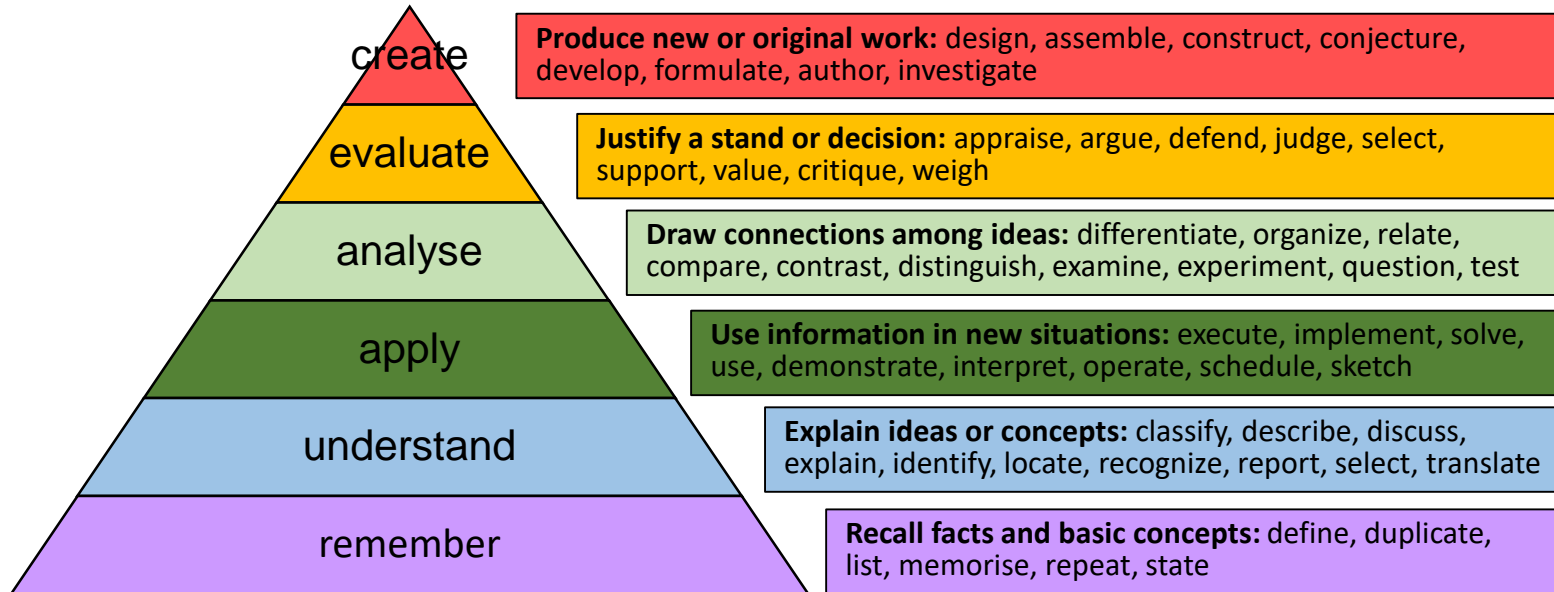# Introduction to research

We'll work through the following topics today

- Research
- Research tools
  - Gantt chart
  - Database development
- Typesetting software:
  - Visio
  - Lyx (open source, since 1995)
  - Word
- Reference management software
  - JabRef (open source, since 2003)
  - EndNote (commercial, since 2018)
  - Zotero (open source, since 2006)

These are the learning outcomes for today's lecture; here written as part of Bloom's taxonomy*

create — **Produce new or original work:** design, assemble, construct, conjecture, develop, formulate, author, investigate

evaluate — **Justify a stand or decision:** appraise, argue, defend, judge, select, support, value, critique, weigh

analyse — **Draw connections among ideas:** differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test

apply — **Use information in new situations:** execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch

understand — **Explain ideas or concepts:** classify, describe, discuss, explain, identify, locate, recognize, report, select, translate

remember — **Recall facts and basic concepts:** define, duplicate, list, memorise, repeat, state

* Vanderbilt university

- Explain research

- Develop a database
- Typeset documents professionally
- Set up a reference management system

