CritiX Research Book of Style
or, How to do Research in the CritiX Lab

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INSPIRED by the Research Book of Style of my previous research group, the Navigators@LaSIGE in the Univ. Lisbon Faculty of Sciences, ADAPTED by the senior members of my current group, CritiX@SnT-UNILU

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Academia in general
Academia
(if you move in the first division)

• Highly competitive environment
  – Funding
  – Recruiting
  – Publishing
  – Impact

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

An example:

<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. Conf. A</td>
<td>1+</td>
</tr>
<tr>
<td></td>
<td>Int. Journal A</td>
<td>1+</td>
</tr>
<tr>
<td></td>
<td>Int. Conf. B</td>
<td>2+</td>
</tr>
</tbody>
</table>
Read a lot!

• Which are the conferences and journals in 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
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 and mentor
    • to the Thesis Follow-up Committee (CET)
    • to the community when you publish later
• 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 a bit of 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?”*; *“Is the writing in acceptable shape?”*
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 basis 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 (as with most papers’ code put on online)
Evaluation
(Be honest and critic but don’t be dumb!)

• Two attitudes to avoid
  – Being too smart: evaluating only the cases that you know are advantageous for your approach; ignoring negative outliers
  – Being too critic: over-evaluating, -discussing and/or -justifying 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 wise-person’s philosophy:
  – Tell people about the problem you are going to solve
  – Tell people how you are going to 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
Steps to writing a paper:

- Write the storyboard for yourself and other authors: a paper should be a good story
- Build a structure (sections and sub-sections)
- 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 😊)
- Add figures, tables, and informal references
- Consolidate bullets into paragraphs
- Collect formal references and related work
- 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, CERTS, SPW, XXXX
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, ECRTS
  – Programming: POPL, ICFP, PLDI, ESOP, OOPSLA
  – XXXXXXX
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
    
    • plus it *does 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, *to be discussed with your co-authors*
Submitting Papers

- Some Good to VG 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
  - Journal of Functional Programming
  - XXXXXXXXXXXX
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/or 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...
  – In rebuttal or response, be friendly, not a good idea to antagonize the reviewer
CritiX’ Publishing Policy

• Submit preliminary work early to a good workshop
• Submit a finished paper to a VG 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
The hard path to Excellence, or ...
Why excellence ... is about details ...

Quality (as in impactful, recognised)

When you start .... nothing you do seems to matter ....

This is where suddenly ... things get hard again ...

When you get good enough ... success starts looking easy

... and why excellence ... is about details ...

? ... You’ll get to know if you stay long enough ...

The hard path to excellence ...

-- Effort (as in work, energy...)
Some References

• Alysson Bessani, with A. Casimiro, P. Veríssimo, *How to do Research in the Navigators group*

• Simon Peyton Jones, *How to give a good talk and write a good paper*
  – https://www.youtube.com/watch?v=g3dkRsTqdDA

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

  – Book about the style of written English, highly recommended.

  – 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, EuroSys 2006 Authoring Workshop*

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

• How to write a bad research paper (R. Gueraouï):
  – https://www.youtube.com/watch?v=K9BhQaOdtjs