw*()` methods. They provide "stand-alone", shortcut versions for the same-named methods of the *Shape* class. For detailed descriptions have a look in that chapter. Some remarks on the relationship between the *Page* and *Shape* methods:

- In contrast to *Shape*, the results of page methods are not interconnected: they do not share properties like colors, line width / dashing, morphing, etc.
- Each page `draw*()` method invokes a *Shape.finish()* and then a *Shape.commit()* and consequently accepts the combined arguments of both these methods.
- Text insertion methods (`insertText()` and `insertTextbox()`) do not need *Shape.finish()* and therefore only invoke *Shape.commit()*.

2. Methods for maintaining annotations. Annotations can be added, modified and deleted without necessarily having full document permissions. Their effect is **not permanent** in the sense, that manipulating them does not require to rebuild the document. **Adding** and **deleting** annotations are page methods. **Changing** existing annotations is possible via methods of the *Annot* class.

Method / Attribute	Short Description
Page.bound()	rectangle of the page
Page.addTextAnnot()	PDF only: add comment and a note icon
Page.addFreetextAnnot()	PDF only: add a text annotation
Page.addLineAnnot()	PDF only: add a line annotation
Page.addFileAnnot()	PDF only: add a file attachment annotation
Page.addRectAnnot()	PDF only: add a rectangle annotation
Page.addCircleAnnot()	PDF only: add a circle annotation
Page.addPolylineAnnot()	PDF only: add a multi-line annotation
Page.addPolygonAnnot()	PDF only: add a polygon annotation
Page.addStrikeoutAnnot()	PDF only: add a "strike-out" annotation
Page.addHighlightAnnot()	PDF only: add a "highlight" annotation
Page.addUnderlineAnnot()	PDF only: add an "underline" annotation
Page.addWidget()	PDF only: add a PDF Form field
Page.deleteAnnot()	PDF only: delete an annotation
Page.deleteLink()	PDF only: delete a link

Continued on next page

Table 2 – continued from previous page

Method / Attribute	Short Description
Page.drawBezier()	PDF only: draw a cubic Bézier curve
Page.drawCircle()	PDF only: draw a circle
Page.drawCurve()	PDF only: draw a special Bézier curve
Page.drawLine()	PDF only: draw a line
Page.drawOval()	PDF only: draw an oval / ellipse
Page.drawPolyline()	PDF only: connect a point sequence
Page.drawRect()	PDF only: draw a rectangle
Page.drawSector()	PDF only: draw a circular sector
Page.drawSquiggle()	PDF only: draw a squiggly line
Page.drawZigzag()	PDF only: draw a zig-zagged line
Page.getFontList()	PDF only: get list of used fonts
Page.getImageList()	PDF only: get list of used images
Page.getLinks()	get all links
Page.getPixmap()	create a *Pixmap*
Page.getSVGimage()	create a page image in SVG format
Page.getText()	extract the page's text
Page.insertImage()	PDF only: insert an image
Page.insertLink()	PDF only: insert a new link
Page.insertText()	PDF only: insert text
Page.insertTextbox()	PDF only: insert a text box
Page.loadLinks()	return the first link on a page
Page.newShape()	PDF only: start a new *Shape*
Page.searchFor()	search for a string
Page.setRotation()	PDF only: set page rotation
Page.setCropBox()	PDF only: modify the visible page
Page.showPDFpage()	PDF only: display PDF page image
Page.updateLink()	PDF only: modify a link
Page.CropBoxPosition	displacement of the /CropBox
Page.CropBox	the page's /CropBox
Page.MediaBoxSize	bottom-right point of /MediaBox
Page.MediaBox	the page's /MediaBox
Page.firstAnnot	first *Annot* on the page
Page.firstLink	first *Link* on the page
Page.number	page number
Page.parent	owning document object
Page.rect	rectangle (mediabox) of the page
Page.rotation	PDF only: page rotation

Class API

class Page

bound()
Determine the rectangle (before transformation) of the page. Same as property *Page.rect* below. For PDF documents this **usually** also coincides with objects `/MediaBox` and `/CropBox`, but not always. The best description hence is probably "`/CropBox`, relocated such that top-left coordinates are (0, 0)". Also see attributes *Page.CropBox* and *Page.MediaBox*.

Return type *Rect*

addTextAnnot(*point*, *text*)
PDF only: Add a comment icon with accompanying text ("sticky note").

Parameters

- **point** (*Point*) – the top left point of a 25 x 25 rectangle containing the "note" icon.
- **text** (*str*) – the commentary text. This will be shown on double clicking the icon. This text may contain any unicode (in contrast to *addFreetextAnnot()*).

Return type *Annot*

Returns the created annotation. To attach other information (like author, creation date, etc.) use methods of *Annot*.

addFreetextAnnot(*point*, *text*, *fontsize = 11*, *color = (0, 0, 0)*)

PDF only: Add text of a given fontsize and color. The font is fixed to "Helvetica" (see *PDF Base 14 Fonts*).

Parameters

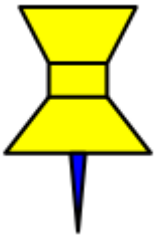
- **point** (*Point*) – the starting point of the text.
- **text** (*str*) – the text. Only ASCII characters are currently supported (a restriction eventually lifted in a future MuPDF release). Characters outside this range will be replaced by (one or more) "?".
- **fontsize** (*float*) – fontsize.
- **color** (*sequ*) – RGB float color triple for text color. Default is black.

Return type *Annot*

Returns the created annotation. To attach other information (like author, creation date, etc.) use methods of *Annot*.

addFileAnnot(*pos*, *buffer*, *filename*, *ufilename = None*, *desc = None*)

PDF only: Add a file attachment annotation.



Parameters

- **pos** (*Point*) – the top-left point of a 20 x 30 rectangle cpntaining the "PushPin" icon.
- **buffer** (*bytes/bytearray*) – the file content.
- **filename** (*str*) – the filename (required).
- **ufilename** (*str*) – the optional PDF unicode filename. Defaults to filename.
- **desc** (*str*) – an optional description of the file. Defaults to filename.

Return type *Annot*

Returns the created annotation. To change, or add information (like author, creation date, etc.) use methods of *Annot*.

addLineAnnot(*p1*, *p2*)

PDF only: Add a line annotation.

Parameters

- **p1** (*Point*) – the starting point of the line.
- **p2** (*Point*) – the end point of the line.

Return type *Annot*

Returns the created annotation. It is drawn with line color black and line width 1. To change, or attach other information (like author, creation date, line properties, colors, line ends, etc.) use methods of *Annot*.

addRectAnnot(*rect*)

addCircleAnnot(*rect*)

PDF only: Add a rectangle or circle annotation.

Parameters **rect** (*Rect*) – the rectangle in which the circle / rectangle is drawn. If the rectangle is not equal-sided, an ellipse is drawn.

Return type *Annot*

Returns the created annotation. It is drawn with line color black, no fill color and line width 1. To change, or attach other information (like author, creation date, line properties, colors, etc.) use methods of *Annot*.

addPolylineAnnot(*points*)

addPolygonAnnot(*points*)

PDF only: Add an annotation consisting of multiple conected lines. A polygon's first and last points are automatically connected. A polyline has a start and an end point, which may be given line end symbols (*Annotation Line End Styles*).

Parameters **points** (*list*) – a list of *Point* objects.

Return type *Annot*

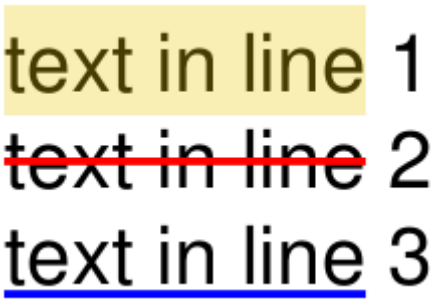
Returns the created annotation. It is drawn with line color black, no fill color and line width 1. To change, or attach other information (like author, creation date, line properties, line ends, colors, etc.) use methods of *Annot*.

addUnderlineAnnot(*rect*)

addStrikeoutAnnot(*rect*)

addHighlightAnnot(*rect*)

PDF only: These annotations are used for marking some text that has previously been located via *searchFor()*. Colors are automatically chosen: yellowish for highlighting, red for strike out and blue for underlining.



Parameters **rect** (*Rect*) – the rectangle containing the text.

Return type *Annot*

Returns the created annotation. To attach other information (like author, creation date, etc.) use methods of *Annot*.

addWidget(*widget*)

PDF only: Add a PDF Form field ("widget") to a page. This also turns the PDF into a Form PDF. Because of the large amount of different options, we have developed a new class *Widget*, which contains the possible PDF field attributes.

Parameters **widget** (*Widget*) – a *Widget* object which has been created upfront.

Returns a widget annotation.

Note: Make sure to use parameter `clean = True` when saving the file. This will cause recalculation of the annotations appearance.

---

deleteAnnot(*annot*)

PDF only: Delete the specified annotation from the page and return the next one.

Parameters **annot** (*Annot*) – the annotation to be deleted.

Return type *Annot*

Returns the annotation following the deleted one.

deleteLink(*linkdict*)

PDF only: Delete the specified link from the page. The parameter must be an **original item** of *getLinks()* (see below). The reason for this is the dictionary's `"xref"` key, which identifies the PDF object to be deleted.

Parameters **linkdict** (*dict*) – the link to be deleted.

insertLink(*linkdict*)

PDF only: Insert a new link on this page. The parameter must be a dictionary of format as provided by *getLinks()* (see below).

Parameters **linkdict** (*dict*) – the link to be inserted.

updateLink(*linkdict*)

PDF only: Modify the specified link. The parameter must be a (modified) **original item** of *getLinks()* (see below). The reason for this is the dictionary's `"xref"` key, which identifies the PDF object to be changed.

Parameters **linkdict** (*dict*) – the link to be modified.

getLinks()

Retrieves **all** links of a page.

Return type list

Returns A list of dictionaries. The entries are in the order as specified during PDF generation. For a description of the dictionary entries see below. Always use this method if you intend to make changes to the links of a page.

insertText(*point*, *text = text*, *fontsize = 11*, *fontname = "Helvetica"*, *fontfile = None*, *idx = 0*, *color = (0, 0, 0)*, *rotate = 0*, *morph = None*, *overlay = True*)
PDF only: Insert text.

insertTextbox(*rect*, *buffer*, *fontsize = 11*, *fontname = "Helvetica"*, *fontfile = None*, *idx = 0*, *color = (0, 0, 0)*, *expandtabs = 8*, *align = TEXT_ALIGN_LEFT*, *charwidths = None*, *rotate = 0*, *morph = None*, *overlay = True*)
PDF only: Insert text into the specified rectangle.

drawLine(*p1*, *p2*, *color = (0, 0, 0)*, *width = 1*, *dashes = None*, *roundCap = True*, *overlay = True*, *morph = None*)
PDF only: Draw a line from *Point* objects `p1` to `p2`.

drawZigzag(*p1*, *p2*, *breadth = 2*, *color = (0, 0, 0)*, *width = 1*, *dashes = None*, *roundCap = True*, *overlay = True*, *morph = None*)
PDF only: Draw a zigzag line from *Point* objects `p1` to `p2`.

drawSquiggle(*p1*, *p2*, *breadth = 2*, *color = (0, 0, 0)*, *width = 1*, *dashes = None*, *roundCap = True*, *overlay = True*, *morph = None*)
PDF only: Draw a squiggly (wavy, undulated) line from *Point* objects `p1` to `p2`.

drawCircle(*center*, *radius*, *color = (0, 0, 0)*, *fill = None*, *width = 1*, *dashes = None*, *roundCap = True*, *overlay = True*, *morph = None*)
PDF only: Draw a circle around `center` with a radius of `radius`.

drawOval(*rect*, *color = (0, 0, 0)*, *fill = None*, *width = 1*, *dashes = None*, *roundCap = True*, *overlay = True*, *morph = None*)
PDF only: Draw an oval (ellipse) within the given rectangle.

drawSector(*center*, *point*, *angle*, *color = (0, 0, 0)*, *fill = None*, *width = 1*, *dashes = None*, *roundCap = True*, *fullSector = True*, *overlay = True*, *closePath = False*, *morph = None*)
PDF only: Draw a circular sector, optionally connecting the arc to the circle's center (like a piece of pie).

drawPolyline(*points*, *color = (0, 0, 0)*, *fill = None*, *width = 1*, *dashes = None*, *roundCap = True*, *overlay = True*, *closePath = False*, *morph = None*)
PDF only: Draw several connected lines defined by a sequence of points.

drawBezier(*p1*, *p2*, *p3*, *p4*, *color = (0, 0, 0)*, *fill = None*, *width = 1*, *dashes = None*, *roundCap = True*, *overlay = True*, *closePath = False*, *morph = None*)
PDF only: Draw a cubic Bézier curve from `p1` to `p4` with the control points `p2` and `p3`.

drawCurve(*p1*, *p2*, *p3*, *color = (0, 0, 0)*, *fill = None*, *width = 1*, *dashes = None*, *roundCap = True*, *overlay = True*, *closePath = False*, *morph = None*)
PDF only: This is a special case of `drawBezier()`.

drawRect(*rect*, *color = (0, 0, 0)*, *fill = None*, *width = 1*, *dashes = None*, *roundCap = True*, *overlay = True*, *morph = None*)
PDF only: Draw a rectangle.

Note: An efficient way to background-color a PDF page with the old Python paper color is `page.drawRect(page.rect, color = py_color, fill = py_color, overlay = False)`, where `py_color = getColor("py_color")`.

---

insertImage(*rect*, *filename = None*, *pixmap = None*, *stream = None*, *overlay = True*)
PDF only: Fill the given rectangle with an image. The image's width-height-proportion will be adjusted to fit. Specify the rectangle appropriately if you want to avoid this. The image is taken from a pixmap, a file or a memory area - of these parameters **exactly one** must be specified.

Parameters

- **rect** (*Rect*) – where to put the image on the page. `rect` must be finite and not empty.
- **filename** (*str*) – name of an image file (all MuPDF supported formats - see *Supported Input Image Types*). If the same image is to be inserted multiple times, choose one of the other two options to avoid some overhead.
- **stream** (*bytes/bytearray*) – memory resident image (all MuPDF supported formats - see *Supported Input Image Types*).
- **pixmap** (*Pixmap*) – pixmap containing the image.

For a description of `overlay` see *Common Parameters*.

This example puts the same image on every page of a document:

```
>>> doc = fitz.open(...)
>>> rect = fitz.Rect(0, 0, 50, 50)       # put thumbnail in upper left␣
↪corner
>>> img = open("some.jpg", "rb").read()  # an image file
>>> for page in doc:
        page.insertImage(rect, stream = img)
>>> doc.save(...)
```

Notes:

1. If that same image had already been present in the PDF, then only a reference will be inserted. This of course considerably saves disk space and processing time. But to detect this fact, existing PDF images need to be compared with the new one. This is achieved by storing an MD5 code for each image in a table and only compare the new image's code against the table entries. Generating this MD5 table, however, is done only when doing the first image insertion - which therefore may have an extended response time.
2. You can use this method to provide a background or foreground image for the page, like a copyright, a watermark or a background color. Or you can combine it with `searchFor()` to achieve a textmarker effect. Please remember, that watermarks require a transparent image ...
3. The image may be inserted uncompressed, e.g. if a `Pixmap` is used or if the image has an alpha channel. Therefore, consider using `deflate = True` when saving the file.
4. The image content is stored in its original size - which may be much bigger than the size you are ever displaying. Consider decreasing the stored image size by using the pixmap option and then shrinking it or scaling it down (see *Pixmap* chapter). The file size savings can be very significant.
5. The most efficient way to display the same image on multiple pages is *showPDFpage()*. Consult *Document.convertToPDF()* for how to obtain intermediary PDFs usable for that method. Demo script fitz-logo.py implements a fairly complete approach.

getText(*output = 'text'*)

Retrieves the content of a page in a large variety of formats.

If `'text'` is specified, plain text is returned **in the order as specified during document creation** (i.e. not necessarily the normal reading order).

Parameters **output** (*str*) – A string indicating the requested format, one of `"text"` (default), `"html"`, `"dict"`, `"xml"`, `"xhtml"` or `"json"`.

Return type (*str* or *dict*)

Returns The page's content as one string or as a dictionary. The information level of JSON and DICT are exactly equal. In fact, JSON output is created via `json.dumps(...)` from DICT. Normally, you probably will use `"dict"`, it is more convenient and faster.

Note: You can use this method to convert the document into a valid HTML version by wrapping it with appropriate header and trailer strings, see the following snippet. Creating XML or XHTML documents works in exactly the same way. For XML you may also include an arbitrary filename like so: `fitz.ConversionHeader("xml", filename = doc.name)`. Also see *Controlling Quality of HTML Output*.

```
>>> doc = fitz.open(...)
>>> ofile = open(doc.name + ".html", "w")
>>> ofile.write(fitz.ConversionHeader("html"))
>>> for page in doc: ofile.write(page.getText("html"))
>>> ofile.write(fitz.ConversionTrailer("html"))
>>> ofile.close()
```

getFontList()
PDF only: Return a list of fonts referenced by the page. Same as *Document.getPageFontList()*.

getImageList()
PDF only: Return a list of images referenced by the page. Same as *Document.getPageImageList()*.

getSVGimage(*matrix = fitz.Identity*)

Create an SVG image from the page. Only full page images are currently supported.

Parameters **matrix** (*Matrix*) – a *Matrix*, default is *Identity*.

Returns a UTF-8 encoded string that contains the image. Because SVG has XML syntax it can be saved in a text file with extension `.svg`.

getPixmap(*matrix = fitz.Identity, colorspace = fitz.csRGB, clip = None, alpha = True*)
Create a pixmap from the page. This is probably the most often used method to create pixmaps.

Parameters

- **matrix** (*Matrix*) – a *Matrix*, default is *Identity*.
- **colorspace** (string, *Colorspace*) – Defines the required colorspace, one of `GRAY`, `RGB` or `CMYK` (case insensitive). Or specify a *Colorspace*, e.g. one of the predefined ones: *csGRAY*, *csRGB* or *csCMYK*.
- **clip** (*IRect*) – restrict rendering to this area.
- **alpha** (*bool*) – A bool indicating whether an alpha channel should be included in the pixmap. Choose `False` if you do not really need transparency. This will save a lot of memory (25% in case of RGB ... and pixmaps are typically **large**!), and also processing time in most cases. Also note an important difference in how the image will appear:
  - `True`: pixmap's samples will be pre-cleared with `0x00`, including the alpha byte. This will result in **transparent** areas where the page is empty.

– `False`: pixmap's samples will be pre-cleared with `0xff`. This will result in **white** where the page has nothing to show.

Return type *Pixmap*

Returns Pixmap of the page.

loadLinks()

Return the first link on a page. Synonym of property `firstLink`.

Return type *Link*

Returns first link on the page (or `None`).

setRotation(*rot*)

PDF only: Sets the rotation of the page.

Parameters **rot** (*int*) – An integer specifying the required rotation in degrees. Should be an integer multiple of 90.

showPDFpage(*rect*, *docsrc*, *pno = 0*, *keep_proportion = True*, *overlay = True*, *reuse_xref = 0*, *clip = None*)

PDF only: Display a page of another PDF as a **vector image** (otherwise similar to *Page.insertImage()*). This is a multi-purpose method, use it to

- create "n-up" versions of existing PDF files, combining several input pages into **one output page** (see example 4-up.py),
- create "posterized" PDF files, i.e. every input page is split up in parts which each create a separate output page (see posterize.py),
- include PDF-based vector images like company logos, watermarks, etc., see svg-logo.py, which puts an SVG-based logo on each page (requires additional packages to deal with SVG-to-PDF conversions).

Parameters

- **rect** (*Rect*) – where to place the image.
- **docsrc** (*Document*) – source PDF document containing the page. Must be a different document object, but may be the same file.

- **pno** (*int*) – page number (0-based) to be shown.
- **keep_proportion** (*bool*) – whether to maintain the width-height-ratio (default).
- **overlay** (*bool*) – put image in foreground (default) or background.
- **reuse_xref** (*int*) – if a source page should be shown multiple times, specify the returned xref number of its first inclusion. This prevents duplicate source page copies, and thus improves performance and saves memory. Note that source document and page must still be provided!
- **clip** (*Rect*) – choose which part of the source page to show. Default is its `/CropBox`.

Returns xref number of the stored page image if successful. Use this as the value of argument `reuse_xref` to show the same source page again.

Note: The displayed source page is shown without any annotations or links. The source page's complete text and images will become an integral part of the containing page, i.e. they will be included in the output of all text extraction methods and appear in methods *getFontList()* and *getImageList()* (whether they are actually visible - see the `clip` parameter - or not).

Note: Use the `reuse_xref` argument to prevent duplicates as follows. For a technical description of how this function is implemented, see *Design of Method Page.showPDFpage()*. The following example will put the same source page (probably a company logo or watermark) on every page of PDF `doc`. The first execution actually inserts the source page, the subsequent ones will only insert pointers to it via its xref number.

```
>>> # the first showPDFpage will include source page docsrc[pno],
>>> # subsequents will reuse it via its xref.
>>> xref = 0
>>> for page in doc:
        xref = page.showPDFpage(rect, docsrc, pno,
                                reuse_xref = xref)
```

newShape()

PDF only: Create a new *Shape* object for the page.

Return type *Shape*

Returns a new *Shape* to use for compound drawings. See description there.

searchFor(*text*, *hit_max = 16*)

Searches for `text` on a page. Identical to *TextPage.search()*.

Parameters

- **text** (*str*) – Text to searched for. Upper / lower case is ignored.
- **hit_max** (*int*) – Maximum number of occurrences accepted.

Return type list

Returns A list of *Rect* rectangles each of which surrounds one occurrence of `text`.

setCropBox(*r*)

PDF only: change the visible part of the page.

Parameters **r** (*Rect*) – the new visible area of the page.

After execution, *Page.rect* will equal this rectangle, shifted to the top-left position (0, 0). Example session:

```
>>> page = doc.newPage()
>>> page.rect
fitz.Rect(0.0, 0.0, 595.0, 842.0)
>>>
>>> page.CropBox                    # CropBox and MediaBox still equal
fitz.Rect(0.0, 0.0, 595.0, 842.0)
>>>
>>> # now set CropBox to a part of the page
>>> page.setCropBox(fitz.Rect(100, 100, 400, 400))
>>> # this will also change the "rect" property:
>>> page.rect
fitz.Rect(0.0, 0.0, 300.0, 300.0)
>>>
>>> # but MediaBox remains unaffected
>>> page.MediaBox
fitz.Rect(0.0, 0.0, 595.0, 842.0)
>>>
>>> # revert everything we did
>>> page.setCropBox(page.MediaBox)
>>> page.rect
fitz.Rect(0.0, 0.0, 595.0, 842.0)
```

rotation
PDF only: contains the rotation of the page in degrees and `-1` for other document types.

Type int

CropBoxPosition
Contains the displacement of the page's `/CropBox` for a PDF, otherwise the top-left coordinates of *Page.rect*.

Type *Point*

CropBox
The page's `/CropBox` for a PDF, else *Page.rect*.

Type *Rect*

MediaBoxSize
Contains the width and height of the page's `/MediaBox` for a PDF, otherwise the bottom-right coordinates of *Page.rect*.

Type *Point*

MediaBox
The page's `/MediaBox` for a PDF, otherwise *Page.rect*.

Type *Rect*

Note: For most PDF documents and for all other types, `page.rect == page.CropBox == page.MediaBox` is true. However, for some PDFs the visible page is a true subset of `/MediaBox`. In this case the above attributes help to correctly locate page elements.

---

firstLink
Contains the first *Link* of a page (or `None`).

Type *Link*

firstAnnot
Contains the first *Annot* of a page (or `None`).

Type *Annot*

number
The page number.

Type int

parent
The owning document object.

Type *Document*

rect
Contains the rectangle of the page. Same as result of *Page.bound()*.

Type *Rect*

4.3.2 Description of `getLinks()` Entries

Each entry of the `getLinks()` list is a dictionay with the following keys:

- `kind`: (required) an integer indicating the kind of link. This is one of `LINK_NONE`, `LINK_GOTO`, `LINK_GOTOR`, `LINK_LAUNCH`, or `LINK_URI`. For values and meaning of these names refer to *Link Destination Kinds*.
- `from`: (required) a *Rect* describing the "hot spot" location on the page's visible representation (where the cursor changes to a hand image, usually).
- `page`: a 0-based integer indicating the destination page. Required for `LINK_GOTO` and `LINK_GOTOR`, else ignored.
- `to`: either a `fitz.Point`, specifying the destination location on the provided page, default is `fitz.Point(0, 0)`, or a symbolic (indirect) name. If an indirect name is specified, `page = -1` is required and the name must be defined in the PDF in order for this to work. Required for `LINK_GOTO` and `LINK_GOTOR`, else ignored.
- `file`: a string specifying the destination file. Required for `LINK_GOTOR` and `LINK_LAUNCH`, else ignored.
- `uri`: a string specifying the destination internet resource. Required for `LINK_URI`, else ignored.
- `xref`: an integer specifying the PDF cross reference entry of the link object. Do not change this entry in any way. Required for link deletion and update, otherwise ignored. For non-PDF documents, this entry contains `-1`. It is also `-1` for **all** entries in the `getLinks()` list, if **any** of the links is not supported by MuPDF - see the note below.

4.3.3 Notes on Supporting Links

MuPDF's support for links has changed in **v1.10a**. These changes affect link types *LINK_GOTO* and *LINK_GOTOR*.

Reading (pertains to method `getLinks()` and the `firstLink` property chain)

If MuPDF detects a link to another file, it will supply either a `LINK_GOTOR` or a `LINK_LAUNCH` link kind. In case of `LINK_GOTOR` destination details may either be given as page number (eventually including position information), or as an indirect destination.

If an indirect destination is given, then this is indicated by `page = -1`, and `link.dest.dest` will contain this name. The dictionaries in the `getLinks()` list will contain this information as the `to` value.

Internal links are always of kind `LINK_GOTO`. If an internal link specifies an indirect destination, it **will always be resolved** and the resulting direct destination will be returned. Names are **never returned for internal links**, and undefined destinations will cause the link to be ignored.

Writing

PyMuPDF writes (updates, inserts) links by constructing and writing the appropriate PDF object **source**. This makes it possible to specify indirect destinations for `LINK_GOTOR` **and** `LINK_GOTO` link kinds (pre `PDF 1.2` file formats are **not supported**).

> **Caution:** If a `LINK_GOTO` indirect destination specifies an undefined name, this link can later on not be found / read again with MuPDF / PyMuPDF. Other readers however **will** detect it, but flag it as erroneous.

Indirect `LINK_GOTOR` destinations can in general of course not be checked for validity and are therefore **always accepted**.

4.3.4 Homologous Methods of Document and Page

This is an overview of homologous methods on the *Document* and on the *Page* level.

Document Level	Page Level
`Document.getPageFontlist(pno)`	*`Page.getFontList()`*
`Document.getPageImageList(pno)`	*`Page.getImageList()`*
`Document.getPagePixmap(pno, ...)`	*`Page.getPixmap()`*
`Document.getPageText(pno, ...)`	*`Page.getText()`*
`Document.searchPageFor(pno, ...)`	*`Page.searchFor()`*
`Document._getPageXref(pno)`	*`Page._getXref()`*

The page number `pno` is 0-based and can be any negative or positive number `< len(doc)`.

Technical Side Note:

Most document methods (left column) exist for convenience reasons, and are just wrappers: `Document[pno].<method>`. So they load and discard the page on each execution.

However, the first two methods work differently. They only need a page's object definition statement - the page need not be loaded. So e.g. *`Page.getFontList()`* is a wrapper the other way round: `Page.parent.getPageFontList(Page.number)`.

4.4 Pixmap

Pixmaps ("pixel maps") are objects at the heart of MuPDF's rendering capabilities. They represent plane rectangular sets of pixels. Each pixel is described by a number of bytes ("components") defining its color, plus an optional alpha byte defining its transparency.

In PyMuPDF, there exist several ways to create a pixmap. Except the first one, all of them are available as overloaded constructors. A pixmap can be created ...

1. from a document page (method *`Page.getPixmap()`*)
2. empty, based on *Colorspace* and *IRect* information
3. from a file
4. from an in-memory image

5. from a memory area of plain pixels
6. from an image inside a PDF document
7. as a copy of another pixmap

Note: A number of image formats is supported as input for points 3. and 4. above. See section *Supported Input Image Types*.

Have a look at the *Pixmap Example Code Snippets* section to see some pixmap usage "at work".

Method / Attribute	Short Description
Pixmap.clearWith()	clear parts of a pixmap
Pixmap.copyPixmap()	copy parts of another pixmap
Pixmap.gammaWith()	apply a gamma factor to the pixmap
Pixmap.getPNGData()	return a PNG as a memory area
Pixmap.invertIRect()	invert the pixels of a given area
Pixmap.setAlpha()	sets alpha values
Pixmap.shrink()	reduce size keeping proportions
Pixmap.tintWith()	tint a pixmap with a color
Pixmap.writeImage()	save a pixmap in various formats
Pixmap.writePNG()	save a pixmap as a PNG file
Pixmap.alpha	transparency indicator
Pixmap.colorspace	pixmap's *Colorspace*
Pixmap.height	pixmap height
Pixmap.interpolate	interpolation method indicator
Pixmap.irect	*IRect* of the pixmap
Pixmap.n	bytes per pixel
Pixmap.samples	pixel area
Pixmap.size	pixmap's total length
Pixmap.stride	size of one image row
Pixmap.width	pixmap width
Pixmap.x	X-coordinate of top-left corner
Pixmap.xres	resolution in X-direction
Pixmap.y	Y-coordinate of top-left corner
Pixmap.yres	resolution in Y-direction

Class API

class Pixmap

__init__(*self*, *colorspace*, *irect*, *alpha*)

New empty pixmap: Create an empty pixmap of size and origin given by the rectangle. So, `irect.top_left` designates the top left corner of the pixmap, and its width and height are `irect.width` resp. `irect.height`. Note that the image area is **not initialized** and will contain crap data - use *clearWith()* to be sure.

Parameters

- **colorspace** (*Colorspace*) – colorspace.
- **irect** (*IRect*) – Tte pixmap's position and dimension.
- **alpha** (*bool*) – Specifies whether transparency bytes should be included. Default is `False`.

__init__(*self*, *colorspace*, *source*)

Copy and set colorspace: Copy `source` pixmap converting colorspace. Any colorspace combination is possible, but source colorspace must not be `None`.

Parameters

- **colorspace** (*Colorspace*) – desired target colorspace. This **may also be** `None`. In this case, a "masking" pixmap is created: its *Pixmap.samples* will consist of the source's alpha bytes only.
- **source** (`Pixmap`) – the source pixmap.

__init__(*self*, *source*, *width*, *height*[, *clip*])

Copy and scale: Copy `source` pixmap choosing new width and height values. Supports partial copying and the source colorspace may be `None`.

Parameters

- **source** (`Pixmap`) – the source pixmap.
- **width** (*float*) – desired target width.
- **height** (*float*) – desired target height.
- **clip** (*IRect*) – a region of the source pixmap to take the copy from.

Note: If width or height are in fact no integers, the pixmap will be created with `alpha = 1`.

__init__(*self*, *source*, *alpha = 1*)

Copy and add or drop alpha: Copy `source` and add or drop its alpha channel. Identical copy if `alpha` equals `source.alpha`. If an alpha channel is added, its values will be set to 255.

Parameters

- **source** (`Pixmap`) – source pixmap.
- **alpha** (*bool*) – whether the target will have an alpha channel, default and mandatory if source colorspace is `None`.

__init__(*self*, *filename*)

From a file: Create a pixmap from `filename`. All properties are inferred from the input. The origin of the resulting pixmap is `(0, 0)`.

Parameters **filename** (*str*) – Path of the image file.

__init__(*self*, *img*)

From memory: Create a pixmap from a memory area. All properties are inferred from the input. The origin of the resulting pixmap is `(0, 0)`.

Parameters **img** (*bytes/bytearray*) – Data containing a complete, valid image. Could have been created by e.g. `img = bytearray(open('image.file', 'rb').read())`. Type `bytes` is supported in **Python 3 only**.

__init__(*self*, *colorspace*, *width*, *height*, *samples*, *alpha*)

From plain pixels: Create a pixmap from `samples`. Each pixel must be represented by a number of bytes as controlled by the `colorspace` and `alpha` parameters. The origin of the resulting pixmap is `(0, 0)`. This method is useful when raw image data are provided by some other program - see *Pixmap Example Code Snippets* below.

Parameters

- **colorspace** (*Colorspace*) – Colorspace of image.
- **width** (*int*) – image width
- **height** (*int*) – image height
- **samples** (*bytes/bytearray*) – an area containing all pixels of the image. Must include alpha values if specified.

- **alpha** (*bool*) – whether a transparency channel is included.

Note: The following equation **must be true**: `(colorspace.n + alpha) * width * height == len(samples)`.

Caution: The method will not make a copy of `samples`, but rather record a pointer. Therefore make sure that it remains available throughout the lifetime of the pixmap. Otherwise the pixmap's image will likely be destroyed or even worse things will happen.

__init__(*self*, *doc*, *xref*)

From a PDF image: Create a pixmap from an image **contained in PDF** `doc` identified by its XREF number. All pimap properties are set by the image. Have a look at extract-img1.py and extract-img2.py to see how this can be used to recover all of a PDF's images.

