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THE PracTeX Journal



The online journal of the
TeX Users Group
ISSN 1556-6994

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Issue 2011, Number 1 [Published 2011-09-19]

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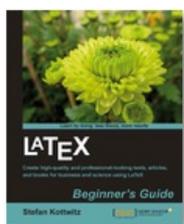
News from Around

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TeX and LaTeX blog



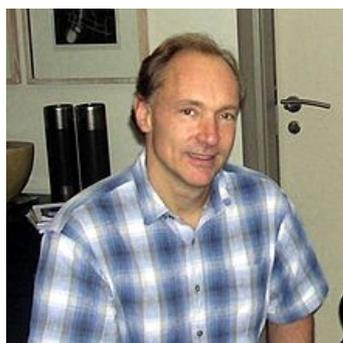
Stefan Kottwitz maintains a useful blog on [all things TeX and LaTeX](#). The material is useful for beginning users, and more advanced users as well. Kottwitz recently published a book, [LaTeX Beginner's Guide](#), a reference for beginners and all LaTeX users.

Typography video blog



This segment about a San Francisco artist who makes amazing hand-painted signs is from a [video blog](#) about fonts and typography.

Internet 20th Anniversary



It seems like the Net has been around forever, but it was only 20 years ago in August 1991 that [Tim Berners-Lee](#) put the first site online at CERN.

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Feedback from readers

Comments from Iwan Setyawan on [Scientific Presentations with LaTeX](#), Marius Hofert & Markus Kohm

Let me first acknowledge the following:

1. The article is very well written.
2. It inspires and instructs people to create presentation templates that are unique.
3. The example design presented is beautiful.

[Marius Hofert: *Thank you very much.*]

However, I have the following comments to make:

1. The authors wrote that using their approach frees one from having to learn another TeX presentation package. While this is true, learning such a package is much easier, in my opinion, than learning the code necessary to implement the authors' approach.

[Marius Hofert: *I tried to use Beamer twice (I also tried several other packages for presentations). I wasn't happy with the standard design, so I read the whole user guide to see how I could change the design. I still have these "trial" files ... the source code is very lengthy. After all this, I still couldn't do some of things I wanted, for example, easy copy-and-paste or to have the nice lists I normally use. I realized that with only a fraction of the code I could create a clean setup, using only the things I normally use in other LaTeX documents. By giving it the document class "article", I made sure I could work with the slides in the same way as any other article document. The same applies to posters which I create with this approach. I can't think of anything simpler.*]

2. The authors wrote that the slides can be designed to be unique, avoiding over-used templates. Again, this is true as evidenced by the beautiful example. But only for people with good design, programming, and typographical skills. Average users may only manage to create a messy layout. Furthermore, this may contradict the TeX credo of separating content and lay-out.

[Marius Hofert: *You are absolutely right. Actually, I don't think the example files we created are beautiful. If you read the text, they contain many of the things presenters often do wrong, for example using tiny labels for plots (or no labels). Our intention was to let the user know he should pay attention to these things. Also, the article provides references to books that deal with these issues. Note that the same things can go wrong in any other presentation package, for example, using no visible axis labels. Indeed, our approach is even more fail-safe in that we do not provide the user with features that can be over-used, such as several incremental displays on one slide. If he wants to use this feature he can, but he has to think about it first. If it's in a package, he just applies it without considering whether it's really necessary (and it almost never is if you think about it). One of the great presenters is Steve Jobs: look at how clean his slides are. His presentations are designed to sell products, and giving a scientific presentation should be equally clean and straightforward. Jobs has no incremental display of bullet points and no magically-appearing images, features that mostly distract the audience and don't help convey your message.*]

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Using LaTeX to produce multi-media clinical reports

Fabien Leboeuf

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Abstract: In this article we demonstrate the LaTeX techniques used to produce high-quality technical reports with multimedia features.

At our hospital, the analysis of biomechanical data is done by a multi-disciplinary team and involves a large amount of inter-related information in a variety of electronic formats. Therefore, it is essential that there be a user-friendly interface to present this data to the team for analysis.

In this context, LaTeX was used to create a comprehensive report, with all text, graphics, and video contained in a single PDF file. We have been using LaTeX to produce this report since 2006, and have received positive feedback from the hospital staff.

Fabien Leboeuf. Since receiving my Ph.D, I have been using LaTeX for all of my presentations and communications. I am a research engineer in Biomechanics in Nantes, France. My main activity is to carry out clinical gait or walking pattern analysis. You may reach me at <fabien dot leboeuf at gmail dot com>.

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Using L_AT_EX to produce multi-media clinical reports

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1 Introduction

Gait analysis is a standardized clinical examination that arose from biomechanical research. The aim of this examination is to identify the dysfunctions in pathological gaits in order to propose an optimized therapeutic treatment.

The clinical interest of gait analysis is well established [5]. De Luca [2] demonstrated that this examination influences the surgical decisions. [3] showed the critical role of gait analysis in the treatment of gait problems in cerebral palsy. This examination allows the correction of all gait alteration in one operation session, reducing the number of operations and their psychological impacts. However, the clinical interpretation remains a difficult task. Some authors ([6], [4]) have noted the variability of interpretation between clinicians. Therapeutic conclusions may be different because the multidisplinary team involved in the interpretation process has to deal with a large amount of inter-related multimodal information concerning a complex task: walking. A user-friendly data presentation interface is critical to supporting this interpretation process. Commercial software applications sold with movement acquisition systems focus on multimedia and multimodal rendering. The 3-D animation of the movement and the graphic interactivity with the videos were favored. A CD is the main information medium. It contains different multimedia files (**.c3d*, **.avi*, **.pdf*). Therefore, it appears difficult to use network software, such as *Clinicom* (Siemens), supplied by the hospital to collect and share medical information amongst its staff.

In this context, L_AT_EX seems to be an interesting alternative. The information flow inherited from the clinical gait examination can be merged into a unique document: a

portable document file (*PDF*). Using this method, data access is improved and clinical interpretation is facilitated.

Since April 2006, technical reports of gait analysis have been produced through L^AT_EX at our hospital, St Jacques Hospital, Nantes, France. The positive feedback of the hospital staff, combined with Thompsons articles ([7] and [8]) about the application of L^AT_EX for clinical trials, have motivated us to write this article. Our goal is to demonstrate that L^AT_EX is suitable for clinical examination which includes large amounts of information, such as a gait analysis. Simple L^AT_EX codes will be proposed for common usage, and specific packages will be highlighted, that produce a high-quality technical gait report with embedded multimedia features.

2 Measurement and progress of a clinical gait analysis

Normal gait is a cyclic movement. Stance phases alternate with swing phases which result in a forward progression of the center of mass. Biomechanical data is commonly normalized and represented as a percentage of the gait cycle.

Two levels of analysis are investigated during the examination. The first, a *qualitative* analysis, is carried out with high-frequency cameras to record spontaneous gait videos. They are essential in assessing the functional ability of the patient.

The second, a *quantitative* analysis, is performed with a 3-D acquisition system. Most laboratories use infra-red cameras to locate external markers placed on anatomical points. In conjunction with cameras, force plates and electromyographic devices are used to respectively measure the reaction forces during stance phases and muscular activity. All measurements become the input data of a model from which biomechanical parameters are computed. For clinical gait analysis, the main biomechanical parameters are the following:

- *Spatio-Temporal Parameters* (STP) provide global indications (for example: gait speed, stride length, duration of each gait phases, . . .)
- *Kinematic parameters* represent the 3-D joint rotations.
- *Kinetic parameters* represent the joint forces involved in producing the movement. Their computation is achieved on the condition that stance phases are performed on the force plates.
- *Muscular parameters* represent the on-off activity of each muscle.

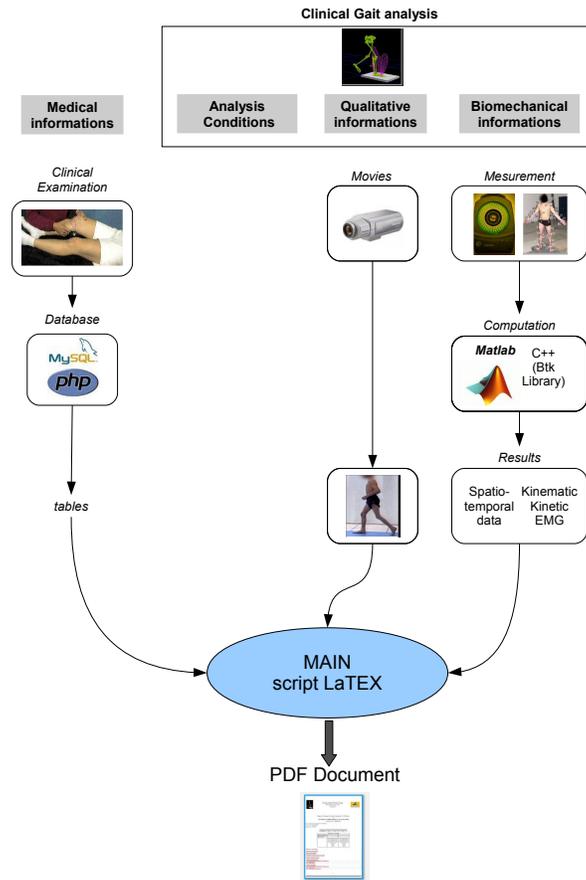


Figure 1: Representation of the information flow inherited in a clinical gait examination

An all-comprehensive gait analysis doesn't deal with biomechanical data solely. Clinicians have to relate them to their medical knowledge to answer the medical question. That is why a gait examination necessarily includes a standardized testing of lower-limb-range of motion [9]. This testing is especially important because it allows better communication between clinicians.

3 The information flow of a clinical gait examination

Figure 1 presents the information flow of a clinical gait examination.

Data set 1 - medical data

The use of $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ for producing a technical gait report has initially been motivated by the need to provide medical information for a database. Software such as Access (Microsoft) or FileMaker (FileMaker Inc.) are perfectly suitable for database work. Nevertheless, we have chosen the programming languages PHP/SQL because $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ can interface with it.

The solution consists in working with the PHP interface: PhpMyAdmin (see figure 3). The results of a SQL request can be exported as a tabular table. This solution is useful for specific SQL requests.

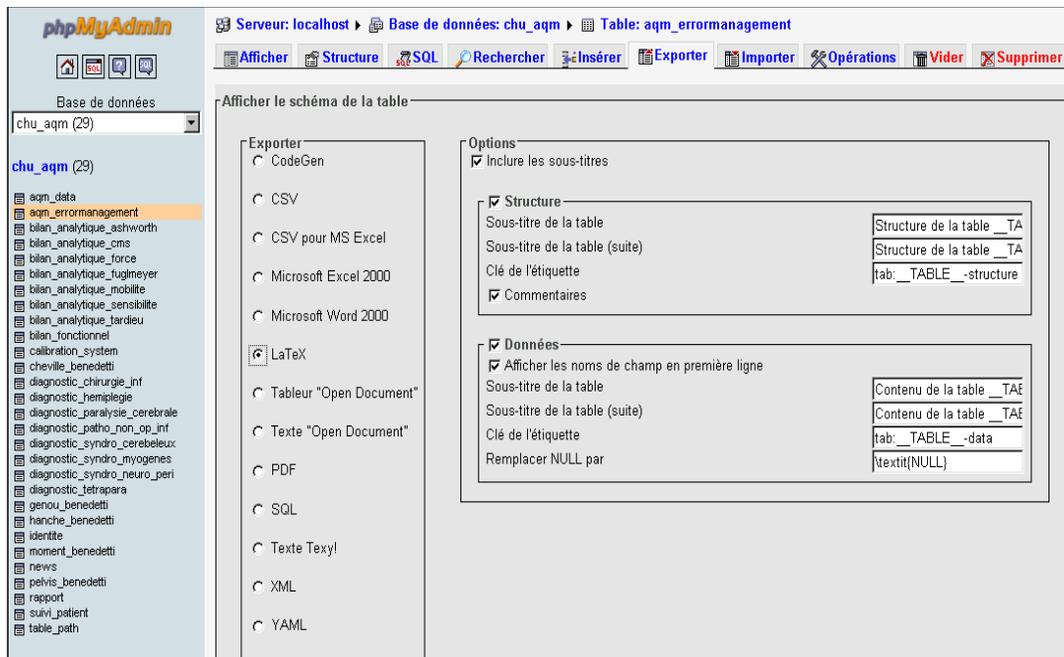


Figure 2: PhpMyAdmin interface for transferring data into a $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ file

When SQL requests are frequent, an automatic process consisting of generating a (*.tex) file from PHP code is used. For example, consider the following SQL table which includes:

- INP: Identification Number of the Patient (INP) (primary Key of the SQL table)

- Date: Examination date
- Field1: (example: passive flexion of the left knee)
- Field2: (example: Ashworth scale of the muscle: tibialis anterior)

The code block 1 shows how to transfer into a L^AT_EX table all fields corresponding to a particular patient (in this case INP=14):

```

1  $sqlrequest = mysql_query("SELECT Date, Field1 ,Field2,
2                                FROM table WHERE INP=14");
3
4  $i=0;
5  $texFile = fopen('file.tex', 'w+');
6  fputs($texFile, "\begin{supertabular}{|c| *{3}{|p{2cm}}|}." "\n");
7  fputs($texFile, "\hline"." "\n");
8  fputs($texFile, "Date & Field1 & Field2 \\\ \hline"." "\n" );
9  fputs($texFile, " & G & D & G & D \\\ \hline"." "\n" );
10 while ($d=mysql_fetch_object($sqlrequest))
11     {
12         $i++;
13         fputs($texFile,$i." & ". $d->Date." & ". $d->Field1." & ". $d->Field2." \\\ \hline"." "\n" );
14     }
15 fputs($texFile, "\end{supertabular}");
    fclose($texFile);

```

Code Block 1: PHP code to export SQL request in a L^AT_EX table

The L^AT_EX package `supertabular` was chosen because it can accommodate the large amount of data which may be returned by the SQL request.

We have implemented this PHP code to collect medical information. Clinicians fill in medical forms using a web page that contains this PHP code. When the form is completed, an SQL database archives the information. Just before doing the L^AT_EX formatting, we create two **.tex* files from the database:

DiagnosisElement.tex, a table recalling the patient diagnosis and his therapeutic treatments.

ClinicalTesting.tex, a table listing values of the clinical testing.

The result is a comprehensive PDF report of the examination. This way, clinicians can easily access medical information useful to the clinical interpretation of biomechanical data. The report is complete and no browsing of online file folders for graphical data is required.

Data set 2 - biomechanical data

Biomechanical data come from the computational analysis of the 3-D measurements, using specific libraries or numerical software (*Scilab*, *Matlab (The MathWorks, Inc.)*, *Btk ([1])*). Data presentation consists of plotting curves and histograms. Their clarity is essential for accurate interpretation by clinicians. To that end, numerical software, like *Matlab (The MathWorks, Inc.)*, allows exporting plots to PDF files. The package `pdfpages` is then used to insert the PDF pages into the final report.

Even though the package `pdfpages` provides a workable solution, we would like to highlight the use of the package `pgfplot`. Indeed, it is a recent package that allows drawing of high quality plots directly in $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ scripts. For our technical gait report, this package was used for plotting kinematic, kinetic, and muscular curves and the STP histograms (see figure 3).

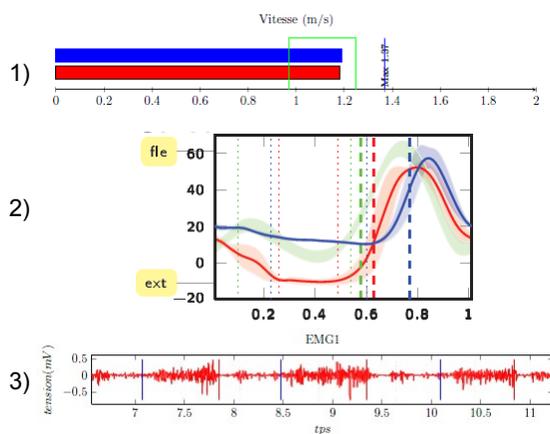


Figure 3: Pgfplot examples. 1) SPT: Gait speed, 2) Kinematic: Knee Flexion, 3) Muscular activity

The external library `clickable` associated with the package `pgfplot` activates the plots. The point coordinates can be displayed. Thanks to the `clickable` library, clinicians can, for example, display the maximal knee flexion value.

The code block [2] contains the commands to plot the gait speed histogram (see figure 3-1). Values of the left- and right-cycle gait speed are inserted at lines 3-4; 7-8.

```
1 % Gait speeds of our patient
2 %-----
3 \newcommand{\Rspeed}{1.39} % right gait cycle
4 \newcommand{\Lspeed}{1.36} % left gait cycle
```

```

5 % Gait speed bounds of our healthy database
6 %-----
7 \newcommand{\NormalSpeedMax}{1.25}
8 \newcommand{\NormalSpeedMin}{0.97}
9
10 \pgfplotsset{width=15cm, height=3cm, compat=newest}
11 \begin{tikzpicture}
12   \begin{axis}[cycle list={{blue,fill=blue},{black,fill=red},{green},{red},{blue}},
13     ymin=0.5,ymax=2,xmin=0,xmax=2,
14     hide y axis,axis x line=bottom,
15     title=Vitesse (m/s)]
16     \addplot+[xbar] coordinates
17       {(\Rspeed, 1.5)};
18     \addplot+[xbar] coordinates
19       {(\Lspeed, 1)};
20     \addplot coordinates
21       {(\NormalSpeedMax, 0) (\NormalSpeedMax,2)
22        (\NormalSpeedMax, 2) (\NormalSpeedMin,2)
23        (\NormalSpeedMin, 2) (\NormalSpeedMin,0) };
24   \end{axis}
25 \end{tikzpicture}

```

Code Block 2: Code for producing a gait speed histogram as figure 3-1

The `pgfplot` manual shows a rich set of plotting techniques. Reading coordinates provided by an external file is useful. For gait analysis, kinematic and kinetic data have to be compared to normal gait. Data dispersion is typically quantified by the standard deviation. As an example, table 1 explains the organization of the external file (*datafile.dat*) associated with the knee flexion-extension.

Columns 6 and 7 are devoted to our healthy gait database.

Table 1: Organization of the external file (datafile.dat) for the knee flexion-extension

Column 1	Cycle percentage
Column 2	Left flexion-extension <i>mean subtracted from its standard Deviation</i>
Column 3	The double of the left flexion-extension <i>standard deviation</i>
Column 4	Right flexion-extension <i>mean subtracted from its standard Deviation</i>
Column 5	The double of the right flexion-extension <i>standard deviation</i>
Column 6	Healthy flexion-extension <i>mean subtracted from its standard Deviation</i>
Column 7	The double of the healthy flexion-extension <i>standard deviation</i>
Column 8	Left <i>mean</i> flexion-extension
Column 9	Right <i>mean</i> flexion-extension

In spite of a large panel of plots, `pgfplot` cannot fill the surface bounded by two curves. A solution explained in the code block [3] consists in handling the area plot mode.

