H14POD so far



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)



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.



	ار ب	5 ±							Document1 ·	· Microsoft Wo	ord
Но	ome	Insert	Page Layout	References	Mailings	Review	View				
Paste V	Cut Copy Format	t Painter	Calibri (Body) ■ I U → al	▼ 11 ▼ Here X ₂ X ² Aa ³	A A A		· • •	₽ 2↓¶ 	AaBbCcDc 1 Normal	AaBbCcDc 1 No Spaci	AaBbC Heading 1
Clipb	oard	G.		Font	G.		Paragraph	5			
				lello Worl	d !						

I≡

MS Word is WYSIWYG (wiz-ee-wig)

LaTeX is a bit different....



Source code

Compiled document

doc.tex

\documentclass[12pt]{article}

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

doc.pdf

	1 of 1		Q	 179.01% 🗸	R	Ξ	-	×
He	ello wor	ld!						
C								

It's harder but has benefits.....

MS Word v.s. LaTeX

- UNITED KINGDOM · CHINA · MALAYSIA
- 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.





- 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



- 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



UNITED KINGDOM · CHINA · MALAYSIA



/home/rod/test/gpvdm4.87



UNITED KINGDOM · CHINA · MALAYSIA



(talk through features)

A latex document: Front page



UNITED KINGDOM · CHINA · MALAYSIA

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]] 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



UNITED KINGDOM · CHINA · MALAYSIA

digant l	Instance and Middle Innovapped means		1.5	
Fie Edit Simulate View Fishs			Hal	
. 🖴 🚊 🕒 🖌 🎽 🏓	• 🔹 👖 🗼 🐙 🕤	@ 🙀 🏪 🗫	÷.	
Simulation mosiv	dy 10 ×		3	
Seven R Mouve R ught R Output R	Dottiger (X Terminel X Information			
Do 5 distribution	 mension 	812		
Electron trap data ty-	4 207452e124			
Hele trap density	3.8723382435	2 w/2-1		
Heatron to La ope	-1037-3	10		
-cle tai sloce	1 000100#-01	41		
Castron meetiky	5 100110w-19	m ² / ² / ²		
⊢ole metil y	5 200320e 07	m ² / ⁻¹ s ⁻¹		
Belatiko permitik@y	8	244		
Doping	0.0	m ?		
Number of traps	10	bence		
Providestrem to Trapped electron	1100110e-23	m ⁻²		
massed electron to -realhale	1:0000000 .8	m ²		
Tracced has no President on	1 2001204-24	m ²		
Preve hole to Trapped hole	1 100110#-11	m.º		
Effective density of free electron states	5 000000+26	m ⁻⁰		
effective density of free mole states	5 100 1100 + 26	m ⁻¹		
×	33	110		
fromwhoddlajwreWorig to	11	41		

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_q

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

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

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

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

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

and for holes

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

The University of

UNITED KINGDOM · CHINA · MALAYSIA

Nottingham

 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



UNITED KINGDOM · CHINA · MALAYSIA

3.2.3 Backwards propagating wave

Rearrange equation, 47 to give,

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

Inserting in equation 44, gives

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

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

$$2E_1^- \frac{n_1}{n_1 + n_2} = E_2^+ \frac{n_1 - n_2}{n_1 + n_2} + E_2^-$$
(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.

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

and

(talk through features)

A latex document: Coupling other software to LaTeX



UNITED KINGDOM · CHINA · MALAYSIA

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:Equilbrium 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.



UNITED KINGDOM · CHINA · MALAYSIA

References

- 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.



