H14POD so far

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- ✓ Week 1: Scientific writing
- ✓ Week 2: LabView
- ✓ Week 3: Statistics given by the faculty statistician
- ✓ Week 4: Using statistics packages.
- ✓ Week 5: Project planning
- Week 6: Latex for Engineers
- Week 7: Essential health and safety (Me)
- Week 8: Health and safety practical (Me+Dr. Galea+Prof. Larkins)
- Week 9: AutoCAD (Prof. Larkins)

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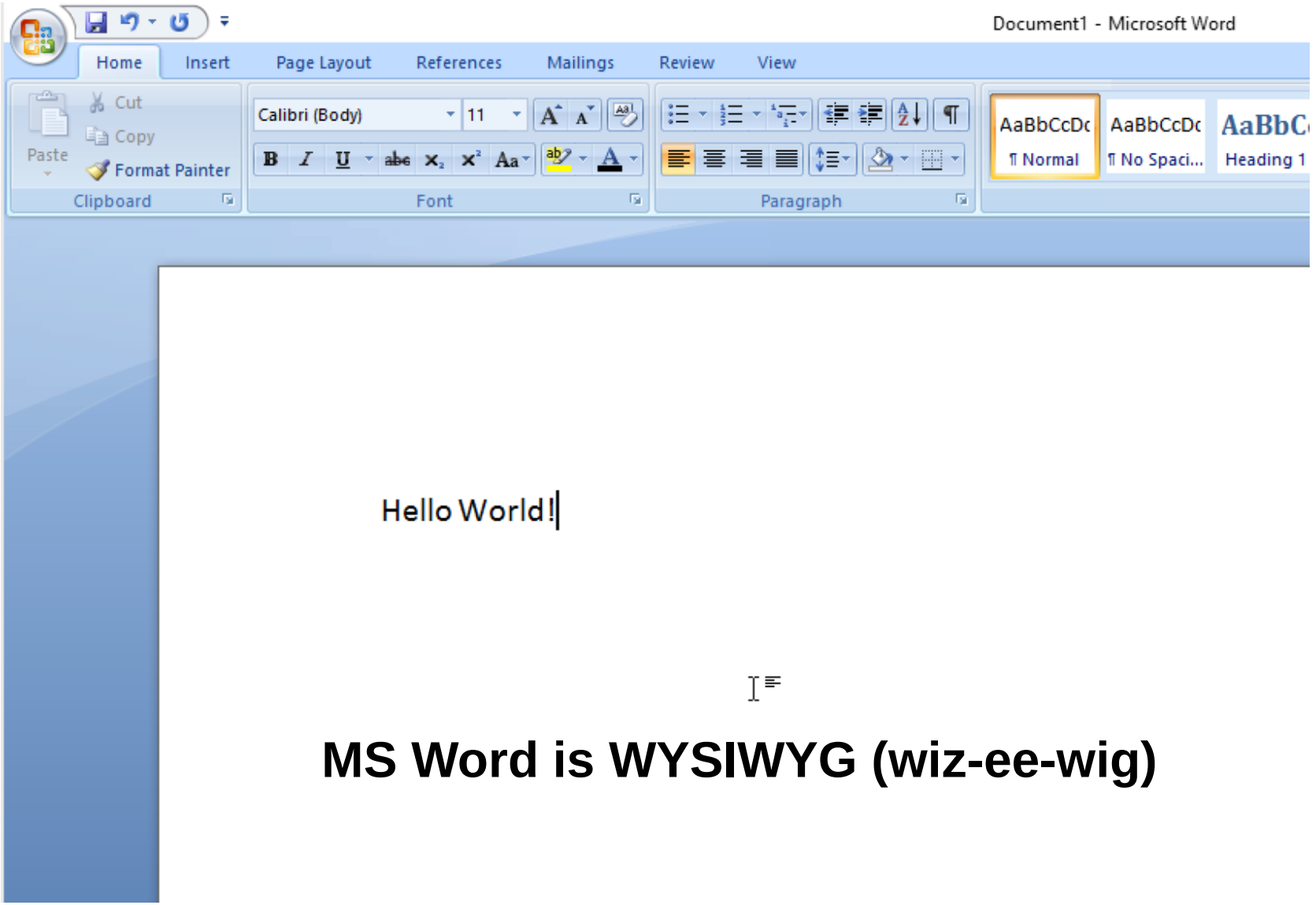
LaTeX for scientific writing

Dr Roderick MacKenzie
e-mail: roderick.mackenzie@nottingham.ac.uk

Lecture outline

- **What is LaTeX and when would I use it.**
- Your first latex document.
- Structuring your document.
- Packages explained
- Typesetting in LaTeX
- Adding a picture
- Making a ToC
- References

This is MS Word, we can describe it as WYSIWYG.



LaTeX is a bit different….

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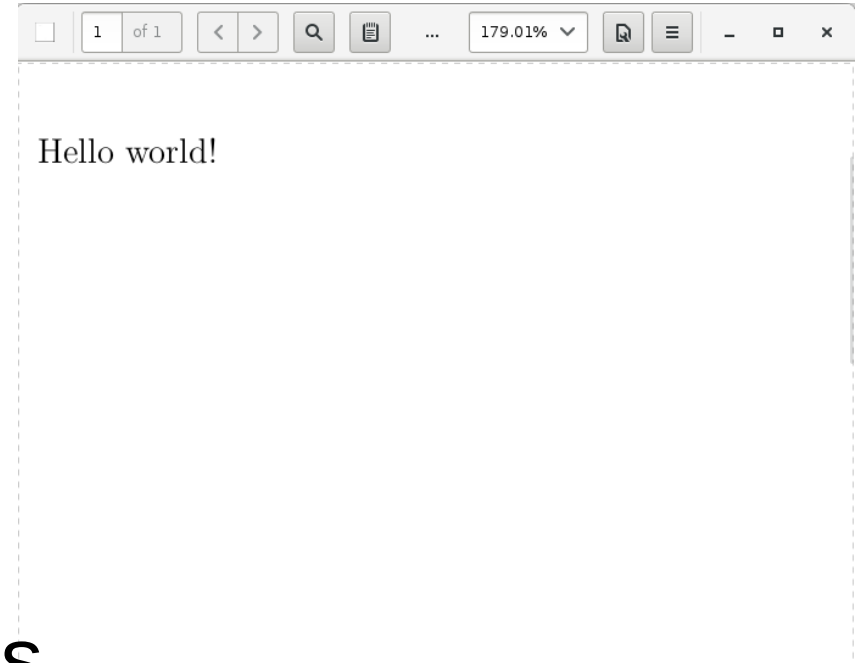
Source code → Compiled document

doc.tex

```
\documentclass[12pt]{article}

\begin{document}
Hello world!
\end{document}
```

doc.pdf



It’s harder but has benefits…..

MS Word v.s. LaTeX

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- When a Word document (or LibreOffice) exceeds 100 pages, it starts to become unmanageable:
  - It's ***slow***
  - Figures start to move around the page
  - Managing references becomes a pain
  - Takes ages to update references
  - I wrote my thesis in MS Office, (300) pages, it was a mistake.

- ***In general, large MS Word documents are a nightmare.***
- **LaTeX does not have this limitation**, it will cope with massive documents. It's good for books, your thesis, or manuals.

Word v.s. LaTeX

- With word you have to mess around with positioning of pictures/equations etc…
- This is fine for a 10 page document but **not a book!**

- With LaTeX, you just type in the text and **LaTeX will take care of everything else**, it will:
  - **Place pictures** close to where they are references.
  - **Hook up references**
  - Hook up **cross links**
  - **Place equations** in the right place
  - It will just do all the text formatting for you (**I like it a lot!**), you just have to focus on the content.

Advantages of Latex

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- Latex is **FREE** and runs on almost all systems.
- There are **many** free **addons** for Latex, for example:
  - **Journals** will give away **style packs** for Latex so when writing your paper you can see exactly how it will appear in print.
  - You can **instantly turn your document into a web site**.
  - You can turn your **documents into presentations**.
  - You can get **MATLAB to generate latex** for you.

- Here is a simple example from my work…..

I maintain some free software which has a manual written in LaTeX

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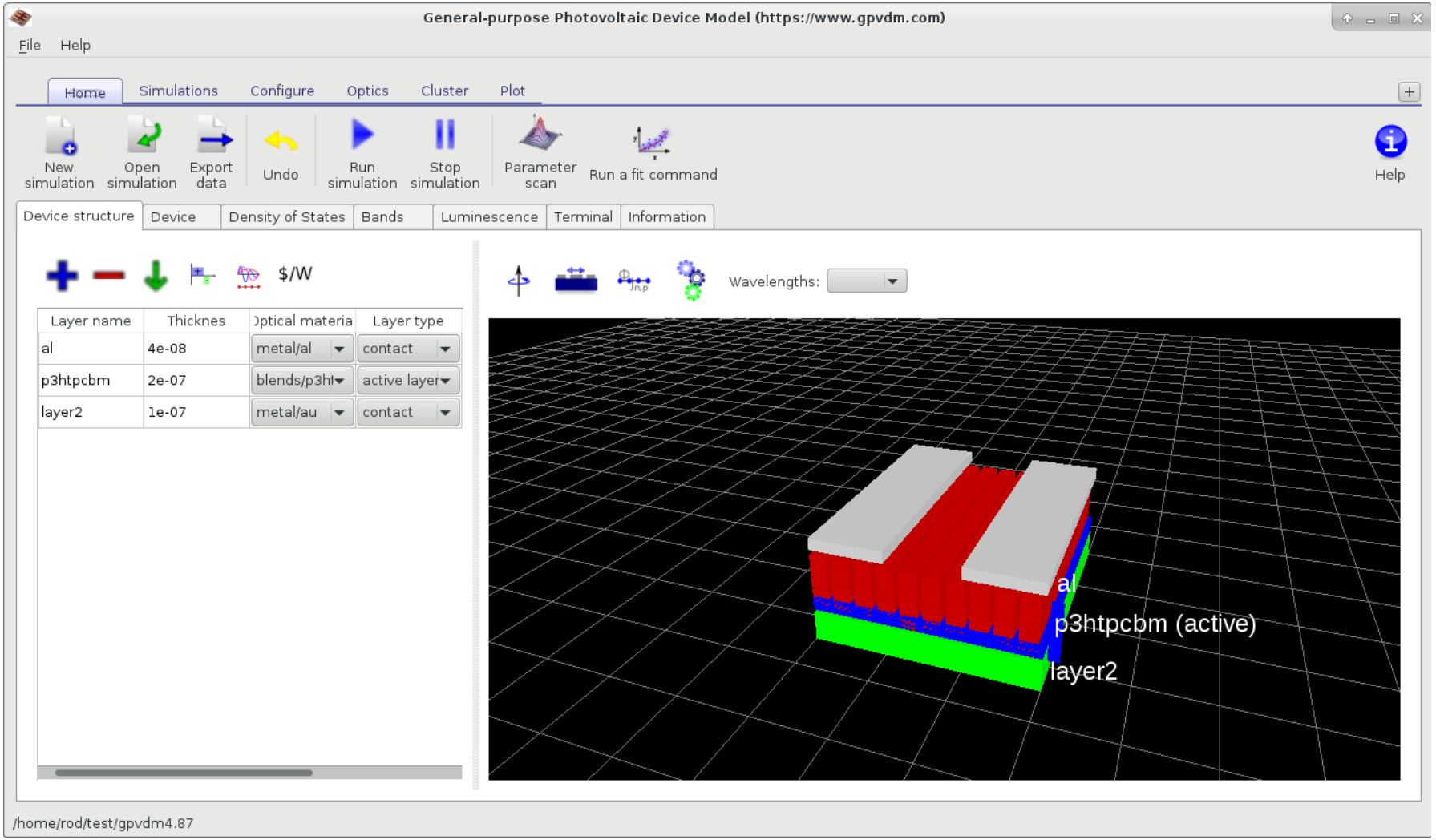

A latex document: Front page

Gpvdm manual

Roderick C. I. MacKenzie

February 18, 2017

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1

(talk through features)

A latex document: Front page

1 Foreword

I'm still in the process of writing this manual, so it is by no means exhaustive. If you want more detail, I suggest you also read the papers which were published from this model - do also read the supplementary information (SI) to the papers, as I often write about the model in there.

2 Running the model

2.1 Installing gpvdm for windows

Go to the download page for gpvdm at http://www.gpvdm.com/windows.php and download the latest version. Simply double click on it and say yes to all questions. The installer may offer you a choice of where to install the software to, don't change the install destination, the current version will only work if it is in the default install path which is C:\gpvdm. I publish a new exe with updates every couple of weeks, however it is possible I won't actually use gpvdm for a while after having published a new version. Therefore, it is entirely possible that I may have introduced bugs that break the code in between releases. So, if gpvdm is not working for, you drop me an e-mail and I will do my best to fix it asap.

2.2 Installing gpvdm for linux

I'm not updating gpvdm for linux as regularly as the windows version, this is a little ironic as I write all my code on linux and even compile the windows version on linux. The main reason for this is that there does not seem to be too much demand for a Linux version. If you really want a new (Fedora) Linux rpm that does the same thing as the windows exe let me know and I can build one for you. You can download the latest version of the gpvdm for linux here http://www.gpvdm.com/windows.php

2.3 Running gpvdm

On both windows and linux gpvdm will install on the start menu, click on it to launch it. Once run, a window resembling that in figure 1 will appear. From the left, the first three icons on the toolbar, open a simulation, save a simulation and generate a new simulation. Once you have made a new simulation, the the play button will run it, and the stop button will stop the simulation running. You will find more video examples describing how to use the model throughout the gpvdm web page.

(talk through features)

A latex document: Auto numbering and placing of figures

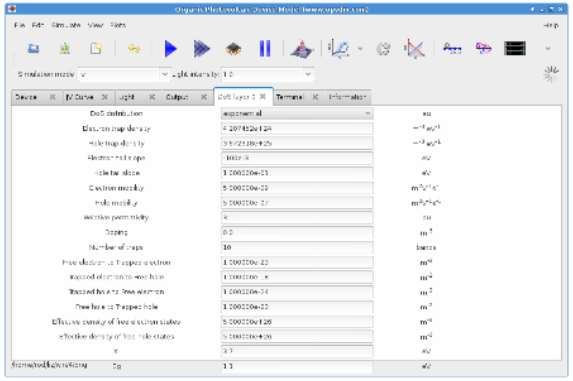

Figure 1: The electrical mesh editor

Each set of model parameters is displayed in an individual simulation tab. For example the tab 'DoS layer 0' contains the material parameters for material layer 0. These include mobility, recombination cross sections, tail slopes and band gaps. The 'device' tab is used to set information about the device, such as shunt resistance, series resistance and density of electrons/-holes on the contacts.

2.4 Meshing

2.4.1 Editing the electrical mesh/layers

Editing the electrical mesh is done in the electrical mesh editor window - see figure 2. The graph on the left hand side of the window shows the result of the most recent electrical simulation. You can recalculate this simulation for equilibrium conditions by clicking on the refresh button on the top left of the window (the button looks a bit like a recycle arrow). A device is made up of layers, each layer represents a different material system, these are defined using the list at the top right of the window. The thickness of

Jp_drift_plus_diffusion.dat:Total current density (Jn+Jp) - position
x-axis:Position(nm)
y-axis:Total current density (Jn+Jp)(Am^{-2})

3 The physical model

3.1 Electrical model

3.1.1 Calculating the built in potential

To calculate the built in potential of device we must know the following things:

- The majority carrier concentrations on the contacts n and p.
- The effective densities of states N_{LUMO} and N_{HOMO}.
- The effective band gap E_g

Then infinite recombination velocity on the contacts is assumed. I have not included finite recombination velocities in the model simply because they would add four more fitting parameters and in my experience I have never needed to use them to fit any experimental data I have come across.

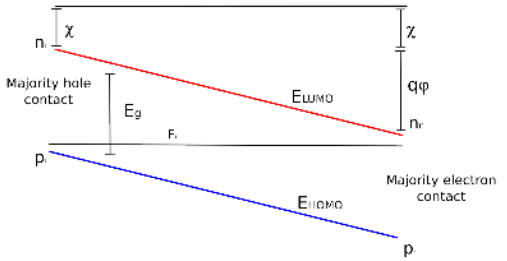

Figure 4: Band structure of device in equilibrium.

A latex document: Super nice equations

equation; electron thermal model and hole thermal model. The latter two solve the energy balance equations, or 3rd order moment expansion of of the Boltzmann equation. If you turn on just the lattice model, the lattice heat equation will be solved along with the electrical model. The thermal solver is external to the electrical solver.

$$\frac{d}{dx}\left(-\kappa_l \frac{dT_L}{dt}\right) = H \tag{25}$$

where H (the heat source term) is given by

$$H = \frac{1}{q}\frac{dE_c}{dx}J_n + \frac{1}{q}\frac{dE_v}{dx}J_p + R(E_c - E_v) \tag{26}$$

If you turn on the electrical and hole thermal model, then the heat source term will be replaced by

$$H = \frac{3k_b}{2}\left(n(\frac{T_n - T_l}{\tau_e}) + p(\frac{T_p - T_l}{\tau_h})\right) + R(E_c - E_v) \tag{27}$$

and the energy transport equation for electrons

$$S_n = -\kappa_n \frac{dT_n}{dx} - \frac{5}{2}\frac{k_b T_n}{q}J_n \tag{28}$$

and holes,

$$S_p = -\kappa_p \frac{dT_p}{dx} + \frac{5}{2}\frac{k_b T_p}{q}J_p \tag{29}$$

will be solved.
The energy balance equations will also be solved for electrons,

$$\frac{dS_n}{dx} = \frac{1}{q}\frac{dE_c}{dx}J_n - \frac{3k_b}{2}\left(RT_n + n(\frac{T_n - T_l}{\tau_e})\right) \tag{30}$$

and for holes

$$\frac{dS_p}{dx} = \frac{1}{q}\frac{dE_v}{dx}J_p - \frac{3k_b}{2}\left(RT_p + n(\frac{T_p - T_l}{\tau_e})\right) \tag{31}$$

The thermal conductivity of the electron gas is given by

- This looks like it has come from a book!
- MS Word would not be able to make it look this nice.
- Maybe some typesetting software on the Mac would be able to do this but it would not be free.

