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FREDERICK UNIVERSITY CYPRUS



Research Methodology



Prof. Dencho N. Batanov



Research



- ❑ *the systematic investigation into and study of materials, sources, etc., in order to establish facts and reach new conclusions.*
- ❑ *an endeavor to discover new or collate old facts etc., by the scientific study of a subject or by a course of critical investigation.*

A research student, a research paper: *engaged in or intended for use in such investigation and discovery*

Research and development: *work directed towards the innovation, introduction, and improvement of products and processes.*



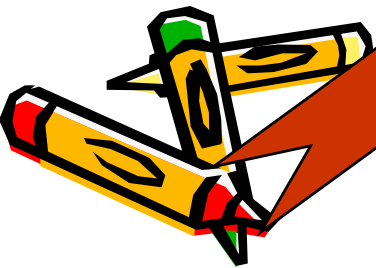
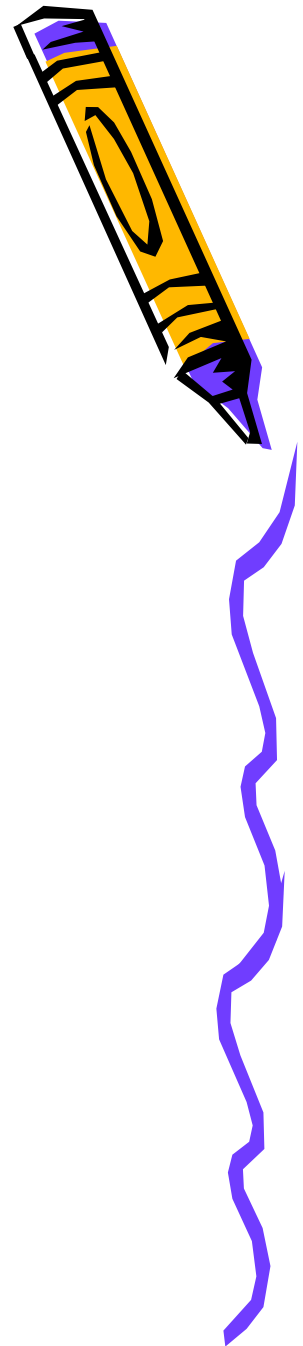
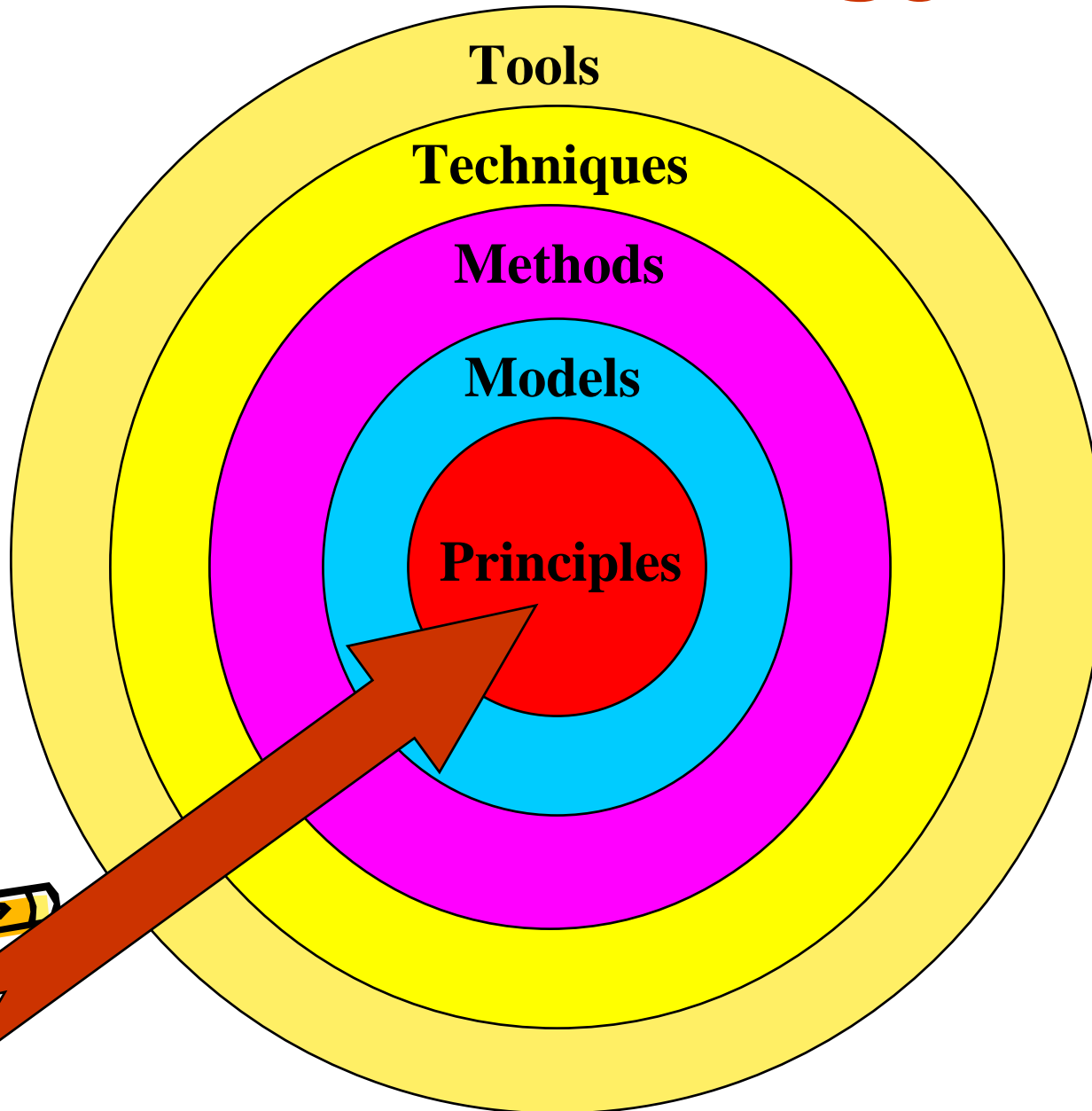
A little bit humor...