UNITED KINGDOM · CHINA · MALAYSIA

≡

9	Gpvdm manual - Mozilla Firefox	+ _ = ×	🥑 Scanning parameters - Mozilla Firefox 🔶 :
<u>F</u> ile <u>E</u> dit <u>V</u> iew Hi <u>s</u> tory <u>B</u> ookn	marks <u>T</u> ools <u>H</u> elp		Eile Edit View History Bookmarks Tools Help
🔮 Recent Visitor Activity 🗙 🛛 Gp	vdm manual 🛛 🗙 G libre office - Google S 🗙 🕂		🔮 Recent Visitor Activity 🗙 Scanning parameters 🛛 🗙 G libre office - Google S 🗴 🕇
🗲 🛈 gpvdm.com/man/gpvdm.htm	130% 🕑 🔍 libre office 🔸 🏠 📋 🛡 🖡 🏫	🐵 ~ 🖗 » ≡	🔶 🛈 gpvdm.com/man/node10.html 🛛 130% C 🔍 🔍 libre office 🔿 🟠 📋 🔍 🖡 🎓 🗢 📎 »
Next Up Previous			Next Up Previous
Next: Foreword			Next: <u>Output directories</u> Up: <u>Meshing</u> Previous: <u>Interfacing the electrical and</u>
	Govdm manual		Scanning parameters
	oprum munuui		Sometimes one wishes to systematically vary a simulation parameter, this is how
	Roderick C. I. MacKenzie		to do it:
			File Simulate View Plots
r	oderick.mackenzie@nottingham.ac.uk		
			Simulation mode: timedomain v Light intensity (Suns): 0.0 v
			Figure: Step 1: Select the 'Parameter scap' tool.
			righter step 1. select the furtherest sound con.
			Parameter scan-spole No Simulations Advected
	N.		
			Parameter to change Values Opperation
• Foreword			
<u>Running the mode</u>			
 Installing gpv Installing gpv 	vdm for linux		
• Running gpv	dm		
∘ <u>Meshing</u>			
 Editing t 	the electrical mesh/layers		pometro de esta mula encons
 Editing t Interfaci 	the optical mesh/layers		Figure: Step 2: Add a 'scan line' to the scan.
 Interfact Scannin 	a parameters		Parameter son - spedm Duc. Dir.
 Output direct 	tories		He Sinulations Advanced Help
∘ <u>Output files</u>			
■ <u>1D posit</u>	tion space output		Datameter ta change Values Opperation





- 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
- Making a ToC
- References

Starting latex



		- computer	u≊ labivew
Programs (3)		Network	abview2
TEX (UoN) Texmaker			Lecture 2
(UoN) Text Output	Location: texmaker (C:\WINDOWS\ AppData\Local\Microsoft\AppV\C AA7B-EE5E03923B22\Root\Texmak	system32\config\syster ient\Integration\826E1E er)	nprofile\ BA-FBF5-4034- e_array2
Make text and other items large Make text and other items large Adjust ClearType text Hear text read aloud with Narrat Change text to speech settings	r or smaller :or		Q7 Split Sum Untitled Iatex
Change display language Change the languages used for	partially translated menus and	latex File folder Off	Date modified: 23/02/2017 line availability: Not availal
See more results tex	× Log off >		
🔊 🏉 🔚 🖸			

• There are lots of front ends to latex

Starting latex



Texmaker	
File Edit Tools LaTeX Math Wizard Bibliography User View Options Help	
Structure	123
B	
Structure Messages / Log Source Viewer Ready U	TF-8 Normal Mode

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



UNITED KINGDOM · CHINA · MALAYSIA



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

Terminal - rod@rodlinuxbox:~/Desktop/latex	+ - • ×)
File Edit View Terminal Tabs Help	
[rod@rodlinuxbox latex]\$ pdflatex doc This is pdfTeX, Version 3.14159265-2.6-1.40.16 (TeX Live 2016/dev) (pr rmat=pdflatex)	reloaded fo

Make a new document





Your first Latex document





Your first Latex document





So, off you go type this in.





