

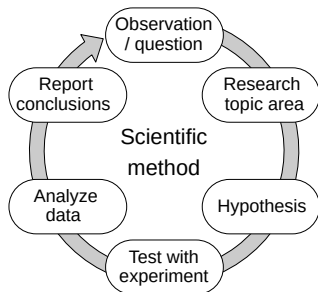
How to do research in deep learning

(Or.. yet another attempt to automate myself away while waiting for AGI)



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The scientific method in my scientific method



The scientific method, Wikipedia

https://en.wikipedia.org/wiki/Scientific_method

Tutorial: Research Methods in Computer Science, Serge Demeyer

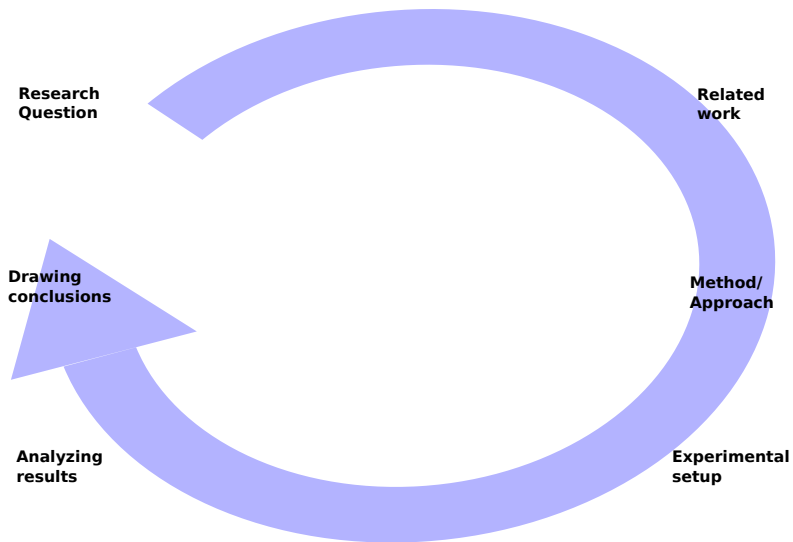
https://win.uantwerpen.be/~sdemey/Tutorial_ResearchMethods/

Research methods in machine learning, Tom Dietterich

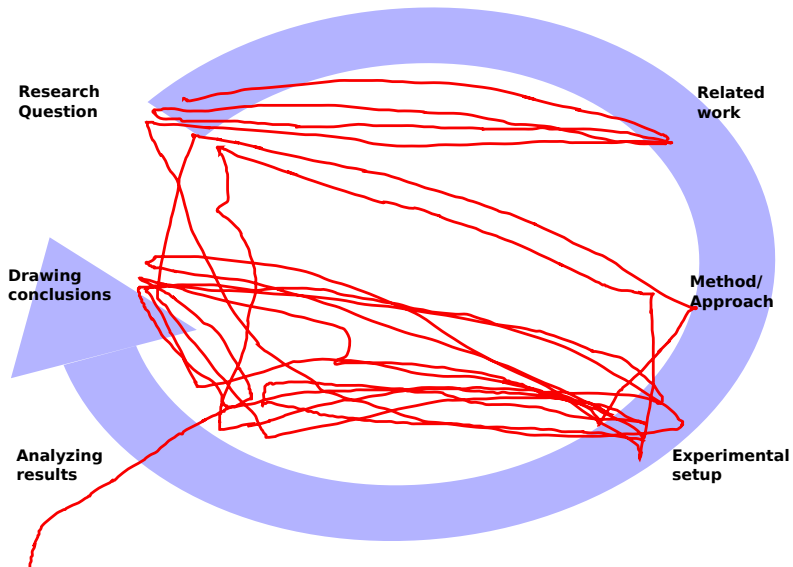
<http://web.engr.oregonstate.edu/~tgd/talks/new-in-ml-2019.pdf>

Here: My individual take on the research method in my research.

Doing research



Doing research with me



Doing research meetings with me

Doing research with me often involves having meetings.

