Tips for Pursuing Computer Science Research and Research Writing

KR Chowdhary
Former Professor & Head

Department of Computer Science and Engineering
MBM Engineering College, Jodhpur
Present: Director, JIETSETG
Email: kr.chowdhary@gmail.com
Web-Page: http://www.krchowdhary.com

May 20, 2014

Outline

- Introduction
- Problem: Making an impact
- Paradigm
  - theoretical, experimental
  - some advice for each kind
- Writing: conference papers, journal papers
- Summary

Introduction

- Main Point: Honesty
- Keep yourself honest
  - to find truth more rapidly
  - to avoid embarrassment
- Goal: positive impact
  - ideas, papers
  - system
- Writing: Do not oversell yourself
  - present the problem
  - present the evidence
  - present the limits and assumptions

How the Research is Judged?

- Impact
  - Is it widely used?
  - Does it lead to new directions?
  - Does it effect teaching?
- Standards differ place to place
  - Conference: timely, interesting, simple, share
  - Journals: correct, relevant, well-written

Challenge?

- Fundamental problems
  - Lots of prior work
  - Lots of researchers
- Approach:
  - Do lot of study to choose proper directions
  - First search is breadth-wise
  - Next search is depth-wise

Research Paradigms

- Theoretical Research
  - "Publish or Perish !"
  - E.g., Algorithm that solves some real problems
  - Evaluation of proof, elegance, clarity
- Experimental or System Research
  - "demo or die!"
  - evaluation by experiment, simplicity, utility
- Multidisciplinary Research

Theoretical Research

- Keep an eye on applications
  - Great source of problems and interest
  - Invest in a field that is starting to develop
- Look for "some thing to push against"
- Theorems relate two things
- Remember the costs
- Speed, space, complexity, etc.
- Strive for simplicity, elegant, clarity

Advice for Theoretical Research

- Stay "light on your feet"
  - Seek new approaches or simplifications
  - Do not work on same area forever
  - Have short goals
- Learn from writings
- Read Selectively and critically

Experimental/System Research

- Find ways to see farther
- Keep an eye on theory - validation or invalidation are both good
- keep other eye on end users
  - main source of problems, feedback
- Look for "some thing to push against"
  - the way to evaluate your system or demo
- Look for insights (lessons, theories, etc.)

Advice for Experimental/System Research

- Do separate short projects
- Pickup simple solutions (avoid complex ones)
- Be sure to finish your project
- Do quantitative evaluation
- Do technology transfer!

Cross-disciplinary Research

- Applying computing to other disciplines
- Use computation for theory construction
- Evaluation in the area of application
  - Originality
  - Utility and results
- Evaluation in computing
  - Soundness and currency of the CS applied
  - Finding new CS problems

Ways to make a positive impact

- Publish important work first
  - think hard
  - use techniques/instruments
  - work in underdeveloped areas
  - start new (sub-) areas
- Publish clear descriptions
- relate to current understanding
- Be persistent

Finding good ideas !

- Look for problems
  - In reading, teaching
  - By using your own tools / systems
- Have lots of ideas
- Pursue one that:
  - you are uniquely qualified to handle
  - tackle important problems that:
    - excites you
    - that on which you make progress

How to improve?

- Ask lot questions (why?)
- Read a lot
- Development judgment about:
  - problems
  - solution techniques
  - explanations, evaluations

Becoming a Researcher

- Read widely and deeply
- Develop judgment about great papers
- Build general knowledge
- Look for issues and questions
- Capture opportunities
- Keep a Research Notebook
- Follow references and use citation index

Writing: Why does it matter?

- Determine if your ideas are:
  - Published
  - Read
  - Understood
  - Cited
  - Taught
- Writing:
  - The *Scientific Style*
  - Writing well, giving talk

The Scientific Style

- Purpose:
  - allow reader judge the research
  - describe present evidence
  - convey ideas and insights
- Different kinds of Writings:
  - teaching (as in textbooks):
    - focus on explanation of science
    - breadth and clarity are more important
    - newness (latest is not important)

Learning how to write?

- Read to observe the stype
  - journals in your field
  - Scientific American
  - story tellers
- Observe, how they:
  - organize
  - explain

The writing Process

- Start by “brainstormig”
- Organize the ideas (as outline)
- Do not “core dump !”
- Once the ideas are on paper, make them clear
- Prefer to edit from paper
- Seek feedback
- Enhance awareness by tracking problems
- Writing is rewriting

Writing my dissertation

- Keep a list
- Hardest lesson: "Do not core dump !"
- Writing is like Programming ¡‘

Programming	v/s	Writing
Declarative	is	definitive
Procedure Interface (Specifications)	is	Theorem statement
Implementation	is	Proof
Subroutine	is	Lemma
Comment	is	Remark
Test case	is	Example

Why Analogy is helpful?

- Is it well organized?
- Is every thing in proper place?
- Is it maintainable?
- Is there repetition?
- Does it work?

Write only related work

- Related to the Problem
  - not just your solution technique
- Help reader fit your work into problem space
- Say how helps to solve problem
- Say why/how it does not solve problem
- Say how solution techniques differ

Getting all the related work

- Read other dissertations
- Ask the experts
- Read the references in good papers
  - citation index
  - recent conferences/journals
- How to link sentences?

- George Gopen and Judisth Swan, "The Science of Scientific Writing" (American Scientist, 78:550-558, 1990). (links available at www.krchowdhary.com)

- Linking Idea

- English sentences have two parts, first links to previous material and the second part provides new information and emphasis

Other writing ideas

- Illustration with examples
  - also, counter examples !
  - Specially any thing unclear
- 'Pair writing" with Professor
- Honesty
  - present facts, don't sell
  - look for flaws

Lower level Tips

- Use sign posting:
  - "This section describes the algorithm for . . ."
- Use topic sentences
  - "The key idea is to use a divide-and-conquer strategy."
- Do not use (very many) adjectives

Summary

- Look for "some thing to push against"
- Read selectively and critically
- Writing is like programming
- Strive for clarity
- Strive for honesty
- Do not over sell