An Introduction to LaTeX

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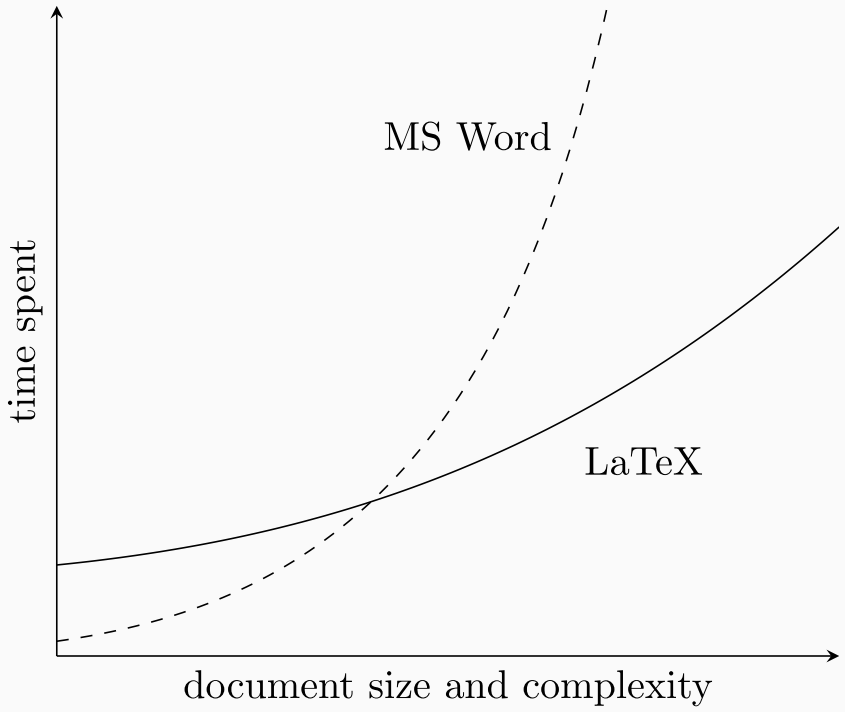
Research Institute for Agriculture, Fisheries and Food (ILVO)

Contents

Contents

Why (not) LaTeX?

+ High typographical quality
+ Separate *content* from *layout* (WYSIWYM vs. WYSIWYG)
+ Modularity
+ Open-source, secure, accessible freely
+ Mathematics
- Learning curve
- Rapid document creation



More Profession Output

More Profession Output

LaTeX

Word

More Profession Output

LaTeX	Word
No double spaces	Double Spaces
Consistent paragraph spacing	User most use consistent number of line breaks
More natural spacing after a full stop	Same spacing after full stop

Modularity

LaTeX vs. Word – structure

Multiple documents (images, sections, tabular data)

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LaTeX vs. Word – editing

Source code is edited directly → no speed loss in large documents (though compilation time increases)

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LaTeX vs. Word – tools

Multiple tools work together (e.g. bibliography, index, abbreviations)

Check your Journal!

Journal

Always make sure your journal accepts PDF and/or LaTeX submissions *before* starting on a document.

Check your Journal!

Journal

Always make sure your journal accepts PDF and/or LaTeX submissions *before* starting on a document.

Formatting

Try to use the formatting of the journal by reading the guidelines online. This saves a late conversion (and all associated issues).

