A PhD Student's Survival Guide

Bernard Deconinck, Applied Math, UW

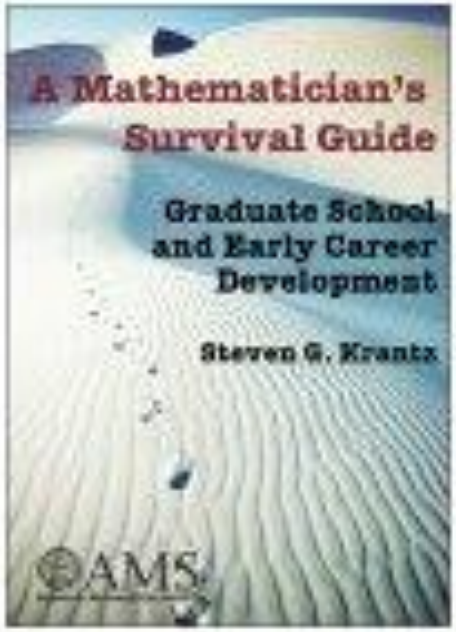
Acknowledgment 1

This talk is modified from a talk on the same topic by David Keyes intended for students at KAUST.

With other modifications introduced by Randy LeVeque.

Acknowledgment 2

- Inspired by and adapted from the book by Steven G. Krantz, Mathematics Department, Washington University
- American Mathematical Society, 2003, 222 pp.
- Focused on graduate school and early career development
- Strongly recommended reading
  - right away, if not earlier
  - periodically (e.g., at the beginning of each quarter)



Lots of online resources

- http://www.siam.org/students/
- http://www.siam.org/careers/

- http://www.ams.org/profession/student
- http://www.ams.org/profession/career-info/new-phds/new-phds

- “On the Art of Procuring Reference Letters” by David Keyes,http://www.siam.org/news/news.php?id=1777

- “Handbook of Writing for the Mathematical Sciences”. N.J. Higham, http://epubs.siam.org/doi/book/10.1137/1.9780898719550

Disclaimer

- Graduate student careers evolve with the changing economy and the changing metrics for research
  - Expectations by employers of new graduates are much higher now than when I emerged in 1982
  - New graduates now have access to *much* better information, but their competition is global for nearly every position
- Like all advice, the advice in this talk should be overruled by adaptation that is local in space and time.
- Take all this advice with a grain of salt and tweak it to apply to YOU

A graduate student's life

- Part I: courses
  - Analyze
  - Focus on specialized theory and technique
  - Build silos of understanding
  - Structured, like the undergraduate experience

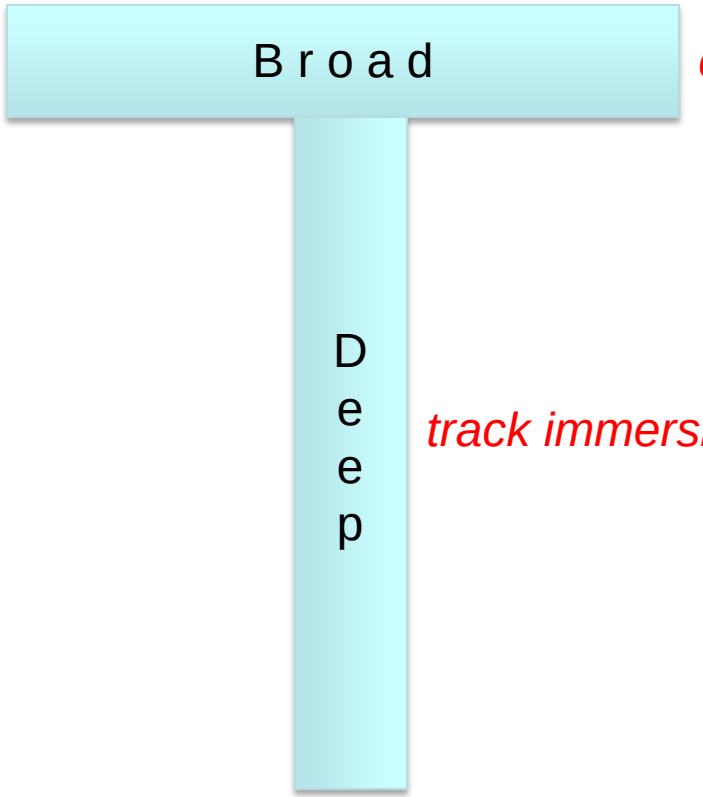
The transition can be difficult !

