How to do Research in the Navigators@LASIGE

Alysson Bessani
(with contributions from Antonio Casimiro, Paulo Verissimo)
Faculdade de Ciências da Universidade de Lisboa

https://navigators.di.fc.ul.pt/
https://lasige.pt/
Academia
Academia
(if you move in the first division)

- Highly competitive environment
  - Funding
  - Publishing
  - Impact

- Good researchers are high-competition athletes
Main issues
Define your Objectives
(Different Objectives at Different Levels)

<table>
<thead>
<tr>
<th>Level</th>
<th>Publication</th>
<th>Quantity/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergrad</td>
<td>Meetings, soft pubs</td>
<td>1</td>
</tr>
<tr>
<td>Masters</td>
<td>Nat. Conf. A</td>
<td>1 or 2</td>
</tr>
<tr>
<td></td>
<td>Nat. Journal A or Int. Conf. B</td>
<td>0 or 1</td>
</tr>
<tr>
<td>PhD/Pos-Doc</td>
<td>Int. Journal A or Conf. A</td>
<td>1+</td>
</tr>
<tr>
<td></td>
<td>Int. Conf. B</td>
<td>1+</td>
</tr>
</tbody>
</table>
Read a lot!

• Which are the confs and journals on your field?
  – When you have the relevant list, go to the internet and read the title (and maybe the abstract) of most papers published there over the last ten years
  – Download the ones you think are interesting (in accordance with your advisor) and read them
  – Periodically, go to the conference/journal website to see what is new

• Find the key researchers and follow their work!
Read a lot!

• How many papers per week?
  – there are no magic figures, but, when you are starting, be prepared to, *on average*:
    • explore 5 to 10 per week (abstract, intro, concl.)
    • read 3 to 5 per week
  – this includes course assignments, your advisor suggestions, your initiative
  – it depends on the phase of your research
Read a lot!
(Don’t worry if you don’t understand everything)

• For each paper you read:
  – Ask yourself whether you understood it:
    • can you explain it in your own words?
  – Exercise your critical view!
    • Is the problem relevant?
    • Are assumptions realistic? Is the model sound?
    • What are the contributions? How practical the solution?
    • Is the provided evaluation/proof fair and/or rigorous?
    • Are experiments repeatable and comparable?
    • How could you improve this work?
Choosing a Research Topic

• Try to find a problem/topic that you care about…
  – Or, at least, find one whose importance you can explain
  – You NEED to know how to sell your idea as a worthwhile research topic:
    • to your advisor
    • to the Thesis Committee
    • to the community when you publish later
The Advisor(s)

• Your advisor will help you, but it is YOUR Masters/PhD

• It is your responsibility to make your advisor be excited about your work and work on it with you
  – The environment is informal, but we are professionals!

• Golden rules to respect his/her time and effort:
  – Be responsible with deadlines
    • Every deadline you miss, you lose the respect of your advisor
  – Be careful with the quality of what you deliver
    • Before delivering something to your advisor(s), ask yourself: “Is this the best I can do (given the time constraints)?”
Doing Research
The Idea

• Always ask the following questions:
  – What is the main contribution?
  – What are the benefits/merits (selling point) of the approach?
  – Why is it different from previous works?
• That’s when you’ll thank yourself for having read enough to answer these questions with some confidence
Formalization

• Problem definition
  – Define your problem and show why solving it is important
  – A solution in search of a problem is just the wrong way

• System model
  – Define your constraints and assumptions
  – You should characterize unambiguously both the problem and the environment where the proposed solution is valid

• Use the formalization approach that is understood and accepted in your community/field
Formalization

• Presenting the solution: Algorithm, Mechanism, Protocol
  – Intuition: give an intuitive overview of the solution
  – Self-containedness: choose the level of abstraction that fits the paper size
  – Pseudo-code: use good latex packages like algorithm2e to enhance presentation, use line numbers

• Formalizing the solution:
  – Operation: describe the operation of your solution concisely but precisely, referring to the pseudo-code (refer to line numbers)
  – Proofs: no protocol/algorithm is correct until proven so
  – Metrics: prototype or simulation may be useful ways of showing your point, whether you have made a proof
Implementation

• If your work requires implementation, try first to modify something that is already done/used

• Advantages:
  – Well-written (maybe) code but above all it’s tested
  – You (automatically) gain a base for comparison
  – Makes the work more interesting for reviewers or thesis committee members

• Disadvantages:
  – Code from others is (generally) more complex than our toy examples and prototypes
  – The code may not work as expected
Evaluation
(Be honest and critic but don’t be dumb!)