First, a white area plot corresponds to the mean value subtracted from its standard deviation (see table 1 [Columns 2;4;6]).The double of standard deviation is then stacked to represent the area dispersion (see table 1 [Columns 3;5;7]).

```

1 \pgfplotstableread{datafile.dat}
2 \begin{tikzpicture}
3   \tikzset{
4     every pin/.style={fill=yellow!50!white,rectangle,rounded corners=3pt,font=\tiny},
5     small dot/.style={fill=black,circle,scale=0.01}
6   }
7 \pgfplotsset{every axis/.append style={font=\tiny, xmin=0.01, xmax=1.01}}
8 %--standard deviation area plot of the Left knee flexion-extension--%
9 %-----%
10 \begin{axis}[enlarge x limits=false,stack plots=y,area style,
11   height=0.4\paperheight,
12   width=0.4\paperwidth,
13   ymin=-20.00,
14   ymax= 70.00,
15   clip=false]
16   \node[small dot,pin=180:{fle}] at (axis description cs:0,0.9){};
17   \node[small dot,pin=180:{ext}] at (axis description cs:0,0.1){};
18   \addplot[color=red!10!white,ultra thin, fill=white, fill opacity=0.2]
19     table[x index=0, y index=1] {datafile.dat};
20   \addplot[color=red!10!white, ultra thin, fill=red, fill opacity=0.2]
21     table[x index=0, y index=2] {datafile.dat} \closedcycle;
22 \end{axis}
23 %--standard deviation area plot of the Right knee flexion-extension--%
24 %-----%
25 \begin{axis}[enlarge x limits=false,stack plots=y,area style,
26   height=0.4\paperheight,
27   width=0.4\paperwidth,
28   ymin=-20.00,
29   ymax= 70.00 ]
30   \addplot[color=blue!10!white,ultra thin, fill=white, fill opacity=0.2]
31     table[x index=0, y index=3] {datafile.dat};
32   \addplot[color=blue!10!white, ultra thin, fill=blue, fill opacity=0.2]
33     table[x index=0, y index=4] {datafile.dat} \closedcycle;
34 \end{axis}
35 %--standard deviation area plot of the healthy knee flexion-extension --%
36 %-----%
37 \begin{axis}[enlarge x limits=false,stack plots=y,area style,
38   height=0.4\paperheight,
39   width=0.4\paperwidth,
40   ymin=-20.00,
41   ymax= 70.00]
42   \addplot[color=green!10!white, ultra thin, fill=white, fill opacity=0.2]
43     table[x index=0, y index=5] {datafile.dat};;
44   \addplot[color=green!10!white,ultra thin, fill=green, fill opacity=0.2]
45     table[x index=0, y index=6] {datafile.dat} \closedcycle;
46 \end{axis}
47 %--Mean curve of the Left knee flexion-extension--%
48 %-----%
49 \begin{axis}[enlarge x limits=false, thick,
50   height=0.4\paperheight,
51   width=0.4\paperwidth,
52   ymin=-20.00,
53   ymax= 70.00]
54   \addplot[red] table[x index=0, y index=7] {datafile.dat};
55 \end{axis}
56 %--Mean curve of the Right knee flexion-extension--%
57 %-----%
58 \begin{axis}[enlarge x limits=false, thick,
59   height=0.4\paperheight,
60   width=0.4\paperwidth,
61   ymin=-20.00,
62   ymax= 70.00]
63   \addplot[blue] table[x index=0, y index=5] {datafile.dat};
64 \end{axis}
65 \end{tikzpicture}

```

Code Block 3: Code for producing area plots of the kinematic (or kinetic) data.

Data set 3 - videos

Videos are essentials for gait analysis. They are the first media interpreted by clinicians. Videos are part of a qualitative analysis, and allow observation of the body type and pathological dysfunctions (e.g. patella dysfunction) which a 3-D system cannot measure.

L^AT_EX is well-suited to media inclusion thanks to the package `movie15`. This package, restricted to Adobe Reader, embeds videos. Videos are played either with the Adobe built-in player or with an external application.

The code block 4 illustrates how to embed a video. All options are explained in the `movie15` manual. However, we underline the usefulness of the three buttons (lines 11 to 13) added to adjust the video rate. Such buttons are valuable for clinicians when an abnormal movement occurs at a specific time.

```
1 \begin{center}
2   \includemovie[text={Click to activate the video},
3     label=videol,autoplay,
4       palindrome=true, toolbar,
5         repeat,continue,
6           mouse,
7             mimetype=video/avi]
8           {.5\linewidth}{.375\linewidth}{videol.avi}\\
9   \vspace{0.3cm}
10  Choose the video rate :\\
11  \movieref[default]{videol}{Normal}
12  \movieref[rate=0.5]{videol}{Slow}
13  \movieref[rate=0.1]{videol}{Very slow}\\
14  \movieref[pause]{videol}{Play/Pause}
15 \end{center}
```

Code Block 4: Code for embedding video file

Data set 4 - examination context

A gait examination may be carried out in different contexts. A standard environment considers that gait analysis was performed barefoot and without external aids. However, crutches or other assistance may be required. All of these elements influence the clinical interpretation, and must be presented on the title page of the technical gait report. To this end, we used a simple process: a `*.tex` file is created that contains a set of L^AT_EX commands that explain the examination context.

The code block 5 presents a minimal `\newcommand` list for describing the examination context. These commands are included in the title page, for example

Gait examination report for: \Title{} \PatientLastName{},
\PatientFirstName.

```
1 \newcommand{\INP}{00} % identification number
2 \newcommand{\PatientLastName}{LEBOEUF}
3 \newcommand{\PatientFirstName}{Fabien}
4 \newcommand{\Gender}{M}
5 \newcommand{\Title}{Mr}
6 \newcommand{\BirthDate}{09/06/1997}
7 \newcommand{\Physician}{Dr ?} % Physician who called the gait examination
8 \newcommand{\ExaminationDate}{20/10/2010}
9 \newcommand{\GaitSpeed}{spontaneous gait}
10 \newcommand{\ClinicalContext}{post-operation}
11 \newcommand{\Shoes}{No}
12 \newcommand{\ProthesisOrthesis}{No}
13 \newcommand{\ExternalHelp}{No}
```

Code Block 5: minimal newcommand list for presenting the examination context

4 The main L^AT_EX script

The main L^AT_EX script (block code 6) includes block codes previously presented:

pst.tex: see code block 2

Kinematic.tex or *Kinetic.tex*: see code block 3

video.tex: see code block 4

title.tex: see code block 5

DiagnosticElement.tex: see section 3

ClinicalTesting.tex: see section 3

The report compilation is done with pdfL^AT_EX.

```
1 %-----Required Packages-----
2 \usepackage{pgfplots}
3 \usepgfplotslibrary{clickable}
4 \usepackage[francais]{babel}
5 \usepackage[latin1]{inputenc}
6 \usepackage{amsmath}
7 \usepackage{amsfonts}
8 \usepackage{amssymb}
9 \usepackage{graphicx}
10 \usepackage{movie15}
11 \usepackage[pdftex]{hyperref}
12 \usepackage[final]{pdfpages}
13 \usepackage{supertabular}
14 \usepackage{ifthen}
15 \usepackage{tabular}
16 %-----Newcommand -----
```

```

17 \input{title.tex}
18 %-- Kinetic choice
19 \def\Cinétique{0}
20 %-----Title page-----
21 \begin{document}
22 \parbox{3cm}{\includegraphics[scale=0.8]{logoLaM1ext.pdf}}
23 \parbox{13cm}
24 {
25   \centering
26   \noindent Laboratory Address
27 }
28
29 \begin{center}
30   \Large{ Technical gait report \ of \ }
31   \textbf{\ PatientFirstName{} \ PatientLastName{} (nIf; le \ BirthDate)} \ \ } %
32   Identification: \IPP
33 \end{center}
34 \noindent \emph{Tif;che}: \tache \CommTache \ \
35 \emph{Clinical Context}: \ClinicalContext \ \
36 \emph{Examination Date}: \ExaminationDate \ \
37 \emph{Called by}: \Physician \ \
38 \begin{center}
39   Data acquisition context :\ \
40   \begin{tabular}{|c|c|c|}
41     \hline \textbf{Shoes} & \textbf{Orthesis-Prothesis} & \textbf{external help} \ \
42     \hline \Shoes & \ProthesisOrthesis & \Externalhelp \ \
43     \hline
44   \end{tabular}
45 \end{center}
46 \newpage
47 %-----Medical information-----
48 \section{Medical information}
49   \input{DiagnosticElement.tex}
50   \input{ClinicalTesting.tex}
51 \newpage
52 %-----Videos-----
53 \section{Videos}
54   \input{Movie.tex}
55 \newpage
56
57 %-----biomechanical data-----
58 \section{Biomechanical data}
59   \subsection{Spatio-temporal parameters}
60     \input{Pst.tex}
61   \subsection{Kinematic charts}
62     \input{Kinematic.tex}
63   \ifthenelse{\Cinétique=1}
64     {\subsection{Kinetic charts}
65       \input{Kinetic.tex}
66     }
67     {No Kinetic charts available}
68 \end{document}

```

Code Block 6: Main tex code

It is worth noting the use of the package `ifthen` for automating the report. The command `\ifthenelse` will include kinetic data *Kinetic.tex* in the report only if it is available (line 19).

5 Conclusions and possible improvements

In this article, we have shown that L^AT_EX is well-suited to producing technical gait analysis reports. L^AT_EX differs from commercial software in its capacity to handle and centralize information flow. Indeed, a gait examination results in a large amount of information, and producing a single document containing everything improves data access and consequently facilitates the clinical interpretation.

An isolated presentation of biomechanical data is not sufficient for clinicians. We have shown the variety of techniques used to create a single clinical document. A L^AT_EX database interface was used to include external information. We used web-based PHP solutions to collect data into a SQL database. Finally, we used a variety of L^AT_EX packages and files to complete the single-document solution.

Improvements. Our SQL database records each gait analysis episode in order to recall the diagnosis and previous data (SPT and clinical testing) of the clinicians into the technical report. An improvement would be to eliminate the PHP script and instead use packages such as `sqltex` or `LaTeXdb`. The database access and SQL requests would be directly implemented within a *.tex* file. This would achieve two efficiencies: the report automation would be improved, and it would be faster to execute a specific SQL request.

In our opinion, the merger of biomechanical and medical information is a first solution to reduce the variability of clinical gait interpretations highlighted by some authors ([6], [4]).

Moreover, L^AT_EX facilitates the spread of useful information, especially in a local hospital where hard copy is widely used. The L^AT_EX PDF output allows printing of a high-quality document. The package `pgfplot` contributes by drawing high-quality vector graphics. The output quality is an element which is worth considering, because a high-quality document will be more readily used.

Nevertheless, currently the paper patient folder has been replaced by a medical e-folder. Our technical report is well-suitable for this framework since the PDF output can be viewed online. The use of the packages `movie15` and `pgfplot` associated with *javascript* plug-ins improve the PDF interactivity. `Movie15` embeds all types of multimedia files without the need to browse online file folders, and can play view videos simultaneously.

Furthermore, `Movie15` enables the inclusion of 3-D objects, such as graphics provided by medical imaging devices. As an example, figure 4 shows a 3-D view of an humerus. This kind of information is of great interest for clinical gait interpretation, and is used to analyze patients that have orthopaedic surgeries.

However, the multimedia performance of commercial software is not yet completely sufficient for clinical analysis. For example, our reports do not include 3-D animation of gait. A future enhancement might be performed with *javascript* plug-ins.

u3D model, Click to active mimetype

Figure 4: 3-D Humerus representation included with the package `movie15`

In our hospital environment, the technical gait reports received positive feedback. Clinicians appreciated getting information in one document, as did the IT department, because the PDF is suitable for data protection and medical e-folder development.

In conclusion, hospitals could benefit greatly from high-quality reports generated in part by \LaTeX . Solutions presented in this article show \LaTeX 's relevance to clinical gait examination reports. The use of \LaTeX to combine text, graphics, and 3-D visualization and animation would make it a promising tool for other medical examinations where data fusion is required.

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Integrating LaTeX and Moodle Questionnaires

L. Garcia-Forte
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C. Rodriguez-Leon

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Abstract: The manufacturing of teaching material conveys the generation of both static (unreactive) data-documents and dynamic (reactive) program-documents based on different technologies. Teaching a subject often implies the maintenance of a large number of both types of documents, usually written in a variety of languages and stored in different formats. Ergo a natural goal for the lecturer is to minimize the amount of work invested during the development and maintenance of the material. There are acceptable solutions regarding the transformation between formats with the same kind of reactivity. This work discusses the problem of integrating Moodle (a Open Source Learning Management System) and LaTeX (a Document Preparation System), proposes a methodology to pursuit this goal and presents a tool to assist in the translation of Moodle Quiz documents to LaTeX.

Resumen: La producción de material para la enseñanza conlleva la generación de documentos tanto estáticos (documentos no-reactivos) como dinámicos (documentos reactivos) basados en diferentes tecnologías. La enseñanza de una asignatura a menudo implica el mantenimiento de un gran número de los dos tipos de documentos, habitualmente escritos en diferentes lenguajes y almacenados en diferentes formatos. En consecuencia, un objetivo natural para el profesor es minimizar la cantidad de trabajo invertida durante el desarrollo y mantenimiento del material. Existen soluciones satisfactorias en lo que se refiere a la transformación entre formatos con el mismo tipo de reactividad. Este trabajo trata el problema de integrar Moodle (un Sistema Gestor de Enseñanza de Código Abierto) y LaTeX (un Sistema de Preparación de Documentos), propone una metodología para conseguir este objetivo y presenta una herramienta que ayuda en la traducción de cuestionarios Moodle a LaTeX.

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Integrating LaTeX and Moodle Questionnaires

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Abstract The manufacturing of teaching material conveys the generation of both static (unreactive) data-documents and dynamic (reactive) program-documents based on different technologies. Teaching a subject often implies the maintenance of a large number of both types of documents, usually written in a variety of languages and stored in different formats. Ergo a natural goal for the lecturer is to minimize the amount of work invested during the development and maintenance of the material. There are acceptable solutions regarding the transformation between formats with the same kind of reactivity. This work discusses the problem of integrating Moodle (a Open Source Learning Management System) and LaTeX (a document preparation system), proposes a methodology to pursuit this goal and presents a tool to assist in the translation of Moodle Quiz documents to LaTeX.

1 Introduction

Like the majority of university people working inside the scientific/mathematic scope, our usual environment for the development of documents is LaTeX. This is a formidable mark-up language based on TeX. TeX was designed by Donald Knuth and is firmly settled among the scientific community. The principal difference between LaTeX and other programs like Word is that LaTeX is a *document processor* rather than a *document editor*. A LaTeX document must be compiled with a LaTeX compiler to produce the target format. The LaTeX family of tools is remarkable efficient for the preparation of scientific and technical documents. Consequently, it is by using these tools that we generate the non reactive documents for the students. A large number of editors have developed their own

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\LaTeX styles for the publication of journals and books. With \LaTeX any kind of document like books, articles, reports and slides combining text, equations, tables, figures, graphics, bibliography, etc. can be prepared. From a \LaTeX document, it is straightforward to generate files in various formats, for example, \DVI , Postscript, \PDF , \HTML , etc., using the proper translators \LaTeX , \dvips , \pdflatex , \latex2html , etc. respectively [1].

However, the trend during the recent years is to add to the traditional and efficient chalk-blackboard approach the use of software tools for the publication of notes, exercises, exams, slides, transparencies, etc. The general direction is to move towards software environments and tools giving support, promoting and easing a bidirectional communication among all the participants, in which students have more opportunities to be active. From this perspective, we can differentiate between reactive and unreactive documents. The manufacturing of teaching materials conveys the generation of passive, unreactive data-documents, in passive unreactive formats: \LaTeX , Postscript, \.doc , \PDF , \HTML , \XML , \gift , \png , \eps , etc. It also implies the production of active, reactive program-documents based on different technologies: Java, \PHP , \CGI , \HTML+JavaScript , Perl, Python, MySQL, PostGres, etc. These tools - being generic - are not appropriate for their direct use inside the education process. New teaching high-level languages and tools are required. Tools like Moodle [2, 3, 4] or ATutor [5] provide forums, chats, user management (differentiating between students and lecturers), work groups, workshops, interactive exercises, polls, calendars, tasks, etc. The interaction is not restricted to the student-lecturer relation but it also facilitates the opportunities for interaction among the students. Moodle is a course management system. Its name stands for Modular Object Oriented Dynamic Learning Environment. It is a free, Open Source software package designed to help educators create effective online learning communities. The underlying philosophy behind Moodle is that learning is a process strongly bounded to our experiences and that learning occurs particularly well when working in a collaborative environment.

The creation of both reactive and unreactive documents associated with the teaching of some subject includes the maintenance of a large number of files written in a variety of languages and perhaps stored in different formats. It is obvious that we, lecturers, want to minimize the amount of work invested during the development and maintenance of the material. The usual strategy that we all follow is to keep a reduced set of source documents, preferably written in

a reduced number of languages, and to rely on software tools to generate all the target formats. There are acceptable solutions regarding the transformation between unreactive formats: It is enough proof to remember the innumerable family of xxx2yyy format translators of which L^AT_EX2HTML is a good example. Also, most Open Source Learning Management Systems - like Moodle - give satisfactory support for translations between reactive formats.

This work discusses the problem of integrating Moodle Quiz module and L^AT_EX, examines the existent solutions, proposes a methodology to pursuit this goal and presents a tool to assist in the translation of exercise sheets as a small step towards lecturers chimerical search for document singleness.

The contents of this contribution are organized as follows: The next section presents the methodology we currently use to integrate L^AT_EX and Moodle documents. The third section describes the use of a translator from GIFT - one of the Moodle formats for the representation of exercises - to L^AT_EX which substantiates some facets of our proposal. The last section attempts to summarize our conclusions and foresees our future works in this direction.

2 Preparing and Maintaining Questionnaires

Moodle has been adopted by our “Escuela Técnica Superior de Ingeniería Informática de la Universidad de La Laguna”, the place where we teach [6] subjects like Compilers, Programming, OOP, Parallel Programming, etc. Therefore, we had to migrate and integrate the existing material to the new platform. The part requiring major effort was the preparation of questionnaires and problem sheets (See Figure 1). It was necessary to export, translate and import the interactive questionnaires to have both reactive and unreactive versions of them.