Make a new folder in z:\ called latex



Т	Socument : untitled	3												
	🍱 Save As								×		_			
	🕞 🗢 💻 Deskt	op 🕨			- - i - j	Search Desktop			٩			_		
	Organize 🔻 Ne	w folder	,				E.		?	icle)		🗴 L: 7 C: 15	123	/ault
	★ Favorites ■ Desktop			Shortcut 1.04 KB MiKTeX Download	Files				*					Art -
	Downloads Lownloads Lownloads Lownloads Lownloads Lownloads	=		File folder										<u> </u>
	iibraries iiDocuments iiDocuments			Email Internet Shortcut 120 bytes Help and Support Internet Shortcut				View Sort by		+	1			ktop
	📄 Pictures 🛃 Videos			146 bytes Print and Scan Internet Shortcut				Refresh Paste	y	•				
	🖳 Computer	-		158 bytes				Paste sh	ortcut			Folder		
	File name:							New		÷	2	Shortcut		
	Save as type:	TeX file	es (*.tex *.bil	o *.sty *.cls *.mp *.Rr	iw *.asy)			Screen re	esolutio	n	48	Microsoft Ac	cess Database	
	Hide Folders					Save		Gadgets Personal	lize			Flash Actions C2 Documen	Script File It Model	
										-		CS Chem3D	Model	
											0	CS ChemFind	der Document	
											0	CS ChemFine	der Document	
	_											Contact		Ci
	_											Microsoft Wo	ord Document	H
											1	PIMSFLOW D	ocument)	
												Geometry.Do	ocument	
	Structure Messages	s / Log	Source Viewe	r Ready							1	Mindjet Mind	dManager 6 Docum	ent
								-			l P 🗐	Microsoft Pro	piect Document	

z:\latex





Save the document as z:\latex\doc





Set the compiler to **PDFLaTeX**





There are many back ends to latex



UNITED KINGDOM · CHINA · MALAYSIA



Front end (GUI)

Now, let's compile the document



TEX	Docume	nt : C:/U	sers/ezzrr	n/Deskt	top/latex/	doc.tex							
Fil	e Edit	Tools	LaTeX	Math	Wizard	Bibliography	User	View	Options	Help			
1	🗎 🕈) @		Х 💼	👌 🔶 PDFLaTe	x -	 	view PDF				
	Structure						छ 🗸	▶	doc.tex	_	•	😣 L: 7 C: 15	123
								L	\docu	mentclass	<pre>s[12pt]{article}</pre>		
÷							ref	2 3 🗖	\begin	n{documer	nt}		
⇒								1 5	Hello	World!			
							B	5	A secold				
λ							e	/	o	locument,	8		
00							E						
*							E						
(].													
X							₽						
PS							\$\$						
MP							×						
							×						
AS							-						
							√_						
	Structure	Mess	ages / Log	Sour	ce Viewer	Ready						UTF-8	Normal Mode

Add a title page





You should get this.



My report Roderick MacKenzie 2017-02-20	Hello World!
1	2

Numbering on the title page



UNITED KINGDOM · CHINA · MALAYSIA

\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!
	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

Adding more text to the document

\documentclass[12pt]{article}

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

\begin{document}
 \pagenumbering{gobble}

\maketitle \newpage

\pagenumbering{arabic}

 Replace Hello world! with 5 random paragraphs of text





• 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.



UNITED KINGDOM · CHINA · MALAYSIA

Subsections in documents are defined like this:

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

They will automatically be numbered

Your document should look something like this



\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!):



UNITED KINGDOM · CHINA · MALAYSIA

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 contime 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 now 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