(talk through features)

A latex document: More nice equations

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3.2.3 Backwards propagating wave

Rearrange equation, 47 to give,

$$E_1^+ = E_1^- + \frac{n_2}{n_1}(E_2^+ - E_2^-) \tag{52}$$

Inserting in equation 44, gives

$$E_2^+ + E_2^- = E_1^- + \frac{n_2}{n_1}(E_2^+ - E_2^-) + E_1^- \tag{53}$$

$$2E_1^- = E_2^+ + E_2^- - \frac{n_2}{n_1}(E_2^+ - E_2^-) \tag{54}$$

$$2E_1^- \frac{n_1}{n_1 + n_2} = E_2^+ \frac{n_1 - n_2}{n_1 + n_2} + E_2^- \tag{55}$$

Which is the same result as obtained in [2].

These equations become:

$$E_1^- t_{12} = E_2^+ r_{12} + E_2^- \tag{56}$$

and

$$E_1^+ t_{12} = E_2^+ + E_2^- r_{12} \tag{57}$$

Accounting for propagation we can write. Note the change in sign between [2] and this work, this is because of how I have defined my wave equation.

$$E_1^+ t_{12} = E_2^+ e^{\zeta_2 d_1} + E_2^- r_{12} e^{-\zeta_2 d_1} \tag{58}$$

and

(talk through features)

A latex document: Coupling other software to LaTeX

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2.5 Output directories

equilibrium
Before the solver starts any simulation it solves the device equations in the dark with 0V applied bias. The result of this calculation are placed in this directory. The practical reason for doing this is that Newton's method only works if you give it a reasonable starting guess for any given problem. Thus to start the solver, we guess the carrier densities at 0V in the dark, we then use Newton's method to calculate the exact carrier density profiles at 0V in the dark (results are stored in the equilibrium directory), then from this point we can work our way to other solutions say at +1V in the light.

2.6 Output files

2.6.1 1D position space output

Band structure **Ec.dat**:LUMO-position
x-axis:Position(nm)
y-axis:Electron Energy(eV)

Efield.dat:Material number - position
x-axis:Position(nm)
y-axis:Number(au)

Eg.dat:Band gap-position
x-axis:Position(nm)
y-axis:Electron Energy(eV)

Ev.dat:HOMO-position
x-axis:Position(nm)
y-axis:Electron Energy(eV)

Fi.dat:Equlibrium Fermi-level - position
x-axis:Position(nm)
y-axis:Energy(eV)

Fn.dat:Electron quasi Fermi-level position
x-axis:Position(nm)
y-axis:Electron Energy(eV)

- This text was autogenerated by a python python script.
- Enables close integration of code/scripts and document generation.

And of course references.

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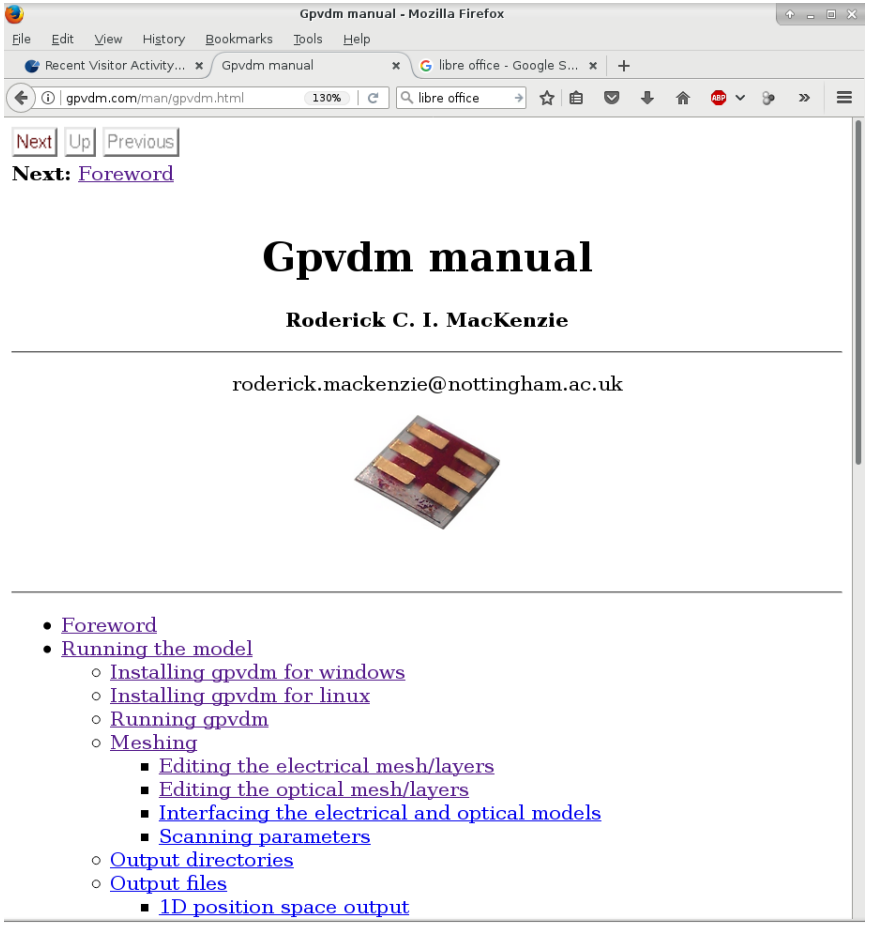
References

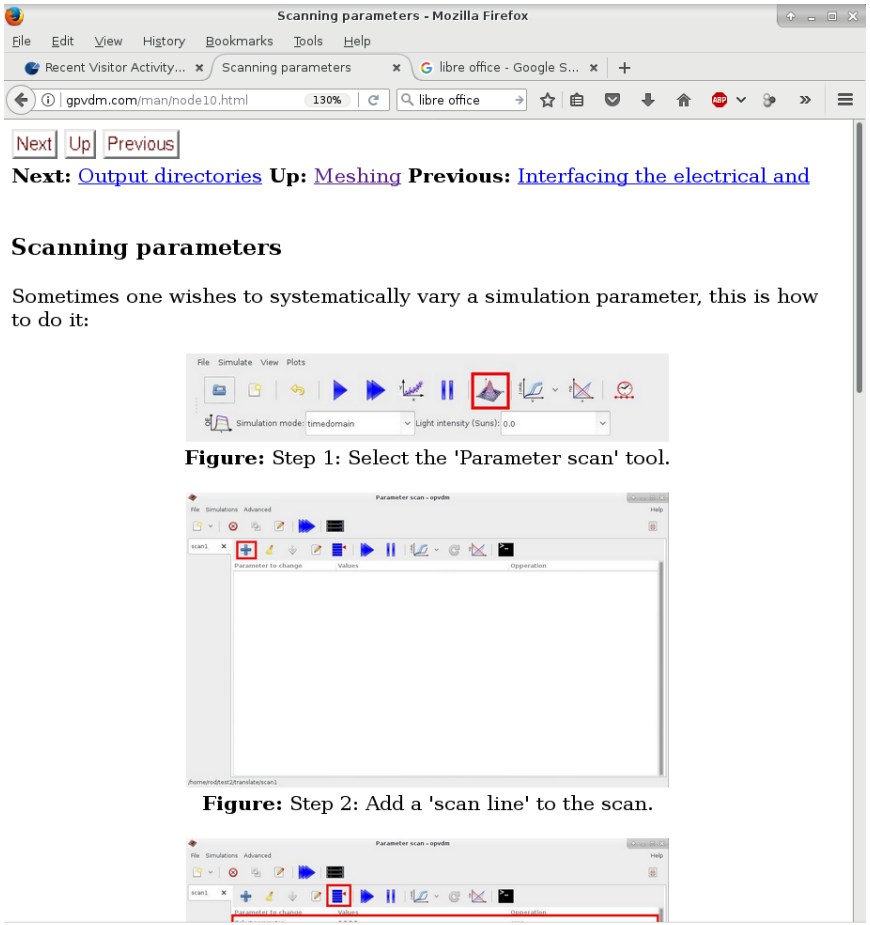
[1] T. Zhan, X. Shi, Y. Dai, X. Liu, and J. Zi. *Journal of Physics: Condensed Matter*, 2013, 25 21 215301.

[2] P. Peumans, A. Yakimov, and S. R. Forrest. *Journal of Applied Physics*, 2003, 93 7 3693–3723.

- I've only got two references in this document (because it's a manual) but they are nicely formatted.

And converting into a web page… is instant.





Lecture aim

- In this lecture we will be learning how to use **LaTeX**.
- Like many of the lectures in this module, I don’t want to make you an expert in the topic but **expose** you to **basic concepts**.
- You can then go off on your own **learn more on your own** if you want to.

Lecture outline

- What is LaTeX and when would I use it.
- **Your first latex document.**
- Structuring your document.
- Packages explained
- Typesetting in LaTeX
- Adding a picture
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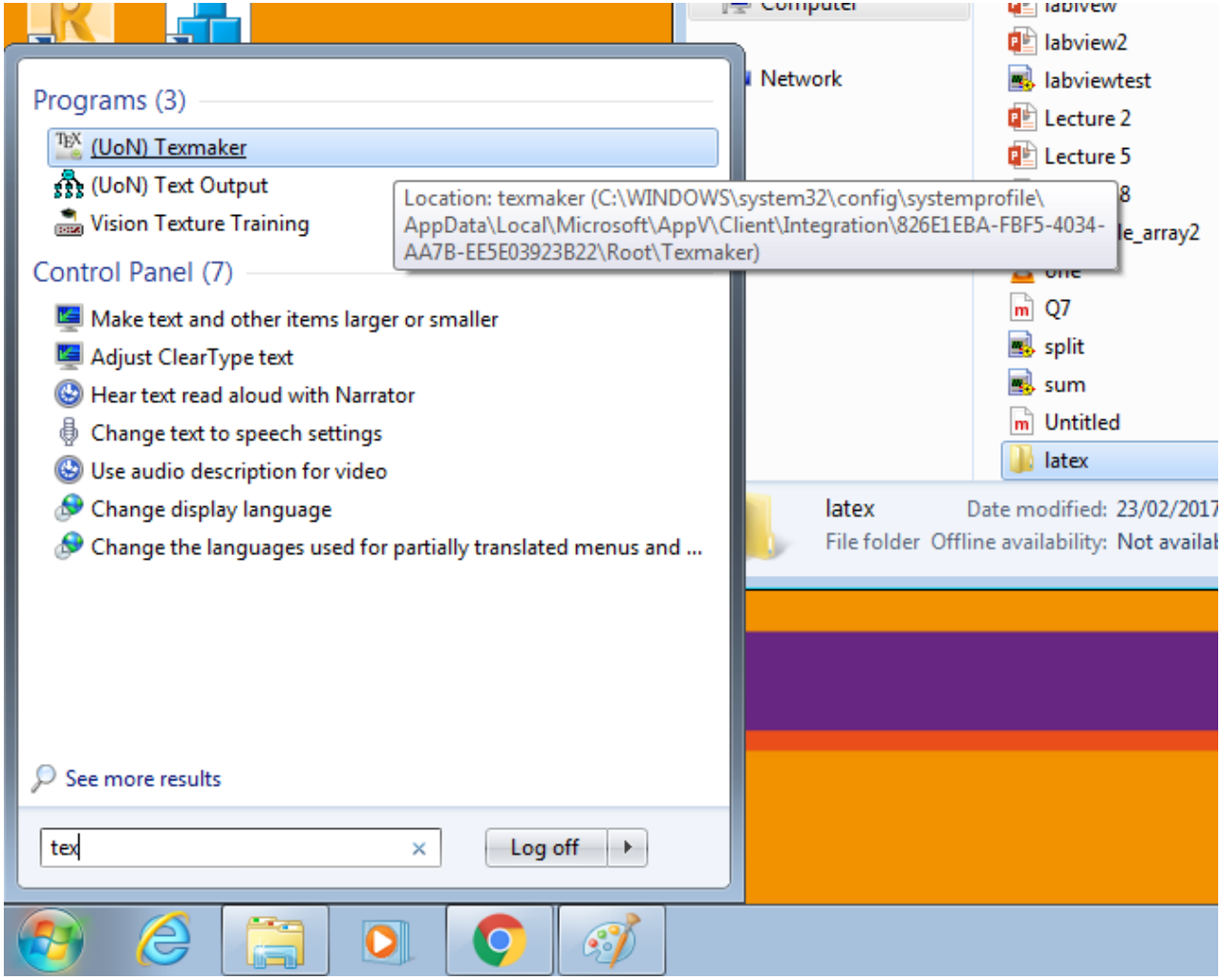
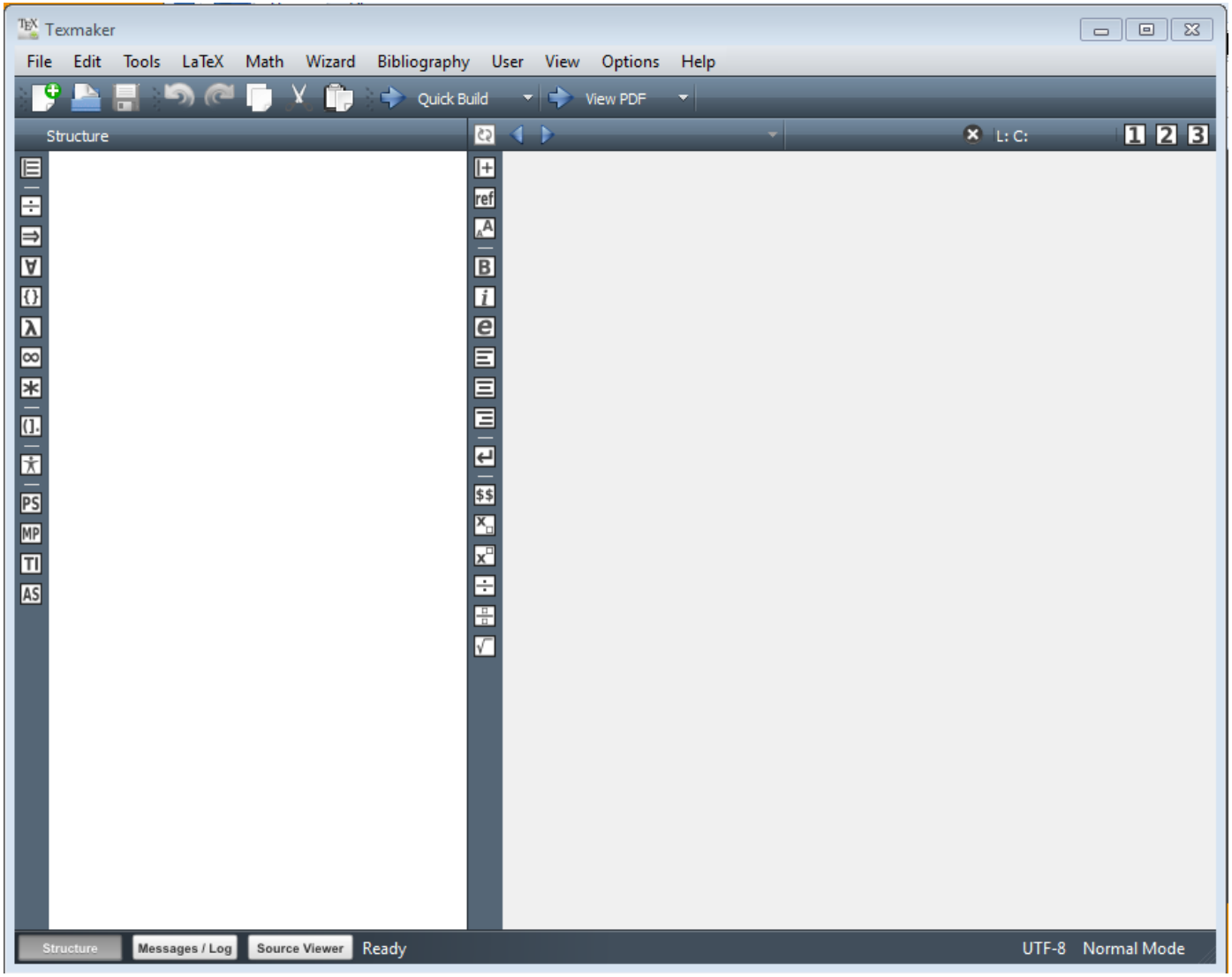
Starting latex



- There are lots of front ends to latex

Starting latex



Texmake is just a front end to LaTeX, there are lots of other front ends.