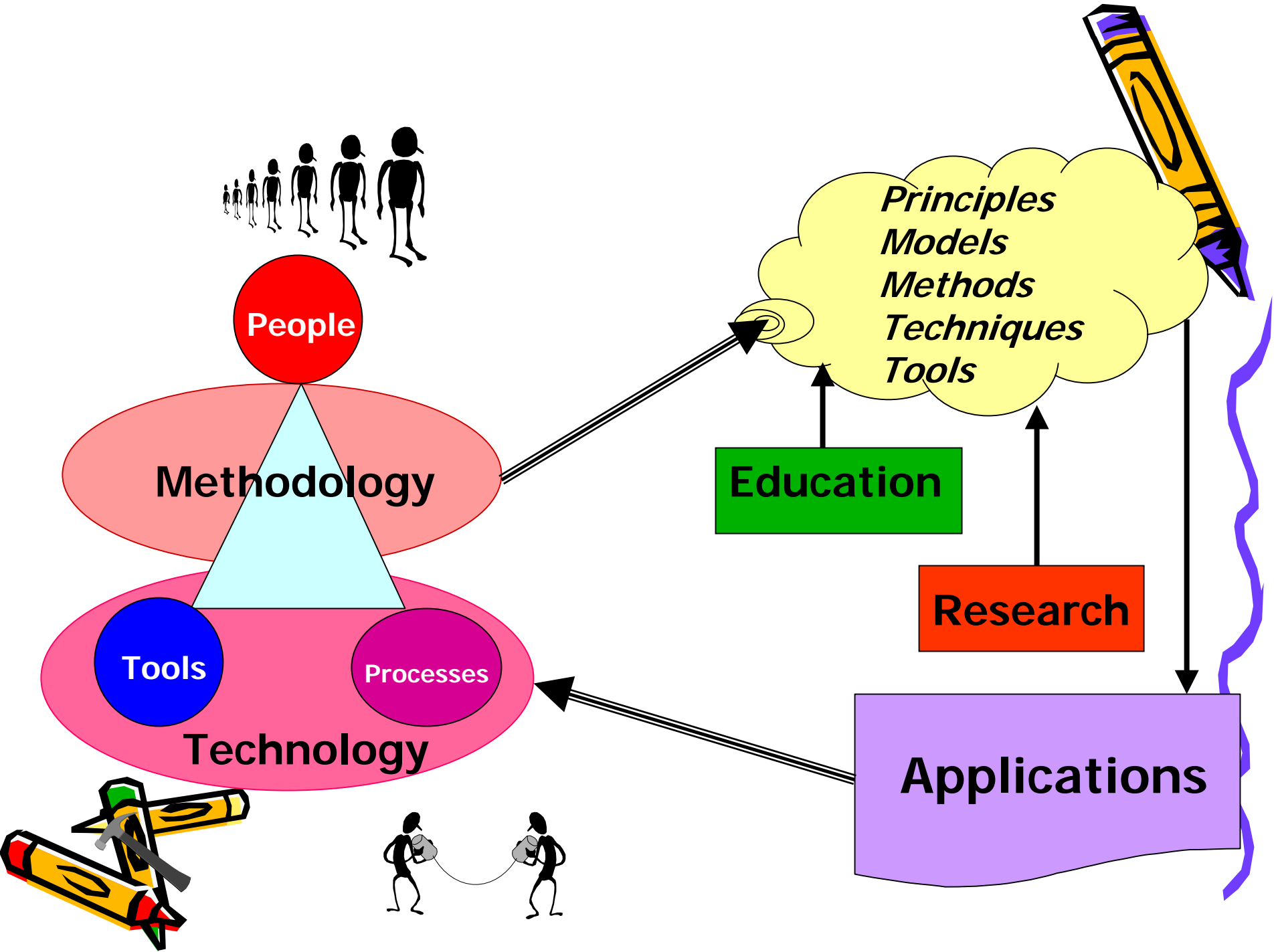
"To steal ideas from one person is plagiarism. To steal ideas from two persons is research."

