A LaTeX template for an astronomy/astrophysics thesis[1]

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[1]This is just a very basic cover page produced by LaTeX – when the thesis is done you can get a more formal cover page from Eva Jurlander.

(this page will contain some more official information in the final version)

Abstract

The abstract is a short summary describing the content of the main text. This should give enough information about the contents to decide for the intended audience whether further reading will be useful. The size should be about half a page, best written at the end, after most of the thesis is written.

Populärvetenskaplig beskrivning

This is meant to be popular *introduction to* and *description of* your thesis, preferably written in Swedish. The name is unfortunately misleading. It is not a summary but mainly an introduction to what you have done. A good idea is to write this when you are about one third through the time allotted for the thesis work.

Especially important here are the context of your project and why this is an interesting project to do. This should be about half a page as well.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

This document is meant as a technical tutorial for writing an astronomy/astrophysics thesis in LaTeX. Detailed rules about the *contents* of the thesis (Bachelor's thesis or Master's thesis) can be found at the course websites.

1.1 TESS

1.2 Transits

1.2.1 Variations

1.3 Simulation of TESS objects

1.4 TTVFast

1.5 Analyzing results from TTVFast

Chapter 2

Results

Chapters always start on a new page. The chapter names in the template are just suggestions. You can name your chapters differently and add more if needed.

2.1 Code

When we write down computer code we might want it to look just like it does in the editor (using a fixed with font). This is done using the *verbatim* environment.

```
PROGRAM myfortran

IMPLICIT NONE

REAL*8 mag(20)
REAL flux(20)
INTEGER nstar

WRITE(*,*) "This program calculates a magnitude"
READ(*,*) flux(1)
mag(1)=-2.5*LOG(flux(1))
```

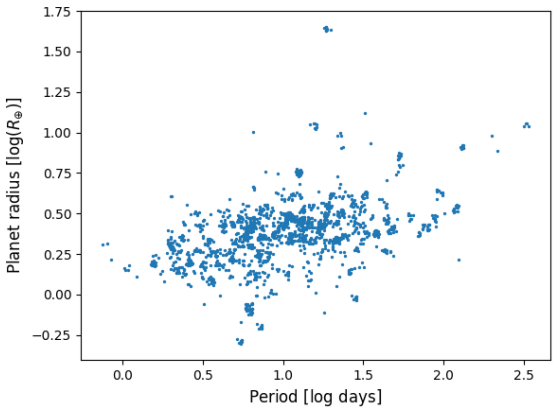

Figure 2.1: Diagram with the radius distribution as a function of period for the simulated TESS objects.

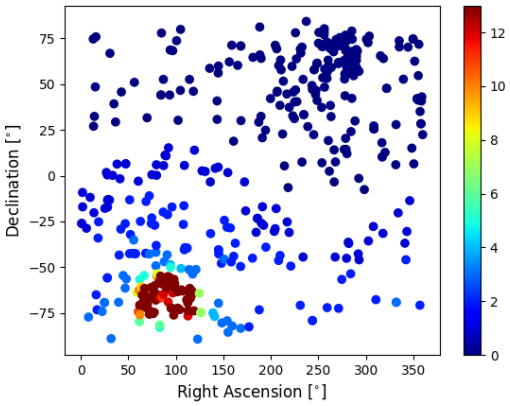

Figure 2.2: Diagram with the position of each observed objects color-coded to show the number of times the object is observed.

2.2 Figures

Figures are of course very important in the thesis. Make sure that your figures have thick lines that stand out in the printed version, that the fonts are not too small, that the axes are labelled and explained and that colours are distinguishable in a black and white printout as well (this is helpful for the not insignificant fraction of the population who are colorblind).

2.3 Tables

This section contains a table which shows the most basic elements and a simple layout. The table can be seen in Table 2.1. Make sure to make your labeling system easy. Maybe table:1 is not so smart – what if you move the table somewhere else, and it is not any longer the first table or you add a table before this one. A label like `table:varstars` is much better.

Table 2.1: This is a table of variable stars

Id of star	I	V	Var.?
1234	15.6	17.3	No
5677	13.4	12.3	Yes

Here we managed to place the table directly in the text (using the !h option). Generally we should let LaTeX control the positions of figures and tables – if you are unhappy with their placement then try to move them around in the raw text or experiment with !h and !t.

2.4 Equations

Writing mathematical formulae in LaTeX is not always so easy at first. But it does look good! This is one of the main reasons why we use LaTeX instead of Word. There are several environments that we can use. If I want simply to have a small equation or some expression in the text I can just do `$ x+a \cdot b= f(x) $`. Which, when LaTeXed, gives us the formula $x + a \cdot b = f(x)$.

If we want an equation by itself, we just add one more `$` at each side:

$$g(x, y) = \sin(x) + 10\ log(y \cdot 20 \cdot 10^{-2x})$$

It is also possible to use an *environment* especially for equations. Remember that equations should be integrated in the flow of the text, even if they are on separate lines. Therefore we should use punctuation in equations as well, for example in the equation which reads

$$\sum_{k=i}^{n}(x - \overline{x})^2 + \sqrt{x^2 + y^3} = h(x, y)\,. \tag{2.1}$$

Remember that the *equation* environment does not like empty lines. This is the same in table, by the way. You can do many more things in the maths-mode. If you are going to write lots of equations you will learn it very quickly.