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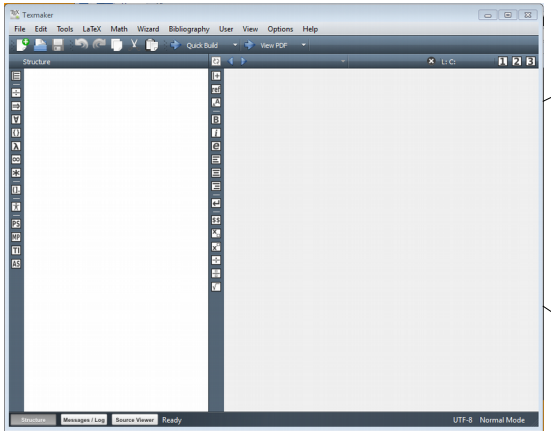
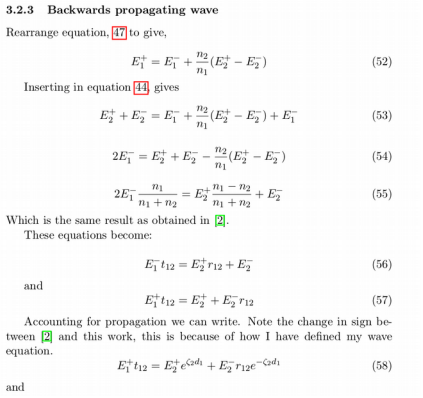


Front end (GUI)

LaTeX

BibTeX

Back end



3.2.3 Backwards propagating wave

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and

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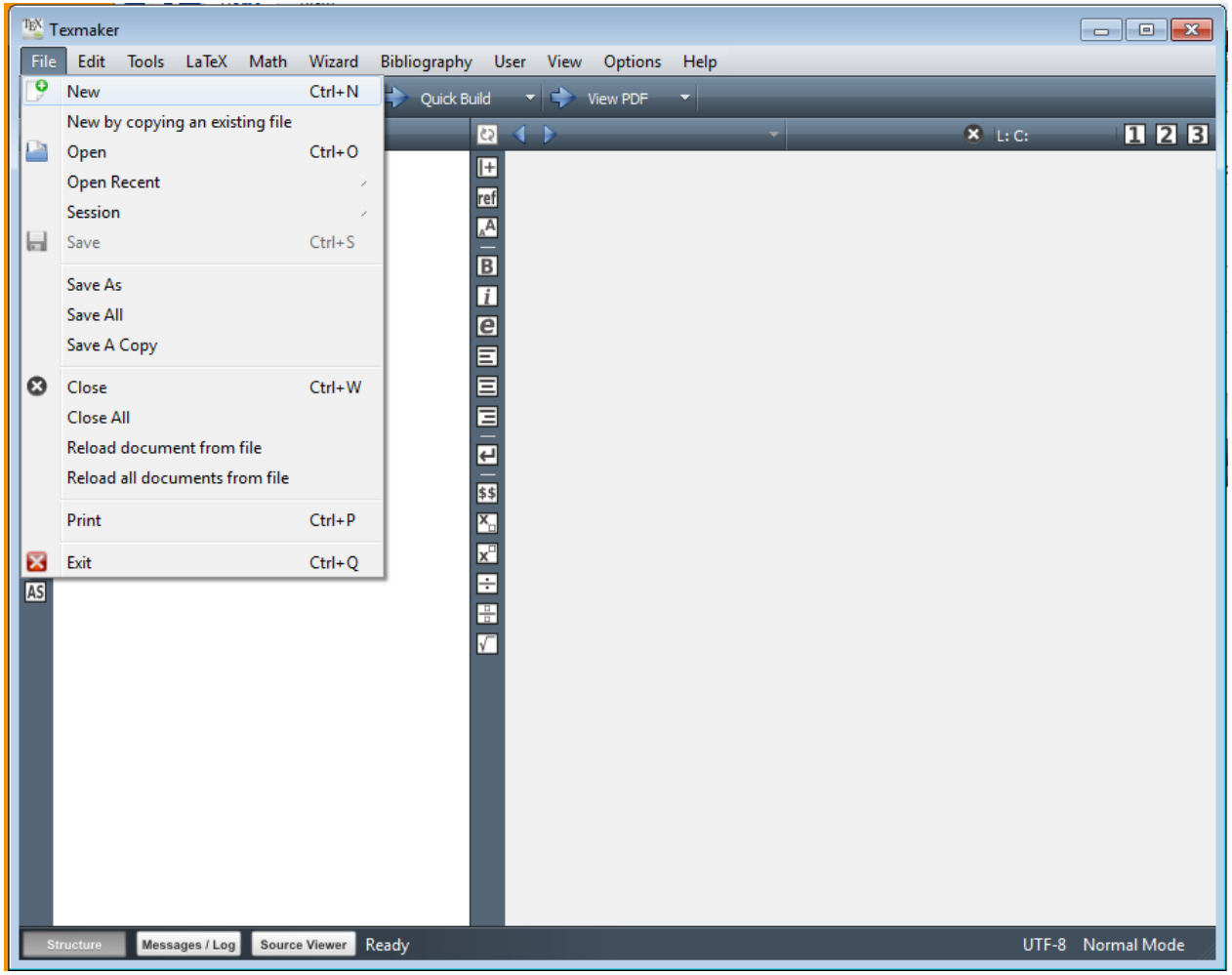
$$E_1^+ t_{12} = E_2^+ e^{\zeta_2 d_1} + E_2^- r_{12} e^{-\zeta_2 d_1} \quad (58)$$

and

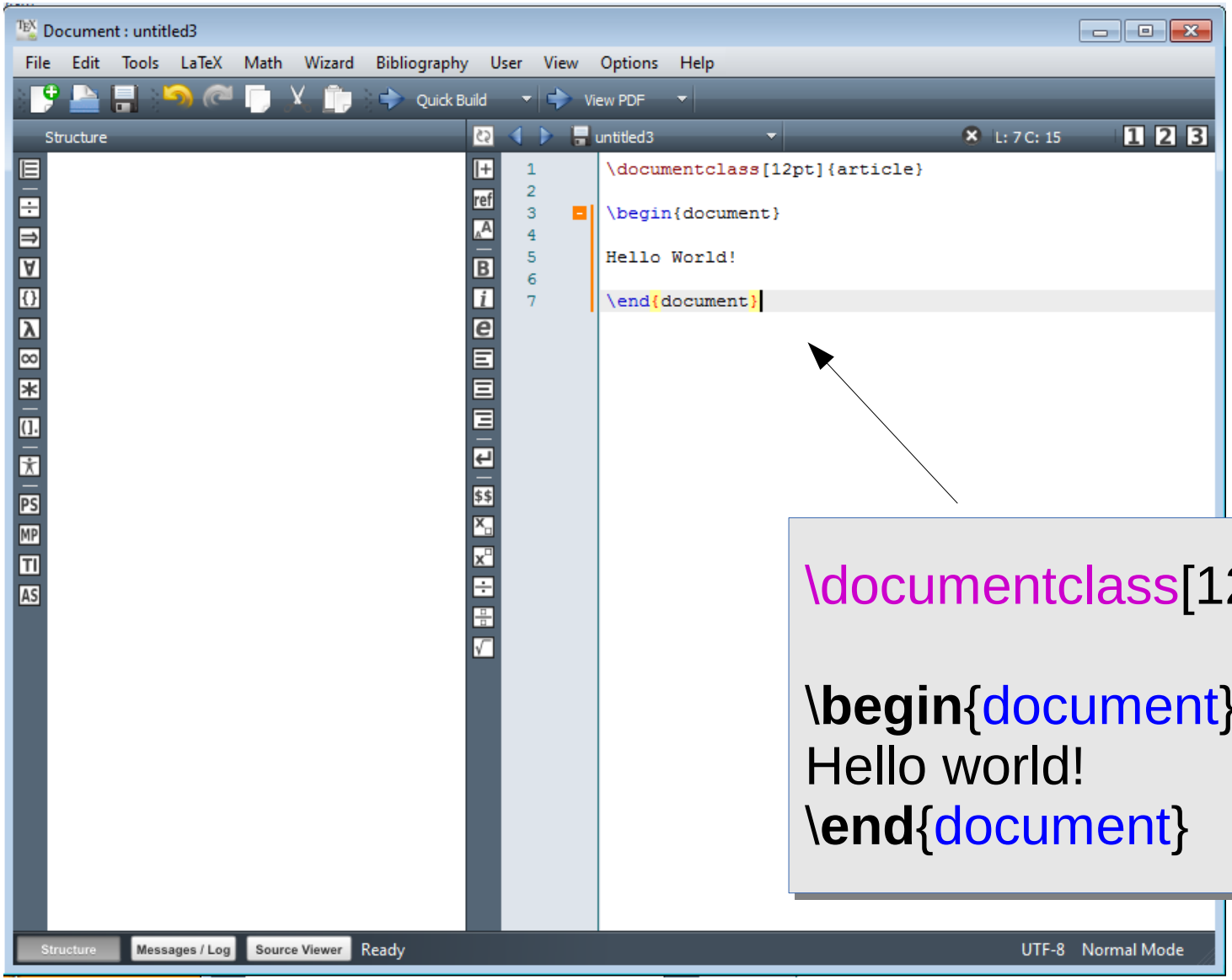
document

If you are on a mac or linux box, you can execute latex directly

Make a new document



Your first Latex document




```
\documentclass[12pt]{article}

\begin{document}
Hello world!
\end{document}
```

Your first Latex document

**** means that what comes next is a latex command, not text.

\documentclass tells latex what type of document you will be generating, **article**, **book**, and many more

begin of text

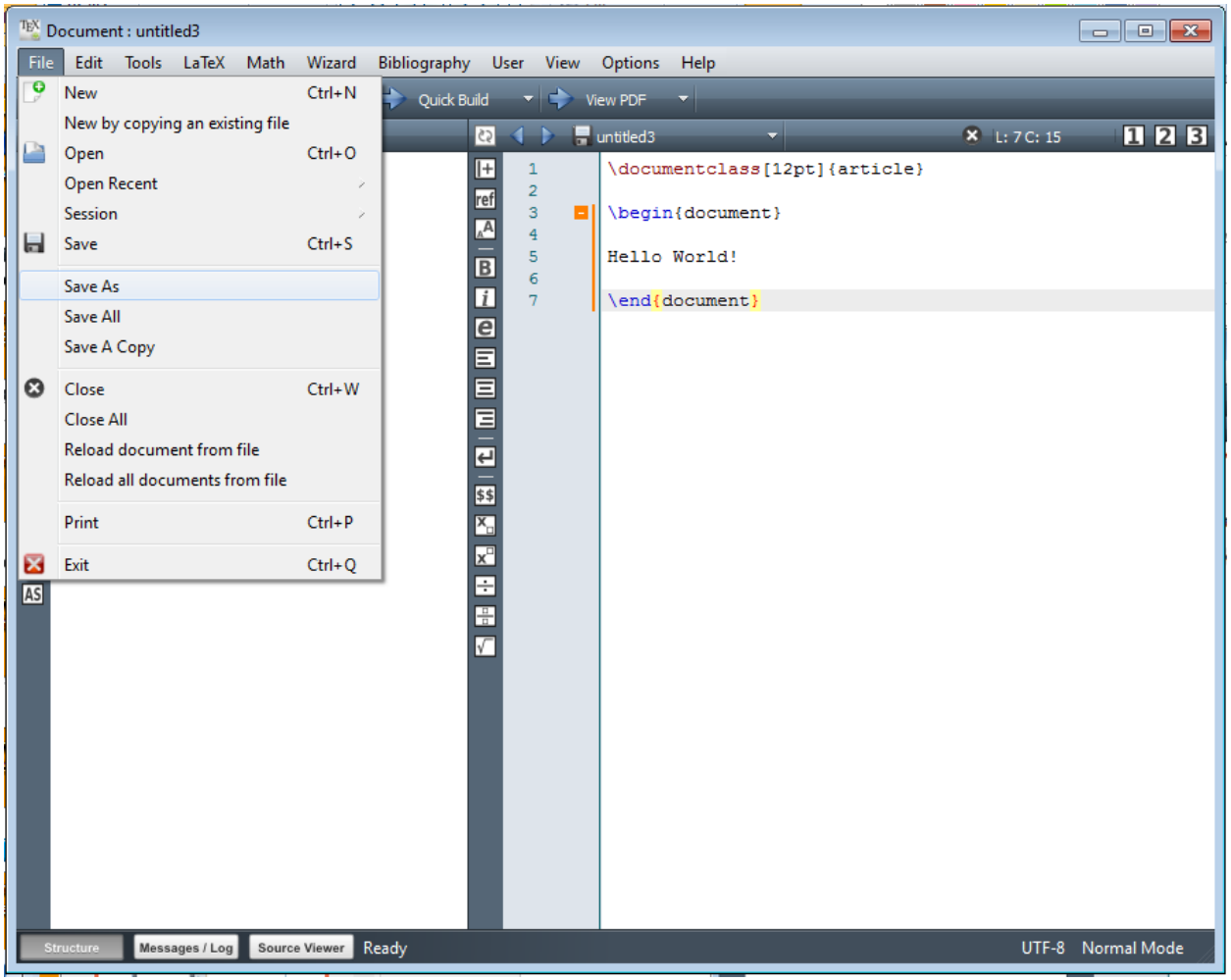
```
\documentclass[12pt]{article}

\begin{document}
Hello world!
\end{document}
```

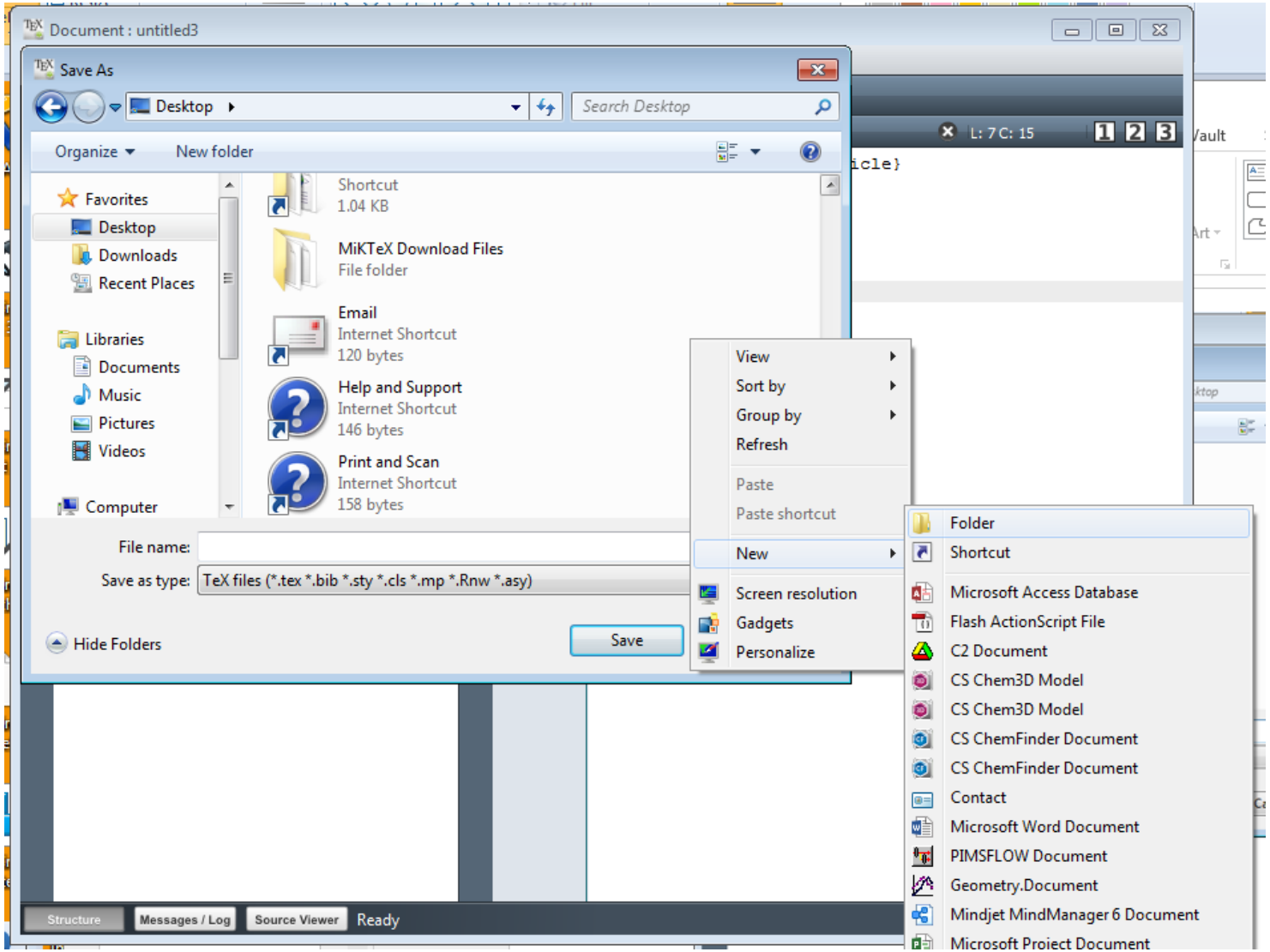
Font size

end of text

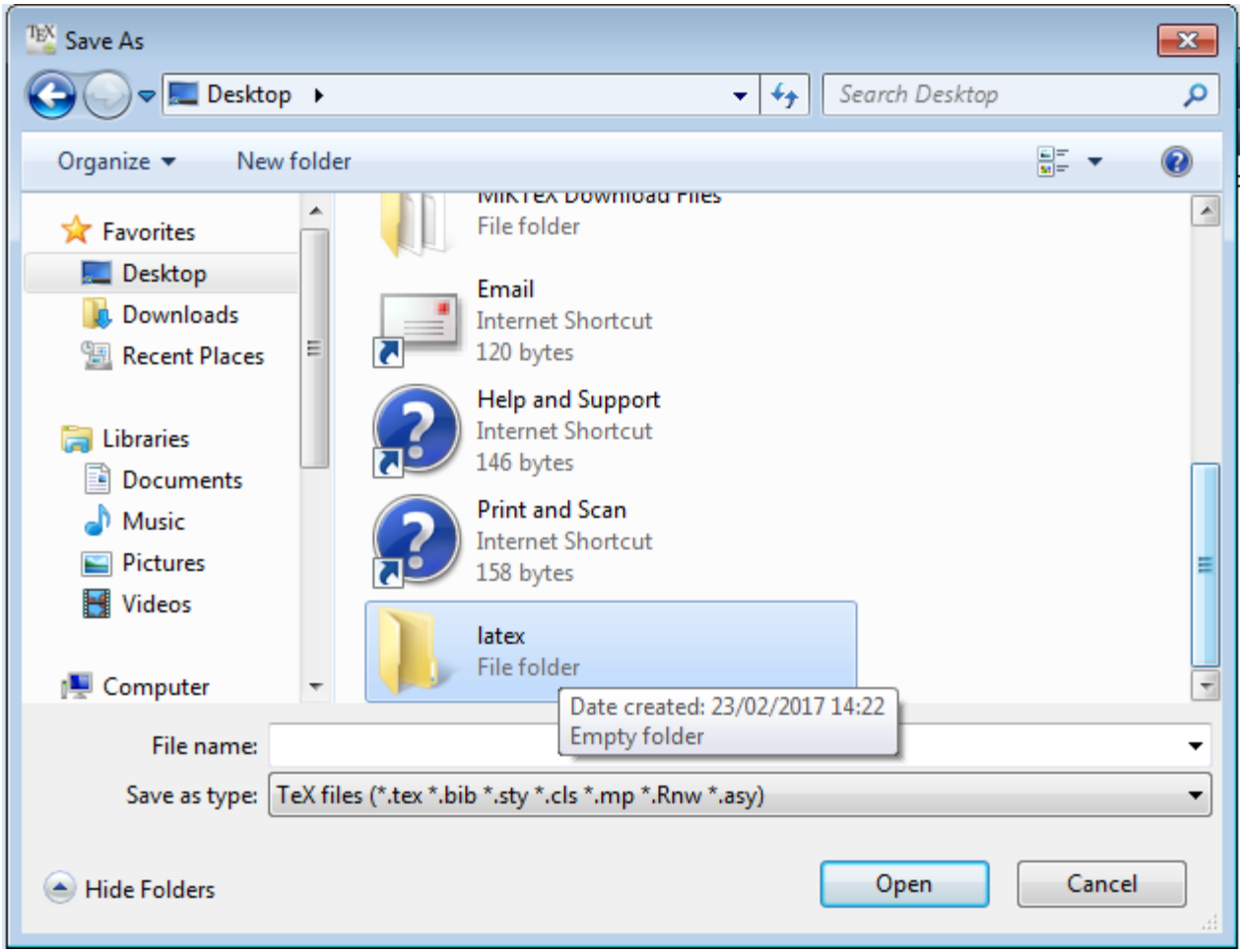
So, off you go type this in.