• Two attitudes to avoid
  – Being too smart: evaluate only the cases that you know are advantageous for your approach; ignore negative outliers
  – Being too critic: over-evaluate, -discuss and -justify the cases in which your approach is not the best one

• Common mistakes:
  – Not defining the questions that the evaluation aims to answer
  – Not giving enough detail so that experiment is reproducible
  – Not justifying experiment’s parameters and workloads
  – Not comparing the proposed approach with others
  – Not interpreting, explaining and justifying obtained results
The Papers
Writing Papers

• Writing well is very hard!
  – First step to writing well is reading a lot
  – Then: practice, practice, practice
  – Every good paper is the result of many successive refinements

• Each paper has a “champion”
  – He/she is the owner of the paper, responsible for splitting the work among authors, asking for their parts and integrating the results in a single paper
  – Never work on a paper without a champion!
Writing Papers

• General philosophy:
  – Tell people about the problem you are going to solve
  – Tell people how you solve the problem
  – Tell them you solved it!
Writing Papers

• TODO list:
  – Description of the problem
  – Make contribution and significance clear
  – Related work
  – Describe environment and model
  – Describe the solution
  – Validate your solution
  – Lessons learned (Why is your paper worth reading?)
Writing Papers

• What writing a good scientific paper is about
  – it must: (i) not only be correct; but (ii) perceived as useful by the community; and (iii) interesting to read
  – papers with just (i) count for your curriculum but they are write-only papers, i.e., papers that no one reads, ergo no one cites
  – papers with (i) and (ii) are ok, specially for Calvinists
  – papers with all three, readers will: love you for that, cite you a lot more, be willing to read your next one
Writing Papers

• Steps to writing a paper:
  1. Write the storyboard for yourself and other authors: a paper should be a good story
  2. Build a structure (sections and sub-sections)
  3. Each section must be filled with a bulleted list
     - You are telling a story, each argument needs to be linked…
     - A scientific text is an algorithm in itself (hence LaTeX 😊)!
  4. Add figures, tables, and informal references
  5. Consolidate bullets into paragraphs
  6. Collect formal references and related work
  7. Reiterate by successive refinement until done
Writing Papers (wrap-up)

• **The introduction needs to be perfect**
  - Most reviewers can decide to reject your paper after reading the introduction

• **Same for the presentation and style (text, figures and general appearance)**
  - Remember, we don’t do write-only papers

• **Ask for feedback from your colleagues**
  - Sometimes better if some don’t work in the same area (like reviewers); *feedback is fundamental!*
  - Include a couple of outside experts
Submitting Papers

• Workshops
  – Very good for
    • disseminating early results
    • discussing a problem
    • getting feedback
    • meeting other people working on your area
  – Counts little for CV evaluation
  – Some of them are very good (and competitive): HotOS, HotNet & HotStorage
Submitting Papers

• Conferences
  – The good conferences in CSE may be harder and have more prestige than the best journals
    • TYP acceptance rate less than 20%
    • Papers with 12-16 pages (longer than some top journals)
  – These are what we call *heavy-weight conferences*
  – PCs in each community expect a particular style of papers, so before submitting to a top conference, try to learn their style (i.e., read a lot!)
Submitting Papers

• Some Excellent and VG confs (not complete):
  – Distributed Systems: ICDCS, IPDPS, Middleware
  – Distributed Syst. Theory: PODC, DISC, OPODIS
  – Dependability: DSN, SRDS, ISSRE
  – Networks: SIGCOMM, NSDI, INFOCOM, CoNEXT
  – Systems: SOSP/OSDI, EuroSys, USENIX ATC
  – Real-time: RTSS, RTAS, EuroMicro
  – Machine Learning: NIPS, ICML, ECML-PKDD
Submitting Papers

• Acceptance rate
  • A good half of the papers submitted to a top conference don’t stand a chance even before the PC show starts
  • From the remainder, bottom half have little chances