Parameters

- **doc** (*Document*) – an opened **PDF** document.
- **xref** (*int*) – the XREF number of an image object. For example, you can make a list of images used on a particular page with *Document.getPageImageList()*, which also shows the xref numbers of each image.

clearWith(*value*, *irect*)

Initialize the samples area.

Parameters

- **value** (*int*) – if specified, values from 0 to 255 are valid. Each color byte of each pixel will be set to this value, while alpha will be set to 255 (non-transparent) if present. If omitted, then all bytes (including any alpha) are cleared to 0x00.
- **irect** (*IRect*) – the area to be cleared. Omit to clear the whole pixmap. Can only be specified, if `value` is also specified.

tintWith(*red*, *green*, *blue*)

Colorize (tint) a pixmap with a color provided as an integer triple (red, green, blue). Only colorspaces *CS_GRAY* and *CS_RGB* are supported, others are ignored with a warning.

If the colorspace is *CS_GRAY*, `(red + green + blue)/3` will be taken as the tint value.

Parameters

- **red** (*int*) – `red` component.
- **green** (*int*) – `green` component.
- **blue** (*int*) – `blue` component.

gammaWith(*gamma*)

Apply a gamma factor to a pixmap, i.e. lighten or darken it. Pixmaps with colorspace `None` are ignored with a warning.

Parameters **gamma** (*float*) – `gamma = 1.0` does nothing, `gamma < 1.0` lightens, `gamma > 1.0` darkens the image.

shrink(*n*)

Shrink the pixmap by dividing both, its width and height by 2^n.

Parameters **n** (*int*) – determines the new pixmap (samples) size. For example, a value of 2 divides width and height by 4 and thus results in a size of one 16^{th} of the original. Values less than 1 are ignored with a warning.

Note: Use this methods to reduce a pixmap's size retaining its proportion. The pixmap is changed "in place". If you want to keep original and also have more granular choices, use the resp. copy constructor above.

setAlpha(*alphavalues*)
Change the alpha values. The pixmap must have an alpha channel.

Parameters **alphavalues** (*bytes/bytearray*) – the new alpha values. If provided, its length must be at least `width * height`. If omitted, all alpha values are to 255 (no transparency).

invertIRect(*irect*)
Invert the color of all pixels in *IRect* `irect`. Will have no effect if colorspace is `None`.

Parameters **irect** (*IRect*) – The area to be inverted. Omit to invert everything.

copyPixmap(*source*, *irect*)
Copy the *IRect* part of `source` into the corresponding area of this one. The two pixmaps may have different dimensions and different colorspaces (provided each is either *CS_GRAY* or *CS_RGB*), but currently **must** have the same alpha property. The copy mechanism automatically adjusts discrepancies between source and target like so:

If copying from *CS_GRAY* to *CS_RGB*, the source gray-shade value will be put into each of the three rgb component bytes. If the other way round, `(r + g + b) / 3` will be taken as the gray-shade value of the target.

Between `irect` and the target pixmap's rectangle, an "intersection" is calculated at first. Then the corresponding data of this intersection are being copied. If this intersection is empty, nothing will happen.

If you want your `source` pixmap image to land at a specific target position, set its `x` and `y` attributes to the top left point of the desired rectangle before copying. See the example below for how this works.

Parameters

- **source** (*Pixmap*) – source pixmap.
- **irect** (*IRect*) – The area to be copied.

writeImage(*filename*, *output="png"*)
Save pixmap as an image file. Depending on the output chosen, only some or all colorspaces are supported and different file extensions can be chosen. Please see the table below. Since MuPDF v1.10a the `savealpha` option is no longer supported and will be ignored with a warning.

Parameters

- **filename** (*str*) – The filename to save to. Depending on the chosen output format, possible file extensions are `.pam`, `.pbm`, `.pgm`, `ppm`, `.pnm`, `.png` and `.tga`.
- **output** (*str*) – The requested image format. The default is `png` for which this function is equal to `writePNG()`, see below. Other possible values are `pam`, `pnm` and `tga`.

writePNG(*filename*)
Save the pixmap as a PNG file. Please note that only grayscale and RGB colorspaces are supported (this is **not** a MuPDF restriction). CMYK colorspaces must either be saved as `*.pam` files or be converted first.

Parameters **filename** (*str*) – The filename to save to (the extension `png` must be specified). Existing files will be overwritten without warning.

getPNGData()
Like `writePNG` but returnes `bytearray` / `bytes` instead (Python2, resp. Python 3).

Return type bytearray / bytes

alpha
Indicates whether the pixmap contains transparency information.

Type bool

colorspace
The colorspace of the pixmap. This value may be `None` if the image is to be treated as a so-called *image mask* or *stencil mask* (currently happens for extracted PDF document images only).

Type *Colorspace*

stride
Contains the length of one row of image data in `samples`. This is primarily used for calculation purposes. The following expressions are true: `len(samples) == height * stride`, `width * n == stride`.

Type int

irect
Contains the *IRect* of the pixmap.

Type *IRect*

samples
The color and (if `alpha == 1`) transparency values for all pixels. `samples` is a memory area of size `width * height * n` bytes. Each n bytes define one pixel. Each successive n bytes yield another pixel in scanline order. Subsequent scanlines follow each other with no padding. E.g. for an RGBA colorspace this means, `samples` is a sequence of bytes like `..., R, G, B, A, ...`, and the four byte values R, G, B, A define one pixel.

This area can be passed to other graphics libraries like PIL (Python Imaging Library) to do additional processing like saving the pixmap in other image formats. See example 3.

Type bytes

size
Contains `len(pixmap)`. This will generally equal `len(pix.samples) + 60` (32bit systems, the delta is 88 on 64bit machines).

Type int

width

w
Width of the region in pixels.

Type int

height

h
Height of the region in pixels.

Type int

x
X-coordinate of top-left corner

Type int

y
Y-coordinate of top-left corner

Type int

n
Number of components per pixel. This number depends on colorspace and alpha. If colorspace is not `None` (stencil masks), then `Pixmap.n - Pixmap.aslpha == pixmap.colorspace.n` is true. If colorspace is `None`, then `n == alpha == 1`.

Type int

xres
Horizontal resolution in dpi (dots per inch).

Type int

yres
Vertical resolution in dpi.

Type int

interpolate
An information-only boolean flag set to `True` if the image will be drawn using "linear interpolation". If `False` "nearest neighbour sampling" will be used.

Type bool

4.4.1 Supported Input Image Types

The following file types are supported as input to construct pixmaps: **BMP, JPEG, GIF, TIFF, JXR,** and **PNG**. This support is two-fold:

1. Directly create a pixmap with `Pixmap(filename)` or `Pixmap(byterray)`. The pixmap will then have properties as determined by the image.
2. Open such files with `fitz.open(...)`. The result will then appear as a document containing one single page. Creating a pixmap of this page offers all options available in this context: apply a matrix, choose colorspace and alpha, confine the pixmap to a clip area, etc.

SVG images are only supported via method 2 above, not directly as pixmaps. If you need a **vector image** from the SVG, you must first convert it to a PDF. Try *`Document.convertToPDF()`*. If this does not work for you, look for other SVG-to-PDF conversion tools like the Python package svglib or the Java solution Apache Batik. Have a look at our Wiki for more examples.

4.4.2 Details on Saving Images with `writeImage()`

The following table shows possible combinations of file extensions, output formats and colorspaces of method `writeImage()`:

output =	CS_GRAY	CS_RGB	CS_CMYK
"pam"	.pam	.pam	.pam
"pnm"	.pnm, .pgm	.pnm, .ppm	invalid
"png"	.png	.png	invalid
"tga"	.tga	.tga	invalid

Note: Not all image file types are available, or at least common on all platforms, e.g. PAM is mostly unknown on Windows. Especially pertaining to CMYK colorspaces, you can always convert a CMYK

pixmap to an RGB pixmap with `rgb_pix = fitz.Pixmap(fitz.csRGB, cmyk_pix)` and then save that as a PNG.

4.4.3 Pixmap Example Code Snippets

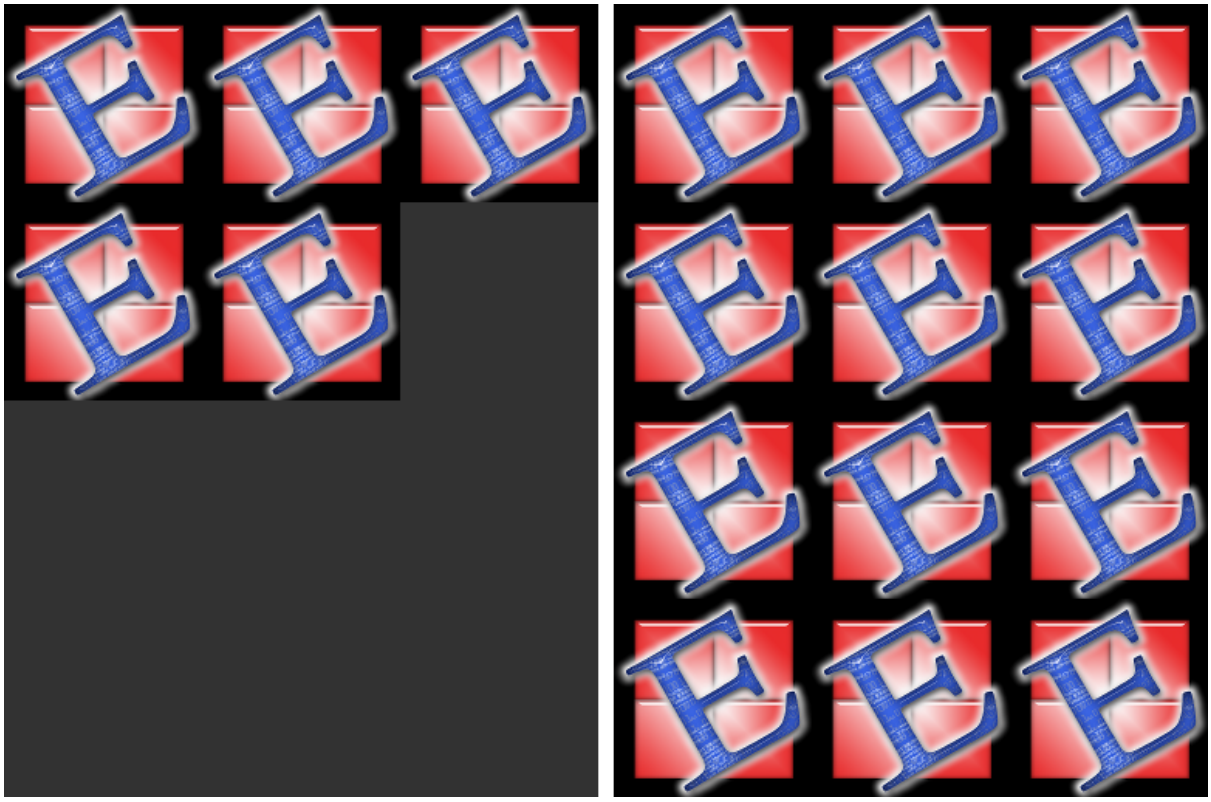
Example 1: Gluing Images

This shows how pixmaps can be used for purely graphical, non-PDF purposes. The script reads a PNG picture and creates a new PNG file which consist of 3 * 4 tiles of the original one:

```
import fitz
# create a pixmap of a picture
pix0 = fitz.Pixmap("editra.png")

# set target colorspace and pixmap dimensions and create it
tar_width  = pix0.width * 3              # 3 tiles per row
tar_height = pix0.height * 4             # 4 tiles per column
tar_irect  = fitz.IRect(0, 0, tar_width, tar_height)
# create empty target pixmap
tar_pix    = fitz.Pixmap(fitz.csRGB, tar_irect, pix0.alpha)
# clear target with a very lively stone-gray (thanks and R.I.P., Loriot)
tar_pix.clearWith(90)

# now fill target with 3 * 4 tiles of input picture
for i in range(4):
    pix0.y = i * pix0.height                    # modify input's y coord
    for j in range(3):
        pix0.x = j * pix0.width                 # modify input's x coord
        tar_pix.copyPixmap(pix0, pix0.irect)    # copy input to new loc
        # save all intermediate images to show what is happening
        fn = "target-%i-%i.png" % (i, j)
        tar_pix.writePNG(fn)
```

This is the input picture `editra.png` (taken from the wxPython directory `/tools/Editra/pixmaps`):

Here is the output, showing some intermediate picture and the final result:



Example 2: Interfacing with NumPy

This shows how to create a PNG file from a numpy array (several times faster than most other methods):

```
import numpy as np
import fitz
#==============================================================================
# create a fun-colored width * height PNG with fitz and numpy
#==============================================================================
height = 150
width  = 100
bild = np.ndarray((height, width, 3), dtype=np.uint8)

for i in range(height):
    for j in range(width):
        # one pixel (some fun coloring)
        bild[i, j] = [(i+j)%256, i%256, j%256]

samples = bytearray(bild.tostring())    # get plain pixel data from numpy array
pix = fitz.Pixmap(fitz.csRGB, width, height, samples, alpha=False)
pix.writePNG("test.png")
```

Example 3: Interfacing with PIL / Pillow

This shows how to interface with `PIL / Pillow` (the Python Imaging Library), thereby extending the reach of image files that can be processed:

```
>>> import fitz
>>> from PIL import Image
>>> pix = fitz.Pixmap(..., alpha = False)
>>> ...
```

(continues on next page)

(continued from previous page)

```
>>> # create and save a PIL image
>>> img = Image.frombytes("RGB", [pix.width, pix.height], pix.samples)
>>> img.save(filename, 'jpeg')
>>> ...
>>> # opposite direction:
>>> # create a pixmap from any PIL-supported image file "some_image.xxx"
>>> img = Image.open("some_image.xxx").convert("RGB")
>>> samples = img.tobytes()
>>> pix = fitz.Pixmap(fitz.csRGB, img.size[0], img.size[1], samples, alpha=False)
```

Example 4: Extracting Alpha Values, Making Stencil Masks

The alpha channel of a pixmap can be extracted by making a copy and choosing target colorspace `None`. The resulting pixmap is sometimes also called "stencil mask". Its samples contain the source's alpha values.

```
>>> pix
fitz.Pixmap(DeviceRGB, fitz.IRect(0, 0, 1168, 823), 1)
>>> pix.n
4
>>> mask = fitz.Pixmap(None, pix)
>>> # now mask.samples will contain the alpha values of pix:
>>> mask
fitz.Pixmap(None, fitz.IRect(0, 0, 1168, 823), 1)
>>> mask.n
1
```

Example 4: Back-Converting Stencil Masks

Stencil masks can be converted to PNG images. Use this to create a `DeviceGRAY` pixmap version:

```
>>> mask                        # stencil mask from previous example
fitz.Pixmap(None, fitz.IRect(0, 0, 1168, 823), 1)
>>> pix = fitz.Pixmap(mask.getPNGData())
>>> pix
fitz.Pixmap(DeviceGRAY, fitz.IRect(0, 0, 1168, 823), 0)
>>> # if required, invert the gray values
>>> pix.invertIRect()
```

4.5 Colorspace

Represents the color space of a *Pixmap*.

Class API

class Colorspace

__init__(*self*, *n*)
Constructor

Parameters **n** (*int*) – A number identifying the colorspace. Possible values are *CS_RGB*, *CS_GRAY* and *CS_CMYK*.

name
The name identifying the colorspace. Example: `fitz.csCMYK.name = 'DeviceCMYK'`.

Type str

n

The number of bytes required to define the color of one pixel. Example: `fitz.csCMYK.n == 4`.

type int

Predefined Colorspaces

For saving some typing effort, there exist predefined colorspace objects for the three available cases.

- *csRGB* = `fitz.Colorspace(fitz.CS_RGB)`
- *csGRAY* = `fitz.Colorspace(fitz.CS_GRAY)`
- *csCMYK* = `fitz.Colorspace(fitz.CS_CMYK)`

4.6 Link

Represents a pointer to somewhere (this document, other documents, the internet). Links exist per document page, and they are forward-chained to each other, starting from an initial link which is accessible by the *Page.firstLink* property.

There is a parent-child relationship between a link and its page. If the page object becomes unusable (closed document, any document structure change, etc.), then so does every of its existing link objects - an exception is raised saying that the object is "orphaned", whenever a link property or method is accessed.

Attribute	Short Description
Link.rect	clickable area in untransformed coordinates.
Link.uri	link destination
Link.isExternal	external link destination?
Link.next	points to next link
Link.dest	points to link destination details

Class API

class Link

rect

The area that can be clicked in untransformed coordinates.

Type *Rect*

isExternal

A bool specifying whether the link target is outside of the current document.

Type bool

uri

A string specifying the link target. The meaning of this property should be evaluated in conjunction with property `isExternal`. The value may be `None`, in which case `isExternal == False`. If `uri` starts with `file://`, `mailto:`, or an internet resource name, `isExternal` is `True`. In all other cases `isExternal == False` and `uri` points to an internal location. In case of PDF documents, this should either be `#nnnn` to indicate a 1-based (!) page number `nnnn`, or a named location. The format varies for other document types, e.g. `uri = '../FixedDoc.fdoc#PG_2_LNK_1'` for page number 2 (1-based) in an XPS document.

Type str

next
The next `Link` or `None`

Type `Link`

dest
The link destination details object.

Type *linkDest*

4.7 linkDest

Class representing the *dest* property of an outline entry or a link. Describes the destination to which such entries point.

Attribute	Short Description
linkDest.dest	destination
linkDest.fileSpec	file specification (path, filename)
linkDest.flags	descriptive flags
linkDest.isMap	is this a MAP?
linkDest.isUri	is this a URI?
linkDest.kind	kind of destination
linkDest.lt	top left coordinates
linkDest.named	name if named destination
linkDest.newWindow	name of new window
linkDest.page	page number
linkDest.rb	bottom right coordinates
linkDest.uri	URI

Class API

class linkDest

dest
Target destination name if *linkDest.kind* is *LINK_GOTOR* and *linkDest.page* is `-1`.

Type str

fileSpec
Contains the filename and path this link points to, if *linkDest.kind* is *LINK_GOTOR* or *LINK_LAUNCH*.

Type str

flags
A bitfield describing the validity and meaning of the different aspects of the destination. As far as possible, link destinations are constructed such that e.g. *linkDest.lt* and *linkDest.rb* can be treated as defining a bounding box. But the flags indicate which of the values were actually specified, see *Link Destination Flags*.

Type int

isMap
This flag specifies whether to track the mouse position when the URI is resolved. Default value: False.

Type bool

isUri
Specifies whether this destination is an internet resource (as opposed to e.g. a local file specification in URI format).

Type bool

kind
Indicates the type of this destination, like a place in this document, a URI, a file launch, an action or a place in another file. Look at *Link Destination Kinds* to see the names and numerical values.

Type int

lt
The top left *Point* of the destination.

Type *Point*

named
This destination refers to some named action to perform (e.g. a javascript, see *Adobe PDF Reference 1.7*). Standard actions provided are `NextPage`, `PrevPage`, `FirstPage`, and `LastPage`.

Type str

newWindow
If true, the destination should be launched in a new window.

Type bool

page
The page number (in this or the target document) this destination points to. Only set if *linkDest.kind* is *LINK_GOTOR* or *LINK_GOTO*. May be `-1` if *linkDest.kind* is *LINK_GOTOR*. In this case *linkDest.dest* contains the **name** of a destination in the target document.

Type int

rb
The bottom right *Point* of this destination.

Type *Point*

uri
The name of the URI this destination points to.

Type str

4.8 Matrix

Matrix is a row-major 3x3 matrix used by image transformations in MuPDF (which complies with the respective concepts laid down in the *Adobe PDF Reference 1.7*). With matrices you can manipulate the rendered image of a page in a variety of ways: (parts of) the page can be rotated, zoomed, flipped, sheared and shifted by setting some or all of just six float values.

Since all points or pixels live in a two-dimensional space, one column vector of that matrix is a constant unit vector, and only the remaining six elements are used for manipulations. These six elements are usually represented by `[a, b, c, d, e, f]`. Here is how they are positioned in the matrix:

$$\begin{bmatrix} a & b & 0 \\ c & d & 0 \\ e & f & 1 \end{bmatrix}$$

Please note:

- the below methods are just convenience functions - everything they do, can also be achieved by directly manipulating the six numerical values
- all manipulations can be combined - you can construct a matrix that rotates **and** shears **and** scales **and** shifts, etc. in one go. If you however choose to do this, do have a look at the **remarks** further down or at the *Adobe PDF Reference 1.7*.

Method / Attribute	Description
`Matrix.preRotate()`	perform a rotation
`Matrix.preScale()`	perform a scaling
`Matrix.preShear()`	perform a shearing (skewing)
`Matrix.preTranslate()`	perform a translation (shifting)
`Matrix.concat()`	perform a matrix multiplication
`Matrix.invert()`	calculate the inverted matrix
`Matrix.a`	zoom factor X direction
`Matrix.b`	shearing effect Y direction
`Matrix.c`	shearing effect X direction
`Matrix.d`	zoom factor Y direction
`Matrix.e`	horizontal shift
`Matrix.f`	vertical shift

Class API

class Matrix

__init__(*self*)

__init__(*self*, *zoom-x*, *zoom-y*)

__init__(*self*, *shear-x*, *shear-y*, *1*)

__init__(*self*, *a*, *b*, *c*, *d*, *e*, *f*)

__init__(*self*, *matrix*)

__init__(*self*, *degree*)

__init__(*self*, *sequence*)

Overloaded constructors.

Without parameters, `Matrix(0.0, 0.0, 0.0, 0.0, 0.0, 0.0)` will be created.

`zoom-*` and `shear-*` specify zoom or shear values (float) and create a zoom or shear matrix, respectively.

For "matrix" a **new copy** will be made.

Float value "degree" specifies the creation of a rotation matrix.

A "sequence" must be a Python sequence object with 6 float entries (see *Using Python Sequences as Arguments in PyMuPDF*).

`fitz.Matrix(1, 1)`, `fitz.Matrix(0.0))` and `fitz.Matrix(fitz.Identity)` create modifyable versions of the *Identity* matrix, which looks like `[1, 0, 0, 1, 0, 0]`.

preRotate(*deg*)

Modify the matrix to perform a counter-clockwise rotation for positive `deg` degrees, else clockwise. The matrix elements of an identity matrix will change in the following way:

`[1, 0, 0, 1, 0, 0] -> [cos(deg), sin(deg), -sin(deg), cos(deg), 0, 0]`.

Parameters **deg** (*float*) – The rotation angle in degrees (use conventional notation based on Pi = 180 degrees).

preScale(*sx*, *sy*)
Modify the matrix to scale by the zoom factors sx and sy. Has effects on attributes `a` thru `d` only: `[a, b, c, d, e, f] -> [a*sx, b*sx, c*sy, d*sy, e, f]`.

Parameters

- **sx** (*float*) – Zoom factor in X direction. For the effect see description of attribute `a`.
- **sy** (*float*) – Zoom factor in Y direction. For the effect see description of attribute `d`.

preShear(*sx*, *sy*)
Modify the matrix to perform a shearing, i.e. transformation of rectangles into parallelograms (rhomboids). Has effects on attributes `a` thru `d` only: `[a, b, c, d, e, f] -> [c*sy, d*sy, a*sx, b*sx, e, f]`.

Parameters

- **sx** (*float*) – Shearing effect in X direction. See attribute `c`.
- **sy** (*float*) – Shearing effect in Y direction. See attribute `b`.

preTranslate(*tx*, *ty*)
Modify the matrix to perform a shifting / translation operation along the x and / or y axis. Has effects on attributes `e` and `f` only: `[a, b, c, d, e, f] -> [a, b, c, d, tx*a + ty*c, tx*b + ty*d]`.

Parameters

- **tx** (*float*) – Translation effect in X direction. See attribute `e`.
- **ty** (*float*) – Translation effect in Y direction. See attribute `f`.

concat(*m1*, *m2*)
Calculate the matrix product `m1 * m2` and store the result in the current matrix. Any of `m1` or `m2` may be the current matrix. Be aware that matrix multiplication is not commutative. So the sequence of `m1`, `m2` is important.

Parameters

- **m1** (*Matrix*) – First (left) matrix.
- **m2** (*Matrix*) – Second (right) matrix.

invert(*m*)
Calculate the matrix inverse of `m` and store the result in the current matrix. Returns `1` if `m` is not invertible ("degenerate"). In this case the current matrix **will not change**. Returns `0` if `m` is invertible, and the current matrix is replaced with the inverted `m`.

Parameters **m** (*Matrix*) – Matrix to be inverted.

Return type int

a
Scaling in X-direction **(width)**. For example, a value of 0.5 performs a shrink of the **width** by a factor of 2. If a < 0, a left-right flip will (additionally) occur.

Type float

b
Causes a shearing effect: each `Point(x, y)` will become `Point(x, y - b*x)`. Therefore, looking from left to right, e.g. horizontal lines will be "tilt" - downwards if b > 0, upwards otherwise (b is the tangens of the tilting angle).

Type float

c
Causes a shearing effect: each `Point(x, y)` will become `Point(x - c*y, y)`. Therefore,

looking upwards, vertical lines will be "tilt" - to the left if c $>$ 0, to the right otherwise (c ist the tangens of the tilting angle).

Type float

d

Scaling in Y-direction **(height)**. For example, a value of 1.5 performs a stretch of the **height** by 50%. If d $<$ 0, an up-down flip will (additionally) occur.

Type float

e

Causes a horizontal shift effect: Each `Point(x, y)` will become `Point(x + e, y)`. Positive (negative) values of `e` will shift right (left).

Type float

f

Causes a vertical shift effect: Each `Point(x, y)` will become `Point(x, y - f)`. Positive (negative) values of `f` will shift down (up).

Type float

4.8.1 Remarks 1

This class adheres to the sequence protocol, so components can be accessed via their index, too. Also refer to *Using Python Sequences as Arguments in PyMuPDF*.

4.8.2 Remarks 2

Changes of matrix properties and execution of matrix methods can be executed consecutively. This is the same as multiplying the respective matrices.

Matrix multiplications are **not commutative** - changing the execution sequence in general changes the result. So it can quickly become unclear which result a transformation will yield.

To keep results foreseeable for a series of transformations, Adobe recommends the following approach (*Adobe PDF Reference 1.7*, page 206):

1. Shift ("translate")
2. Rotate
3. Scale or shear ("skew")

4.8.3 Matrix Algebra

For a general background, see chapter *Operator Algebra for Geometry Objects*.

This makes the following operations possible:

```
>>> m45p = fitz.Matrix(45)             # rotate 45 degrees clockwise
>>> m45m = fitz.Matrix(-45)            # rotate 45 degrees counterclockwise
>>> m90p = fitz.Matrix(90)             # rotate 90 degrees clockwise
>>>
>>> abs(m45p * ~m45p - fitz.Identity) # should be (close to) zero:
8.429369702178807e-08
>>>
>>> abs(m90p - m45p * m45p)            # should be (close to) zero:
8.429369702178807e-08
>>>
>>> abs(m45p * m45m - fitz.Identity)  # should be (close to) zero:
```

(continues on next page)

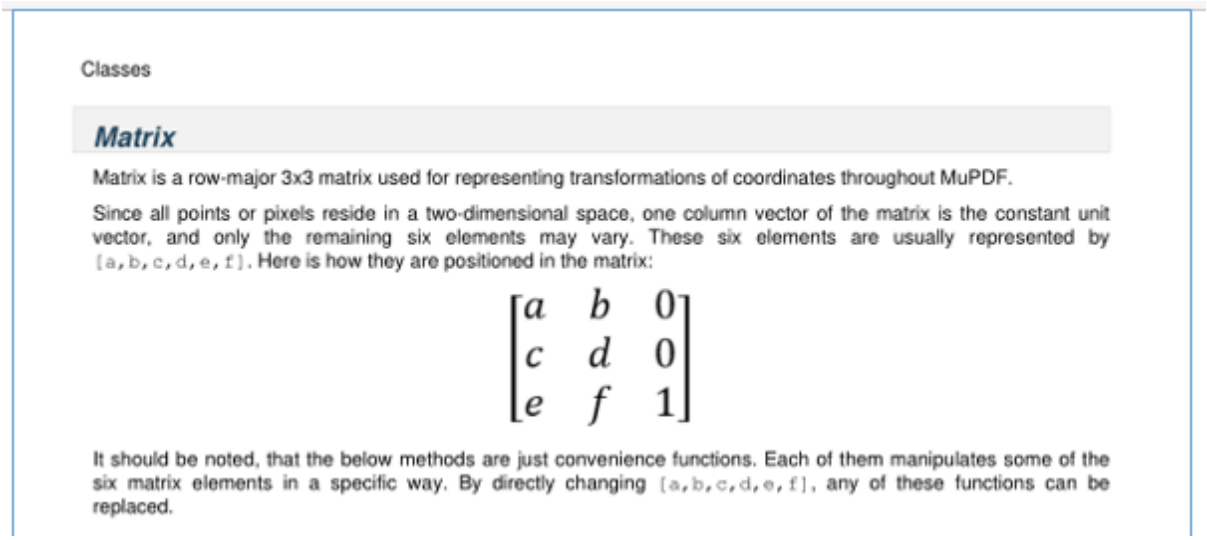
(continued from previous page)

```
2.1073424255447017e-07
>>>
>>> abs(m45p - ~m45m)                  # should be (close to) zero:
2.384185791015625e-07
>>>
>>> m90p * m90p * m90p * m90p          # should be 360 degrees = fitz.Identity
fitz.Matrix(1.0, -0.0, 0.0, 1.0, 0.0, 0.0)
```

4.8.4 Examples

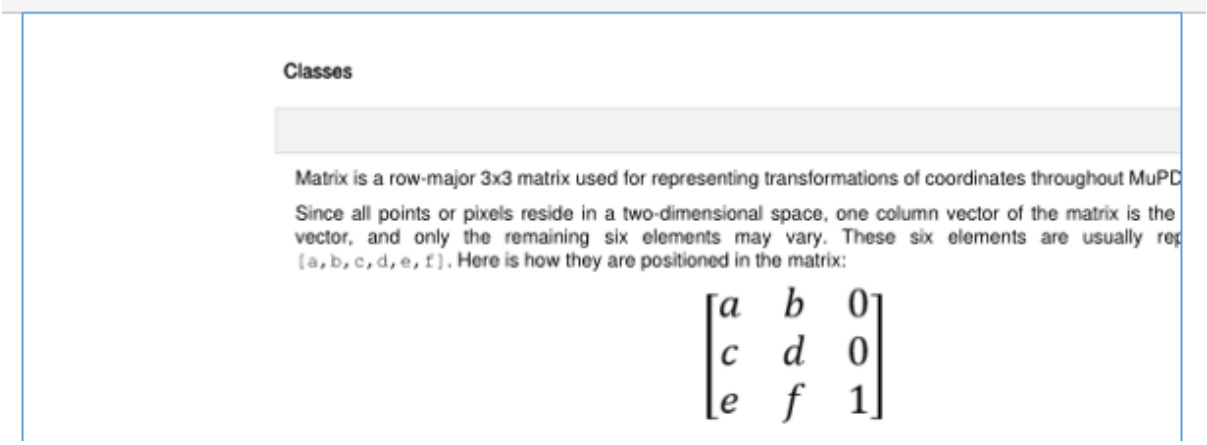
Here are examples to illustrate some of the effects achievable. The following pictures start with a page of the PDF version of this help file. We show what happens when a matrix is being applied (though always full pages are created, only parts are displayed here to save space).

This is the original page image:

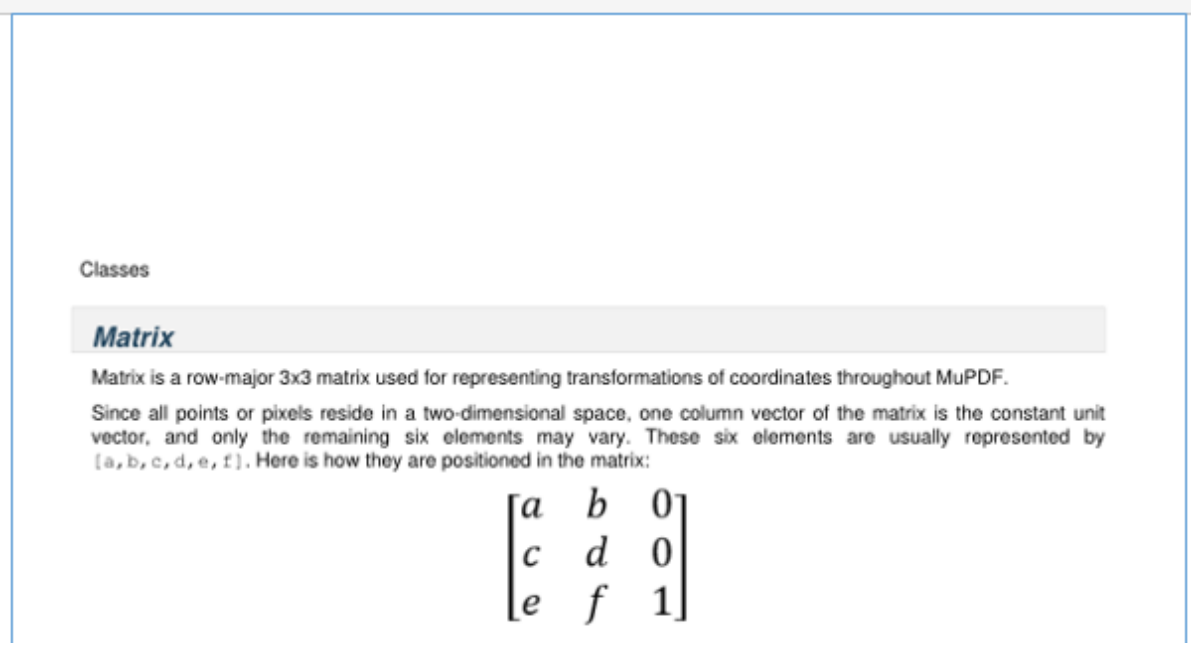


4.8.5 Shifting

We transform it with a matrix where `e = 100` (right shift by 100 pixels).