- 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



UNITED KINGDOM · CHINA · MALAYSIA

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

<u>raleway</u>

Use Raleway with $T_E X(-alike)$ systems

ran_toks Randomise token strings

randbild

Marginal pictures

<u>random</u>

Generating "random" numbers in T_EX

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 m- A Hebrew font

REdit Menu-based editor

refcheck Check references (in figures, table, equa-

tions, etc) refcount Counter operations with label references

<u>refenums</u>

Define reference labels items with names

of their own

refer Convert a BiBT_EX bibliography to refer format

refer-tools

Convert between refer format and BIBTEX format

references

refman

Bibliographic software supporting L^{AT}EX/ВівТЕХ

reflectgraphics Techniques for reflecting graphics

³ resphilosophica

Typeset articles for the journal Res Philosophica

resumecis

Typeset a resume both in English and Chinese

resumemac Plain T_FX macros for resumés

reverxii Playing Reversi in T_FX

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

<u>rotpages</u>

Typeset sets of pages upside-down and backwards

<u>rotunda</u>

Rotunda manuscript book-hand font

roundbox Bound boxes in

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 Dedefines f

Redefines the plain pagestyle

RRGtrees

Linguistic tree diagrams for Role and Reference Grammar (RRG) with ${\rm \sc Larger}X$

rsc

BIBTEX style for use with RSC Journals

<u>rsfs</u>

Ralph Smith's Formal Script font

<u>rsfso</u>

A mathematical calligraphic font based on rsfs

RST

Drawing rhetorical structure analysis diagrams in $\ensuremath{\mathbb{P}} T_F X$

rterface

Access to R analysis from within a docu-

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



UNITED KINGDOM · CHINA · MALAYSIA

```
\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





Lecture outline



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



- 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.



• 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.



UNITED KINGDOM · CHINA · MALAYSIA

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.

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

$$f(x) = x + x^2 + x^3$$
(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.

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}
```



UNITED KINGDOM · CHINA · MALAYSIA

 $frac{1}{sqrt{x}}$

 $F(x) = \inf^a_b \frac{1}{3}x^3$

 $N(x) = \frac{1}{\sqrt{2}}$

Hint for matrix: \usepackage{amsmath}

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



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

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

$$\frac{1}{\sqrt{x}}$$
(3)

$$\frac{1}{\sqrt{x}}$$
(4)

$$\begin{bmatrix} 1 & 0\\ 0 & 1 \end{bmatrix}$$
(5)

Lecture outline



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

Making a table of contents





Adding a content page



Document : Z:/latex/doc.tex File Edit Tools LaTeX Math Wizard Bibliography User Vie	Options Help	
New Image: Operation of the second	Image: Sector (manners however one village) Image: Sector (manners however one village) <t< th=""><th></th></t<>	
\begin{document} \tableofcontents \newpage	VTF-8 Normal Mo	de

Lecture outline



- What is LaTeX and when would I use it.
- Your first latex document.
- Structuring your document.
- Packages explained
- Equations in LaTeX
- 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



Document : untitled6	
File Edit Tools LaTeX Math Wizard Bibliography User View Options Help	
Ctrl+N PDFLaTeX View PDF View PDF	
New by copying an existing file	
Dpen Ctrl+O	
Open Recent >	
Session >	
🖶 Save Ctrl+S	
Save As	
Save A Conv	
Close Ctrl+W	
Reload document from file	
Reload all documents from file	
Print Ctrl+P	
Evit Ctrl+O	
4	
8	
Structure Messages / Log Source Viewer Ready	UTF-8 Normal Mode

Saving your bib file



TEX Save As		×					
Search latex							
Organize 🔻 Ne	w folder	:= 🗸 🔞					
Desktop	Name	Date modified Type					
 Downloads Recent Places Libraries Documents Music Pictures 	TeX doc	23/02/2017 14:49 LaTeX do					
Computer		Þ					
File name:	doc.bib						
Save as type:	TeX files (*.tex *.bib *.sty *.cls *.mp *.Rnw *.asy)	▼					
Hide Folders		Save Cancel					

The interface should now look like this.