Anonymous



Methodology





Research starts in Courses



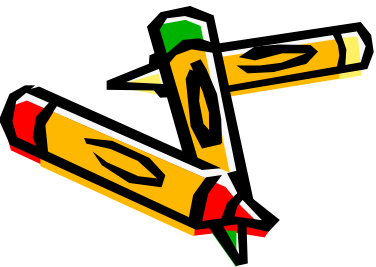
❖ RISC, SPUR, RAID, NOW, IRAM, ROC
all started in advanced graduate courses

- initial investigations and discussions with real deadlines

❖ Students learn how to do research in first
year graduate courses:

- Make transition from undergraduate student to graduate researcher;

- First year courses: select topic from offers, start doing research, think about writing paper, giving talks, doing poster session...and even preparing, submitting and publishing papers.

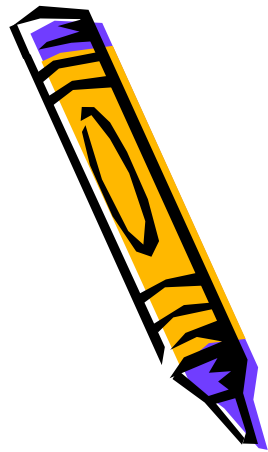


What to Look for in a Potential Advisor?

The ideal advisor might have the following traits:

- Has research interests in common with you.
- Has a national or international reputation among researchers.
- Has successfully directed students in the past.
- Has a reputation as a fair and reasonable advisor.
- Is someone you like and admire.
- Has an active research group.