Research
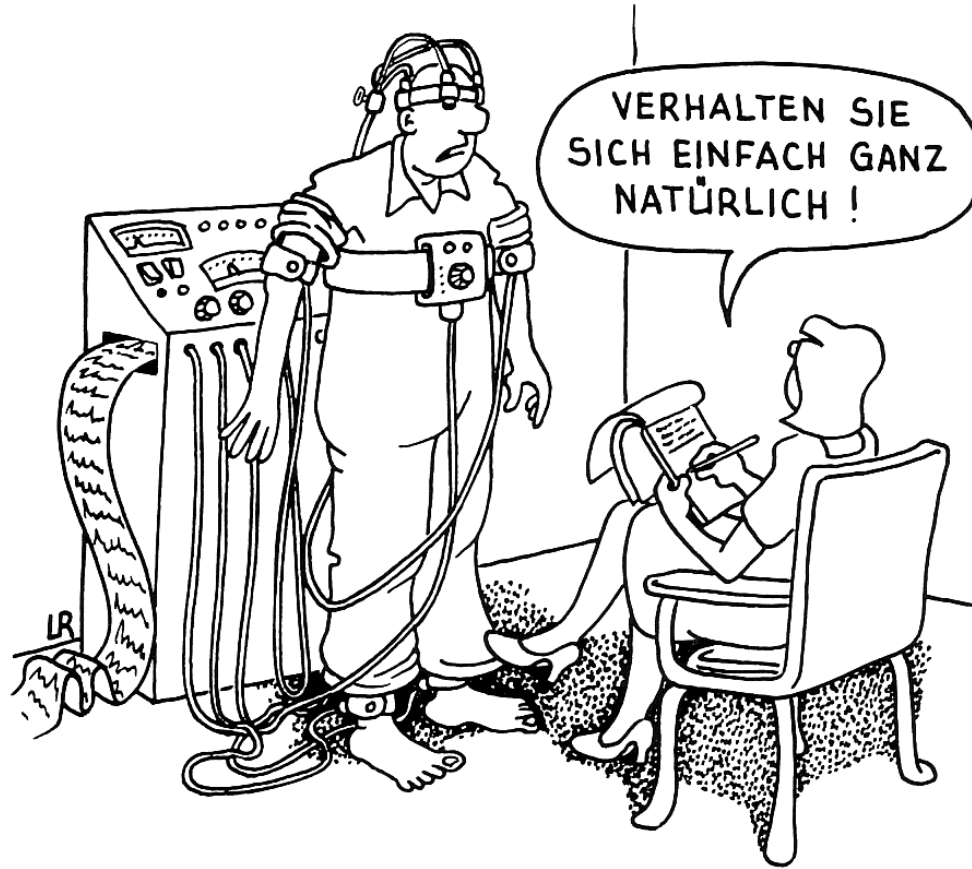
Why FYP? Think about it

Perhaps you want to:
- Make the most out of the experience
- Learn to operate new equipment
- Pick up new skills
- Solve open ended problems
- Learn new software
- Work independently

What is **not** research? The word "research" is used in everyday speech in many different situations

- Research is not mere information gathering: "I went to the library to do research on ships"

- Research is not mere transportation of facts from one location to another: "from a book to your thesis"

- Research is not merely rummaging for information: "I have to do some research (=window shopping) to find the cheapest watch"

- Research is not a catch-word to get attention: "Several years of R&D are behind this latest shaver: the super-duper shaver with 10 blades"

There are several definitions of research*,**

- Etymology: Middle French *recerche,* from *recercher* to go about seeking, from Old French *recerchier,* from *re- + cerchier, sercher* to search
- Careful or diligent search
- Studious inquiry or examination: investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws
- The collecting of information about a particular subject
- Systematic investigation to establish facts
- A search for knowledge

Example of steps in research

1. Originates with a question or problem. "Why?"
2. Requires articulation of a goal
3. Usually divides the problem into manageable sub-problems "Divide-and-conquer"
4. Guided by research problem, question, or hypothesis
5. Accepts assumptions
6. Requires the collection and interpretation of data: e.g., design of experiments, verification, and validation
7. Requires communication of research
8. Research is iterative