📡 Document : Z:/latex/doc.bib		- • •
File Edit Tools LaTeX Math Wizard Bibliography User View Options H	felp	
📑 🎦 🔚 🦏 🍘 🧊 🗴 👘 💠 PDFLaTEX 🔹 🜩 View PDF 📼		
Structure	🖸 🔹 b doc.bib 🔻 😵 L: 1:	C: 1 123
 Control <		IITE-8 Normal Mode
incody		on o normanioac

Add the reference



TeX Document : Z:/latex/doc.bib			
File Edit Tools LaTeX Math Wizard Bibliography User Vie	w Options Help		
: 👌 📑 🔚 📑 🧖 🧖 🗍 💃 🏥 🔶 PDFLaTex — 🔻 🖨	View PDF 🔻		
Structure Save	🙋 🗸 🕨 🗖 doc.bib	•	× L: 6 C: 2 1 2 3
□ □ doc.tex	1 @book{ma/	kenzie, oderick MacKenzie"	
BLOCKS	a 3 TITLE="O	ganic Semicopnductors",	
 perceive do greatest 	4 PUBLISHE	="My Publisher", 0",	
speedily me addition wedding			
λ	e -		
X	Ľ		
25	\$\$ /		
<pre>@hook/mackanzia</pre>			
WDUUKIIIACKEIIZIE,			
ALITHOR="Roderick Mac	·Konzio"		
TITI E="Organic Semicor	iductors"		
PUBLISHER="Mv Publis	ner"		
	101 ;		
YEAR="2100".			UTF-8 Normal Mode
•			

Using the bib file 1/2



The Document : Z:/latex/doc.tex					x
File Edit Tools LaTeX Math Wizard Bibliography User View Options Help					
📑 📑 🍯 🧖 🖉 🧊 Y 👘 🜩 Quick Build 🔹 🜩 View PDF 🔹					
Structure	v →	doc.tex		▼ L: 45 C: 9 1 2	3
Structure Image: Constraint of the second secon		<pre>doc.tex</pre>			
	🔜 🛛 File	Туре	Line	Message	
	▶				
	▼				
	OG FILE : This is pdfTe entering ext **./doc.tex (doc.tex	X, Version 3. tended mode	. 1415926	55-2.6-1.40.17 (MiKTeX 2.9) (preloaded format=pdflatex 2017.2.23) 23 FEB 2017 14:58	*
Structure Messages / Log Source Viewer Ready				UTF-8 Normal Mode	

Using the bib file 2/2



TEX Document : Z:/latex/doc.tex				
File Edit Tools LaTeX Math Wizard Bibliography User View Options	Help			
📑 🚰 🗐 🍋 🦳 🧎 🏌 👘 🔸 Quick Build 🔷 💠 View PDF				
Structure	2 🗸 🕨	doc.tex	*	× L: 45 C: 9 1 2 3
□ doc.tex ► LARELS	H 33 34	$f(x) = x^2$ \label{equ:one}		· ·
BLOCKS	ref 35	\end{equation}		
manners however one village perceive do greatest	A 36 37	\begin{equation}		
S speedily me addition wedding	B 38	$f(x) = x + x^2 + x^3$		
	1 33	(Tabel (equ. two)		
\documentclass{article}				
t j				lightful. \ref{ <u>equ</u> :one} Waiting him holy especially so to.
				actoniched What ack leaf may non
\begin (decument)				ie} Oh smiling amiable am so visited
\ begin {document}				
				E
Dandom citation \cita	rkonzi	ial amhadda	ad in taxt	
Ranuom challon icheima				
\newpage				
"Tempage				
				A
				23 FEB 2017 14:58
lesson/al	•			
\hibliographyotylo(icooty	า			UTF-8 Normal Mode
\u00fapriystyle{leeetr	}			
				1
\end{document}				1

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



UNITED KINGDOM · CHINA · MALAYSIA

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 **Copyright © 2011 American Chemical Society**

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

Abstract



У f 🕞	⊻ +		
Article O	ptions		
 ACS ActiveView PDF Hi-Fes Print, Annotate, Reference Quick View PDF (3461 KB) PDF w/ Links (1010 KB) Full Text HTML 	Abstract Figures References Citing Articles		
e Add to ACS ChemWorx			
 ★ Add to Favorites Download Citation ≅ Email a Colleague In Order Reprints In Rights & Permissions S Citation Alerts 			
Metrics			

Getting citations from the web



UNITED KINGDOM · CHINA · MALAYSIA

Download a citation file in RIS format that can be imported by all major citation management software, including BibTex, EndNote, ProCite, RefWorks, and Reference Manager.