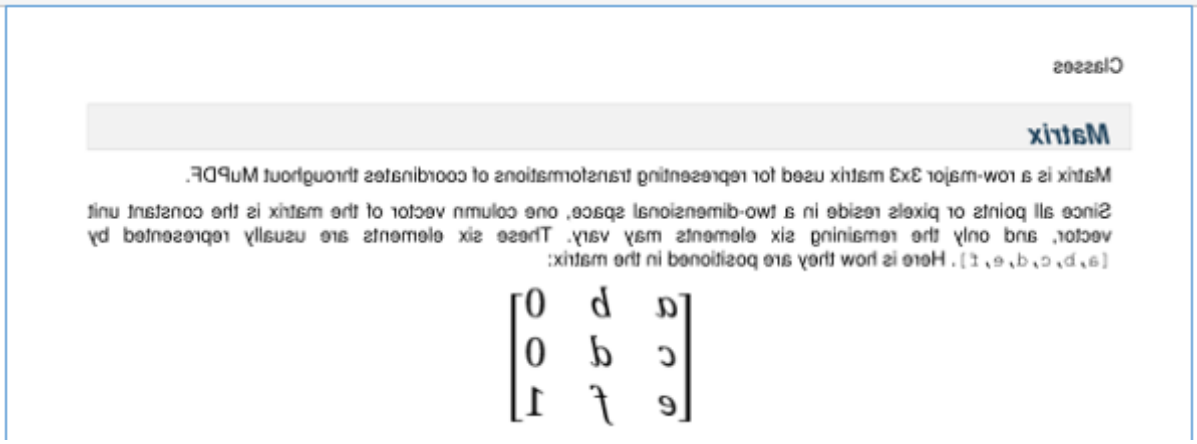


Next we do a down shift by 100 pixels: `f = 100`.

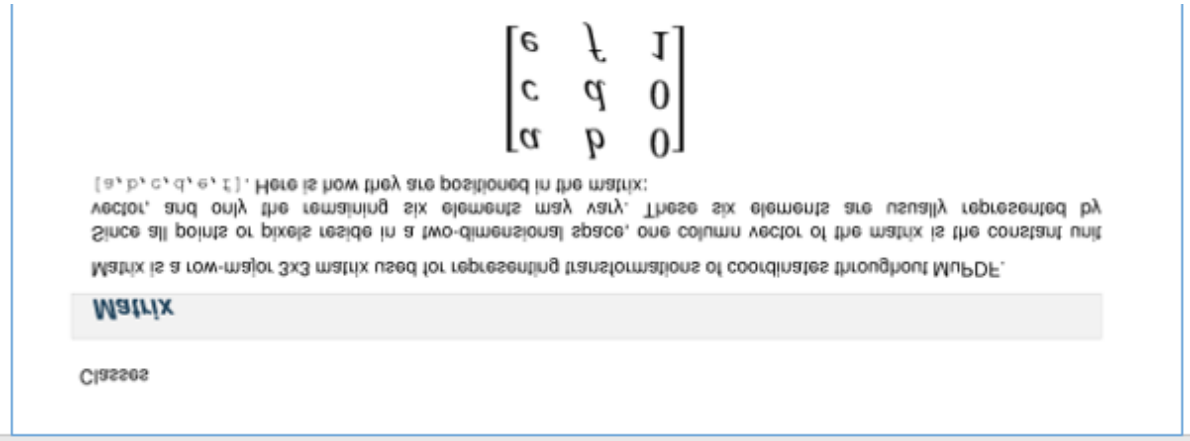


4.8.6 Flipping

Flip the page left-right (`a = -1`).

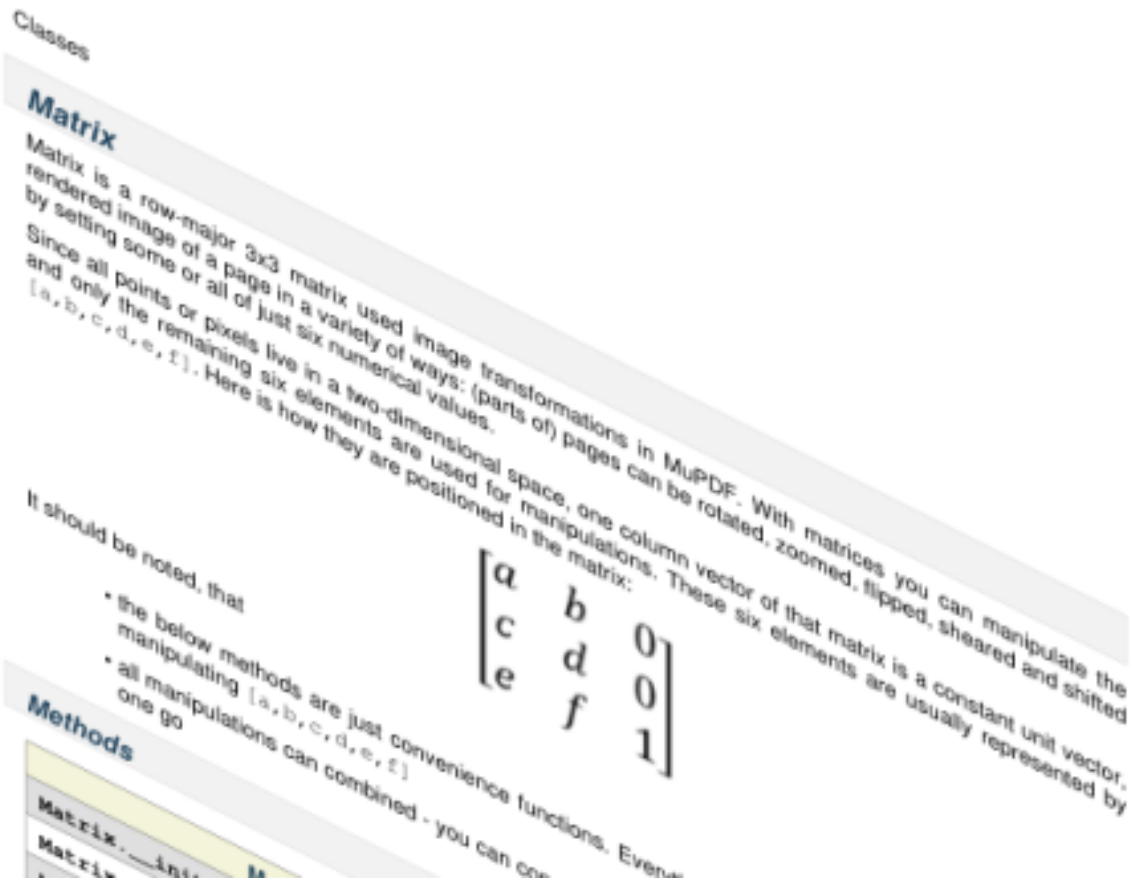


Flip up-down (`d = -1`).

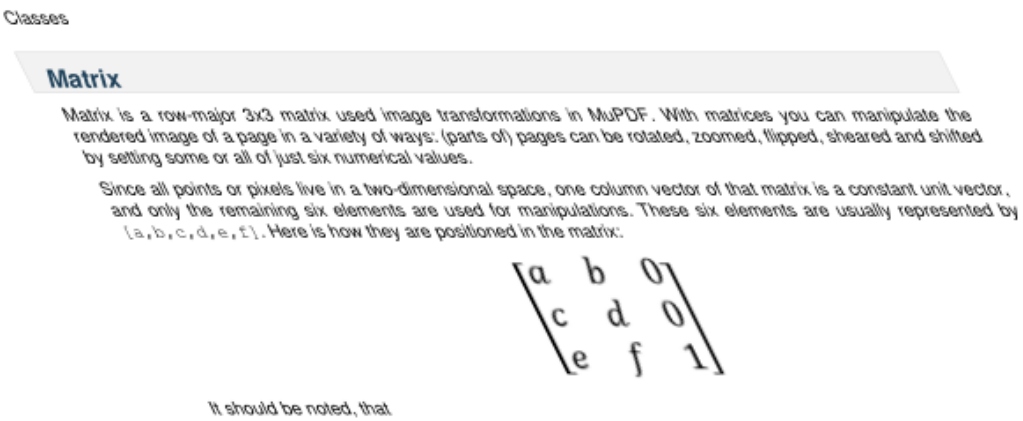


4.8.7 Shearing

First a shear in Y direction (`b = 0.5`).

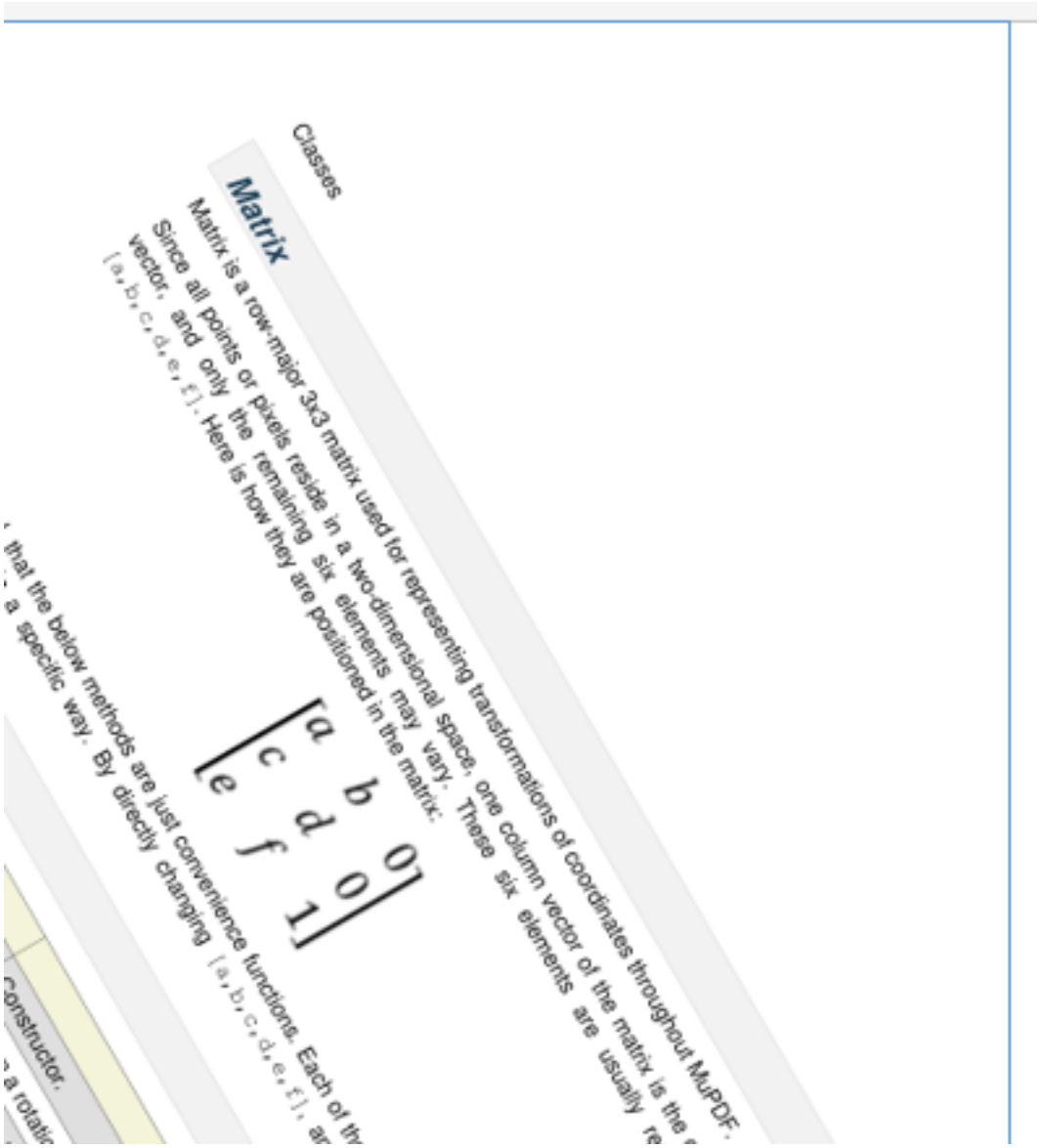


Second a shear in X direction (`c = 0.5`).



4.8.8 Rotating

Finally a rotation by 30 clockwise degrees (`preRotate(-30)`).



4.9 Identity

Identity is just a *Matrix* that performs no action, to be used whenever the syntax requires a *Matrix*, but no actual transformation should take place.

Identity is a constant, an "immutable" object. So, all of its matrix properties are read-only and its methods are disabled.

If you need a do-nothing matrix as a starting point, use `fitz.Matrix(1, 1)` or `fitz.Matrix(0)` instead, like so:

```
>>> fitz.Matrix(0).preTranslate(2, 5)
fitz.Matrix(1.0, 0.0, -0.0, 1.0, 2.0, 5.0)
```

4.10 IRect

IRect is a rectangular bounding box similar to *Rect*, except that all corner coordinates are integers. IRect is used to specify an area of pixels, e.g. to receive image data during rendering. Otherwise, many

similarities exist, e.g. considerations concerning emptiness and finiteness of rectangles also apply to `IRects`.

Attribute / Method	Short Description
IRect.contains()	checks containment of another object
IRect.getArea()	calculate rectangle area
IRect.getRect()	return a *Rect* with same coordinates
IRect.getRectArea()	calculate rectangle area
IRect.intersect()	common part with another rectangle
IRect.intersects()	checks for non-empty intersection
IRect.normalize()	makes a rectangle finite
IRect.bottom_left	bottom left point, synonym `bl`
IRect.bottom_right	bottom right point, synonym `br`
IRect.height	height of the rectangle
IRect.isEmpty	whether rectangle is empty
IRect.isInfinite	whether rectangle is infinite
IRect.rect	equals result of method `getRect()`
IRect.top_left	top left point, synonym `tl`
IRect.top_right	top_right point, synonym `tr`
IRect.width	width of the rectangle
IRect.x0	X-coordinate of the top left corner
IRect.x1	X-coordinate of the bottom right corner
IRect.y0	Y-coordinate of the top left corner
IRect.y1	Y-coordinate of the bottom right corner

Class API

class IRect

__init__(*self*)

__init__(*self*, *x0*, *y0*, *x1*, *y1*)

__init__(*self*, *irect*)

__init__(*self*, *sequence*)

Overloaded constructors. Also see examples below and those for the *Rect* class.

If another irect is specified, a **new copy** will be made.

If sequence is specified, it must be a Python sequence type of 4 integers (see *Using Python Sequences as Arguments in PyMuPDF*). Non-integer numbers will raise an exception.

The other parameters mean integer coordinates.

getRect()

A convenience function returning a *Rect* with the same coordinates. Also available as attribute `rect`.

Return type *Rect*

getRectArea(*unit*)

getArea(*unit*)

Calculates the area of the rectangle and, with no parameter, equals `abs(IRect)`. Like an empty rectangle, the area of an infinite rectangle is also zero.

Parameters **unit** (*str*) – Specify required unit: respective squares of `px` (pixels, default), `in` (inches), `cm` (centimeters), or `mm` (millimeters).

Return type float

intersect(*ir*)
The intersection (common rectangular area) of the current rectangle and `ir` is calculated and replaces the current rectangle. If either rectangle is empty, the result is also empty. If one of the rectangles is infinite, the other one is taken as the result - and hence also infinite if both rectangles were infinite.

Parameters **ir** (*IRect*) – Second rectangle.

contains(*x*)
Checks whether `x` is contained in the rectangle. It may be an `IRect`, `Rect`,"Point" or number. If `x` is an empty rectangle, this is always true. Conversely, if the rectangle is empty this is always `False`, if `x` is not an empty rectangle and not a number. If `x` is a number, it will be checked to be one of the four components. `x in irect` and `irect.contains(x)` are equivalent.

Parameters **x** (*IRect* or *Rect* or *Point* or int) – the object to check.

Return type bool

intersects(*r*)
Checks whether the rectangle and `r` (`IRect` or *Rect*) have a non-empty rectangle in common. This will always be `False` if either is infinite or empty.

Parameters **r** (*IRect* or *Rect*) – the rectangle to check.

Return type bool

normalize()
Make the rectangle finite. This is done by shuffling rectangle corners. After this, the bottom right corner will indeed be south-eastern to the top left one. See *Rect* for a more details.

top_left

tl
Equals `Point(x0, y0)`.

Type *Point*

top_right

tr
Equals `Point(x1, y0)`.

Type *Point*

bottom_left

bl
Equals `Point(x0, y1)`.

Type *Point*

bottom_right

br
Equals `Point(x1, y1)`.

Type *Point*

width
Contains the width of the bounding box. Equals `x1 - x0`.

Type int

height
Contains the height of the bounding box. Equals `y1 - y0`.

Type int

x0
X-coordinate of the left corners.

Type int

y0
Y-coordinate of the top corners.

Type int

x1
X-coordinate of the right corners.

Type int

y1
Y-coordinate of the bottom corners.

Type int

isInfinite
`True` if rectangle is infinite, `False` otherwise.

Type bool

isEmpty
`True` if rectangle is empty, `False` otherwise.

Type bool

4.10.1 Remark

This class adheres to the sequence protocol, so components can be accessed via their index, too. Also refer to *Using Python Sequences as Arguments in PyMuPDF*.

4.10.2 IRect Algebra

Algebra provides handy ways to perform inclusion and intersection checks between Rects, IRects and Points. For a general background, see chapter *Operator Algebra for Geometry Objects*.

4.10.3 Examples

Example 1:

```
>>> ir = fitz.IRect(10, 10, 410, 610)
>>> ir
fitz.IRect(10, 10, 410, 610)
>>> ir.height
600
>>> ir.width
400
>>> ir.getArea('mm')     # calculate area in square millimeters
29868.51852
```

Example 2:

```
>>> m = fitz.Matrix(45)
>>> ir = fitz.IRect(10, 10, 410, 610)
>>> ir * m                          # rotate rectangle by 45 degrees
fitz.IRect(-425, 14, 283, 722)
>>>
>>> ir | fitz.Point(5, 5)           # enlarge rectangle to contain a point
fitz.IRect(5, 5, 410, 610)
>>>
```

(continues on next page)

(continued from previous page)

```
>>> ir + 5                          # shift the rect by 5 points
fitz.IRect(15, 15, 415, 615)
>>>
>>> ir & fitz.Rect(0.0, 0.0, 15.0, 15.0)
fitz.IRect(10, 10, 15, 15)
>>> ir /= (1, 2, 3, 4, 5, 6)        # divide by a matrix
>>> ir
fitz.IRect(-14, 0, 4, 8)
```

Example 3:

```
>>> # test whether two rectangle are disjoint
>>> if not r1.intersects(r2): print("disjoint rectangles")
>>>
>>> # test whether r2 containes x (x is point-like or rect-like)
>>> if r2.contains(x): print("x is contained in r2")
>>>
>>> # or even simpler:
>>> if x in r2: print("x is contained in r2")
```

4.11 Rect

`Rect` represents a rectangle defined by four floating point numbers x0, y0, x1, y1. They are viewed as being coordinates of two diagonally opposite points. The first two numbers are regarded as the "top left" corner $P_{x0,y0}$ and $P_{x1,y1}$ as the "bottom right" one. However, these two properties need not coincide with their intuitive meanings - read on.

The following remarks are also valid for *IRect* objects:

- Rectangle borders are always parallel to the respective X- and Y-axes.
- The constructing points can be anywhere in the plane - they need not even be different, and e.g. "top left" need not be the geometrical "north-western" point.
- For any given quadruple of numbers, the geometrically "same" rectangle can be defined in (up to) four different ways: Rect($P_{x0,y0}$, $P_{x1,y1}$), Rect($P_{x1,y1}$, $P_{x0,y0}$), Rect($P_{x0,y1}$, $P_{x1,y0}$), and Rect($P_{x1,y0}$, $P_{x0,y1}$).

Hence some useful classification:

- A rectangle is called **finite** if `x0 <= x1` and `y0 <= y1` (i.e. the bottom right point is "south-eastern" to the top left one), otherwise **infinite**. Of the four alternatives above, only one is finite (disregarding degenerate cases).
- A rectangle is called **empty** if `x0 = x1` or `y0 = y1`, i.e. if its area is zero.

Note: It sounds like a paradox: a rectangle can be both, infinite **and** empty ...

Methods / Attributes	Short Description
Rect.contains()	checks containment of another object
Rect.getArea()	calculate rectangle area
Rect.getRectArea()	calculate rectangle area
Rect.includePoint()	enlarge rectangle to also contain a point
Rect.includeRect()	enlarge rectangle to also contain another one
Rect.intersect()	common part with another rectangle
Rect.intersects()	checks for non-empty intersections
Rect.normalize()	makes a rectangle finite
Rect.round()	create smallest *IRect* containing rectangle
Rect.transform()	transform rectangle with a matrix
Rect.bottom_left	bottom left point, synonym `bl`
Rect.bottom_right	bottom right point, synonym `br`
Rect.height	rectangle height
Rect.irect	equals result of method `round()`
Rect.isEmpty	whether rectangle is empty
Rect.isInfinite	whether rectangle is infinite
Rect.top_left	top left point, synonym `tl`
Rect.top_right	top _right point, synonym `tr`
Rect.width	rectangle width
Rect.x0	top left corner's X-coordinate
Rect.x1	bottom right corner's X-coordinate
Rect.y0	top left corner's Y-coordinate
Rect.y1	bottom right corner's Y-coordinate

Class API

class Rect

__init__(*self*)

__init__(*self*, *x0*, *y0*, *x1*, *y1*)

__init__(*self*, *top_left*, *bottom_right*)

__init__(*self*, *top_left*, *x1*, *y1*)

__init__(*self*, *x0*, *y0*, *bottom_right*)

__init__(*self*, *rect*)

__init__(*self*, *sequence*)

Overloaded constructors: `top_left`, `bottom_right` stand for *Point* objects, "sequence" is a Python sequence type with 4 float values (see *Using Python Sequences as Arguments in PyMuPDF*), "rect" means another rectangle, while the other parameters mean float coordinates.

If "rect" is specified, the constructor creates a **new copy** of it.

Without parameters, the rectangle `Rect(0.0, 0.0, 0.0, 0.0)` is created.

round()

Creates the smallest containing *IRect* (this is **not** the same as simply rounding the rectangle's edges!).

1. If the rectangle is **infinite**, the "normalized" (finite) version of it will be taken. The result of this method is always a finite `IRect`.
2. If the rectangle is **empty**, the result is also empty.
3. **Possible paradox:** The result may be empty, **even if** the rectangle is **not** empty! In such cases, the result obviously does **not** contain the rectangle. This is because MuPDF's

algorithm allows for a small tolerance (1e-3). Example:

```
>>> r = fitz.Rect(100, 100, 200, 100.001)
>>> r.isEmpty
False
>>> r.round()
fitz.IRect(100, 100, 200, 100)
>>> r.round().isEmpty
True
```

To reproduce this funny effect on your platform, you may need to adjust the numbers a little after the decimal point.

Return type *IRect*

transform(*m*)

Transforms the rectangle with a matrix and **replaces the original**. If the rectangle is empty or infinite, this is a no-operation.

Parameters **m** (*Matrix*) – The matrix for the transformation.

Return type Rect

Returns the smallest rectangle that contains the transformed original.

intersect(*r*)

The intersection (common rectangular area) of the current rectangle and `r` is calculated and **replaces the current** rectangle. If either rectangle is empty, the result is also empty. If `r` is infinite, this is a no-operation.

Parameters **r** (*Rect*) – Second rectangle

includeRect(*r*)

The smallest rectangle containing the current one and `r` is calculated and **replaces the current** one. If either rectangle is infinite, the result is also infinite. If one is empty, the other one will be taken as the result.

Parameters **r** (*Rect*) – Second rectangle

includePoint(*p*)

The smallest rectangle containing the current one and point `p` is calculated and **replaces the current** one. **Infinite rectangles remain unchanged.** To create a rectangle containing a series of points, start with (the empty) `fitz.Rect(p1, p1)` and successively perform `includePoint` operations for the other points.

Parameters **p** (*Point*) – Point to include.

getRectArea(*[unit]*)

getArea(*[unit]*)

Calculate the area of the rectangle and, with no parameter, equals `abs(rect)`. Like an empty rectangle, the area of an infinite rectangle is also zero. So, at least one of `fitz.Rect(p1, p2)` and `fitz.Rect(p2, p1)` has a zero area.

Parameters **unit** (*str*) – Specify required unit: respective squares of `px` (pixels, default), `in` (inches), `cm` (centimeters), or `mm` (millimeters).

Return type float

contains(*x*)

Checks whether `x` is contained in the rectangle. It may be an `IRect`, `Rect`, `Point` or number. If `x` is an empty rectangle, this is always true. If the rectangle is empty this is always `False` for all non-empty rectangles and for all points. If `x` is a number, it will be checked against the four components. `x in rect` and `rect.contains(x)` are equivalent.

Parameters **x** (*IRect* or *Rect* or *Point* or number) – the object to check.

Return type bool

intersects(*r*)
Checks whether the rectangle and `r` (a `Rect` or *IRect*) have a non-empty rectangle in common. This will always be `False` if either is infinite or empty.

Parameters **r** (*IRect* or *Rect*) – the rectangle to check.

Return type bool

normalize()
Replace the rectangle with its finite version. This is done by shuffling the rectangle corners. After completion of this method, the bottom right corner will indeed be south-eastern to the top left one.

irect
Equals result of method `round()`.

top_left

tl
Equals `Point(x0, y0)`.

Type *Point*

top_right

tr
Equals `Point(x1, y0)`.

Type *Point*

bottom_left

bl
Equals `Point(x0, y1)`.

Type *Point*

bottom_right

br
Equals `Point(x1, y1)`.

Type *Point*

width
Contains the width of the rectangle. Equals `x1 - x0`.

Return type float

height
Contains the height of the rectangle. Equals `y1 - y0`.

Return type float

x0
X-coordinate of the left corners.

Type float

y0
Y-coordinate of the top corners.

Type float

x1
X-coordinate of the right corners.

Type float

y1
Y-coordinate of the bottom corners.

Type float

isInfinite
`True` if rectangle is infinite, `False` otherwise.

Type bool

isEmpty
`True` if rectangle is empty, `False` otherwise.

Type bool

4.11.1 Remark

This class adheres to the sequence protocol, so components can be accessed via their index, too. Also refer to *Using Python Sequences as Arguments in PyMuPDF*.

4.11.2 Rect Algebra

For a general background, see chapter *Operator Algebra for Geometry Objects*.

4.11.3 Examples

Example 1 - different ways of construction:

```
>>> p1 = fitz.Point(10, 10)
>>> p2 = fitz.Point(300, 450)
>>>
>>> fitz.Rect(p1, p2)
fitz.Rect(10.0, 10.0, 300.0, 450.0)
>>>
>>> fitz.Rect(10, 10, 300, 450)
fitz.Rect(10.0, 10.0, 300.0, 450.0)
>>>
>>> fitz.Rect(10, 10, p2)
fitz.Rect(10.0, 10.0, 300.0, 450.0)
>>>
>>> fitz.Rect(p1, 300, 450)
fitz.Rect(10.0, 10.0, 300.0, 450.0)
```

Example 2 - what happens during rounding:

```
>>> r = fitz.Rect(0.5, -0.01, 123.88, 455.123456)
>>>
>>> r
fitz.Rect(0.5, -0.009999999776482582, 123.87999725341797, 455.1234436035156)
>>>
>>> r.round()     # = r.irect
fitz.IRect(0, -1, 124, 456)
```

Example 3 - inclusion and itersection:

```
>>> m = fitz.Matrix(45)
>>> r = fitz.Rect(10, 10, 410, 610)
>>> r * m
fitz.Rect(-424.2640686035156, 14.142135620117188, 282.84271240234375, 721.
↪2489013671875)
```

(continues on next page)

(continued from previous page)

```
>>>
>>> r | fitz.Point(5, 5)
fitz.Rect(5.0, 5.0, 410.0, 610.0)
>>>
>>> r + 5
fitz.Rect(15.0, 15.0, 415.0, 615.0)
>>>
>>> r & fitz.Rect(0, 0, 15, 15)
fitz.Rect(10.0, 10.0, 15.0, 15.0)
```

Example 4 - containment:

```
>>> r = fitz.Rect(...)     # any rectangle
>>> ir = r.irect           # its IRect version
>>> # even though you get ...
>>> ir in r
True
>>> # ... and ...
>>> r in ir
True
>>> # ... r and ir are still different types!
>>> r == ir
False
>>> # corners are always part of non-epmpty rectangles
>>> r.bottom_left in r
True
>>>
>>> # numbers are checked against coordinates
>>> r.x0 in r
True
```

Example 5 - create a finite copy:

Create a copy that is **guarantied to be finite** in two ways:

```
>>> r = fitz.Rect(...)     # any rectangle
>>>
>>> # alternative 1
>>> s = fitz.Rect(r.top_left, r.top_left)   # just a point
>>> s | r.bottom_right     # s is a finite rectangle!
>>>
>>> # alternative 2
>>> s = (+r).normalize()
>>> # r.normalize() changes r itself!
```

Example 6 - adding a Python sequence:

Enlarge rectangle by 5 pixels in every direction:

```
>>> r  = fitz.Rect(...)
>>> r1 = r + (-5, -5, 5, 5)
```

Example 7 - inline operations:

Replace a rectangle with its transformation by the inverse of a matrix-like object:

```
>>> r /= (1, 2, 3, 4, 5, 6)
```

4.12 Point

`Point` represents a point in the plane, defined by its x and y coordinates.

Attribute / Method	Short Description
Point.distance_to()	calculate distance to point or rect
Point.transform()	transform point with a matrix
Point.x	the X-coordinate
Point.y	the Y-coordinate

Class API

class Point

__init__(*self*)

__init__(*self*, *x*, *y*)

__init__(*self*, *point*)

__init__(*self*, *sequence*)

Overloaded constructors.

Without parameters, `Point(0, 0)` will be created.

With another point specified, a **new copy** will be crated. A sequence must be Python sequence object of 2 values (see *Using Python Sequences as Arguments in PyMuPDF*).

Parameters
- **x** (*float*) – X coordinate of the point
- **y** (*float*) – Y coordinate of the point

distance_to(*x*[, *unit*])

Calculates the distance to `x`, which may be a *Rect*, *IRect* or *Point*. The distance is given in units of either `px` (pixels, default), `in` (inches), `mm` (millimeters) or `cm` (centimeters).

Note: If `x` is a rectangle, the distance is calculated as if the rectangle were finite.

Parameters
- **x** (*Rect* or *IRect* or *Point*) – the object to which the distance is calculated.
- **unit** (*str*) – the unit to be measured in. One of `px`, `in`, `cm`, `mm`.

Returns distance to object `x`.
Return type float

transform(*m*)

Applies matrix `m` to the point.

Parameters **m** – The matrix to be applied.
Return type `Point`

x
x Coordinate

y
y Coordinate

4.12.1 Remark

This class adheres to the sequence protocol, so components can be accessed via their index, too. Also refer to *Using Python Sequences as Arguments in PyMuPDF*.

4.12.2 Point Algebra

For a general background, see chapter *Operator Algebra for Geometry Objects*.

4.12.3 Examples

This should illustrate some basic uses:

```
>>> fitz.Point(1, 2) * fitz.Matrix(90)
fitz.Point(-2.0, 1.0)
>>>
>>> fitz.Point(1, 2) * 3
fitz.Point(3.0, 6.0)
>>>
>>> fitz.Point(1, 2) + 3
fitz.Point(4.0, 5.0)
>>>
>>> fitz.Point(25, 30) + fitz.Point(1, 2)
fitz.Point(26.0, 32.0)
>>> fitz.Point(25, 30) + (1, 2)
fitz.Point(26.0, 32.0)
>>>
>>> fitz.Point([1, 2])
fitz.Point(1.0, 2.0)
>>>
>>> -fitz.Point(1, 2)
fitz.Point(-1.0, -2.0)
>>>
>>> abs(fitz.Point(25, 30))
39.05124837953327
```

4.13 Shape

This class allows creating interconnected graphical elements on a PDF page. Its methods have the same meaning and name as the corresponding *Page* methods. Their *Common Parameters* are however exported to a separate method, `finish()`. In addition, all draw methods return a *Point* object to support connected drawing paths. This point always equals the **"current point"**, that PDF maintains during path construction.

Methods of this class record the area they are covering in a rectangle (*`Shape.rect`*). This property can for instance be used to set *`Page.CropBox`*.

Also supported are text insertion methods `insertText()` and `insertTextbox()`. They need a slightly different handling compared to the draw methods:

1. They do not use *`Shape.contents`*. Instead they directly modify *`Shape.totalcont`*.
2. They do not use nor need *`Shape.finish()`*.
3. They provide their own `color` and `morph` arguments.
4. They do not use nor change *`Shape.lastPoint`*.

