Research and Writing Tips for Graduate Students

Shou-de Lin (林守德)
Professor
National Taiwan University
sdlin@csie.ntu.edu.tw
Machine Discovery and Social Network Mining Lab, CSIE, NTU

- **PI:** Shou-de Lin
  - B.S. in NTUEE
  - M.S. in EECS, UM
  - M.S. in Computational Linguistics, USC
  - Ph.D. in CS, USC (EELD project)
  - Postdoc in Los Alamos National Lab

- **Courses:**
  - Social network Analysis
  - Technical Writing and Research Method
  - Probabilistic Graphical Model
  - Machine Discovery

- **Awards:**
  - Best Paper Award W2003, TAAI 2010, and ASONAM 2011
  - Google Research Award 2008
  - Microsoft Research Award 2009
  - IBM research award 2015
  - INTEL research Funding 2011~2015

Dept. of CSIE & GINM, NTU

2016/6/18
Acknowledgement

• Some of the materials and ideas are originated from other people, including:
  – Marie desJardins
  – Kevin Knight
  – Ed Hovy
  – Dianne O'Leary
  – Duane A. Bailey
  – Ronald T. Azuma
  – Possibly others here and there
Agenda

• How to find good research topics
• How to do good research
• Improving your RQ
• How to write a good paper
How to Find a Good Research Topic?
What is a Good Research Topic

• Something that interests you, your advisor, and your research community.

• A real problem, not a toy problem (or even worse, not a well-defined problem).

• Have certain connection to the existing research (If not, you need to make sure people think it is interesting and worth doing.)

• There is a chance for you to have solid theoretical contribution or practical/empirical results (preferably both).

• Significant yet manageable, with extensions and additions that are successively riskier but will make the thesis more exciting (Chapman)
A Good Research Topic Makes you Halfway to the Success

• A novel research topic is a big plus
  – You know people would appreciate your work even before starting working on it.
  – The topic itself is novel/interesting/challenging enough to have certain value.
  – Usually you need to hurry up since somebody else might come up with similar ideas.
  – Usually you need to do a lot of literature survey to make sure nobody does the same thing.

• If you cannot find a novel topic, then find a novel solution for an existing topic
  – Sometimes the problem is trivial, but the solution is not.
  – Novel solution is hard to come up with, so you don’t need to worry that much about being stolen by others.
What should I do if I cannot find a good research topic on my own

• Talk to your advisor and friends.
• Taking relevant courses.
• Read some papers.
• Don’t just read papers, do something (join a group, implement a system).
• Read tech news.
• Open yourself to new/novel/interesting ideas, even if it has nothing to do with your expertise.
How to do Good Research?
Foundation, Foundation, Foundation

• Algorithm: Dynamic Programming, Graph theory, Clustering, automata, logic, cryptography
• Search methods:
  – Optimization (e.g. heuristic search) : adjusting parameters of a system to optimize an explicit or implicit objection function (e.g. Maximum likelihood Estimation)
  – Learning (classification or regression): Given a set of input/output pairs, learning tells you how to predict the output given some unseen input. Proposed methods: SVM, NN, ME, DT, GE, EM...
• Math: probability and statistics, information theory, coding theory, queuing theory, linear algebra, discrete math...
• Programming Skills: C++, Java, design related tools, Python, Perl, MPI, database management...
• Background knowledge in other areas: biology, music...
Finding your Own Hammers

• You need to identify your “secret weapon”.

• For example, the hammers in MS lab:
  – Estimation-Maximization Algorithm.
  – Master in classifiers (e.g. ME, SVM, DT, GA).
  – Bayesian Inference Tools.
  – Reinforcement Learning Packages.
  – Probabilistic Graphical Model
  – Social Network Analysis Tools.
  – Using Clustering Machines.
  – Dealing with GigaWords of data
Find New and Better Ideas (knight)

- Listen to the data (Herb Simon)
- Kick around ideas with senior students and your advisor
  - Reject mediocre ideas
  - Reject complex ideas
- Get animated by a giant goal
  - Narrow it down immediately – what’s the first experiment?
- Learn powerful techniques by implementing them
- Pick problems that will teach you something
- Obsess yourself with the research problem, and wait for the ideas to come.
Getting feedbacks

• To be successful at research, it is essential that you learn to cope with criticism, and even that you actively seek it out.

