

3 Choosing a Computer Science research problem

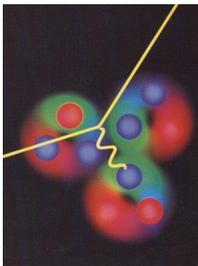
If there are no stupid questions, then what kind of questions do stupid people ask? Do they get smart just in time to ask questions?

Scott Adams

One of the hardest problems with doing research in any field of science is selecting a problem. This is a very important decision as it sets the stage for;

- The research itself,
- Research after the research, and
- Potentially, the rest of your research career.

3.1 Basic and Applied Research



Some research projects are intended to add to our basic knowledge about the world. For example, a physicist might be interested in the basic elements that make up matter (usually at great expense) or a psychologist might want to shed light on human cognition. This type of research that attempts to shed light on humanities conceptualization about a particular phenomenon is known as *basic research*. Basic research results tend to be generally true but not immediately (if ever) applicable to real world problems. They tend to be looked upon with great respect and adoration by academia as both success and failure in this type of research tends to tell us something about the world.



Other types of research have more immediate relevance to existing practice. For example, a farmer might experiment with different mixes of organic fertilizer to increase the yield of a field. A mechanic might adjust an engine injection port to improve the speed of a car. This type of research that relates to practical problems is known as *applied research*. Applied research tends to be the darling of industry and government as it is likely to have consequences that can be measured in the shorter term.

The line between basic and applied research is often fine or missing completely. Basic research can often lead to changes in current practices if a connection is made between its result and how things are currently done. Applied research often inspires how a basic research problem might be attacked. In either case, both types of problems are valid

3.2 Unsuitable problems

At the most basic level the gist of research consists of the collection of data and its interpretation. This leads to certain situation you cannot call research.

3.2.1 Research is not simply learning about something

Gathering information to know more about a certain area is different from looking at a body of data and deciding how it contributes to the solution of a problem.

3.2.2 Research is not the simple comparison of data sets

This does not meet the bar of analysis. Simply gather data and then gathering more data and perhaps showing the data together in table or chart form is often little more than a graphical trick.

3.2.3 Correlating data sets is not research

Using a statistics to indicate that two data sets are related is simply a calculation. It does not involve investigation and does not shed light on why the data is related.

3.2.4 Research problems do not simply result in a “yes” or a “no” answer

In a sense, this is the same as the section above. A simple statistical trick is often all that is necessary. Again, the important concept of why something happens is missing.

3.3 What is a good problem for you?

Man approaches the unattainable truth through a succession of errors.

Aldous Huxley

Selecting a problem is highly influenced by the personality of the person picking it. In general, a good problem for an individual has all three of the following characteristics:

- You find the problem interesting
- You feel the problem is something you can tackle in a reasonable amount of time.
- You care about the problem enough to expend resources on in terms of time, effort, money, etc.
- You think you might be able to make a contribution to solving the problem or part of it.

If any of these characteristics is missing in the perspective problem you examine, it is time to find a new problem!

3.4 Finding a legitimate problem

There are often many places one can search to find legitimate research problems.

3.4.1 Supervisor Suggestions

Your supervisor may have many suggestions based on their own research in an area for your research project. Often, they can provide detailed insight into the nature of any problem they suggest. As such, your supervisor should always be tried first.

3.4.2 Suggestions of Others

It is often valuable to read the “future research” section of a research paper. Suggestions are often made by a paper’s author. These suggestions may spur your interest in a research problem. This approach may be problematic as some papers attempt to leave everything that is hard to do for the distant future.

3.4.3 Replicate Research with modifications

Changing some of the settings of previous research often leads to new and sometime unexpected results.

3.4.4 Apply an existing technique to a new domain

This might be using a modified algorithm to manipulate data in another field in order to achieve a new result

3.4.5 Address Contradiction and Ambiguity

You may be able to find results that contradict each other. The contradictions may be reported by two or more researchers exploring an existing problem. Finding ways of explaining the contradictions requires research.

Often the research results of others have areas of ambiguity that may be ripe for exploration. If something is unclear in a paper, it is wise to contact the author for an explanation before assuming the ambiguity is worthy of additional research.

3.4.6 Challenge Findings

If you believe some one else's result may be incorrect, you may attempt to disprove their results formally as your research effort.

3.5 Stating the problem—Famous First Words

In this section a large number of opening words are provided for the creation of research questions. Start off with one of these babies and you are on your way ;-)

- The current study investigates the relationship between . . .
- The focus of this study will be on . . .
- The main purpose of this study is . . .
- The objective of this research is to determine . . .
- The present study is designed to examine . . .
- The primary goal of this study is . . .
- The primary concern of this research is . . .
- The principal objective of this study is . . .
- The purpose of this study is to address the problem of . . .
- The purpose of the present study is . . .
- The purpose of this study is to advance understanding of . . .
- The purpose of this study is to determine . . .
- The purpose of this study is to develop a conceptual model . . .
- The purpose of this study is to evaluate . . .
- The purpose of this study is to explore the . . .
- The purpose of this study is to examine and better understand the effects of . . .
- The purpose of this study is to inventory . . .
- The purpose of this study is twofold. First, this study will assess the . . .
- This research concentrates on . . .
- The research problem for this study is to describe the . . .

- The specific objectives of the present study are . . .
- This study examines the relationships among . . .
- There are several reasons for inquiring into . . .
- This thesis explores the idea . . .
- This thesis will deal with . . .
- My thesis is...
- This investigation will explore . . .
- This investigation represents an attempt to address several . . .
- This paper is concerned with . . .
- This paper will focus on . . .
- This research represents an investigation into the problem of . . .
- This research represents an attempt to test the effectiveness of . . .
- This study examines . . .
- This study has two purposes . . .
- This study is concerned with . . .
- This study is an attempt to . . .
- This study is based on several assumptions . . .
- This study is designed to replicate...

3.6 Evaluating the problem statement

There is an associated checklist for creating a problem statement.

- Research statement written clearly.
- Problem stated in grammatically complete sentences.
- Problem has clearly stated limitations.
- Statement has potential for leading to important results.
- The statement will lead to the analysis of data.
- The problem is focused enough to lead to an answer with reasonable effort.
- Problem has been reviewed by someone else who provided feedback.

3.7 Caveat Section



Several years ago I attended a student conference involving many Engineering graduate students. One of the presentations I listened to was made by a former Engineering masters student who had recently graduated. The talk was titled something like “Fourier Methods for Resolving Antennae Noise”. Over the next 45 minutes he showed many slides indicating the different Fourier methods he had used to attempt to reduce the amount of intermittent noise that had been experienced in the signal of an antennae mounted on the CN Tower. Clearly, the student had done quite a bit of research and wanted to share it.

Not knowing much about Fourier methods, I started asking questions about the problem he was trying to solve. Eventually I asked which Fourier method yielded the best results? He seemed quite surprised at this question and responded with, “Why none of them. It

turns out the noise was being caused by a defective coax cable. Once that was replaced the noise disappeared.”

3.8 Assignment

Read the paper available on the web site: “Grand Challenges for Computing Research”.

Write a half page description of what area within Computer Science holds the most promise for you to find a research question to work on.