As with the draw methods, text insertions require using *Shape.commit()* to update the page.

Method / Attribute	Description
Shape.commit()	update the page's /Contents object
Shape.drawBezier()	draw a cubic Bézier curve
Shape.drawCircle()	draw a circle around a point
Shape.drawCurve()	draw a cubic Bézier using one helper point
Shape.drawLine()	draw a line
Shape.drawOval()	draw an ellipse
Shape.drawPolyline()	connect a sequence of points
Shape.drawRect()	draw a rectangle
Shape.drawSector()	draw a circular sector or piece of pie
Shape.drawSquiggle()	draw a squiggly line
Shape.drawZigzag()	draw a zigzag line
Shape.finish()	finish a set of draws
Shape.insertText()	insert text lines
Shape.insertTextbox()	insert text into a rectangle
Shape.contents	draw commands since last finish()
Shape.doc	stores the page's document
Shape.height	stores the page's height
Shape.lastPoint	stores the current point
Shape.page	stores the owning page
Shape.rect	rectangle surrounding drawings
Shape.width	stores the page's width
Shape.totalcont	accumulated string to be stored in /Contents

Class API

class Shape

__init__(*self*, *page*)

Create a new drawing. During importing PyMuPDF, the fitz.Page object is being given the convenience method newShape() to construct a Shape object. During instantiation, a check will be made whether we do have a PDF page. An exception is otherwise raised.

Parameters **page** (*Page*) – an existing page of a PDF document.

drawLine(*p1*, *p2*)

Draw a line from *Point* objects p1 to p2.

Parameters

- **p1** (*Point*) – starting point
- **p2** (*Point*) – end point

Return type *Point*

Returns the end point, p2.

drawSquiggle(*p1*, *p2*, *breadth = 2*)

Draw a squiggly (wavy, undulated) line from *Point* objects p1 to p2. An integer number of full wave periods will always be drawn, one period having a length of 4 * breadth. The breadth parameter will be adjusted as necessary to meet this condition. The drawn line will always turn "left" when leaving p1 and always join p2 from the "right".

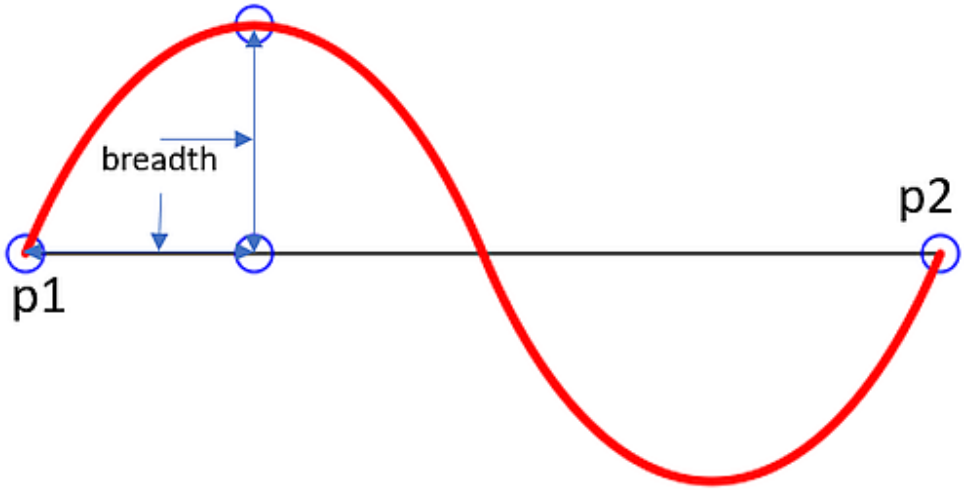
Parameters

- **p1** (*Point*) – starting point
- **p2** (*Point*) – end point

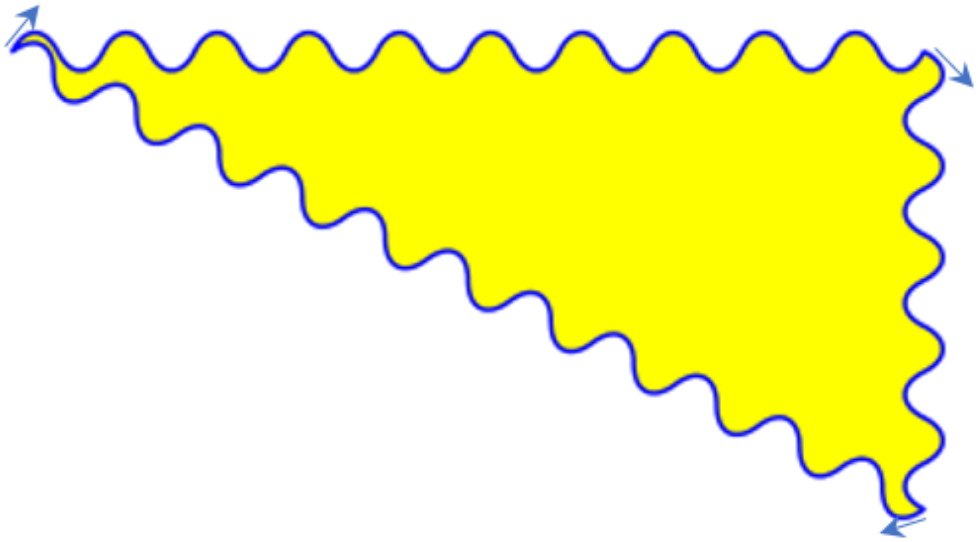
- **breadth** (*float*) – the amplitude of each wave. The condition `2 * breadth < abs(p2 - p1)` must be true to fit in at least one wave. See the following picture, which shows two points connected by one full period.

Return type *Point*

Returns the end point, `p2`.



Here is an example of three connected lines, forming a closed, filled triangle. Little arrows indicate the stroking direction.



Note: Waves drawn are **not** trigonometric (sine / cosine). If you need that, have a look at draw-sines.py.

drawZigzag(*p1*, *p2*, *breadth = 2*)

Draw a zigzag line from *Point* objects `p1` to `p2`. An integer number of full zigzag periods will always be drawn, one period having a length of `4 * breadth`. The breadth parameter will be adjusted to meet this condition. The drawn line will always turn "left" when leaving `p1` and always join `p2` from the "right".

Parameters

- **p1** (*Point*) – starting point
- **p2** (*Point*) – end point
- **breadth** (*float*) – the amplitude of the movement. The condition `2 * breadth < abs(p2 - p1)` must be true to fit in at least one period.

Return type *Point*

Returns the end point, `p2`.

drawPolyline(*points*)

Draw several connected lines between points contained in the sequence `points`. This can be used for creating arbitrary polygons by setting the last item equal to the first one.

Parameters **points** (*sequence*) – a sequence of *Point* objects. Its length must at least be 2 (in which case it is equivalent to `drawLine()`).

Return type *Point*

Returns `points[-1]` - the last point in the argument sequence.

drawBezier(*p1*, *p2*, *p3*, *p4*)

Draw a standard cubic Bézier curve from `p1` to `p4`, using `p2` and `p3` as control points.

Parameters

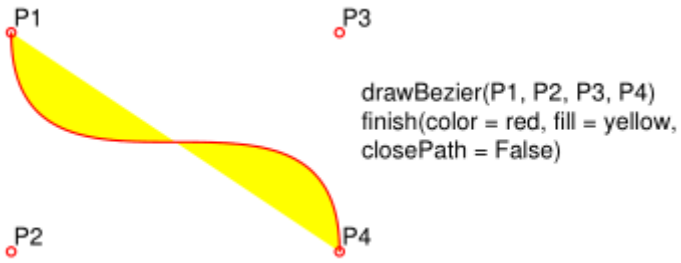
- **p1** (*Point*) – starting point
- **p2** (*Point*) – control point 1
- **p3** (*Point*) – control point 2
- **p4** (*Point*) – end point

Return type *Point*

Returns the end point, `p4`.

Note: The points do not need to be different - experiment a bit with some of them being equal!

Example:



drawOval(*rect*)

Draw an ellipse inside the given rectangle. If `rect` is a square, a standard circle is drawn. The drawing starts and ends at the middle point of the left rectangle side in a counter-clockwise movement.

Parameters **rect** (*Rect*) – rectangle, must be finite and not empty.

Return type *Point*

Returns the middle point of the left rectangle side.

drawCircle(*center*, *radius*)

Draw a circle given its center and radius. The drawing starts and ends at point `start = center - (radius, 0)` in a counter-clockwise movement. `start` corresponds to the middle point of the enclosing square's left border.

The method is a shortcut for `drawSector(center, start, 360, fullSector = False)`. To draw a circle in a clockwise movement, change the sign of the degree.

Parameters

- **center** (*Point*) – the center of the circle.
- **radius** (*float*) – the radius of the circle. Must be positive.

Return type *Point*

Returns `center - (radius, 0)`.

drawCurve(*p1*, *p2*, *p3*)

A special case of `drawBezier()`: Draw a cubic Bézier curve from `p1` to `p3`. On each of the two lines from `p1` to `p2` and from `p2` to `p3` one control point is generated. This guaranties that the curve's curvature does not change its sign. If these two connecting lines intersect with an angle of 90 degress, then the resulting curve is a quarter ellipse (or quarter circle, if of same length) circumference.

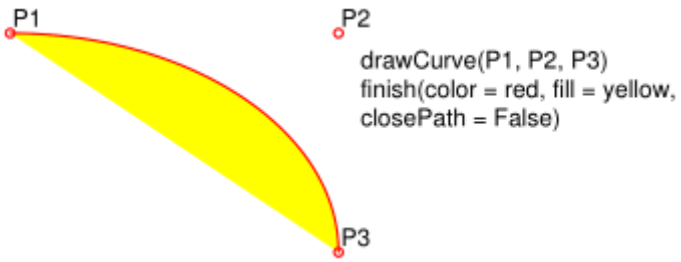
Parameters

- **p1** (*Point*) – starting point.
- **p2** (*Point*) – helper point.
- **p3** (*Point*) – end point.

Return type *Point*

Returns the end point, `p3`.

Example: a filled quarter ellipse segment.



drawSector(*center*, *point*, *angle*, *fullSector = True*)

Draw a circular sector, optionally connecting the arc to the circle's center (like a piece of pie).

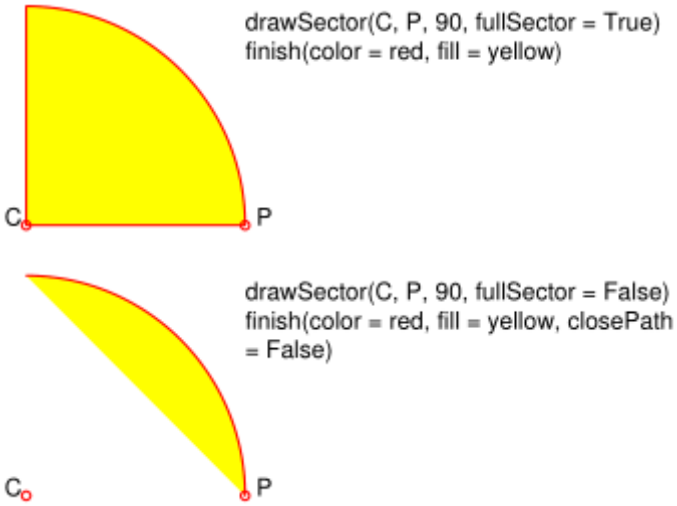
Parameters

- **center** (*Point*) – the center of the circle.
- **point** (*Point*) – one of the two end points of the pie's arc segment. The other one is calculated from the `angle`.
- **angle** (*float*) – the angle of the sector in degrees. Used to calculate the other end point of the arc. Depending on its sign, the arc is drawn counter-clockwise (postive) or clockwise.
- **fullSector** (*bool*) – whether to draw connecting lines from the ends of the arc to the circle center. If a fill color is specified, the full "pie" is colored, otherwise just the sector.

Returns the other end point of the arc. Can be used as starting point for a following invocation to create logically connected pies charts.

Return type *Point*

Examples:



drawRect(*rect*)

Draw a rectangle. The drawing starts and ends at the top-left corner in a counter-clockwise movement.

Parameters **rect** (*Rect*) – where to put the rectangle on the page.

Return type *Point*

Returns `rect.top_left` (top-left corner of the rectangle).

insertText(*point*, *text*, *fontsize = 11*, *fontname = "Helvetica"*, *fontfile = None*, *idx = 0*, *set_simple = False*, *color = (0, 0, 0)*, *rotate = 0*, *morph = None*)

Insert text lines beginning at a *Point* `point`.

Parameters

- **point** (*Point*) – the bottom-left position of the first `text` character in pixels. `point.x` specifies the distance from left border, `point.y` the distance from top of page. This is independent from text orientation as requested by `rotate`. However, there must always be sufficient room "above", which can mean the distance from any of the four page borders.
- **text** (*str or sequence*) – the text to be inserted. May be specified as either a string type or as a sequence type. For sequences, or strings containing line breaks `\n`, several lines will be inserted. No care will be taken if lines are too wide, but the number of inserted lines will be limited by "vertical" space on the page (in the sense of reading direction as established by the `rotate` parameter). Any rest of `text` is discarded - the return code however contains the number of inserted lines. Only single byte character codes are currently supported.
- **rotate** (*int*) – determines whether to rotate the text. Acceptable values are multiples of 90 degrees. Default is 0 (no rotation), meaning horizontal text lines oriented from left to right. 180 means text is shown upside down from **right to left**. 90 means counter-clockwise rotation, text running **upwards**. 270 (or -90) means clockwise rotation, text running **downwards**. In any case, `point` specifies the bottom-left coordinates of the first character's rectangle. Multiple lines, if present, always follow the reading direction established by this parameter. So line 2 is located **above** line 1 in case of `rotate = 180`, etc.

Return type int

Returns number of lines inserted.

For a description of the other parameters see *Common Parameters*.

insertTextbox(*rect*, *buffer*, *fontsize* = *11*, *fontname* = *"Helvetica"*, *fontfile* = *None*, *idx* = *0*, *set_simple* = *False*, *color* = *(0, 0, 0)*, *expandtabs* = *8*, *align* = *TEXT_ALIGN_LEFT*, *rotate* = *0*, *morph* = *None*)

PDF only: Insert text into the specified rectangle. The text will be split into lines and words and then filled into the available space, starting from one of the four rectangle corners, depending on `rotate`. Line feeds will be respected as well as multiple spaces will be.

Parameters

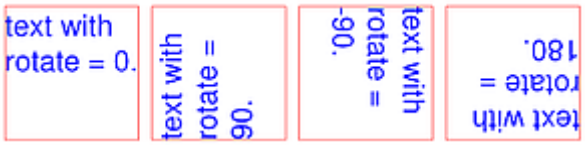
- **rect** (*Rect*) – the area to use. It must be finite and not empty.
- **buffer** – the text to be inserted. Must be specified as a string or a sequence of strings. Line breaks are respected also when occurring in a sequence entry.
- **align** (*int*) – align each text line. Default is 0 (left). Centered, right and justified are the other supported options, see *Text Alignment*. Please note that the effect of parameter value `TEXT_ALIGN_JUSTIFY` is only achievable with "simple" (single-byte) fonts (including the *PDF Base 14 Fonts*). Refer to *Adobe PDF Reference 1.7*, section 5.2.2, page 399.
- **expandtabs** (*int*) – controls handling of tab characters `\t` using the `string.expandtabs()` method **per each line**.
- **rotate** (*int*) – requests text to be rotated in the rectangle. This value must be a multiple of 90 degrees. Default is 0 (no rotation). Effectively, four different values are processed: 0, 90, 180 and 270 (= -90), each causing the text to start in a different rectangle corner. Bottom-left is 90, bottom-right is 180, and -90 / 270 is top-right. See the example how text is filled in a rectangle. This argument takes precedence over morphing. See the second example, which shows text first rotated left by 90 degrees and then the whole rectangle rotated clockwise around is lower left corner.

Return type float

Returns

If positive or zero: successful execution. The value returned is the unused rectangle line space in pixels. This may safely be ignored - or be used to optimize the rectangle, position subsequent items, etc.

If negative: no execution. The value returned is the space deficit to store text lines. Enlarge rectangle, decrease `fontsize`, decrease text amount, etc.



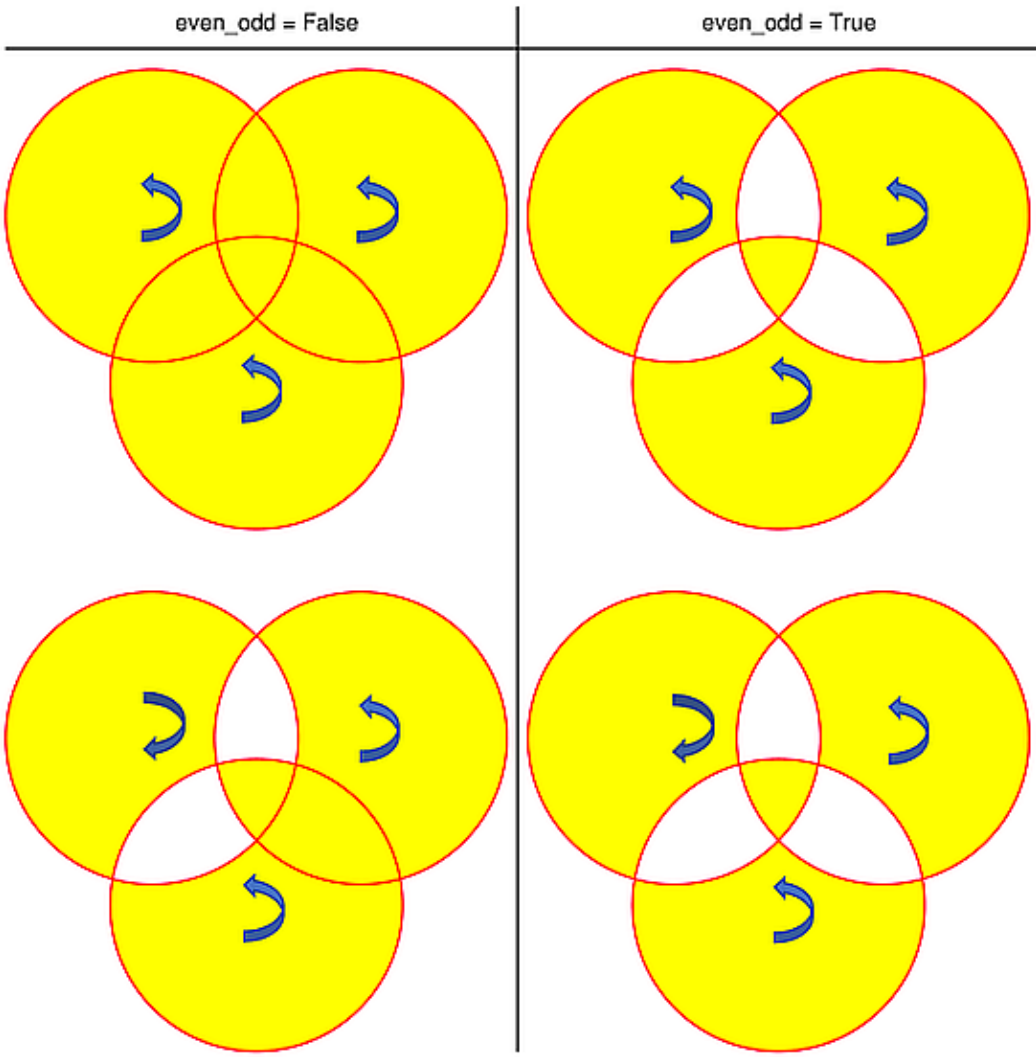
For a description of the other parameters see *Common Parameters*.

finish(*width = 1*, *color = (0, 0, 0)*, *fill = None*, *roundCap = True*, *dashes = None*, *closePath = True*, *even_odd = False*, *morph = (pivot, matrix)*)

Finish a set of `draw*()` methods by applying *Common Parameters* to all of them. This method also supports morphing the resulting compound drawing using a pivotal *Point*.

Parameters

- **morph** (*sequence*) – morph the compound drawing around some arbitrary pivotal *Point* `pivot` by applying *Matrix* `matrix` to it. Default is no morphing (`None`). The matrix can contain any values in its first 4 components, `matrix.e == matrix.f == 0` must be true, however. This means that any combination of scaling, shearing, rotating, flipping, etc. is possible, but translations are not.
- **even_odd** (*bool*) – request the **"even-odd rule"** for filling operations. Default is `False`, so that the **"nonzero winding number rule"** is used. These rules are alternative methods to apply the fill color where areas overlap. Only with fairly complex shapes a different behavior is to be expected with these rules. For an in-depth explanation, see *Adobe PDF Reference 1.7*, pp. 232 ff. Here is an example to demonstrate the difference.



Note: Method **"even-odd"** counts the number of overlaps of areas. Pixels in areas overlapping an odd number of times are regarded **inside**, otherwise **outside**. In contrast, the default method **"nonzero winding"** also looks at the area orientation: it counts `+1` if an area is drawn counter-clockwise and `-1` else. If the result is zero,the pixel is regarded **outside**, otherwise **inside**. In the top two shapes, three circles are drawn in standard manner (anti-clockwise, look at the arrows). The lower two shapes contain one (top-left) circle drawn clockwise. As can be seen, area orientation is irrelevant for the even-odd rule.

commit(*overlay = True*)

Update the page's `/Contents` with the accumulated drawing commands. If a `Shape` is not committed, the page will not be changed. The method must be preceeded with at least one `finish()` or one text insertion method.

The method will reset attributes *Shape.rect*, *Shape.lastPoint*, *Shape.contents* and *Shape.totalcont*. Afterwards, the shape object can be reused for the **same page**.

Parameters **overlay** (*bool*) – determine whether to put content in foreground (default) or background. Relevant only, if the page has a non-empty `/Contents` object.

doc

For reference only: the page's document.

Type *Document*

page
For reference only: the owning page.

Type *Page*

height
Copy of the page's height

Type float

width
Copy of the page's width.

Type float

contents
Accumulated command buffer for draw methods since last finish.

Type str

rect
Rectangle surrounding drawings. This attribute is at your disposal and may be changed at any time. Its value is set to `None` when a shape is created or committed. Every `draw*` method, and *`Shape.insertTextbox()`* update this property (i.e. **enlarge** the rectangle as needed). **Morphing** operations, however (*`Shape.finish()`*, *`Shape.insertTextbox()`*) are ignored.

A typical use of this attribute would be setting *`Page.CropBox`* to this value, when you are creating shapes for later or external use. If you have not manipulated the attribute yourself, it should reflect a rectangle that contains all drawings so far.

If you have used morphing and want to adjust this attribute accordingly, use the following code:

```
>>> # assuming ...
>>> morph = (point, matrix)
>>> # ... recalculate the shape rectangle like so:
>>> img.rect = (img.rect - fitz.Rect(point, point)) * ~matrix + fitz.
↪Rect(point, point)
```

Type *Rect*

totalcont
Total accumulated command buffer for draws and text insertions. This will be used by *`Shape.commit()`*.

Type str

lastPoint
For reference only: the current point of the drawing path. It is `None` at `Shape` creation and after each `finish()` and `commit()`.

Type *Point*

4.13.1 Usage

A drawing object is constructed by `img = page.newShape()`. After this, as many draw, finish and text insertions methods as required may follow. Each sequence of draws must be finished before the drawing is committed. The overall coding pattern looks like this:

```
>>> img = page.newShape()
>>> img.draw1(...)
>>> img.draw2(...)
```

(continues on next page)

(continued from previous page)

```
>>> ...
>>> img.finish(width=..., color = ..., fill = ..., morph = ...)
>>> img.draw3(...)
>>> img.draw4(...)
>>> ...
>>> img.finish(width=..., color = ..., fill = ..., morph = ...)
>>> ...
>>> img.insertText*
>>> ...
>>> img.commit()
>>> ....
```

Notes

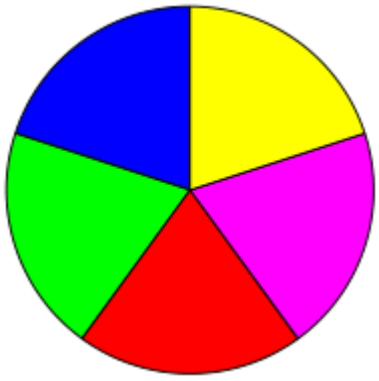
1. Each `finish()` combines the preceding draws into one logical shape, giving it common colors, line width, morphing, etc. If `closePath` is specified, it will also connect the end point of the last draw with the starting point of the first one.
2. To successfully create compound graphics, let each draw method use the end point of the previous one as its starting point. In the above pseudo code, `draw2` should hence use the returned *Point* of `draw1` as its starting point. Failing to do so, would automatically start a new path and `finish()` may not work as expected (but it won't complain either).
3. Text insertions may occur anywhere before the commit (they neither touch *Shape.contents* nor *Shape.lastPoint*). They are appended to `Shape.totalcont` directly, whereas draws will be appended by `Shape.finish`.
4. Each `commit` takes all text insertions and shapes and places them in foreground or background on the page - thus providing a way to control graphical layers.
5. Only `commit` will update the page's contents, the other methods are basically string manipulations. With many draw / text operations, this will result in a much better performance, than issuing the corresponding page methods separately (they each do their own commit).

4.13.2 Examples

1. Create a full circle of pieces of pie in different colors:

```
>>> img  = page.newShape()       # start a new shape
>>> cols = (...)                 # a sequence of RGB color triples
>>> pieces = len(cols)           # number of pieces to draw
>>> beta = 360. / pieces         # angle of each piece of pie
>>> center = fitz.Point(...)     # center of the pie
>>> p0     = fitz.Point(...)     # starting point
>>> for i in range(pieces):
        p0 = img.drawSector(center, p0, beta,
                            fullSector = True) # draw piece
        # now fill it but do not connect ends of the arc
        img.finish(fill = cols[i], closePath = False)
>>> img.commit()                 # update the page
```

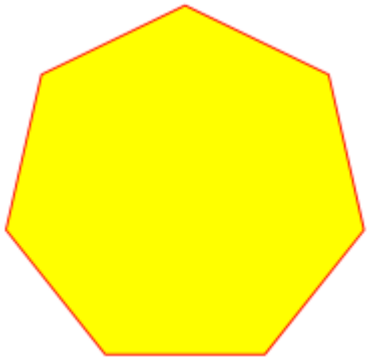
Here is an example for 5 colors:



2. Create a regular n-edged polygon (fill yellow, red border). We use `drawSector()` only to calculate the points on the circumference, and empty the draw command buffer before drawing the polygon:

```
>>> img  = page.newShape()        # start a new shape
>>> beta = -360.0 / n             # our angle, drawn clockwise
>>> center = fitz.Point(...)     # center of circle
>>> p0     = fitz.Point(...)     # start here (1st edge)
>>> points = [p0]                 # store polygon edges
>>> for i in range(n):            # calculate the edges
        p0 = img.drawSector(center, p0, beta)
        points.append(p0)
>>> img.contents = ""             # do not draw the circle sectors
>>> img.drawPolyline(points)      # draw the polygon
>>> img.finish(color = (1,0,0), fill = (1,1,0), closePath = False)
>>> img.commit()
```

Here is the polygon for n = 7:



4.13.3 Common Parameters

fontname (*str*)

In general, there are three options:

1. Use one of the standard *PDF Base 14 Fonts*. In this case, `fontfile` **must not** be specified and `"Helvetica"` is used if this parameter is omitted, too.
2. Choose a font already in use by the page. Then specify its **reference** name prefixed with a slash "/", see example below.
3. Specify a font file present on your system. In this case choose an arbitrary, but new name for this parameter (without "/" prefix).

If inserted text should re-use one of the page's fonts, use its reference name appearing in `getFontList()` like so:

Suppose the font list has the entry `[1024, 0, 'Type1', 'CJXQIC+NimbusMonL-Bold', 'R366']`, then specify `fontname = "/R366", fontfile = None` to use font `CJXQIC+NimbusMonL-Bold`.

---

fontfile (*str*)

File path of a font existing on your computer. If you specify `fontfile`, make sure you use a `fontname` **not occurring** in the above list. This new font will be embedded in the PDF upon `doc.save()`. Similar to new images, a font file will be embedded only once. A table of MD5 codes for the binary font contents is used to ensure this.

---

idx (*int*)

Font files may contain more than one font. Use this parameter to select the right one. This setting cannot be reverted. Subsequent changes are ignored.

---

set_simple (*bool*)

Fonts installed from files are installed as **Type0** fonts by default. If you want to use 1-byte characters only, set this to true. This setting cannot be reverted. Subsequent changes are ignored.

---

fontsize (*float*)

Font size of text. This also determines the line height as `fontsize * 1.2`.

---

dashes (*str*)

Causes lines to be dashed. A continuous line with no dashes is drawn with `"[]0"` or `None`. For (the rather complex) details on how to achieve dashing effects, see *Adobe PDF Reference 1.7*, page 217. Simple versions look like `"[3 4]"`, which means dashes of 3 and gaps of 4 pixels length follow each other. `"[3 3]"` and `"[3]"` do the same thing.

---

color / **fill** (*list, tuple*)

Line and fill colors are always specified as RGB triples of floats from 0 to 1. To simplify color specification, method `getColor()` in `fitz.utils` may be used. It accepts a string as the name of the color and returns the corresponding triple. The method knows over 540 color names - see section *Color Database*.

---

overlay (*bool*)

Causes the item to appear in foreground (default) or background.

---

morph (*sequence*)

Causes "morphing" of either a shape, created by the `draw*()` methods, or the text inserted by page methods `insertTextbox()` / `insertText()`. If not `None`, it must be a pair `(pivot, matrix)`, where `pivot` is a *Point* and `matrix` is a *Matrix*. The matrix can be anything except translations, i.e. `matrix.e == matrix.f == 0` must be true. The point is used as a pivotal point for the matrix operation. For example, if `matrix` is a rotation or scaling operation, then `pivot` is its center. Similarly, if `matrix` is a left-right or up-down

flip, then the mirroring axis will be the vertical, respectively horizontal line going through `pivot`, etc.

Note: Several methods contain checks whether the to be inserted items will actually fit into the page (like *`Shape.insertText()`*, or *`Shape.drawRect()`*). For the result of a morphing operation there is however no such guaranty: this is entirely the rpogrammer's responsibility.

---

roundCap (*bool*)

Cause lines, dashes and edges to be rounded (default). If false, sharp edges and square line and dashes ends will be generated. Rounded lines / dashes will end in a semi-circle with a diameter equal to line width and make longer by the radius of this semi-circle.

---

closePath (*bool*)

Causes the end point of a drawing to be automatically connected with the starting point (by a straight line).

4.14 Annot

Quote from the *Adobe PDF Reference 1.7*: "An annotation associates an object such as a note, sound, or movie with a location on a page of a PDF document, or provides a way to interact with the user by means of the mouse and keyboard."

This class supports accessing such annotations - not only for PDF files, but for all MuPDF supported document types. However, only a few methods and properties apply to non-PDF documents.

There is a parent-child relationship between an annotation and its page. If the page object becomes unusable (closed document, any document structure change, etc.), then so does every of its existing annotation objects - an exception is raised saying that the object is "orphaned", whenever an annotation property or method is accessed.

Attribute	Short Description
Annot.getPixmap()	image of the annotation as a pixmap
Annot.setInfo()	PDF only: change metadata of an annotation
Annot.setBorder()	PDF only: changes the border of an annotation
Annot.setFlags()	PDF only: changes the flags of an annotation
Annot.setRect()	PDF only: changes the rectangle of an annotation
Annot.setColors()	PDF only: changes the colors of an annotation
Annot.setOpacity()	PDF only: changes the annot's transparency
Annot.updateImage()	PDF only: applies border and color values to shown image
Annot.updateWidget()	PDF only: change an exsiting form field
Annot.fileInfo()	PDF only: returns attached file information
Annot.fileGet()	PDF only: returns attached file content
Annot.fileUpd()	PDF only: sets attached file new content
Annot.border	PDF only: border details
Annot.colors	PDF only: border / background and fill colors
Annot.flags	PDF only: annotation flags
Annot.info	PDF only: various information
Annot.lineEnds	PDF only: start / end appearance of line-type annotations
Annot.next	link to the next annotation
Annot.opacity	the annot's transparency
Annot.parent	page object of the annotation
Annot.rect	rectangle containing the annotation
Annot.type	PDF only: type of the annotation
Annot.vertices	PDF only: point coordinates of Polygons, PolyLines, etc.
Annot.widget_name	PDF only: "Widget" field name
Annot.widget_value	PDF only: "Widget" field value
Annot.widget_choices	PDF only: possible values for "Widget" list / combo boxes
Annot.widget_type	PDF only: "Widget" field type

Class API

class Annot

getPixmap(*matrix = fitz.Ientity*, *colorspace = fitz.csRGB*, *alpha = False*)

Creates a pixmap from the annotation as it appears on the page in untransformed coordinates. The pixmap's *IRect* equals `Annot.rect.irect` (see below).

Parameters

- **matrix** (*Matrix*) – a matrix to be used for image creation. Default is the `fitz.Identity` matrix.
- **colorspace** (*Colorspace*) – a colorspace to be used for image creation. Default is `fitz.csRGB`.
- **alpha** (*bool*) – whether to include transparency information. Default is `False`.

Return type *Pixmap*

setInfo(*d*)

Changes the info dictionary. This is includes dates, contents, subject and author (title). Changes for `name` will be ignored.

