USP

Institute of Physics

A soft template
for homework solutions

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2023

Understanding the template

In this first part, I will dedicate myself to explaining how to use all the commands in this template. To start off, the entire `solutionclass` was initially based on the `book` class in order to increase the compatibility of some commands, such as the inclusion of the `\chapter{}`.

For the document cover, the commands `\author{}`, `\title{}`, etc. are not needed so the command `\pretitle{#1}{#2}{#3}` was created to include the title, subtitle and author's name respectively. In this command, the year has also been entered, but it is done automatically with the command `\theyear`, so you don't have to worry about it.

The `\divider` command creates a dashed line that can be used to visually separate specific content.

The `\section{}` command has a proprietary style that automatically generates a hexagonal background on the left side of the section title. Note that the section number is removed in the class configuration to maintain a cleaner appearance in the mini-summary. Speaking of the mini-summary, it has a fixed size so that the content recommended to be inside it is approximately 12 items. This means that the font size will decrease as more sections are added.

This template was initially develop to make solutions of exercises, therefore the first paragraph was thought to write the exercise enunciate, in this way, I didn't modify the text formatting in this part. However, I decided do develop a personalized environment to write the respective solution of the exercise. These environment has two forms: an unbreakable and a breakable form. In the first Section, I will write an example for the unbreakable form, and in the second Section an example for the breakable form.

Unbreakable Form

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Solution: This is a unbreakable example

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Breakable Form

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Solution: This is a breakable example

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Sed feugiat. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Ut pellentesque augue sed urna. Vestibulum diam eros, fringilla et, consectetuer eu, nonummy id, sapien. Nullam at lectus. In sagittis ultrices mauris. Curabitur malesuada erat sit amet massa. Fusce blandit. Aliquam erat volutpat. Aliquam euismod. Aenean vel lectus. Nunc imperdiet justo nec dolor.

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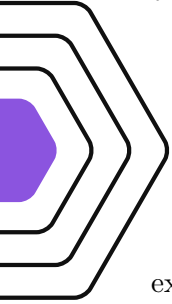
Using the references

To use references, we have two methods for citing a book, article, etc. The first method is written as `\therefs\cite{#key}` where `#key` represents the citation key of the bibliographic reference. For example, `\therefs\cite{WaldGR}` produces:

References: Choquet-Bruhat 2009; Wald 1984

This method is recommended for use when the citation is not a direct one, i.e., when the paragraph

or text is based on the reference, but not directly using it. The second method is recommended to use when the citation are directly used to write the text or explain some argument. This method is really simple, you just need to use `\textcite{#key}`, for example: "The book written by Wald (1984) and the books written by Choquet-Bruhat (2009, 2015) are the best books to study General Relativity"

Equations style

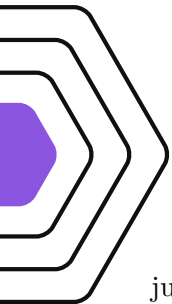In general, the `\begin{equation}` environments are simple, just the label color changes. An example to show:

$$\mathcal{R}^{\alpha\beta} - \frac{1}{2}g^{\alpha\beta}\mathcal{R} = 8\pi G T^{\alpha\beta} \tag{1.1}$$

In addition, the environment `\begin{align}` or `\begin{align*}` has vertical lines at each line break and to do this, there is a specific way:

$$\frac{1}{\sqrt{-g}}\partial_\rho(\sqrt{-g}) = -\frac{1}{2(-g)}\partial_\rho(g) \tag{1.2}$$
$$= \frac{1}{2g}\frac{\delta(g)}{\delta(g_{\mu\nu})}\partial_\rho(g_{\mu\nu})$$
$$= \frac{1}{2g}gg^{\mu\nu}\partial_\rho(g_{\mu\nu})$$
$$= \frac{1}{2}g^{\mu\nu}\partial_\rho(g_{\mu\nu}) = \Gamma^\alpha_{\rho\alpha} \tag{1.3}$$

Note that for line breaks, I use the command `\\` and after that, to align, `&` along with a custom command `\eq`. Also, if you don't want to align a specific single line, use the command `\noeq` instead of `\eq` to make the line continue to the next equation, see the following example usingo `\begin{align*}`:
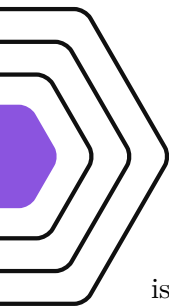
$$\Gamma^\rho_{\mu\nu} = \frac{1}{2}g^{\rho\sigma}\left(\partial_\mu g_{\sigma\nu} + \partial_\nu g_{\sigma\mu} - \partial_\sigma g_{\mu\nu}\right)$$
$$= \frac{1}{2}(\eta^{\rho\sigma} + h^{\rho\sigma})[\partial_\mu(\eta_{\sigma\nu} + h_{\sigma\nu}) +$$
$$+ \partial_\nu(\eta_{\sigma\mu} + h_{\sigma\mu}) - \partial_\sigma(\eta_{\mu\nu} + h_{\mu\nu})]$$
$$= \frac{1}{2}(\eta^{\rho\sigma} + h^{\rho\sigma})\left(\partial_\mu h_{\sigma\nu} + \partial_\nu h_{\sigma\mu} - \partial_\sigma h_{\mu\nu}\right)$$
$$= \frac{1}{2}\eta^{\rho\sigma}\left(\partial_\mu h_{\sigma\nu} + \partial_\nu h_{\sigma\mu} - \partial_\sigma h_{\mu\nu}\right) + \mathcal{O}(h)$$

Additional Boxes

I created a new environment which make a adaptable size box around the equation. To use this, you just need to write `\begin{answer}` to start the environment. Use this like the equation environment. Below I show an example.

$$\mathcal{R}^{\alpha\beta} - \frac{1}{2}g^{\alpha\beta}\mathcal{R} = 8\pi G T^{\alpha\beta} \tag{1.4}$$

Final instructions

To change the homework number, in line 13 of the `main.tex`, the definition `\homeworkNumber{\#}` is responsible for change the number, therefore, just put the number you want instead `\#`.

If you want to change the colors of the template, open the `solutionclass.cls` file, find the "*Color settings*" (line 127), and follow the guide written there.

If you like to create `\newcommand` in your `.tex` files, I suggest you to write them in the last lines of the file `solutionclass.cls` (line 512), to ensure that all packages are read. In addition, to add new packages in `solutionclass.cls` you want to write `\RequirePackage[]{}` instead `\usepackage[]{}`.

To finish, I'll comment on some extra commands that I implemented in the template to make things a little prettier.

- Vectors `\vec{}` are always written using **bold** notation. The reason for this is that when the math gets more complicated, the notation with the arrow ends up making things more "messy", so to speak;

- A unitary matrix is represented by the command `\boldone` and looks like that: $\mathbb{1}$;

- To comment some part of the text, I created the command `\Acomment{}` to write the text "*Like that*".

Template by L. R. Ximenes (Jimeens)

References

Choquet-Bruhat, Yvonne (2009). *General Relativity and the Einstein Equations.* Vol. I. Oxford: Oxford University Press.

Choquet-Bruhat, Yvonne (2015). *Introduction to general relativity, black holes, and cosmology.* Vol. I. Oxford: Oxford University Press.

Wald, Robert M. (1984). *General Relativity.* Chicago: University of Chicago Press.