See our rubric

Research tools
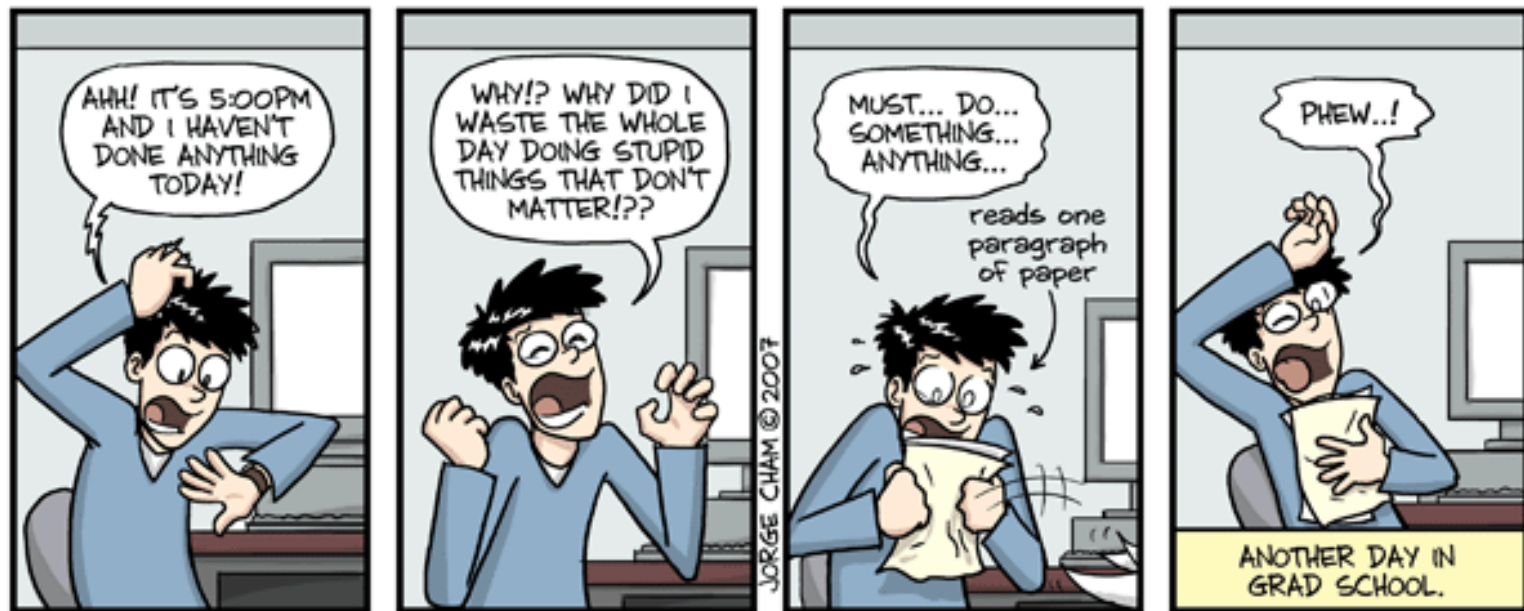
A Gantt chart is a graphical representation, useful for planning, scheduling and monitoring of a project

Year	2006		2007				2008				2009				2010	
Quarter	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
Course Work																
Literature Review																
Single-phase																
3D model																
2D with porous flow channel																
Half-cell — Scaling analysis																
Half-cell — Parabolic																
Half-cell — Publications																
Thesis proposal																
Full cell — Scaling analysis																
Full cell — Parabolic																
Full cell — Publications																
Agglomerate model																
Volume averaging																
Publications																
Two-phase																
Publications																
Stacks																
Publications																
Thesis																

Develop your own database; check with your supervisor on any preferences

- When you carry out a literature review and download PDF files (articles etc.)
- When you search and find good useful sites online
- Create a database for easy access
- Store all information for a project in one place
- JabRef, EndNote, Zotero…
- Excel
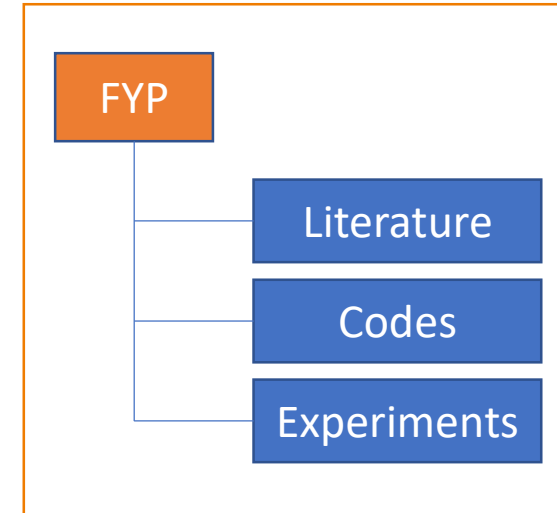
Folder structure

Below is an example of a database in Excel; can also be done in JabRef, Zotero, EndNote, etc.