Parameters **d** (*dict*) – a dictionary compatible with the `info` property (see below). All entries must be `unicode`, `bytes`, or strings. If `bytes` values in Python 3 they will be treated as being UTF8 encoded.

setOpacity(*value*)

PDF only: Change an annotation's transparency.

Parameters **value** (*float*) – a float in range `[0, 1]`. Any value outside is assumed to be 1. E.g. a value of 0.5 sets the transparency to 50%.

setRect(*rect*)

Changes the rectangle of an annotation. The annotation can be moved around and both sides of the rectangle can be independently scaled. However, the annotation appearance will never get rotated, flipped or sheared.

Parameters **rect** (*Rect*) – the new rectangle of the annotation. This could e.g. be a rectangle `rect = Annot.rect * M` with a suitable *Matrix* M (only scaling and translating will yield the expected effect).

setBorder(*border*)

PDF only: Change border width and dashing properties.

Parameters **border** (*dict*) – a dictionary with keys `width` (*float*), `style` (*str*) and `dashes` (*list*). Omitted values will leave the resp. property unchanged. To remove dashing and get a contiguous line, specify `"dashes": []`. Style values may be given in upper or lower case - only the first character is significant, i.e. "s" is treated as "Solid".

setFlags(*flags*)

Changes the annotation flags. See *Annotation Flags* for possible values and use the `|` operator to combine several.

Parameters **flags** (*int*) – an integer specifying the required flags.

setColors(*d*)

PDF only: Changes the "stroke" and "fill" colors for supported annotation types.

Parameters **d** (*dict*) – a dictionary containing color specifications. For accepted dictionary keys and values see below. The most practical way should be to first make a copy of the `colors` property and then modify this dictionary as required.

Note: This method **does not work** for widget annotations and results in a no-op with a warning message. Use *updateWidget()* instead. Certain annotation types have no fill colors. In these cases this value is ignored and a warning is issued.

---

updateImage()

Attempts to modify the displayed graphical image such that it coincides with the values currently contained in the `border` and `colors` properties. This is achieved by modifying the contents stream of the associated appearance XObject. Nested XObject invocations are currently not supported and ignored with a warning message.

updateWidget(*widget*)

Modifies an existing form field. The existing and the changed widget attributes must all be provided by way of a *Widget* object. This is because the method will update the field with **all properties** of the *Widget* object.

Parameters **widget** (*Widget*) – a widget object containing the **complete** (old and new) properties of the widget. Create the object via *widget* and apply your changes before passing it to this method.

Note: As with *Page.addWidget()*, make sure to use option `clean = True` when saving the file. This will cause an update of the annotation's appearance.

---

fileInfo()

Basic information of the attached file.

Return type dict

Returns a dictionary with keys `filename`, `ufilename`, `desc` (description), `size` (uncompressed file size), `length` (compressed length).

fileGet()
Returns attached file content.

Return type bytes

Returns the content of the attached file.

fileUpd(*buffer = None*, *filename=None*, *ufilename=None*, *desc = None*)
Updates the content of an attached file.

Parameters

- **buffer** (*bytes/bytearray*) – the new file content. May be omitted to only change meta-information.
- **filename** (*str*) – new filename to associate with the file.
- **ufilename** (*str*) – new unicode filename to associate with the file.
- **desc** (*str*) – new description of the file content.

opacity
The annotation's transparency, a value in range `[0, 1]`. Always 1 for non-PDFs.

Return type float

parent
The owning page object of the annotation.

Return type *Page*

rect
The rectangle containing the annotation in untransformed coordinates.

Return type *Rect*

next
The next annotation on this page or `None`.

Return type `Annot`

type
Meaningful for PDF only: A number and one or two strings describing the annotation type, like `[2, 'FreeText', 'FreeTextCallout']`. The second string entry is optional and may be empty. `[]` if not PDF. See the appendix *Annotation Types* for a list of possible values and their meanings.

Return type list

info
Meaningful for PDF only: A dictionary containing various information. All fields are (unicode) strings.

- `name` - e.g. for `[12, 'Stamp']` type annotations it will contain the stamp text like `Sold` or `Experimental`.
- `content` - a string containing the text for type `Text` and `FreeText` annotations. Commonly used for filling the text field of annotation pop-up windows. For `FileAttachment` it should be used as description for the attached file. Initially just contains the filename.
- `title` - a string containing the title of the annotation pop-up window. By convention, this is used for the annotation author.
- `creationDate` - creation timestamp.
- `modDate` - last modified timestamp.
- `subject` - subject, an optional string.

Return type dict

flags
Meaningful for PDF only: An integer whose low order bits contain flags for how the annotation should be presented. See section *Annotation Flags* for details.

Return type int

lineEnds
Meaningful for PDF only: A dictionary specifying the starting and the ending appearance of annotations of types `Line`, `PolyLine`, among others. An example would be `{'start': 'None', 'end': 'OpenArrow'}`. `{}` if not specified or not applicable. For possible values and descriptions in this list, see the *Adobe PDF Reference 1.7*, table 8.27 on page 630.

Return type dict

vertices
PDF only: A list containing point ("vertices") coordinates (each given by a pair of floats) for various types of annotations:

- `Line` - the starting and ending coordinates (2 float pairs).
- `[2, 'FreeText', 'FreeTextCallout']` - 2 or 3 float pairs designating the starting, the (optional) knee point, and the ending coordinates.
- `PolyLine` / `Polygon` - the coordinates of the edges connected by line pieces (n float pairs for n points).
- text markup annotations - 4 float pairs specifying the `QuadPoints` of the marked text span (see *Adobe PDF Reference 1.7*, page 634).
- `Ink` - list of one to many sublists of vertex coordinates. Each such sublist represents a separate line in the drawing.

Return type list

widget
PDF only: A class containing all properties of a **form field** - including the following three attributes. `None` for other annotation types.

Return type *Widget*

widget_name
PDF only: The field name for an annotation of type `ANNOT_WIDGET`, `None` otherwise. Equals *`Widget.field_name`*.

Return type str

widget_value
PDF only: The field content for an annotation of type `ANNOT_WIDGET`. Is `None` for non-PDFs, other annotation types, or if no value has been entered. For button types the value will be `True` or `False`. Push button states have no permanent reflection in the file and are therefore always reported as `False`. For text, list boxes and combo boxes, a string is returned for single values. If multiple selections have been made (may happen for list boxes and combo boxes), a list of strings is returned. For list boxes and combo boxes, the selectable values are contained in *`widget_choices`* below. Equals *`Widget.field_value`*.

Return type bool, str or list

widget_choices
PDF only: Contains a list of selectable values for list boxes and combo boxes (annotation type `ANNOT_WIDGET`), else `None`. Equals *`Widget.choice_values`*.

Return type list

widget_type
PDF only: The field type for an annotation of type `ANNOT_WIDGET`, else `None`.

Return type tuple

Returns a tuple `(int, str)`. E.g. for a text field `(3, 'Text')` is returned. For a complete list see *Annotation Types*. The first item equals *Widget.field_type*, and the second is *Widget.field_type_string*.

colors

Meaningful for PDF only: A dictionary of two lists of floats in range `0 <= float <= 1` specifying the `stroke` and the interior (`fill`) colors. The stroke color is used for borders and everything that is actively painted or written ("stroked"). The fill color is used for the interior of objects like line ends, circles and squares. The lengths of these lists implicitely determine the colorspaces used: 1 = GRAY, 3 = RGB, 4 = CMYK. So `[1.0, 0.0, 0.0]` stands for RGB color red. Both lists can be `[]` if not specified. The dictionary will be empty `{}` if no PDF. The value of each float `f` is mapped to the integer value `i` in range 0 to 255 via the computation `f = i / 255`.

Return type dict

border

Meaningful for PDF only: A dictionary containing border characteristics. It will be empty `{}` if not PDF or when no border information is provided. Technically, the PDF entries `/Border`, `/BS` and `/BE` will be checked to build this information. The following keys can occur:

- `width` - a float indicating the border thickness in points.
- `effect` - a list specifying a border line effect like `[1, 'C']`. The first entry "intensity" is an integer (from 0 to 2 for maximum intensity). The second is either 'S' for "no effect" or 'C' for a "cloudy" line.
- `dashes` - a list of integers (arbitrarily limited to 10) specifying a line dash pattern in user units (usually points). `[]` means no dashes, `[n]` means equal on-off lengths of `n` points, longer lists will be interpreted as specifying alternating on-off length values. See the *Adobe PDF Reference 1.7* page 217 for more details.
- `style` - 1-byte border style: `S` (Solid) = solid rectangle surrounding the annotation, `D` (Dashed) = dashed rectangle surrounding the annotation, the dash pattern is specified by the `dashes` entry, `B` (Beveled) = a simulated embossed rectangle that appears to be raised above the surface of the page, `I` (Inset) = a simulated engraved rectangle that appears to be recessed below the surface of the page, `U` (Underline) = a single line along the bottom of the annotation rectangle.

Return type dict

4.14.1 Example

Change the graphical image of an annotation. Also update the "author" and the text to be shown in the popup window:

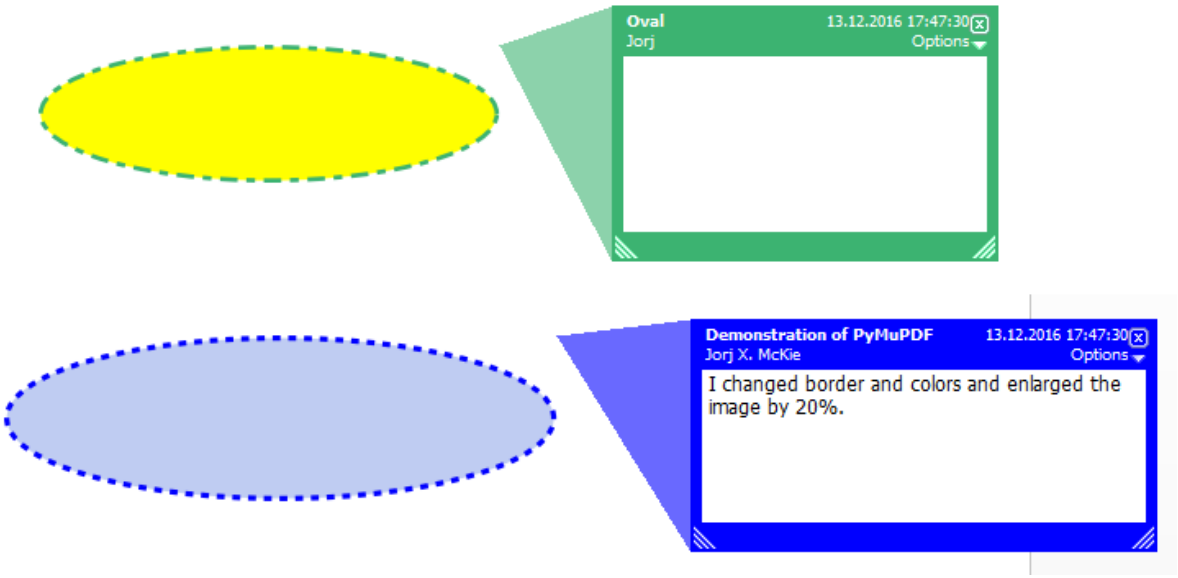
```
doc = fitz.open("circle-in.pdf")
page = doc[0]                           # page 0
annot = page.firstAnnot                 # get the annotation
annot.setBorder({"dashes": [3]})        # set dashes to "3 on, 3 off ..."

# set border / popup color to blue and fill color to some light blue
annot.setColors({"stroke":[0, 0, 1], "fill":[0.75, 0.8, 0.95]})
info = annot.info                       # get info dict
info["title"] = "Jorj X. McKie"         # author name in popup title

# text in popup window ...
info["content"] = "I changed border and colors and enlarged the image by 20%."
info["subject"] = "Demonstration of PyMuPDF"     # some readers also show this
annot.setInfo(info)                     # update info dict
```

(continues on next page)

(continued from previous page)

```
r = annot.rect                          # take annot rect
r.x1 = r.x0 + r.width  * 1.2            # new location has same top-left
r.y1 = r.y0 + r.height * 1.2            # but 20% longer sides
annot.setRect(r)                        # update rectangle
annot.updateImage()                     # update appearance
doc.save("circle-out.pdf", garbage=4)   # save
```

This is how the circle annotation looks like, before and after the change:



4.15 Widget

This class represents the properties of a PDF Form field, a "widget". Fields are a special case of annotations, which allow users with limited permissions to enter information in a PDF. This is usually used for filling out forms.

Class API

class Widget

border_color
A list of up to 4 floats defining the field's border. Default value is `None` which causes border style and border width to be ignored.

border_style
A string defining the line style of the field's border. See *Annot.border*. Default is "s" ("Solid") - a continuous line. Only the first character (upper or lower case) will be regarded when creating a widget.

border_width
A float defining the width of the border line. Default is 1.

border_dashes
A list of integers defining the dash properties of the border line. This is only meaningful if `border_style == "D"` and *border_color* is provided.

choice_values
A mandatory Python sequence of strings defining the valid choices of listboxes and comboboxes. Ignored for other field types. Equals *Annot.widget_choices*. The sequence

must contain at least two items. When updating the widget, always the complete new list of values must be specified.

field_name
A mandatory string defining the field's name. Equals *Annot.widget_name*. No checking for duplicates takes place.

field_value
The value of the field. Equals *Annot.widget_value*.

field_flags
An integer defining a large amount of proprties of a field. Handle this attribute with care

field_type
A mandatory integer defining the field type. This is a value in the range of 0 to 6. It cannot be changed when updating the widget.

field_type_string
A string describing (and derived from) the field type.

fill_color
A list of up to 4 floats defining the field's background color.

button_caption
For future use: the caption string of a button-type field.

rect
The rectangle containing the field.

text_color
A list of **1, 3 or 4 floats** defining the text color. Default value is black (*[0, 0, 0]*).

text_font
A string defining the font to be used. Default and replacement for invalid values is `"Helv"`. For valid font reference names see the table below.

text_fontsize
A float defining the text fontsize. Default value is zero, which causes PDF viewer software to dynamically choose a size suitable for the annotation's rectangle and text amount.

text_maxlen
An integer defining the maximum number of text characters. PDF viewers will (should) not accept larger text amounts.

text_type
An integer defining acceptable text types (e.g. numeric, date, time, etc.). For reference only for the time being - will be ignored when creating or updating widgets.

4.15.1 Standard Fonts for Widgets

Widgets use their own resources object `/DR`. A widget resources object must at least contain a `/Font` object. Widget fonts are independent from page fonts. We currently support the 14 PDF base fonts using the following fixed reference names, or any name of an already existing field font. When specifying a text font for new or changed widgets, **either** choose one in the first table column (upper and lower case supported), **or** one of the already existing form fonts. In the latter case, spelling must exactly match.

To find out already existing field fonts, inspect the list *Document.FormFonts*.

Reference	Base14 Fontname
CoBI	Courier-BoldOblique
CoBo	Courier-Bold
CoIt	Courier-Oblique
Cour	Courier
HeBI	Helvetica-BoldOblique
HeBo	Helvetica-Bold
HeIt	Helvetica-Oblique
Helv	Helvetica **(default)**
Symb	Symbol
TiBI	Times-BoldItalic
TiBo	Times-Bold
TiIt	Times-Italic
TiRo	Times-Roman
ZaDb	ZapfDingbats

You are generally free to use any font for every widget. However, we recommend using `ZaDb` ("ZapfDingbats") and fontsize 0 for check boxes: typical viewers will put a correctly sized tickmark in the field's rectangle, when it is clicked.

CHAPTER

FIVE

OPERATOR ALGEBRA FOR GEOMETRY OBJECTS

Instances of classes *Point*, *IRect*, *Rect* and *Matrix* are collectively also called "geometry" objects.

They all are special cases of Python sequences, see *Using Python Sequences as Arguments in PyMuPDF* for more background.

We have defined operators for these classes that allow dealing with them (almost) like ordinary numbers in terms of addition, subtraction, multiplication, division, and some others.

This chapter is a synopsis of what is possible.

5.1 General Remarks

1. Operators can be either **binary** (i.e. involving two objects) or **unary**.
2. The resulting type of **binary** operations is either a **new object** of the **left operand's class** or a bool.
3. The result of **unary** operations is either a **new object** of the same class, a bool or a float.
4. `+, -, *, /` are defined for all classes. They do what you would expect from them.
5. Rectangles have two additional binary operators: `&` (intersection) and `|` (union).
6. Binary operators fully support in-place operations: if `"°"` denotes any binary operator, then `a °= b` is the same as `a = a ° b`.
7. For binary operations, the **second** operand may always be a number sequence of the same size as the left one. We allude to this fact by e.g. saying "point-like object" when we mean, that a *Point* is possible as well as any sequence of two numbers. Similar applies to "rect-like" (sequence length 4) or "matrix-like" (sequence length 6).

5.2 Unary Operations

Operation	Result
bool(O)	is false exactly if all components of `O` are zero.
abs(O)	is the Euclidean norm (square root of the sum of component squares), if `O` is a *Point* or a *Matrix*. For rectangles, its area is returned.
+O	is a copy of `O`
-O	is a copy of `O` with negated components.
~m	is the inverse of *Matrix* `m`.

5.3 Binary Operations

For the operators `+, -, *, /`, the **second operand** may be a number, which will be applied to each component. Otherwise:

Operation	Result
a + b a - b	component-wise execution, `b` must be `a`-like.
a * m a / m	`a` can be any geometry object and `m` must be matrix - like. If `a` is a **point** or a **rectangle**, then `a.transform(m)`, resp. `a.transform(~m)` is executed. If `a` is a **matrix**, then `a * m`, resp. `a * ~m` is executed.
a & b	**intersection rectangle:** `a` must be a rectangle and `b` rect-like. Delivers the **largest rectangle** contained in both operands.
a | b	**union rectangle:** `a` must be a rectangle, and `b` can be point-like or rect-like. Delivers the **smallest rectangle** containing both operands.
"b in a"	if `b` is a number, then `b in tuple(a)` is returned. If `b` is point-like or rect-like, then `a` must be a rectangle, and the result of `a.contains(b)` is returned.
a == b	is true if `abs(a - b) == 0` and `type(a) == type(b)` (but maybe there is `id(a) != id(b)`).

CHAPTER

SIX

LOW LEVEL FUNCTIONS AND CLASSES

Contains a number of functions and classes for the experienced user. To be used for special needs or performance requirements.

6.1 Functions

The following are miscellaneous functions on a fairly low-level technical detail.

Some functions provide detail access to PDF structures. Others are stripped-down, high performance versions of functions providing more information.

Yet others are handy, general-purpose utilities.

Function	Short Description
Document.FontInfos	PDF only: information on inserted fonts
Annot._cleanContents()	PDF only: clean the annot's `/Contents` objects
Annot._getXref()	PDF only: return XREF number of annotation
ConversionHeader()	return header string for `getText` methods
ConversionTrailer()	return trailer string for `getText` methods
Document._delXmlMetadata()	PDF only: remove XML metadata
Document._getGCTXerrmsg()	retrieve C-level exception message
Document._getNewXref()	PDF only: create and return a new XREF entry
Document._getObjectString()	PDF only: return object source code
Document._getOLRootNumber()	PDF only: return / create XREF of `/Outline`
Document._getPageObjNumber()	PDF only: return XREF and generation number of a page
Document._getPageXref()	PDF only: same as `_getPageObjNumber()`
Document._getXmlMetadataXref()	PDF only: return XML metadata XREF number
Document._getXrefLength()	PDF only: return length of XREF table
Document._getXrefStream()	PDF only: return content of a stream
Document._getXrefString()	PDF only: return object source code
Document._updateObject()	PDF only: insert or update a PDF object
Document._updateStream()	PDF only: replace the stream of an object
Document.extractFont()	PDF only: extract embedded font
Document.extractImage()	PDF only: extract raw embedded image
Document.getCharWidths()	PDF only: return a list of glyph widths of a font
getPDFnow()	return the current timestamp in PDF format
getPDFstr()	return PDF-compatible string
Page._cleanContents()	PDF only: clean the page's `/Contents` objects
Page._getContents()	PDF only: return a list of content numbers
Page._setContents()	PDF only: set page's /Contents object to specified yref
Page._getXref()	PDF only: return XREF number of page
Page.getDisplayList()	create the page's display list
Page.insertFont()	PDF only: store a new font in the document

Continued on next page

Table 1 – continued from previous page

Function	Short Description
Page.getTextBlocks()	extract text blocks as a Python list
Page.getTextWords()	extract text words as a Python list
Page.run()	run a page through a device
PaperSize()	return width, height for known paper formats

PaperSize(*s*)

Convenience function to return width and height of a known paper format code. These values are given in pixels for the standard resolution 72 pixels = 1 inch.

Currently defined formats include A0 through A10, B0 through B10, C0 through C10, Card-4x6, Card-5x7, Commercial, Executive, Invoice, Ledger, Legal, Legal-13, Letter, Monarch and Tabloid-Extra, each in either portrait or landscape format.

A format name must be supplied as a string (case insensitive), optionally suffixed with "-L" (landscape) or "-P" (portrait). No suffix defaults to portrait.

Parameters **s** (*str*) – a format name like `"A4"` or `"letter-l"`.

Return type tuple

Returns `(width, height)` of the paper format. For an unknown format `(-1, -1)` is returned. Esamples: `PaperSize("A4")` returns `(595, 842)` and `PaperSize("letter-l")` delivers `(792, 612)`.

---

getPDFnow()

Convenience function to return the current local timestamp in PDF compatible format, e.g. `D:20170501121525-04'00'` for local datetime May 1, 2017, 12:15:25 in a timezone 4 hours westward of the UTC meridian.

Return type str

Returns current local PDF timestamp.

---

getPDFstr(*obj*, *brackets = True*)

Make a PDF-compatible string: if `obj` contains code points `ord(c) > 255`, then it will be converted to UTF-16BE as a hexadecimal character string like `<feff...>`. Otherwise, if `brackets = True`, it will enclose the argument in `()` replacing any characters with code points `ord(c) > 127` by their octal number `\nnn` prefixed with a backslash. If `brackets = False`, then the string is returned unchanged.

Parameters **obj** (*str or bytes or unicode*) – the object to convert

Return type str

Returns PDF-compatible string enclosed in either `()` or `<>`.

ConversionHeader(*output = "text"*, *filename = "UNKNOWN"*)

Return the header string required to make a valid document out of page text outputs.

Parameters

- **output** (*str*) – type of document. Use the same as the output parameter of `getText()`.
- **filename** (*str*) – optional arbitrary name to use in output types "json" and "xml".

Return type str

ConversionTrailer(*output*)

Return the trailer string required to make a valid document out of page text outputs. See *Page.getText()* for an example.

Parameters **output** (*str*) – type of document. Use the same as the output parameter of `getText()`.

Return type str

`Document.`**`_delXmlMetadata`**`()`

Delete an object containing XML-based metadata from the PDF. (Py-) MuPDF does not support XML-based metadata. Use this if you want to make sure that the conventional metadata dictionary will be used exclusively. Many thirdparty PDF programs insert their own metadata in XML format and thus may override what you store in the conventional dictionary. This method deletes any such reference, and the corresponding PDF object will be deleted during next garbage collection of the file.

`Document.`**`_getXmlMetadataXref`**`()`

Return he XML-based metadata object id from the PDF if present - also refer to *Document._delXmlMetadata()*. You can use it to retrieve the content via *Document._getXrefStream()* and then work with it using some XML software.

`Document.`**`_getPageObjNumber`**`(`*pno*`)`

or

`Document.`**`_getPageXref`**`(`*pno*`)`

Return the XREF and generation number for a given page.

Parameters **pno** (*int*) – Page number (zero-based).

Return type list

Returns XREF and generation number of page `pno` as a list `[xref, gen]`.

`Page.`**`_getXref`**`()`

Page version for `_getPageObjNumber()` only delivering the XREF (not the generation number).

`Page.`**`run`**`(`*dev*, *transform*`)`

Run a page through a device.

Parameters

- **dev** (*Device*) – Device, obtained from one of the *Device* constructors.
- **transform** (*Matrix*) – Transformation to apply to the page. Set it to *Identity* if no transformation is desired.

`Page.`**`getTextBlocks`**`(`*images = False*`)`

Extract all blocks of the page's *TextPage* as a Python list. Provides basic positioning information but at a much higher speed than *TextPage.extractDICT()*. The block sequence is as specified in the document. All lines of a block are concatenated into one string, separated by `\n`.

Parameters **images** (*bool*) – also extract image blocks. Default is false. This serves as a means to get complete page layout information. Only image metadata, **not the binary image data** itself is extracted, see below (use the resp. *Page.getText()* versions for accessing full information detail).

Return type *list*

Returns

a list whose items have the following entries.

- `x0, y0, x1, y1`: 4 floats defining the bbox of the block.
- `text`: concatenated text lines in the block *(str)*. If this is an image block, a text like this is contained: `<image: DeviceRGB, width 511, height 379, bpc 8>` (original image properties).
- `block_n`: 0-based block number *(int)*.
- `type`: block type *(int)*, 0 = text, 1 = image.

`Page.`**`getTextWords`**`()`

Extract all words of the page's *TextPage* as a Python list. A "word" in this context is any character string surrounded by spaces. Provides positioning information for each word, similar to information contained in *`TextPage.extractDICT()`* or *`TextPage.extractXML()`*, but more directly and at a much higher speed. The word sequence is as specified in the document. The accompanying bbox coordinates can be used to re-arrange the final text output to your liking. Block and line numbers help keeping track of the original position.

Return type list

Returns

a list whose items are lists with the following entries:

- `x0, y0, x1, y1`: 4 floats defining the bbox of the word.
- `word`: the word, spaces stripped off *(str)*. Note that any non-space character is accepted as part of a word - not only letters. So, " Hello world! " will yield the two words `Hello` and `world!`.
- `block_n, line_n, word_n`: 0-based counters for block, line and word *(int)*.

`Page.`**`insertFont`**`(`*fontname = "Helvetica", fontfile = None, idx = 0, set_simple = False*`)`

Store a new font for the page and return its XREF. If the page already references this font, it is a no-operation and just the XREF is returned.

Parameters

- **`fontname`** (*`str`*) – The reference name of the font. If the name does not occur in *`Page.getFontList()`*, then this must be either the name of one of the *PDF Base 14 Fonts*, or `fontfile` must also be given. Following this method, font name prefixed with a slash "/" can be used to refer to the font in text insertions. If it appears in the list, the method ignores all other parameters and exits with the xref number.
- **`fontfile`** (*`str`*) – font file name. This file will be embedded in the PDF.
- **`idx`** (*`int`*) – index of the font in the given file. Has no meaning and is ingored if `fontfile` is not specified. Default is zero. An invalid index will cause an exception.

Note: Certain font files can contain more than one font. This parameter can be used to select the right one. PyMuPDF has no way to tell whether the font file indeed contains a font for any non-zero index.

> **Caution:** Only the first choice of `idx` will be honored - subsequent specifications are ignored.

- **set_simple** (*bool*) – When inserting from a font file, a "Type0" font will be installed by default. This option causes the font to be installed as a simple font instead. Only 1-byte characters will then be presented correctly, others will appear as "?" (question mark).

> **Caution:** Only the first choice of `set_simple` will be honored. Subsequent specifications are ignored.

Return type int

Returns

the XREF of the font. PyMuPDF records inserted fonts in two places:

1. An inserted font will appear in *Page.getFontList()*.
2. *Document.FontInfos* records information about all fonts that have been inserted by this method on a document-wide basis.

Page.**getDisplayList**()

Run a page through a list device and return its display list.

Return type *DisplayList*

Returns the display list of the page.

Page.**_getContents**()

Return a list of XREF numbers of `/Contents` objects belongig to the page. The length of this list will always be at least one.

Return type list

Returns a list of XREF integers.

Each page has one or more associated contents objects (streams) which contain PDF operator syntax describing what appears where on the page (like text or images, etc. See the *Adobe PDF Reference 1.7*, chapter "Operator Summary", page 985). This function only enumerates the XREF number(s) of such objects. To get the actual stream source, use function *Document._getXrefStream()* with one of the numbers in this list. Use *Document._updateStream()* to replace the content[1][2].

Page.**_setContents**(*xref*)

PDF only: Set a given object (identified by its xref) as the page's `/Contents` object. Useful for joining mutiple `/Contents` objects into one as in the following snippet:

[1] If a page has multiple contents streams, they are treated as being one logical stream when the document is processed by reader software. A single operator cannot be split between stream boundaries, but a single **instruction** may well be. E.g. invoking the display of an image looks like this: `q a b c d e f cm /imageid Do Q`. Any single of these items (PDF notation: "lexical tokens") is always contained in one stream, but `q a b c d e f cm` may be in one and `/imageid Do Q` in the next one.

[2] Note that `/Contents` objects (similar to /Resources) may be **shared** among pages. A change to a contents stream may therefore affect other pages, too. To avoid this: (1) use *Page._cleanContents()*, (2) read the `/Contents` object (there will now be only one left), (3) make your changes.

```
>>> c = b""
>>> xreflist = page._getContents()
>>> for xref in xreflist: c += doc._getXrefStream(xref)
>>> doc._updateStream(xreflist[0], c)
>>> page._setContents(xreflist[0])
>>> # doc.save(..., garbage = 4) will remove the unused objects
```

Parameters **xref** (*int*) – the cross reference number of a `/Contents` object. An exception is raised if outside the valid xref range or not a stream object.

`Page.`**`_cleanContents`**`()`

Clean all `/Contents` objects associated with this page (including contents of all annotations on the page). "Cleaning" includes syntactical corrections, standardizations and "pretty printing" of the contents stream. If a page has several contents objects, they will be combined into one. Any discrepancies between `/Contents` and `/Resources` objects will also be resolved / corrected. Note that the resulting contents stream will be stored uncompressed (if you do not specify `deflate` on save). See *Page._getContents()* for more details.

Return type int

Returns 0 on success.

`Annot.`**`_getXref`**`()`

Return the xref number of an annotation.

Return type int

Returns XREF number of the annotation.

`Annot.`**`_cleanContents`**`()`

Clean the `/Contents` streams associated with the annotation. This is the same type of action *Page._cleanContents()* performs - just restricted to this annotation.

Return type int

Returns 0 if successful (exception raised otherwise).

`Document.`**`getCharWidths`**`(`*xref = 0*, *limit = 256*`)`

Return a list of character glyphs and their widths for a font that is present in the document. A font must be specified by its PDF cross reference number `xref`. This function is called automatically from *Page.insertText()* and *Page.insertTextbox()*. So you should rarely need to do this yourself.

Parameters

- **xref** (*int*) – cross reference number of a font embedded in the PDF. To find a font xref, use e.g. `doc.getPageFontList(pno)` of page number `pno` and take the first entry of one of the returned list entries.
- **limit** (*int*) – limits the number of returned entries. The default of 256 is enforced for all fonts that only support 1-byte characters, so-called "simple fonts" (checked by this method). All *PDF Base 14 Fonts* are simple fonts.

Return type list

Returns a list of `limit` tuples. Each character `c` has an entry `(g, w)` in this list with an index of `ord(c)`. Entry `g` (integer) of the tuple is the glyph id of the character, and float `w` is its normalized width. The actual width for some fontsize can be calculated as `w * fontsize`. For simple fonts, the `g` entry can always be safely ignored. In all other cases `g` is the basis for graphically representing `c`.

This function calculates the pixel width of a string called `text`:

```
def pixlen(text, widthlist, fontsize):
try:
    return sum([widthlist[ord(c)] for c in text]) * fontsize
except IndexError:
    m = max([ord(c) for c in text])
    raise ValueError:("max. code point found: %i, increase limit" % m)
```

Document.**_getObjectString**(*xref*)

Document.**_getXrefString**(*xref*)

Return the string ("source code") representing an arbitrary object. For stream objects, only the non-stream part is returned. To get the stream content, use *_getXref-Stream()*.

Parameters **xref** (*int*) – XREF number.

Return type string

Returns the string defining the object identified by `xref`.

Document.**_getGCTXerrmsg**()

Retrieve exception message text issued by PyMuPDF's low-level code. This in most cases, but not always, are MuPDF messages. This string will never be cleared - only overwritten as needed. Only rely on it if a `RuntimeError` had been raised.

Return type str

Returns last C-level error message on occasion of a `RuntimeError` exception.

Document.**_getNewXref**()

Increase the XREF by one entry and return that number. This can then be used to insert a new object.

Return type int

Returns the number of the new XREF entry.

Document.**_updateObject**(*xref*, *obj_str*, *page = None*)

Associate the object identified by string `obj_str` with the XREF number `xref`, which must already exist. If `xref` pointed to an existing object, this will be replaced with the new object. If a page object is specified, links and other annotations of this page will be reloaded after the object has been updated.

Parameters

- **xref** (*int*) – XREF number.
- **obj_str** (*str*) – a string containing a valid PDF object definition.
- **page** (*Page*) – a page object. If provided, indicates, that annotations of this page should be refreshed (reloaded) to reflect changes incurred with links and / or annotations.

Return type int

Returns zero if successful, otherwise an exception will be raised.

`Document._getXrefLength()`
Return length of XREF table.

Return type int

Returns the number of entries in the XREF table.

`Document._getXrefStream(xref)`
Return decompressed content stream of the object referenced by `xref`. If the object has / is no stream, an exception is raised.

Parameters **xref** (*int*) – XREF number.

Return type bytes

Returns the (decompressed) stream of the object.