A Simple Document

```
\documentclass[11pt, english]{article}

\usepackage[a4paper]{geometry}
\usepackage{babel}
\usepackage{lipsum}

\title{A simple title}
\author{Jane Doe}

\begin{document}

\maketitle

\section{First section}

  \lipsum[4]

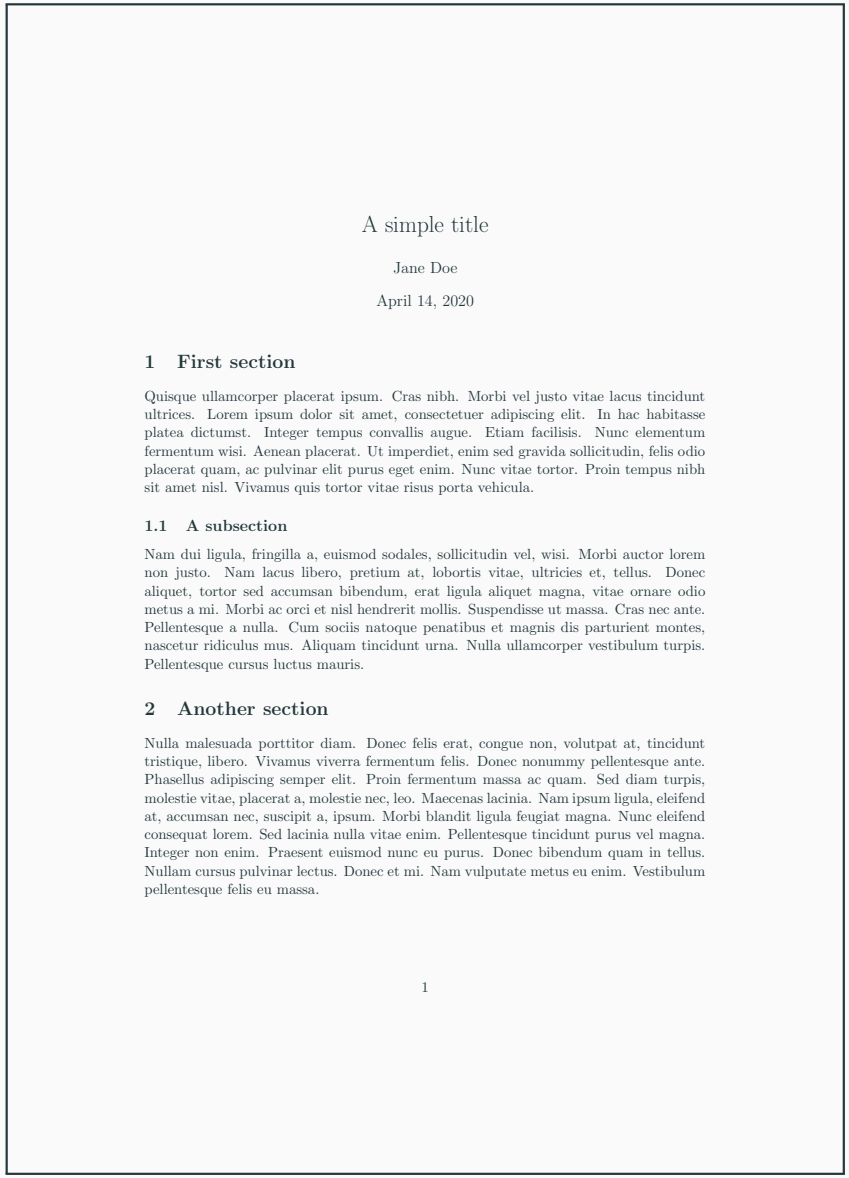
  \subsection{A subsection}

    \lipsum[2]

\section{Another section}

  \lipsum[3]

\end{document}
```



A simple title

Jane Doe

April 14, 2020

1 First section

Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacus tincidunt ultrices. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. In hac habitasse platea dictumst. Integer tempus convallis augue. Etiam facilisis. Nunc elementum fermentum wisi. Aenean placerat. Ut imperdiet, enim sed gravida sollicitudin, felis odio placerat quam, ac pulvinar elit purus eget enim. Nunc vitae tortor. Proin tempus nibh sit amet nisl. Vivamus quis tortor vitae risus porta vehicula.

1.1 A subsection

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.

2 Another section

Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

1

Some Syntax

Macro

Starts with a backslash and can have some arguments

```
\macro[optional]{required}
```

Some Syntax

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Environment

Starts with `\begin{environment}[optional keys]`

Stops at `\end{environment}`

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Starts with `\begin{environment}[optional keys]`

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Special characters (subset)

```
\ # _ & % { }
```

Some Syntax

Macro

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Environment

Starts with `\begin{environment}[optional keys]`

Stops at `\end{environment}`

Special characters (subset)

`\ # _ & % { }`

Strings

No special treatment of strings like in most programming languages, everything is *some* kind of string

LaTeX is not a programming language

Important!

While LaTeX might resemble a programming language, it is not a programming language but a *typesetting system* built on top the programming language TeX.