2.5 The list environment

If you want to make good looking lists, short or long, LaTeX can do it for you.

- This is the first entry
- and the second one

- lets go down one level
- and stay there
  * And one more
  * very deep

But you can also do other types of lists. For example with numbers. Very useful as you cna refer to them later.

1. First entry
2. Second entry
3. Third entry
   (a) First entry
   (b) Second entry

   - And you can mix the listings
   - like this

Chapter 3

Conclusions

3.1 Cross-referencing

LaTeX is very nice because it can help you to refer to the right table, figure, item section or page. Just remember that you need to compile with `latex` or `pdflatex` twice (!) before it has updated all the cross references. This is also true for references (see Sect. 3.2).

In item 3a on page 8 you can find some important information that was not covered in Eq. (2.1) or in Table 2.1. That covers the most important references.

3.2 References

You also need to cite all the thick and good papers that you have read during your thesis work. There are several ways. Here we will use the `natbib` style as that one is the one that most resembles the way we write references in astronomy journal papers.

You can add the references in a so called bibtex file. This file contains all the information LaTeX needs about a single paper in order to make an entry in the reference list and to write the correct reference inside your text. You can go to ADS and download references and add them to the bibtex file. Click on the link marked “Bibtex entry for this abstract" and paste the entry into the bibtex file. You can then compile the document with `latex thesis_template`, `bibtex thesis_template`, `latex thesis_template`, `latex thesis_template`.

Alternatively we can add a list of bibitems directly in the LaTeX file. On ADS, click instead on the link marked “Preferred format for this abstract" and paste the bibitem into the reference list. This method is included in the template but is commented out. If you use bibitems then you can compile the document by simply typing `latex thesis_template` twice.

Both methods allow you to cite the important paper by Alexander & Armitage (2007) which was based on earlier work (Santos et al. 2001).

3.3 Spelling

Remember to check the text carefully for typos and grammatical errors. You can use a tool like Spell Right for this (`http://nile.lub.lu.se/loDownload/101/Spellright.htm`) – but note that you must paste the text into a Word file in order to feed it into Spell Right.

Acknowledgements

There is no acknowledgements section in the regular LaTeX, but you can easily make one yourself. (Kervella et al. 2017)

Bibliography

Alexander, R. D. & Armitage, P. J. 2007, MNRAS, 375, 500

Kervella, P., Thévenin, F., & Lovis, C. 2017, A&A, 598, L7

Santos, N. C., Israelian, G., & Mayor, M. 2001, A&A, 373, 1019

Appendix A

This is an appendix

You can put long mathematical derivations or tables in appendices.

Appendix B

This is another appendix

```
import matplotlib.pyplot as plt
import numpy as np
import sys

timesFile = []
valueArray = []
transitTime1Float = []
epoch1Float = []
count = 0
period = 1.0917340278625494e+01
kepMag = []
transitDur = []
rStar = []

with open(sys.argv[1],'r') as timesFile:
valueArray = timesFile.readlines()
planet = [k.split(' ')[0] for k in valueArray]
epoch1 = [k.split(' ')[1] for k in valueArray]
transitTime1 = [k.split(' ')[2] for k in valueArray]


for k in range(len(valueArray)):
if planet[k] == '0':
epoch1Float.append(float(epoch1[k]))
transitTime1Float.append(float(transitTime1[k]))
```

```
epoch1Float = np.array(epoch1Float)
transitTime1Float = np.array(transitTime1Float)

transitTime1Min = transitTime1Float * 1440
fitTimes = np.polyfit(epoch1Float, transitTime1Min, 1)

transitTimesLinFitted = transitTime1Min-fitTimes[0]*epoch1Float
transitMax = np.amax(transitTimesLinFitted)
transitMin = np.amin(transitTimesLinFitted)
transitAmplitude = (transitMax - transitMin) / 2
transitCorrection = (transitMax + transitMin) / 2

outputFile = open('transAmpl.txt', 'a')
outputFile.write(repr(transitAmplitude) + '\n')

print "Amplitude:", transitAmplitude, "minutes or", transitAmplitude/60, "hours"

if transitMax < 0:
transitTime1Corrected = transitTimesLinFitted + abs(transitCorrection)
else:
transitTime1Corrected = transitTimesLinFitted - abs(transitCorrection)

with open('timingErrors.csv','r') as inputFile:
data = inputFile.readlines()[0:]
errorTiming = float(data[int(sys.argv[2])])


plt.scatter(epoch1Float*fitTimes[0]/1440, transitTime1Corrected, label='Transit Time'
plt.errorbar(epoch1Float*fitTimes[0]/1440, transitTime1Corrected, yerr = errorTiming,
plt.xlabel('Time [Days]')
plt.ylabel('Transit time [Minutes]')
plt.title('Transit Timing variations')
plt.legend()
plt.tight_layout()
textstr = 'Amplitude=%.2f\nError=%.2f\n'%(transitAmplitude, errorTiming)
plt.figtext(0.75, 0.5, textstr, fontsize=10)
plt.subplots_adjust(right=0.7)
```

```
plt.savefig('plots/' + sys.argv[1] + '.png')
```