AUTHOR(s)	TITLE	YEAR	DESCRIPTION
A. Huther, X. Xu and G. Maurer	**Swelling of n-isopropyl acrylamide hydrogels in water and aqueous solutions of ethanol and acetone**	2004	
A. Richter, S. Howitz, D. Kuckling and K-F. Arndt	**Influence of volume phase transition phenomena on the behavior of hydrogel-based valves**	2004	
B. Isik	**Swelling behavior and determination of diffusion characteristics of acrylamide-acrylic acid hydrogels**	**2004**	
C. Folk et al.	**Micro/nano fluidics for bio-signature detection**	2004	Experiments showing the closing/opening of a hydrogel valve subject to temperature stimuli.
C. Li, R. I. Borja and R.A. Regueiro	**Dynamics of porous media at finite strain**	**2004**	Good description of transformations from and to Lagrangian and Eulerian.
C. Ni and X. X. Zhu	**Synthesis and swelling behavior of thermosensitive hydrogels based on N-substitutedacrylamides and sodium acrylate**	**2004**	Charged polymer.
D. T. Eddington and D. J. Beebe	**Flow control with hydrogels**	**2004**	Interesting paper on various applications of hydrogels for flow control.
E. D. Oliveira, A. F.S. Silva and R. F.S. Freitas	**Contributions to the thermodynamics of polymer hydrogel systems**	**2004**	They model temperature dependent swelling of PNIPAA gels! Have a review of available temperature models.
G. A. Ateshain, N. O. Chahine, I. M. Basalo and C. T. Hung	**The correspondence between equilibrium biphasic and triphasic material properties in mixture models of articular cartilge**	**2004**	Biphasic models are linked to triphasic models. Good for extension of thermosensitive models to also include the ion-phase for nonpolar gels.
H. Li, J. Chen and K.Y. Lam	**Multiphysical modeling and meshless simulation of electric-sensitive hydrogels**	**2004**	
J. Dolbow, E. Fried and H. Ji	**Chemically induced swelling of hydrogels**	**2004**	

Hyperlink to PDFs or internet pages etc.

