Making the Most out of Grad School

Dr. Alexandra (Sasha) Fedorova

School of Computing Science

SFU

Introduction

- Ph.D. in Computer Science at Harvard 2000-2006

- From December 2006: Assistant Professor at SFU

- Co-founded Systems Networking and Architecture research Lab

Outline

- What is your goal?
  - Industry
  - Industrial research
  - Academia
- Imagine your ideal CV
- Work towards your ideal CV
- A few words on networking

Identify your Target

- Say you want to go to academia
- Very competitive: 200-500 applicants per position
- Identify your target schools
- Find CVs of recently hired assistant professors
- Identify common key properties of their CVs:
  - The number and kind of publications
  - The kind of experience
- Now you know your target

Typical Properties of a "Good" CV

- Visibility in top conferences or journals
- Hard to say how *many* publications you need, but it is the *impact* that counts
- 10-15 publications in workshops or low-end conferences may look worse than 1-2 publications in top conferences in your field
- Good publications are key
- How to maximize your chances of getting them?

Getting Published

- Identify the topic
- Pose the research question
- Imagine your "final product"
- Set the milestones
- Be efficient
- Adjust your course

Identify the Topic

- Often students tend to choose grand and vague topics
  - I will find a cure for cancer
- Honourable goal, but may not get you where you want
  - You only have limited time and resources

Identify the Topic

- Choose something doable
- Something that _maximizes your own skills and abilities_
- This will take time! Be patient
- Become _very_ familiar with a particular area
  - Take a grad course
  - Do a directed reading course
  - Ask your supervisor for directions
  - Work with another student/researcher on a project – the fastest way to learn

Pose the Research Question

- Pose your research question such that *you cannot fail*

  - Do not set yourself up for a negative result

  - For example...

Posing the Research Question

- Example 1:

  <u>"The goal of my research is to find the cure for cancer."</u>

  If you do not find the cure by the time you graduate, you will have failed.

- Example 2:

  <u>"The goal of my research is to identify how therapy X affects the growth rate of cancer tumours."</u>

  Regardless of the answer you will have *learned* something and so you will have contributed to research.

What Is Research?

- By the time you graduate your need to demonstrate that you _know how to do research well_
- Research is:
  - Application of the scientific method
  - To a problem area of interest to the community
  - With the goal of _furthering the understanding_
  - Deepened understanding may bring new solutions
  - …or suggest new research directions

What Research is NOT

- Building / implementing things for their own sake
- A common misconception: "I will build this new software/model/etc. and this will be by research".
  - Hmm…. Will your system/model *further the understanding of a problem or a phenomenon?*
- Another misconception: I must find a new solution to problem X
  - This will likely happen if you understand the problem. But setting this as your goal may be too rigid.

A Word about Random Experiments

- Several groundbreaking scientific discoveries were made through random experimentation
- Be discrete about this
- Remember, _you have limited time_
- If you like doing this, leave some time in your week for this
- But _diversify your investment_ by following the traditional path as well

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Imagine Your Final Product

- So you have posed your research question

- Imagine the _ideal conference paper_ addressing this question

- Before you begin doing anything WRITE AS MUCH OF THAT PAPER AS YOU CAN
  - You've already done much research when deciding on a topic choice
  - So you can already do a lot

Writing Before Doing

- Writing helps thinking
- Imagine you are writing for someone else
  - For a program committee member reviewing your paper
- You will subconsciously attempt to be clear
- As you write you will identify gaps in your understanding and in methodology

Early Paper Structure

- Introduction:
  - Here you must identify the goal of your research and _motivate_ it
  - Writing this section will tell you if your goal and motivation are clear, if they need work or must be changed

- Methodology
  - Once your goal is clear, identify _how you will get there_
  - What resources will you need? Do you have them?
  - Will your methodology lead you to answer the questions you posed?

Early Paper Structure (cont.)

- Format of the final results
  - What kind of results can you get? Think of all possible outcomes
  - What results do you expect to get and why?
  - Describe those imaginary results in the paper
  - Even create imaginary charts

Early Paper Structure (cont.)

- Look critically at the resulting early paper
  - Are you satisfied? Would you accept this paper to a top conference or journal?
  - What must be changed?
- Do write!!! Don't just think over it.
- This will take time – it's okay, it will help you later
- This is already doing research
- This is risk management
- This is maximizing your productivity

Knowing Where Your Are Going

- You cannot get to your destination unless you know where you are going

- Imagining your destination in vivid detail is like knowing exactly how to get there

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Set the Milestones

- If you have a good "early" paper – that's trivial
- Your milestones will fall naturally out of your section on methodology
- You will also identify areas where you must do more reading or thinking

Set <u>Timed</u> Milestones

- Associate a deadline with each milestone
- You will have a short-range milestones and long-range milestones
- Milestones *<u>make things appear doable</u>*
- Before you begin your year, have milestones for the year
- Before you begin your week, have milestones for the week
- Before you begin your day, have milestones for the day

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Be Efficient: A Few Obvious Facts

- It was shown that checking e-mail 100 times a day makes you stupid
  - Do one thing at a time, don't context switch
- Listening to music / watching TV while doing research makes you forget what you have done
  - Create good conditions for productive thinking

Be Efficient

- Do not reinvent the wheel
- If someone has already done something, use their data, use their methodology
- There is no glory in doing lots of hard work
- Work hard, but also work smart

Collaborating With Other People

- Scientists with most publications collaborate a lot
- Simple math: you cannot do it all by yourself
- Can you benefit from working with others?
- Example:
  - You investigate effect of therapy X on the growth rate of cancer cells.
  - It would be also useful to know the side effect of X w.r.t. Z
  - You cannot do it all yourself. Maybe your supervisor can suggest this supplementary project to another student?
  - Are there junior grad students or undergrads that can help you with experiments?

People Are Your Greatest Resource

- Talk to people about your research
- Talk to people who serve on program committees of journal review boards
- Give them a 5-minute spiel about your research
- They will ask questions, they will give you constructive criticism
- You will get clues how to adjust your work
- They will be ready to accept your work once they see it
- They are also potential employers – they must know you!

Adjust Your Course

- Research is risky
- Sometimes things do not turn out the way you thought
- It's okay – research *must* be risky!
- Be ready to adjust:
  - Modify your goal, your methodology
  - What have you *learned*?
  - If you have learned something new, you have not wasted time, so it's okay

Summary

- Set your goals
- Envision your final product ... in the greatest detail
- Goes for your CV, for papers
- Write early paper drafts. Writing helps thinking.
- Be efficient, collaborate and talk with others
- Adjust your course – research is a risky business. Minimize your risk, but don't fear it
- Have fun! Treat this like your own enterprise!