Format:

- RIS For EndNote, ProCite, RefWorks, and most other reference management software
- BibTeX For JabRef, BibDesk, and other BibTeX-specific software

Include:

- Citation for the content below
- Citation and references for the content below
- Citation and abstract for the content below

Download Citation(s)

Getting citations from the web



```
1
                               *achs jpccck115 9806.bib (~/Downloads) - Pluma
File Edit View Search Tools Documents Help
                                             🔏 🖣 👘 🔍 📿
     📮 Open 🔻 🔙
                          🥽 Undo 🎻
                   Save
 📄 *achs_jpccck115_9806.bib 🔳
 1@article doi:10.1021/jp200234m,
 2 author = {MacKenzie, Roderick C. I. and Kirchartz, Thomas and Dibb, George F. A.
  and Nelson, Jenny},
 3title = {Modeling Nongeminate Recombination in P3HT:PCBM Solar Cells},
 4 journal = {The Journal of Physical Chemistry C},
 5 volume = \{115\},\
 6 \text{ number} = \{19\},\
 7 pages = \{9806 - 9813\},
 8 year = \{2011\},\
 9 \text{ doi} = \{10.1021/\text{jp}200234m\},\
10
11 \text{ URL} = \{
12
           http://dx.doi.org/10.1021/jp200234m
13
14\},
15 eprint = {
            http://dx.doi.org/10.1021/jp200234m
16
17
18 }
19
20
```

Turning on BibTex





Select quick build.



TRX D			
Document : 2://atex/ doc.tex			
File Edit lools LaleX Math Wizard Bibliography User View Options He	elp	_	
🛛 🚰 🔚 🥱 🧖 🧊 X 👘 💠 Quick Build 🔹 💠 View PDF 💌			
Structure	য় ∢ ▶	doc.tex	× L: 45 C: 9 1 2 3
 doctex LABELS BLOCKS Speceive do greatest Speceily me addition wedding doc doc 	Image: Signal system 33 Image: Signal system 36 Image: Signal system 37 Image: Signal system 37 Image: Signal system 37 Image: Signal system 37 Image: Signal system 40 Image: Signal system 47 Image: Signal system 47 Image: Signal system 50 Image: Signal system 52 Image: Signal system 53 Image: Signal system 53 Image: Signal system 53 Image: Signal system 53 Image: Signal system 54 Image: Signal system 54	f(x)=x^2 f(x)=x^2 label{e end{equ begin{e f(x)=x+x label{e end{equ section Oh accep new last paragra Me unple cordial subsect bibliog bibliog lend{doc	<pre>2 equione; uation; equation; x^2+x^3 equitwo; uation; n(speedily me addition wedding) ptance apartments up sympathize astonished delightful. \ref(equ:one) Waiting him ting \ref(equ:two) towards. Continuing melancholy especially so to. abh() easing impossible in attachment announcing so astonished. What ask leaf may nor or. Tended remain my do stairs. \cite(mackenzie) Oh smiling amiable am so visited in offices hearted. tion{} graphy(doc) graphystyle(ieeetr) cument; ine Message 4159265-2.6-1.40.17 (MKTex 2.9) (preloaded format-pdflatex 2017.2.23) 23 FEB 2017 14:58</pre>
	**./doc.tex		•
Structure Messages / Log Source Viewer Ready	(doc.tex		UTF-8 Normal Mode
Configure quick build