A warning about the use of electronic questionnaires. When dealing with the evaluation of our students we usually differentiate between two kinds of evaluation:

- Additive Evaluation: The information is used to grade and credit the student certifying the level of competence reached.
- Formative Evaluation: the information is used to guide and improve the learning process

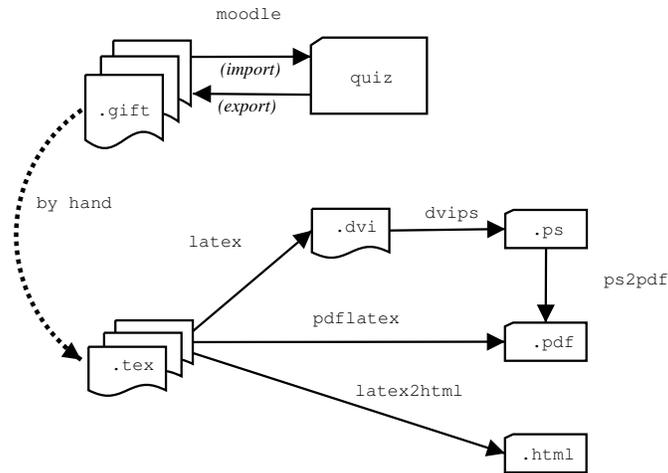


Figure 1: Scheme of the methodology for the document generation

The most important attribute of the Formative Evaluation is its capacity to provide timely information even if not as accurately as we can expect for Additive Evaluation. It is for this purpose that the use of electronic questionnaires and multiple-choice type exams is valuable.

To better illustrate the methodology for the preparation of documents, let us consider the make up of an exercise sheet for autoevaluation.

Step 1. Preparing the Quiz

The easiest way to write a questionnaire is to take advantage of the Moodle interface for building questionnaires. That is straightforward to use, but, depending on the circumstances, it can be unbearably slow. After filling the corresponding forms you can export the questionnaire to GIFT format.

According to the Moodle manual, GIFT is the most comprehensive import / export format available for importing quiz questions from/to a text file. It supports Multiple-Choice, True-False, Short Answer, Matching and Numerical questions. Various question-types can be mixed in a single text file, and the format also supports line comments, question names, feedback for the student and percentage-weight grades.

To export the questionnaire, select “Questionnaire”. Once in the edition window, choose the option “Export questions to file” . That will open a new window. Choose the format and the name of the file. By default the file is stored in the server inside the course subdirectory questionnaire.

```

1 // question: 401 name: FIRST
2 ::FIRST::[html]Given a <i>grammar</i>
3 $$$G\=(\Sigma,V,P,S)$$$ and a
4 <i>production</i> $$$A \rightarrow \alpha$$$
5 it holds that
6 $$$FIRST(\alpha) \neq \emptyset$$$ implies
7 $$$A$$$ is annihilable?{FALSE}
8
9 // question: 402 name: accesing
10 ::accesing::[html]A multidimensional array in C
11 is simulated defining 1 dimensional arrays
12 whose elements are arrays. To compute the
13 relative position of one element
14 $$$a[i_1, i_2, \dots, i_k]$$$
15 the following formula is applied:{
16 =$$$ (i_k + D_k(\dots (i_2 + i_1 * D_2 \dots)) * size +
17   base - (L_k + D_k(\dots L_2 + L_1 * D_2 \dots)) * size$$$
18 ~$$$ (i_k + D_k(\dots (i_3 + (i_2 + i_1 * D_2) * D_3)
19   \dots)) * size + base$$$
20 ~None of them
21 }

```

Figure 2: GIFT file generated by Moodle from a Quiz

Figure 2 shows the result. We’ll keep working with this example along this article. Observe that questions are delimited by a double carriage-return. The first question (lines 1-7) is an example of a TRUE-FALSE question. Each question is divided into three sections: The statement prefix, the answer section bounded by the pair of non escaped curly brackets and the statement postfix. Comments, like the one in line 1, start with two slashes and expand to the end of the line. The prefix occupies lines from 2 to 7. The text between pairs of colons is the question identifier. Next, between brackets comes the format used for this question. These two fields are optional. The source format in the example is HTML expanded with T_EX. This is achieved through the T_EX filter MimeTeX. The MimeTeX filter

extends Moodle with the capacity of managing $\text{T}_\text{E}\text{X}$ formulas ([7, 8]). MimeTeX is always in math-like mode. Any text between $\text{\$}\text{\$}$ delimiters is interpreted by Moodle as a math formula and sent to the filter which renders the corresponding image. It may optionally start with the name of the question enclosed by a pair of colons and the format (HTML, PLAIN, etc.). When the $\text{T}_\text{E}\text{X}$ filter is installed the text is a combination of HTML and $\text{L}_\text{A}\text{T}_\text{E}\text{X}$. The correct answer appears between braces in line 7. $\text{L}_\text{A}\text{T}_\text{E}\text{X}$ formulas can also be used in this section. Lines 9-21 present a MULTIPLE-OPTION question. The correct answer is prefixed by the symbol “=” while wrong answers have a “~” at the beginning.

```

Given a grammar
 $\text{\$}\text{\$}G = (\Sigma, V, P, S)\text{\$}\text{\$}$ 
and a production
 $\text{\$}\text{\$}A \rightarrow \alpha\text{\$}\text{\$}$ 
does  $\text{\$}\text{\$}\text{FIRST}(\alpha) = \emptyset\text{\$}\text{\$}$ 
implies  $\text{\$}\text{\$}A\text{\$}\text{\$}$  is annihilable? $\{\text{FALSE}\}$ 

A multidimensional array in C
is simulated defining 1-dimensional arrays
whose elements are arrays. To compute the
relative position of one element
 $\text{\$}\text{\$}a[i_1, i_2, \dots, i_k]\text{\$}\text{\$}$ 
the following formula is applied:
{
=  $\text{\$}\text{\$}(i_k + D_k(\dots (i_2 + i_1 * D_2 \dots)) * \text{size} +$ 
base -  $(L_k + D_k(\dots L_2 + L_1 * D_2 \dots)) * \text{size}\text{\$}\text{\$}$ 
~  $\text{\$}\text{\$}(i_k + D_k(\dots (i_3 + (i_2 + i_1 * D_2) * D_3)$ 
...)) * size + base $\text{\$}\text{\$}$ 
~None of them
}

```

Figure 3: GIFT file. “Human Informal Style”

An alternative and faster way to the Moodle interface is to directly write the GIFT with your document favourite editor. This approach makes easier the recycling of existing $\text{L}_\text{A}\text{T}_\text{E}\text{X}$ and HTML material and may be automatized through somewhat ad-hoc scripts. It also allows for a more “relaxed” and human readable GIFT files.

Figure 3 shows a typical “human edited” version of the example in Figure 2.

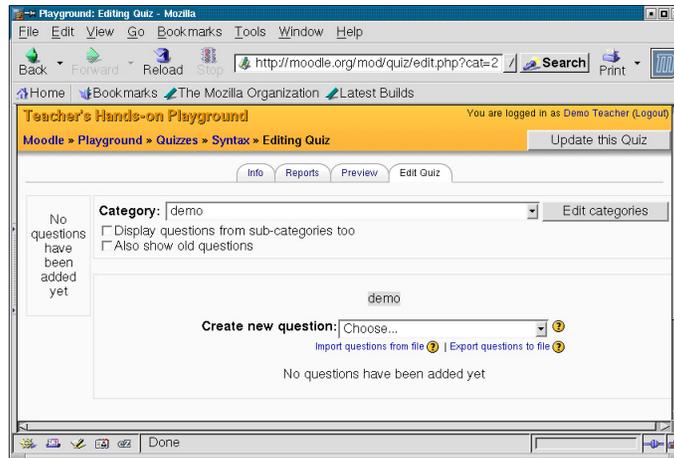


Figure 4: Editing a Quiz

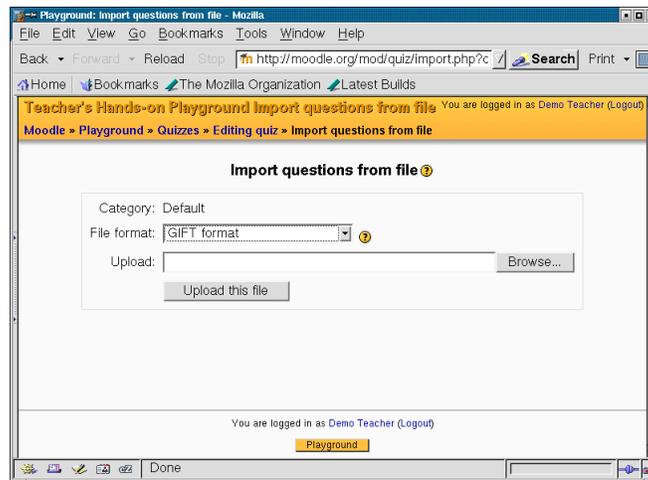


Figure 5: Loading the file

The file appears less cluttered among other reasons because GIFT metasympols (like =, ~, {,}, etc.) aren't escaped. The escape is done through a utility script accompanying the software presented in Section 3.

If we choose the last option, we have to import/upload the GIFT file to the Moodle site. This also gives a path to migrate the exercises to another courses

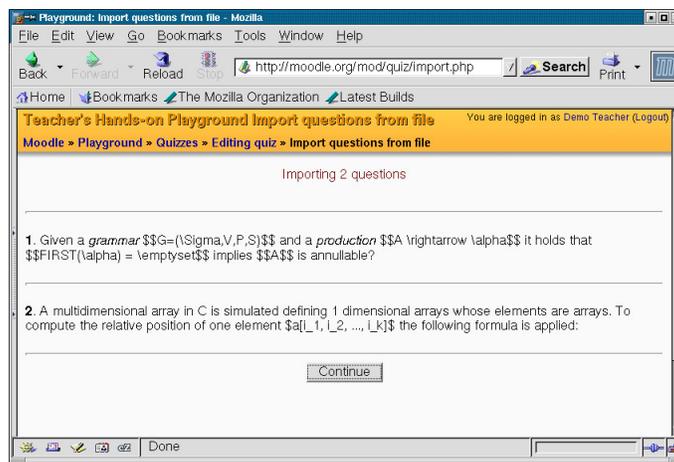


Figure 6: A GIFT file has been uploaded

or another Moodle installation. To import a quiz, edit an activity of type “questionnaire” and once in the edition window (Figure 4) select the option “Import questions from file”. A window like the one in Figure 5 is open. From there we can proceed to locate the file and to upload it. The result of a succesful upload is displayed in Figure 6.

Step 2. Preparing the Material in L^AT_EX

To obtain equivalent high-quality non-reactive formats we translate the GIFT file into a new L^AT_EX file. Figure 7 shows a human-made direct translation to L^AT_EX where two nested enumerate environments have been used. From the L^AT_EX version we can easily obtain postscript using dvips, PDF using pspdf or pdflatex and HTML using latex2html. Though they were actually obtained using the tool to be described next in Section 3, Figures 8 and 9 give you an idea of the final appearance.

3 Automatic Solution

Starting from an interactive quiz and following the steps described in the former section there is always a mean to produce a file in GIFT format describing the

```

1 \begin{enumerate}
2 \item
3   Given a \emph{grammar}  $G=(\Sigma,V,P,S)$  and
4   a \emph{production}  $A \rightarrow \alpha$  it
5   holds that  $FIRST(\alpha) = \emptyset$ 
6   implies \emph{A} is annullable?
7   \begin{enumerate}
8     \item
9       True
10    \item
11      False
12  \end{enumerate}
13
14 \item
15   A multidimensional array in C is simulated
16   defining 1 dimensional arrays whose elements
17   are arrays. To compute the relative position
18   of one element  $a[i_1, i_2, \dots, i_k]$  the
19   following formula is applied:
20   \begin{enumerate}
21     \item
22        $(i_k + D_k(\dots (i_2 + i_1 * D_2 \dots)) * size +$ 
23        $base - (L_k + D_k(\dots L_2 + L_1 * D_2 \dots)) * size)$ 
24     \item
25        $(i_k + D_k(\dots (i_3 + (i_2 +$ 
26        $i_1 * D_2) * D_3) \dots)) * size + base)$ 
27     \item
28       None of them
29   \end{enumerate}
30 \end{enumerate}

```

Figure 7: Quiz exercises in L^AT_EX format

questions. The translation is made by a Perl [9] program named `gift2latex`. Figure 10 outlines the process. The first step to obtain one of the unreactive formats from the quiz (PDF, Postscript, etc.) is to export the quiz to GIFT format. As is described in the previous section, this transformation is bidirectional, that is, Moodle allows both import and export operations on GIFT files. From this source, the script `gift2latex` produces two L^AT_EX files; Each one contains a L^AT_EX

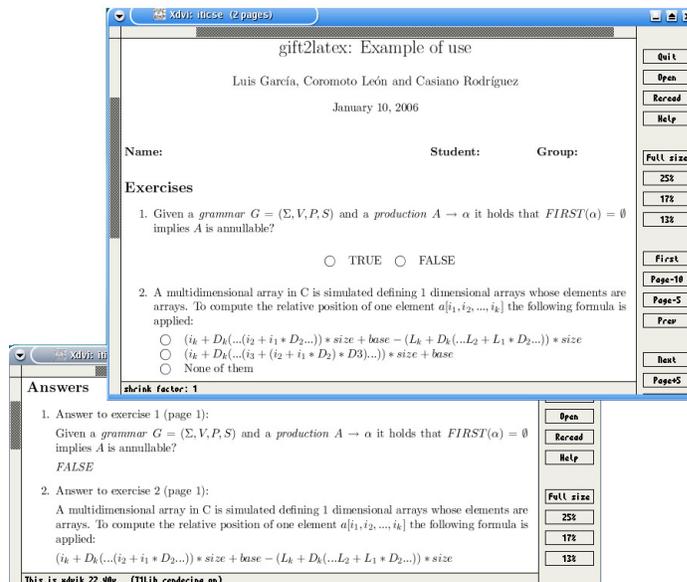


Figure 8: Postscript generated from \LaTeX

section. The first one describes the questions. The second (referenced by the former) describes the answers. However, depending on the execution options the output can be a standalone full latex document or the two files describing the questions and answers, to be included inside a main document.

Let us assume the quiz shown in Figure 2 is stored in a file named `exercises.gift`. Figures 11 and 12 show fragments of the outputs obtained when executing the command line:

```
$ gift2latex exercises.gift
```

the two generated files (named `exercises_questions.tex` and `exercises_answers.tex`) can then be embedded inside a main document using the \LaTeX `\input` command.

Observe that the \LaTeX code in Figure 11 is more sophisticated than the one in Figure 7. Links between each pair of question-answer items are generated.

Figures 8 and 9 showed a visual sample of the result of compiling with \LaTeX and $\text{\LaTeX}2\text{HTML}$ the \LaTeX files generated by `GIFT2LATEX`. The `HTML` version is navigable: Clicking the question buttons (left figure) takes you to the corresponding item inside the Answer section (right).

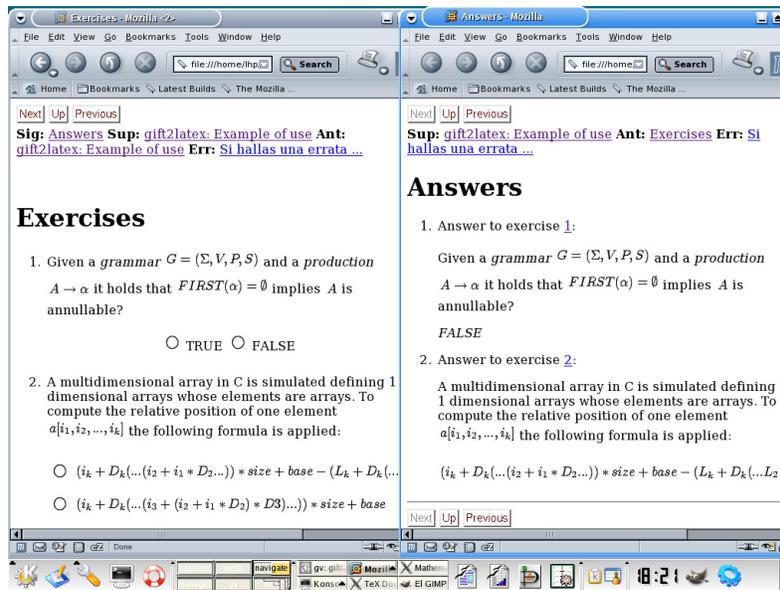


Figure 9: HTML generated by LATEX2HTML

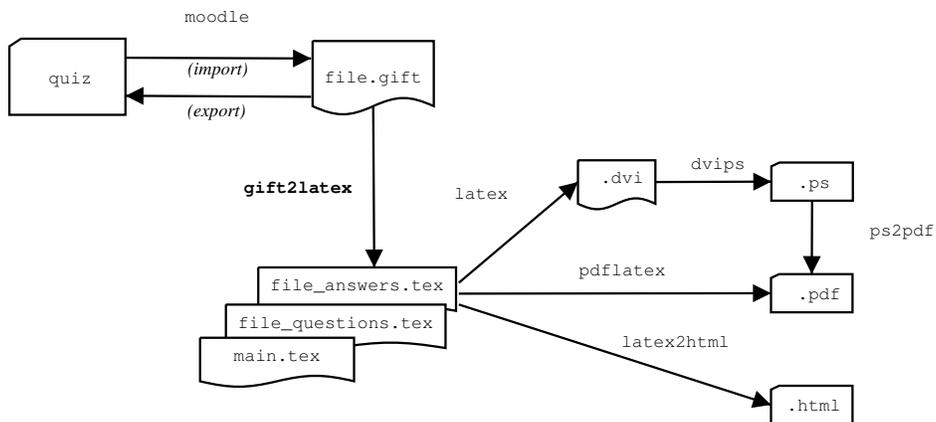


Figure 10: Scheme using automatic translation

Teachers can change the style of the output modifying the corresponding style files, usually found in the etc distribution directory. There are a couple of style files per type of question. They control the output aspects for the question and

```

1 \item
2 \label{question:syntax1}
3 Given a \emph{grammar}
4  $G=(\Sigma,V,P,S)$  and a \emph{production}
5  $A \rightarrow \alpha$  it holds that
6  $FIRST(\alpha) = \emptyset$ 
7 implies  $GA$  is annullable?
8
9 \begin{center}
10 \begin{tabular}{llll}
11  $\bigcirc$  & TRUE &  $\bigcirc$  & FALSE
12 \end{tabular}
13
14 \noindent
15 \end{center}

```

Figure 11: Excerpt of the L^AT_EX file for the question section

answer sections. The syntax to describe a style is a mixture of L^AT_EX and Perl. Figure 13 presents a fragment of a translation template or style file for TRUE-FALSE questions. Chunks of text between the %< and %> correspond to the variable part (Perl code) inside the fix L^AT_EX structure.