Document Structure

Preamble

set certain options and settings and include packages that are needed in the rest of the document, everything *before* `\begin{document}`

Contents

the contents of the document, everything *after* `\begin{document}` and *before* `\end{document}`

The Preamble

```
\documentclass[11pt, english]{article}

\usepackage[a4paper]{geometry}
\usepackage{babel}
\usepackage{lipsum}

\title{A simple title}
\author{Jane Doe}

\begin{document}
```

The Preamble - explained

```
1 \documentclass[11pt, english]{article}
```

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```
1 \documentclass[11pt, english]{article}
```

Define the document type, default font size and language. Common document types are:

- `article`
- `book` (and `report`)
- `letter`
- `beamer`
- many journals have their own class (e.g. `mdpi`, `elsarticle`)

The following font sizes are supported by default: `10pt` (default), `11pt` and `12pt`

Other options include settings for the number of columns, two sided typesetting...

The Preamble - explained

```
1 \documentclass[11pt, english]{article}

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The Preamble - explained

```
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4 \usepackage{lipsum}
```

Load packages (`\usepackage`)

- `geometry`: page layout (A4)
- `babel`: language settings (hyphenation etc.)
- `lipsum`: dummy text (normally not loaded)

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```

Define the title of this document and the author

The Preamble - explained

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5 \title{A simple title}
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Start the actual document

The Preamble - explained

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7 \begin{document}

8 \maketitle
```

The Preamble - explained

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7 \begin{document}

8 \maketitle

9 \end{document}
```

Overleaf

`https://www.overleaf.com`

Local installation is also possible:

`https://www.latex-project.org/get/`

Exercise

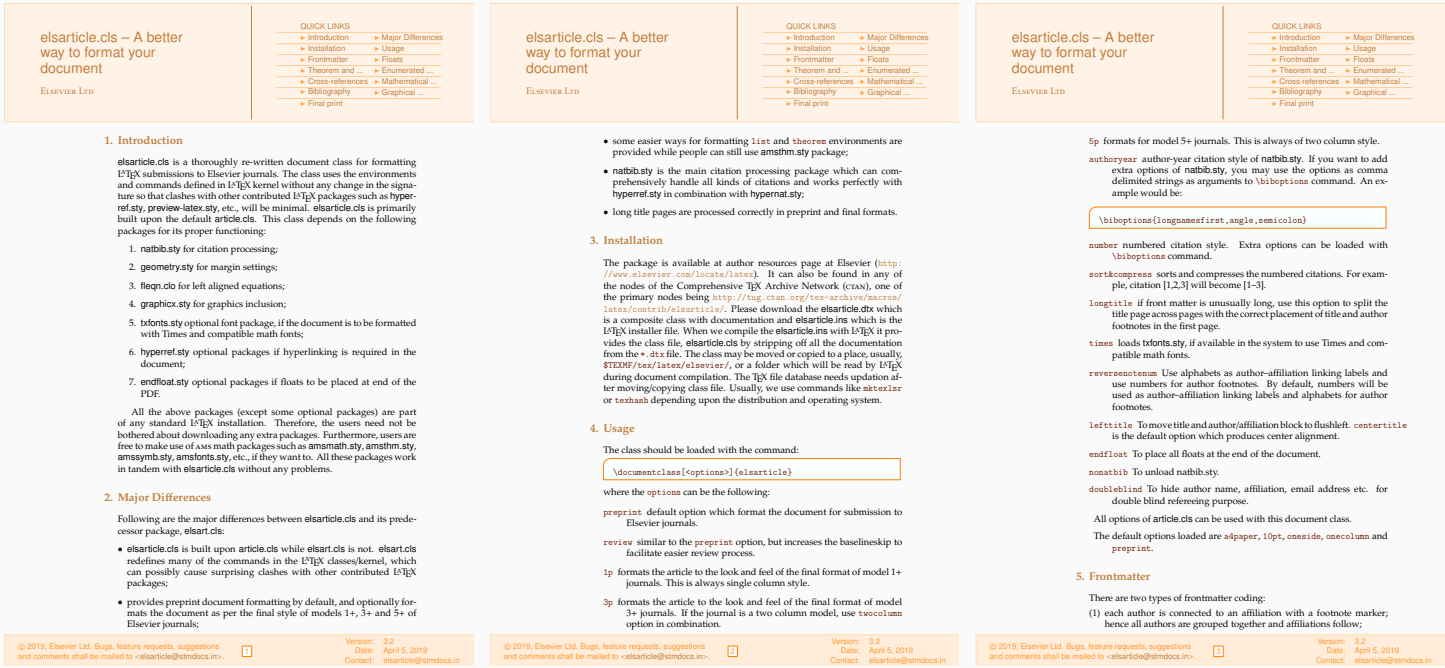
Exercise

Journal article in *Computer and Electronics in Agriculture*

Writing a First Document

Exercise

Journal article in *Computer and Electronics in Agriculture*



elsarticle.cls – A better way to format your document

Elsevier Ltd

QUICK LINKS

- ▸ Introduction
- ▸ Installation
- ▸ Frontmatter
- ▸ Theorem and ...
- ▸ Cross-references
- ▸ Bibliography
- ▸ Final print
- ▸ Major Differences
- ▸ Usage
- ▸ Floats
- ▸ Enumerated ...
- ▸ Mathematical ...
- ▸ Graphical ...

1. Introduction

elsarticle.cls is a thoroughly re-written document class for formatting LaTeX submissions to Elsevier journals. The class uses the environments and commands defined in LaTeX kernel without any change in the signature so that clashes with other contributed LaTeX packages such as hyperref.sty, preview-latex.sty, etc., will be minimal. elsarticle.cls is primarily built upon the default article.cls. This class depends on the following packages for its proper functioning:

1. natbib.sty for citation processing;
2. geometry.sty for margin settings;
3. fleqn.clo for left aligned equations;
4. graphicx.sty for graphics inclusion;
5. txfonts.sty optional font package, if the document is to be formatted with Times and compatible math fonts;
6. hyperref.sty optional packages if hyperlinking is required in the document;
7. endfloat.sty optional packages if floats to be placed at end of the PDF.

All the above packages (except some optional packages) are part of any standard LaTeX installation. Therefore, the users need not be bothered about downloading any extra packages. Furthermore, users are free to make use of AMS math packages such as amsmath.sty, amsthm.sty, amssymb.sty, amsfonts.sty, etc., if they want to. All these packages work in tandem with elsarticle.cls without any problems.

2. Major Differences

Following are the major differences between elsarticle.cls and its predecessor package, elsart.cls:

- elsarticle.cls is built upon article.cls while elsart.cls is not. elsart.cls redefines many of the commands in the LaTeX classes/kernel, which can possibly cause surprising clashes with other contributed LaTeX packages;
- provides preprint document formatting by default, and optionally formats the document as per the final style of models 1+, 3+ and 5+ of Elsevier journals;
- some easier ways for formatting `list` and `theorem` environments are provided while people can still use amsthm.sty package;
- natbib.sty is the main citation processing package which can comprehensively handle all kinds of citations and works perfectly with hyperref.sty in combination with hypernat.sty;
- long title pages are processed correctly in preprint and final formats.

3. Installation

The package is available at author resources page at Elsevier (`http://www.elsevier.com/locate/latex`). It can also be found in any of the nodes of the Comprehensive TeX Archive Network (CTAN), one of the primary nodes being `http://tug.ctan.org/tex-archive/macros/latex/contrib/elsarticle/`. Please download the elsarticle.dtx which is a composite class with documentation and elsarticle.ins which is the LaTeX installer file. When we compile the elsarticle.ins with LaTeX it provides the class file, elsarticle.cls by stripping off all the documentation from the `*.dtx` file. The class may be moved or copied to a place, usually, `$TEXMF/tex/latex/elsevier/`, or a folder which will be read by LaTeX during document compilation. The TeX file database needs updation after moving/copying class file. Usually, we use commands like `mktexlsr` or `texhash` depending upon the distribution and operating system.

4. Usage

The class should be loaded with the command:

```
\documentclass[<options>]{elsarticle}
```

where the `options` can be the following:

`preprint` default option which format the document for submission to Elsevier journals.

`review` similar to the `preprint` option, but increases the baselineskip to facilitate easier review process.

`1p` formats the article to the look and feel of the final format of model 1+ journals. This is always single column style.

`3p` formats the article to the look and feel of the final format of model 3+ journals. If the journal is a two column model, use `twocolumn` option in combination.

`5p` formats for model 5+ journals. This is always of two column style.

`authoryear` author-year citation style of natbib.sty. If you want to add extra options of natbib.sty, you may use the options as comma delimited strings as arguments to `\biboptions` command. An example would be:

```
\biboptions{longnamesfirst,angle,semicolon}
```

`number` numbered citation style. Extra options can be loaded with `\biboptions` command.