• If you follow the rules presented, you have:
  • a good chance of staying out of the sudden-death half, right from the beginning
  • Getting to the top quarter and fighting for an accept is another thing…
Submitting Papers

• As you build experience, you should aim to *systematically* be in the top 25%
  – You get to know you’re there because reviews get better
  – Getting there implies keeping on reading reviews with self-criticism and scrupulously analysing constructive criticism
  – Above a certain standard, fair English is an obstacle --- not making mistakes is not enough, you need style.
    • Improve!
    • Rely on senior co-authors, their touch may make the difference

• Still, you paper may be accepted or not 😊
  – Everyone has rejected papers! Especially if you aim high!
Submitting Papers

• Journal
  – Disadvantages:
    • “arguably” less immediate visibility, which may be counterproductive in a lively field as CSE
    • to overcome this, consider first submitting to conferences and evolve best works to journal
  – Advantages:
    • Science bureaucrats love it, gives substance to your CV and plus it makes sense, it’s an archival grade work, read below
Submitting Papers

- Papers in the best journals are **substantive** and **archival grade**
  - Clear and complete contribution in a subject
  - Rigorous in the formalization, proofs or metrics
  - Carefully evaluated, no loose ends
- Reviewers are generally more responsible and accountable
  - You have a chance for a dialogue and rebuttal
  - (this is the case also in many top conferences)
Submitting Papers

Revising and Responding to Reviewers

- Always show that you took reviewers’ comments into account, through the response letter.
- Consider politely challenging the review points with which you don’t agree, the editor is an arbiter between you and the reviewer.
- A good method to prepare both your revision and your response, is to pass all reviews to a text processor and exhaustively comment all significant remarks in-line in different colour, proposing what to do to address or challenge.
Submitting Papers

- Some good journals and magazines (far from complete) in no special order:
  - IEEE Transactions on …
  - ACM Transactions on …
  - Journal of ACM
  - Distributed Computing (Springer)
  - Computer Networks
  - IEEE Security and Privacy Magazine
  - Journal of Computer Security
The Reviewer

• Often (though not always) reviewers are very smart and have good intentions

• However,
  – They don’t have time
  – They expect fair amounts of scientific and engineering work
  – They may not be experts in your topic
  – Some (rare) may not have good intentions
The Reviewer

• Keep these things in mind:
  – Don’t make it easy for them to reject your paper
  – Try to finish it up as sphere (no place to grab)
  – Citations are (typically) free, certain people don’t like not to be cited
  – Don’t belittle past work that you are advancing from:
    • you should step on others’ shoulders, not on their toes
    • you may be next…
Navigators’ Publishing Policy

• Submit preliminary work early to a *good* workshop
• Submit a finished paper to a *good* conference
• If accepted, great!
  – If it is worthwhile, prepare an extended version (at least 25% of new content) and submit to a journal
• If rejected, ask yourself:
  – Some problems or just unlucky? Solve them and try again
  – Misunderstood? Under fire? Improve and send to a journal
To Conclude…

• What you get for staying in the academia:
  – You don’t need to work under direct orders
  – You get to participate in defining what you work on
  – You get to know the world and meet the smartest people
  – You have substantial freedom to manage your time

• What you must give:
  – Reciprocate with top quality, self-responsibility, team spirit
  – **Work hard! Be better than you were yesterday!**
  – Love what you do and be proud of how good you are
  – Don’t be afraid to have ideas, ask questions, criticize
  – Be your greatest critic but accept constructive criticism
Some References

• Randy Pausch. The Last Lecture.
  – Video: http://www.youtube.com/watch?v=ji5_MqicxSo

• Strunk & White. The Elements of Style. 4th edition. Longman.
  – Book about the style of written English, highly recommended.

• Phil Guo. The PhD Grind - A Ph.D. Student Memoir. 2012.
  – http://pgbovine.net/PhD-memoir/pguo-PhD-grind.pdf

• Levin & Redell. How (and how not) to write a good systems paper.
  – http://www.usenix.org/event/samples/submit/advice.html

• John Wilkes. How to write a good [systems] paper (things I wish my mother had told me), EuroSys 2006 Authoring Workshop

• Material in the pages of professors Priya Narasimhan and Mike Dahlin