And ... talk to other students and faculty members that you respect about various candidate advisors. Once you have a good candidate advisor, ask that person to be your advisor. Don't be discouraged by a "no" - try a different advisor...



The Advisor-Advisee Relationship



The best analogy for the relationship between an advisor and a student is probably that between a parent and a child.

- *At the beginning, the child has little independence, and almost every action is directed by the parent.*
- *As the child grows, independence develops.*
- *As adolescence sets in, conflicts arise.*
- *In adulthood, parent and child redefine the relationship.*

As in any relationship, conflicts should be faced and discussed. Cultural and generational differences can lead to misunderstandings that are easily resolved once they are recognized. In rare cases, however, the relationship just does not work. In such cases, the student should seek another advisor, leaving the first with as little ill-will as possible.



Finding a Topic and Beginning Research



□ Getting Research Ideas

❖ Becoming an Active Reader and Listener

Whenever you read technical material, evaluate a piece of software, or listen to a research talk, ask yourself these *canonical questions*:

- From where did the author seem to draw the ideas?
- What exactly was accomplished by this piece of work?
- How does it seem to relate to other work in the field?
- What would be the reasonable next step to build upon this work?
- What ideas from related fields might be brought to bear upon this subject?



Make detailed notices and review them periodically!!

Finding a Topic and Beginning Research



❖ Exposing Yourself to Research

Set aside some time every week for trying to **generate research ideas**.
Some possible catalysts are:

- Make a weekly trip to the library, or search Internet, to read at least the abstracts from the premier journals in your field. Choose an article or two to read in depth and critique.
- Make a weekly investigation to find technical reports in your field, using electronic resources or libraries. Read selectively and critique.
- Attend at a research seminar or colloquium series (webcasts, podcasts). Listen and critique.



**Make detailed notices and review them periodically!!
Ask the canonical questions!**

Finding a Topic and Beginning Research



❖ Developing the Germ of an Idea

Once you have identified a topic that looks feasible, make sure you are aware of all of the literature in the area. **Keep reading and listening, and keep distinct in your mind what is different between your work and others.** If you do not frequently review the literature you read months ago, you may find yourself unconsciously claiming credit for other people's ideas. On the other hand, don't let other people's frame of mind limit your creativity.

❖ Directed Study

Which comes first: the thesis advisor or the thesis topic? **The answer is, both ways work.**



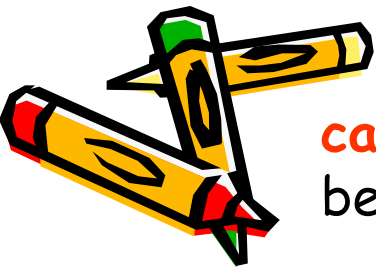
Finding a Topic and Beginning Research



□ A Pitfall to Avoid

It is possible to spend almost all of your time in literature review and seminars. It is easy to convince yourself that by doing this you are working hard and accomplishing something. The truth of the matter is that nothing will come of it unless you are an **active** reader and listener and unless you assign yourself time to develop your own ideas, too. **It is impossible to "finish a literature review and then start research"**. **New literature is always appearing, and as your depth and breadth increases, you will continually see new connections and related areas that must be studied.** Active

listening and reading must be viewed as **"continuing education"** that **will involve you for the rest of your career**. Don't fool yourself into thinking it must be finished before you can begin research.



Finding a Topic and Beginning Research



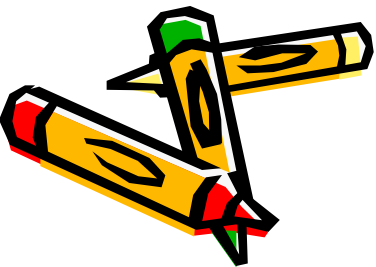
□ Choosing an Idea

From reading, interacting with your advisor during independent study, or work on a research assistantship, some **possible projects** will emerge.

Make a list of open problems and possible projects that are of interest to you, and discuss them with your advisor.