`Document._updateStream(xref, stream, new = False)`
Replace the stream of an object identified by `xref`. If the object has no stream, an exception is raised unless `new = True` is used. The function automatically performs a compress operation ("deflate").

Parameters

- **xref** (*int*) – XREF number.
- **stream** (*bytes/bytearray*) – the new content of the stream.
- **new** (*bool*) – whether to force accepting the stream, and thus turning `xref` into a stream object.

This method is intended to manipulate streams containing PDF operator syntax (see pp. 985 of the *Adobe PDF Reference 1.7*) as it is the case for e.g. page content streams.

If you update a contents stream, you should use save parameter `clean = True`. This ensures consistency between PDF operator source and the object structure.

Example: Let us assume that you no longer want a certain image appear on a page. This can be achieved by deleting[2] the respective reference in its contents source(s) - and indeed: the image will be gone after reloading the page. But the page's `/Resources` object would still[3] show the image as being referenced by the page. This save option will clean up any such mismatches.

`Document._getOLRootNumber()`

Return XREF number of the /Outlines root object (this is **not** the first outline entry!). If this object does not exist, a new one will be created.

Return type int

Returns XREF number of the /**Outlines** root object.

[3] Resources objects are inheritable. This means that many pages can share one. Keeping a page's `/Resources` object in sync with changes of its `/Contents` therefore may require creating an own `/Resources` object for the page. This can best be achieved by using `clean` when saving, or by invoking *Page._cleanContents()*.

Document.**extractImage**(*xref = 0*)

PDF Only: Extract raw image data. The output can be directly stored in an image file, be used as input for packages like PIL, for *Pixmap* creation, etc.

Parameters **xref** (*int*) – cross reference number of an image object. If outside valid xref range, an exception is raised. If the object is not an image or other errors occur, an empty dictionary is returned.

Return type *dict*

Returns a dictionary with keys `'ext'` (the type of image as a string, e.g. `'jpeg'`, usable also as file extension) and `'image'` (embedded image data as a `bytes` object).

```
>>> d = doc.extractImage(25)
>>> d
{}
>>> d = doc.extractImage(8593)
>>> d["ext"], d["image"]
('jpeg', b'\xff\xd8\xff\xee\x00\x0eAdobe\x00d\x00\x00\x00\x00 ...)
>>> imgout = open("image." + d["ext"], "wb")
>>> imgout.write(d["image"])
1238
>>> imgout.close()
```

Note: You can also use this method for diagnostic purposes: creating a pixmap or a PIL image directly from this output will reflect the original image properties (width, height, alpha, etc.). These can be compared with the PDF object definition as shown in the PDF source, or the output of *Document.getPageImageList()*. Another possible use would be outputting PDF images in their original format (e.g. JPEG, TIFF, GIF, etc.) and not necessarily converting them all to PNG, see extract-img3.py.

Document.**extractFont**(*xref, info_only = False*)

PDF Only: Return an embedded font file's data and appropriate file extension. This can be used to store the font as an external file. The method does not throw exceptions (other than via checking for PDF).

Parameters

- **xref** (*int*) – PDF object number of the font to extract.
- **info_only** (*bool*) – only return font information, not the buffer. To be used for information-only purposes, saves allocation of large buffer areas.

Return type tuple

Returns

a tuple `(basename, ext, subtype, buffer)`, where `ext` is a 3-byte suggested file extension (*str*), `basename` is the font's name (*str*), `subtype` is the font's type (e.g. "Type1") and `buffer` is a bytes object containing the font file's content (or `b""`). For possible extension values and their meaning see *Font File Extensions*. Return details on error:

- `("", "", "", b"")` - invalid xref or xref is not a (valid) font object.
- `(basename, "n/a", "Type1", b"")` - `basename` is one of the *PDF Base 14 Fonts*, which cannot be extracted.

Example:

```
>>> # store font as an external file
>>> name, ext, buffer = doc.extractFont(4711)
```

(continues on next page)

(continued from previous page)

```
>>> # assuming buffer is not None:
>>> ofile = open(name + "." + ext, "wb")
>>> ofile.write(buffer)
>>> ofile.close()
```

Caution: The basename is returned unchanged from the PDF. So it may contain characters (such as blanks) which disqualify it as a valid filename for your operating system. Take appropriate action.

Document.**FontInfos**

Contains following information for any font inserted via *Page.insertFont()*:

- xref *(int)* - XREF number of the `/Type/Font` object.
- info *(dict)* - detail font information with the following keys:
  - name *(str)* - name of the basefont
  - idx *(int)* - index number for multi-font files
  - type *(str)* - font type (like "TrueType", "Type0", etc.)
  - ext *(str)* - extension to be used, when font is extracted to a file (see *Font File Extensions*).
  - glyphs (*list*) - list of glyph numbers and widths (filled by textinsertion methods).

Return type list

6.2 Tools

This class is a collection of low-level MuPDF utility methods and attributes, mainly around memory management.

Method / Attribute	Description
Tools.gen_id()	generate a unique identifyer
Tools.store_shrink()	shrink the storables cache[1]
Tools.store_maxsize	maximum storables cache size
Tools.store_size	current storables cache size

Class API

class Tools

gen_id()

A convenience method returning a unique positive integer which will increase by 1 with every invocation. The numbers generated are guarantied to be unique within this execution of PyMuPDF (its implementation is also threadsafe should this ever be become relevant for

[1] This memory area is internally used by MuPDF, and it serves as a cache for objects that have already been read and interpreted, thus improving performance. The most bulky object types are images and also fonts. When an application starts up the MuPDF library (in our case this happens as part of `import fitz`), it must specify a maximum size for this area. PyMuPDF's uses the default value (256 MB) to limit memory consumption. Use the methods here to control or investigate store usage. For example: even after a document has been closed and all related objects have been deleted, the store usage may still not drop down to zero. So you might want to enforce that before opening another document.

PyMuPDF). Example usages include using it as a unique key in a database - its creation should be faster than using timestamps by an order of magnitude.

Note: Because it is implemented as an ordinary 4-bytes signed integer, wraparounds may theoretically indeed occur though after over 2.147e+9 executions.

Return type int

Returns a unique positive integer.

store_shrink(*percent*)

Reduce the storables cache by a percentage of its current size.

Parameters **percent** (*int*) – the percentage of current size to free. If 100+ the store will be emptied, if zero, nothing will happen. MuPDF's caching strategy is "least recently used", so low-usage elements get deleted first.

Return type int

Returns the new current store size. Depending on the situation, the size reduction may be larger than the requested percentage.

store_maxsize

Maximum storables cache size in bytes. PyMuPDF is generated with a value of 268'435'456 (256 MB, the default value), which you should therefore always see here. If this value is zero, then an "unlimited" growth is permitted.

store_size

Current storables cache size in bytes. This value may change (and will usually increase) with every use of a PyMuPDF function. It will (automatically) decrease only when `Tools.store_maxize` is going to be exceeded: in this case, MuPDF will evict low-usage objects until the value is again in range.

6.2.1 Example Session

```
>>> import fitz
>>> tools = fitz.Tools()
# print the maximum and current cache sizes
>>> tools.store_maxsize
268435456
>>> tools.store_size
0
>>> doc = fitz.open("demo1.pdf")
# pixmap creation puts lots of object in cache (text, images, fonts),
# apart from the pixmap itself
>>> pix = doc[0].getPixmap(alpha=False)
>>> tools.store_size
454519
# release (at least) 50% of the storage
>>> tools.store_shrink(50)
13471
>>> tools.store_size
13471
# get a few unique numbers
>>> tools.gen_id()
1
>>> tools.gen_id()
2
>>> tools.gen_id()
3
```

(continues on next page)

(continued from previous page)

```
# close document and see how much cache is still in use
>>> doc.close()
>>> tools.store_size
0
>>>
```

6.3 Device

The different format handlers (pdf, xps, etc.) interpret pages to a "device". Devices are the basis for everything that can be done with a page: rendering, text extraction and searching. The device type is determined by the selected construction method.

Class API

class Device

__init__(*self*, *object*, *clip*)
Constructor for either a pixel map or a display list device.

Parameters

- **object** (*Pixmap* or *DisplayList*) – either a `Pixmap` or a `DisplayList`.
- **clip** (*IRect*) – An optional *IRect* for `Pixmap` devices to restrict rendering to a certain area of the page. If the complete page is required, specify `None`. For display list devices, this parameter must be omitted.

__init__(*self*, *textpage*, *flags = 0*)
Constructor for a text page device.

Parameters

- **textpage** (*TextPage*) – `TextPage` object
- **flags** (*int*) – control the way how text is parsed into the text page. Currently 3 options can be coded into this parameter, see *Preserve Text Flags*. To set these options use something like `flags = 0 | TEXT_PRESERVE_LIGATURES | ...`.

Note: In higher level code (*Page.getText()*, *Document.getPageText()*), the following decisions for creating text devices have been implemented: (1) `TEXT_PRESERVE_LIGATURES` and `TEXT_PRESERVE_WHITESPACES` are always set, (2) `TEXT_PRESERVE_IMAGES` is set for JSON and HTML, otherwise off.

6.4 DisplayList

DisplayList is a list containing drawing commands (text, images, etc.). The intent is two-fold:

1. as a caching-mechanism to reduce parsing of a page
2. as a data structure in multi-threading setups, where one thread parses the page and another one renders pages. This aspect is currently not supported by PyMuPDF.

A `DisplayList` is populated with objects from a page usually by executing *Page.getDisplayList()*. There also exists an independent constructor.

"Replay" the list (once or many times) by invoking one of its methods *run()*, *getPixmap()* or *getTextPage()*.

Method	Short Description
run()	Run a display list through a device.
getPixmap()	generate a pixmap
getTextPage()	generate a text page
rect	mediabox of the display list

Class API

class DisplayList

__init__(*self*, *mediabox*)
Create a new display list.

Parameters **mediabox** (*Rect*) – The page's rectangle - output of `page.bound()`.

Return type `DisplayList`

run(*device*, *matrix*, *area*)
Run the display list through a device. The device will populate the display list with its "commands" (i.e. text extraction or image creation). The display list can later be used to "read" a page many times without having to re-interpret it from the document file.

You will most probably instead use one of the specialized run methods below - `getPixmap()` or `getTextPage()`.

Parameters

- **device** (*Device*) – Device
- **matrix** (*Matrix*) – Transformation matrix to apply to the display list contents.
- **area** (*Rect*) – Only the part visible within this area will be considered when the list is run through the device.

getPixmap(*matrix = fitz.Identity*, *colorspace = fitz.csRGB*, *alpha = 0*, *clip = None*)
Run the display list through a draw device and return a pixmap.

Parameters

- **matrix** (*Matrix*) – matrix to use. Default is the identity matrix.
- **colorspace** (*Colorspace*) – the desired colorspace. Default is `RGB`.
- **alpha** (*int*) – determine whether or not (`0`, default) to include a transparency channel.
- **clip** (*IRect* or *Rect*) – an area of the full mediabox to which the pixmap should be restricted.

Return type *Pixmap*

Returns pixmap of the display list.

getTextPage(*flags*)
Run the display list through a text device and return a text page.

Parameters **flags** (*int*) – control which information is parsed into a text page. Default value in PyMuPDF is `3 = TEXT_PRESERVE_LIGATURES | TEXT_PRESERVE_WHITESPACE`, i.e. ligatures are **passed through** ("æ" **will not be decomposed** into its components "a" and "e"), white spaces are **passed through** (not translated to spaces), and images are **not included**. See *Preserve Text Flags*.

Return type *TextPage*

Returns text page of the display list.

rect
Contains the display list's mediabox. This will equal the page's rectangle if it was created via `page.getDisplayList()`.

Type *Rect*

6.5 TextPage

This class represents text and images shown on a document page. All MuPDF document types are supported.

Method	Short Description
TextPage.extractText()	Extract the page's plain text
TextPage.extractTEXT()	synonym of previous
TextPage.extractHTML()	Extract the page's content in HTML format
TextPage.extractJSON()	Extract the page's content in JSON format
TextPage.extractXHTML()	Extract the page's content in XHTML format
TextPage.extractXML()	Extract the page's text in XML format
TextPage.extractDICT()	Extract the page's content in *dict* format
TextPage.search()	Search for a string in the page

Class API

class TextPage

extractText()

extractTEXT()
Extract all text from a `TextPage` object. Returns a string of the page's complete text. The text is UTF-8 unicode and in the same sequence as specified at the time of document creation.

Return type str

extractHTML()
Extract all text and images in HTML format. This version contains complete formatting and positioning information. Images are included (encoded as base64 strings). You need an HTML package to interpret the output in Python. Your internet browser should be able to adequately display this information, but see *Controlling Quality of HTML Output*.

Return type str

extractDICT()
Extract content as a Python dictionary. Provides same information detail as HTML. See below for the structure.

Return type dict

extractJSON()
Extract content as a string in JSON format. Created by applying `json.dumps()` to the output of *extractDICT()*. Any images are base64 encoded. You will probably use this method ever only for outputting the result in some text file or the like.

Return type str

extractXHTML()
Extract all text in XHTML format. Text information detail is comparable with *extractTEXT()*, but also contains images (base64 encoded). This method makes no attempt to re-create the original visual appearance.

Return type str

extractXML()
Extract all text in XML format. This contains complete formatting information about every single character on the page: font, size, line, paragraph, location, etc. Contains no images. You need an XML package to interpret the output in Python.

Return type str

search(*string*, *hit_ max = 16*)
Search for `string`.

Parameters

- **string** (*str*) – The string to search for.
- **hit_max** (*int*) – Maximum number of expected hits (default 16).

Return type list

Returns a list of *Rect* objects (without transformation), each surrounding a found `string` occurrence.

Note: All of the above can be achieved by using the appropriate *Page.getText()* and *Page.searchFor()* methods. Also see further down and in the *Page* chapter for examples on how to create a valid file format by adding respective headers and trailers.

6.5.1 Structure of extractDICT() / extractJSON():

Both methods return equivalent information: `extractJSON()` is a string that must be interpreted using a JSON module for use in Python. You will probably use `extractDICT()` for this.

`extractJSON()` may be useful for text file output and similar. This string is created by applying `json.dumps()` to `extractDICT()` (with a plugin encoding binary content as base64 strings).

`extractDICT()` has the following structure.

Page Dictionary

Key	Value
width	page width in pixels *(float)*
height	page height in pixels *(float)*
blocks	*list* of blocks (*dict*)

Block Dictionaries

Blocks come in two different formats: **image blocks** and **text blocks**.

Image block:

Key	Value
type	1 = image *(int)*
bbox	block / image rectangle, formatted as `list(fitz.Rect)`
ext	image type *(str)*, as its file extension, see below
width	original image width *(float)*
height	original image height *(float)*
image	image content *(bytearray)*, may be empty if not supported!

Possible values of key `"ext"` are `"bmp"`, `"gif"`, `"jpeg"`, `"jpx"` (JPEG 2000), `"jxr"` (JPEG XR), `"png"`, `"pnm"`, and `"tiff"`.

Text block:

Key	Value
type	0 = text *(int)*
bbox	block rectangle, formatted as `list(fitz.Rect)`
lines	*list* of text lines (*dict*)

Line Dictionary

Key	Value
bbox	line rectangle, formatted as `list(fitz.Rect)`
wmode	writing mode *(int)*: 0 = horizontal, 1 = vertical
dir	writing direction *(list of floats)*: `[x, y]`
spans	*list* of spans (*dict*)

The value of key `"dir"` should be interpreted as follows:

- `x`: positive = "left-right", negative = "right-left", 0 = neither
- `y`: positive = "top-bottom", negative = "bottom-top", 0 = neither

The values indicate the "relative writing speed" in each direction, such that $x^2 + y^2 = 1$. In other words `dir = [cos(beta), sin(beta)]` is a unit vector, where `beta` is the writing angle relative to the horizontal.

Span Dictionary

Spans contain the actual text. In contrast to MuPDF versions prior to v1.12, a span no longer includes positioning information. Therefore, to reconstruct the text of a line, the text pieces of all spans must be concatenated. A span since v1.12 also contains font information. A line contains more than one span only, when the font or its attributes of the text are changing.

Key	Value
font	font name *(str)*
size	font size *(float)*
flags	font characteristics *(int)*
text	text *(str)*

`flags` is an integer encoding bools of font properties:

- bit 0: superscripted
- bit 1: italic
- bit 2: serifed
- bit 3: monospaced
- bit 4: bold

6.6 Working together: DisplayList and TextPage

Here are some instructions on how to use these classes together.

In some situations, performance improvements may be achievable, when you fall back to the detail level explained here.

6.6.1 Create a DisplayList

A *DisplayList* represents an interpreted document page. Methods for pixmap creation, text extraction and text search are - behind the curtain - all using the page's display list to perform their tasks. If a page must be rendered several times (e.g. because of changed zoom levels), or if text search and text extraction should both be performed, overhead can be saved, if the display list is created only once and then used for all other tasks.

```
>>> dl = page.getDisplayList()              # create the display list
```

You can also create display lists for many pages "on stack" (in a list), may be during document open, during idling times, or you store it when a page is visited for the first time (e.g. in GUI scripts).

Note, that for everything what follows, only the display list is needed - the corresponding *Page* object could have been deleted.

6.6.2 Generate Pixmap

The following creates a Pixmap from a *DisplayList*. Parameters are the same as for *Page.getPixmap()*.

```
>>> pix = dl.getPixmap()                    # create the page's pixmap
```

The execution time of this statement may be up to 50% shorter than that of `Page.getPixMap()`.

6.6.3 Perform Text Search

With the display list from above, we can also search for text.

For this we need to create a *TextPage*.

```
>>> tp = dl.getTextPage()                   # display list from above
>>> rlist = tp.search("needle")             # look up "needle" locations
>>> for r in rlist:                         # work with the found locations, e.g.
        pix.invertIRect(r.irect)            # invert colors in the rectangles
```

6.6.4 Extract Text

With the same *TextPage* object from above, we can now immediately use any or all of the 5 text extraction methods.

Note: Above, we have created our text page without argument. This leads to a default argument of `3 = fitz.TEXT_PRESERVE_LIGATURES | fitz.TEXT_PRESERVE_WHITESPACE`, IAW images will **not** be extracted - see below.

```
>>> txt  = tp.extractText()                 # plain text format
>>> json = tp.extractJSON()                 # json format
>>> html = tp.extractHTML()                 # HTML format
>>> xml  = tp.extractXML()                  # XML format
>>> xml  = tp.extractXHTML()                # XHTML format
```

6.6.5 Further Performance improvements

Pixmap

As explained in the *Page* chapter:

If you do not need transparency set `alpha = 0` when creating pixmaps. This will save 25% memory (if RGB, the most common case) and possibly 5% execution time (depending on the GUI software).

TextPage

If you do not need images extracted alongside the text of a page, you can set the following option:

```
>>> flags = fitz.TEXT_PRESERVE_LIGATURES | fitz.TEXT_PRESERVE_WHITESPACE
>>> tp = dl.getTextPage(flags)
```

This will save ca. 25% overall execution time for the HTML, XHTML and JSON text extractions and **hugely** reduce the amount of storage (both, memory and disk space) if the document is graphics oriented.

If you however do need images, use a value of 7 for flags:

```
>>> flags = fitz.TEXT_PRESERVE_LIGATURES | fitz.TEXT_PRESERVE_WHITESPACE | fitz.TEXT_
↪PRESERVE_IMAGES
```

CHAPTER

SEVEN

CONSTANTS AND ENUMERATIONS

Constants and enumerations of MuPDF as implemented by PyMuPDF. Each of the following variables is accessible as `fitz.variable`.

7.1 Constants

Base14_Fonts
Predefined Python list of valid *PDF Base 14 Fonts*.

Return type list

csRGB
Predefined RGB colorspace `fitz.Colorspace(fitz.CS_RGB)`.

Return type *Colorspace*

csGRAY
Predefined GRAY colorspace `fitz.Colorspace(fitz.CS_GRAY)`.

Return type *Colorspace*

csCMYK
Predefined CMYK colorspace `fitz.Colorspace(fitz.CS_CMYK)`.

Return type *Colorspace*

CS_RGB
1 - Type of *Colorspace* is RGBA

Return type int

CS_GRAY
2 - Type of *Colorspace* is GRAY

Return type int

CS_CMYK
3 - Type of *Colorspace* is CMYK

Return type int

VersionBind
'x.xx.x' - version of PyMuPDF (these bindings)

Return type string

VersionFitz
'x.xxx' - version of MuPDF

Return type string

VersionDate
ISO timestamp `YYYY-MM-DD HH:MM:SS` when these bindings were built.

Return type string

Note: The docstring of `fitz` contains information of the above which can be retrieved like so: `print(fitz.__doc__)`, and should look like: `PyMuPDF 1.10.0: Python bindings for the MuPDF 1.10 library, built on 2016-11-30 13:09:13`.

`version`
(VersionBind, VersionFitz, timestamp) - combined version information where `timestamp` is the generation point in time formatted as "YYYYMMDDhhmmss".

Return type tuple

7.2 Font File Extensions

The table show file extensions you should use when extracting fonts from a PDF file.

Ext	Description
ttf	TrueType font
pfa	Postscript for ASCII font (various subtypes)
cff	Type1C font (compressed font equivalent to Type1)
cid	character identifier font (postscript format)
otf	OpenType font
n/a	one of the *PDF Base 14 Fonts* (cannot be extracted)

7.3 Text Alignment

`TEXT_ALIGN_LEFT`
0 - align left.

`TEXT_ALIGN_CENTER`
1 - align center.

`TEXT_ALIGN_RIGHT`
2 - align right.

`TEXT_ALIGN_JUSTIFY`
3 - align justify.

7.4 Preserve Text Flags

Options controlling the amount of data a text device parses into a *TextPage*.

`TEXT_PRESERVE_LIGATURES`
1 - If this option is activated ligatures are passed through to the application in their original form. If this option is deactivated ligatures are expanded into their constituent parts, e.g. the ligature ffi is expanded into three eparate characters f, f and i.

`TEXT_PRESERVE_WHITESPACE`
2 - If this option is activated whitespace is passed through to the application in its original form. If this option is deactivated any type of horizontal whitespace (including horizontal tabs) will be replaced with space characters of variable width.

`TEXT_PRESERVE_IMAGES`
4 - If this option is set, then images will be stored in the structured text structure. The default is to ignore all images.

7.5 Link Destination Kinds

Possible values of `linkDest.kind` (link destination kind). For details consult *Adobe PDF Reference 1.7*, chapter 8.2 on pp. 581.

LINK_NONE
0 - No destination. Indicates a dummy link.

Return type int

LINK_GOTO
1 - Points to a place in this document.

Return type int

LINK_URI
2 - Points to a URI - typically a resource specified with internet syntax.

Return type int

LINK_LAUNCH
3 - Launch (open) another file (of any "executable" type).

Return type int

LINK_GOTOR
5 - Points to a place in another PDF document.

Return type int

7.6 Link Destination Flags

Note: The rightmost byte of this integer is a bit field, so test the truth of these bits with the & operator.

LINK_FLAG_L_VALID
1 (bit 0) Top left x value is valid

Return type bool

LINK_FLAG_T_VALID
2 (bit 1) Top left y value is valid

Return type bool

LINK_FLAG_R_VALID
4 (bit 2) Bottom right x value is valid

Return type bool

LINK_FLAG_B_VALID
8 (bit 3) Bottom right y value is valid

Return type bool

LINK_FLAG_FIT_H
16 (bit 4) Horizontal fit

Return type bool

LINK_FLAG_FIT_V
32 (bit 5) Vertical fit

Return type bool

LINK_FLAG_R_IS_ZOOM
64 (bit 6) Bottom right x is a zoom figure

Return type bool

7.7 Annotation Types

Possible values (integer) for PDF annotation types. See chapter 8.4.5, pp. 615 of the *Adobe PDF Reference 1.7* for more details.

ANNOT_TEXT
0 - Text annotation

ANNOT_LINK
1 - Link annotation

ANNOT_FREETEXT
2 - Free text annotation

ANNOT_LINE
3 - Line annotation

ANNOT_SQUARE
4 - Square annotation

ANNOT_CIRCLE
5 - Circle annotation

ANNOT_POLYGON
6 - Polygon annotation

ANNOT_POLYLINE
7 - PolyLine annotation

ANNOT_HIGHLIGHT
8 - Highlight annotation

ANNOT_UNDERLINE
9 - Underline annotation

ANNOT_SQUIGGLY
10 - Squiggly-underline annotation

ANNOT_STRIKEOUT
11 - Strikeout annotation

ANNOT_STAMP
12 - Rubber stamp annotation

ANNOT_CARET
13 - Caret annotation

ANNOT_INK
14 - Ink annotation

ANNOT_POPUP
15 - Pop-up annotation

ANNOT_FILEATTACHMENT
16 - File attachment annotation

ANNOT_SOUND
17 - Sound annotation

ANNOT_MOVIE
18 - Movie annotation

ANNOT_WIDGET
19 - Widget annotation. This annotation comes with the following subtypes:

ANNOT_WG_NOT_WIDGET
-1 not a widget

ANNOT_WG_PUSHBUTTON
0 PushButtom

ANNOT_WG_CHECKBOX
1 CheckBox

ANNOT_WG_RADIOBUTTON
2 RadioButton

ANNOT_WG_TEXT
3 Text

ANNOT_WG_LISTBOX
4 ListBox

ANNOT_WG_COMBOBOX
5 ComboBox

ANNOT_WG_SIGNATURE
6 Signature

ANNOT_SCREEN
20 - Screen annotation

ANNOT_PRINTERMARK
21 - Printers mark annotation

ANNOT_TRAPNET
22 - Trap network annotation

ANNOT_WATERMARK
23 - Watermark annotation

ANNOT_3D
24 - 3D annotation

7.8 Annotation Flags

Possible mask values for PDF annotation flags.

Note: Annotation flags is a bit field, so test the truth of its bits with the & operator. When changing flags for an annotation, use the | operator to combine several values. The following descriptions were extracted from the Adobe manual, pages 608 pp.

ANNOT_XF_Invisible
1 - If set, do not display the annotation if it does not belong to one of the standard annotation types and no annotation handler is available. If clear, display such an unknown annotation using an appearance stream specified by its appearance dictionary, if any.

ANNOT_XF_Hidden
2 - If set, do not display or print the annotation or allow it to interact with the user, regardless of its annotation type or whether an annotation handler is available. In cases where screen space is limited, the ability to hide and show annotations selectively can be used in combination with appearance streams to display auxiliary pop-up information similar in function to online help systems.

ANNOT_XF_Print
4 - If set, print the annotation when the page is printed. If clear, never print the annotation, regardless of whether it is displayed on the screen. This can be useful, for example, for annotations representing interactive pushbuttons, which would serve no meaningful purpose on the printed page.

ANNOT_XF_NoZoom
8 - If set, do not scale the annotation's appearance to match the magnification of the page. The location of the annotation on the page (defined by the upper-left corner of its annotation rectangle) remains fixed, regardless of the page magnification.

ANNOT_XF_NoRotate
16 - If set, do not rotate the annotation's appearance to match the rotation of the page. The upper-left corner of the annotation rectangle remains in a fixed location on the page, regardless of the page rotation.

ANNOT_XF_NoView
32 - If set, do not display the annotation on the screen or allow it to interact with the user. The annotation may be printed (depending on the setting of the Print flag) but should be considered hidden for purposes of on-screen display and user interaction.

ANNOT_XF_ReadOnly
64 - If set, do not allow the annotation to interact with the user. The annotation may be displayed or printed (depending on the settings of the NoView and Print flags) but should not respond to mouse clicks or change its appearance in response to mouse motions.

ANNOT_XF_Locked
128 - If set, do not allow the annotation to be deleted or its properties (including position and size) to be modified by the user. However, this flag does not restrict changes to the annotation's contents, such as the value of a form field.

ANNOT_XF_ToggleNoView
256 - If set, invert the interpretation of the NoView flag for certain events. A typical use is to have an annotation that appears only when a mouse cursor is held over it.

ANNOT_XF_LockedContents
512 - If set, do not allow the contents of the annotation to be modified by the user. This flag does not restrict deletion of the annotation or changes to other annotation properties, such as position and size.

7.9 Annotation Line End Styles

The following descriptions are taken from the Adobe manual TABLE 8.27 on page 630. The respective visualizations are either dynamically done by PDF viewers or explicitely hardcoded by the PDF generator software.

ANNOT_LE_None
0 - No line ending.

ANNOT_LE_Square
1 - A square filled with the annotation's interior color, if any.

ANNOT_LE_Circle
2 - A circle filled with the annotation's interior color, if any.

ANNOT_LE_Diamond
3 - A diamond shape filled with the annotation's interior color, if any.

ANNOT_LE_OpenArrow
4 - Two short lines meeting in an acute angle to form an open arrowhead.

ANNOT_LE_ClosedArrow
5 - Two short lines meeting in an acute angle as in the OpenArrow style (see above) and connected

by a third line to form a triangular closed arrowhead filled with the annotation's interior color, if any.

ANNOT_LE_Butt
6 - (PDF 1.5) A short line at the endpoint perpendicular to the line itself.

ANNOT_LE_ROpenArrow
7 - (PDF 1.5) Two short lines in the reverse direction from OpenArrow.

ANNOT_LE_RClosedArrow
8 - (PDF 1.5) A triangular closed arrowhead in the reverse direction from ClosedArrow.

ANNOT_LE_Slash
9 - (PDF 1.6) A short line at the endpoint approximately 30 degrees clockwise from perpendicular to the line itself.

7.10 PDF Form Field Flags

Bit positions in an integer (called `/Ff` in the Adobe manual) controlling a wide range of PDF form field ("widget") behaviours.

7.10.1 Common to all field types

WIDGET_Ff_ReadOnly
1 content cannot be changed

WIDGET_Ff_Required
2 must enter

WIDGET_Ff_NoExport
4 not available for export

7.10.2 Text fields

WIDGET_Ff_Multiline
4096 allow for libne breaks

WIDGET_Ff_Password
8192 do not show entered text

WIDGET_Ff_FileSelect
1048576 file sect field

WIDGET_Ff_DoNotSpellCheck
4194304 suppress spell checking

WIDGET_Ff_DoNotScroll
8388608 do not scroll screen automatically

WIDGET_Ff_Comb
16777216

WIDGET_Ff_RichText
33554432 richt text field

7.10.3 Button fields

WIDGET_Ff_NoToggleToOff
16384 do not toggle off

WIDGET_Ff_Radio
32768 make this a radio button (caution: overrides field type!)

WIDGET_Ff_Pushbutton
65536 make this a push button (caution: overrides field type!)

WIDGET_Ff_RadioInUnison
33554432 controls multiple radio buttons in a group

7.10.4 Choice fields

WIDGET_Ff_Combo
131072 make this combo box (caution: overrides field type!)

WIDGET_Ff_Edit
262144 make choice field editable (do not restrict to value list)

WIDGET_Ff_Sort
524288 sort value list for display

WIDGET_Ff_MultiSelect
2097152 make multiple choice fields selectable

WIDGET_Ff_CommitOnSelCHange
67108864 changing selected choice values counts as data entered

CHAPTER

EIGHT

COLOR DATABASE

Since the introduction of methods involving colors (like *Page.drawCircle()*), a requirement may be to have access to predefined colors.

The fabulous GUI package wxPython has a database of over 540 predefined RGB colors, which are given more or less memorizable names. Among them are not only standard names like "green" or "blue", but also "turquoise", "skyblue", and 100 (not only 50 ...) shades of "gray", etc.

We have taken the liberty to copy this database (a list of tuples) modified into PyMuPDF and make its colors available as PDF compatible float triples: for wxPython's `("WHITE", 255, 255, 255)` we return `(1, 1, 1)`, which can be directly used in `color` and `fill` parameters. We also accept any mixed case of "wHiTe" to find a color.

8.1 Function `getColor()`

As the color database may not be needed very often, one additional import statement seems acceptable to get access to it:

```
>>> # "getColor" is the only method you really need
>>> from fitz.utils import getColor
>>> getColor("aliceblue")
(0.9411764705882353, 0.9725490196078431, 1.0)
>>> #
>>> # to get a list of all existing names
>>> from fitz.utils import getColorList
>>> cl = getColorList()
>>> cl
['ALICEBLUE', 'ANTIQUEWHITE', 'ANTIQUEWHITE1', 'ANTIQUEWHITE2', 'ANTIQUEWHITE3',
'ANTIQUEWHITE4', 'AQUAMARINE', 'AQUAMARINE1'] ...
>>> #
>>> # to see the full integer color coding
>>> from fitz.utils import getColorInfoList
>>> il = getColorInfoList()
>>> il
[('ALICEBLUE', 240, 248, 255), ('ANTIQUEWHITE', 250, 235, 215),
('ANTIQUEWHITE1', 255, 239, 219), ('ANTIQUEWHITE2', 238, 223, 204),
('ANTIQUEWHITE3', 205, 192, 176), ('ANTIQUEWHITE4', 139, 131, 120),
('AQUAMARINE', 127, 255, 212), ('AQUAMARINE1', 127, 255, 212)] ...
```

8.2 Printing the Color Database

If you want to actually see how the many available colors look like, use scripts colordbRGB.py or colordbHSV.py in the examples directory. They create PDFs (already existing in the same directory) with all these colors. Their only difference is sorting order: one takes the RGB values, the other one the Hue-Saturation-Values as sort criteria. This is a screen print of what these files look like.


hotpink3
hotpink3
violetred1
violetred1
violetred2
violetred2
violetred3
violetred3
violetred4
violetred4
deeppink1
deeppink1
deeppink2
deeppink2
deeppink3
deeppink3
deeppink4
deeppink4
mediumvioletred
mediumvioletred
orchid2
orchid2
orchid1
orchid1
orchid
orchid
orchid3
orchid3
orchid4
orchid4
magenta4
magenta4
violet
violet
plum
plum
plum1
plum1
plum2
plum2
thistle3
thistle3
thistle4
thistle4
mediumorchid1
mediumorchid1
mediumorchid2
mediumorchid2
mediumorchid
mediumorchid

CHAPTER

NINE

APPENDIX 1: PERFORMANCE

We have tried to get an impression on PyMuPDF's performance. While we know this is very hard and a fair comparison is almost impossible, we feel that we at least should provide some quantitative information to justify our bold comments on MuPDF's **top performance**.