4 Conclusions

This work discusses the problem of integrating Moodle and LaTeX documents proposes a methodology to solve it and presents a tool to assist in the translation of questionnaires. The steps to produce the materials are:

1. Write a questionnaire taking advantage of the Moodle interface for building questionnaires.
2. After filling the corresponding forms, export the questionnaire to GIFT format.
3. Run the script `gift2latex` on this file: it produces two L^AT_EX files; One describes the questions, the other the answers.
4. Finally, include these files in the main latex document.

```

1 \item Answer to exercise
2 \label{answer:syntax1}
3 \ref{question:syntax1}
4 (page
5 \pageref{question:syntax1}):
6
7 \noindent Given a \emph{grammar}
8  $G=(\Sigma,V,P,S)$  and a \emph{production}
9  $A \rightarrow \alpha$  it holds that
10  $\text{FIRST}(\alpha) = \emptyset$ 
11 implies  $AA$  is annullable?
12
13 \emph{FALSE}
```

Figure 12: Excerpt of the L^AT_EX file for the answer section

```

1 %<$separator%>
2 \label{question:%<$label%>}
3 %<$prefix%>
4
5 \begin{center}
6 \begin{tabular}{lllll}
7 $\bigcirc$ & TRUE & $\bigcirc$ & FALSE
8 \end{tabular}
9
10 \noindent %<$suffix%>
11 \end{center}
```

Figure 13: Excerpt of the template for TRUE-FALSE

Alternatively, since GIFT is more human friendly than other formats as XML, the lecturer can omit steps 1 and 2 and directly edit the questionnaire in GIFT formatusing her favourite editor.

The tool is currently a functional prototype and we expect it will be soon delivered in CPAN [10]. A version of the front-end GIFT parser is already there [11].

5 Acknowledgments

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Ryan S. Higginbottom

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Abstract: This brief report describes a course I developed for teaching LaTeX to a diverse undergraduate audience. Of special note are the changes and improvements I made to this class after the first time it was taught.

Mini bio: Ryan Higginbottom is an Assistant Professor of Mathematics at Washington & Jefferson College, in Pennsylvania (USA). His mathematical interests lie in the field of algebraic topology, but he is also interested in digital typography and the potential uses of LaTeX among undergraduates. You may reach him at [ryan dot higginbottom at washjeff dot edu](mailto:ryan.higginbottom@washjeff.edu) or <http://www.washjeff.edu/users/rhigginbottom>.

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Teaching L^AT_EX at a Liberal Arts College

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Abstract This brief report describes a course I developed for teaching L^AT_EX to a diverse undergraduate audience. Of special note are the changes and improvements I made to this class after the first time it was taught.

1 Introduction

Finding a place in the standard curriculum to teach L^AT_EX at a small, liberal arts college is a challenging task. In some cases, the demand for this training is small or non-existent. In other cases, the relevant departments are stretched thin with service course obligations and no one is available to staff such a class. I teach in the Mathematics Department at Washington & Jefferson College, located in southwestern Pennsylvania. Like a good number of schools, we have a January term (we call ours “Intersession”) in which students take and faculty teach just one class. This term is usually 3.5 weeks long, and everyone has only one topic on which to focus. Even better, our faculty are encouraged to offer non-catalog courses and to be creative in the classes they teach. This was a perfect venue for me to offer a course I called “Introduction to Scientific Typesetting.” In other words, this was my way to teach an introduction to L^AT_EX.

I first taught this course in January of 2009. As with most classes I’ve developed, this one was significantly better the second time I offered it. While the topics were virtually the same, the class flowed much better in January 2010, and I believe the students learned more as well. In this article I will explain the improved structure of my course as well as the lessons I’ve learned along the way.

2 Goal

An obvious goal for this class was to help students become comfortable with \LaTeX . By the end of the class, I wanted them to be able to use \LaTeX to create any sort of document they could imagine. But I was not only concerned with technical skill—I wanted my students to see that documents (especially scientific documents) created with \LaTeX were both easier to produce and more attractive than similar documents produced by a word processor. In general, \LaTeX automatically makes better decisions about layout and formatting than does the average Microsoft Word user, and I wanted my students to see this. But I also wanted them to get a small taste of some of the stylistic issues in the scientific typesetting world: When should formulas, equations, and symbols be displayed (as opposed to written in-line)? How important is the font choice for the mathematical symbols? Would this document be easier to read in a two-column layout?

3 Audience

The audience for this class has been mixed. I have tried to persuade mathematics majors to enroll with little success. My class doesn't satisfy any general education requirements for graduation (which students like to complete during Intersession), and most of our mathematics majors are either content to muck around in Microsoft Word's equation editor (gasp!) or to use Scientific Notebook (or Scientific Workplace). Consequently, in a class of 15 students, there may be at most 2 or 3 current or potential mathematics majors. I have recruited a few students from other scientific disciplines, such as chemistry, physics, and computer science, who could benefit from learning \LaTeX . Also, a portion of the students are first-year students who registered late enough that they were unable to find a better Intersession option. Predictably, this last group of students is the most difficult to persuade of the usefulness of the class.

Most pleasantly, my course is currently affiliated with the Professional Writing concentration at my school, and as such it is starting to draw some students from outside the science divisions. The students who enroll as part of this concentration typically finish near the top of the class.

4 Content

Throughout the class, I argue that \LaTeX can make one's work beautiful. So, in addition to completing exercises and assignments where they practice using \LaTeX , my students must dig through the library for examples of beautiful and ugly books and articles of all types. They need to confront what affects their assessment of the aesthetic value of a document. My students must also take their work from previous semesters and improve its appearance using \LaTeX . They usually find that their presentations, papers (with bibliographies), and even foreign-language assignments look much better the second time around.

In the first few days of class we cover all of the usual topics. After an introduction to \TeX , \LaTeX , and the free software we will be using (Mi \KTeX and TeXnicCenter), the students learn about typing text, lists and tables, and typing formulas. We then spend time on the bigger picture with investigations into document structure, counters, and cross-references. We move on to graphics and floats and then Bib \TeX . Since most electronic documents are viewed in PDF form these days, we spend one class studying the `hyperref` package. We learn how to construct slides in \LaTeX using the `beamer` and `powerdot` document classes. We end the class by spending two days on `pstricks`, a day on fonts, and other time on small miscellaneous topics. (By visiting my web page [1], you can view the complete list of lessons for my class.)

5 Techniques

The structure of the class changed dramatically the second time I offered it. The first time, in 2009, we met twice a day for 1.5 hours at a time. I would nervously deliver a 30-minute, slide-filled lecture on some feature of \LaTeX and then give an assignment which was due the following day. And though I would stay to answer questions and help the students as they began to work on that assignment, the class time was unbalanced and inefficiently used.

The second time the class was offered, in 2010, I decided that we would meet just once each day for 2.5 hours and that I would emphasize in-class work to a much greater degree. I generally covered one topic per day but found two or three stopping points throughout the class where students could immediately get their hands dirty. (It now seems unthinkable to me to teach students \LaTeX with-

out insisting that they practice typing and compiling frequently throughout the class.) My class was small enough that I could walk through the classroom and give suggestions on problems or check to see that everyone was ready to move on. Most of these small exercises were of the “reproduce this” variety: I either projected a document on the screen or passed out a hard copy to all the students and asked them to duplicate it. Usually I would supply my students with some example code or a template that I use for such a task, but they occasionally needed to create the document from scratch. This in-class practice technique had several advantages: the students were engaged throughout the class; students were confronted with all of the newest material in a concrete way; and I knew almost instantly how effective my explanations had been and which of the concepts and techniques were most difficult.

The final assignment for my class was such a success during the 2009 class that I repeated it with only slight modifications in 2010. Each student chose a \LaTeX package to investigate and reported on its use and usefulness. Students needed my approval for the package they researched, but they enjoyed the freedom to explore a \LaTeX package related to an area of their interest. The final paper and presentation brought together most of the topics that we covered during the class, and students enjoyed learning about some of the more obscure, niche uses of \LaTeX . Some examples of packages on which students have completed final projects include: `cwpuzzle` for making crossword puzzles, `mhchem` for chemical formulas and equations, and `cuisine` for typing recipes.

6 Conclusion

Since I plan to offer this course in the future, I have been pondering other improvements. I cannot think of additional \LaTeX material that will be of interest to a general audience, but I do hope to recruit more aggressively in the other science departments. One aspect of the class that I could improve is an increased emphasis on digital typography. Perhaps in the future we will read some selections from a collection of articles of Donald Knuth ([2]).

I have been adding to and improving my material each time I teach this class, and I have posted all of the lectures, examples, assignments and resources on [my web page](#). Any interested reader should feel free to use these materials and pass them along to other interested parties, provided the appropriate attribution is included.

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Abstract: As first a physics professor and now a math and physics high school teacher, my teaching materials are always evolving and I am always looking for ways to make this easier for myself and to avoid reinventing the wheel (often my own wheel). Over the last three years, LaTeX has been a key part of that process.

Mini bio: I've been using LaTeX exclusively for almost a year now in teaching physics and math classes at university and high school levels. lenore dot horner at 7hills dot org.

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How \LaTeX can save you time

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The Seven Hills Schools, Cincinnati, OH

Abstract As first a physics professor and now a math and physics high school teacher, my teaching materials are always evolving and I am always looking for ways to make this easier for myself and to avoid reinventing the wheel (often my own wheel). Over the last three years, \LaTeX has been a key part of that process.

1 Introduction

When I started teaching I used various word processors for preparing lecture notes, tests, quizzes, solutions, and all the other documents of teaching. I reserved \LaTeX for research papers. Gradually two aspects of this became increasingly frustrating to me: editing equations was slow in a couple of different ways that I routinely ran into and as I switched between algebra-based and calculus-based versions of introductory physics I was either repeatedly swapping algebraic and calculus-based versions of material within my latest set of notes or else I was trying to remember to make additions and corrections to both versions of the course. The end result of this swapping was that I was forever digging through old notes in search of a diagram or a problem I'd used before and lost in some modification or other. Ultimately, it was the math that really pushed me to \LaTeX . While it wasn't obvious to me at first that I could do much to improve my life with the parallel-courses issues, they at least weren't going to be any worse using \LaTeX and working with math would be easier. Gradually, over the last three years, I have found ways to make organizing parallel courses easier. Along the way I've found ways to make numbers with units easily look nice and not split across lines. I've also gradually acquired some skill with assorted other tools useful for particular subjects I teach: combining mathematical and musical notation in one document; making detailed, repetitive drawings (mostly circuitry) that I can modify later without having to practically redraw from scratch.

2 Math

The most frequent speed-bump I ran into using standard word processors for class preparation was modifying entire sets of equations to a new font size or to replace the use of a specific symbol everywhere the symbol occurred. Traditional word processors required that I open each equation individually, modify it, click back out of the equation editor and then select the next equation. By contrast, in L^AT_EX I can change the font sizes used in every equation in the document by putting

`\DeclareMathSizes{display}{text}{super/subscript}{subsub/supersuper}` in the preamble of my document and replacing each word with a number which is assumed to be a font size in points (pt). If I only want one or a few equations to change size I can use the standard size-changing commands: `tiny`, `scriptsize`, `footnotesize`, `small`, `normalsize`, `large`, `Large`, `LARGE`, `huge`, `Huge`.

$$\sum \vec{F} = m\vec{a}$$

$$\vec{F} = \frac{d\vec{p}}{dt}$$

`$$ \sum \vec{F} = m \vec{a} $$`

`{\tiny $$ \vec{F} = \frac{\mathrm{d}\vec{p}}{\mathrm{d}t} $$ }`

Experienced users will note that I have used the deprecated `$$` markers for displayed equations. I usually have shortcuts set for `\left[` to equal `\left[` and similarly for the right side which means I can't use those as the `display-math` commands as is standard. In practice, much of my math goes in the `\begin{align} . . . \end{align}` environment which is better for showing how to work out math problems because it supports multiple lines of math.

$$y = y_0 + v_{0y}t + \frac{1}{2}a_y t^2 \tag{1}$$

$$= v_0 \sin(\theta) \frac{v_0 \sin(\theta)}{g} - \frac{g}{2} \left(\frac{v_0 \sin(\theta)}{g} \right)^2 \tag{2}$$

$$= \frac{1}{2} \frac{v_0^2 \sin^2(\theta)}{g} \tag{3}$$

```
\begin{align}
y &= y_0 + v_{0y}t + \frac{1}{2}a_y t^2 \\
&= v_0 \sin(\theta) \frac{v_0 \sin(\theta)}{g} - \frac{g}{2} \left( \frac{v_0 \sin(\theta)}{g} \right)^2 \\
&= \frac{1}{2} \frac{v_0^2 \sin^2(\theta)}{g}
\end{align}
```

When writing my lecture notes or solution sets for upper-level physics classes, I was often ending up with pages that were more math than text. As I made the transition from handwritten notes to computer-generated notes, I found that editing such notes in conventional word processors was excruciatingly slow. Part of this again is having to move into and out of the equation editor. Another part is the continuous updating of the equation while it is being typed. Another part is the slowness of scrolling past the equations. When I work with .tex files, I work in a text editor so I am never waiting for the computer to make the equations pretty. This makes modifying equations, in particular cutting and pasting from one equation to another, much faster. I also find scrolling through the final PDF file faster than scrolling through a similar file in a word processor.

The disadvantage to writing math in L^AT_EX is that we've invented pretty mathematical notation for a reason and plain-text forms are harder to read. If I am writing equations big enough that I'm having trouble reading them in L^AT_EX, or I'm actually doing the math as I type, I open LaTeXit so that the computer only has to typeset the equation I'm working on rather than the entire document. For a single test this typically doesn't make much difference. However, if I have ten pages of notes that are mostly mathematics (my lecture notes for an upper-level physics class for instance), using LaTeXit on one equation at a time does speed up typing (or debugging) that equation.

Even with L^AT_EX typing math is slower than handwriting it. I find it worthwhile to take the extra time for things I expect to re-use for several reasons: it's more legible, I can use copy and paste to reduce errors when only small parts of an equation change from one step to the next, and I can insert extra steps, add comments, and make corrections much more quickly and neatly with electronic notes than I could ever do with handwritten notes.

There are a few other things about math in L^AT_EX that I particularly like. One is automatic equation numbering coupled with easy references to a numbered equation which are immune to rearrangements of the document. Another is that turning numbering off is easy, too. I also like being able to have math appear this way $\frac{ds}{dt}$ as easily as this way

$$\frac{ds}{dt}$$

just by typing `$ \frac{\mathrm{d}s}{\mathrm{d}t} $` versus `$$ \frac{\mathrm{d}s}{\mathrm{d}t} $$`. (Again, I'm using deprecated nota-

tion. The current standards would be respectively
 $\left(\frac{\mathrm{d}s}{\mathrm{d}t}\right)$ and
 $\left[\frac{\mathrm{d}s}{\mathrm{d}t}\right]$ or alternatively
 $\begin{math} \frac{\mathrm{d}s}{\mathrm{d}t} \end{math}$ and
 $\begin{displaymath} \frac{\mathrm{d}s}{\mathrm{d}t} \end{displaymath}$.)

3 Multiple Uses of Content

A major component of my teaching has been introductory physics at roughly three different levels. Sometimes I teach different levels in parallel, sometimes serially. Either way, I was having trouble keeping up with switching material in and out of my notes for different versions of the class and getting incremental improvements into all the versions of my courses. I could either start from the last time I had taught that level of the course and then add any appropriate improvements from more recent teachings of other levels or I could start with the most recent iteration of an introductory course and modify the level appropriately. Either way, I was doing a lot of work even if I used cut-and-paste to the hilt. In addition I kept losing material that I didn't use one time and then forgot to put back in the next time.

Having switched to L^AT_EX, I started looking for a L^AT_EX cure for these problems. A useful, but still fairly tedious, tool is using the % symbol at the beginning of a line to hide — comment out — certain material. This was faster than cutting it and losing track of when I'd used it last and even faster than pasting to the bottom of a document and then remembering not to print the tail pages. A good text editor is helpful with this because chunks of a document can be selected and then commented out with one keyboard shortcut.

Still, I wasn't satisfied. When I switch from an algebra-based to a calculus-based version of the same material, there are whole sets of material that need to be swapped for each other. I didn't like spending the time to find them all or the fact that I usually missed at least one. The comment package solved my problems very neatly. I use it by putting `\usepackage{comment}` in the preamble of all my documents. Then, when I have content that should only show up for students in the calculus-based version of the class, the following appears in my .tex file.

```

\begin{calc}
Paragraphs, equations, sections, etc. for calculus-based class.
\end{calc}

```

Usually, there is a parallel section for the algebra-based section of the class, but it is not necessary. To include these chunks, I have a line in the preamble that says `\includecomment{calc}`. To exclude these chunks, that line changes to `\excludecomment{calc}`.

I also use the comment package for anything (tests, homework, ...) for which I might later post solutions. For example, each problem on my tests has the following structure.

```

\begin{topics}

\end{topics}
\begin{problem}{0}
  \begin{questions}

    \end{questions}
    \newpart{0}
    \begin{questions}

      \end{questions}
      \begin{work}
        \vspace{2in}
      \end{work}
      \begin{solutions}
        \begin{quotation}
          \noindent\textbf{Solution}

          \begin{align}
            &
          \end{align}

        \end{quotation}
      \end{solutions}
      \begin{answers}
        \begin{quotation}

```

```

        \noindent\textbf{Answer}

        $\displaystyle \quad $

        \end{quotation}
    \end{answers}
\begin{grading}
    {\color{red} { Grading
        \begin{itemize}
            \item

        \end{itemize}
    }}
\end{grading}
\end{problem}

```

Figure 1: The structure of a problem.

By setting the following commands in the preamble

```

\excludecomment{topics}
\includecomment{questions}
\includecomment{work}
\excludecomment{solutions}
\excludecomment{answers}
\excludecomment{grading}

```

the output will have the questions plus space for the students to work out their solutions. By changing what is included and excluded, a matter of changing pairs of letters, I can print questions with solutions or answers only, and various other combinations. Since all of these versions are coming from one file, any modifications I make need to be made in only one place and I always have the “right” file open. For instance, when grading papers, I usually work from the solutions, even if I won’t ever post them. It is not uncommon to find that a large number of students misread a problem in a particular way that I want to fix in case I ever use the problem again. In the old days of having a test version and a solutions version, that meant opening another file and making the correction in two places. Now, the file is already open and I only have to make the correction once. The file `SampleTest.tex` contains a sample test file with a single, two-part problem in it.

The file `SampleTest_SetForTest.tex` shows how I set the includes and excludes to print out the test and its output is shown in `SampleTest_SetForTest.pdf`. Similarly, The file `SampleTest_SetForSolutions.tex` shows how I set the includes and excludes to print out solutions and the output is shown in `SampleTest_SetForSolutions.pdf`. Normally, there is no need to show the split for extra time in the solutions.

4 Speeding things up

I have found three things that make creating L^AT_EX faster. One is using the same content in multiple documents by referring to a single original document rather than by copying and pasting, a second is creating keyboard shortcuts, and the third is creating templates.

4.1 Include and Input

The `\input{full-path-to-another-tex-file}` command is very useful for repetitive content. I use it in writing syllabi, in content I use repeatedly within a class, and in conjunction with the `\includecomment{}` command to create two courses from one master file. To organize the various files I use, I have the following folders: Common, Phys-Content, and then folders for each course.