- Part II: research
  - Synthesize
  - Focus on a problem
  - Build bridges between the silos
  - Unstructured, like other creative professionals (playwrights, architects, consultants, etc.)

Your intellectual development

- The faculty's hope, but your responsibility
- The process of discovery has two aspects
  - Systematic
    - Books, journals, conferences, seminars, courses
    - Priming the pump with exposure to applications
    - Deriving, programming, correlating
  - Serendipitous
    - Conversations, inspirations, dreams
- You need both; you also need
  - skill and providence
  - breadth and depth

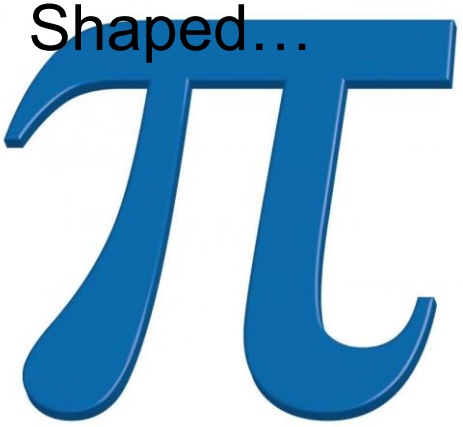
Become a “T”-shaped student



Narrow

Shallow

Or Pi-Shaped…



Your career development

- The faculty's pride, but your responsibility
- Start now!
  - read professional society publications
  - meet leaders (including outside your home department)
  - get teaching experience
  - get presentation experience
  - get someone to seriously criticize your expository writing (before writing your thesis)
  - try out scientific roles: organize sessions at conferences, participate in SIAM UW, math fair, …
  - read job ads
- Prioritize short-term work against long-term goals
- Become a professional

Miscellaneous words to the wise

- Learn local rules and regulations, timetables
  - next 4-6 years are your professional “hinge” years
- Learn the “big picture” beyond your university
  - you are only here 4-6 years ☹
- Diversify beyond your undergraduate major area(s)
- Work on both your long-term development (e.g., seminar attendance) and short-term (e.g., studying for quals) in a disciplined, balanced way
- *Specific (personal) suggestions follow*

Keep a personal research journal

- Quad-ruled lab notebook or electronic notebook (twiki, evernote®)
- Try for an entry per day; no less than one per week
- Record what roads you went down and why
  - what you read
  - what you observed in the lab
  - what you proved or demonstrated
  - what you computed (with reproducible input deck and archived code version)
- Make note of obstacles (perhaps to return to them with more knowledge)
- Make note of puzzles (perhaps to raise them with senior people in the field)
- Bring to your weekly meeting with your advisor

Use a “lab notebook” and version control for computer experiments

- Keep track of what you’ve tried and where the code is. Documentation too!
- Use version control for developing code, keeping history of past working versions.
- Write scripts or programs for every figure/table you plan to use.
- Make sure your results are reproducible.
- Make it easy for others (and yourself) to build on your work.

Keep a career webpage

- As a PhD student, your group may feature your face and e-mail on their webpage
- You need more:
  - for a link to your CV
  - for a link to your papers and presentations
  - to show what you think is important
    - fast-to-find reference pages
    - seminar series
    - conferences
- If you don't have a webpage, people cannot find useful things about you without contacting you directly
- Sometimes people like to do a preliminary evaluation of you before they make contact – essential complement to a job application
- Keep the personal to things that are neutral

Read the literature

- Pick 10-20 journals that span your methodological and applications interests
  - e.g., *SIAM J. Sci. Comput.* and *JFM*
- Start collecting your own library
- Go online regularly to see who is writing about what – journals, arXiv.org, blogs, etc.
  - Scan contents: titles, authors, affiliations, abstracts
  - *Read* at least one article of interest per journal per month
- Follow the publications of big shots in your field of interest
- Be your advisor's scout
  - He or she doesn't have the time you have to keep up!