Following are three sections that deal with different aspects of performance:

- document parsing
- text extraction
- image rendering

In each section, the same fixed set of PDF files is being processed by a set of tools. The set of tools varies - for reasons we will explain in the section.

Here is the list of files we are using. Each file name is accompanied by further information: **size** in bytes, number of **pages**, number of bookmarks (**toc** entries), number of **links**, **text** size as a percentage of file size, **KB** per page, PDF **version** and remarks. **text %** and **KB index** are indicators for whether a file is text or graphics oriented.

name	size	pages	toc size	links	text %	KB index	version	remarks
Adobe.pdf	32.472.771	1.310	794	32.096	8,0%	24	PDF 1.6	linearized, text oriented, **many** links / bookmarks
Evolution.pdf	13.497.490	75	15	118	1,1%	176	PDF 1.4	graphics oriented
PyMuPDF.pdf	479.011	47	60	491	13,2%	10	PDF 1.4	text oriented, many links
sdw_2015_01.pdf	14.668.972	100	36	0	2,5%	143	PDF 1.3	graphics oriented
sdw_2015_02.pdf	13.295.864	100	38	0	2,7%	130	PDF 1.4	graphics oriented
sdw_2015_03.pdf	21.224.417	108	35	0	1,9%	192	PDF 1.4	graphics oriented
sdw_2015_04.pdf	15.242.911	108	37	0	2,7%	138	PDF 1.3	graphics oriented
sdw_2015_05.pdf	16.495.887	108	43	0	2,4%	149	PDF 1.4	graphics oriented
sdw_2015_06.pdf	23.447.046	100	38	0	1,6%	229	PDF 1.4	graphics oriented
sdw_2015_07.pdf	14.106.982	100	38	2	2,6%	138	PDF 1.4	graphics oriented
sdw_2015_08.pdf	12.321.995	100	37	0	3,0%	120	PDF 1.4	graphics oriented
sdw_2015_09.pdf	23.409.625	100	37	0	1,5%	229	PDF 1.4	graphics oriented
sdw_2015_10.pdf	18.706.394	100	24	0	2,0%	183	PDF 1.5	graphics oriented
sdw_2015_11.pdf	25.624.266	100	20	0	1,5%	250	PDF 1.4	graphics oriented
sdw_2015_12.pdf	19.111.666	108	36	0	2,1%	173	PDF 1.4	graphics oriented

Decimal point and comma follow European convention

E.g. `Adobe.pdf` and `PyMuPDF.pdf` are clearly text oriented, all other files contain many more images.

9.1 Part 1: Parsing

How fast is a PDF file read and its content parsed for further processing? The sheer parsing performance cannot directly be compared, because batch utilities always execute a requested task completely, in one go, front to end. `pdfrw` too, has a `lazy` strategy for parsing, meaning it only parses those parts of a document that are required in any moment.

To yet find an answer to the question, we therefore measure the time to copy a PDF file to an output file with each tool, and doing nothing else.

These were the tools

All tools are either platform independent, or at least can run both, on Windows and Unix / Linux (pdftk).

Poppler is missing here, because it specifically is a Linux tool set, although we know there exist Windows ports (created with considerable effort apparently). Technically, it is a C/C++ library, for which a Python binding exists - in so far somewhat comparable to PyMuPDF. But Poppler in contrast is tightly coupled to **Qt** and **Cairo**. We may still include it in future, when a more handy Windows installation is available. We have seen however some analysis, that hints at a much lower performance than MuPDF. Our comparison of text extraction speeds also show a much lower performance of Poppler's PDF code base **Xpdf**.

Image rendering of MuPDF also is about three times faster than the one of Xpdf when comparing the command line tools `mudraw` of MuPDF and `pdftopng` of Xpdf - see part 3 of this chapter.

Tool	Description
PyMuPDF	tool of this manual, appearing as "fitz" in reports
pdfrw	a pure Python tool, is being used by rst2pdf, has interface to ReportLab
PyPDF2	a pure Python tool with a very complete function set
pdftk	a command line utility with numerous functions

This is how each of the tools was used:

PyMuPDF:

```
doc = fitz.open("input.pdf")
doc.save("output.pdf")
```

pdfrw:

```
doc = PdfReader("input.pdf")
writer = PdfWriter()
writer.trailer = doc
writer.write("output.pdf")
```

PyPDF2:

```
pdfmerge = PyPDF2.PdfFileMerger()
pdfmerge.append("input.pdf")
pdfmerge.write("output.pdf")
pdfmerge.close()
```

pdftk:

```
pdftk input.pdf output output.pdf
```

Observations

These are our run time findings (in **seconds**, please note the European number convention: meaning of decimal point and comma is reversed):

Runtimes	Tool			
File	fitz	pdfrw	pdftk	PyPDF2
Adobe.pdf	4,96	20,72	136,34	683,27
Evolution.pdf	0,40	0,41	1,22	0,94
PyMuPDF.pdf	0,04	0,19	1,03	0,97
sdw_2015_01.pdf	0,19	1,19	6,13	6,49
sdw_2015_02.pdf	0,23	1,52	7,74	7,02
sdw_2015_03.pdf	0,39	2,76	13,39	12,67
sdw_2015_04.pdf	0,25	2,14	8,55	7,50
sdw_2015_05.pdf	0,29	1,71	8,92	7,99
sdw_2015_06.pdf	0,53	3,30	16,05	15,56
sdw_2015_07.pdf	0,33	2,17	10,65	10,81
sdw_2015_08.pdf	0,29	2,01	9,65	9,39
sdw_2015_09.pdf	0,36	2,49	11,48	10,97
sdw_2015_10.pdf	0,27	1,87	3,31	6,74
sdw_2015_11.pdf	1,47	12,79	40,18	62,44
sdw_2015_12.pdf	0,39	2,21	10,40	10,19
Total Times	**10,40**	**57,46**	**285,04**	**852,96**

Time Ratios			
1,00	5,52	27,40	81,98
	1,00	4,96	14,84
		1,00	2,99
			1,00

If we leave out the Adobe manual, this table looks like

Runtimes	Tool			
File	fitz	pdfrw	pdftk	PyPDF2
Evolution.pdf	0,40	0,41	1,22	0,94
PyMuPDF.pdf	0,04	0,19	1,03	0,97
sdw_2015_01.pdf	0,19	1,19	6,13	6,49
sdw_2015_02.pdf	0,23	1,52	7,74	7,02
sdw_2015_03.pdf	0,39	2,76	13,39	12,67
sdw_2015_04.pdf	0,25	2,14	8,55	7,50
sdw_2015_05.pdf	0,29	1,71	8,92	7,99
sdw_2015_06.pdf	0,53	3,30	16,05	15,56
sdw_2015_07.pdf	0,33	2,17	10,65	10,81
sdw_2015_08.pdf	0,29	2,01	9,65	9,39
sdw_2015_09.pdf	0,36	2,49	11,48	10,97
sdw_2015_10.pdf	0,27	1,87	3,31	6,74
sdw_2015_11.pdf	1,47	12,79	40,18	62,44
sdw_2015_12.pdf	0,39	2,21	10,40	10,19
Gesamtergebnis	**5,44**	**36,75**	**148,70**	**169,69**

Time Ratios			
1,00	6,75	27,32	31,18
	1,00	4,05	4,62
		1,00	1,14
			1,00

PyMuPDF is by far the fastest: on average 4.5 times faster than the second best (the pure Python tool pdfrw, **chapeau pdfrw!**), and almost 20 times faster than the command line tool pdftk.

Where PyMuPDF only requires less than 13 seconds to process all files, pdftk affords itself almost 4 minutes.

By far the slowest tool is PyPDF2 - it is more than 66 times slower than PyMuPDF and 15 times slower than pdfrw! The main reason for PyPDF2's bad look comes from the Adobe manual. It obviously is slowed down by the linear file structure and the immense amount of bookmarks of this file. If we take out this special case, then PyPDF2 is only 21.5 times slower than PyMuPDF, 4.5 times slower than pdfrw and 1.2 times slower than pdftk.

If we look at the output PDFs, there is one surprise:

Each tool created a PDF of similar size as the original. Apart from the Adobe case, PyMuPDF always created the smallest output.

Adobe's manual is an exception: The pure Python tools pdfrw and PyPDF2 **reduced** its size by more than 20% (and yielded a document which is no longer linearized)!

PyMuPDF and pdftk in contrast **drastically increased** the size by 40% to about 50 MB (also no longer linearized).

So far, we have no explanation of what is happening here.

9.2 Part 2: Text Extraction

We also have compared text extraction speed with other tools.

The following table shows a run time comparison. PyMuPDF's methods appear as "fitz (TEXT)" and "fitz (JSON)" respectively. The tool `pdftotext.exe` of the Xpdf toolset appears as "xpdf".

- **extractText():** basic text extraction without layout re-arrangement (using `GetText(..., output = "text")`)
- **pdftotext:** a command line tool of the **Xpdf** toolset (which also is the basis of Poppler's library)
- **extractJSON():** text extraction with layout information (using `GetText(..., output = "json")`)
- **pdfminer:** a pure Python PDF tool specialized on text extraction tasks

All tools have been used with their most basic, fanciless functionality - no layout re-arrangements, etc.

For demonstration purposes, we have included a version of `GetText(doc, output = "json")`, that also re-arranges the output according to occurrence on the page.

Here are the results using the same test files as above (again: decimal point and comma reversed):

Runtime	Tool				
File	1 fitz (TEXT)	2 fitz bareJSON	3 fitz sortJSON	4 xpdf	5 pdfminer
Adobe.pdf	5,16	5,53	6,27	12,42	216,32
Evolution.pdf	0,29	0,29	0,33	1,99	12,91
PyMuPDF.pdf	0,11	0,10	0,12	1,71	4,71
sdw_2015_01.pdf	0,95	0,98	1,12	2,84	43,96
sdw_2015_02.pdf	1,04	1,09	1,14	2,86	48,26
sdw_2015_03.pdf	1,81	1,92	1,97	3,82	153,51
sdw_2015_04.pdf	1,23	1,27	1,37	3,17	80,95
sdw_2015_05.pdf	1,00	1,08	1,15	2,82	48,65
sdw_2015_06.pdf	1,83	1,92	1,98	3,70	138,75
sdw_2015_07.pdf	0,99	1,11	1,16	2,93	55,59
sdw_2015_08.pdf	0,97	1,04	1,12	2,80	48,09
sdw_2015_09.pdf	1,92	1,97	2,05	3,84	159,62
sdw_2015_10.pdf	1,10	1,18	1,25	3,45	74,25
sdw_2015_11.pdf	2,37	2,39	2,50	5,82	166,14
sdw_2015_12.pdf	1,14	1,19	1,26	2,93	69,79
Gesamtergebnis	**21,92**	**23,08**	**24,82**	**57,10**	**1321,51**
	1,00	1,05	1,13	2,60	60,28
		1,00	1,08	2,47	57,27
			1,00	2,30	53,24
				1,00	23,15

Again, (Py-) MuPDF is the fastest around. It is 2.3 to 2.6 times faster than xpdf.

`pdfminer`, as a pure Python solution, of course is comparatively slow: MuPDF is 50 to 60 times faster and xpdf is 23 times faster. These observations in order of magnitude coincide with the statements on this web site.

9.3 Part 3: Image Rendering

We have tested rendering speed of MuPDF against the `pdftopng.exe`, a command lind tool of the **Xpdf** toolset (the PDF code basis of **Poppler**).

MuPDF invocation using a resolution of 150 pixels (Xpdf default):

```
mutool draw -o t%d.png -r 150 file.pdf
```

PyMuPDF invocation:

```
zoom = 150.0 / 72.0
mat = fitz.Matrix(zoom, zoom)
def ProcessFile(datei):
    print "processing:", datei
    doc=fitz.open(datei)
    for p in fitz.Pages(doc):
        pix = p.getPixmap(matrix=mat, alpha = False)
        pix.writePNG("t-%s.png" % p.number)
        pix = None
    doc.close()
    return
```

Xpdf invocation:

```
pdftopng.exe file.pdf ./
```

The resulting runtimes can be found here (again: meaning of decimal point and comma reversed):

Render Speed	tool		
file	mudraw	pymupdf	xpdf
Adobe.pdf	105,09	110,66	505,27
Evolution.pdf	40,70	42,17	108,33
PyMuPDF.pdf	5,09	4,96	21,82
sdw_2015_01.pdf	29,77	30,40	76,81
sdw_2015_02.pdf	29,67	30,00	74,68
sdw_2015_03.pdf	32,67	32,88	85,89
sdw_2015_04.pdf	30,07	29,59	78,09
sdw_2015_05.pdf	31,37	31,39	77,56
sdw_2015_06.pdf	31,76	31,49	87,89
sdw_2015_07.pdf	33,33	34,58	78,74
sdw_2015_08.pdf	31,83	32,73	75,95
sdw_2015_09.pdf	36,92	36,77	84,37
sdw_2015_10.pdf	30,08	30,48	77,13
sdw_2015_11.pdf	33,21	34,11	80,96
sdw_2015_12.pdf	31,77	32,69	80,68
Gesamtergebnis	**533,33**	**544,90**	**1594,18**

1	1,02	2,99
	1	2,93

- MuPDF and PyMuPDF are both about 3 times faster than Xpdf.
- The 2% speed difference between MuPDF (a utility written in C) and PyMuPDF is the Python overhead.

CHAPTER

TEN

APPENDIX 2: DETAILS ON TEXT EXTRACTION

This chapter provides background on the text extraction methods of PyMuPDF.

Information of interest are

- what do they provide?
- what do they imply (processing time / data sizes)?

10.1 General structure of a TextPage

TextPage is one of PyMuPDF's classes. It is normally created behind the curtain, when *Page* text extraction methods are used, but it is also available directly. In any case, an intermediate class, *DisplayList* must be created first (display lists contain interpreted pages, they also provide the input for *Pixmap* creation). Information contained in a *TextPage* has the following hierarchy. Other than its name suggests, images may optionally also be part of a text page.

```
<page>
    <text block>
        <line>
            <span>
                <char>
    <image block>
        <img>
```

A **text page** consists of blocks (= roughly paragraphs).

A **block** consists of either lines and their characters, or an image.

A **line** consists of spans.

A **span** consists of font information and characters that share a common baseline.

10.2 Plain Text

This function extracts a page's plain **text in original order** as specified by the creator of the document (which may not equal a natural reading order).

An example output:

```
PyMuPDF Documentation
Release 1.12.0
Jorj X. McKie
Dec 04, 2017
```

10.3 HTML

HTML output fully reflects the structure of the page's `TextPage` - much like DICT or JSON below. This includes images, font information and text positions. If wrapped in HTML header and trailer code, it can readily be displayed be an internate browser. Our above example:

```
<div style="width:595pt;height:841pt">
<img style="top:88pt;left:327pt;width:195pt;height:86pt" src="data:image/jpeg;
↪base64,
/9j/4AAQSkZJRgABAQEAYABgAAD/4Q (... omitted image data ...) ">
<p style="top:189pt;left:195pt;"><b><span style="font-family:SFSX2488,serif;font-
↪size:24.7871pt;">PyMuPDF Documentation</span></b></p>
<p style="top:223pt;left:404pt;"><b><i><span style="font-family:SFSO1728,serif;
↪font-size:17.2154pt;">Release 1.12.0</span></i></b></p>
<p style="top:371pt;left:400pt;"><b><span style="font-family:SFSX1728,serif;font-
↪size:17.2154pt;">Jorj X. McKie</span></b></p>
<p style="top:637pt;left:448pt;"><b><span style="font-family:SFSX1200,serif;font-
↪size:11.9552pt;">Dec 04, 2017</span></b></p>
</div>
```

10.4 Controlling Quality of HTML Output

Though HTML output has improved a lot in MuPDF v1.12.0, it currently is not yet bug-free: we have found problems in the areas **font support** and **image positioning**.

- HTML text contains references to the fonts used of the original document. If these are not known to the browser (a fat chance!), it will replace them with his assumptions, which probably will let the result look awkward. This issue varies greatly by browser - on my Windows machine, MS Edge worked just fine, whereas Firefox looked horrible.
- For PDFs with a complex structure, images may not be positioned and / or sized correctly. This seems to be the case for rotated pages and pages, where the various possible page bbox variants do not coincide (e.g. `MediaBox != CropBox`). We do not know yet, how to address this - we filed a bug at MuPDF's site.

To address the font issue, you can use a simple utility script to scan through the HTML file and replace font references. Here is a little example that replaces all fonts with one of the *PDF Base 14 Fonts*: serifed fonts will become "Times", non-serifed "Helvetica" and monospaced will become "Courier". Their respective variations for "bold", "italic", etc. are hopefully done correctly by your browser:

```
import sys
filename = sys.argv[1]
otext = open(filename).read()                  # original html text string
pos1 = 0                                        # search start poition
font_serif = "font-family:Times"                # enter ...
font_sans  = "font-family:Helvetica"            # ... your choices ...
font_mono  = "font-family:Courier"              # ... here
found_one  = False                              # true if search successfull

while True:
    pos0 = otext.find("font-family:", pos1)    # start of a font spec
    if pos0 < 0:                                # none found - we are done
        break
    pos1 = otext.find(";", pos0)               # end of font spec
    test = otext[pos0 : pos1]                   # complete font spec string
    testn = ""                                  # the new font spec string
    if test.endswith(",serif"):                 # font with serifs?
        testn = font_serif                      # use Times instead
    elif test.endswith(",sans-serif"):          # sans serifs font?
```

(continues on next page)

(continued from previous page)

```
        testn = font_sans                       # use Helvetica
    elif test.endswith(",monospace"):           # monospaced font?
        testn = font_mono                       # becomes Courier

    if testn != "":                             # any of the above found?
        otext = otext.replace(test, testn)      # change the source
        found_one = True
        pos1 = 0                                # start over

if found_one:
    ofile = open(filename + ".html", "w")
    ofile.write(otext)
    ofile.close()
else:
    print("Warning: could not find any font specs!")
```

10.5 DICT or JSON

DICT (JSON) output fully reflects the structure of a `TextPage` and provides image content and position details (`bbox` - boundary boxes in pixel units) for every block and line. This information can be used to present text in another reading order if required (e.g. from top-left to bottom-right). Have a look at PDF2textJS.py. Images are stored as `bytes` (`bytearray` in Python 2) for DICT output and base64 encoded strings for JSON output. Here is how this looks like:

```
{"width": 595.276, "height": 841.89,
 "blocks": [
  {"type": 1, "bbox": [327.526, 88.936, 523.276, 175.186],
   "ext": "jpeg", "width": 261, "height": 115, "image":
<bytes / bytearray object, base64 encoded if JSON>
  },
  {"type": 0, "bbox": [195.483, 189.041, 523.243, 218.91],
   "lines": [
    {"bbox": [195.483, 189.041, 523.243, 218.91], "wmode": 0, "dir": [1, 0],
     "spans": [
      {"font": "SFSX2488", "size": 24.7871, "flags": 20, "text": "PyMuPDF␣
↪Documentation"}
     ]
    }
   ]
  },
  {"type": 0, "bbox": [404.002, 223.505, 523.305, 244.49],
   "lines": [
    {"bbox": [404.002, 223.505, 523.305, 244.49], "wmode": 0, "dir": [1, 0],
     "spans": [
      {"font": "SFSO1728", "size": 17.2154, "flags": 22, "text": "Release 1.12.0"}
     ]
    }
   ]
  },
  {"type": 0, "bbox": [400.529, 371.31, 517.284, 392.312],
   "lines": [
    {"bbox": [400.529, 371.31, 517.284, 392.312], "wmode": 0, "dir": [1, 0],
     "spans": [
      {"font": "SFSX1728", "size": 17.2154, "flags": 20, "text": "Jorj X. McKie"}
     ]
    }
   ]
  },
```

(continues on next page)

(continued from previous page)

```
  {"type": 0, "bbox": [448.484, 637.531, 523.252, 652.403],
   "lines": [
    {"bbox": [448.484, 637.531, 523.252, 652.403], "wmode": 0, "dir": [1, 0],
     "spans": [
      {"font": "SFSX1200", "size": 11.9552, "flags": 20, "text": "Dec 13, 2017"}
     ]
    }
   ]
  }
 ]
}
```

10.6 XML

The XML version takes the level of detail even a lot deeper: every single character is provided with its position detail, and every span also contains font information:

```
<page width="595.276" height="841.89">
<image bbox="327.526 88.936038 523.276 175.18604" />
<block bbox="195.483 189.04106 523.2428 218.90952">
<line bbox="195.483 189.04106 523.2428 218.90952" wmode="0" dir="1 0">
<font name="SFSX2488" size="24.7871">
<char bbox="195.483 189.04106 214.19727 218.90952" x="195.483" y="211.052" c="P"/>
<char bbox="214.19727 189.04106 227.75582 218.90952" x="214.19727" y="211.052" c="y
↪"/>
<char bbox="227.75582 189.04106 253.18738 218.90952" x="227.75582" y="211.052" c="M
↪"/>
<char bbox="253.18738 189.04106 268.3571 218.90952" x="253.18738" y="211.052" c="u
↪"/>
(... omitted data ...)
</font>
</line>
</block>
<block bbox="404.002 223.5048 523.30477 244.49039">
<line bbox="404.002 223.5048 523.30477 244.49039" wmode="0" dir="1 0">
<font name="SFSO1728" size="17.2154">
<char bbox="404.002 223.5048 416.91358 244.49039" x="404.002" y="238.94702" c="R"/>
(... omitted data ...)
<char bbox="513.33706 223.5048 523.30477 244.49039" x="513.33706" y="238.94702" c=
↪"0"/>
</font>
</line>
</block>
(... omitted data ...)
</page>
```

We have successfully tested `lxml` to interpret this output.

10.7 XHTML

A variation of TEXT but in HTML format, containing the bare text and images ("semantic" output):

```
<div>
<p><img width="195" height="86" src="
/9j/4AAQSkZJRgABAQEAYABgAAD/4Q (... omitted image data ...)"/></p>
<p><b>PyMuPDF Documentation</b></p>
```

(continues on next page)

(continued from previous page)

```
<p><b><i>Release 1.12.0</i></b></p>
<p><b>Jorj X. McKie</b></p>
<p><b>Dec 13, 2017</b></p>
</div>
```

10.8 Further Remarks

1. We have modified MuPDF's **plain text** extraction: The original prints out every line followed by a newline character. This leads to a rather ragged, space-wasting look. We have combined all lines of a text block into one, separating lines by space characters. We also do not add extra newline characters at the end of blocks.
2. The extraction methods each have its own default behavior concerning images: "TEXT" and "XML" do not extract images, while the others do. On occasion it may make sense to switch off images for them, too. See chapter *Working together: DisplayList and TextPage* on how to achieve this. Use an argument of `3` when you create the *TextPage*.
3. Apart from the above "standard" ones, we offer additional extraction methods *`Page.getTextBlocks()`* and *`Page.getTextWords()`* for performance reasons. They return lists of a page's text blocks, resp. words. Each list item contains text accompanied by its rectangle ("bbox", location on the page). This should help to resolve extraction issues around multi-column or boxed text.
4. For uttermost detail, down to the level of one character, use XML extraction.

10.9 Performance

The text extraction methods differ significantly: in terms of information they supply, and in terms of resource requirements. More information of course means that more processing is required and a higher data volume is generated.

To begin with, all methods are **very fast** in relation to what is out there on the market. In terms of processing speed, we couldn't find a faster (free) tool. Even the most detailed method, XML, processes all 1'310 pages of the *Adobe PDF Reference 1.7* in less than 8 seconds.

Relative to each other, **"XML"** is about 2 times slower than **"TEXT"**, the others range between them. E.g. **"DICT"** / **"JSON", "HTML", "XHTML"** need about 20% more time than **"TEXT"** (heavily depending on the size of images contained in the document), whereas *`Page.getTextBlocks()`* and *`Page.getTextWords()`* are only 1% resp. 3% slower than **"TEXT"**.

In versions prior to v1.13.1, JSON was a standalone extraction method. After we have added the DICT extraction, JSON output is now created from it, using the **json** module contained in Python for serialization. We believe, DICT output is more handy for the programmer's purpose, because all of its information is directly usable - including images. Previously, for JSON, you had to bsae64-decode images before using them. We also have replaced the old "imgtype" dictionary key (an integer bit code) with the key "ext", which contains the appropriate extension string for the image.

Overall, these changes also allow image extraction for non-PDF documents.

Look into the previous chapter **Appendix 1** for more performance information.

CHAPTER

ELEVEN

APPENDIX 3: CONSIDERATIONS ON EMBEDDED FILES

This chapter provides some background on embedded files support in PyMuPDF.

11.1 General

Starting with version 1.4, PDF supports embedding arbitrary files as part ("Embedded File Streams") of a PDF document file (see chapter 3.10.3, pp. 184 of the *Adobe PDF Reference 1.7*).

In many aspects, this is comparable to concepts also found in ZIP files or the OLE technique in MS Windows. PDF embedded files do, however, *not* support directory structures as does the ZIP format. An embedded file can in turn contain embedded files itself.

Advantages of this concept are that embedded files are under the PDF umbrella, benefitting from its permissions / password protection and integrity aspects: all files a PDF may reference or even be dependent on can be bundled into it and so form a single, consistent unit of information.

In addition to embedded files, PDF 1.7 adds *collections* to its support range. This is an advanced way of storing and presenting meta information (i.e. arbitrary and extensible properties) of embedded files.

11.2 MuPDF Support

MuPDF v1.11 added initial support for embedded files and collections (also called *portfolios*).

The library contains functions to add files to the `EmbeddedFiles` name tree and display some information of its entries.

Also supported is a full set of functions to maintain collections (advanced metadata maintenance) and their relation to embedded files.

11.3 PyMuPDF Support

Starting with PyMuPDF v1.11.0 we fully reflect MuPDF's support for embedded files and partly go beyond that scope:

- We can add, extract **and** delete embedded files.
- We can display **and** change some meta information (outside collections). Informations available for display are **name**, **filename**, **description**, **length** and compressed **size**. Of these properties, *filename* and *description* can also be changed, after a file has been embedded.

Support of the *collections* feature has been postponed to a later version. We will probably include this ever only on user request.

CHAPTER

TWELVE

APPENDIX 4: ASSORTED TECHNICAL INFORMATION

12.1 PDF Base 14 Fonts

The following 14 builtin font names must be supported by every PDF aplication. They are available as the Python list `fitz.Base14_Fonts`:

- Courier
- Courier-Oblique
- Courier-Bold
- Courier-BoldOblique
- Helvetica
- Helvetica-Oblique
- Helvetica-Bold
- Helvetica-BoldOblique
- Times-Roman
- Times-Bold
- Times-Italic
- Times-BoldItalic
- Symbol
- ZapfDingbats

12.2 Adobe PDF Reference 1.7

This PDF Reference manual published by Adobe is frequently quoted throughout this documentation. It can be viewed and downloaded from here: http://www.adobe.com/content/dam/Adobe/en/devnet/acrobat/pdfs/pdf_reference_1-7.pdf.

12.3 Using Python Sequences as Arguments in PyMuPDF

In most cases, when PyMuPDF objects and methods require a Python list of numerical values, other Python sequence types are also allowed.

This generally means, you can interchangeably use Python `list` or `tuple` or even `array.array` or `numpy.array` types in these cases.

For example,

- `s = [1, 2]`
- `s = (1, 2)`
- `s = array.array("i", (1, 2))`
- `s = numpy.array((1,2))`

will all produce the same result when used in `fitz.Point(s)` or `fitz.Point(x, y) + s` or `doc.select(s)`. This applies to all geometry objects *Rect*, *IRect*, *Matrix* and *Point*.

Throughout this documentation we allude to this fact, whenever we talk about "sequences". We will refer to the concrete Python subtype where this is actually required.

In general, this support includes object types which support the sequence protocol, i.e. Python classes with a `__getitem__()` method.

So, e.g. Python types `set` and `frozenset` are **not supported**.

Because all PyMuPDF geometry classes themselves are special cases of sequences, they can be freely used where sequences can be used, e.g. as arguments for functions like `list()`, `tuple()`, `array.array()` or `numpy.array()`. Look at the following snippet to see this work.

```
>>> import fitz, array, numpy as np
>>> m = fitz.Matrix(1,2,3,4,5,6)
>>>
>>> list(m)
[1.0, 2.0, 3.0, 4.0, 5.0, 6.0]
>>>
>>> tuple(m)
(1.0, 2.0, 3.0, 4.0, 5.0, 6.0)
>>>
>>> array.array("f", m)
array('f', [1.0, 2.0, 3.0, 4.0, 5.0, 6.0])
>>>
>>> np.array(m)
array([1., 2., 3., 4., 5., 6.])
```

12.4 Ensuring Consistency of Important Objects in PyMuPDF

PyMuPDF is a Python binding for the C library MuPDF. While a lot of effort has been invested by MuPDF's creators to approximate some sort of an object-oriented behavior, they certainly could not overcome basic shortcomings of the C language in that respect.

Python on the other hand implements the OO-model in a very clean way. The interface code between PyMuPDF and MuPDF consists of two basic files: `fitz.py` and `fitz_wrap.c`. They are created by the excellent SWIG tool for each new version.

When you use one of PyMuPDF's objects or methods, this will result in excution of some code in `fitz.py`, which in turn will call some C code compiled with `fitz_wrap.c`.

Because SWIG goes a long way to keep the Python and the C level in sync, everything works fine, if a certain set of rules is being strictly followed. For example: **never access** a *Page* object, after you have closed (or deleted or set to `None`) the owning *Document*. Or, less obvious: **never access** a page or any of its children (links or annotations) after you have executed one of the document methods `select()`, `deletePage()`, `insertPage()` ... and more.

But just no longer accessing invalidated objects is actually not enough: They should rather be actively deleted entirely, to also free C-level resources.

The reason for these rules lies in the fact that there is a hierachical 2-level one-to-many relationship between a document and its pages and between a page and its links and annotations. To maintain a consistent situation, any of the above actions must lead to a complete reset - in **Python and, synchronously, in C**.

SWIG cannot know about this and consequently does not do it.

The required logic has therefore been built into PyMuPDF itself in the following way.

1. If a page "loses" its owning document or is being deleted itself, all of its currently existing annotations and links will be made unusable in Python, and their C-level counterparts will be deleted and deallocated.
2. If a document is closed (or deleted or set to `None`) or if its structure has changed, then similarly all currently existing pages and their children will be made unusable, and corresponding C-level deletions will take place. "Structure changes" include methods like `select()`, `delePage()`, `insertPage()`, `insertPDF()` and so on: all of these will result in a cascade of object deletions.

The programmer will normally not realize any of this. If he, however, tries to access invalidated objects, exceptions will be raised.

Invalidated objects cannot be directly deleted as with Python statements like `del page` or `page = None`, etc. Instead, their `__del__` method must be invoked.

All pages, links and annotations have the property `parent`, which points to the owning object. This is the property that can be checked on the application level: if `obj.parent == None` then the object's parent is gone, and any reference to its properties or methods will raise an exception informing about this "orphaned" state.

A sample session:

```
>>> page = doc[n]
>>> annot = page.firstAnnot
>>> annot.type                      # everything works fine
[5, 'Circle']
>>> page = None                     # this turns 'annot' into an orphan
>>> annot.type
<... omitted lines ...>
RuntimeError: orphaned object: parent is None
>>>
>>> # same happens, if you do this:
>>> annot = doc[n].firstAnnot     # deletes the page again immediately!
>>> annot.type                     # so, 'annot' is 'born' orphaned
<... omitted lines ...>
RuntimeError: orphaned object: parent is None
```

This shows the cascading effect:

```
>>> doc = fitz.open("some.pdf")
>>> page = doc[n]
>>> annot = page.firstAnnot
>>> page.rect
fitz.Rect(0.0, 0.0, 595.0, 842.0)
>>> annot.type
[5, 'Circle']
```

(continues on next page)

(continued from previous page)

```
>>> del doc                          # or doc = None or doc.close()
>>> page.rect
<... omitted lines ...>
RuntimeError: orphaned object: parent is None
>>> annot.type
<... omitted lines ...>
RuntimeError: orphaned object: parent is None
```

Note: Objects outside the above relationship are not included in this mechanism. If you e.g. created a table of contents by `toc = doc.getToC()`, and later close or change the document, then this cannot and does not change variable `toc` in any way. It is your responsibility to refresh such variables as required.

12.5 Design of Method `Page.showPDFpage()`

12.5.1 Purpose and Capabilities

The method displays an image of a ("source") page of another PDF document within a specified rectangle of the current ("containing") page.