L^AT_EX has two commands for combining files: `\include` and `\input`. As I was creating the structures outlined here for my own teaching, I found that the former gave me some problems depending on my directory structure, but the latter did not. Hence you will see `\input` in my examples.

There are substantial chunks of my syllabi that are the same for all the classes I teach either because they are based on school policy or they are basic policies I have for any class. I write a master syllabus for all classes and then where policies differed, I used the comment package to label chunks for inclusion and exclusion on a class-by-class basis. I put this master file in my Common folder and call it `Desc-Policies.tex`. In the folder for each class is a file called `ClassName-Desc-Policies.tex`. This file contains a series of `\includecomment` and `\excludecomment` statements in the preamble so that only the material for one class is included in the syllabus and `\input{../Common/Desc-Policies.tex}` is the only material between the `\begin{document}` and the `\end{document}` commands. The `../` at

the beginning of the path to the file tells the computer to go up one level in the file hierarchy within that folder to find the folder named Common. Year-to-year modifications and corrections again get made in one file and then I know all my syllabi will have that change next time I recreate the PDF output from the .tex file.

During the first few weeks of the year, I need to teach my physics students how to use a spreadsheet efficiently to analyze their data. This means that for the first several labs, I attach a long list of tips. Again, I used the `\input{path-to-file}` command and created a tips file separate from the weekly lab instructions. The `\input` command is faster than copying and pasting into two lab documents over a period of several weeks. In addition, over the first few weeks of this year, I rewrote sections of the introduction to more specifically address issues the students were having. Because my various labs pull the tips from a single file, I know that all my labs next year will have the latest version of that document. This file lives in the Labs folder inside the Phys-Content folder.

Labs generally have a three-file structure. The main file, stored in the Labs folder in Phys-Content, is called LabName.tex and contains the content of the lab: everything that goes between the `\begin{document}` and `\end{document}`. Usually the two classes aren't quite synchronized so at the very least there will be one due date for the AP students and a different one for the Honors students. Often there are also differences in the instructions: more detail is needed for the honors students or more rigorous data analysis techniques for the AP students.

```
\begin{AP}
Individual reports are due via email Feb. 3, 2011.
\end{AP}
\begin{Hons}
Individual reports are due via email Feb. 10, 2011.
\end{Hons}
```

In the respective folder for each class, I have another file that pulls the common content in and picks which set of alternative content to use. These files each have a preamble containing, among other things, the following commands.

```
\includecomment{AP}
\excludecomment{Hon}
\begin{document}
```

```

\center{\bf Physics Lab - LabName -
        Dr. Horner - 2010-2011} %%%%%%%%% Title %%%%%%%%%

\RaggedRight % Because I like this look better.
\setlength{\parskip}{0.05in} % Because raggedright undoes paragraph
                             % skips and indents

\parindent=0.5in

%%% Content %%%
\input{../../Phys-Content/Labs/LabName.tex}
%%% End Content %%%
\end{document}

```

The only difference between the two files is swapping the “in” for “ex” at the top of the excerpt. This way, when I improve the lab for next year, I don’t have to remember to make the changes twice.

4.2 Keyboard Shortcuts

Keyboard shortcuts can be for individual commands (such as we are accustomed to for opening, printing, and saving documents) or they can be for macros (sets of commands). For instance, I type a lot of fractions. Rather than typing out `\frac{}{}` every time, I have assigned the typing of that cluster of characters to `option-command-f`. Since the specific fraction $\frac{1}{2}$ also comes up a lot in my work, I have `option-command-shift-f` set to produce `\frac{1}{2}`. It does help to have some system for picking the keyboard shortcuts because forgotten shortcuts don’t save time. The macros I am most dependent on are the ones that do the greatest amount of work for me. For instance, I have one that inserts the entire structure of a test problem at once, including indentation I find helpful, by hitting three keys (see 1). If the macros are done correctly, the undo command in the editor will take the whole chunk back out as well.

Other keyboard shortcuts I frequently use involve the process of turning a `.tex` file into a pretty document. I prefer PDF output and I don’t normally want to see the various auxiliary files that \LaTeX creates. Many text editors intended for use with \LaTeX come with this shortcut built-in and generally the editors provide

a way for the set of commands to be tweaked. In my case, for example, I taught a course where I was using musical notation and mathematics frequently in the same document so I wrote a macro that executes that two-step process (send the music to a Lilypond, a musical equivalent of L^AT_EX, and then put the result into my L^AT_EX document) with a single function-key.

In all I have about three dozen macros assigned to keyboard shortcuts. Some of them I use in nearly every document I create. Others I created because I needed them for one particular project. A text editor **you** find helpful can do more than any single other thing to make L^AT_EX a time-saver.

4.3 Templates

Another kind of repeated content in using L^AT_EX is the preamble. I have one large template that I start all my files from. Alternatively, I could create test templates, lecture templates, lab templates. Using templates, either via a template mechanism in your text editor (the safe way) or by conscientiously using Save-As, is as big an asset in making the life of a teacher easier as keyboard shortcuts. Templates are by no means unique to L^AT_EX but they are very effective with it in part because the content and the layout are both visible in the document and it is easy to add content to the template without botching the formatting. Like macros, templates preserve tricks learned so that they are always in use even after a lapse of years during which a human would forget the trick.

5 Other Useful Tools

5.1 Slides and Notes

There are several slide-creator packages for L^AT_EX. I use Beamer. I do a lot with internal and external hyperlinks within Beamer and have also been happy with my ability to customize slide-layout and behavior. Here again, I end up using a cluster of files to produce the end product. For a typical set of lecture notes that I will use in different levels of introductory physics, I end up with five files. The biggest file I call Topic-content.tex. Like the lab file, that contains the material between the `\begin{document}` and the `\end{document}` commands and is stored in the Phys-Content folder, generally in a subfolder so that relevant figures or

other kinds of documents referred to are all grouped together. The content is separated out in two different ways. Beamer provides tools for putting some content only in the slide-show version (`\mode<presentation>{}`) and other content only in the posted-notes version (`\mode<article>{}`). In addition, I use the comment package to mark content as “algebra” (by using

```
\begin{algebra}
(stuff - must be whole slides or article-mode only)
\end{algebra}
```

or “calculus” so that by changing four letters I can produce notes for either version of the class. The three remaining files consist of preambles that select whether the output is a set of slides for projection in class (`\documentclass{beamer}`) or a set of notes (laid out very differently with `\documentclass{article}` plus `\usepackage{beamerarticle}` to save paper and ink and with additional content) for the algebra-based class (set with `\excludecomment{calc}` and `\includecomment{algebra}`) or for the calculus-based class (set with `\includecomment{calc}` and `\excludecomment{algebra}`). The first file gets stored in the same folder with `Topic-content.tex` and is called `Topic-class.tex`. In the respective folders for different classes are files the two files called `Topic-postClassID.tex`. This structure took me a while to figure out and set up, but now I can create a new unit by copying the four files, rewriting the content file and changing file names and references in the other three files. I can spend all my time on content creation and know that I can easily switch the level of the content next time I teach it. I’m not cutting content out in years I don’t use it, I’m simply hiding it and I can hide all of it at once.

An example of generating slides for in-class use and a more-compact set of notes with some extra information is in the files `SampleContent.tex`, `SampleNotes.tex`, `SampleSlides.tex`, `SampleNotes.pdf`, and `SampleSlides.pdf`. The content file is necessary for compiling the notes and slides files. The slides file requires XeLaTeX although the notes version does not.

5.2 Writing Tests

I’ve already noted my use of the comment package to create tests and solutions from the same file. I also routinely use a tweaked version of the testpoints

file found at <http://www.math.duke.edu/computing/tex/templates.html>. (I've tweaked some font and spacing settings for my preferences.) The file makes layout of multi-part problems simple and pretty, does all the numbering for you (no more accidental 1,3,2,4,5 sequences after rearranging questions on different versions of the same test), and warns if point totals for parts don't add to the assigned points for the whole problem. It also tells how many points were assigned on the test. I've managed to lose track of a point or two on a test often enough to really appreciate having the latter check feature.

5.3 Numbers and Units

One of my pet peeves is having the units that go with a number wrap onto the next line. While I could do all my work without the `siunitx` package, I really like having it because, in addition to putting a non-breaking space between the number and the unit so that the two don't get split across the end of a line, it does a lot of pretty things from fairly simple input. In particular, it lets me keep track of units all the way through solutions to problems using my text font for units even inside math environments so that units and variables have distinct appearances. At the same time it keeps the font sizes appropriate (smaller as the fractions get more complex). It also just makes numbers and units look nice outside of equations; with my preamble settings, `\SI{29979.24580e4}{\m\per\s}` produces $29\,979.245\,80 \times 10^4 \frac{\text{m}}{\text{s}}$. This package, as with many of the packages I use, is capable of much more than I use.

6 Tweaking L^AT_EX

Only the first four items in this section really contribute to saving time. The rest are here to show you that L^AT_EX can be tweaked to suit your tastes and applications. The spacing commands matter more for my students printing the notes, and occasionally for test formats, than they do for my time. A skeleton document is listed in the appendix.

Sometimes the L^AT_EX command syntax isn't what I want. For example, L^AT_EX has the ability to make parentheses, brackets, and braces grow to match what they enclose. I almost always want to use this feature, but never want to wade through an equation filled with `\left(... \right)` pairs in it. I find it hard to

parse. I therefore have the following (and matching for brackets and braces) in my preamble.

```
\renewcommand{\left}{\left(}
\renewcommand{\right}{\right)}
```

This permits me to type $\left(\right)$ in my equations which is much easier to read. I have, of course, assigned a keyboard shortcut for insertion of that pair, with a space between and the cursor in the middle all ready for my input. Note that this redefines the current preferred short command for in-line math in \LaTeX , however the deprecated $\$$ still works and is what I use.

I also define color shortcuts because I use colors in solutions to show cancellation and substitution connections. A keyboard shortcut wasn't enough because I prefer reading $\backslash rd$ to reading $\backslash color\{red\}$ as I proofread or update my documents.

Although I like the `siunitx` package, I find some of its syntax too cumbersome and there are a few units that I use for a week every year in introductory physics that aren't on its standard list. Therefore, I have a section of modifications to `siunitx` in my preamble (shown in the appendix).

There are various ways of setting up basic page geometry in \LaTeX : paper size, margins, headers, etc. The geometry package makes it easy. At its most basic, it lets me set page height and width as well as top and left margins. The rest \LaTeX computes itself. This is another package that I do not use even close to its fullest potential.

Beamer is another package that I use with several modifications. In this case I have created my own style files (by relatively minor modifications of files that come with Beamer). Of course if I'm not using Beamer in a particular document, I comment out that entire section.

Finally, I have found, especially in posting notes in two-column landscape mode, that I prefer the page layout that results from modifying several parameters that \LaTeX uses in creating page layouts.

There are other things that I tweak in my preamble, but the final one that might be generally illuminating is my exam titles and instructions. I set both in definitions in the preamble. Often my exams have an in-class and a take-home component. Setting the title in the preamble and then just calling for it later in the document ensures that all the parts of the exam end up with the same title so

that when students come back to me with papers or sort their papers the pieces of the exam match. In addition, some of my students get extended time on tests and where I teach now this is handled by splitting the exam into two parts with one part to be taken later when the student has study hall. I always want to be sure that when I split up the exam, the second half has the same instructions for the study hall teacher as the first half had. Defining a command that echoes my instructions makes that easy.

This is a skeleton of my typical test file. I've included the whole preamble — including parts that are commented out as they would be when I actually use them — to show how I use various packages. The comments are my notes to myself about what I might want to use the packages for. Essentially, this preamble is the repository of most of what I know about using L^AT_EX effectively for my purposes.

7 File Output

Although there are many ways to produce PDF output these days, L^AT_EX does it automatically and PDF is by far the best way to post notes and solutions on-line for students. PDF files do not get mangled, they don't even get touched, by having the wrong version of a word processor on the wrong operating system. This is critical for files containing have math and drawings. In addition, most web browsers will open the PDF in the browser window. My college students' unsolicited feedback (because it hadn't occurred to me to ask) was that this is faster and simpler for them and they definitely preferred it to other formats that were used. Current PDF readers (at least on OS X and I think on Windows and Linux as well) permit students to circle material in downloaded PDF files and to attach notes to the files both of which can be saved.

8 Reflections and advice

I didn't become a fan of L^AT_EX until I saw past the very nice typesetting to the more valuable time-saving features. The speed of editing and copying and pasting of math combined with the ability to have multiple versions of a document a few keystrokes away won me over. I continue to find ways to simplify my life. So


```

% % transparent<=opaqueness> -- mix with background so not completely there
% % dynamic -- mix depends on steps to/from uncovering
% % highly dynamic -- more so
%\setbeamertheme{navigation symbols}{} % don't show nav symbols on each slide (too small to use)
%\setbeamertheme{bibliography item}[text] % show number instead of symbol to link to bib
%\setbeamercolor{alerted text}{fg=orange} % orange as acceptable contrast on blue and white for most visions
% End Beamer stuff %
\input{testpoints} % create the problem environment and assign points (in folder with test file or in texmf-local)
% Spacing refinements %
%separate rows of arrays just a tad more
\renewcommand{\arraystretch}{1.2}
% shrink vertical space in lists
\newenvironment{enumerate*}{\begin{enumerate}\setlength{\itemsep}{-2pt}}{\end{enumerate}}
\newenvironment{itemize*}{\begin{itemize}\setlength{\itemsep}{-2pt}}{\end{itemize}}
% Alter the LaTeX defaults so in-line math will hardly ever break across a line
\relpenalty=9999
\binoppenalty=9999
% Alter some LaTeX defaults for better treatment of figures to fit better on page:
% See p.105 of "TeX Unbound" for suggested values.
% See pp. 199-200 of Lamport's "LaTeX" book for details.
% General parameters, for ALL pages:
\renewcommand{\topfraction}{0.99} % max fraction of floats at top
\renewcommand{\bottomfraction}{0.99} % max fraction of floats at bottom
% Parameters for TEXT pages (not float pages):
\setcounter{topnumber}{6}
\setcounter{bottomnumber}{6}
\setcounter{totalnumber}{12} % 2 may work better
\setcounter{dbltopnumber}{2} % for 2-column pages
\renewcommand{\dbltopfraction}{0.9} % fit big float above 2-col. text
\renewcommand{\textfraction}{0.01} % allow minimal text w. figs
% Parameters for FLOAT pages (not text pages):
\renewcommand{\floatpagefraction}{0.9} % require fuller float pages
% N.B.: floatpagefraction MUST be less than topfraction !!
\renewcommand{\dblfloatpagefraction}{0.9} % require fuller float pages
% End Spacing refinements %
% Color %
%color redefinitions (cyan and blue defaults were too close)
\definecolor{DarkBlue}{rgb}{0.1,0.1,0.9}
\definecolor{RealCyan}{rgb}{0.2,0.7,0.9}
%color shortcuts
\newcommand{\rd}{\color{red}}
\newcommand{\bl}{\color{DarkBlue}}
\newcommand{\gr}{\color{green}}
\newcommand{\mt}{\color{magenta}}
\newcommand{\cy}{\color{RealCyan}}
% End Color %
% Numbering %
%Set the enumerate labels to go in the order A I a i
\renewcommand{\theenumi}{\Alph{enumi}}
\renewcommand{\labelenumi}{\theenumi}
\renewcommand{\theenumii}{\Roman{enumii}}
\renewcommand{\labelenumii}{\theenumii}
\renewcommand{\theenumiii}{\alph{enumiii}}
\renewcommand{\labelenumiii}{\theenumiii}
\renewcommand{\theenumiv}{\roman{enumiv}}
\renewcommand{\labelenumiv}{\theenumiv}
% End Numbering %
% Other shortcuts %
%create shortcut for the autoscaled (), [], <>, and || - don't autocolor because it breaks ^ placement
\renewcommand{\l}{\left()}
\renewcommand{\r}{\right)}
\renewcommand{\lbracket}{\left[}
\renewcommand{\rbracket}{\right]}
\renewcommand{\langle}{\left\langle}
\renewcommand{\rangle}{\right\rangle}
\renewcommand{\lvert}{\left|}
%end (), [], <>, || automation
\providecommand{\e}[1]{\ensuremath{\times 10^{#1}}} %short-cut for powers of ten
% End Other shortcuts %
% modifications to SIunits %
\DeclareSIUnit\sq{2} % briefer squaring than default; XeTeX croaks on \2 here
\DeclareSIUnit\cu{3} % briefer cubing than default

```

```

\DeclareSIUnit\power{W} % briefier fourth power than default
\DeclareSIUnit\lightyear{ly} % units I use occasionally that aren't predefined in siunitx
\DeclareSIUnit\torr{torr}
\DeclareSIUnit\gauss{G}
\DeclareSIUnit\J{J}
%%%%% end modifications to SIunitx %%%%%
%%%%% Use EnergyBar font %%%%%
%extra font for energy bars
\setmonofont{EnergyBar}
%now fix urls so they don't come out in energybar font
\urlstyle{same}
%%%%% End Use EnergyBar font %%%%%
%create annotated and unannotated output from this file by changing include <-> exclude
\excludecomment{topics}
\includecomment{questions}
\includecomment{work}
\excludecomment{solutions}
\excludecomment{answers}
\excludecomment{grading}

\newcommand{\mytitle}{\noindent\textbf{ Test 8 Ch 5 - AP Calculus BC - Dr. Horner - 2010-2011 \hspace{0.25in}NAME}}
\newcommand{\inrules}{\bf Directions:} Show as much detail as possible for partial credit. Use proper mathematical
notation. Make explanations short but accurate. Place final answers in a box and be sure your presentation is in
a clear, logical format. You may use your calculators.}

\begin{document}

\RaggedRight
\setlength{\parskip}{0.05in} % Because raggedright undoes paragraph skips and indents
\parindent=0.5in

\mytitle %%%%%%% Title %%%%%%%%%

\inrules

%%% Content %%%

% questions

\newpage
\mytitle

\inrules

% more questions - split is for a student who gets extra time and takes half the test in study hall

\newpage
\mytitle

ALL WORK MUST BE YOUR OWN. YOU MAY USE {\bf YOUR} TEXT, {\bf YOUR} NOTES AND YOUR CALCULATOR, BUT NOT ANY OTHER
MATERIALS NOR MAY YOU DISCUSS (in any form) THESE QUESTIONS OR ANY MATHEMATICS WITH ANYONE ELSE. THE
CONSEQUENCES OF ANY VIOLATION OF THIS TRUST ARE SEVERE. I fully understand the above statement and have
complied with all it states:

Sign Here {\underline{\hspace{3in}}}
\vspace{0.25in}

PAPERS ARE DUE BY 8:10AM NEXT SCHOOL DAY IN ROOM 119 OR TO XXX.

Email me if you feel you need clarification of any questions.

% take-home question

%%% End Content %%%
\showpoints
\end{document}

```

(courtesy of Google)

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Thesis style

Robert Ipanaqué Chero
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Abstract: FcUnp is a LaTeX class for writing the bachelor thesis used at the Science Faculty of the National University of Piura, Perú. The goal of FcUnp is to provide a bachelor thesis format with a consistent layout that conforms to the rules of the Faculty so that students can concentrate solely on the content. It provides a set of commands to create the cover page, the title page, the signatures page, the dedication page and the acknowledgments page. When required, there is another set of commands to create the conclusions, the annexes, the appendices, and the abstract. In addition, this class allows generating PDF output, using both dvipdfm and directly with pdflatex.