`sort&compress` sorts and compresses the numbered citations. For example, citation [1,2,3] will become [1–3].

`longtitle` if front matter is unusually long, use this option to split the title page across pages with the correct placement of title and author footnotes in the first page.

`times` loads txfonts.sty, if available in the system to use Times and compatible math fonts.

`reversenotenum` Use alphabets as author–affiliation linking labels and use numbers for author footnotes. By default, numbers will be used as author–affiliation linking labels and alphabets for author footnotes.

`lefttitle` To move title and author/affiliation block to flushleft. `centertitle` is the default option which produces center alignment.

`endfloat` To place all floats at the end of the document.

`nonatbib` To unload natbib.sty.

`doubleblind` To hide author name, affiliation, email address etc. for double blind refereeing purpose.

All options of article.cls can be used with this document class.

The default options loaded are `a4paper`, `10pt`, `oneside`, `onecolumn` and `preprint`.

5. Frontmatter

There are two types of frontmatter coding:

(1) each author is connected to an affiliation with a footnote marker; hence all authors are grouped together and affiliations follow;

Version: 3.2
Date: April 5, 2019
Contact: elsarticle@stmdocs.in

`https://ctan.org/pkg/elsarticle`

The preamble (for now)

```
1 \documentclass[10pt,authoryear,a4paper]{
    elsarticle}
2
3 \usepackage{geometry}
4 \newgeometry{margin=2.5cm}

5 \journal{Computers and Electronics in
    Agriculture}
```

Staring the Document

```
\begin{document}

\begin{frontmatter}

    \title{Limitations of snapshot
       hyperspectral cameras to monitor plant
       response dynamics in stress-free
       conditions}
```

Authorship

```
6     \author[a,b]{Olivier~Pieters\corref{cor1}}
7     \ead{olivier.pieters@ugent.be}
8     \ead[url]{olivierpieters.be}
9
10    \author[b]{Tom~De~Swaef}
11    \ead{tom.deswaef@ilvo.vlaanderen.be}
12
13    \cortext[cor1]{Corresponding author}
```

Addresses

```
14    \address[a]{IDLab-AIRO -- Ghent University
          -- imec, Technologiepark-Zwijnaarde
          126, 9052 Zwijnaarde, Belgium}
15    \address[b]{Plant Sciences Unit, Flanders
          Research Institute for Agriculture,
          Fisheries and Food, Caritasstraat 39,
          9090 Melle, Belgium}
```

Abstract (part 1)

```
16      \begin{abstract}
```

Abstract contents added later.

```
17      \end{abstract}
```

Highlights

```
18    \begin{highlights}
19        \item Study of eco-physiological plant
              response dynamics in stress-free
              conditions
20        \item We acquired a hyperspectral
              dataset with high spatial and
              temporal resolution
21    \end{highlights}
```

Keywords

```
22      \begin{keyword}
23          Hyperspectral camera\sep phenotyping\
                sep proximal sensing\sep dynamic\
                sep monitoring
24      \end{keyword}
```

Ending the Document (for now)

```
25 \end{frontmatter}

26 \end{document}
```

→ Compile the document and see the output!

Adding the abstract

Inside the `abstract` environment, add:

```
In perennial ryegrass breeding programs, dry matter yield (DMY) of
individual plots is monitored destructively at the different cuts or
derived from non-destructive canopy height measurements using devices
like rising plate meters (RPM). These approaches both have constraints.
Destructive sampling implies low temporal resolution, restraining the
study of dry matter accumulation rates, while RPM measurements are
influenced by the canopy structure and limit intra-field variability
identification. We present a phenotyping methodology, based on the use
of an affordable RGB camera mounted on an Unmanned Aerial Vehicle (UAV),
to monitor the spatial and temporal evolution of canopy height and to
estimate DMY. Weekly flights were carried out from April to October
above a field comprising a diverse set of accessions. To test the
capability of the model extracted from the data to estimate canopy height,
8 ground control points and 28 artificial height references were placed
at different locations. Accurate flights with an RMSE as low as 0.94 cm were
achieved. In addition, canopy height was recorded using an RPM and
destructive biomass samples were collected. Different models (linear,
multiple linear, principal components, partial least squares regression
and random forest) were used to predict DMY and their performance was
evaluated. The best estimations were obtained by combining variables
including canopy height, vegetation indices and environmental data in a
multiple linear regression (${R^2 = 0.81}$). All models built using UAV data
obtained a lower RMSE than the one using RPM data. The approach
presented is a possibility for breeders to incorporate new information
in their selection process.
```

Math in LaTeX

Inline math

Use `$ ... $` or `\( ... \)` for inline math

Formulas

Use the `equation` environment or `\[ ... \]` for formulas etc.