- **In contrast** to *`Page.insertImage()`*, this display is vector-based and hence remains accurate across zooming levels.
- **Just like** *`Page.insertImage()`*, the size of the display is adjusted to the given rectangle.

The following variations of the display are currently supported:

- Bool parameter `keep_proportion` controls whether to maintain the width-height-ratio (default) or not.
- Rectangle parameter `clip` controls which part of the source page to show, and hence can be used for cropping. Default is the full page.
- Bool parameter `overlay` controls whether to put the image on top (foreground, default) of current page content or not (background).

Use cases include (but are not limited to) the following:

1. "Stamp" a series of pages of the current document with the same image, like a company logo or a watermark.
2. Combine arbitrary input pages into one output page to support "booklet" or double-sided printing (known as "4-up", "n-up").
3. Split up (large) input pages into several arbitrary pieces. This is also called "posterization", because you e.g. can split an A4 page horizontally and vertically, print the 4 pieces as separate A4 pages, and end up with an A2 version of your original page.

12.5.2 Technical Implementation

This is done using PDF **"Form XObjects"**, see section 4.9 on page 355 of *Adobe PDF Reference 1.7*. On execution of a `Page.showPDFpage(rect, src, pno, ...)`, the following things happen:

1. The `/Resources` and `/Contents` objects of page `pno` in document `src` are copied over to the current document, jointly creating a new **Form XObject** with the following properties. The PDF `xref` number of this object is returned by the method.

   (a) `/BBox` equals `/Mediabox` of the source page

   (b) `/Matrix` equals the identity matrix `[1 0 0 1 0 0]`

   (c) `/Resources` equals that of the source page. This involves a "deep-copy" of hierarchically nested other objects (including fonts, images, etc.). The complexity involved here is covered by MuPDF's grafting[1] technique functions.

   (d) This is a stream object type, and its stream is exactly equal to the `/Contents` object of the source (if the source has multiple such objects, these are first concatenated and stored as one new stream into the new form XObject).

2. A second **Form XObject** is then created which the containing page uses to invoke the previous one. This object has the following properties:

   (a) `/BBox` equals the `/CropBox` of the source page (or `clip`, if specified).

   (b) `/Matrix` represents the mapping of `/BBox` to the display rectangle of the containing page (parameter 1 of `showPDFpage`).

   (c) `/XObject` references the previous XObject via the fixed name `fullpage`.

   (d) The stream of this object contains exactly one fixed statement: `/fullpage Do`.

3. The `/Resources` and `/Contents` objects of the invoking page are now modified as follows.

   (a) Add an entry to the `/XObject` dictionary of `/Resources` with the name `fitz-xref-uid`, which is unique for this page. Uniqueness is required because the same source might be displayed more than once on the containing page. `xref` is the PDF cross reference number of XObject 1, and `uid` is a globally unique[2] integer provided by the MuPDF library.

   (b) Depending on `overlay`, prepend or append the following statement to the contents object: `/fitz-xref-uid Do`.

4. Return `xref` to the caller.

Observe the following guideline for optimum results:

The second XObject is small (just about 270 bytes), specific to the containing rectangle, and therefore different each time.

If no precautions are taken, process **step 1** leads to another XObject on every invocation - even for the same source page. Its size may be several dozens of kilobytes large. To avoid identical source page copies, use parameter `reuse_xref = xref` with the `xref` value returned by previous executions. If `reuse_xref > 0`, the method will not create XObject 1 again, but instead just point to it via XObject 2. This significantly saves processing time and memory usage.

If you forget to use `reuse_xref`, garbage collection (`mutool clean -gggg` or save option `garbage = 4`) can still take care of the duplicates.

[1] MuPDF supports "deep-copying" objects between PDF documents. To avoid duplicate data in the target, it uses "graftmaps", a form of scratchpad: for each object to be copied, its xref number is looked up in the graftmap. If found, copying is skipped. Otherwise, the xref is recorded and the copy takes place. PyMuPDF makes use of this technique in two places so far: *Document.insertPDF()* and *Page.showPDFpage()*. This process is fast and very efficient, as our tests have shown, because it prevents multiple copies of typically large and frequently referenced data, like images and fonts. Whether the target document **originally** had identical data is, however, not checked by this technique. Therefore, using save-option `garbage = 4` is reasonable when copying to a non-empty target.

[2] Arguably, `uid` alone would suffice to ensure uniqueness: this integer is maintained threadsafe as part of the global context. However, if a PDF is updated again later, `uid` would start over from 1. A reference name like `/fitz-uid` would therefore no longer be guarantied unique if more objects are shown on the containing page. Theoretically, the uniqueness of `/fitz-xref-uid` could also break, when PDF garbage collection leads to renumbering the PDF objects ... but chances for this seem tolerably low. What would be the effect of a non-uniqueness? If a page contains several identical XObject references, intentionally pointing to different XObjects, unexpected behaviour will result. Which in turn can only happen if garbage collection (1) changes the original `xref` and (2) a new *Page.showPDFpage()* happens to generate an XObject with the now-free xref number ...

CHAPTER

THIRTEEN

CHANGE LOGS

13.1 Changes in Version 1.13.13

This patch version contains several improvements for embedded files and file attachment annotations.

- **Added** *Document.embeddedFileUpd()* which allows changing **file content and metadata** of an embedded file. It supersedes the old method *Document.embeddedFileSetInfo()* (which will be deleted in a future version). Content is automatically compressed and metadata may be unicode.
- **Changed** *Document.embeddedFileAdd()* to now automatically compress file content. Accompanying metadata can now be unicode (had to be ASCII in the past).
- **Changed** *Document.embeddedFileDel()* to now automatically delete **all entries** having the supplied identifying name. The return code is now an integer count of the removed entries (was `None` previously).
- **Changed** embedded file methods to now also accept or show the PDF unicode filename as additional parameter `ufilename`.
- **Added** *Page.addFileAnnot()* which adds a new file attachment annotation.
- **Changed** *Annot.fileUpd()* (file attachment annot) to now also accept the PDF unicode `ufilename` parameter. The description parameter `desc` correctly works with unicode. Furthermore, **all** parameters are optional, so metadata may be changed without also replacing the file content.
- **Changed** *Annot.fileInfo()* (file attachment annot) to now also show the PDF unicode filename as parameter `ufilename`.
- **Fixed** issue #180 ("page.getText(output='dict') return invalid bbox") to now also work for vertical text.
- **Fixed** issue #185 ("Can't render the annotations created by PyMuPDF"). The issue's cause was the minimalistic MuPDF approach when creating annotations. Several annotation types have no `/AP` ("appearance") object when created by MuPDF functions. MuPDF, SumatraPDF and hence also PyMuPDF cannot render annotations without such an object. This fix now ensures, that an appearance object is always created together with the annotation itself. We still do not support line end styles.

13.2 Changes in Version 1.13.12

- **Fixed** issue #180 ("page.getText(output='dict') return invalid bbox"). Note that this is a circumvention of an MuPDF error, which generates zero-height character rectangles in some cases. When this happens, this fix ensures a bbox height of at least fontsize.
- **Changed** for ListBox and ComboBox widgets, the attribute list of selectable values has been renamed to *Widget.choice_values*.

- **Changed** when adding widgets, any missing of the *PDF Base 14 Fonts* is automatically added to the PDF. Widget text fonts can now also be chosen from existing widget fonts. Any specified field values are now honored and lead to a field with a preset value.
- **Added** *Annot.updateWidget()* which allows changing existing form fields - including the field value.

13.3 Changes in Version 1.13.11

While the preceeding patch subversions only contained various fixes, this version again introduces major new features:

- **Added** basic support for PDF widget annotations. You can now add PDF form fields of types Text, CheckBox, ListBox and ComboBox. Where necessary, the PDF is tranformed to a Form PDF with the first added widget.
- **Fixed** issues #176 ("wrong file embedding"), #177 ("segment fault when invoking page.getText()")and #179 ("Segmentation fault using page.getLinks() on encrypted PDF").

13.4 Changes in Version 1.13.7

- **Added** support of variable page sizes for reflowable documents (e-books, HTML, etc.): new parameters `rect` and `fontsize` in *Document* creation (open), and as a separate method *Document.layout()*.
- **Added** *Annot* creation of many annotations types: sticky notes, free text, circle, rectangle, line, polygon, polyline and text markers.
- **Added** support of annotation transparency (*Annot.opacity*, *Annot.setOpacity()*).
- **Changed** *Annot.vertices*: point coordinates are now grouped as pairs of floats (no longer as separate floats).
- **Changed** annotation colors dictionary: the two keys are now named `"stroke"` (formerly `"common"`) and `"fill"`.
- **Added** `Document.isDirty` which is `True` if a PDF has been changed in this session. Reset to `False` on each *Document.save()* or *Document.write()*.

13.5 Changes in Version 1.13.6

- Fix #173: for memory-resident documents, ensure the stream object will not be garbage-collected by Python before document is closed.

13.6 Changes in Version 1.13.5

- New low-level method *Page._setContents()* defines an object given by its xref to serve as the `/Contents` object.
- Changed and extended PDF form field support: the attribute `widget_text` has been renamed to *Annot.widget_value*. Values of all form field types (except signatures) are now supported. A new attribute *Annot.widget_choices* contains the selectable values of listboxes and comboboxes. All these attributes now contain `None` if no value is present.

13.7 Changes in Version 1.13.4

- *Document.convertToPDF()* now supports page ranges, reverted page sequences and page rotation. If the document already is a PDF, an exception is raised.
- Fixed a bug (introduced with v1.13.0) that prevented *Page.insertImage()* for transparent images.

13.8 Changes in Version 1.13.3

Introduces a way to convert **any MuPDF supported document** to a PDF. If you ever wanted PDF versions of your XPS, EPUB, CBZ or FB2 files - here is a way to do this.

- *Document.convertToPDF()* returns a Python `bytes` object in PDF format. Can be opened like normal in PyMuPDF, or be written to disk with the `".pdf"` extension.

13.9 Changes in Version 1.13.2

The major enhancement is PDF form field support. Form fields are annotations of type `(19, 'Widget')`. There is a new document method to check whether a PDF is a form. The *Annot* class has new properties describing field details.

- *Document.isFormPDF* is true if object type `/AcroForm` and at least one form field exists.
- *Annot.widget_type*, `Annot.widget_text` and *Annot.widget_name* contain the details of a form field (i.e. a "Widget" annotation).

13.10 Changes in Version 1.13.1

- *TextPage.extractDICT()* is a new method to extract the contents of a document page (text and images). All document types are supported as with the other *TextPage* `extract*()` methods. The returned object is a dictionary of nested lists and other dictionaries, and **exactly equal** to the JSON-deserialization of the old *TextPage.extractJSON()*. The difference is that the result is created directly - no JSON module is used. Because the user needs no JSON module to interpet the information, it should be easier to use, and also have a better performance, because it contains images in their original **binary format** - they need not be base64-decoded.
- *Page.getText()* correspondingly supports the new parameter value `"dict"` to invoke the above method.
- *TextPage.extractJSON()* (resp. `Page.getText("json")`) is still supported for convenience, but its use is expected to decline.

13.11 Changes in Version 1.13.0

This version is based on MuPDF v1.13.0. This release is "primarily a bug fix release".

In PyMuPDF, we are also doing some bug fixes while introducing minor enhancements. There only very minimal changes to the user's API.

- *Document* construction is more flexible: the new `filetype` parameter allows setting the document type. If specified, any extension in the filename will be ignored. More completely addresses issue #156. As part of this, the documentation has been reworked.
- **Changes to *Pixmap* constructors:**

  - Colorspace conversion no longer allows dropping the alpha channel: source and target **alpha will now always be the same**. We have seen exceptions and even interpreter crashes when using `alpha = 0`.
  - As a replacement, the simple pixmap copy lets you choose the target alpha.

- *Document.save()* again offers the full garbage collection range 0 thru 4. Because of a bug in XREF maintenance, we had to temporarily enforce `garbage > 1`. Finally resolves issue #148.
- *Document.save()* now offers to "prettify" PDF source via an additional argument.
- *Page.insertImage()* has the additional `stream` -parameter, specifying a memory area holding an image.
- Issue with garbled PNGs on Linux systems has been resolved ("Problem writing PNG" #133).

13.12 Changes in Version 1.12.4

This is an extension of 1.12.3.

- Fix of issue #147: methods `Document.getPageFontlist()` and `Document.getPageImagelist()` now also show fonts and images contained in `/Resources` nested via "Form XObjects".
- Temporary fix of issue #148: Saving to new PDF files will now automatically use `garbage = 2` if a lower value is given. Final fix is to be expected with MuPDF's next version. At that point we will remove this circumvention.
- Preventive fix of illegally using stencil / image mask pixmaps in some methods.
- Method `Document.getPageFontlist()` now includes the encoding name for each font in the list.
- Method `Document.getPageImagelist()` now includes the decode method name for each image in the list.

13.13 Changes in Version 1.12.3

This is an extension of 1.12.2.

- Many functions now return `None` instead of `0`, if the result has no other meaning than just indicating successful execution (*Document.close()*, *Document.save()*, *Document.select()*, *Pixmap.writePNG()* and many others).

13.14 Changes in Version 1.12.2

This is an extension of 1.12.1.

- Method *Page.showPDFpage()* now accepts the new `clip` argument. This specifies an area of the source page to which the display should be restricted.
- New *Page.CropBox* and *Page.MediaBox* have been included for convenience.

13.15 Changes in Version 1.12.1

This is an extension of version 1.12.0.

- New method *Page.showPDFpage()* displays another's PDF page. This is a **vector** image and therefore remains precise across zooming. Both involved documents must be PDF.
- New method *Page.getSVGimage()* creates an SVG image from the page. In contrast to the raster image of a pixmap, this is a vector image format. The return is a unicode text string, which can be saved in a `.svg` file.
- Method *Page.getTextBlocks()* now accepts an additional bool parameter "images". If set to true (default is false), image blocks (metadata only) are included in the produced list and thus allow detecting areas with rendered images.
- Minor bug fixes.
- "text" result of *Page.getText()* concatenates all lines within a block using a single space character. MuPDF's original uses "\n" instead, producing a rather ragged output.
- New properties of *Page* objects *Page.MediaBoxSize* and *Page.CropBoxPosition* provide more information about a page's dimensions. For non-PDF files (and for most PDF files, too) these will be equal to `Page.rect.bottom_right`, resp. `Page.rect.top_left`. For example, class *Shape* makes use of them to correctly position its items.

13.16 Changes in Version 1.12.0

This version is based on and requires MuPDF v1.12.0. The new MuPDF version contains quite a number of changes - most of them around text extraction. Some of the changes impact the programmer's API.

- `Outline.saveText()` and `Outline.saveXML()` have been deleted without replacement. You probably haven't used them much anyway. But if you are looking for a replacement: the output of *Document.getToC()* can easily be used to produce something equivalent.
- Class `TextSheet` does no longer exist.
- Text "spans" (one of the hierarchy levels of *TextPage*) no longer contain positioning information (i.e. no "bbox" key). Instead, spans now provide the font information for its text. This impacts our JSON output variant.
- HTML output has improved very much: it now creates valid documents which can be displayed by browsers to produce a similar view as the original document.
- There is a new output format XHTML, which provides text and images in a browser-readable format. The difference to HTML output is, that no effort is made to reproduce the original layout.
- All output formats of *Page.getText()* now support creating complete, valid documents, by wrapping them with appropriate header and trailer information. If you are interested in using the HTML output, please make sure to read *Controlling Quality of HTML Output*.
- To support finding text positions, we have added special methods that don't need detours like *TextPage.extractJSON()* or *TextPage.extractXML()*: use *Page.getTextBlocks()* or resp. *Page.getTextWords()* to create lists of text blocks or resp. words, which are accompanied by their rectangles. This should be much faster than the standard text extraction methods and also avoids using additional packages for interpreting their output.

13.17 Changes in Version 1.11.2

This is an extension of v1.11.1.

- New *Page.insertFont()* creates a PDF `/Font` object and returns its object number.
- New *Document.extractFont()* extracts the content of an embedded font given its object number.

- Methods `*FontList(...)` items no longer contain the PDF generation number. This value never had any significance. Instead, the font file extension is included (e.g. "pfa" for a "PostScript Font for ASCII"), which is more valuable information.
- Fonts other than "simple fonts" (Type1) are now also supported.
- New options to change *Pixmap* size:
  - Method *`Pixmap.shrink()`* reduces the pixmap proportionally in place.
  - A new *Pixmap* copy constructor allows scaling via setting target width and height.

13.18 Changes in Version 1.11.1

This is an extension of v1.11.0.

- New class `Shape`. It facilitates and extends the creation of image shapes on PDF pages. It contains multiple methods for creating elementary shapes like lines, rectangles or circles, which can be combined into more complex ones and be given common properties like line width or colors. Combined shapes are handled as a unit and e.g. be "morphed" together. The class can accumulate multiple complex shapes and put them all in the page's foreground or background - thus also reducing the number of updates to the page's `/Contents` object.
- All `Page` draw methods now use the new `Shape` class.
- Text insertion methods `insertText()` and `insertTextBox()` now support morphing in addition to text rotation. They have become part of the `Shape` class and thus allow text to be freely combined with graphics.
- A new `Pixmap` constructor allows creating pixmap copies with an added alpha channel. A new method also allows directly manipulating alpha values.
- Binary algebraic operations with geometry objects (matrices, rectangles and points) now generally also support lists or tuples as the second operand. You can add a tuple `(x, y)` of numbers to a *Point*. In this context, such sequences are called "point-like" (resp. matrix-like, rectangle-like).
- Geometry objects now fully support in-place operators. For example, `p /= m` replaces point p with `p * 1/m` for a number, or `p * ~m` for a matrix-like object `m`. Similarly, if `r` is a rectangle, then `r |= (3, 4)` is the new rectangle that also includes `fitz.Point(3, 4)`, and `r &= (1, 2, 3, 4)` is its intersection with `fitz.Rect(1, 2, 3, 4)`.

13.19 Changes in Version 1.11.0

This version is based on and requires MuPDF v1.11.

Though MuPDF has declared it as being mostly a bug fix version, one major new feature is indeed contained: support of embedded files - also called portfolios or collections. We have extended PyMuPDF functionality to embrace this up to an extent just a little beyond the `mutool` utility as follows.

- The `Document` class now support embedded files with several new methods and one new property:
  - `embeddedFileInfo()` returns metadata information about an entry in the list of embedded files. This is more than `mutool` currently provides: it shows all the information that was used to embed the file (not just the entry's name).
  - `embeddedFileGet()` retrieves the (decompressed) content of an entry into a `bytes` buffer.
  - `embeddedFileAdd(...)` inserts new content into the PDF portfolio. We (in contrast to `mutool`) **restrict** this to entries with a **new name** (no duplicate names allowed).
  - `embeddedFileDel(...)` deletes an entry from the portfolio (function not offered in MuPDF).

  - `embeddedFileSetInfo()` - changes filename or description of an embedded file.
  - `embeddedFileCount` - contains the number of embedded files.
- Several enhancements deal with streamlining geometry objects. These are not connected to the new MuPDF version and most of them are also reflected in PyMuPDF v1.10.0. Among them are new properties to identify the corners of rectangles by name (e.g. `Rect.bottom_right`) and new methods to deal with set-theoretic questions like `Rect.contains(x)` or `IRect.intersects(x)`. Special effort focussed on supporting more "Pythonic" language constructs: `if x in rect ...` is equivalent to `rect.contains(x)`.
- The *Rect* chapter now has more background on empty amd infinite rectangles and how we handle them. The handling itself was also updated for more consistency in this area.
- We have started basic support for **generation** of PDF content:
  - `Document.insertPage()` adds a new page into a PDF, optionally containing some text.
  - `Page.insertImage()` places a new image on a PDF page.
  - `Page.insertText()` puts new text on an existing page
- For **FileAttachment** annotations, content and name of the attached file can extracted and changed.

13.20 Changes in Version 1.10.0

13.20.1 MuPDF v1.10 Impact

MuPDF version 1.10 has a significant impact on our bindings. Some of the changes also affect the API - in other words, **you** as a PyMuPDF user.

- Link destination information has been reduced. Several properties of the `linkDest` class no longer contain valuable information. In fact, this class as a whole has been deleted from MuPDF's library and we in PyMuPDF only maintain it to provide compatibilty to existing code.
- In an effort to minimize memory requirements, several improvements have been built into MuPDF v1.10:
  - A new `config.h` file can be used to de-select unwanted features in the C base code. Using this feature we have been able to reduce the size of our binary `_fitz.o` / `_fitz.pyd` by about 50% (from 9 MB to 4.5 MB). When UPX-ing this, the size goes even further down to a very handy 2.3 MB.
  - The alpha (transparency) channel for pixmaps is now optional. Letting alpha default to `False` significantly reduces pixmap sizes (by 20% - CMYK, 25% - RGB, 50% - GRAY). Many `Pixmap` constructors therefore now accept an `alpha` boolean to control inclusion of this channel. Other pixmap constructors (e.g. those for file and image input) create pixmaps with no alpha alltogether. On the downside, save methods for pixmaps no longer accept a `savealpha` option: this channel will always be saved when present. To minimize code breaks, we have left this parameter in the call patterns - it will just be ignored.
- `DisplayList` and `TextPage` class constructors now **require the mediabox** of the page they are referring to (i.e. the `page.bound()` rectangle). There is no way to construct this information from other sources, therefore a source code change cannot be avoided in these cases. We assume however, that not many users are actually employing these rather low level classes explixitely. So the impact of that change should be minor.

13.20.2 Other Changes compared to Version 1.9.3

- The new *Document* method `write()` writes an opened PDF to memory (as opposed to a file, like `save()` does).

- An annotation can now be scaled and moved around on its page. This is done by modifying its rectangle.
- Annotations can now be deleted. *Page* contains the new method `deleteAnnot()`.
- Various annotation attributes can now be modified, e.g. content, dates, title (= author), border, colors.
- Method `Document.insertPDF()` now also copies annotations of source pages.
- The `Pages` class has been deleted. As documents can now be accessed with page numbers as indices (like `doc[n] = doc.loadPage(n)`), and document object can be used as iterators, the benefit of this class was too low to maintain it. See the following comments.
- `loadPage(n)` / `doc[n]` now accept arbitrary integers to specify a page number, as long as `n < pageCount`. So, e.g. `doc[-500]` is always valid and will load page `(-500) % pageCount`.
- A document can now also be used as an iterator like this: `for page in doc: ...<do something with "page"> ...`. This will yield all pages of `doc` as `page`.
- The *Pixmap* method `getSize()` has been replaced with property `size`. As before `Pixmap.size == len(Pixmap)` is true.
- In response to transparency (alpha) being optional, several new parameters and properties have been added to *Pixmap* and *Colorspace* classes to support determining their characteristics.
- The *Page* class now contains new properties `firstAnnot` and `firstLink` to provide starting points to the respective class chains, where `firstLink` is just a mnemonic synonym to method `loadLinks()` which continues to exist. Similarly, the new property `rect` is a synonym for method `bound()`, which also continues to exist.
- *Pixmap* methods `samplesRGB()` and `samplesAlpha()` have been deleted because pixmaps can now be created without transparency.
- *Rect* now has a property `irect` which is a synonym of method `round()`. Likewise, *IRect* now has property `rect` to deliver a *Rect* which has the same coordinates as floats values.
- Document has the new method `searchPageFor()` to search for a text string. It works exactly like the corresponding `Page.searchFor()` with page number as additional parameter.

13.21 Changes in Version 1.9.3

This version is also based on MuPDF v1.9a. Changes compared to version 1.9.2:

- As a major enhancement, annotations are now supported in a similar way as links. Annotations can be displayed (as pixmaps) and their properties can be accessed.
- In addition to the document `select()` method, some simpler methods can now be used to manipulate a PDF:
  - `copyPage()` copies a page within a document.
  - `movePage()` is similar, but deletes the original.
  - `deletePage()` deletes a page
  - `deletePageRange()` deletes a page range
- `rotation` or `setRotation()` access or change a PDF page's rotation, respectively.
- Available but undocumented before, *IRect*, *Rect*, *Point* and *Matrix* support the `len()` method and their coordinate properties can be accessed via indices, e.g. `IRect.x1 == IRect[2]`.
- For convenience, documents now support simple indexing: `doc.loadPage(n) == doc[n]`. The index may however be in range `-pageCount < n < pageCount`, such that `doc[-1]` is the last page of the document.

13.22 Changes in Version 1.9.2

This version is also based on MuPDF v1.9a. Changes compared to version 1.9.1:

- `fitz.open()` (no parameters) creates a new empty **PDF** document, i.e. if saved afterwards, it must be given a `.pdf` extension.
- *Document* now accepts all of the following formats (`Document` and `open` are synonyms):
  - `open()`,
  - `open(filename)` (equivalent to `open(filename, None)`),
  - `open(filetype, area)` (equivalent to `open(filetype, stream = area)`).

  Type of memory area `stream` may be `bytes` or `bytearray`. Thus, e.g. `area = open("file.pdf", "rb").read()` may be used directly (without first converting it to bytearray).
- New method `Document.insertPDF()` (PDFs only) inserts a range of pages from another PDF.
- `Document` objects doc now support the `len()` function: `len(doc) == doc.pageCount`.
- New method `Document.getPageImageList()` creates a list of images used on a page.
- New method `Document.getPageFontList()` creates a list of fonts referenced by a page.
- New pixmap constructor `fitz.Pixmap(doc, xref)` creates a pixmap based on an opened PDF document and an XREF number of the image.
- New pixmap constructor `fitz.Pixmap(cspace, spix)` creates a pixmap as a copy of another one `spix` with the colorspace converted to `cspace`. This works for all colorspace combinations.
- Pixmap constructor `fitz.Pixmap(colorspace, width, height, samples)` now allows `samples` to also be `bytes`, not only `bytearray`.

13.23 Changes in Version 1.9.1

This version of PyMuPDF is based on MuPDF library source code version 1.9a published on April 21, 2016.

Please have a look at MuPDF's website to see which changes and enhancements are contained herein.

Changes in version 1.9.1 compared to version 1.8.0 are the following:

- New methods `getRectArea()` for both `fitz.Rect` and `fitz.IRect`
- Pixmaps can now be created directly from files using the new constructor `fitz.Pixmap(filename)`.
- The Pixmap constructor `fitz.Pixmap(image)` has been extended accordingly.
- `fitz.Rect` can now be created with all possible combinations of points and coordinates.
- PyMuPDF classes and methods now all contain `__doc__` strings, most of them created by SWIG automatically. While the PyMuPDF documentation certainly is more detailed, this feature should help a lot when programming in Python-aware IDEs.
- A new document method of `getPermits()` returns the permissions associated with the current access to the document (print, edit, annotate, copy), as a Python dictionary.
- The identity matrix `fitz.Identity` is now **immutable**.
- The new document method `select(list)` removes all pages from a document that are not contained in the list. Pages can also be duplicated and re-arranged.

- Various improvements and new members in our demo and examples collections. Perhaps most prominently: `PDF_display` now supports scrolling with the mouse wheel, and there is a new example program `wxTableExtract` which allows to graphically identify and extract table data in documents.
- `fitz.open()` is now an alias of `fitz.Document()`.
- New pixmap method `getPNGData()` which will return a bytearray formatted as a PNG image of the pixmap.
- New pixmap method `samplesRGB()` providing a `samples` version with alpha bytes stripped off (RGB colorspaces only).
- New pixmap method `samplesAlpha()` providing the alpha bytes only of the `samples` area.
- New iterator `fitz.Pages(doc)` over a document's set of pages.
- New matrix methods `invert()` (calculate inverted matrix), `concat()` (calculate matrix product), `preTranslate()` (perform a shift operation).
- New `IRect` methods `intersect()` (intersection with another rectangle), `translate()` (perform a shift operation).
- New `Rect` methods `intersect()` (intersection with another rectangle), `transform()` (transformation with a matrix), `includePoint()` (enlarge rectangle to also contain a point), `includeRect()` (enlarge rectangle to also contain another one).
- Documented `Point.transform()` (transform a point with a matrix).
- `Matrix`, `IRect`, `Rect` and `Point` classes now support compact, algebraic formulations for manipulating such objects.
- Incremental saves for changes are possible now using the call pattern `doc.save(doc.name, incremental=True)`.
- A PDF's metadata can now be deleted, set or changed by document method `setMetadata()`. Supports incremental saves.
- A PDF's bookmarks (or table of contents) can now be deleted, set or changed with the entries of a list using document method `setToC(list)`. Supports incremental saves.

CHAPTER

FOURTEEN

ERROR MESSAGES

This a list of exception messages raised by PyMuPDF together with an explanation and possible solution.

In addition, the underlying C library MuPDF also raises exceptions on the Python level. We have included a few of those as well and may extend this in future.

In general, `RuntimeError` is raised by the C-level (MuPdf or PyMuPDF), other exception types are always raised on the Python level.

annot has no /AP

- Bad specification - no changes possible for this annotation.

arg 1 not bytes or bytearray

- Specify parameter as type `bytes` or `bytearray`.

bad PDF: Contents is no stream object

- The `/Contents` object(s) of a page must be streams. Repair PDF.

bad PDF: file has no stream

- An embedded / attached file is not a stream. Repair PDF.

buffer too large to deflate

- Internal error - report an issue.

cannot deflate buffer

- Internal error - report an issue.

cannot open <path>: No such file or directory

- Specify a valid file name / path.

cannot recognize archive

- Trying to open an invalid CBZ document.

cannot recognize zip archive

- Trying to open an invalid XPS document.

color components must be in range 0 to 1

- Color components must be floats in interval [0, 1].

could not load root object

- Root object of PDF not found. Repair PDF.

encrypted file - save to new

- Trying incremental save for a decrypted file. Save to a new file.

exactly one of filename, pixmap or stream must be given

- You specified none or more than one of these parameters.

expected a sequence

- Parameter type must be `list`, `tuple`, etc.

filename must be a string

- Specify a valid file path / name.

filename must be string or None

- Specify a valid file path / name or omit parameter.

filename must end with '.png'

- `writePNG()` requires file extension `.png`.

filetype missing with stream specified

- Document open from memory needs its type as a string.

fontname must be supplied

- A new font file requires some (arbitrary) **new** reference name.

found code point nnn: increase charlimit

- Trying to get a glyph width beyond the current table size limit.

incremental excludes garbage

- Garbage collection cannot occur during incremental saves.

incremental excludes linear

- Linearization cannot occur during incremental saves.

incremental save needs original file

- Incremental save is only possible to the original file.

info not a dict

- Specify correct Python parameter type.

invalid font - FontDescriptor missing

- Specify correct XREF to read font.

invalid font descriptor subtype

- Bad font description in PDF. Repair file.

unhandled font type / unhandled font type '<type>'

- MuPDF does not yet handle this font type. Requesting method cannot be used, unfortunately. Report an issue.

invalid key in info dict

- Dictionary key misspelled.

invalid page range

- Page numbers must be in range `[0, pageCount - 1]`.

invalid stream

- Stream object updates need type `bytes` or `bytearray`.

len(samples) invalid

- Length of samples must equal `width * height * n` (where `n` is the number of components per pixel).

line endpoints must be within page rect

- The `Page.rect` must contain the points.

name already exists

- The name is in use by some other embedded file.

name not valid

- Specify a name of non-zero length.

need 3 color components

- Only RGB colors are supported, which need three components.

no embedded files

- PDF has no embedded files.

no objects found

- Trying to open an invalid PDF, FB2, or EPUB document.

not a file attachment annot

- Accessed an annotation with the wrong type.

not a PDF

- Using some method or attribute only valid for PDF document type.

nothing to change

- No data supplied for embedded file metadata change.

operation illegal for closed doc

- Trying to use methods / properties after close of document.

orphaned object: parent is None

- Accessing an object whose parent no longer exists (e.g. an annotation of an unavailable page).

invalid page number(s)

- Page numbers must be integers `< pageCount`, but also non-negative for some methods.

rect must be contained in page rect

- Image insertion requires a target rectangle contained in `page.rect`.

rect must be finite and not empty

- Top-left corner must be "northeast" of bottom-right one, and rectangle area must be positive.

repaired file - save to new

- Trying incremental save for file repaired during open. Use `doc.save()` to a new file.

save to original requires incremental

- Using original filename in `doc.save()` without also specifying option `incremental`. Consider using `doc.saveIncr()`.

sequence length must be <n>

- Creating Point, Rect, Irect, Matrix with wrong length sequences.

some text is needed

- Specify text with a positive length.

source and target too close

- Target number of moved page `pno` must be `> pno` or `< pno - 1`.

source must not equal target PDF

- Method `doc.insertPDF()` requires two distinct document objects (which may point to the same file, however).

source not a PDF

- Method `doc.insertPDF()` only works with PDF documents.

source page out of range

- Specify a valid page number.

target not a PDF

- Method *`Document.insertPDF()`* only works with PDF documents.

text position outside page height range

- If text starts at *Point* `point`, `fontsize <= point.y <= (page height - fontsize * 1.2)` must be true.

type(ap) invalid

- Internal error - report an issue.

type(imagedata) invalid

- Use type `bytearray`.

type(samples) invalid

- Use type `bytes` or `bytearray`.

unknown PDF Base 14 font

- Use a valid PDF standard font name.

xref entry is not an image

- Trying to create a pixmap from a non-image PDF object.

xref invalid

- Internal error - report an issue.

xref is not a stream

- Trying to access the stream part of a non-stream object.

xref out of range

- PDF xref numbers must be `1 <= xref <= doc._getXrefLength()`.

INDEX