Resumen: FcUnp es una clase para LaTeX2e para escribir la tesis de licenciatura en la Facultad de Ciencias de la Universidad Nacional de Piura, Perú. Ésta proporciona un conjunto de comandos para crear la cubierta, la portada, la página de firmas, la página de la dedicatoria y la página de agradecimientos; y, otro conjunto de comandos para crear las conclusiones, los anexos, los apéndices y el resumen. Todos esto de acuerdo con las reglas de dicha Facultad. Además, esta clase permite obtener el documento pdf, ya sea por medio de dvipdfm o directamente con pdfLaTeX. FcUnp entonces se ocupará del formato de tesis de licenciatura de estudiantes con un diseño coherente, mientras que ellos sólo se concentrarán en el contenido.

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You can reach both Robert Ipanaqué and Gloria Crespo at <https://sites.google.com/site/ripanaque/>

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Tesis de pregrado en $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ con $F_C\mathbf{U}_{\eta p}$ class

Robert Ipanaqué Chero¹, Gloria Solvey Crespo Guerrero²

Email ¹robertchero@hotmail.com, ²gloriasol148@hotmail.com

Abstract $F_C\mathbf{U}_{\eta p}$ is a $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}2_{\epsilon}$ class for writing the bachelor thesis in the Science Faculty of the National University of Piura, Perú. It provides a set of commands to create the cover page, the title page, the signatures page, the dedication page and the acknowledgments page; as such, another set of commands to create the conclusions, the annexes, the appendixes and the abstract. All that according to the rules of that Faculty. In addition, this class allow obtained the PDF output, whether by means dvipdfm or directly with $\text{pdf}\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$. $F_C\mathbf{U}_{\eta p}$ will then format the bachelor thesis of students with a consistent layout while they can just concentrate on the contents.

1 Introducción

Cualquier estudiante de pregrado de la Facultad de Ciencias de la Universidad Nacional de Piura (FC-UNP) que desea redactar su tesis se encuentra con el inconveniente de generar, en formato adecuado, las primeras cinco páginas de la misma; así como, las páginas de la lista de contenidos, lista de figuras, lista de tablas, anexos, apéndices y resumen. Además de la carencia de un adecuado editor de fórmulas matemáticas que son de uso común a tales estudiantes.

Este artículo presenta la clase $F_C\mathbf{U}_{\eta p}$ que permite, al estudiante de pregrado de la FC-UNP, redactar todo el trabajo tesis, en $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ (ver [6, 8]) de acuerdo con el formato que exige el Reglamento de Tesis de dicha facultad. Adicionalmente, y dado que es requisito presentar un ejemplar de la tesis en formato virtual, la clase $F_C\mathbf{U}_{\eta p}$ permite obtener un archivo pdf (ver [12]) de la misma, mediante $\text{pdf}\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ (ver [3]). De este modo, el alumno que utilice la clase $F_C\mathbf{U}_{\eta p}$ para redactar su trabajo de tesis se concentrará únicamente en el contenido del mismo, sin tener que invertir tiempo en darle formato. Por otra parte, si la FC-UNP oficializa el uso de dicha clase obtendrá como beneficio que la totalidad de los trabajos tendrán un formato único y de nivel profesional.

2 Obtención de la clase $F_C U_{np}$

La clase $F_C U_{np}$ puede obtenerse desde <https://sites.google.com/site/ripanaque/docencia>

3 Cómo invocar la clase $F_C U_{np}$

La clase $F_C U_{np}$ es una modificación de la clase estándar “book” (ver [7]) de L^AT_EX. Por tanto, es posible que el estudiante utilice todos los comandos de “book” en la preparación del cuerpo de la tesis. La clase $F_C U_{np}$ se invoca reemplazando “book” por “fcunp” en la primera línea del documento:

```
\documentclass{fcunp}
%
\begin{document}
<Cuerpo de la tesis>
\end{document}
```

4 Comandos implementados en $F_C U_{np}$

4.1 Comando para separar datos ingresados

1. `\and`
Permite separar diversos datos, tales como: nombres de autores, nombres de patrocinadores, dedicatorias, etc.

4.2 Comandos para ingresar datos

Los datos se pueden ingresar con letras minúsculas, exceptuando la primera letra de los nombres de personas.

1. `\school{<n>}`
Permite ingresar un número entero positivo entre 1 y 5, incluidos, para identificar la Escuela Profesional. Admite
 - n=1 para referirse a la Escuela de Biología,

- n=2 para referirse a la Escuela de Física,
 - n=3 para referirse a la Escuela de Matemática,
 - n=4 para referirse a la Escuela de Electrónica,
 - n=5 para referirse a la Escuela de Estadística.
2. `\title{<Título de la tesis>}`
Permite ingresar el título de la tesis.
 3. `\author{<Autor de la tesis>}`
Permite ingresar el nombre del autor de la tesis. En caso de ser dos autores los nombres de los mismos deberán ir separados con el comando `\and`.
 4. `\sponsor{<Patrocinador>}`
Permite ingresar el nombre del patrocinador de la tesis. En caso de ser dos patrocinadores los nombres de los mismos deberán ir separados con el comando `\and`.
 5. `\jury{<Miembros del Jurado>}`
Permite ingresar los nombres de los miembros del Jurado de la tesis, los mismos que se separarán con el comando `\and`.
 6. `\dedication{<Dedicatoria>}`
Permite ingresar la dedicatoria del autor. En caso de ser dos autores las dedicatorias de los mismos deberán ir separadas con el comando `\and`.
 7. `\acknowledgments{<Agradecimientos>}`
Permite ingresar los agradecimientos del autor (o de los autores), los mismos que se separarán con el comando `\and`.
 8. `\resumen{<Resumen>}`
Permite ingresar el resumen de la tesis.
 9. `\palabrasclave{<Palabras clave>}`
Permite ingresar las palabras clave.
 10. `\abstract{<Resumen en inglés>}`
Permite ingresar el resumen en idioma inglés.
 11. `\keywords{<Palabras clave en inglés>}`
Permite ingresar las palabras clave en idioma inglés.

4.3 Comandos para generar páginas

1. `\makecover`
Permite generar la portada.
2. `\maketitle`
Permite generar la página de título.
3. `\makesignature`
Permite generar la página de firmas.
4. `\makededication`
Permite generar la página de la(s) dedicatoria(s).
5. `\makeacknowledgments`
Permite generar la página de los agradecimientos.

4.4 Otros comandos

1. `\frontmatter`
Apertura de la tesis. La numeración de las páginas ubicadas después de este comando se realiza con números romanos.
2. `\mainmatter`
Parte central de la tesis. Aquí también se ubican las conclusiones y recomendaciones (inmediatamente después del comando `\conclusions`), los anexos (inmediatamente después del comando `\annex`) y los apéndices (inmediatamente después del comando `\appendix`).
3. `\backmatter`
Cierre de la tesis.

5 Paquetes inicializados con $F_C U_{np}$

5.1 Paquetes estándar de L^AT_EX

geometry Este paquete se utiliza para establecer los márgenes de página de la Tesis (ver [5]).

babel Este paquete se utiliza activando la opción `spanish` con la finalidad de conseguir una adecuada partición silábica de las palabras (ver [1]).

inputenc Este paquete se utiliza activando la opción `latin1` con la finalidad de permitir el uso y la compilación de caracteres que no corresponden al código ASCII (ver [2]).

amsthm Este paquete se utiliza para darle un formato adecuado a las definiciones, teoremas, corolarios, lemas, proposiciones, etc. y también a las demostraciones (ver [4]).

graphicx Este formato se utiliza para poder insertar gráficos y es preciso incluirlo en la clase pues de otra forma no se podría incluir el logo de la UNP en la cubierta (ver [9]).

epstopdf Este paquete se utiliza para convertir los gráficos `.eps` a `.pdf` y poder así generar el archivo pdfL^AT_EX (ver [10]).

5.2 Paquetes estándar modificados

hyperrefn Este paquete constituye una ligera modificación¹ del paquete estándar `hyperref` y se utiliza para generar los hipervínculos del índice general, de las referencias, de las direcciones web, así como también para generar los marcadores (ver [11]).

6 Un ejemplo específico

El ejemplo que se presenta en esta sección permite observar el código elemental de una tesis², así como algunas páginas importantes (ver páginas 13–19), generadas con la clase `FCUNP`. Además en las figuras 1 y 2 se aprecia la salida obtenida por pdfL^AT_EX con el paquete `hyperrefn` que permite generar hipervínculos y marcadores en forma automática.

La línea 1 del código anexo (ver páginas 6, 7 y 8) invoca la clase `FCUNP`. La línea 3 invoca tres paquetes, de la American Mathematical Society, para trabajar

1. Nos hemos visto obligados a realizar tal modificación pues la versión estándar, `hyperref`, presentaba problemas para manejar simultáneamente anexos y apéndices.

2. Este ejemplo corresponde a la Escuela Profesional de Matemática (esto se indica en la línea 5 [Pág. 6], con `\school{3}`).

con matemática. Las líneas 5–17, muestran el correcto uso de los *comandos para ingresar datos* y del *comando para separar datos ingresados*; mientras que las líneas 23–27, 77 y 78 muestran el correcto uso de los *comandos para generar páginas*. Las líneas 21, 35 y 67, separan la apertura, la parte central y el cierre de la tesis y las líneas 53, 60 y 64 indican el inicio de las conclusiones (y recomendaciones), los anexos y apéndices, respectivamente. El resto de líneas terminan de completar el cuerpo del documento y son de uso común en cualquier documento L^AT_EX generado con la clase estándar “book”.

```
1 \documentclass{fcunp}
2
3 \usepackage{amssymb,amsmath,amsfonts}
4
5 \school{3}
6 \title{‘‘Título de la Tesis’’}
7 \author{Primer Autor \and Segundo Autor}
8 \sponsor{Primer patrocinador \and Segundo patrocinador}
9 \jury{Presidente \and Secretario \and Vocal}
10 \dedication{Primera dedicatoria.\\\textit{Primer Autor} \and
11 Segunda dedicatoria.\\\textit{Segundo Autor}}
12 \acknowledgments{Primer agradecimiento. \and Segundo agradecimiento.}
13 \resumen{Este es el resumen.}
14 \palabrasclave{Palabraclave1, palabraclave2.}
15 \abstract{This is the abstract.}
16 \keywords{Keyword1, keyword2.}
17
18 \begin{document}
19
20 \frontmatter
21
22 \makecover
23 \maketitle
24 \makesignature
```

25 \makededication
26 \makeacknowledgments
27 \chapter{Prólogo}
28 Éste es el prólogo.
29 \tableofcontents
30 \listoffigures
31 \chapter{Introducción}
32 Ésta es la introducción.
33
34 \mainmatter
35
36 \chapter{Este es el primer capítulo}
37 Texto para el primer capítulo.
38 \section{La primera sección del primer capítulo}
39 Texto para la primera sección del primer capítulo.
40 \begin{equation}ax^2+bx+c=0\,,.\end{equation}
41
42 \chapter{Este es el segundo capítulo}
43 \section{La primera sección del segundo capítulo}
44 Texto para la primera sección del segundo capítulo.
45 \begin{figure}
46 \centering
47 \includegraphics[scale=0.5]{img/unp.eps}
48 \caption{Mi primera figura.}
49 \end{figure}
50
51 \conclusions
52 \chapter{Conclusiones}
53 Aquí van las conclusiones.
54
55 \chapter{Recomendaciones}
56 Aquí van las recomendaciones.
57
58 \annex

```

59 \chapter{Este es un anexo}
60 Texto para el anexo.
61
62 \appendix
63 \chapter{Este es un apéndice}
64 Texto para el apéndice.
65
66 \backmatter
67
68 \begin{thebibliography}{CM}
69 \bibitem{Buh}
70 Buhmann, M. D. (2004).
71 Radial Basis Functions: Theory and Implementations.
72 Cambridge University Press. United Kingdom.
73 \end{thebibliography}
74 \makeresumen
75 \makeabstract
76
77 \makeresumen
78 \makeabstract
79
80 \end{document}

```

7 Portadas de acuerdo con la Escuela Profesional

Adicionalmente, el texto referente a las escuelas y al título profesional (en la parte superior de la cubierta, la portada y la página de firmas), así como el color de la primera página (cubierta), es modificado en forma automática cuando el código de la línea 5 (Pág. 6) se sustituye por

- \school{1} (Fig. 3, izquierda-arriba),
- \school{2} (Fig. 3, derecha-arriba),
- \school{4} (Fig. 3, izquierda-abajo),
- \school{5} (Fig. 3, derecha-abajo).

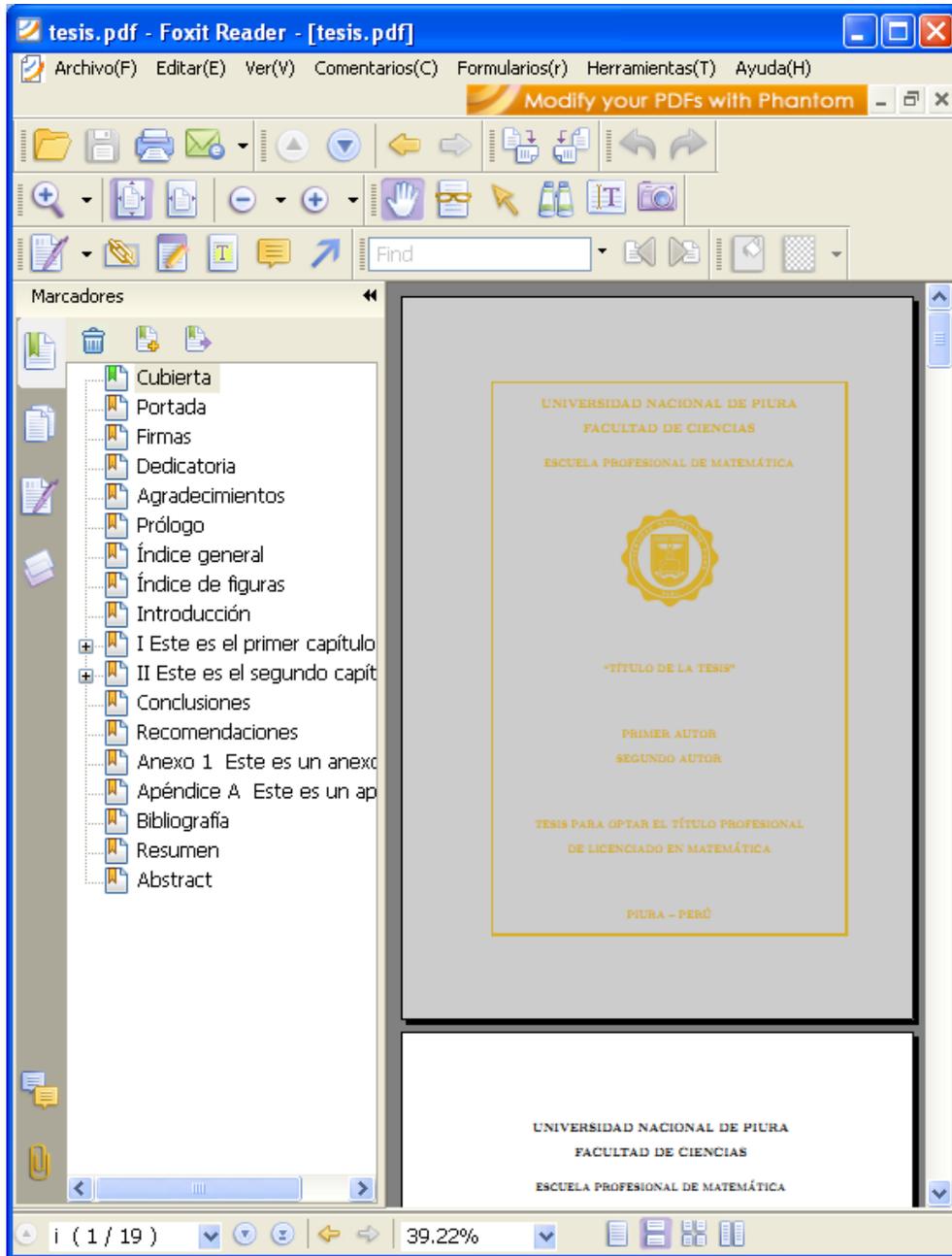


Figure 1: Salida formateada por $F_{C}U_{HP}$ y producida por pdf $L^A T E X$ con el paquete hyperrefn, con sus respectivos marcadores.

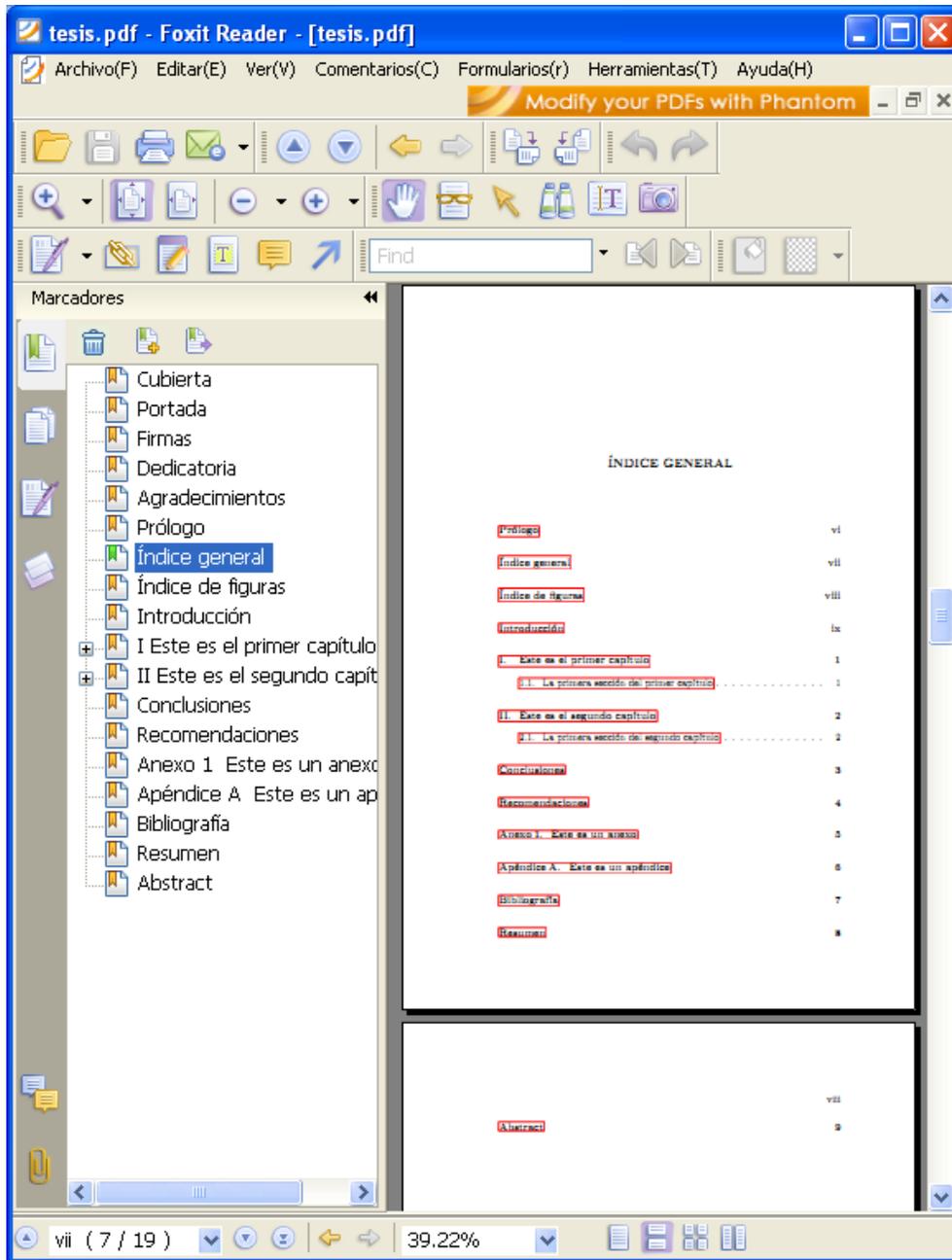


Figure 2: Salida formateada por F_{cUhp} y producida por pdf $L^A_T E_X$ con el paquete hyperrefn, con sus respectivos hipervínculos y marcadores.