- ▶ During research meetings I'm often asking questions.
- ▶ Not clear what goal I have when asking these questions.
- ▶ This might give: Confusion, frustration, sense of lost control, ...
- ▶ Here: Generalized my questions to specific question types.
- ▶ Goal: Clearer why and where I'm trying to go.
- ▶ Benefit: Whenever you are stuck; you can ask the questions yourself.
- ▶ Benefit: You can prepare my questions in advance of the meeting.

Questions about The Research Question (RQ)

- ▶ **Why is RQ interesting?**

Why do you care? Who else cares? Why should others care?
Change RQ?

- ▶ **What is the 10-15 bullet point main story line?**

http://jvgemert.github.io/paper_skeleton.rtf

- ▶ **What is the RQ precisely? (Formalize/Simplify)**

Why can't we ask a simpler question? How to formalize it? Which part is most uncertain? Change RQ?

- ▶ **Does the problem exist? How often? When (not)?**

How to show an example? How to convincingly demonstrate the problem? Change RQ?

Questions about Related Work

- ▶ **For which work is the RQ interesting?**

Why can't your approach be used for X? Why can't X also make use of this? Change RQ?

- ▶ **How different from existing work?**

Why can't X solve this? What assumptions are different from X?
What other related papers are there? Change RQ?

- ▶ **Building on what existing work?**

Why do we use X? What is so great about X? Why don't we use Y?

- ▶ **How does existing work (baselines?) work?**

What do they do? Why? How do they solve this part?

Questions about Method/Approach

- ▶ **Can you motivate why this method? Each step?**
Why not another method? What is so essential about this step?
- ▶ **What's going on? (Visualize output for each step)**
What is it really doing? Please explain this step? Please show this part, and keep the rest constant.
- ▶ **What precisely? (Formalize/Simplify)**
How to make it simpler? What exactly is going on there?
- ▶ **Does method make sense? (Alternatives?)**
What are other options? Why not use them?
- ▶ **Does method align with RQ?**
Which part of the RQ aligns with this step? Where does this part of the RQ come back? If this works so well, what is it really doing?
Change RQ?

Questions about Experimental Setup

- ▶ **What empirical questions belong to the RQ?**
What questions do we wish to answer? Why? What would answering this question give? Change RQ?
- ▶ **What are relevant baselines?**
To which methods do we compare? Why? Why not more/less? Change RQ?
- ▶ **What exact question is answered by this experiment?**
Why does this experiment answer this question? What other experiments are possible? Which experiment to do?
- ▶ **What exact outcome is expected? What outcome is wanted?**
What outcome would you like? What are the exact numbers that you expect as an outcome? Does doing the analysis on those numbers give the wanted outcome? Change RQ?
- ▶ **What is the minimal setting? (Simplify)**
How to use a smaller problem? How to use a less complex setting? Why can't X be removed from this setting?

Questions about Analyzing Results

- ▶ **How to validate results?**

No bugs? How to do semantic debugging? Do we have stddevs?
Do results consistently align with previous results? Can we do a small test to validate?

- ▶ **How to verify correctness of baseline?**

Do not assume baselines directly work. How well do we match the reported results in their paper? Are these results expected? How to optimize a fair baseline?

- ▶ **Do we understand all results?**

Explain each row in the summary table? Can we see some individual cases?

- ▶ **When does it fail?**

Can we systematically predict when it fails? Can we look at some individual mistakes? Do these failures make sense?

- ▶ **Do results answer the question of the experiment?**

Each experiment has a question to answer. What was the question? Do these results answer that question?

Questions about Drawing Conclusions

- ▶ **What are all conclusions we can draw?** List all patterns, interpret later. Which patterns have we missed?
- ▶ **How well do results align with previous expectations?**
What were the previous expectation? How to explain deviations?
- ▶ **How well do results align with RQ?**
What results did we want? How much are these results what we wanted? Change RQ?
- ▶ **Is there a simpler experiment with same conclusions?**
Which properties are not essential? Which properties should be more emphasized?
- ▶ **To which new hypotheses lead these results?**
How well do these align with RQ? Change RQ?

Questions I will ask you when doing research with me