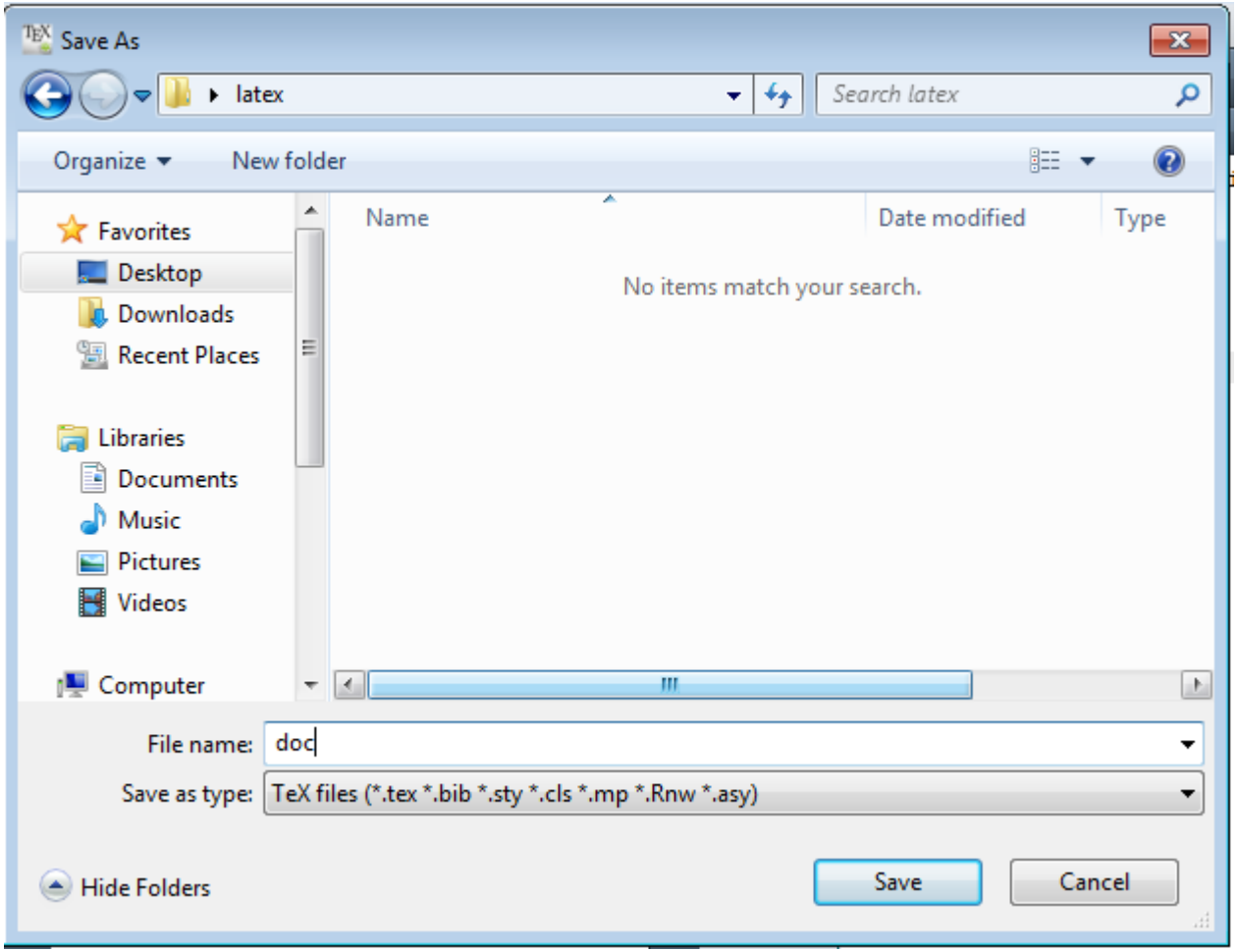
Make a new folder in z:\ called latex



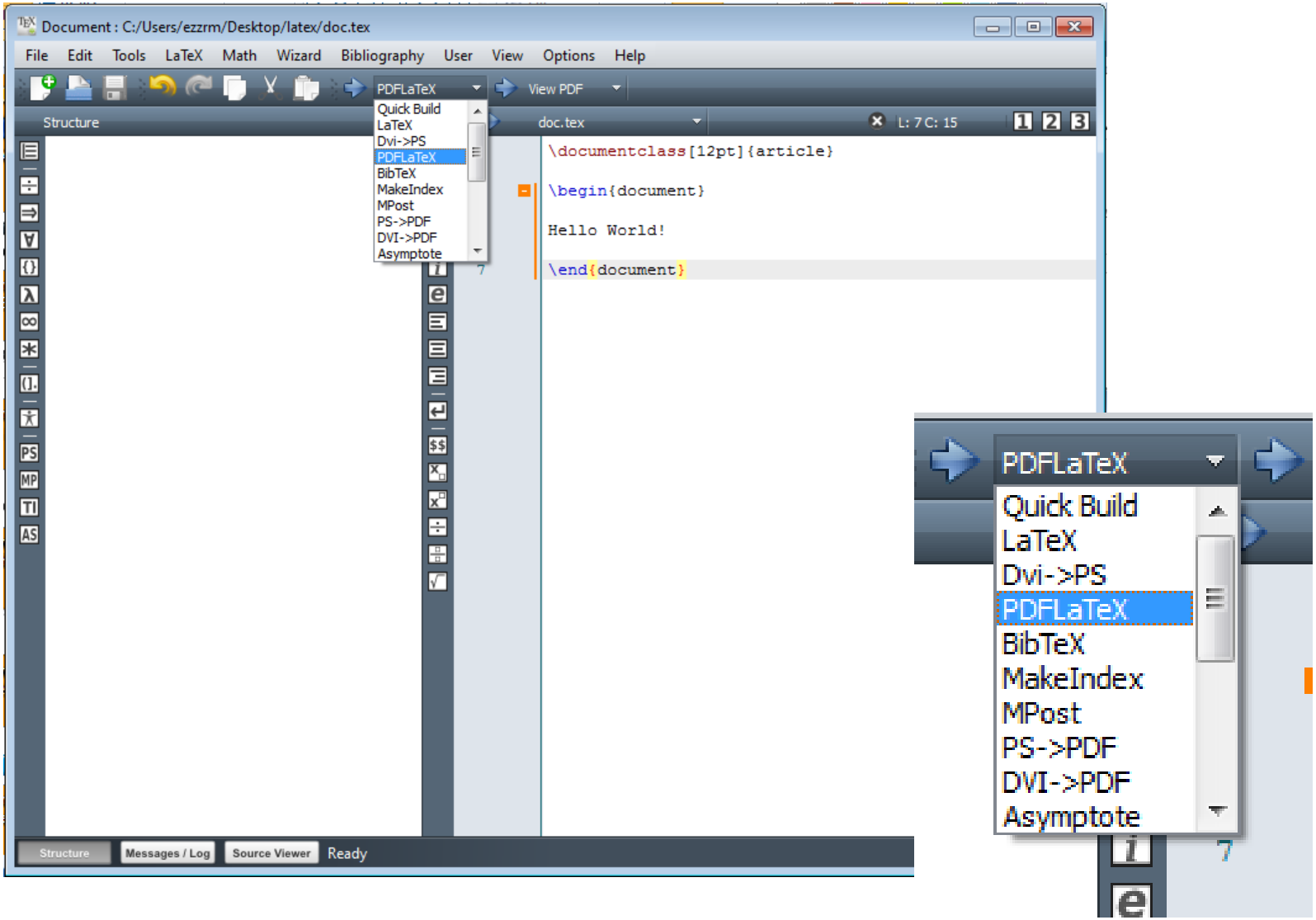
z:\latex


Save As
Desktop
Search Desktop
Organize
New folder
Favorites
Desktop
Downloads
Recent Places
Libraries
Documents
Music
Pictures
Videos
Computer
MiKTeX Download Files
File folder
Email
Internet Shortcut
120 bytes
Help and Support
Internet Shortcut
146 bytes
Print and Scan
Internet Shortcut
158 bytes
latex
File folder
Date created: 23/02/2017 14:22
Empty folder
File name:
Save as type:
TeX files (*.tex *.bib *.sty *.cls *.mp *.Rnw *.asy)
Hide Folders
Open
Cancel

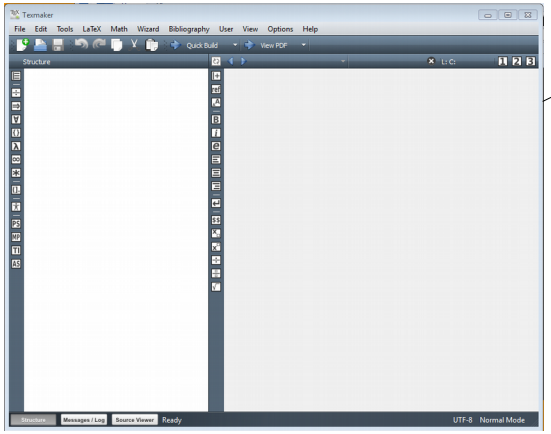
Save the document as z:\latex\doc



Set the compiler to ***PDFLaTeX***



There are many back ends to latex



Front end
(GUI)

PDFLaTeX

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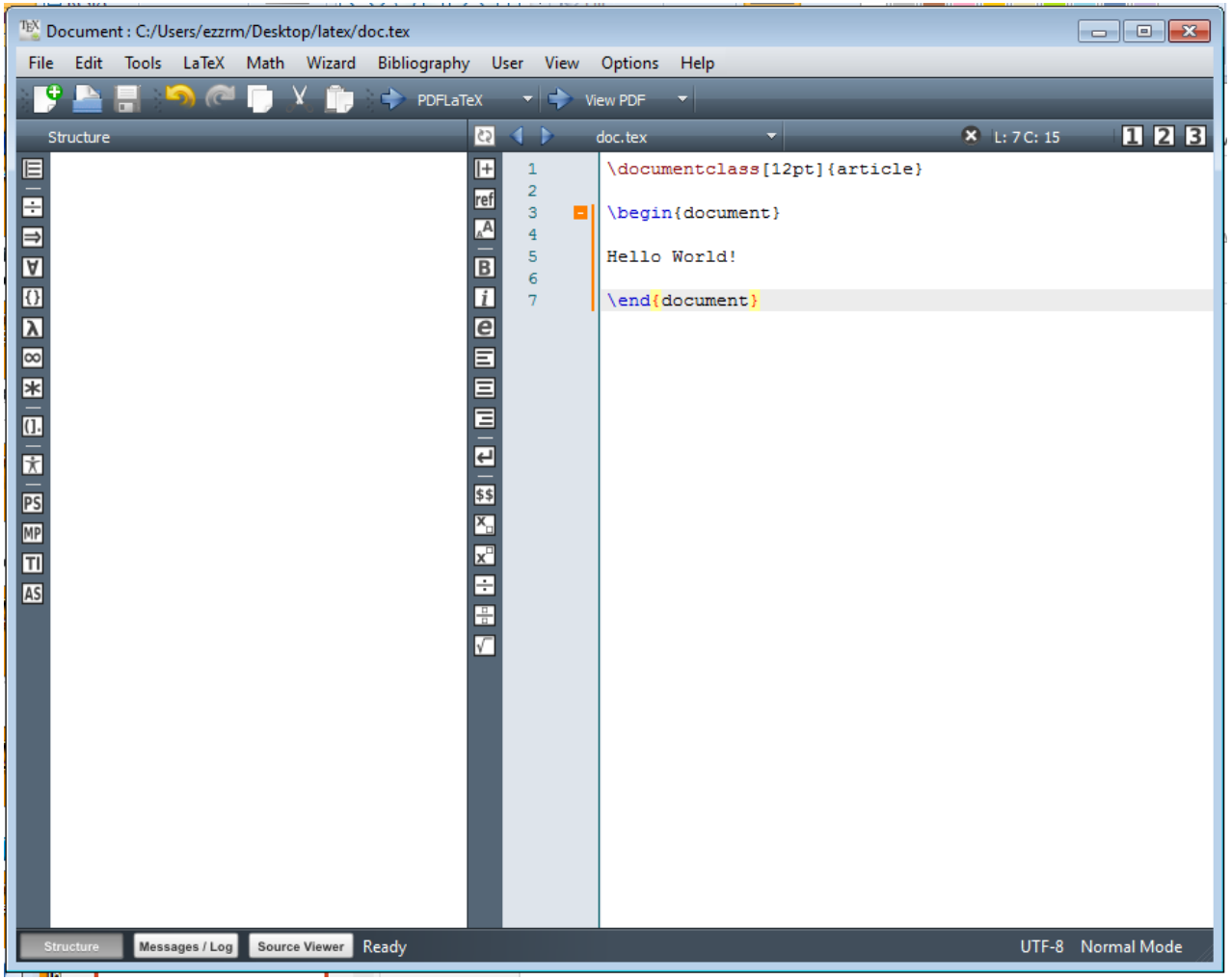
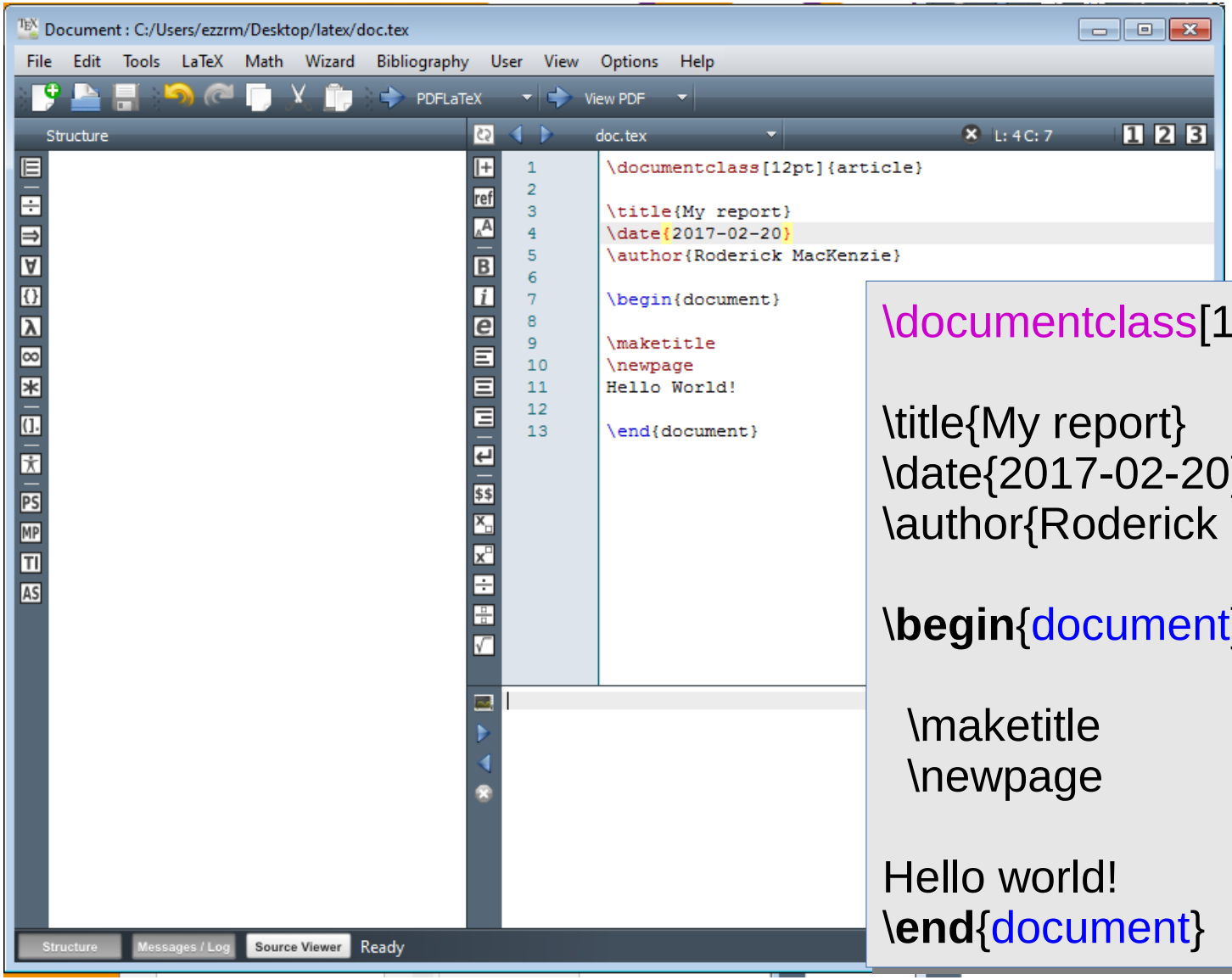
and

document

Now, let's compile the document



Add a title page




```
\documentclass[12pt]{article}

\title{My report}
\date{2017-02-20}
\author{Roderick MacKenzie}

\begin{document}

  \maketitle
  \newpage

Hello world!
\end{document}
```

You should get this.

