The Black Magic of Floats in LaTeX

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https://github.com/alpenwasser/TeX/

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Abstract

The behavior of floats can often be confusing for the uninitiated, and yield unexpected results. This document gives a brief overview on the subject, primarily based on Leslie Lamport's *LaTeX – A Document Preparation System* [1].

I will not cover every possible edge case, but present some usage examples and common problem one tends to run into while working with floats.

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Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

Figure 1: A `figure` environment with placeholder text

Table 1: A `table` environment with placeholder text

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1 What Are Floats, Anyway?

Normal text is broken by TEX across lines and pages automatically. Some content, such as images, are not well-suited to being split into pieces. That is what floating environments are for: To provide a way to put such content in a place where it does not need to be broken; a way for it to *float* to a suitable location for an optimal overall result.

Two such floating environments are provided by LATEX by default: The `figure` and the `table`[1] environment. There are packages which define more floating environments (for example, the `listings` packages can let its code listings float, if so desired), or the user may define their own floating environments, if they so wish.

Fundamentally, the only important difference between these environments is how they are captioned and numbered: `figure` environments will get a different caption and number to a `table` environment. However, one may in principle put pretty much anything one desires into either environment. As long as the code itself is valid, LATEX will not complain. Figure 1 and Table **??** demonstrate this by placing some Lorem Ipsum text inside their environments.

The floating behavior can be demonstrated by the fact that, in the source code of this document, 1 and 1 are placed right after this sentence. In the resulting document, they may be placed wherever LATEX deems most suitable (maybe at the top of this page[2], maybe not).

Because captions are a moving argument (Section 3.5.1 in [1]), fragile commands such as linebreaks inside them must be preceded by `\protect`, as shown in the caption of Figure 2.

The `\caption` command can only be used inside a floating environment by default. If you require captions for non-floating arguments, there are packages which provide such facilities, as well as more caption customisation options, see [3, 4] and Chapter 6 of this document.

2 Basic Usage

Listing 1[3] shows the basic code for including an external graphics file inside a `figure` environment.

[1] Because confusion is fun: The `table` environment does not actually typeset a table. That is what `tabular`, `tabularx` and similar environments are for. See [2] for an overview. The `table` environment is merely a floating container intended for containing tabular content.

[2] LATEX usually tries to place floats either at the top of a page, the bottom of a page, or on a separate page. See 3 for more information.

[3] Incidentally, Listing 1 is one of those cases where a new type of floating environment has been provided; in this case by the `minted` package.

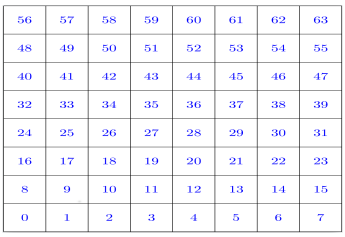

Figure 2: One can place arbitrary content inside a `figure` environment, though this does not usually make much sense.
Note that you can also have linebreaks inside a `caption`, but it requires the `\protect` command before the linebreak, like so: `\protect\\`

```
\begin{figure}
    \includegraphics[height=3cm,width=4.5cm]{images/grid8cm.png}
    \caption{A very interesting and slightly distorted picture of a grid}
    \label{fig:distorted-grid}
\end{figure}
```

Listing 1: Code block for includeing a graphics in a figure

It is often desirable to center a table or a picture, in which case we add a `\centering` directive into the environment, as done in Listing 2[4].

```
\begin{table}
    \centering
    \caption{Results for an experiment}
    \label{tab:experiment}
    \begin{tabular}{ll}
        \toprule
        Experiment Input  & Experiment Output        \\
        \midrule
        interesting thing & interesting result!      \\
        boring thing      & mildly surprising result \\
        weird thing       & very unexpected result   \\
        fascinating thing & machine broke            \\
        Xenomorph XX121   & dead scientists          \\
        \bottomrule
    \end{tabular}
\end{table}
```

Listing 2: Centering a `tabular` environment inside a `table` floating environment

You may have noticed that the `\caption` is placed above the content for tables and below the picture in a `figure` environment. This is not prescribed by LaTeX, obviously, and will depend on the style guide you're following or your own preferences. All I will say on the subject is that most tables I've seen had their caption above the table and most images had them below the picture.

What does matter, however, is where the `\label` is put! In order to pick up the correct number, it must always come after the `\caption` command to which it is supposed to be connected. If you put it before the `\caption` command, the `\label` will pick up whichever counter was the last

[4] There exists also a `\begin{center} ...\end{center}` environment. For the curious, some information on the differences between that and `\centering` can be found at [5, 6]

active one before the `\caption`, which can be anything (another picture or table or float of some sort, but also a chapter, section or similar). This is a mistake which is easily made and often hard to detect.

3 Placement Options

So you have written your document, or a large part of it, and the floats are just not where you'd like them to be? That is where placement options come in. They allow you to tell LaTeX where you would like your floats to be, with more or less vehemence. It will then try to accomodate your wishes as best it can while still following its internal rules to some extent.

Whatever your preferences, only use placement options once your text is (almost) complete. Otherwise you will end up needing to change them again and again and again, causing a lot more work. Also, it is quite easily possible to overlook a bad placement option from an earlier version of a document which makes you jump through hoops trying to get the best result even though LaTeX would actually do the right thing if you would just let it[5].

4 Help, My Floats Are Jinxed!

Too many floats, not enough text, ...

5 LaTeX's Dark Magic

6 Alternatives to Using Floats

[5] I am obviously *not* speaking from personal experience here. I am smarter than that, I assure you.

7 References

[1] Leslie Lamport, Digital Equipment Corporation, *"LaTeX – A Document Preparation System"*, 2nd Edition, 1994, Addison-Wesley Publishing Company.

[2] Lapo Mori, *"Tables in LaTeX 2ε: Packages and Methods"*, The PracTeX Journal, 2007-FEB-20. [Online], https://www.tug.org/pracjourn/2007-1/mori/mori.pdf, [Accessed: 2017-MAR-27].

[3] Comprehensive TeX Archive Network. *"Package caption – Customising captions in floating environments"*. [Online], http://ctan.org/pkg/caption, [Accessed: 2017-MAR-26].

[4] Comprehensive TeX Archive Network. *"Topic caption"*. [Online], http://ctan.org/topic/caption, [Accessed: 2017-MAR-26].

[5] Enrico Gregorio, *"When should we use* `\begin{center}` *instead of* `\centering`*?"*, [Online], http://tex.stackexchange.com/a/23653, [Accessed: 2017-MAR-26].

[6] stefan, *"TeXBlog – center vs. centering"*. [Online], http://texblog.net/latex-archive/floats/center-centering/, [Accessed: 2017-MAR-27].