How to do Research in the Navigators@LaSIGE

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http://www.navigators.di.fc.ul.pt/
http://lasige.di.fc.ul.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>
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<tr>
<td></td>
<td>Nat. Journal A or Int. Conf. B</td>
<td>0 or 1</td>
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<tr>
<td>PhD/Pos-Doc</td>
<td>Int. Conf. A</td>
<td>1+</td>
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<td></td>
<td>Int. Journal A</td>
<td>1+</td>
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<td>Int. Conf. B</td>
<td>2+</td>
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Read a lot!

• Which are the conferences 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
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 of 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 Follow-up 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
- **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?*”
Doing Research
The Idea

• Always ask the following questions:
  – What is the main contribution?
  – 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
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 nrs)
  – Proofs: no protocol/algorithm is correct until proven so
  – Metrics: prototype or simulation may be useful ways of showing your point, whether or not 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 (e.g., Zyzzyva)
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 & HotDep
Submitting Papers

• Conferences
  – The really good conferences in CSE may be harder and have more prestige than the best journals from IEEE/ACM
    • TYP acceptance rate less than 20%
    • Papers with 12-16 pages (as long as some 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 Good to VG conferences (not complete):
  – Distributed Systems: ICDCS, IPDPS, Middleware
  – Distributed Syst. Theory: PODC, DISC, OPODIS
  – Dependability: DSN, SRDS, ISSRE
  – Networks: SIGCOMM, INFOCOM, NSDI, CoNEXT
  – Systems: SOSP/OSDI, EuroSys, USENIX ATC
  – Real-time: RTSS, RTAS, EuroMicro
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! (subscribe to, say, National Geographic 😊 )
    • Rely on senior co-authors, their touch may make the difference

• Still, you paper may be accepted or not 😊
  – Everyone has rejected papers!
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
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
  – Journal of Computer Security
  – Journal of Parallel and Distributed Computing
  – Computer Journal
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 actually 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 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

- Simon Peyton Jones, How to give a good talk and write a good paper
- Randy Pausch. The Last Lecture.
  - Video: http://www.youtube.com/watch?v=ji5_MqixSo
  - 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