Typesetting software

Visio is a diagramming and vector graphics app.
Draw your own schematics and visualisations
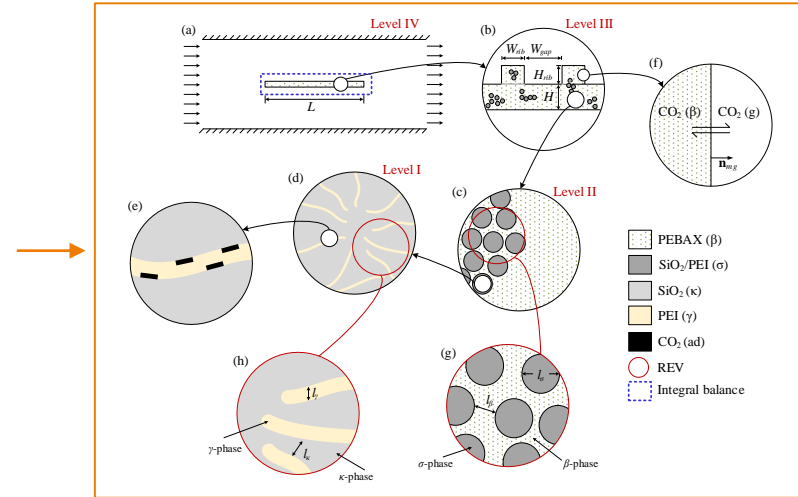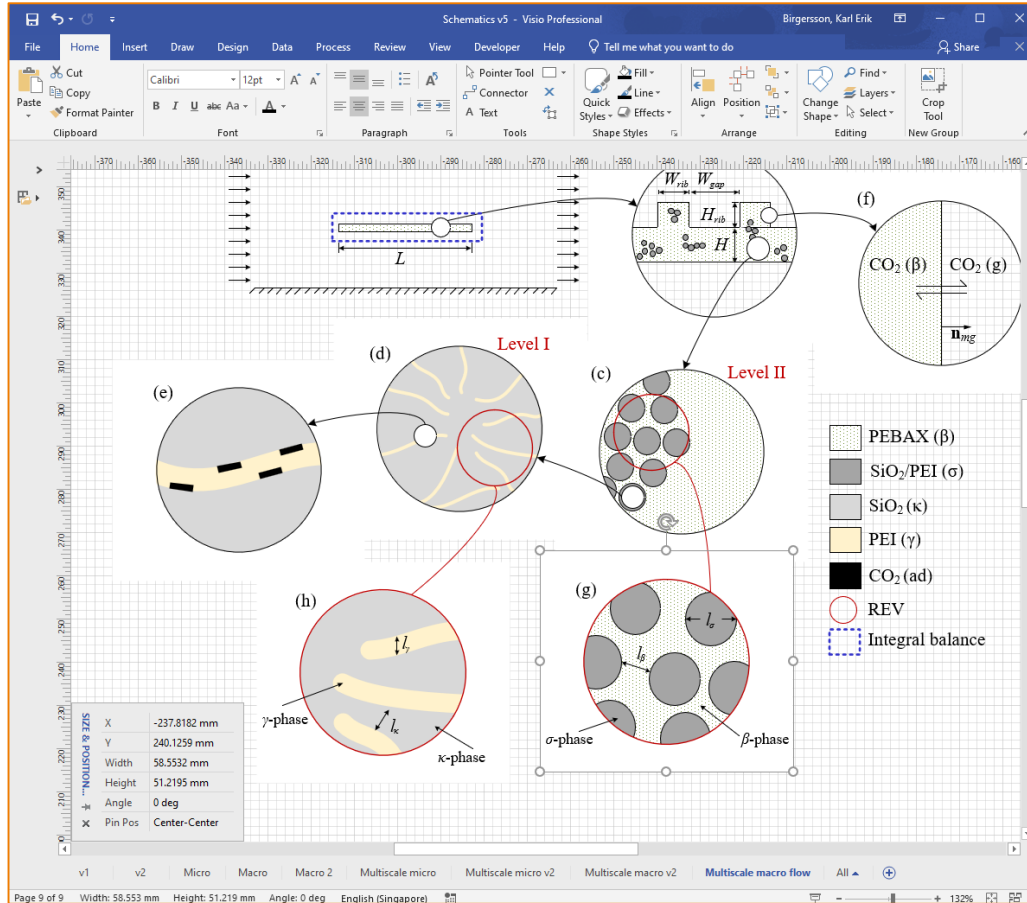