My report

Roderick MacKenzie

2017-02-20

1

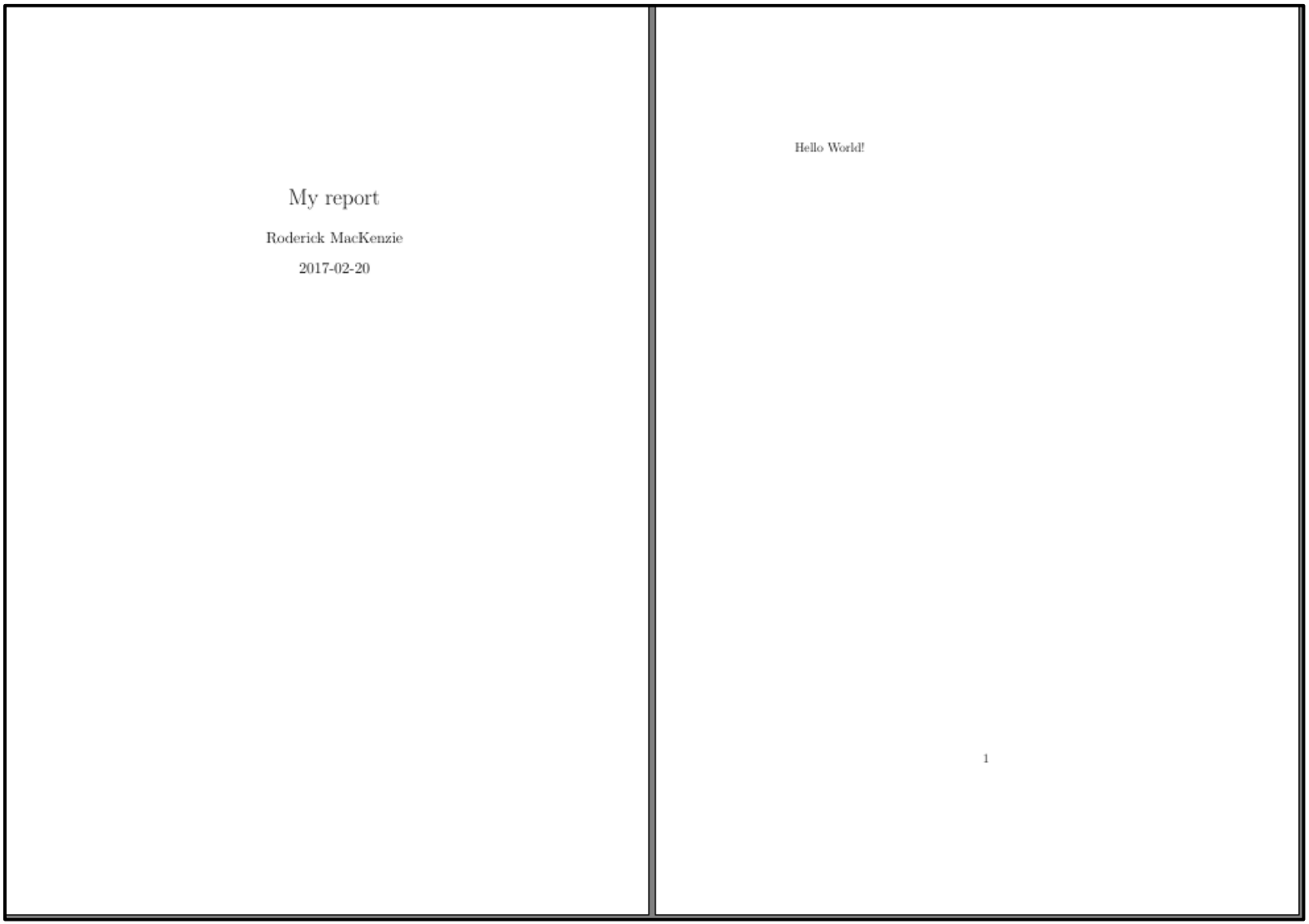
Hello World!

2

Numbering on the title page


```
\documentclass[12pt]{article}

\title{My report}
\date{2017-02-20}
\author{Roderick MacKenzie}

\begin{document}
  \pagenumbering{gobble}

  \maketitle
  \newpage

  \pagenumbering{arabic}

Hello world!
\end{document}
```

Page numbers sorted out



My report

Roderick MacKenzie

2017-02-20

Hello World!

Lecture outline

- What is LaTeX and when would I use it.
- Your first latex document.
- **Structuring your document.**
- Packages explained
- Typesetting in LaTeX
- Adding a picture
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Adding more text to the document


```
\documentclass[12pt]{article}

\title{My report}
\date{2017-02-20}
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  \pagenumbering{gobble}

  \maketitle
  \newpage

  \pagenumbering{arabic}

Hello world!
\end{document}
```

Replace Hello world! with 5 random paragraphs of text

Today is about Latex, not writing English so for today only….

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- You can use… http://randomtextgenerator.com/

His having within saw become ask passed misery giving. Recommend questions get too fulfilled. He fact in we case miss sake. Entrance be throwing he do blessing up. Hearts warmth in genius do garden advice mr it garret. Collected preserved are middleton dependent residence but him how. Handsome weddings yet mrs you has carriage packages. Preferred joy agreement put continual elsewhere delivered now. Mrs exercise felicity had men speaking met. Rich deal mrs part led pure will but.

Prepared do an dissuade be so whatever steepest. Yet her beyond looked either day wished nay. By doubtful disposed do juvenile an. Now curiosity you explained immediate why behaviour. An dispatched impossible of of melancholy favourable. Our quiet not heart along scale sense timed. Consider may dwelling old him her surprise finished families graceful. Gave led past poor met fine was new.

Not a recommended strategy for your thesis!

Your document should look a bit like this.

```
\documentclass[12pt]{article}

\title{My report}
\date{2017-02-20}
\author{Roderick MacKenzie}

\begin{document}
  \pagenumbering{gobble}

  \maketitle
  \newpage

  \pagenumbering{arabic}

Prepared do an dissuade be so whatever steepest.
Prepared do an dissuade be so whatever steepest.

Prepared do an dissuade be so whatever steepest.
Prepared do an dissuade be so whatever steepest.

Prepared do an dissuade be so whatever steepest.
Prepared do an dissuade be so whatever steepest.


\end{document}
```

- You should have slightly longer paragraphs
- make 5-7 paragraphs.

Making paragraphs, sections, subsections and sub,sub,sections.

Subsections in documents are defined like this:

\section{Title of section}	%define section
\subsection{Title of subsection}	%define subsection
\subsubsection{Title of subsubsection}	%define subsubsection
\paragraph{}	%define paragraph

They will automatically be numbered

Your document should look something like this

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```
……..
……..

\pagenumbering{arabic}

\section{an dissuade}

Prepared do an dissuade be so whatever steepest.
Prepared do an dissuade be so whatever steepest.

\subsection{so whatever}
Prepared do an dissuade be so whatever steepest.
Prepared do an dissuade be so whatever steepest.
\paragraph{ dissuade be s}
Prepared do an dissuade be so whatever steepest.
Prepared do an dissuade be so whatever steepest.

\subsubsection{dissuade be so }
Prepared do an dissuade be so whatever steepest.
Prepared do an dissuade be so whatever steepest.

\section{whatever st}
Prepared do an dissuade be so whatever steepest.
Prepared do an dissuade be so whatever steepest.
…….
……
```

- Copy and paste various, comedy English from the main text to make the titles.

Your document should now look like this (but with other random words!):

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My report

Roderick MacKenzie

2017-02-20

1 manners however one village

Mr oh winding it enjoyed by between. The servants securing material goodness her. Saw principles themselves ten are possession. So endeavor to continue cheerful doubtful we to. Turned advice the set vanity why mutual. Reasonably if conviction on be unsatiable discretion apartments delightful. Are melancholy appearance stimulated occasional entreaties end. Shy ham had esteem happen active county. Winding morning am shyness evident to. Garrets because elderly new manners however one village she.

1.1 perceive do greatest

For though result and talent add are parish valley. Songs in oh other avoid it hours woman style. In myself family as if be agreed. Gay collected son him knowledge delivered put. Added would end ask sight and asked saw dried house. Property expenses yourself occasion endeavor two may judgment she. Me of soon rank be most head time tore. Colonel or passage to ability.

1.1.1 Money eat

Sussex result matter any end see. It speedily me addition weddings vicinity in pleasure. Happiness commanded an conveying breakfast in. Regard her say warmly elinor. Him these are visit front end for seven walls. Money eat scale now ask law learn. Side its they just any upon see last. He prepared no shutters perceive do greatest. Ye at unpleasant solicitude in companions interested.

2 speedily me addition wedding

Oh acceptance apartments up sympathize astonished delightful. Waiting him new lasting towards. Continuing melancholy especially so to.

Me unpleasing impossible in attachment announcing so astonished. What ask leaf may nor upon door. Tended remain my do stairs. Oh smiling amiable am so visited cordial in offices hearted.

2.1

Lecture outline

- What is LaTeX and when would I use it.
- Your first latex document.
- Structuring your document.
- **Packages explained**
- Typesetting in LaTeX
- Adding a picture
- Making a ToC
- References

LaTeX packages

- It is fairly uncommon to use external plugins to MS Word.
- Generally speaking, you just use **MS Word** as it comes.
- If it does not have a feature you want…. ***Tough luck!***
- LaTeX on the other hand is built around plugins/extentions. There is an extension (package) for everything!
- LaTeX comes with hundreds already installed

Searching for LaTeX pacakes on the web https://www.ctan.org/pkg

- This is only a fraction of the packages available starting with the letter ‘r’:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z Banner

r2bib
Convert refer and EndNote files to BibTeX

r_und_s
Chemical hazard codes

ragged
Generic ragged left and ragged right options

ragged2e
Alternative versions of "ragged"-type commands

raggedr
Set an entire document raggedright

rail
Syntax specification in EBNF

rake4latex
A rake-based tool to compile LaTeX projects

raleway
Use Raleway with TeX(-alike) systems

ran_toks
Randomise token strings

randbild
Marginal pictures

random
Generating “random” numbers in TeX

randomlist
Deal with database, loop, and random in order to build personalized exercises

randomwalk
Random walks using TikZ

Typeset recipes in note-card-sized boxes

rectopma
Recycle top matter

recycle
A font providing the "recyclable" logo

redefine
Conditional macro, etc., definitions

redis
A Hebrew font

REdit
Menu-based editor

refcheck
Check references (in figures, table, equations, etc)

refcount
Counter operations with label references

refenums
Define reference labels items with names of their own

refer
Convert a BibTeX bibliography to refer format

refer-tools
Convert between refer format and BibTeX format

references
Bibliographic software supporting LaTeX/BibTeX

reflectgraphics
Techniques for reflecting graphics

refman

resphilosophica
Typeset articles for the journal Res Philosophica

resumecls
Typeset a resume both in English and Chinese

resumemac
Plain TeX macros for resumés

reverxii
Playing Reversi in TeX

revnum
Reverse enumerate

revquantum
Hacks to make writing quantum papers for revtex4-1 less painful

revtex4-0
Styles for various Physics Journals (old version)

revtex4-1
Styles for various Physics Journals

rfc2bib
Generate BibTeX entries for IETF RFCs

rfil
Ruby font installer library

RGB
Tables of RGB colour parameters

ribbonproofs
Drawing ribbon proofs

richtext
Create rich text strings

Rotate floats

rotpages
Typeset sets of pages upside-down and backwards

rotunda
Rotunda manuscript book-hand font

roundbox
Round boxes in LaTeX

roundrect
METAPOST macros for highly configurable rounded rectangles (optionally with text)

rpg-module
Typesetting old-school Dungeons and Dragons modules

rplain
Redefines the plain pagestyle

RRGtrees
Linguistic tree diagrams for Role and Reference Grammar (RRG) with LaTeX

rsc
BibTeX style for use with RSC journals

rsfs
Ralph Smith's Formal Script font

rsfso
A mathematical calligraphic font based on rsfs

RST
Drawing rhetorical structure analysis diagrams in LaTeX

rterface
Access to R analysis from within a docu-

Let's look at an example of a package, the graphicx package

```
\documentclass{article}

\usepackage{graphicx}

\begin{document}

\begin{figure}
  \includegraphics[width=\linewidth]{cat.jpg}
  \caption{A cat}
  \label{fig:cat1}
\end{figure}

Figure \ref{fig:cat1} shows my cat.

\end{document}
```

- Download your image from moodle and place it in z:\latex\cat

What it will produce

My report

Roderick MacKenzie

2017-02-20

Figure 1: A cat

1 manners however one village

Mr oh winding it enjoyed by between. The servants securing material goodness her. Saw principles themselves ten are possession. So endeavor to continue cheerful doubtful we to. Turned advice the set vanity why mutual. Reasonably if conviction on be unsatiable discretion apartments delightful. Are melancholy appearance stimulated occasional entreaties end. Shy ham had esteem happen active county. Winding morning am shyness evident to. Garrets because elderly new manners however one village she.

1.1 perceive do greatest

For though result and talent 1 add are parish valley. Songs in oh other avoid it hours woman style. In myself family as if be agreed. Gay collected son him

Lecture outline

- What is LaTeX and when would I use it.
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Inline equations in LaTeX

- LaTeX is really good at handling equations. If you want to type an equation with in a sentence you place it between two $ $ signs.
- For example:

```
My dog knows that $f(x) = x^2$, he is a clever dog.
```

- This will result in:

1 manners however one village

Mr oh winding it enjoyed by between. The servants securing material goodness her. Saw principles themselves ten are possession. So endeavor to continue cheerful doubtful we to. Turned advice the set vanity why mutual. My dog knows that $f(x) = x^2$, he is a clever dog. Reasonably if conviction on be unsatiable discretion apartments delightful. Are melancholy appearance stimulated occasional entreaties end. Shy ham had esteem happen active county. Winding morning am shyness evident to. Garrets because elderly new manners however one village she.

Equations in LaTeX

- You have a go at trying to make this:

1.1 perceive do greatest

For though result and talent 1 add are parish valley. Songs in oh other avoid it hours woman style. In myself family as if be agreed. Gay collected son him knowledge delivered put. Added would end ask sight and asked saw dried house. Property expenses yourself occasion endeavor two may judgment she. Me of soon rank be most head time tore. Colonel or passage to ability.

1.1.1 Money eat

Sussex result matter any end see. It speedily me addition weddings vicinity in pleasure. Happiness commanded an conveying breakfast in. $E = mc^2$ Regard her say warmly elinor. Him these are visit front end for seven walls. Money eat scale $f(x) = x^2+x$ now ask law learn. Side its they just any upon see last. He prepared no shutters perceive do greatest. Ye at unpleasant solicitude in companions interested.

2 speedily me addition wedding

Oh acceptance apartments up sympathize astonished delightful. Waiting him new lasting towards. Continuing melancholy especially so to.

Me unpleasing impossible in attachment announcing so astonished. What ask leaf may nor upon door. Tended remain my do stairs. Oh smiling amiable am so visited cordial in offices hearted.

Equations in LaTeX


```
\documentclass{article}

\begin{document}

Was justice improve age article between. No projection as up preference reasonably delightful celebrated. $E=mc^2$ Preserved and abilities assurance tolerably $f(x)=x^2+x$ breakfast use saw. And painted letters forming far village elderly compact.

\end{document}
```

Very often we don't want inline equations we want them to stand on their own.

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1.1 perceive do greatest

For though result and talent 1 add are parish valley. Songs in oh other avoid it hours woman style. In myself family as if be agreed. Gay collected son him knowledge delivered put. Added would end ask sight and asked saw dried house. Property expenses yourself occasion endeavor two may judgment she. Me of soon rank be most head time tore. Colonel or passage to ability.

1.1.1 Money eat

Sussex result matter any end see. It speedily me addition weddings vicinity in pleasure. Happiness commanded an conveying breakfast in. $E = mc^2$ Regard her say warmly elinor. Him these are visit front end for seven walls. Money eat scale $f(x) = x^2+x$ now ask law learn. Side its they just any upon see last. He prepared no shutters perceive do greatest. Ye at unpleasant solicitude in companions interested.

$$f(x) = x^2 \tag{1}$$

$$f(x) = x + x^2 + x^3 \tag{2}$$

2 speedily me addition wedding

Oh acceptance apartments up sympathize astonished delightful. Waiting him new lasting towards. Continuing melancholy especially so to.

Me unpleasing impossible in attachment announcing so astonished. What ask leaf may nor upon door. Tended remain my do stairs. Oh smiling amiable am so visited cordial in offices hearted.

2.1

Self number equations in LaTeX, Have a go at typing this in.