□ Remain Active

- Remember that often **the initial idea is quite far from the final thesis topic**. That's why it is important to continue a routine of reading new things in your field. This for sure can contribute to the **development of your idea**.
- At this stage you can add one question to the list of canonical questions: **How can these ideas help me solve my research problem?**



The Thesis Writing Process



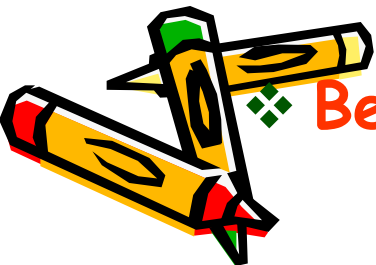
- ❑ **Remember:** writing results in a form that other people can understand is a **difficult and very slow process!**
- ❑ **Don't be surprised:** in order to get a well-written thesis (paper), the first 2 or 3 drafts must often be completely **discarded!**
- ❑ **Make difference:** A **research paper** is addressed to a group of experts in the field, who presumably know the literature and the background issues quite well. **A thesis is written more for the generalist!** A thorough literature review must be included, as well as an evaluation of where your work fits into the scheme of things.



How Can You Minimize the Pain of Writing?



- ❖ **Keep careful notes about your work!** You might choose to keep bound logbooks (square ruled paper is helpful) or on-line notes. Write your notes regularly: write up every new result, but make an entry at least weekly even if you believe that nothing of significance has been accomplished. Even noting what you are thinking about can be helpful.
- ❖ **Write up each piece of the work as it is completed!** This makes the final writing easier because each piece is documented at its completion time rather than months or years later, and the early write-ups give a basis for organizing the thesis. In addition, it establishes your reputation early and makes the job search much easier.



- ❖ **Be a student of technical writing styles!** Find out what works and what doesn't. **Study a good writing manual!**

Example: Some writing tips



➤ Active voice

For example, use "Figure X shows ..." rather than "... as shown in Figure X." Also, it is much better to mention a figure that summarizes a lot of information early in a paragraph rather than go into details and mention the figure at the end.

➤ Ambiguous use of pronoun "This" to summarize sense of previous sentence

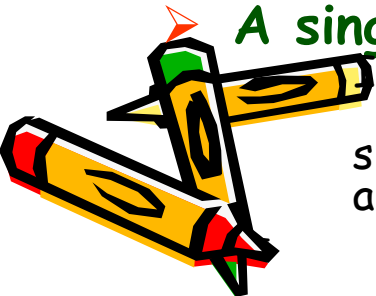
Put a noun after "This" to make it clear what you are referring to.

➤ "While" instead of "and", "but", "although"

In general while should be used only in the strict sense of "during the time", so search for "While" in your text to see if the sentence is about time, or could be replaced with "Although".

➤ A single numbered subsection

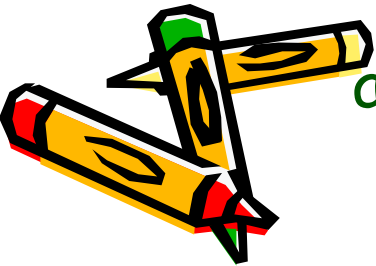
It's strange to have a single subsection (e.g., 5.2.1 in section 5.2). Why do you need to number it if there is only one? Either eliminate the single subsection, or change the part that precedes the subsection into a second subsection



...and a little bit humor...



- *"It is believed that..."* <-> I think.
- *"It is generally believed that..."* <-> A couple of other guys think so, too.
- *"It has long been known..."* <-> I didn't look up the original reference.
- *"A definite trend is evident..."* <-> These data are practically meaningless.
- *"Of great theoretical and practical importance..."* <-> Interesting to me.
- *"A highly significant area for exploratory study..."* <-> A totally useless topic suggested by my advisor (committee).