LyX is a professional free typesetting software, WYSIWYM, based on TeX/LaTex
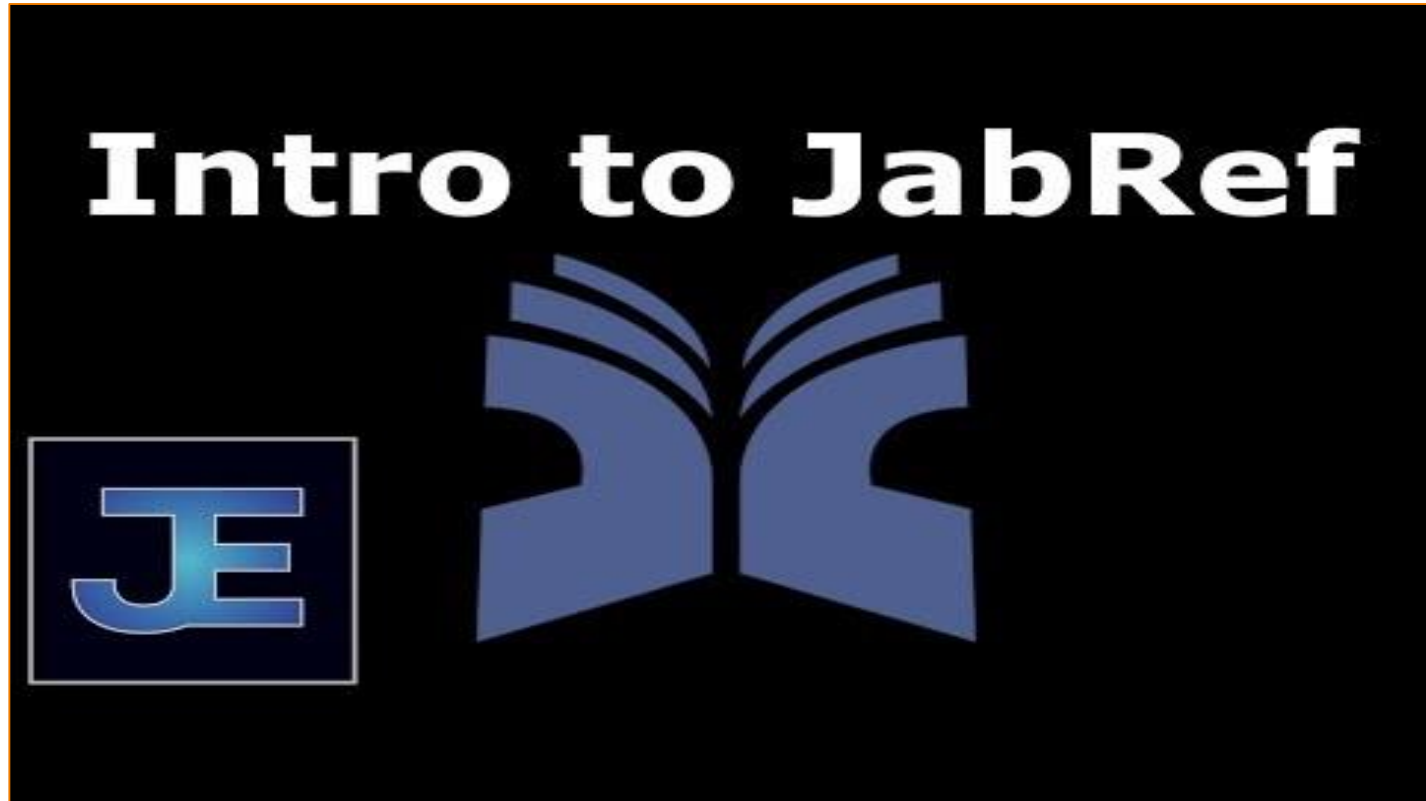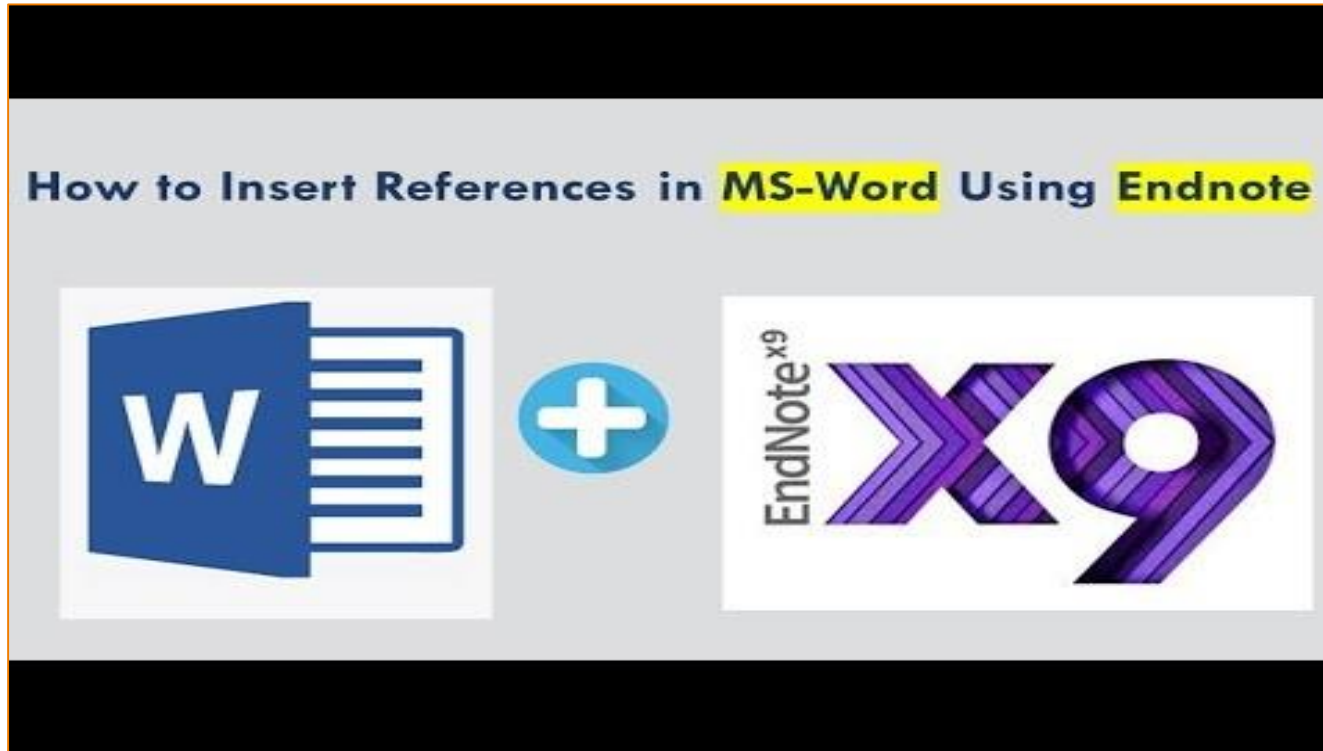
Word is a typesetting software, WYSIWYG