Apply for Fellowships

- Good professional experience: like practicing for applying for jobs or grants
- Allows more research focus
- Great networking
- Great CV fodder

Join (at least) two prof socs

- A “technique” society: SIAM, AMS, MAA, etc.
- An “application domain” society: AGU, AIAA, APS, ASME, IEEE, etc.
- Students can join for no or low cost
  - Worth it for publications, employment services
  - Helps give definition to your early résumé

Try to go to a conference each year

- A local conference that is free or cheap, even if it is not of central interest
  - to acquire the culture
- A conference specialized to your interest
  - get travel support by presenting a poster or paper
- Keep informed by subscribing to electronic newsletters, and reading notices in your professional societies' monthly or quarterly tabloids

Participate in the department

- Attend seminars
- Learn what others here are doing
- Learn *how* others here are doing
- Learn how to give a talk
- Learn how *not* to give a talk
- *Be seen, be heard, participate, be a member of the local community*

Participate in other departments

- Learn what others outside are doing
- Learn *how* others outside are doing
- Learn how (not) to give a talk
- Be seen, be heard, make a favorable impression of the local community
- Don’t set your attendance expectations by others’ attendance
  - Your advisor may be writing the proposal that feeds you or knocking on doors precisely so that *YOU* have the luxury of attending the colloquium!
  - Set a good example for your fellow students; *lift them up*; don’t be dragged down!

Get some teaching experience

- Your life will be spent persuading and informing, whether you are a professional academic or a research leader in another sector
- You will be a much better student when you understand the difficulties of teaching
- You *may need* to have a teaching resume, even if you don't need the financial support
- Be choosy about what course you teach, if you have a choice
- Another potentially very valuable letter of reference

Get to know your peers

- Older peers understand how the department works and can advise you
  - sometimes more knowledgeably than the faculty (who studied somewhere else)
  - sometimes more objectively than the faculty
- Same-year peers can help you study effectively
- Peers within the same group can be excellent collaborators in research
- Peers may be lifelong sources of knowledge, invitations, “students in trade”, etc.

Learn the simple e-tools

- Linux
- LaTeX
- *Mathematica, Maple* and *Matlab, Python,...*
- Microsoft Office products (*Powerpoint*, *Word*, *Excel*) or their OpenOffice freely available equivalents
- Bibliographic services (mathscinet, WoS)
- Web repositories for mathematics reprints, downloadable codes, etc.

Stay in communication

- Check your mail *and your e-mail* daily
  - you may be held responsible for deadlines that are late breaking
  - you may miss a free lunch, otherwise ☺
- Attend classes and seminars for announcements, and ask about announcements when you have to miss
- Develop collegial and respectful relationships with departmental office staff
- Visit the department during the day on occasion, even if you are incorrigibly nocturnal or domestic

On the art of finding an advisor…

Strategize about your advisor

- *See chapter in Krantz!*
- Intellectual match
- Financial support
- Supportive research group
- Availability of mentoring
- Connections to the community
- Placement of previous students
- Need to feel good about how you spend the next 4-6 years

Considerations

- A successful PhD student will cost an advisor $200,000 or more
- A false start is expensive for both student (time of youth) and advisor (could have had other students or a post-doc – never a lack)
  - To look worthy of investment, the student should be familiar with a lot of the research of the advisor
  - To be comfortable, the students should have read a lot of the research of the advisor

What advisors want

- Brilliance
- Creativity
- Endurance for long working hours
- Full-time availability
- Loyalty
- Honesty and integrity
- Resourcefulness
- Patience and joy
- Good communication skills
- Good reputation with other local faculty
- Good marketability (people skills, acceptability within scientific social circles)

How to win an advisor

- If courses are available, take his or her courses and utterly excel in them
- Pursue an independent study with the prospective advisor and always be steps ahead of the advisor
- Feed the advisor's own intellect with references and ideas
- Fulfill commitments promptly and thoroughly (and other best practices of employment)
- Pitch in to help the advisor's group
- Take initiative for personal growth (e.g., ask for papers to read or review, volunteer to present an internal seminar, etc.)