Figure 3: Formato automático por Escuelas Profesionales con $F_C U_{11} p$.

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FACULTAD DE CIENCIAS
ESCUELA PROFESIONAL DE MATEMÁTICA



"TÍTULO DE LA TESIS"

PRIMER AUTOR
SEGUNDO AUTOR

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Ejecutor

Segundo Autor
Ejecutor

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Patrocinador

Segundo patrocinador
Co-Patrocinador

Presidente
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Secretario Jurado de Tesis

Vocal
Vocal Jurado de Tesis

DEDICATORIA

Primera dedicatoria.

Primer Autor

Segunda dedicatoria.

Segundo Autor

AGRADECIMIENTOS

Los autores desean expresar su más sincero agradecimiento:

- Primer agradecimiento.
- Segundo agradecimiento.

PRÓLOGO

Éste es el prólogo.

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CAPÍTULO I
ESTE ES EL PRIMER CAPÍTULO

Texto para el primer capítulo.

1.1. La primera sección del primer capítulo

Texto para la primera sección del primer capítulo.

$$ax^2 + bx + c = 0. \quad (1.1)$$

CAPÍTULO II
ESTE ES EL SEGUNDO CAPÍTULO

2.1. La primera sección del segundo capítulo

Texto para la primera sección del segundo capítulo.



Figura 2.1. Mi primera figura.

ANEXO 1
ESTE ES UN ANEXO

Texto para el anexo.

APÉNDICE A
ESTE ES UN APÉNDICE

Texto para el apéndice.

RESUMEN

Este es el resumen.

Palabras Clave

Palabraclave1, palabraclave2.

ABSTRACT

This is the abstract.

Keywords

Keyword1, keyword2.

8 Conclusiones

Este artículo presenta la clase $F_C\mathbf{U}_{\eta}p$ que permite redactar la tesis de pregrado de cualquier estudiante de la FC-UNP ajustándose al formato exigido por el Reglamento de Tesis de la mencionada Facultad. Los comandos implementados en dicha clase permiten que el estudiante se concentre únicamente en el contenido de la tesis sin tener que invertir tiempo en darle formato al mismo. Además, la clase $F_C\mathbf{U}_{\eta}p$ permite obtener un archivo pdf producido por pdf \LaTeX , el cual constituye un requisito adicional que exige la FC-UNP.

Agradecimientos

Este trabajo ha sido solventado por el Estado peruano (Ley Universitaria N°23733) y el Instituto de Investigación y Promoción para el Desarrollo de la Universidad Nacional de Piura.

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Intelligent commas

Claudio Beccari

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Abstract: The decimal fractional part of a number must be separated from the integer part with a decimal separator. The ISO regulations specify a different sign for different languages; the internal LaTeX mathematical character codes do their best to avoid a simple treatment of the decimal separator. Here we describe a few ways to handle this problem.

Claudio Beccari is a long time LaTeX user and in 1991 wrote a book in Italian with the title "LaTeX— Guida a un sistema di editoria elettronica". Since then he is considered one of the gurus of the Italian TeX Users, even if this fame is totally undeserved. He has contributed several papers to TUGboat; he produced the hyphenation patterns for Italian and Latin, still in use today; he designed the default Greek fonts for use with Babel and supplied the Greek hyphenation patterns (luckily enough the Greek Users produced better patterns and these replaced Claudio's). Presently the Italian language definition file of the Babel package, although under the full control of Johannes Braams, is regularly updated and enriched by Claudio. He has participated in various TeX conferences and is a member of GuLT, the official Group of the Italian TeX Users. He can be reached at `claudio dot beccari at gmail dot com`.

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Intelligent commas

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Abstract The decimal fractional part of a number must be separated from the integer part with a decimal separator. The ISO regulations specify a different sign for different languages; the internal \LaTeX mathematical character codes do their best to *avoid* a simple treatment of the decimal separator. Here we describe a few ways to handle this problem.

1 Introduction

The history of the decimal separator between the integer and the fractional part of a decimal number is quite interesting, but nowadays, where the ISO regulations standardise everything, the historical traditions reflect themselves only in the language dependent variations of this sign. The ISO regulations require the decimal point when a number is within a text in English, or a decimal comma otherwise. In Great Britain the centered dot is still common, but this nice tradition is in contrast with the ISO regulations.

Therefore this different language dependent treatment of the decimal separator, according to my opinion, should be dealt with during the language selection of the `babel` or the `polyglossia` packages. Up to now the efforts I made to insert a proper treatment connected with the `italian` option to the `babel` package have produced no effects. It's reasonable: why only Italian and not all other languages?

The other side of the medal is the \TeX point of view: any symbol to be used in mathematics has a mathcode that specifies its rôle. When the decimal point is used as a separator, its mathcode classifies it as a 'normal' symbol, which means that it receives no spacing before and after it; when the period is used as a punctuation mark, this happens only at the end of a mathematical expression and it does not separate anything, so the default null spacing is irrelevant.

Quite the opposite is the case, however, when the comma is used as a decimal separator. It must be treated differently from when it is used a punctuation mark, for example when it is used as a list item separator. Compare, as an example, the independent variable list $f(x, y)$ with $f(x, y)$; compare also the decimal separator $e = 2,718$ and $e = 2, 718$. This happens because the rôle of a punctuation mark implies a small space on its right. Of course the spacing may be fixed by using the math spacing commands, but this is contrary to good sense. (L^A)T_EX should be able to treat the problem letting the author concentrate on what s/he has to write, not on what it looks like.

2 Ready made solutions

There are several packages that solve this problem; on the one hand, there are packages that deal with both the right sign and the substitution of the wrong sign. Among these we can cite numprint [1] and siunitx [4].

The first package not only works in both text and math mode, but it also changes the ‘wrong’ decimal sign into the ‘right’ one, besides transforming the computer output into a mathematical expression: it can change $12345.6e789$ into $12345,6 \cdot 10^{789}$ while using the proper fonts both in math and text mode.

The second package is a complete instrument for dealing with units (SI units in particular) and their numerical values not only in math and text modes, but also in tabular mode so as to have a perfect typeset document with the proper decimal signs, the proper fonts, the proper alignment in table columns, the proper unit symbols with the proper unbreakable spacings. Complete service!

On the other hand, there are also packages that deal only with the proper mathcodes in mathematical typesetting; I can cite for example icomma [3] and ncccomma [2].

The first package defines an active math comma that tests whether or not it is followed by a space; if it is, it inserts a punctuation comma, if not, it inserts a normal symbol comma.

The second package also defines an active math comma that tests whether or not it is followed by a digit; if it is, it inserts a normal symbol comma, if not, it inserts a punctuation comma. The second package is handier, because the typist does not need to do anything special in setting up the source L^AT_EX file, except

when the comma is used as a numerical list separator as in $\forall i \in 0, 1, 2, \dots, n$ to be input as `\forall_{i \in 0, 1, 2, \dots, n}`.

3 A proposal for an intelligent comma

Actually I have created a macro that is simpler than the one by Alexander Rozhenko; his macro exploits a lot of `\expandafter` commands, while I think my version is simpler and more easily understood:

```
\makeatletter % not necessary when this code is in a .sty file

% 1st part
\DeclareMathSymbol{\punctcomma}{\mathpunct}{letters}{"3B}
\DeclareMathSymbol{\decimalcomma}{\mathord}{letters}{"3B}

% 2nd part
\AtBeginDocument{\mathcode'\,="8000}
{\catcode'\,=\active \gdef{\futurelet\let@token\m@thcomma}}

% 3rd part
\def\m@thcomma{\let\@tempB\punctcomma
\@tfor\@tempA:=0123456789\do{%
\expandafter\ifx\@tempA\let@token\let\@tempB\decimalcomma
\@break@tfor\fi}\@tempB}
```

As can be seen from the listing, the code is divided in three simple parts:

1. Two math symbols are defined: `\punctcomma` is the definition of a punctuating comma, while `\decimalcomma` represents the decimal separator. The second parameter of the declarative command clearly states their rôles.
2. The comma sign is made an active character in math mode: the hexadecimal code "8000 is the special active maths code that $\text{T}_{\text{E}}\text{X}$ defines for mathematical active characters. But this activeness is deferred until the beginning of the actual document, so as not to disturb other packages, should they use other active characters, possibly including the comma. The active comma is

then defined within a group, but the definition is global so it overrides the group boundaries.

3. Eventually the real macro is defined, `\m@thcomma`. This macro first creates a temporary control sequence as an alias to the punctuating comma; then it scans a token list by means of the internal \LaTeX recursive macro `\@tfor`. This macro recursively *defines* another temporary macro with one of the tokens of the list contained within the `:=` and the `\do` delimiters (in our case the ten decimal digits) and then executes what appears to be the argument of the `\do` command (actually `\do` is just a delimiter). This temporary macro is first expanded in order to extract the token it contains and then is compared with the `\let@token` that the main macro had `\let` as an alias to whatever token followed the source text comma. If it is a digit, then the temporary control sequence `\@tempB` is `\let` to the decimal separator. The last operation in the definition is used only for terminating the recursiveness as soon as a digit is found in the list that matches the `\let@token` alias. At the very end the temporary control sequence `\@tempB` contains whatever was the last equivalence of this temporary control sequence, *i.e.* either one of the two comma meanings.

Nothing new, except simplicity and versatility. In fact, by making only minor changes to parts 1 or 2 of the small sequence of declarations and definitions, it is possible to change the decimal period into a decimal comma, or any other symbol that the comma or the period character is to be transformed into.

Since the `\iflanguage` test is implemented with both `babel` and `polyglossia`, one may include the `mathcode` active declaration into such a test in order to change the math code, depending on the language used.

4 Conclusion

The macros above play well with both *pdf \LaTeX* and *x \LaTeX* ; with the latter even when using the declaration `unicode-math`.

The whole code amounts to a mere eight lines that may be copied into a personal macro file, or in the preamble of any document where the main language is not one of the English varieties.

I use these few lines of code in any one of my documents written in Italian; the only thing I have to pay attention to, is to insert spaces after commas in the input files when those commas separate numerical items in a list. Otherwise, the comma is intelligent enough to play the rôle it is assumed to play.

I wish that such a simple solution, or a similar better one, might eventually be taken into consideration by the maintainers of the `babel` and `polyglossia` packages, so that in due time we can forget about intelligent commas, because they will be incorporated into the language changing mechanism by default.

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Speedy LaTeX on the Mac

Lenore Horner

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Abstract: As first a physics professor and now a math and physics high school teacher, my teaching materials are always evolving and I am always looking for ways to make this easier for myself and to avoid reinventing the wheel (often my own wheel). Over the last three years, LaTeX has been a key part of that process. Here are the Mac-specific tools I use to make the typesetting as fast as possible so I can spend my time on content rather than on formatting.

Mini bio: I've been using LaTeX exclusively for almost a year now in teaching physics and math classes at university and high school levels. `lenore dot horner at 7hills dot org`.

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Speedy \LaTeX on the Mac

M.L. Horner

The Seven Hills Schools, Cincinnati, OH

Abstract As first a physics professor and now a math and physics high school teacher, my teaching materials are always evolving and I am always looking for ways to make this easier for myself and to avoid reinventing the wheel (often my own wheel). Over the last three years, \LaTeX has been a key part of that process. Here are the Mac-specific tools I use to make the typesetting as fast as possible so I can spend my time on content rather than on formatting.

1 Introduction

I've used a few different versions of \LaTeX on the Mac over the years, and gone through a couple of try-every-free-text-editor offerings hunting for one that I liked. Some of my choices may not suit your tastes or needs and the scripts I refer to may well not be exactly what you need. However, I hope that both choices and scripts create a few more tools for \LaTeX users: especially new users.

2 \LaTeX

There are several \LaTeX distributions for the Mac. All will give you a functional \LaTeX . My preference is for the \TeX Live distribution because it has tools for updating it quite easily. While \LaTeX is very stable over time, new features get added in packages and sometimes something new turns out to be useful to me, so I appreciate being able to easily grab the update when I find out it matters to me. I also like \TeX Live because it doesn't install editors or other "front-ends".

3 Text Editor

I've moved away from the front-ends (text editors with some extra bells and whistles specifically for L^AT_EX) for two reasons: I became frustrated with the details of how parenthesis matching worked (checking that for every open paren there is a closing paren); I started wanting to extend the capabilities of the front-ends and found that inconvenient. For the last couple of years I have used TextWrangler. It's free. It's easy to learn. It works very easily with AppleScript (including easy assignment of keyboard shortcuts to AppleScripts and opening of the AppleScript editor from within TextWrangler), which has lead me to tricks I never dreamed of when I started down this road.

4 Scripts

These are the scripts I use for L^AT_EX. Some of these scripts are fairly long. They are long because they are for typing lots of text into my file with one shortcut. The way they are written in AppleScript includes formatting to make my L^AT_EX file easier for me to read (the reason for so many occurrences of `&tab*` in the script) and so that when I hit the wrong shortcut, `command-z` takes the whole mess out in one step. I've also generally worked to put the cursor in the place I usually want to start typing after I insert that particular chunk. If you prowl through these scripts, you'll find slight differences in the way I do similar things. Some have to do with whether I want to take text already in my file and modify it or whether I want only to insert new things. The insertion point commands differ most. I'm not sure I entirely understand these commands and have used what worked in various situations. Insertion at the end of a line is much easier than insertion in the middle of a line.

The divisions below do not exactly reflect the folder structure where I store the scripts. Changing where a script is in the folder structure forces a redo of the keyboard shortcut but has no other consequences. These scripts live in `/Users/myusername/Library/Application Support/TextWrangler/Scripts`. TextWrangler creates this folder *automagically* during installation. These scripts can be copied into that folder by the usual Mac method of drag-and-drop.

4.1 Compiling

- **Myxelatex**: this is what I use most
- **Mylatex**: for when I want to use just ordinary L^AT_EX
- **Lilypond-xelatex**: for combining music and math

4.2 General L^AT_EX

basic text formatting: **bold**, *italic*, **roman**: All of these take any highlighted text and apply the formatting to that text. If nothing is highlighted, the empty environment is inserted with the cursor inside the environment waiting for the text to be formatted.

graphics and tables

figure-notes: figure environment with centered graphics (scaling possible)

graphics: just a graphic (scaling possible)

figure-solns: figure environment with centered graphics (scalable), caption, and label for reference from elsewhere in the document

table: the bare bones of a L^AT_EX table

lists : All except **item** will take one or more lines of highlighted text and insert `\item` at the beginning of the line (including a space). If no text is highlighted, the insertion is ready for typing with the first item in the list.

- **enumerate**: create a numbered/lettered list by inserting its `\begin{enumerate}` and `\end{enumerate}` statements and one `\item` statement
- **item**: insert `\item` with a space (because I routinely mistype this word)
- **itemize**: the same as `enumerate` but bulleted rather than numbered or lettered
- **inpara-enum**: requires `\usepackage{paralist}` in the preamble to not be commented out; inserts environment that permits horizontal lists (for instance multiple choice answers if they are short)

specific environments (some beyond basic L^AT_EX)

- **center**: insert centered stuff; will put highlighted material inside the environment
- **quote**: for block-quoting from someone else’s work; a way to create indented margins quickly for small amounts of material
- **mailto**: insert commands to turn an email address into a clickable link with the email address human-readable in the pdf output
- **block**: for Beamer slides; block of text or graphic with a title
- **frame**: for Beamer; start and end for slides in the presentation
- **lilypond-snippet**: the proper pieces to put around musical notation so that they are handed to Lilypond and then put into the document as pretty notes (requires XeTeX if I remember right)

4.3 Math

math environments

- **align**: the align environment for multiple lines of math
- **math-display**: for single lines of math set on their own line and numbered
- **math-inline**: for math within a paragraph

autosizing parentheses etc. : all require the following commands in the preamble

```
%create shortcut for the autoscaled (), [], <>, and ||
%- don't autocolor because it breaks ^ placement
\renewcommand{\left}{\left(}
\renewcommand{\right}{\right)}

\renewcommand{\left[}{\left[}
\renewcommand{\right]}{\right]}

\newcommand{\left\langle}{\left\langle}
\renewcommand{\right\rangle}{\right\rangle}
```

```
\renewcommand{\l}{\left|}
%end (), [], <>, || automation
```

- **brackets**: matching pair of [and]; if used with text highlighted, the enclosed text will be within the brackets
- **parens**: same for ()

other bits I use a lot

- **units**: requires
`\usepackage[per-mode=fraction,sticky-per=true,
load-configurations=abbreviations,
separate-uncertainty=true]{siunitx}`
in the preamble; inserts `\si{\}`
- **number-units**: also requires `siunitx`; inserts `\SI{\}{\}` for number followed by units
- **v-units**: also requires `siunitx`; inserts SI speed units
- **a-units**: also requires `siunitx`; inserts SI acceleration units
- **fraction**: inserts `\frac{}{\}` with the cursor in the first set of curly braces
- **half**: inserts the L^AT_EX for $\frac{1}{2}$
- **partial**: inserts the L^AT_EX for the partial derivative $\frac{\partial}{\partial}$ with the cursor in the numerator

4.4 Teaching

- **exampleList**: creates the slide-and-notes framework for a clickable list of examples in the notes
- **example**: creates all the structure for individual examples for material to appear in lecture and material that appears only in notes posted online
- **ProbPartSolAns**: requires `\input testpoints` at the beginning of the file and the file `testpoints.tex` where L^AT_EX can find it; requires `\usepackage{comments}`; all the pieces of a problem: the statement; space for student work; space for

solutions; space for the answer with all the pieces turned on or off by `\includecomment{name}` or `\excludecomment{name}` commands in the preamble

- **PartSolAns**: insert another part into an existing problem; same requirements as `ProbPartSolAns`
- **rightAnswer**: highlight the right answer on a multiple choice test and quickly reformat it for creation of an answer key
- **version**: the environment for sections that can be commented in or out of the document; `version` needs to be replaced by specific names (problem, space, solutions, etc.)