UNITED KINGDOM · CHINA · MALAYSIA

^{TEX} Document : Z:/latex/doc.tex	
File Edit Tools LaTeX Math Wizard Bibliography User View	Deptions Help
👎 🕒 🗐 🦳 🔽 👘 🔶 Ouide Build 🖃 🔿 🗸	Donfigure Texmaker
Structure	Define Current Document as 'Master Document'
Structure	Define Current Document as Master Document Interface Appearance Interface Language Settings File Image: Settings File Image: Setting Sple Image: Setting Sple
	**./doc.tex (doc.tex
Structure Messages / Log Source Viewer Ready	UTF-8 Normal Mode

Select PdfLaTex+BibTex



UNITED KINGDOM · CHINA · MALAYSIA

Ex Configure Texmaker		8	x				
TFX	Quick Build Command	💿 LaTeX + dvips + View PS					
	OPdfLaTeX + Bib(la)tex + PdfLaTeX (x2) + View Pdf	C LaTeX + View DVI					
	LaTeX + dvips + ps2pdf + View PDF	LaTeX + dvipdfm + View PDF					
Commands	LaTeX + Bib(la)tex + LaTeX (x2) + dvips + ps2pdt + View Pdt	Sweave + PdfLaTeX + View Pdf					
ТъХ	PdfLaTeX + Asymptote + PdfLaTeX + View Pdf						
- Cr.	LatexMk + View PDF						
	XeLaTeX + View PDF						
Quick Build	C LuaLaTeX + View PDF						
T - V	○ User : (% : filename without extension)						
1	[latex -interaction=nonstopmode %.tex bibtex %.aux latex -interaction=n	onstopmode %.tex latex -interaction=nonstopmode %.tex xdvi %.dvi 🛛 🔘 wizard					
	(the commands must be separated by ' ')						
Editor	For .asy files "C:/Program Files/Asymptote/asy.exe" -f pdf -noView %.asy "C:/Program Files/Adobe/Reader 11.0/Reader/AcroRd32.exe" %.pdf						
T - V	Don't launch a new instance of the viewer if the dvi/ps/pdf file is already opened						
IEV							
Ctrl 💢							
Shortcuts							
Shortcuts							
		OK	el				







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

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.

$$f(x) = x^2$$
(1)

$$f(x) = x + x^2 + x^3$$
 (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

R. MacKenzie, Organic Semicopnductors. My Publisher, 2100.

Lecture outline



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

Closing remarks



- 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



UNITED KINGDOM · CHINA · MALAYSIA

TEX Desument + 7/(htex/des.tex						
Eile Edit Taala LaTay Math Wizard Bibliography User View Ontions He	ln.					
	φ	_	-			
📑 📑 🐄 (<< 🛄 X 🛄 😴 Quick Build 🔹 🖓 View PDF 🔹			_			
Structure	22 ◀ ▶	doc.tex		× L: 45 C: 9 1 2 3		
 Acctex LABELS BLOCKS Smanners however one village perceive do greatest Speedily me addition wedding doc doc 	33 34 34 35 36 37 38 37 39 40 41 42 41 42 41 42 43 44 45 46 55 51 51 51 51 52	<pre>f(x)=x^2 \label{equ:one} \end{equation} \begin{equation} f(x)=x+x^2+x^3 \label{equ:two} \end{equation} \section{speedily me addition wedding} Oh acceptance apartments up sympathize astonished delightful. \ref{equ:one} Waiting him new lasting \ref{equ:two} 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. \cite{mackenzie} Oh smiling amiable am so visited cordial in offices hearted. \bibliographystyle{ieeetr} \end{document}</pre>				
	🔜 File	Туре	Line	Message		
	*					
	LOG FILE : This is pdfTe) entering exte **./doc.tex (doc.tex	LOG FILE : This is pdfTeX, Version 3.14159265-2.6-1.40.17 (MiKTeX 2.9) (preloaded format=pdflatex 2017.2.23) 23 FEB 2017 14:58 entering extended mode **./doc.tex (doc.tex (doc.tex				
Structure Messages / Log Source Viewer Ready				UTF-8 Normal Mode		