Finding Good Ideas and Problems

Nick Feamster and Alex Gray
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Questions

- What’s a good idea?
- What makes a good research problem?
- How to find a good research problem?

What's a good idea?

- Advance in the field
- Needs to address some need (real problem)
  - Need could be immediate or longer term
  - Specific need, connected to practice
  - Can address the needs of some specific group
  - May not be immediately obvious today that it's useful
- Needs to offer new perspective/angle
- "I should have thought of that!" (strong emotions)
- Market value
- Can you explain it to mom? (should be simple and coherent)
- Elegance, simplicity, generality, practicality
- Opens a new direction
- Many interpretations, applications to other areas not previously thought of

What's a Bad Idea/Problem? (and where to find them)

- Your imagination
  - Comic books, cartoons
- Ideas/Problems that are solved
  - Literature reviews are important
- Those that can't be solved or validated
- When your advisor tries to talk you out of it…when should you listen?
  - "Problem is too hard." Can you figure out how to leverage help, make some new assumptions, new subproblem that people hadn't thought of, a new perspective to the problem (new technique, approach, etc.)…?
  - "Field/problem area is dead." Don't completely accept this. You may know something that your advisor doesn't. Find a connection with another field… Ask yourself: Has the situation changed? (e.g., memory cheaper, CPU faster, etc.)
  - "Problem area is 'too crowded'." Can you say something new?
- When to bail out on an idea?
  - Solution is impractical

What’s a good idea?

- Looking backward, from n years from now
- Opens up new thinking
- Treats fundamental issues better
- Elegance

What Makes a Good Research Problem?

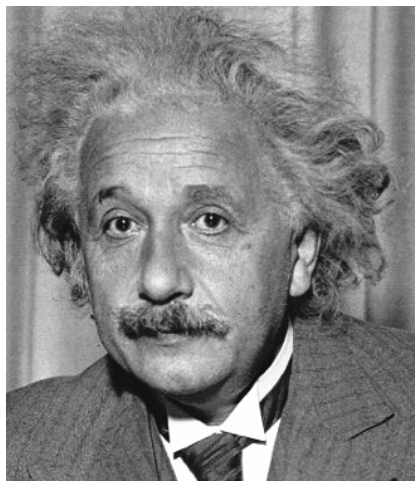
- Problem needs a solution/must be tractable
  - Solutions need not be complete, but they should offer new insight
  - Solution sometimes distills a problem to its essence
- Problem should be challenging
- Clearly differentiated from previous work. Context is clearly defined.

The Problem Must be Important

- How to judge this?
  - Matter of taste (maybe)
  - Requires seeing good and bad to help get a sense
- Test 1: critical mass
  - Is there some group of people that would benefit from a solution? Is it a group you care about?
  - Examples: network operators, citizens in developing countries, other researchers, etc.
- Test 2: time travel
  - Will the problem go away on its own? (e.g., memory is getting cheaper, CPUs faster, etc.)

The Problem Must Be Difficult

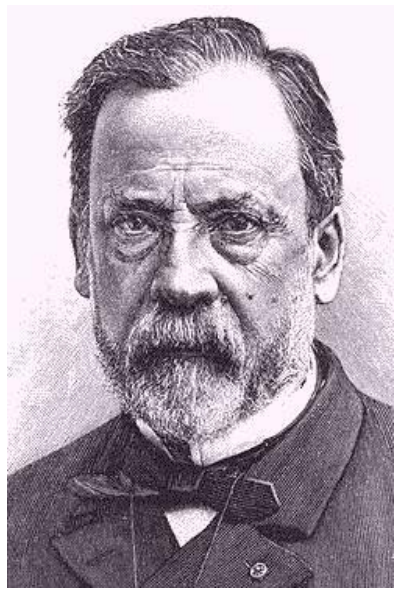
- There is no point in solving easy problems
- Recognize the difference between research and a “simple matter of engineering”



“We can’t solve problems by using the same kind of thinking we used when we created them.”

The Problem Must Create Knowledge

- Research: the process of creating knowledge
  - Building systems, tools, etc.: not research unless you devise new techniques or lessons along the way
  - Good questions to ask
    - Do I know the answer to this before I start?
    - Are there places to expect surprises?
- Starting points
  - Hypothesis
  - A new approach
  - Serendipity sometimes takes over!



Problem Should Have a Solution

- Solution need not always be complete
  - Opening up a new direction for others to explore
- Negative results are OK sometimes
  - If you knew you'd come up with a positive result, then you wouldn't be creating knowledge ☺
  - Prevents others from going down the same path

What's a good problem? (to work on)

- Current hype (short-term)
- Actual impact (long-term)
  - Question: How to measure impact?
- Need some reason you think you can make progress
- Clear objective and success criterion

Secret weapons

- Bigger brain
- Mastery of a technique or theory
- Fresh perspective
  - From another field or culture
  - From much later

Where to find research ideas/problems?

- Could draw on ideas from multiple areas
  - New connections between multiple areas that people hadn't thought of before
- Other people have tried and failed

How do you find ideas/problems?

- Frustrations
  - Your own
  - Others'… how to find out about these?

- Read, read, read to stay relevant
  - Mailing lists
  - Conferences ("real world" ones, in particular)
  - Certain news rags (*Economist, Tech Review*, etc.)
    - Can often be a good source of ideas for applying one problem domain to another, etc.

How do you find ideas/problems?

- The recent literature
- The old literature
- Other literatures
- Analogies
- Elegance as a guide

Where *not* to find ideas/problems

- Your imagination
  - Don't make problems up. Plenty of real ones out there…
  - The new approach, question, etc., should come from your thoughts. The problem itself should not.
  - Asking for feedback is key
- Conference proceedings (sometimes)
  - The last 80% of papers on a topic solve the last 5% of the problem
  - Often, that 5% "doesn't matter"
    - Engineering or time travel will solve it…

How to solve a big problem?

- Baby steps: simplifications of the problem
- Special cases of the problem
- Multiple perspectives on the same problem
- Surrounding the problem by knowing all aspects; massive knowledge
- Big analogical leaps