• Talking to other people will help you realize
  – which aspects of your research are truly different and innovative
  – how your work fits into the current state of your field and where it's going
  – which aspects of your work are harder to sell (and, therefore, which aspects you need to think more about justifying).

• Give presentations at seminar series at your university, at conferences, and at other universities and research labs when you get the chance.

• Talk to people as much as they're willing to listen to. You should have 30-second, 2-minute, 5-minute and 10-minute summaries of your project ready at a moment's notice.
Improving your RQ (Research Quotient)

Unfortunately, IQ ↑ + EQ ↑ ≠ RQ↑
Mentality

• Initiative
• Tenacity
• Discipline
• Flexibility
• Awareness
• Selective
• Ambitious but practical
• Get your hands dirty (mind the details)
Initiative

• Rather aggressive than passive
  – your adviser is NOT going to hold your hands and tell you what to do every step of the way.
  – Your goal is to prove that you can do high-quality research, not just to get a degree.
"Let me tell you the secret that has led me to my goal. My strength lies solely in my tenacity." - Louis Pasteur

- You don't need to be a genius to earn a degree, but very few finish a dissertation without being tenacious.

- No one can tell you in advance exactly how long the dissertation will take, so it's hard to see where the "end of the road" lies.
Discipline

• Do research EVERYDAY, instead of doing it when you are in the mood.

• Try to find your own routine, and stick to it.
  – Know which time slots in a day are best/worst for you mentally and physically.

• Simplify your life.
  – Minimize distractions and detours.
Flexibility

• Working around problems if it is not possible to directly solve it
• Being willing to change plans if necessary
• Taking advantage of opportunities and synergies
• Accept the things you can't change (e.g. network broken).
  – Control the controllables.
  – Save the cursing time, it is YOU that should be responsible for how your time is spent.
Awareness

• Pay attention to the rules, news, tips that benefit you.
• Be aware of the new opportunities (e.g. new research direction, new technology, new scholarship, etc.)
• Have a sense or urgency. It is YOUR future.
• keep in touch with the "real world," remind yourself that the graduate student population is not representative of humanity in general and keep your own perspectives.
Selective

• Be aware that you have only limited amount of time (at most 24 hours a day).
• Don’t spend too much of your time on subordinate things or tasks.
  – Learn how to say no
Ambitious but Practical

• Everything is possible, unless you prove it impossible.
• Don’t give up too early.
• Don’t settle for mediocre.
• Be realistic (there are more research to be done after graduation).
Get your hands dirty

• Walk the talk (Talk the talk, walk the walk).
  – Smartness can be learned through experience.
• Have the determination to start working on a tough problem ASAP (Do it NOW!!)
• Knowing what is critical and what is minor (e.g. the speed is sometimes as important as the quality)
• The last 10% to perfection typically consumes 80% of the effort. The devil is always in the detail (Prof. Tzi-cker Chiueh)
How to Write a Good Paper
What’s so important about publishing?

• To convey your research ideas and results accurately, clearly and economically to others.

• Presenting a coherent, written scientific argument is a learned skill – learn by doing!

• For application science, your works would not become applicable without first letting people know what it is.

• You’d be thrilled to realize that there are strangers reading your stuffs!

• To earn better understanding about your research
  – Writing down your method usually can reveal its pitfalls.
  – Sometimes it's difficult to define or formalize an idea well enough until you have written it down.
The Peer-reviewing Era

• You cannot publish your papers at will.
• You need to get the approval from a bunch of (usually anonymous) judges
  – Good or bad?
• All of us have been reminded: a good writer should always consider the readers...
  – It turns out your papers have two different kinds of readers: the reviewers and the normal readers
  – The former determines whether your paper can be accepted, the later determines whether it will be cited
  – A good paper has to satisfy both types of readers
Why My Papers are Accepted/Rejected

Good research ≠ good paper

Writing Skill

Language skill

Research Quality

Others (reviewer, luck, etc)

Paper Acceptance?