Strategize about your committee

- Should contain other departmental members
- Should contain outsider(s), at most universities
- Take courses from them before you face them in oral exams
- Know about their work before you go to their offices
- Consult with your advisor about your committee (about intellectual support base needed for the thesis, and also in case of political considerations)

Look for your thesis where you have advantages

- Special knowledge and interest
- Special access to expertise
- Special data
- Early insight

Develop passion

- No passion, no thesis
- The PhD is a marathon, not a sprint

Closing words

- The PhD is not for everyone
  - Don’t fool yourself and get a slow start on life outside of research, if it is not for you
- On the other hand, don’t be prematurely discouraged
  - If you got in *here*, you can almost certainly get out with a PhD
  - Only *you* can make it happen
- Your success is one of *our* best chances of success

On the art of procuring reference letters…

Entering the market (1)

- Your portfolio consists of:
  - Transcripts
  - Certifications and tests
  - Statements of purpose (research, teaching, etc.)
  - Curriculum vitae
  - Thesis and papers
  - Letters of reference
- If you wait until you are in the market before assembling these materials, you may be too late to present your best possible case

Entering the market (2)

- Plan how you are going to build
  - Transcripts
  - Certifications and tests
  - Curriculum vitae
- Get advice as you write
  - Statements of purpose
- Time the release of
  - Papers (long review/acceptance period)
- Strategize about how to procure and prepare
  - Letters of reference

Letters of reference (1)

- The mysterious and invisible part of the portfolio
- Typical packet consists of the advisor (extensive) and a complement of people who have known the candidate for just one course or one year (apologetic)
- Better packets have multiple extensive authors
- But there's much more …

Letters of reference (2)

- Aim for impact

  (impact) = (acquaintance) × (authority) × (objectivity)

  – Not just someone who knows you well
  – Not just someone who is famous
  – Not someone with an obvious conflict of interest
- Span the space of application criteria
  – Each reference has a designed role to expose one or more of your
    - Brilliance, creativity, background, leadership, motivation, endurance, oral communication, written communication, dependability, fairness, ability to work alone, ability to collaborate in a team, dimensionality
- Pare down to only excellent letters

Recruit and Prepare

- Consider capacity to deliver on time
- Deliver clear instructions:
  - deadline and contact information
  - how to complete
  - full set of your materials
  - explanation of niche and sample paragraphs
- Deliver as far in advance as possible
- Complete as much as possible on line or in hardcopy forms
  - faster compliance
  - fewer errors

Ask from strength

- Do not ask for a letter that must be weak
- Do your homework thoroughly first
  - Then ask for advice
- After delivering the packet, ask for an appointment or catch your writer casually
  - Go over details that may not be obvious

On the Art of Procuring Reference Letters

July 23, 2010

Careers in the Math Sciences
David Keyes

Reference letters are among the most important documents shaping an individual researcher's career, and they are further distinguished by being largely inaccessible to the individual. There is an art to writing reference letters and an art to reading them. There is even an art to discussing and comparing them in admissions, fellowship, hiring, prize, and promotion committees. The subject of this column, however, is the art, in the face of their invisibility, of procuring effective letters for a portfolio: choosing their authors, chasing them in on schedule, and checking on their status. The target audience is junior applicants---from undergraduates seeking graduate fellowships to postdocs and graduate students seeking their first permanent positions---although many of the principles apply at all levels.

Selecting the Ideal Reference Set
When you are free to choose some or all of your references (the usual case for junior-level positions), the choice is one of the most important of your entire application campaign and should be exercised strategically. Junior candidates often instinctively reach for the easiest-to-approach letter writers, without considering the importance of the integrated picture of themselves that should emerge from a collection of perspectives. You should carefully consider whether your reference set effectively "spans the space" of criteria related to the application at hand.

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Read the rest of the article at
http://www.siam.org/news/news.php?id=1777

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Following Up
Downstream of the campaign for your degree program, job, or summer internship, you should follow up with your reference writers to document the outcome. Normally, this will entail a short e-mail or a quick office visit to say thanks and to receive heartfelt congratulations. If things haven't worked out, such an exchange might provide consolation and enhanced perspective, based on public or inside knowledge about the general success of candidates from the institution in some window of years. It might also lead to custom career advice and new directions. Reference writing, remember, is an art of its own and a natural outgrowth of the art of mentoring. Most artists like to know how their art is received.

As vice president of SIAM (2006–2009), David Keyes was the ex-officio chair of SIAM's Committee on Membership. He was invited by Susan Minkoff, the current chair, to be a rotating columnist in the new SIAM Careers in the Math Sciences column. Keyes is the inaugural dean of the Division of Mathematical and Computer Sciences and Engineering at the King Abdullah University of Science and Technology and the Fu Foundation Professor of Applied Mathematics at Columbia University. He has written or read thousands of reference letters in his first 25 years in academia.

Follow up

- Patiently track compliance of the writer
- Let the writers know about outcomes
- Pass it on!
  - the payback is to the *next* generation