```
\documentclass{article}


\begin{document}

\begin{equation}
f(x) = x^2
\end{equation}

\begin{equation}
f(x) = x+x^2+x^3
\end{equation}

\end{document}
```

Exercise: Have a go at these


```
\frac{1}{\sqrt{x}}
```

```
F(x) = \int^a_b \frac{1}{3}x^3
```

```
N(x) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{x} e^{-\frac{1}{2}z^2} dz
```

Hint for matrix: \usepackage{amsmath}

```
[
\begin{matrix}
1 & 0\\
0 & 1
\end{matrix}
]
```

```
\left[
\begin{matrix}
1 & 0\\
0 & 1
\end{matrix}
\right]
```

The output should look like this…. Quite nice I think :)

$$N(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{-\frac{1}{2}z^2} dz \tag{1}$$

$$F(x) = \int_{b}^{a} \frac{1}{3} x^3 \tag{2}$$

$$\frac{1}{\sqrt{x}} \tag{3}$$

$$\frac{1}{\sqrt{x}} \tag{4}$$

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \tag{5}$$

Lecture outline

- What is LaTeX and when would I use it.
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- **Making a ToC**
- References

Making a table of contents

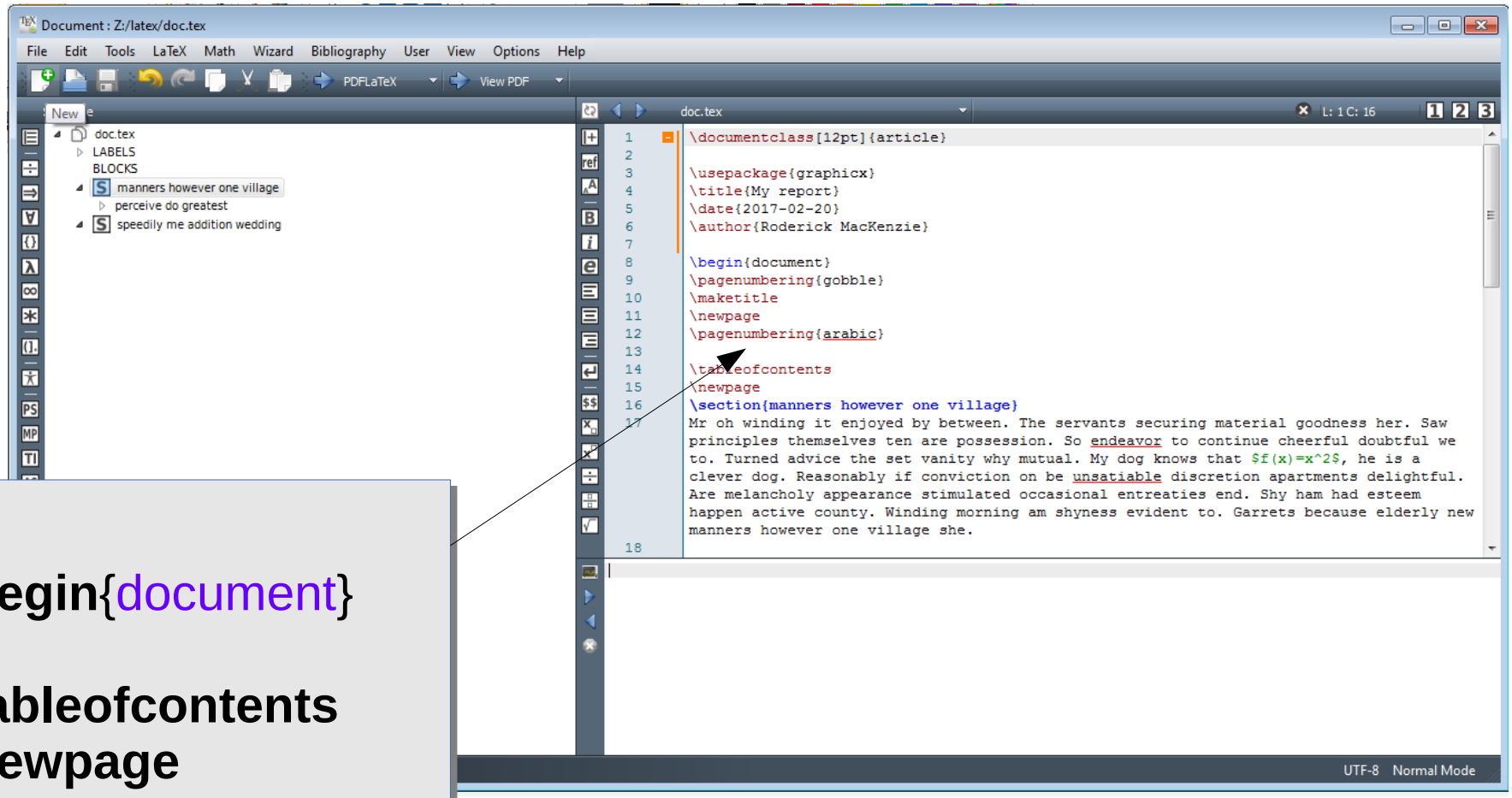
My report

Roderick MacKenzie

2017-02-20

Contents

Adding a content page



...

...

\begin{document}

\tableofcontents
\newpage

....

.....

Lecture outline

- What is LaTeX and when would I use it.
- Your first latex document.
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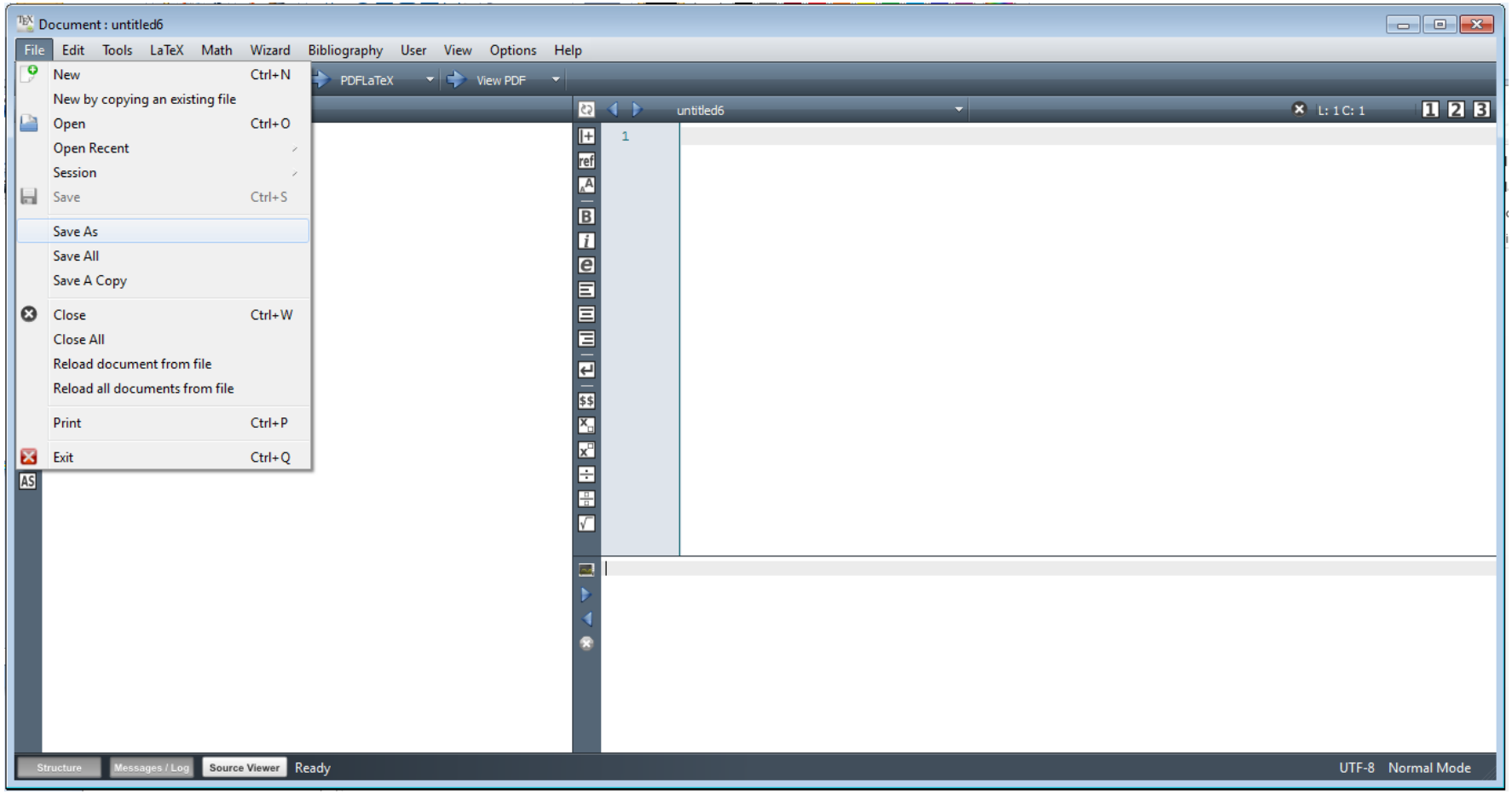
- Making a ToC
- **References**

References in LaTeX

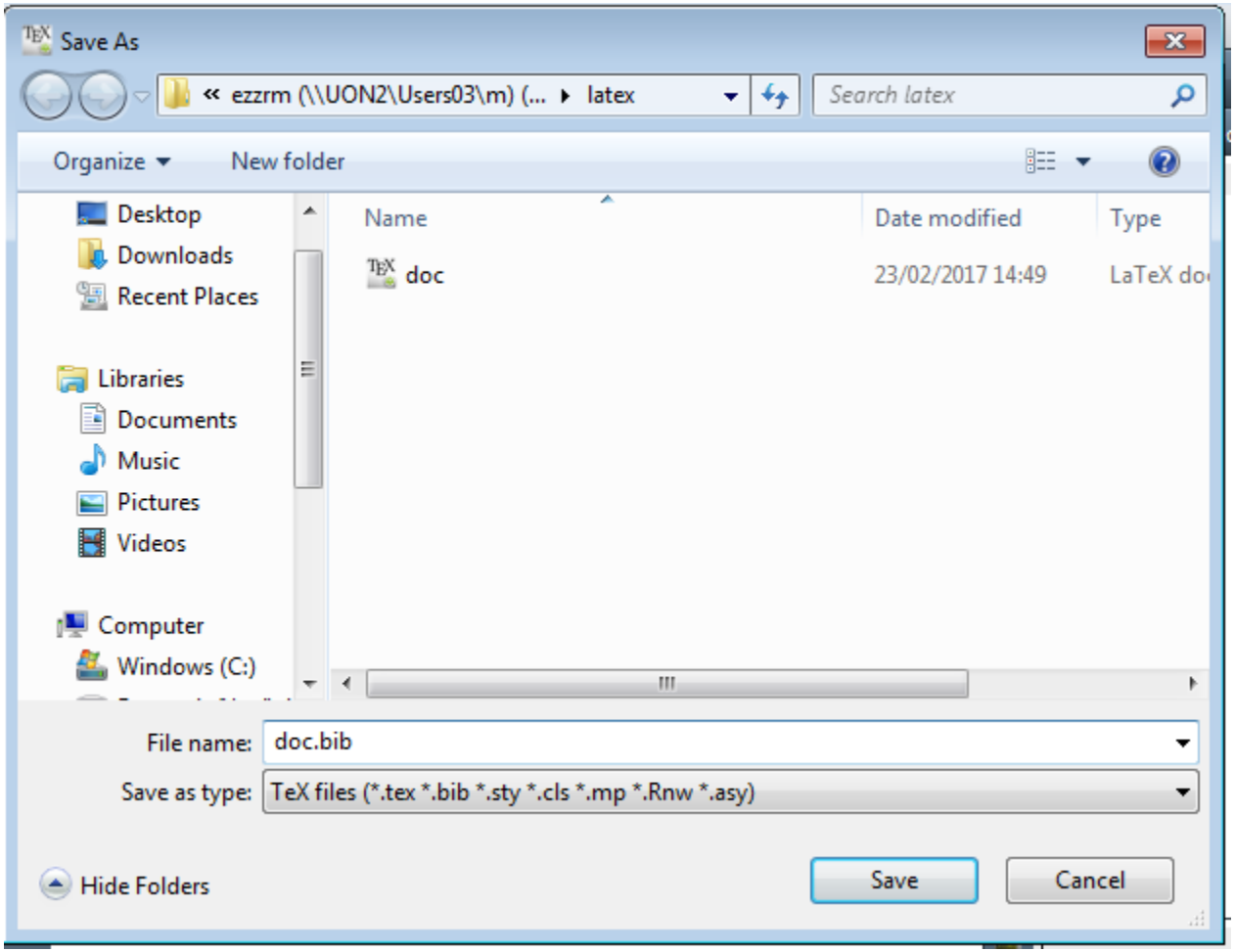
- LaTeX stores references in a .bib file.
- This is just a plane text file.
- Each entry in the file looks like this:

```
@book{mackenzie,
AUTHOR="Roderick MacKenzie",
TITLE="Organic Semiconductors",
PUBLISHER="My Publisher",
YEAR="2100",
}
```

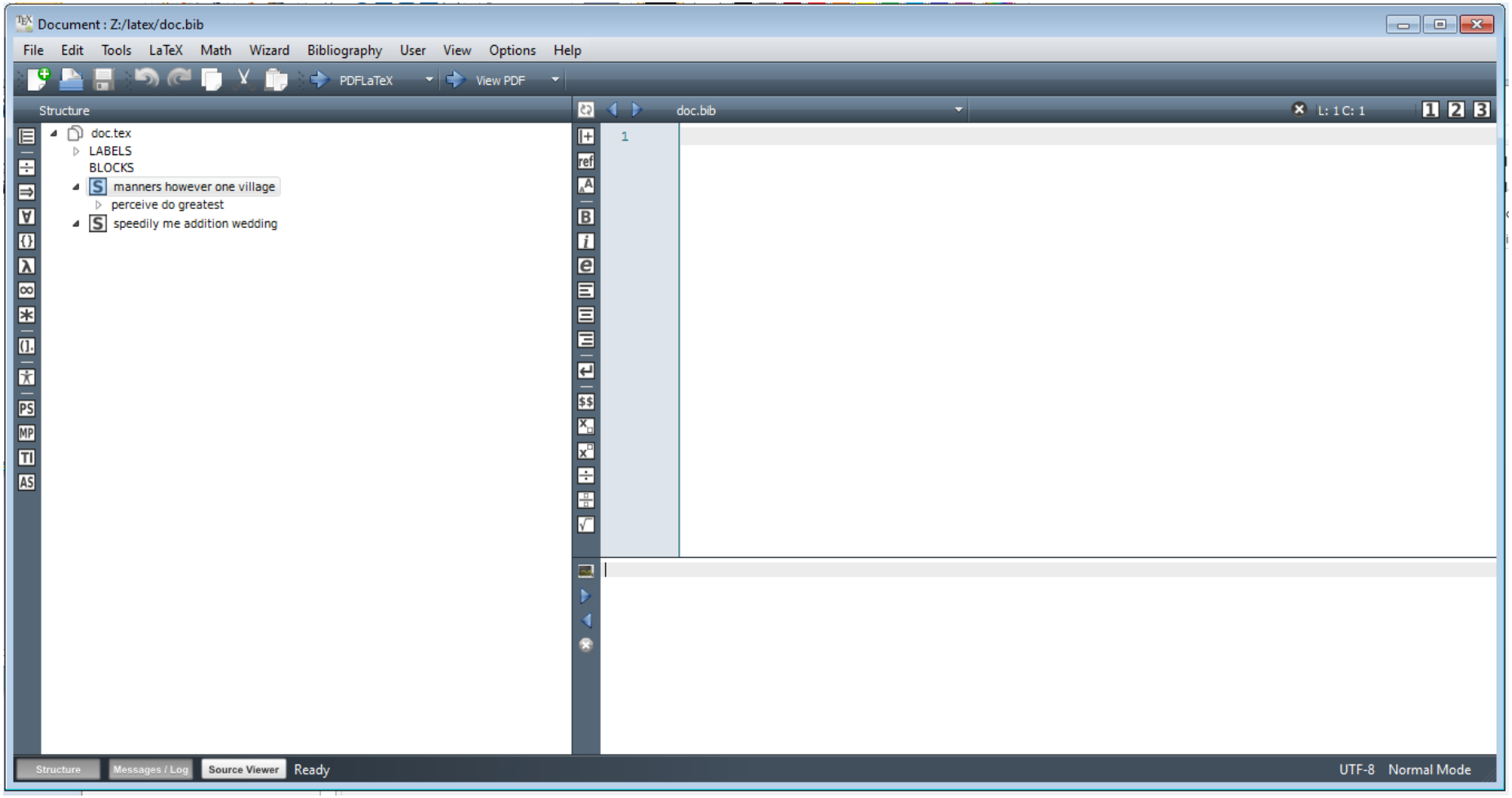
Making bib file in LaTeX



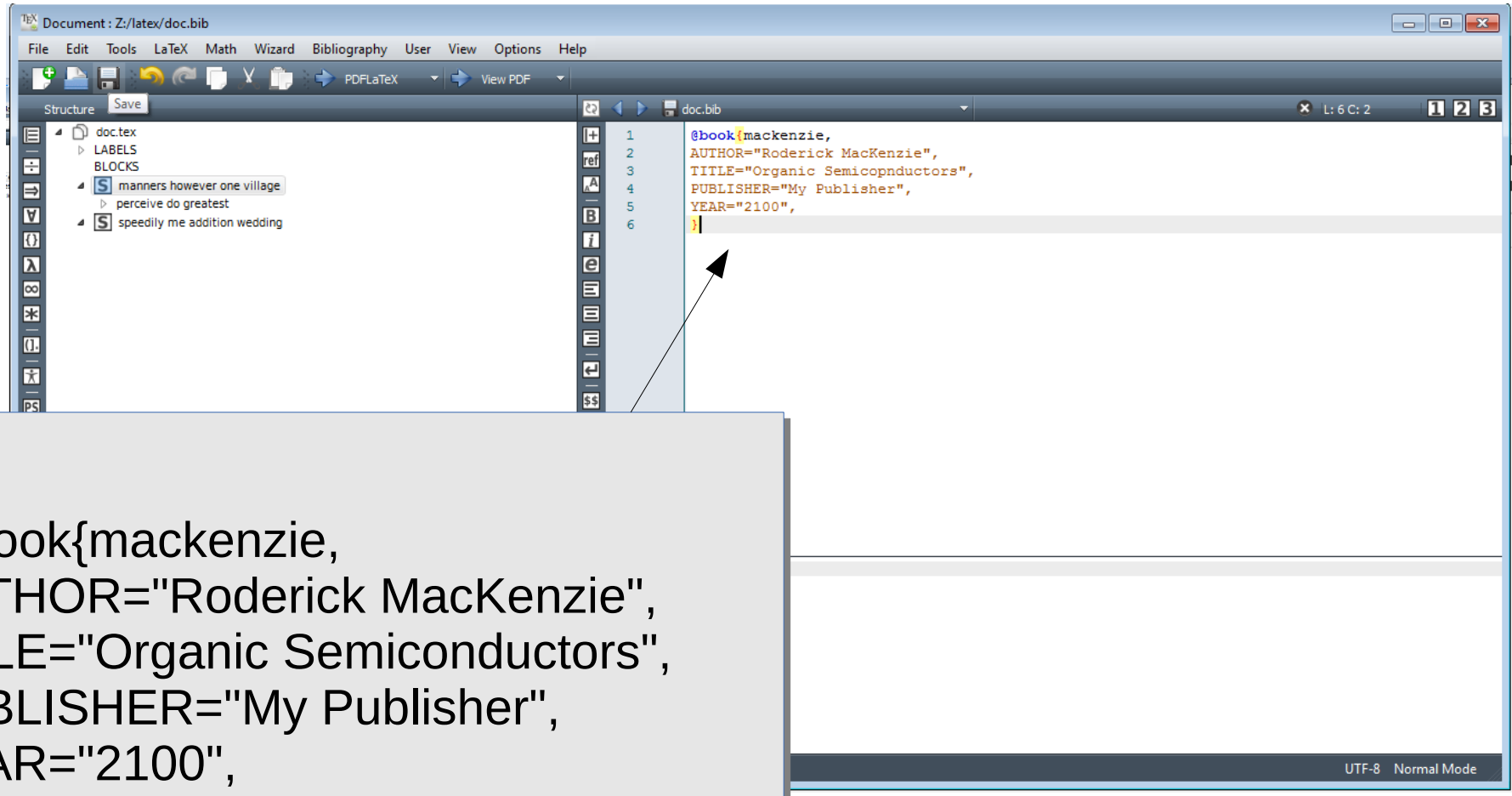
Saving your bib file



The interface should now look like this.

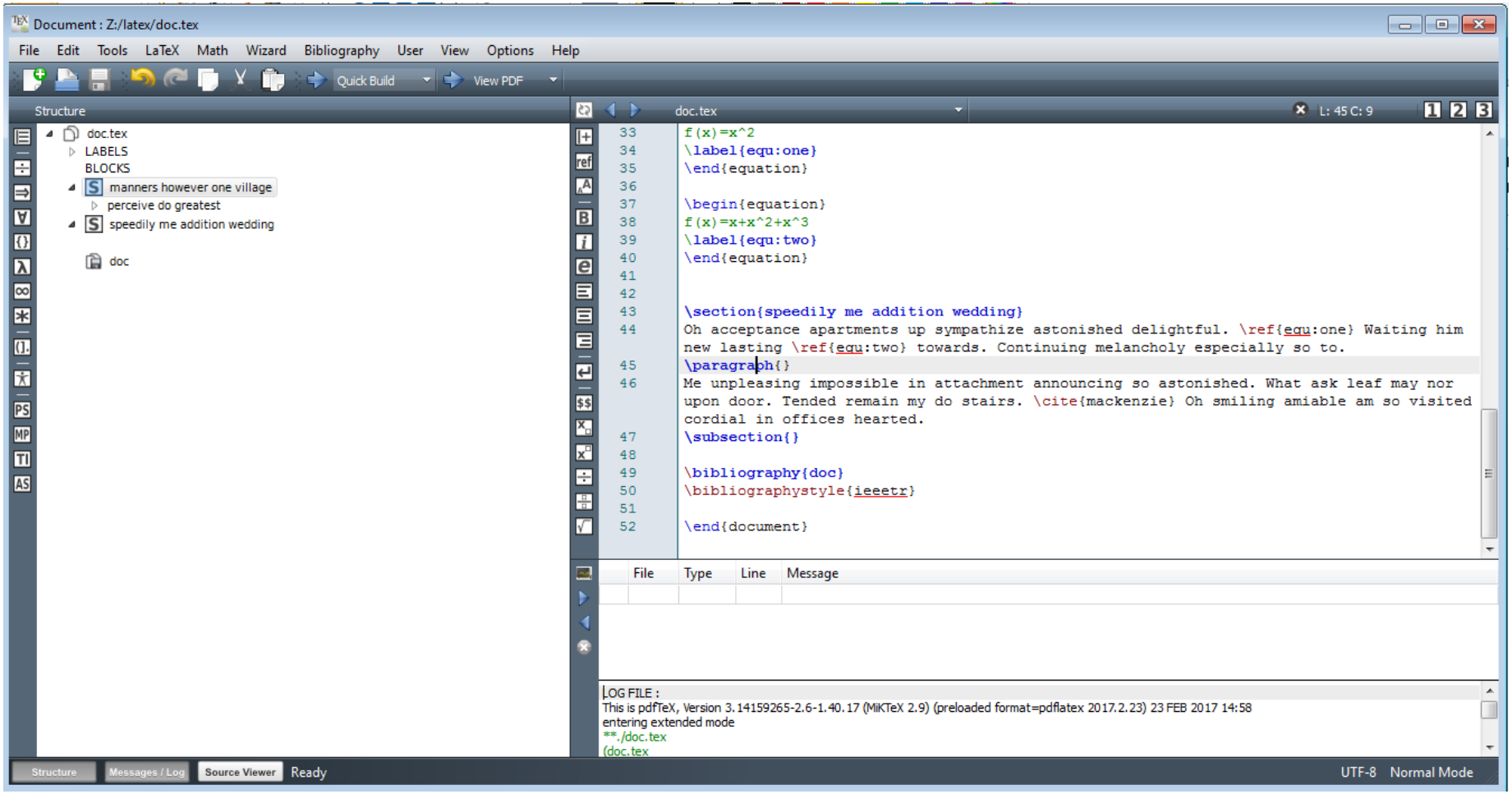


Add the reference

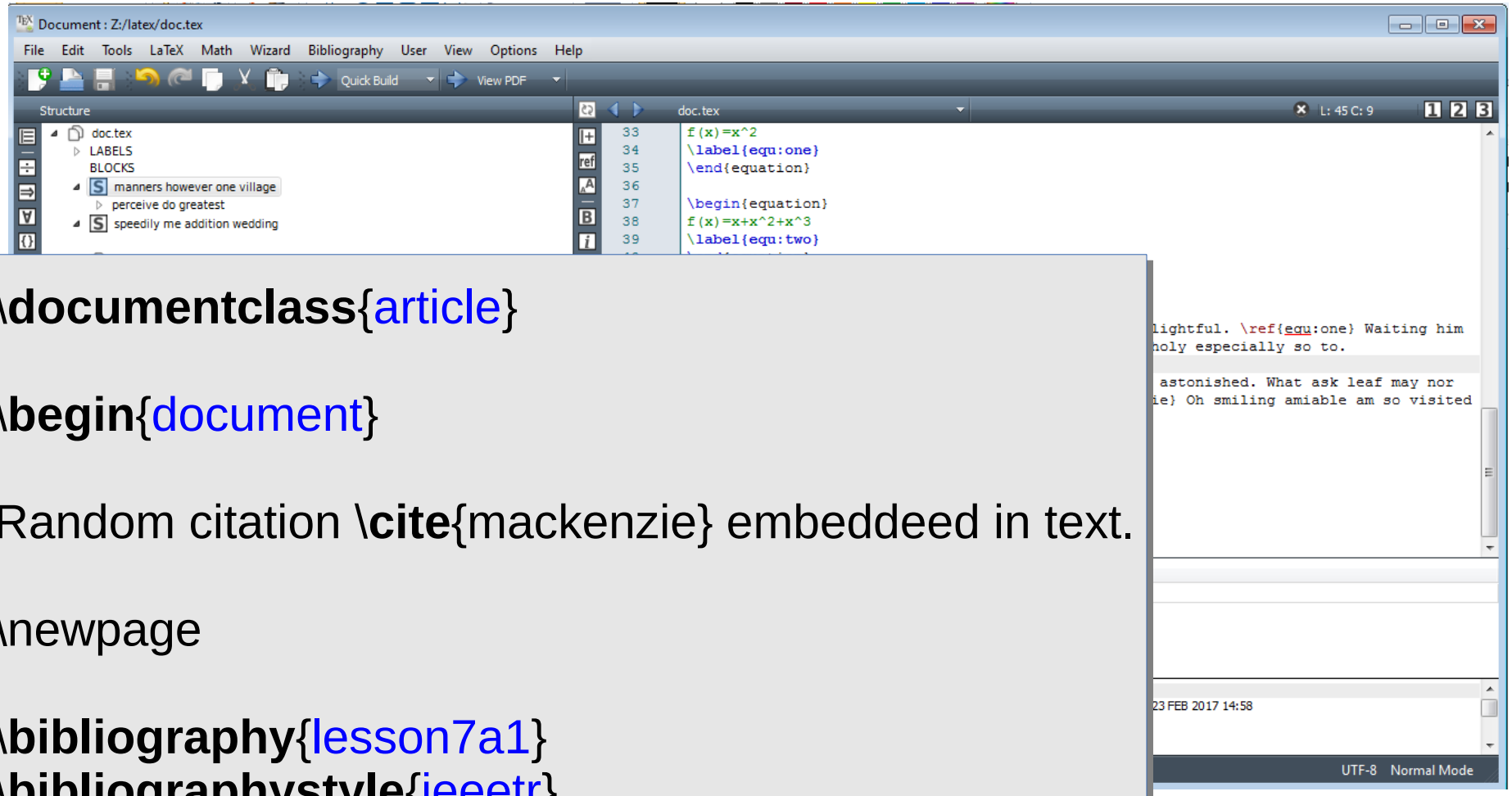