A typical Thesis Outline

Title page, Abstract, Contents, Acknowledgements,
List of Figures, List of Abbreviations

Chapter 1: Introduction

What is the problem?
Why is important?
What have other people done?
What is central idea(s) of my approach?
How is the rest of the thesis organized?

Chapter 2: The problem

Define the problem.
Introduce the jargon.
Discuss the basic properties.

Chapter 3: Big idea 1

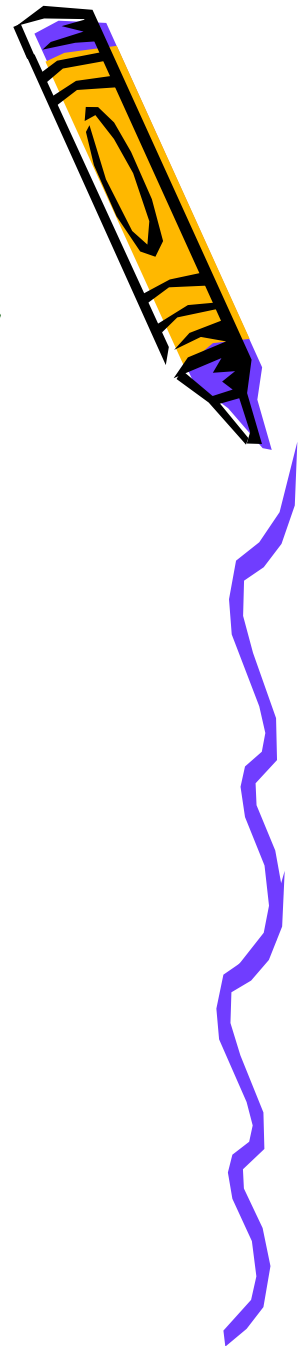
...

Chapter k : Big idea k

Chapter $k+i$: Conclusion

Recapitulate what has been accomplished.
Discuss ideas for future work.

References, Appendices



Some lessons learned...



- ❑ Don't think that the thesis must be written starting at page 1 and continuing until the end.
- ❑ The important thing is to **jump in and begin writing something**, and make notes along the way of how other sections need to be adapted so that they all work together.
- ❑ Very often writing seems to be more difficult than finding the solution of the thesis problem.

Don't be surprised!



Important:

The intellectual property!

Plagiarism - taking of someone's words or ideas

Stealing words or ideas is theft !!

Some ethic rules:

- If you take a paragraph from someone else's written work and include it in your own work, **you must enclose it in quotation marks and give a citation**. Even if you change some of the words but leave the writing essentially unchanged, you must put the unchanged pieces in quotation marks and list your source.
- If a substantial part of your paper (say, a page or more) consists of a summary of someone else's work using a condensation of their words, or following the same outline as their work, then **you must say so**: "This section is taken directly from [...]," or "This summary closely follows [...]," etc.
- You cannot publish a work that is substantially taken from another; **you must have "added some value"** by new ideas or new derivations or new implementations and you must clearly distinguish between your work and that of others.



Thesis Presentation Outline

- Introduction/background
- Objectives - main and sub
- Applied methodology
- Presentation of results
- Demonstration, if any
- Interpretation of results
- Conclusions and future work



Thesis Presentation Guidelines



- Keep your presentation to the suggested duration!
- Focus on motivation, significance of your thesis, your contribution, what's exciting, issues, conclusion and future work!
- Keep the size of the fonts fairly large!
- Choose carefully the design and color schemas of your slides!
- Balance the animation!
- Focus on presenting information in a consistent, cohesive form to keep the attention and interest of audience!



Thesis Presentation Guidelines



While presenting:

❖ *Look at people while talking (and not the computer, slides, wall or ceiling).*

❖ *Don't read from the slides!!*

Practice your presentation!





Research Methodology

Something like a summary



Some guidelines...

- ❑ set up your own paradigm
- ❑ understand deeply your task(s) and related problem domain

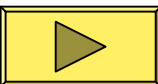
Tips: - read and think;

- think and read;

- ask questions and try to answer them;

- don't make early conclusions such as:

“This is too easy.”, “This is too difficult.”, “This is a stupid problem.”...



