How to Do Research

Hang Liu
University of Massachusetts Lowell
Research Experience

- Ph.D. study: Reading, Creating, Writing and Presenting.
- Rule of thumb, these four parts are **atomic**.

How to effectively read a paper? - know the typical layout of a paper

**Abstract**: Background (1 sentence), Problem (1 sentence), Contributions (3 -- 4 sentences), Evaluation (1 -- 2 sentences).

**Introduction**: An extension of Abstract.
Background 1 paragraph. Current problem (related work) 1 paragraph. Overview of the system 1 paragraph. Techniques 3 paragraphs. Organization 1 paragraph.

Till here, you should already understand the novelty of this paper.

**Techniques**: This is the most fruitful part. If interested, you should read all of them.

**Experiments**: Configuration, dataset, comparison, effectiveness of the techniques.
If you are new to this area, read the related work as well.
Come up with new ideas (Research Experience cont’d)
This is something differs us from machine. Project starts from a single, small and interesting idea which may found invalid down the road.

This idea could come from:
- **Incremental.** Reading paper -- unveil the drawbacks in this paper, and address them.
- **Interdisciplinary.**
  - Same technique, different platforms: GPU ← → CPU, Cache ← → Disk.
  - Combine ideas from multiple sources.
- **Implementation analysis.**
  - Only after your hands are dirty, you know what is inside.
  - Profile every corner of the system, you may find “usual suspects”.
- **Discussion.**
  - You present a paper to colleagues, they questioned you. You try to defend, ending up with brand new ideas.
  - You present your WIP result to the audience, they questioned, you come up with more novel ideas.
- **From prior project.**
  - You finished your first paper, you have follow-up ideas, you continue.
- **Come from anywhere.** A new idea gets bumped in your mind from nowhere.
Writing and Presenting (Research Experience cont’d)
“I wish I can whisper you a secret effective recipe towards elegant writing. Unfortunately, I failed. The only way I found beneficial is do NOT try to combine idea-writing with polishing. Once idea is there, polishing can be done via repeatedly rewriting.” -- from someone I forgot. :)

Think Like an Audience. How to think like an audience?
● Still remember how to read papers? You are an audience over there, what do you expect from that paper? Write your own paper that way.
● If the first bullet is hard, try to find fresh eyes for your paper, e.g., like a good friend.
● You can also make yourself a fresh mind. After extensive sports, sleep, travel etc.
● Be picky about your own writing, question it!
● Never hope reviewers will not find the problems you already noticed. Go ahead fix it!
● If you already think the paper is twisted, it’s definitely unclear for reviewers.
● Use figures if too many notations are needed.
● Writing and implementation should form a feedback loop.

How to make your writing more interestingly?
Reading → Newspapers, books. Learn their sentences, words.
Listening → Movies or tv shows. Talk to other guys.

Just keep in mind, if you feel your paper read weird, it’s definitely much worse for the readers.
How to Manage Your Time? (Research Experience cont’d)

Always work? Very unlikely.

Deadline time vs. non-deadline time
Have a good rest during non-deadline time, retain full energy for deadline sprinting.

During typical time:
   I prefer work when I am not tired, sports to relax.
   Tennis, Basketball, Photography, Reading

   I prefer work one day and relax the other during weekends.

Your own stuff, your collaborator stuff, your colleagues stuff? How do you manage that?

Never hesitate to bother your mentor/advisor ...
Time Till Cookout Sth. (Research Experience cont’d)

Completed:


Enterprise: 2013/Dec -- 2014/April (Submitted to SC) -- 2014/Oct (Submitted to Eurosys) -- 2015/Jan (Submitted to Usenix ATC) -- 2015/April (Submitted to SC and accepted).

iBFS: 2015/Feb -- 2015/July (Submitted to SIGMOD and accepted).

What about now?
Graphene: 2015/August -- 2016/May (Submitted to OSDI).

Pie: 2015/August -- now (Still working).

SSSP: From a few days ago …

Not limited to a single paper, think BIG, think 10 papers a time!