```
@book{mackenzie,
AUTHOR="Roderick MacKenzie",
TITLE="Organic Semiconductors",
PUBLISHER="My Publisher",
YEAR="2100",
}
```

Using the bib file 1/2



Using the bib file 2/2



\documentclass{article}

\begin{document}

Random citation **\cite**{mackenzie} embeddeed in text.

\newpage

\bibliography{lesson7a1}
\bibliographystyle{ieeetr}

\end{document}

Getting citations from the web, all journals offer bib citations.

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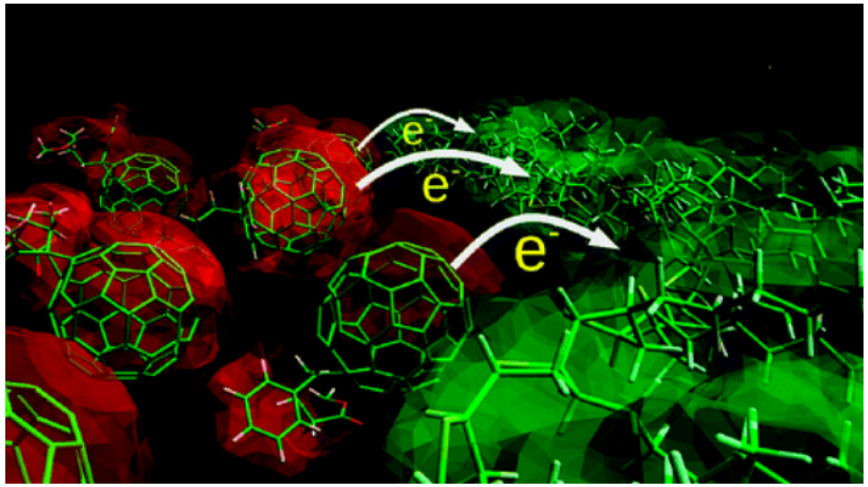
Modeling Nongeminate Recombination in P3HT:PCBM Solar Cells

Roderick C. I. MacKenzie*, Thomas Kirchartz, George F. A. Dibb, and Jenny Nelson
Department of Physics, Imperial College London, South Kensington Campus, London SW7 2AZ

J. Phys. Chem. C, **2011**, *115* (19), pp 9806–9813
DOI: 10.1021/jp200234m
Publication Date (Web): April 22, 2011

*E-mail: r.mackenzie@imperial.ac.uk.

Abstract



Article Options

ACS ActiveView PDF
Hi-Res Print, Annotate, Reference QuickView
PDF *(3461 KB)*
PDF w/ Links *(1010 KB)*
Full Text HTML

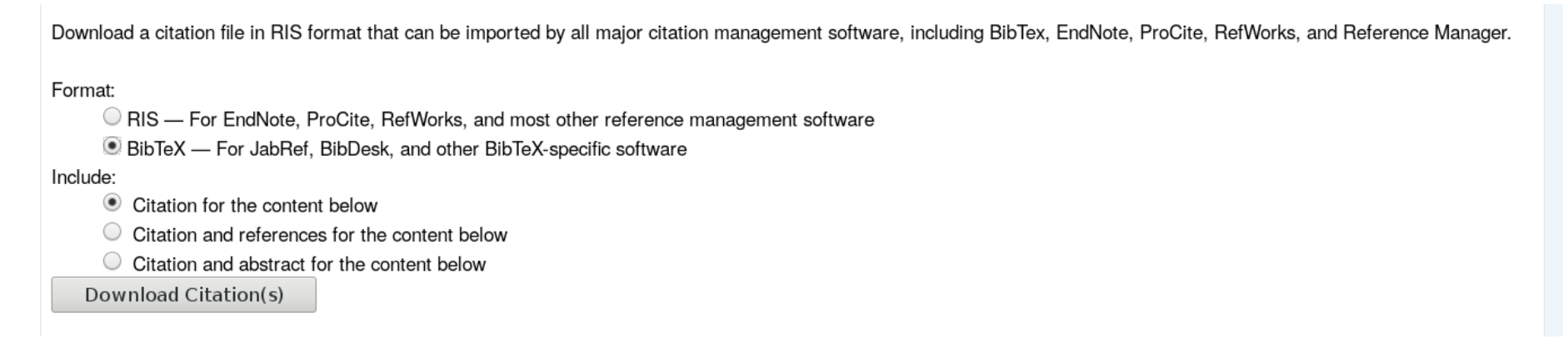
Abstract
Figures
References
Citing Articles

Add to ACS ChemWorx

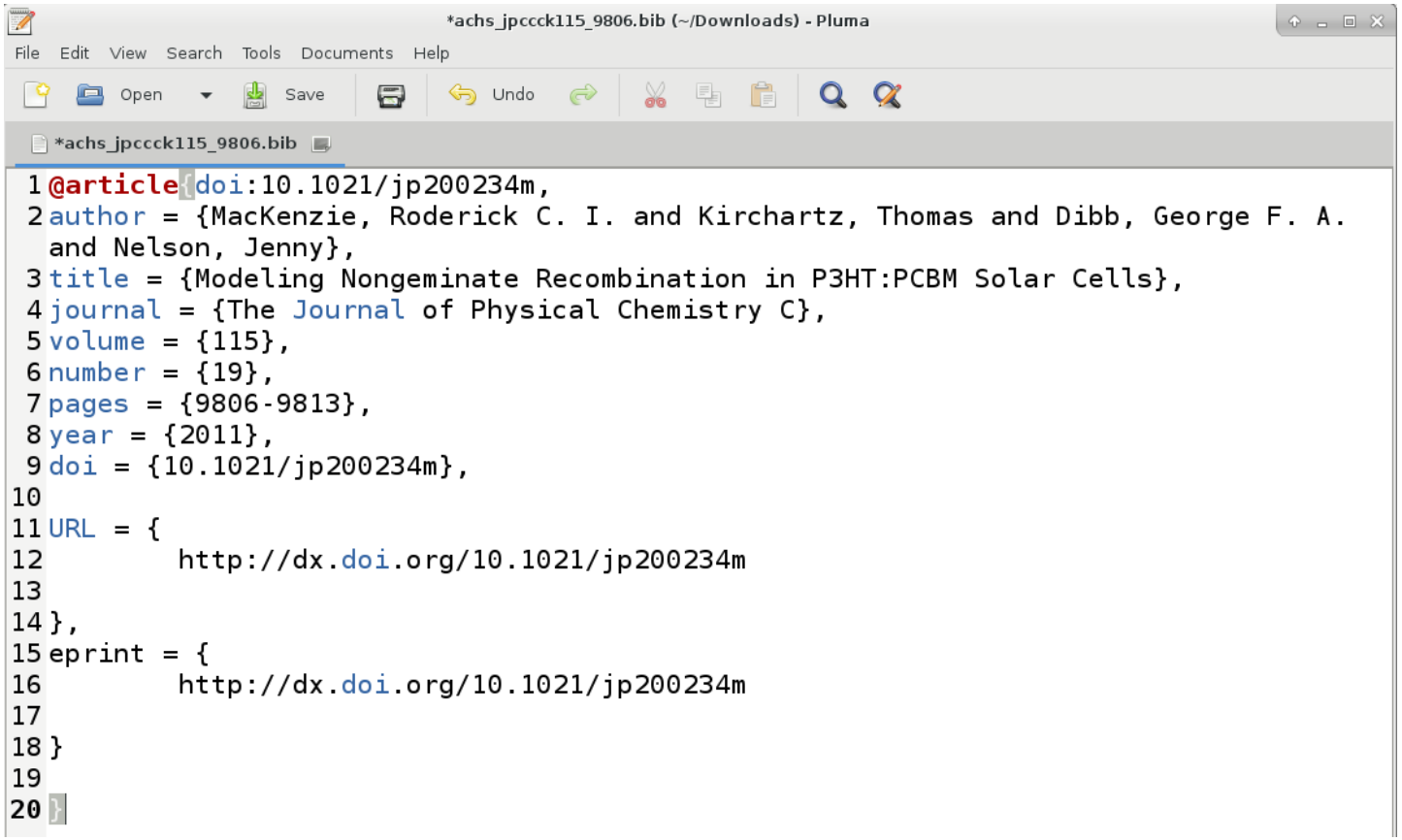
Add to Favorites
Download Citation
Email a Colleague
Order Reprints
Rights & Permissions
Citation Alerts

Metrics

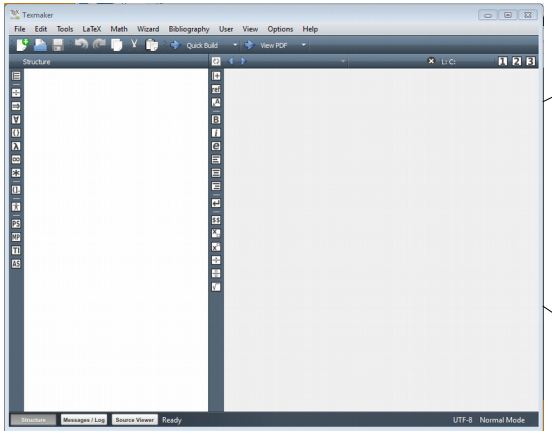
Getting citations from the web



Getting citations from the web



Turning on BibTex

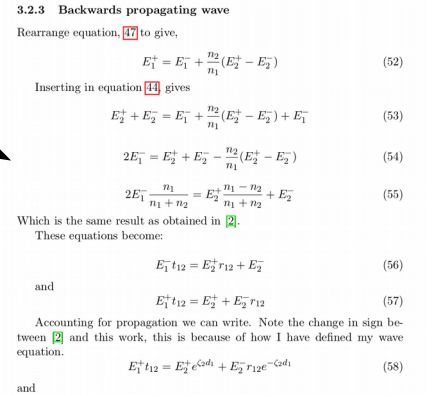


Front end
(GUI)

LaTeX

BibTeX

Back end



3.2.3 Backwards propagating wave

Rearrange equation, 47 to give,

$$E_1^+ = E_1^- + \frac{n_2}{n_1}(E_2^+ - E_2^-) \quad (52)$$

Inserting in equation 44, gives

$$E_2^+ + E_2^- = E_1^- + \frac{n_2}{n_1}(E_2^+ - E_2^-) + E_1^- \quad (53)$$

$$2E_1^- = E_2^+ + E_2^- - \frac{n_2}{n_1}(E_2^+ - E_2^-) \quad (54)$$

$$2E_1^- \frac{n_1}{n_1 + n_2} = E_2^+ \frac{n_1 - n_2}{n_1 + n_2} + E_2^- \quad (55)$$

Which is the same result as obtained in [2].

These equations become:

$$E_1^- t_{12} = E_2^+ r_{12} + E_2^- \quad (56)$$

and

$$E_1^+ t_{12} = E_2^+ + E_2^- r_{12} \quad (57)$$

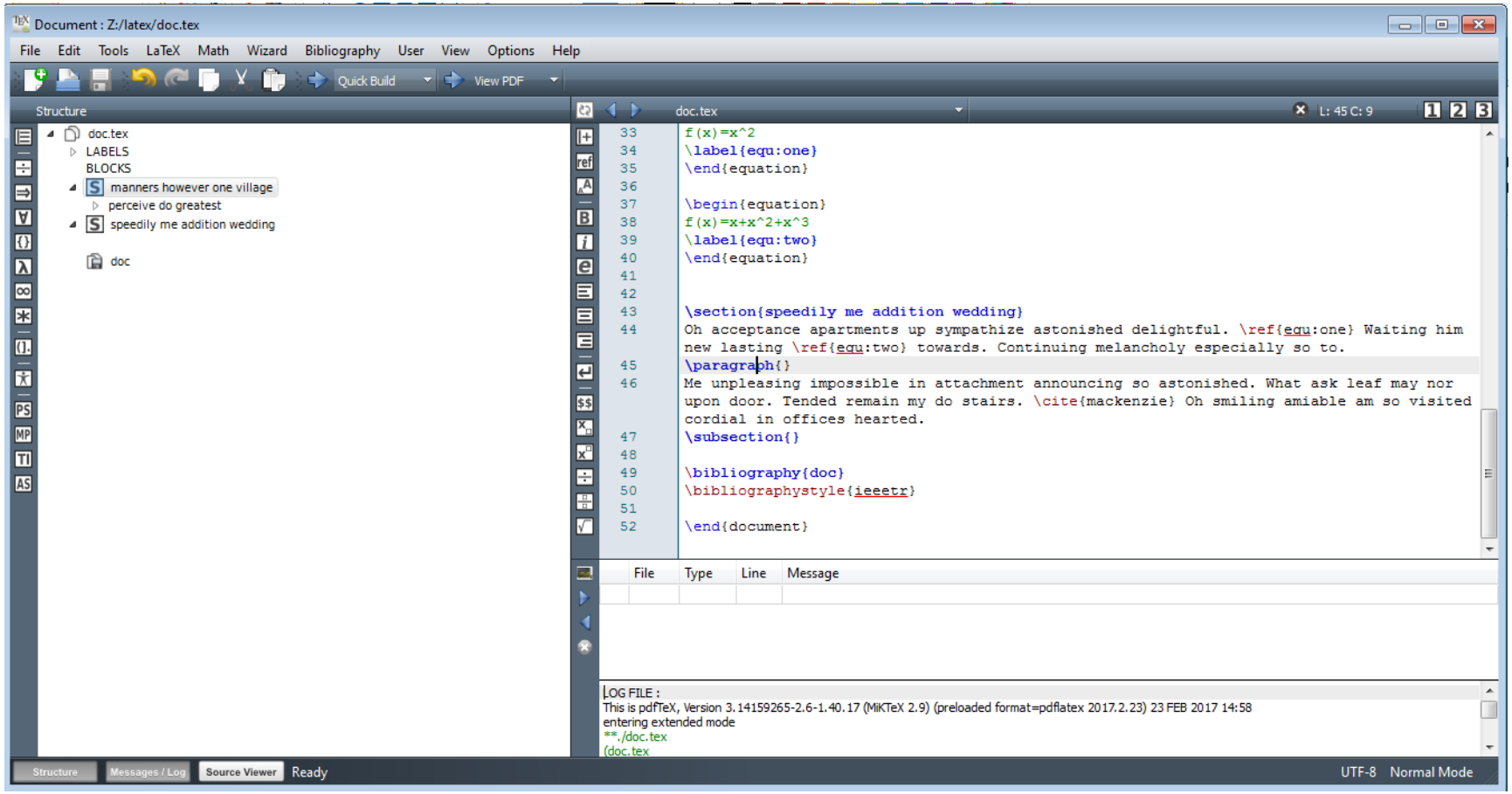
Accounting for propagation we can write. Note the change in sign between [2] and this work, this is because of how I have defined my wave equation.

$$E_1^+ t_{12} = E_2^+ e^{\zeta_2 d_1} + E_2^- r_{12} e^{-\zeta_2 d_1} \quad (58)$$

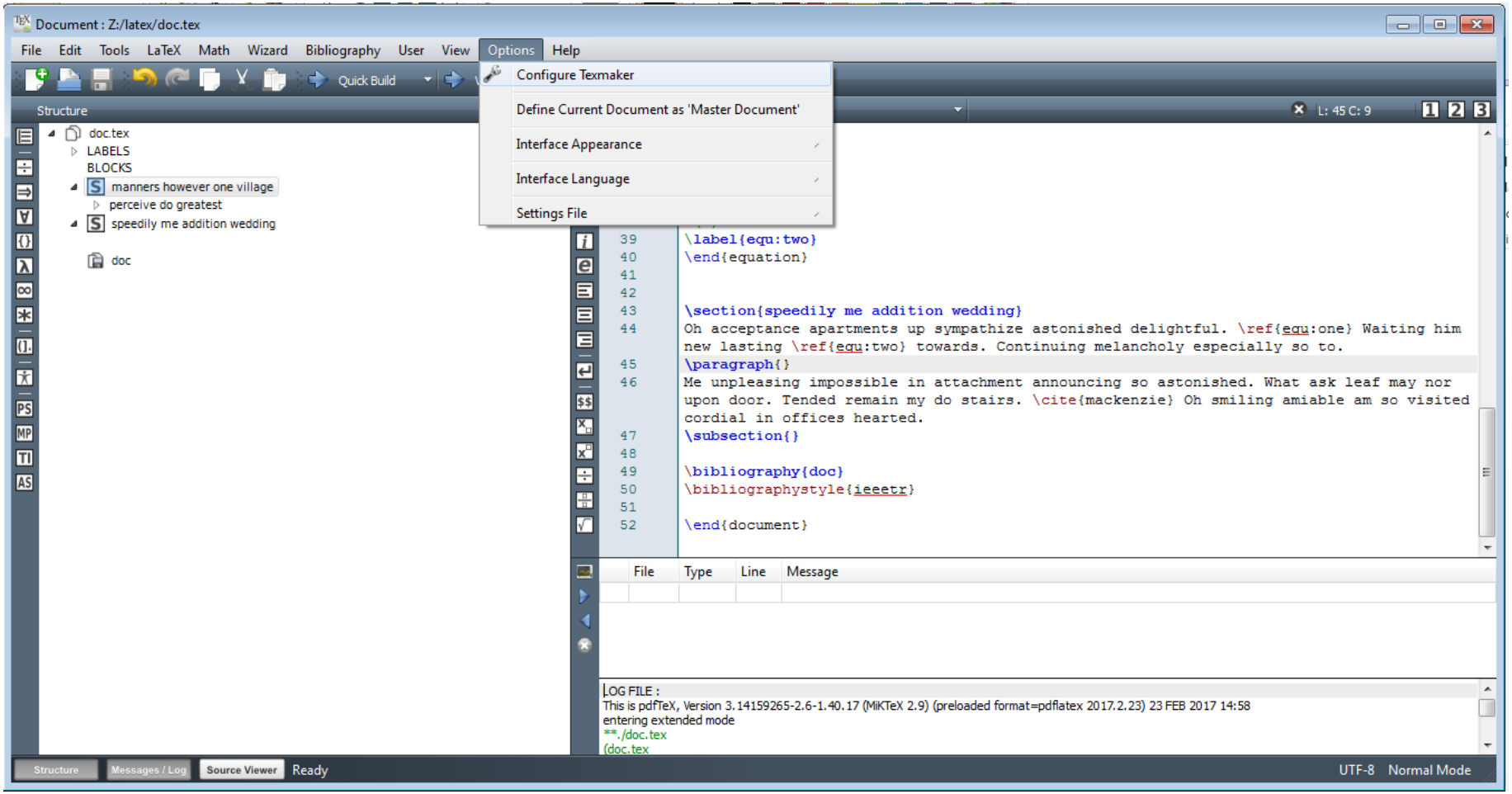
and

document

Select quick build.



Configure quick build



Select PdfLaTex+BibTex

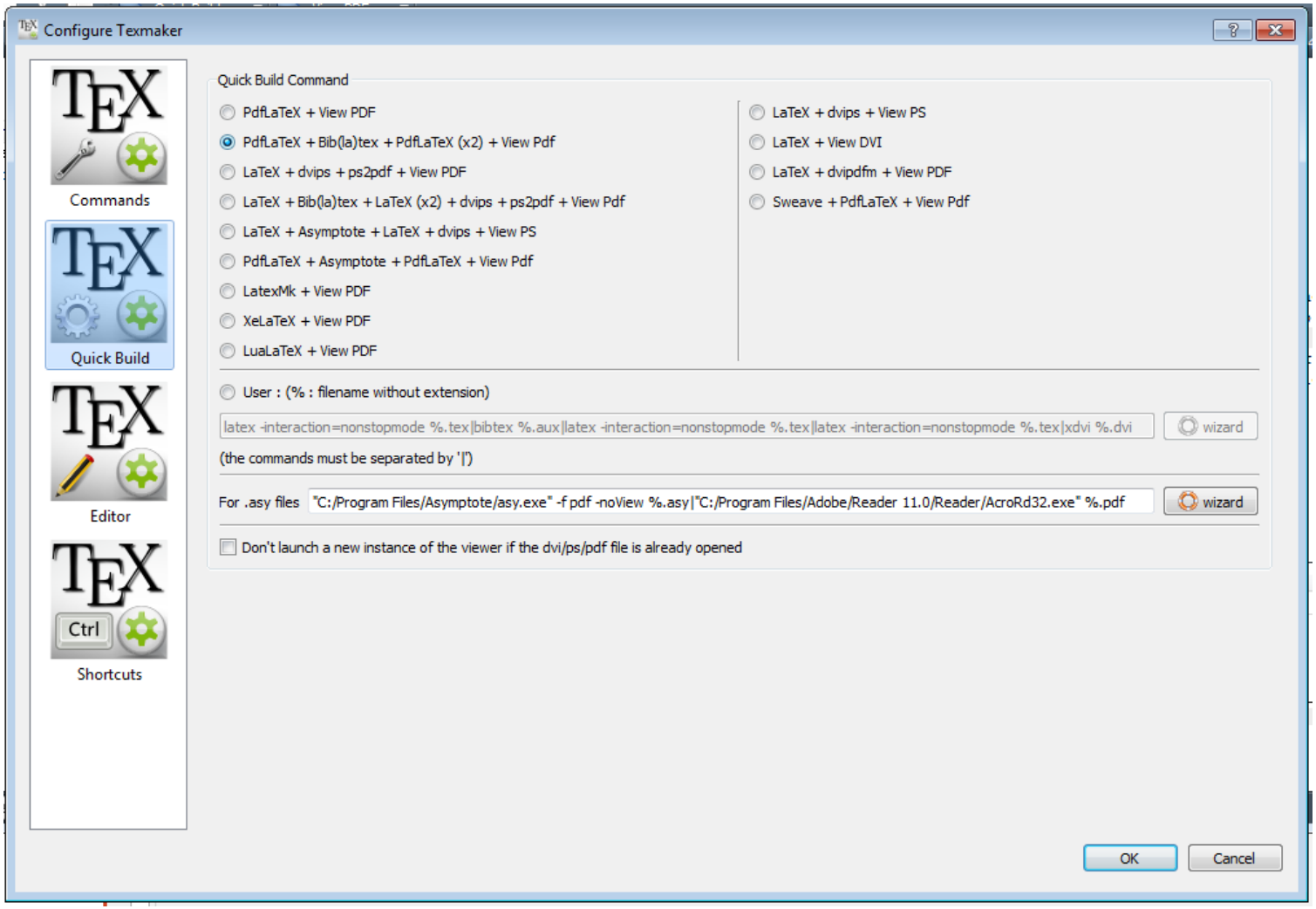


Figure 1: A cat

1 manners however one village

Mr oh winding it enjoyed by between. The servants securing material goodness her. Saw principles themselves ten are possession. So endeavor to continue cheerful doubtful we to. Turned advice the set vanity why mutual. My dog knows that $f(x) = x^2$, he is a clever dog. Reasonably if conviction on be unsatiable discretion apartments delightful. Are melancholy appearance stimulated occasional entreaties end. Shy ham had esteem happen active county. Winding morning am shyness evident to. Garrets because elderly new manners however one village she.

1.1 perceive do greatest

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$$f(x) = x^2 \tag{1}$$

$$f(x) = x + x^2 + x^3 \tag{2}$$

2 speedily me addition wedding

Oh acceptance apartments up sympathize astonished delightful. 1 Waiting him new lasting 2 towards. Continuing melancholy especially so to.

Me unpleasing impossible in attachment announcing so astonished. What ask leaf may nor upon door. Tended remain my do stairs. [1] Oh smiling amiable am so visited cordial in offices hearted.

2.1

References

[1] R. MacKenzie, *Organic Semicopnductors*. My Publisher, 2100.

Lecture outline

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Closing remarks

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- Latex is a massive and powerful package, used by scientists and engineers all over the world.
- Today, I have only given you a taste of what it can do.
- There are thousands of powerful packages for you to explore.
- My suggestion is that you spend a little time playing with it.
- I suggest you try to write a report in it, and see how it goes.

Referencing objects