Paradigm

- *An acquired way of thinking about something that shapes thought and action in ways that are both conscious and unconscious*
- *Paradigms are essential because they provide a culturally shared model for how to think and act*
- *They can present major obstacles to adopting newer, better approaches*

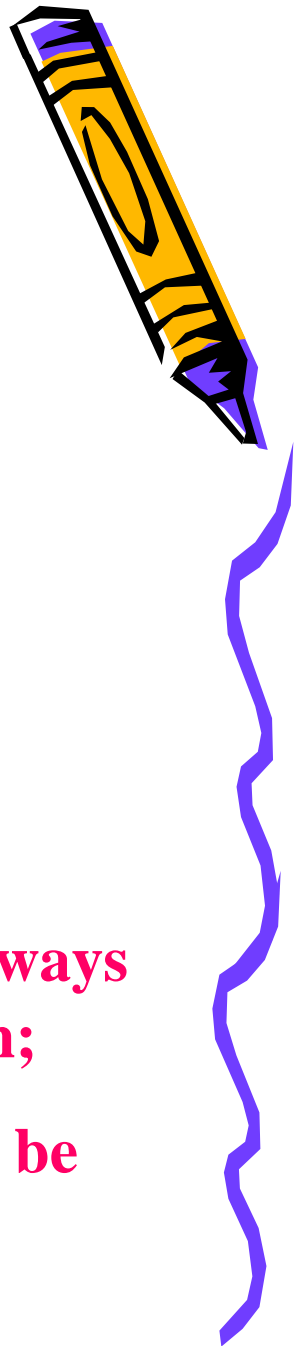


Some guidelines...

- try to identify as much as clearly the problem you should solve

Tips: - the same as above plus

- never try to re-invent the wheel;
- however, not all existing solutions are probably the best ones...there is always room for your (better) contribution;
- trust the literature...but to some extent, be critical...and read more.



Some guidelines...



- ❑ Rely on principles...but you should know them very well...
- ❑ Use models and modeling as much as possible

Tips: - if your model is more complicated than the problem at hand...forget about it;

- models are not right or wrong; they are more or less useful;

- the simplest (and the best) model is not necessarily the first one you think of. ...But simple models are always worth the effort;

- ideally a conceptual modeling technique is totally independent of software technology (implementation) --> use conceptual modeling!



Some guidelines...

- ❑ Research needs permanent concentration.

Keep always focused!!!

Tips: - concentration means and requires deep knowledge on and understanding of the problem at hand;

- try to think everywhere and at any time about your current research task

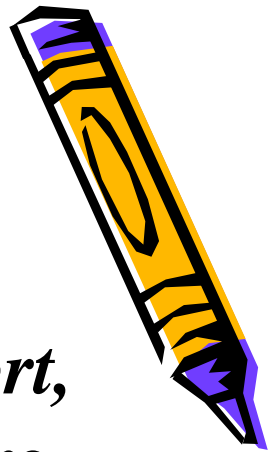
“...what should I do?...”, “how can I do that?...”

- when you start dreaming about your topic while sleeping...you are almost ready...



Some guidelines...

- ❑ Documenting the research (*writing the report, paper, thesis, etc.*) is sometimes even more important...**and difficult!**, than the process of research - **keep consistency and logic of your work in mind!**
- ❑ Presentation should be concise, well prepared (*rehearsal is necessary!*) and emphasizing the major points of your work and, **the most important!**, contributions.



Finally - about values...

"Some people live to work;
others work to live."

Whether your job is your greatest joy in life or just a duty, it is worth reflecting on whether what you do at work contributes to making the world better. Maybe your work won't win a Nobel Prize, a Turing Award, or a Fields Medal, but you can

use some of your creative energy to see that your efforts have some positive value.



Good luck...

and

have nice dreams...