Good English ≠ Nice paper writing

Good research ≠ good paper

Good English ≠ Nice paper writing
## Research Quality: Meet Reviewers’ Demand

### Reviewers want

<table>
<thead>
<tr>
<th>Important problems</th>
<th>Novel Solutions</th>
<th>Solid Results</th>
<th>Repeatable outcomes</th>
</tr>
</thead>
</table>

### Writing Strategy: to show

1. The applications.
2. The challenge parts of the research.
3. The theoretical insight.
4. You have surveyed a lot of alternatives.
5. Prove your results theoretically, or use convincing experiments.
6. Provide detailed methods
   - Describe the resource (e.g. data, equipment)
Things most likely to be criticized by reviewers

- Experiment (not enough, not convincing, not fair, no baseline, no confidence interval, etc)
- Methodology (too ad hoc, no complexity analysis, too complicated, too simple)
- Value (not important, not challenging, not applicable in the real world)
- References (too few, not citing somebody’s work)
Why My Papers are Accepted/Rejected

- Writing Skill
- Language skill
- Research Quality
- Others (reviewer, luck, etc)

Paper Accept?
Technical Writing Pyramid

1. Conveying your research ideas **clearly**.

2. Presenting the methods and results in a **convincing** manner (that is, being able to persuade others that you are doing great work).

3. Doing stage 1 and 2 **efficiently** (using as few space as possible).

4. Doing stage 1-3 **elegantly**.
How should one describe the idea

• The route you have come up with the idea.

≠

• The way you implement your idea.

≠

• The best logic you should present your idea.
What makes a good piece of technical writing

1. Clear and forthright
2. Convincing (logically sound)
3. Precise and familiar
4. Concise and fluid (smooth)
Clarity: what to avoid?

• A sentence that is too long
• A sentence that contains too many pronouns
• A sentence that contains too many relative pronouns (e.g., who, which, that)
• A sentence that contains many prepositional phrases (e.g., before the class, behind the door)
• A sentence that contains more than one idea.
Composition

- Writing down the most important points in this paper first.
- Prepare the skeleton (logical sequence of sections). Writing down section and subsection titles first.
- Write the introduction draft first, and go back to revise it after finishing the whole paper.
- Writing the abstract in the very end.
- For novice writers, a good strategy is imitation: choose a well-written paper that is of a similar flavor, analyze its organization, and sketch an organization for your results based on the same pattern.
Avoid grandiloquence

• Grandiloquence:
  – The use of extravagant language
  – The use of long pompous words
  – Creating a text that is difficult to read
Example:
  – It may seem reasonable to suggest that the necrotic effect may possibly due to toxins
  ➔ Necrosis may be caused by toxins
Why My Papers are Accepted/Rejected

Paper Accept?

- Writing Skill
- Language skill
- Research Quality
- Others (reviewer, luck, etc)
The Impression to the Reviewers

• Avoid providing the following impressions to the reviewers:
  – You are arrogant
  – You are a novice
  – You are not confident about your research
  – You are not working as hard as you can
Be Humble but Confident

Avoiding arrogant/exaggerate statements such as:

- We are the first team to ... ➔ To our knowledge, our idea of ... is novel

Be sure about your idea/proposal/results

- It seems to me that ... ➔ In my opinion, ...
Don’t Feel Frustrated about Rejection

• Whether a paper gets accepted is sometimes a random process (i.e. the likelihood changes with time and environment)

• Sometimes the reviewers just cannot accept your submission, and it is easy to identify some flaws if they are determined to do so.
How to Improve Your Writing/language Skills?

• Writing English papers and reports
• Writing more English papers and reports.
• Reading well-written papers (not necessary the best-known paper) from the writer’s point of view, and pondering:
  – Why are they clear and easy to understand?
  – The usage of language
  – The structure and flow
• Analyzing other people’s editing (why and how) on your write-ups.
• Don’t give up: Never feel that your writing skills cannot be improved (and don’t feel that it is all about English)