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Page numbers in bibliography

Dear Nelly,

A number of books incorporate into their bibliography items a list of one or more pages on which the given reference is cited in that book. For example, the book *The Analysis of Variance*, by H. Scheffe, contains this entry in the bibliography:

```
G. Birkhoff and S. MacLane (1953), A Survey of Modern Algebra, Macmillan,
New York. [371, 380, 387]
```

The three numbers in brackets indicate the pages on which Scheffe cites Birkhoff and MacLane. Scheffe did this for every entry.

Is there a simple way (or any way) to do this in LaTeX? I've looked at <http://tug.ctan.org> and also at the documentation for `makebst.tex`, but don't see this issue discussed.

This is of course a useful feature for readers of a book, but it is also useful for someone (like me) writing a book in LaTeX, to track easily where I myself have used a citation.

Sincerely, Jay

Dear Jay,

The package `backref` from the `hyperref` suite does exactly what you need. Just adding

```
\usepackage{backref}
```

to the preamble of your LaTeX document will load this package. Once loaded, it will create a list of page numbers on which each bibliographic item is cited, and it will print those as part of each entry in your bibliography.

The default behaviour of `backref` is to list page numbers, but it can also be made to list section numbers instead, by loading it thusly:

```
\usepackage[backref]{backref}
```

whereas the default behaviour is equivalent to

```
\usepackage[backpageref]{backref}
```

and in documents that are to be used electronically, the listed page or section numbers can be made into hyperlinks.

There are a few caveats:

- If your document uses a `thebibliography` environment be sure to leave empty lines or a `\par` between entries in your bibliographic database. If you don't, `backref` may behave oddly

```
\begin{thebibliography} % separate \bibitem's when using backref
\bibitem ...
\bibitem ...
\bibitem ...
\end{thebibliography}
```

- Make sure to perform an extra run of `latex` when compiling your document, since the insertion of the page numbers by `backref` may very well change page breaks in the back matter of your document
- The package `backref` is not compatible with every bibliographic package CTAN has to offer. `natbib` is recommended.

I hope this answers your question.

Kind regards,

Yuri (on behalf of Nelly)

Teacher vs student course materials

Dear Nelly: When I write course materials for my students, I often create a student version of the syllabus, as well as a version for me and my assistants that contains additional material, such as answers to exercises. I do, however, find that maintaining two documents with mostly identical content is not only tedious, but also rather error-prone. Surely there is a better way to do this? I've searched CTAN in vain, so I've set my hopes on you...

Answer: Thank you for your trust! There is indeed a better way!

By using the `package comment` you can do this as follows:

- In the preamble of your LaTeX document add

```
\usepackage{comment}
\includecomment{teacher} % use this to make a document *with* teacher materials
%\excludecomment{teacher} % use this to make a document without teacher materials
```

- In the body of your document use, for example,

```
What is the circumference of the circle?
\begin{teacher}
  The answer is  $2\pi r$ $.
\end{teacher}
...
How much of the cheese did the mouse eat?
\begin{teacher}
  The answer is  $\frac{7}{8}$ $.
\end{teacher}
```

If you typeset your document now it will include the answers to both questions.

To make a document without the answers, change the two preamble lines above to

```
%\includecomment{teacher} % use this to make a document *with* teacher materials
\excludecomment{teacher} % use this to make a document without teacher materials
```

and typeset again.

For an example of this method, see [the article by Lenore Homer](#) in this issue. In the file [Sample test](#) she uses six variables to make different versions of the document — see halfway down this file where she uses

```
%create annotated and unannotated output from this file by changing include <-> exclude
\excludecomment{topics}
\includecomment{questions}
...
```

Advanced refinements

If you operate from the command line, you can use the same method shown above, and automate this as follows:

- To make a teacher version do

```
latex '\AtBeginDocument{\includecomment{teacher}}\input{syllabus}'
```

- To make a version without teacher material do

```
latex '\AtBeginDocument{\excludecomment{teacher}}\input{syllabus}'
```

where `syllabus` is the name of your source file, `syllabus.tex`.

If you are on Linux, UNIX, or Mac OS X, you can additionally create a `Makefile` as follows:

```
student:
  latex '\AtBeginDocument{\excludecomment{teacher}}\input{syllabus}'
teacher:
  latex '\AtBeginDocument{\includecomment{teacher}}\input{syllabus}'
```

This way you can typeset the student version by giving the command `make student` and the teacher version by issuing the command `make teacher`.

The above question was answered by [Yuri Robbers](#), a member of the editorial board of this journal. He can be reached at `pracjourn at tug dot org`.

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“Babeş-Bolyai” University

Faculty of Mathematics and Computer Sciences

MMG1001-131-1-2011 Riemannian Geometry

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(01) M 12.00–13.00hrs
(02) M 13.00–14.00hrs

Room
 π
 π

Textbooks

- Blaga, Paul A., 2005. *Lectures on Classical Differential Geometry*. Risoprint, Cluj-Napoca.
- do Carmo, Manfredo, 1992. *Riemannian Geometry*. Birkhauser.
- Gallot, S., Hulin, D., Lafontaine, J., 2004. *Riemannian Geometry*, (ed. III). Springer.

Course Description

1. Omnium hominum quos ad amorem veritatis natura superior impressit hoc maxime interesse videtur: ut, quemadmodum de labore antiquorum ditati sunt, ita et ipsi posteris prolaborent, quatenus ab eis posteritas habeat quo ditetur. 2. Longe nanque ab offitio se esse non dubitet qui, publicis documentis imbutus, ad rem publicam aliquid afferre non curat; non enim est lignum, quod secus decursus aquarum fructificat in tempore suo, sed potius pernicioso vorago semper ingurgitans et

nunquam ingurgitata refundens. 3. Hec igitur sepe mecum recogitans, ne de infossi talenti culpa quandoque redarguar, publice utilitati non modo turgescere, quinymo fructificare desidero, et intemptatas ab aliis estendere veritates. 4. Nam quem fructum ille qui theorema quoddam Euclidis iterum demonstraret? qui ab Aristotile felicitatem ostensam reostendere conaretur? qui senectutem a Cicerone defensam resumeret defensandam? Nullum quippe, sed fastidium potius illa superfluitas tediosa prestaret. 5. Cumque, inter alias veritates occultas et utiles, temporalis Monarchie notitia utilissima sit et maxime latens et, propter non se habere immediate ad lucrum, ab omnibus intemptata, in proposito est hanc de suis enucleare latibulis, tum ut utiliter mundo pervigilem, tum etiam ut palmam tanti bravii primus in meam gloriam adipiscar. 6. Arduum quidem opus et ultra vires aggredior, non tam de propria virtute confidens, quam de lumine Largitoris illius "qui dat omnibus affluenter et non improperat".

Evaluation

1. Primum quidem igitur videndum quid est quod 'temporalis Monarchia' dicitur, typo ut dicam et secundum intentionem. 2. Est ergo temporalis Monarchia, quam dicunt 'Imperium', unicus principatus et super omnes in tempore vel in hiis et super hiis que tempore mensurantur. 3. Maxime autem de hac tria dubitata queruntur: primo nanque dubitatur et queritur an ad bene esse mundi necessaria sit; secundo an romanus populus de iure Monarche offitium sibi asciverit; et tertio an auctoritas Monarche dependeat a Deo immediate vel ab alio, Dei ministro seu vicario. 4. Verum, quia omnis veritas que non est principium ex veritate alicuius principii fit manifesta, necesse est in qualibet inquisitione habere notitiam de principio, in quod analetice recurratur pro certitudine omnium propositionum que inferius assumuntur. Et quia presens tractatus est inquisitio quedam, ante omnia de principio scriptandum esse videtur in cuius virtute inferiora consistant. 5. Est ergo sciendum quod quedam sunt que, nostre potestati minime subiacentia, speculari tantummodo possumus, operari autem non: velut mathematica, physica et divina; quedam vero sunt que, nostre potestati subiacentia, non solum speculari sed etiam operari possumus: et in hiis non operatio propter speculationem, sed hec propter illam assummitur, quoniam in talibus operatio finis. 6. Cum ergo materia presens politica sit, ymo fons atque principium rectorum politiarum, et omne politicum nostre potestati subiacet, manifestum est quod materia presens non ad speculationem per prius, sed ad operationem ordinatur. 7. Rursus, cum in operabilibus principium et causa omnium sit ultimus finis movet enim primo agentem, consequens est ut omnis ratio eorum que sunt ad finem ab ipso fine summatur. Nam alia erit ratio incidendi lignum propter domum constituendam, et alia propter navim. 8. Illud igitur, siquid est, quod est finis universalis civilitatis humani generis, erit hic principium per quod omnia que inferius probanda sunt erunt manifesta sufficienter: esse autem finem huius civilitatis et illius, et non esse unum omnium finem arbitrari stultum est.

Lecture Schedule

1. Nunc autem videndum est quid sit finis totius humane civilitatis: quo viso, plus quam dimidium laboris erit transactum, iuxta Phylosophum ad Nicomacum. 2. Et ad evidentiam eius quod queritur

advertendum quod, quemadmodum est finis aliquis ad quem natura producit pollicem, et alius ab hoc ad quem manum totam, et rursus alius ab utroque ad quem brachium, aliusque ab omnibus ad quem totum hominem; sic alius est finis ad quem singularem hominem, alius ad quem ordinat domesticam comunitatem, alius ad quem viciniam, et alius ad quem civitatem, et alius ad quem regnum, et denique optimus ad quem universaliter genus humanum Deus eternus arte sua, que natura est, in esse producit. Et hoc queritur hic tanquam principium inquisitionis directivum.

3. Propter quod sciendum primo quod Deus et natura nil otiosum facit, sed quicquid prodit in esse est ad aliquam operationem. Non enim essentia ulla creata ultimus finis est in intentione creantis, in quantum creans, sed propria essentie operatio: unde est quod non operatio propria propter essentiam, sed hec propter illam habet ut sit. 4. Est ergo aliqua propria operatio humane universitatis, ad quam ipsa universitas hominum in tanta moltitudine ordinatur; ad quam quidem operationem nec homo unus, nec domus una, nec una vicinia, nec una civitas, nec regnum particulare pertingere potest. Que autem sit illa, manifestum fiet si ultimum de potentia totius humanitatis appareat. 5. Dico ergo quod nulla vis a pluribus spetie diversis partecipata ultimum est de potentia alicuius illorum; quia, cum illud quod est ultimum tale sit constitutum spetiei, sequeretur quod una essentia pluribus spetiebus esset specificata: quod est impossibile. 6. Non est ergo vis ultima in homine ipsum esse simpliciter sumptum, quia etiam sic sumptum ab elementis participatur; nec esse complexionatum, quia hoc reperitur in mineralibus; nec esse animatum, quia sic etiam in plantis; nec esse apprehensivum, quia sic etiam participatur a brutis; sed esse apprehensivum per intellectum possibilem: quod quidem esse nulli ab homine alii competit vel supra vel infra. 7. Nam, etsi alie sunt essentie intellectum participantes, non tamen intellectus earum est possibilis ut hominis, quia essentie tales speties quedam sunt intellectuales et non aliud, et earum esse nichil est aliud quam intelligere quod est quod sunt; quod est sine interpolatione, aliter sempiternae non essent. Patet igitur quod ultimum de potentia ipsius humanitatis est potentia sive virtus intellectiva. 8. Et quia potentia ista per unum hominem seu per aliquam particularium comunitatum superius distinctarum tota simul in actum reduci non potest, necesse est multitudinem esse in humano genere, per quam quidem tota potentia hec actuetur; sicut necesse est multitudinem rerum generabilium ut potentia tota materie prime semper sub actu sit: aliter esset dare potentiam separatam, quod est impossibile. 9. Et huic sententie concordat Averrois in comento super hiis que De anima. Potentia etiam intellectiva, de qua loquor, non solum est ad formas universales aut speties, sed etiam per quandam extensionem ad particulares: unde solet dici quod intellectus speculativus extensione fit practicus, cuius finis est agere atque facere. 10. Quod dico propter agibilia, que politica prudentia regulantur, et propter factibilia, que regulantur arte: que omnia speculationi ancillantur tanquam optimo ad quod humanum genus Prima Bonitas in esse produxit; ex quo iam innotescit illud Politice: intellectu, scilicet, vigentes aliis naturaliter principari.

Assignment Details

1. Satis igitur declaratum est quod proprium opus humani generis totaliter accepti est actuare semper totam potentiam intellectus possibilis, per prius ad speculandum et secundario propter hoc ad operandum per suam extensionem. 2. Et quia quemadmodum est in parte sic est in toto, et in homine particulari contingit quod sedendo et quiescendo prudentia et sapientia ipse perficitur, patet quod genus humanum in quiete sive tranquillitate pacis ad proprium suum opus,

quod fere divinum est iuxta illud "Minuisti eum paulominus ab angelis", liberrime atque facillime se habet. Unde manifestum est quod pax universalis est optimum eorum que ad nostram beatitudinem ordinantur. 3. Hinc est quod pastoribus de sursum sonuit non divitie, non voluptates, non honores, non longitudo vite, non sanitas, non robur, non pulcritudo, sed pax; inquit enim celestis militia: "Gloria in altissimis Deo, et in terra pax hominibus bone voluntatis". 4. Hinc etiam "Pax vobis" Salus hominum salutabat; decebat enim summum Salvatorem summam salutationem exprimere: quem quidem morem servare voluerunt discipuli eius et Paulus in salutationibus suis, ut omnibus manifestum esse potest. 5. Ex hiis ergo que declarata sunt patet per quod melius, ymo per quod optime genus humanum pertingit ad opus proprium; et per consequens visum est propinquissimum medium per quod itur in illud ad quod, velut in ultimum finem, omnia nostra opera ordinantur, quia est pax universalis, que pro principio rationum subsequentium supponatur. 6. Quod erat necessarium, ut dictum fuit, velut signum prefixum in quod quicquid probandum est resolvatur tanquam in manifestissimam veritatem.

Tutorials

1. Resummens igitur quod a principio dicebatur, tria maxime dubitantur et dubitata queruntur circa Monarchiam temporalem, que comuniori vocabulo nuncupatur 'Imperium'; et de hiis, ut predictum est, propositum est sub assignato principio inquisitionem facere secundum iam tactum ordinem. 2. Itaque prima questio sit: utrum ad bene esse mundi Monarchia temporalis necessaria sit. Hoc equidem, nulla vi rationis vel auctoritatis obstante, potissimis et patentissimis argumentis ostendi potest, quorum primum ab autoritate Phylosophi assummat de suis Politicis. 3. Asserit enim ibi venerabilis eius autoritas quod, quando aliqua plura ordinantur ad unum, oportet unum eorum regulare seu regere, alia vero regulari seu regi; quod quidem non solum gloriosum nomen auctoris facit esse credendum, sed ratio inductiva. 4. Si enim consideremus unum hominem, hoc in eo contingere videbimus, quia, cum omnes vires eius ordinentur ad felicitatem, vis ipsa intellectualis est regulatrix et rectrix omnium aliarum: aliter ad felicitatem pervenire non potest. 5. Si consideremus unam domum, cuius finis est domesticos ad bene vivere preparare, unum oportet esse qui regulet et regat, quem dicunt patremfamilias, vel eius locum tenentem, iuxta dicentem Phylosophum: "Omnis domus regitur a senissimo"; et huius, ut ait Homerus, est regulare omnes et leges imponere aliis. Propter quod proverbialiter dicitur illa maledictio: "Parem habeas in domo". 6. Si consideremus vicum unum, cuius finis est commoda tam personarum quam rerum auxiliatio, unum oportet esse aliorum regulatorem, vel datum ab alio vel ex ipsis preheminentem consentientibus aliis; aliter ad illam mutuam sufficientiam non solum non pertingitur, sed aliquando, pluribus preheminerentibus, vicinia tota destruitur. 7. Si vero unam civitatem, cuius finis est bene sufficienterque vivere, unum oportet esse regimen, et hoc non solum in recta politia, sed etiam in obliqua; quod si aliter fiat, non solum finis vite civilis amictitur, sed etiam civitas desinit esse quod erat. 8. Si denique unum regnum particulare, cuius finis est is qui civitatis cum maiori fiducia sue tranquillitatis, oportet esse regem unum qui regat atque gubernet; aliter non modo existentes in regno finem non assecuntur, sed etiam regnum in interitum labitur, iuxta illud infallibilis Veritatis: "Omne regnum in se divisum desolabitur". 9. Si ergo sic se habet in hiis et in singulis que ad unum aliquod ordinantur, verum est quod assummitur supra; nunc constat quod totum humanum genus ordinatur ad unum, ut iam preostensum fuit: ergo unum oportet esse regulans sive regens,

et hoc 'Monarcha' sive 'Imperator' dici debet. 10. Et sic patet quod ad bene esse mundi necesse est Monarchiam esse sive Imperium.

Miscellaneous

1. Et sicut se habet pars ad totum, sic ordo partialis ad totalem. Pars ad totum se habet sicut ad finem et optimum: ergo et ordo in parte ad ordinem in toto, sicut ad finem et optimum. Ex quo habetur quod bonitas ordinis partialis non excedit bonitatem totalis ordinis, sed magis e converso.

2. Cum ergo duplex ordo reperiatur in rebus, ordo scilicet partium inter se, et ordo partium ad aliquod unum quod non est pars, sicut ordo partium exercitus inter se et ordo earum ad ducem, ordo partium ad unum est melior tanquam finis alterius: est enim alter propter hunc, non e converso.

3. Unde si forma huius ordinis reperitur in partibus humane multitudinis, multo magis debet reperiri in ipsa multitudine sive totalitate per vim sillogismi premissi, cum sit ordo melior sive forma ordinis; sed reperitur in omnibus partibus humane multitudinis, ut per ea que dicta sunt in capitulo precedenti satis est manifestum: ergo et in ipsa totalitate reperiri debet.

4. Et sic omnes partes prenotate infra regna et ipsa regna ordinari debent ad unum principem sive principatum, hoc est ad Monarcham sive Monarchiam.