
HOW TO DO
RESEARCH

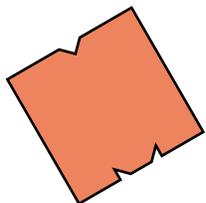
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How To Do Research (Well)

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First Things First: Why?

SCENARIO ONE:

- Person A **is a fool**

SCENARIO TWO:

- Person A **is extremely intelligent, has extremely good ideas and insights, but conducts research foolishly**

SCENARIO THREE:

- Person A **is extremely intelligent, has extremely good ideas and insights, conducts research brilliantly, but writes papers foolishly**

A Good Algorithm

1. Answer question:

WHAT DO I WANT TO KNOW?

2. Devise appropriate experiments

3. Gather data; stare at data; think

4. goto 1 unless satisfied

5. Write abstract; goto 1 unless satisfied

6. Write intro; goto 1 unless satisfied

7. Write remainder; goto 1 unless satisfied

8. Answer question:

DOES PAPER TELL THE STORY?

goto 5 unless satisfied

1. Answer Question

What do I want to know?

The hardest part of research
is asking good questions

- Point of Advisor: **Direction**
- Point of Colleagues: **Sounding boards**
- Point of Research: **PROVIDE INSIGHTS**

What would be **useful?** **influential?**
interesting? **long-lived?**

IN GENERAL: Be general. Compare things.
Why do they differ? What causes behavior?
What is unimportant to behavior?

2. Devise Experiments

CROSS-PRODUCTS are useful

Scenario 1:

**Prefetch scheme A vs. scheme B;
fixed caches; fixed memory latency;
fixed memory bandwidth**

Scenario 2:

**Prefetch scheme A vs. scheme B;
cache sizes 1,2,4,8; memory latency 1,2,4,8;
memory bandwidth 1,2,4,8**

**Scenario 2 is MUCH, MUCH HARDER
but MUCH MORE USEFUL**

3. Gather Data; Stare; Think

POINT:

DATA -> **SYNTHESIS** -> **INFORMATION**

Plot data every which way imaginable

Look for apparent connections

This is where advisor is useful ...

4. goto 1 unless satisfied

**Does the information synthesized
tell you what you want to know?**

Does it answer the question?

If not, start again ...

Does the information raise more questions?

IF NOT, THERE IS LIKELY A PROBLEM

Are the new questions within the scope?

Yes: start again ...

No: you have a new study to do next ...

5. Write Abstract

**Here is a topic, its importance,
how it affects YOU (the reader)**

**Within that topic, here is an
unsolved problem (unanswered question)**

**Here is how we solved the problem
(answered the question)**

Here are the most important results

PROVIDES FRAMEWORK FOR PAPER

Does it say what you intended? If not ...

6. Write Intro

**Here is a topic, its importance,
how it affects YOU (the reader)**

**Within that topic, here is an
unsolved problem (unanswered question)**

**Here is how we solved the problem
(answered the question)**

Here are the most important results

[*DOES THIS LOOK FAMILIAR?*]

Does it say what you intended? If not ...

7. Write Remainder

Background: Be sophisticated (finer points as well as primer-level points)

**Related Work: Pay homage to prior art;
Distinguish present work**

Experiments: Reproducible set-up

**Discussion: PROVIDE INSIGHTS
(those that require a few weeks of thinking)**

References: Don't miss important papers

8. Answer Question

Does the paper tell your story?

Hard to answer this. Get others to read it.

IN GENERAL:

- **Have at least ONE MAIN POINT**
- **Don't assume reader knows anything (but do assume reader is intelligent)**
- **Beware of prophecies/heresies/etc.**
- **Goal: the perfect sphere :)**

**If not "perfect," rewrite abstract,
perhaps run new experiments ...**

Summary

EXCELLENT RESEARCH* \neq *COOL IDEA
EXCELLENT RESEARCH* = *ANY IDEA
DONEWELL

Investigate all possibilities

Look at problem from all angles

(x is good, x is bad, x doesn't matter ...)

Provide deep insights

(those not obvious at first or second glance)

Show connections between things

(x causes y causes z causes good/badness)