

The nature and tools of research in computer science

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1. The nature of research in computer science

The word research is originally from an old French word *recherche* which means to find out about something thoroughly. In science, research is defined as human activity based on various intellectual applications in the investigation of matter to discover, interpret, develop and extend the methods and systems of human knowledge on a wide range. Specifically, research refers to a systematic process, which involves a series of collection, analysis and interpretation of data (or information) to obtain more understanding of a specific matter or interesting phenomenon.

Computer science is about solving problems. That is to say, research in computer science is the systematic process related to the development of the algorithms and protocols required for automated processing and manipulation of data stored in a computer memory or transcribed in genes and protein structures of a human cell. For example, this includes how to create algorithms for improving the calculating efficiency of software.

Like research in other all areas, research in computer science is initiated with a question, problem or idea. To be more practical, the question or idea might be developed to a hypothesis, which is logical and reasonable. For example, whether a multithread program would run faster. Then, research requires a goal with a specific plan to achieve it. A complicated problem is commonly divided into several relative or consecutive subproblems. To improve the efficiency of software problem, for instance should be considered containing the former efficiency status, the reason why the efficiency is not satisfactory, methods to improve the efficiency and how the expected efficiency is. All types of research, including research in computer science, could not be conducted without collecting and interpreting

reliable data. Whats more, certain critical assumptions are acceptable if the researchers believe they are true. Research in those would finally find out their authenticity.

2. The research tools

Research tools contain all tools, strategies and mechanisms which could be applied to collect, analyze or interpret data. To choose which tools for research is decided by which research methodology researchers would employ. There are several prevailing research tools.

Firstly, the library provides almost available hard-copy and electronic resources for research, like books and online databases. People could have access to all kinds of resources all over the world by searching librarys internet. In recent decades, computer technology has become an important tool for doing research since software serves for searching, writing, calculating and analyzing. As we all know, reliable data and analyzing data are indispensable in all research projects. That makes measurement and statistics irreplaceable research tools. Measurements use valid instruments, reasonable questionnaires or surveys to obtain reliable data for analyzing. All research proposals, reports and publications should be written clearly and readable so that people could understand what researchers plan to do and they have done. Since English is used in many influential publication channels. In this condition, language is another significant tool to describe the goals, methods, procedures and results. Researchers are needed to write well in English no matter whether English is their mother language.

In addition, all researches should be conducted with all minds, which provide critical thinking, deductive logic, inductive reasoning, scientific methods, theory building and collaboration with others. Critical thinking suggests that researchers are needed to evaluate ex-

isting arguments rather than just accepting and using them. With deductive logic, research activities could be processed step by step since they initiate correctly and truly. Inductive reasoning is used to draw conclusions from observations and analysis for research. Scientific method and theory building compose the main parts of a specific research, which would impact the results and success of the research. Since researchers tend to difficult and interdisciplinary, it requires researchers communicate and collaborate with others. For example, fulfilling a project related to computer science, it may need experts in operating systems, algorithms and software engineering and others.

3. Things UTSA expert researchers told us

By interviewing with 13 expert researchers in UTSA, former PhD student wrote many interesting things about research and research tools. All professors highly recommended that reading and finding an interesting area are most significant when starting research. Reading is for knowing what people do and getting new problems and ideas. All experts used library, online resources and computer technology in their research, especially online searching, software and programs. Fifty percent of professors mentioned the importance of statistics in research. Measurements and language were just considered as important by 15% professors. That might results in that measurements are normally used together with statistics and they are used to write proposals and papers in English. These experts in computer science gained their expertise with their own secrets, such as learning from trials and errors, practicing many times to improve, attending training courses and self-study. Latex was mentioned as a great help by approximately 30% in the experts. Being an expert, each provides great advice to new researchers. Almost all experts believed that reading, thinking understanding and writing are the first principles for researchers. Doing big thing with realistic expectations were considered useful by 15% professors. More than 50% of them suggested that new researchers should practice as much as possible with great patience and persistence. Getting to know what people are doing and what the leading research is are recommended by about 40% of these experts in computer science. 30% of the professors asked new researchers to attend top conferences. Other great advices are like learning mathematics and

algorithms well, supporting others and being always creative and interested in research.

Among all these questions, there are four interesting questions and answers to me. First is when to publish the results. One professor suggested that we should publish until having solid experimental and analytical results with good experimental structure and analysis. Secondly, what to do when some new ideas come to mind? A professor said he would write down first and check with many different input to see whether it is practical and producible. Thirdly, which is the biggest challenge for research? One of professors said time is not enough is a biggest challenge. Another thought getting so involved in a single problem while could not think others is hindrance. Another interesting question is what kind of quality professors appreciate for new researcher in their team. Researchers with great performance in courses, hardworking and persistence are highly desired in their team.

4. Conclusion

Research is about finding and creating new things, especially in computer science. Researchers should think independently, read more, find problems to solve and find new solutions to big problems. To do research, they may utilize all kinds of available tools and resources, such as library and online resources, conveniences brought by the development of computer technology, measurement and statistics and collaborating with other minds. UTSA expert researchers presented many beneficial suggestions and advices to new researchers. Among all, understanding what you know, what you need do and what leading researchers do are critically significant in computer science area. They recommended great research tools in relative area like software, programs, online searching, source code and communicating with others. For us new researchers, I believe it means a lot that independent critical thinking, hardworking and problem solving abilities.