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Legacy code

Sometimes, you might see `$$ math $$`, which is old and *deprecated* code that should be avoided, but gives the same result (mostly).

Math in LaTeX

Inline math

Use `$ ... $` or `\( ... \)` for inline math

Formulas

Use the `equation` environment or `\[ ... \]` for formulas etc.

It's always a good idea to load the `amsmath` package.

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($R^2 = 0.81$) requires additional attention:

```
$R^2 = 0.81$
```

$R^2 = 0.81$

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($R^2 = 0.81$) requires additional attention:

```
$R^2 = 0.81$
```

$R^2 = 0.81$

But now the R is in italics...

```
$\text{R}^2 = 0.81$
```

$\text{R}^2 = 0.81$

Math in LaTeX

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Use the `equation` environment or `\[ ... \]` for formulas etc.

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($R^2 = 0.81$) requires additional attention:

```
$R^2 = 0.81$
```

$R^2 = 0.81$

But now the R is in italics...

```
$\text{R}^2 = 0.81$
```

$\text{R}^2 = 0.81$

There might still be a line break somewhere...

```
${\text{R}^2 = 0.81}$
```

${\text{R}^2 = 0.81}$

Some formatting issues

Abstract

In perennial ryegrass breeding programs, dry matter yield (DMY) of individual plots is monitored destructively at the different cuts or derived from non-destructive canopy height measurements using devices like rising plate meters (RPM). These approaches both have constraints. Destructive sampling implies low temporal resolution, restraining the study of dry matter accumulation rates, while RPM measurements are influenced by the canopy structure and limit intra-field variability identification. We present a phenotyping methodology, based on the use of an affordable RGB camera mounted on an Unmanned Aerial Vehicle (UAV), to monitor the spatial and temporal evolution of canopy height and to estimate DMY. Weekly flights were carried out from April to October above a field comprising a diverse set of accessions. To test the capability of the model extracted from the data to estimate canopy height, 8 ground control points and 28 artificial height references were placed at different locations. Accurate flights with an RMSE as low as 0.94 cm were achieved. In addition, canopy height was recorded using an RPM and destructive biomass samples were collected. Different models (linear, multiple linear, principal components, partial least squares regression and random forest) were used to predict DMY and their performance was evaluated. The best estimations were obtained by combining variables including canopy height, vegetation indices and environmental data in a multiple linear regression ($R^2 = 0.81$). All models built using UAV data obtained a lower RMSE than the one using RPM data. The approach presented is a possibility for breeders to incorporate new information in their selection process.

Keywords: Hyperspectral camera, phenotyping, proximal sensing, dynamic, monitoring

The Abstract – Potential Issues

```
8 ground
28 artificial
0.94 cm
```

The Abstract – Potential Issues

```
8 ground
28 artificial
0.94 cm
```

Non breaking space

Add a tilde (~) when you need a space, but do not want the line to break

The Abstract – Potential Issues

```
8 ground
28 artificial
0.94 cm
```

```
8~ground
28~artificial
0.94~cm
```

Non breaking space

Add a tilde (~) when you need a space, but do not want the line to break

Sections

```
\section{Materials and Methods}
\subsection{Data Sources}
\subsubsection{Handheld Camera}
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Non-numbered sections

Starred version: `\section*{Materials and Methods}`

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Starred version: `\section*{Materials and Methods}`

Labelling

Create a label to refer to this section in the text:

```
\label{materials-and-methods}
```

Sections

```
\section{Materials and Methods}
\subsection{Data Sources}
\subsubsection{Handheld Camera}
```

Non-numbered sections

Starred version: `\section*{Materials and Methods}`

Labelling

Create a label to refer to this section in the text:
`\label{materials-and-methods}`

Beware of special characters

Never use %, _ or spaces to label items. Use a dash or CamelCase to distinguish words. Sometimes it's useful to add a class: `\label{sec:materials-and-methods}`.

The introduction

Add the contents to the introduction and hit compile.

The introduction

Add the contents to the introduction and hit compile.

New Macros	
`\citep`	normal citation
`\citet`	inline citation
`\textit`	italics
`\textbf`	bold
`\textsubscript`	subscript
`\emph`	put the emphasis on this (usually in italics)

Citations: Workflow

Biber / biblatex

External programme that processes the citations in this document, based on `.bib`-file.

Citations: Workflow

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External programme that processes the citations in this document, based on `.bib`-file.

Workflow:

1. Create a database in Mendeley/Zotero with all your articles
2. Export database to `.bib`-file
3. Reference `.bib`-file in LaTeX
4. Add references to citations using e.g. `\cite`, `\citep`
5. Compile LaTeX document at least once
6. Run biber/biblatex
7. Compile LaTeX document at least once

Citations: Workflow

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External programme that processes the citations in this document, based on `.bib`-file.

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But.. Overleaf manages this for you!

Adding Citations

Default management

`\cite{key}` `\citet{key}` `\citep{key}`

Set the bibliography style

`\bibliographystyle{elsarticle-harv}` many styles are predefined

Load the `.bib`-file

`\bibliography{bibliography}` notice that the file extension is emitted!

Misc

This is the `natbib` workflow, `bibtex` and `biblatex` have a similar workflow.

Adding Materials and Methods

Let's increase the interactivity a bit.

Open the Word document next to the LaTeX document and we'll covert it ourselves.

Adding Figures

LaTeX uses floats

There is no direct relationship between figure location and placement in LaTeX, figures float around in the document and are optimally placed based on references and surrounding text.

```
\begin{figure}[ht]
    \centering
    \includegraphics[width=7.5cm]{media/image6.png}
    \caption{Pearson correlation map...}
    \label{fig:pearson-correlation-map}
\end{figure}
```

Referencing in the text

```
Fig.~\ref{fig:pearson-correlation-map}
```

Lengths in LaTeX

long name	LaTeX unit	description
centimetres	cm	the SI unit
millimetres	mm	the SI unit
inches	in	the empirical unit
point	pt	based on the font size
with of an *m*	em	advanced use
height of an *x*	ex	advanced use

Lengths in LaTeX

long name	LaTeX unit	description
centimetres	cm	the SI unit
millimetres	mm	the SI unit
inches	in	the empirical unit
point	pt	based on the font size
with of an *m*	em	advanced use
height of an *x*	ex	advanced use

But one can also use predefined lengths

macro	description
`\linewidth`	length of one line of text
`\textheight`	height of the text on a page
`\paperwidth`	width of the page
`\paperheight`	height of the page

Float placement in LaTeX

specifier	description
t	top
b	bottom
p	separate page
h	here
!	really here

Nicely formatted units in LaTeX

New package

`siunitx` is a page that can be used to format numbers and units.

$1.00\,\mathrm{m} \times 0.70\,\mathrm{m} \times 1.10\,\mathrm{m}$

```
\SI{1.00 x 0.70 x 1.10}{\metre}
$1.00 \text{m} \times 0.70 \text{m} \times
1.10 {m}$
```

11 °C and 33 °C

```
\SIlist{11;33}{\celsius}
$11^{\circ}\text{C}$ and $33^{\circ}\text{C}$
```

Adding Tables

```
\begin{table}[!ht]
    \centering
    \caption{Best MLR to predict DMY...}
    \label{tab:MLR}
    \begin{tabular}{lcr}
        a & b & c \\
    \end{tabular}
\end{table}
```

Column separator

& is used to go to the next column

Row separator

\\ is used to go to the next row

Table Options

specifier	description
l	align content to the left
c	centre content
r	align content to the right
|	vertical separator (do not use this!)
@{}	specify column separation (usually not needed, e.g. `\hskip 1cm`)

Newlines

`\\` is also used to force a line break. Use `\newline` instead in tables. The default table environment does *not* support automated line breaks. There are more capable ones though.

Defining New Commands

Typing the same long sequence over and over again can get tiring. LaTeX is expendable, so let's define a new command.

```
\usepackage{xparse}
\NewDocumentCommand{\Tair}{}{T\textsubscript{air}}
\NewDocumentCommand{\english}{m}{T\textit{#1}}
```

So much more...

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- Special packages for chemistry, linguistics, genetics

Questions and suggestions

Are there things that we did not cover but that you think are essential?