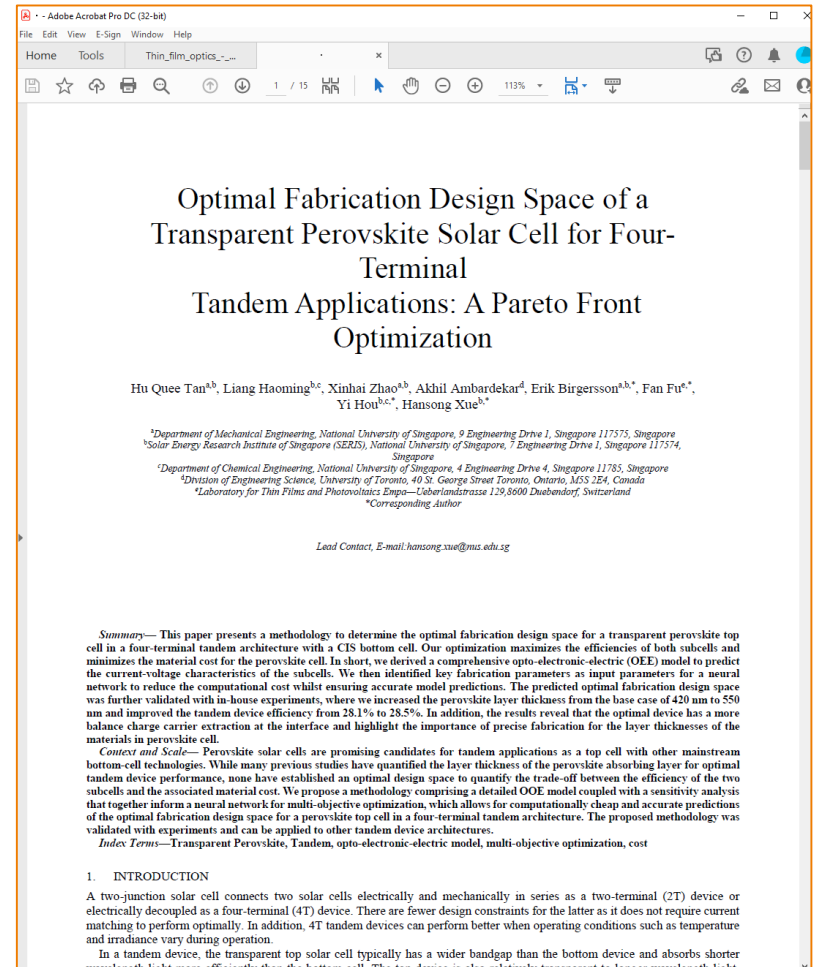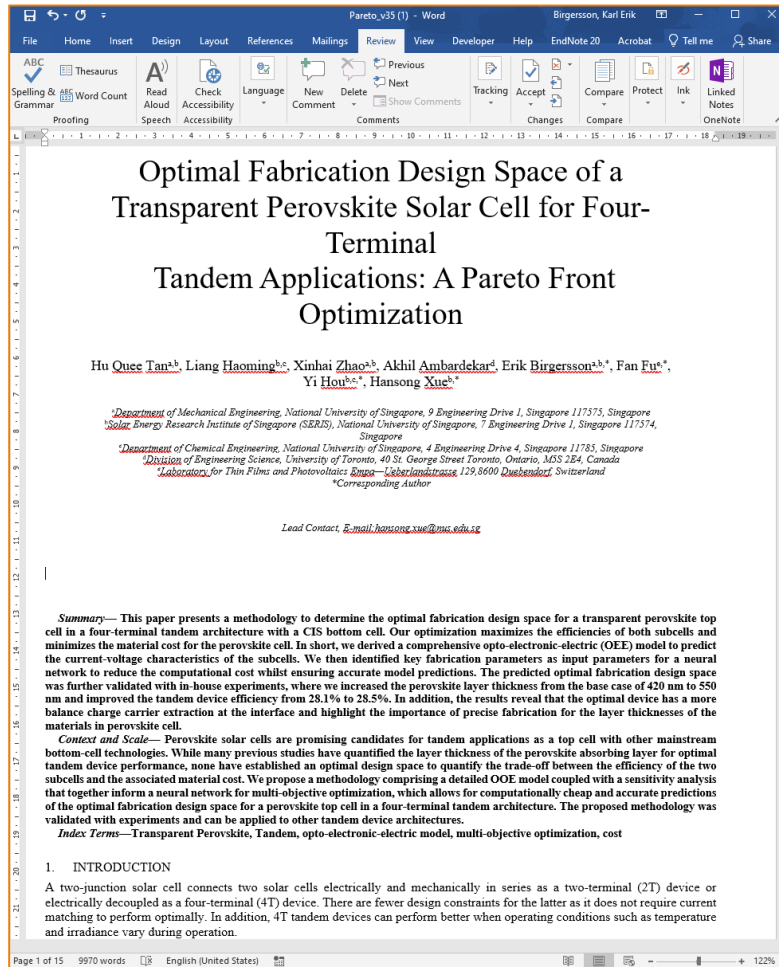
Reference management software
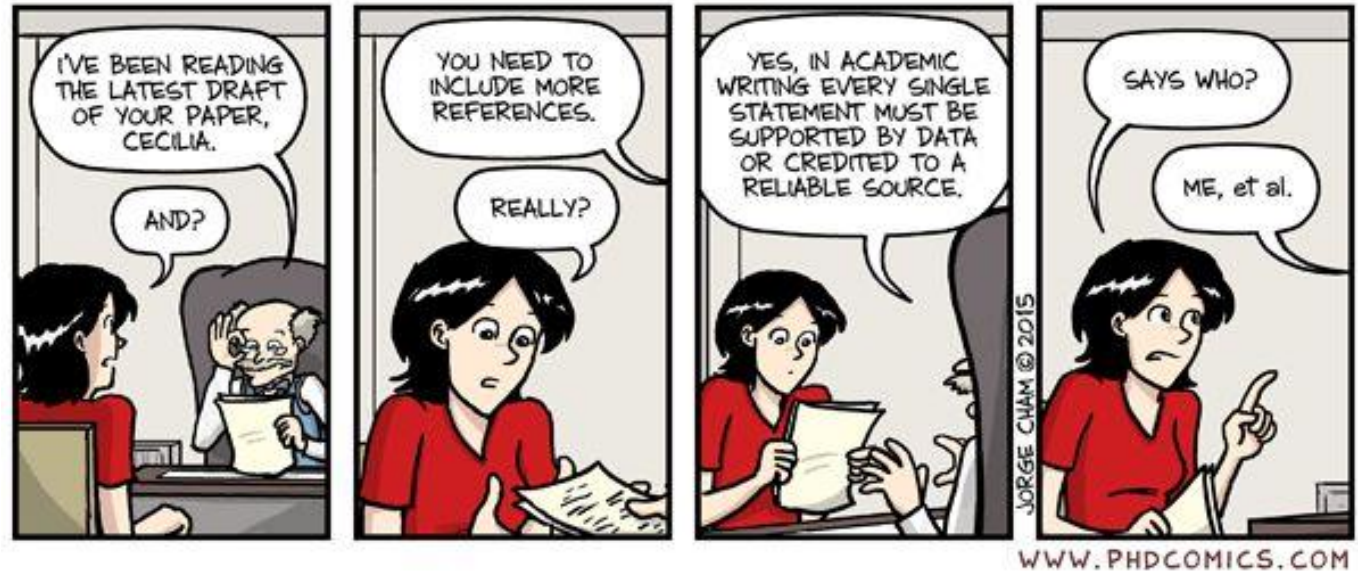
JabRef is a open-source reference management system; here is a video on how to use it with Latex

EndNote is a commercial reference management system

Zotero is an open-source reference management system