

BASIC TOPICS IN EXPERIMENTAL COMPUTER SCIENCE

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Abstract

Computer science has an experimental scientific aspect—like every other science. Experiments are made with suitable computer programs in order to discover facts. The programs are usually not applications but specialized to the scientific problem being investigated. It is a mistake to divide computer science simply into *theoretical* and *applied* parts. Basic computer science has both theoretical and applied parts. Applied computer science certainly has an experimental part, and presumably it has a theoretical part also.

We wouldn't expect to have to tell you this.

Unfortunately, many computer scientists and other people divide computer science into *theoretical* and *applied* computer science, leaving no place for basic experimental work.

This report describes basic experimental work in several domains of computer science.

1 Introduction

Some computer scientists and some computer engineers mistakenly identify basic research with theory and applied research with experiment. A recent report by the National Research Council **Academic Careers for Experimental Computer Scientists and Engineers**¹ [Cou95] was particularly bad about this. All the experimental work mentioned was explicitly applied, i.e. in support of specific applied projects. This may have something to do

¹<http://www.nap.edu/nap/online/acesc/>

with the persistent tendency of that body to deny any distinction between science and engineering in computing.

However, computer science also has an important basic research experimental component, and our object is to describe some of this work enough to show the important role experiment plays in basic computer science research.

At present this is only an outline.

Here are some topics:

search Richard Korf (korf@cs.ucla.edu) will write a section on this.

game playing Turing proposed a chess program in the 1940s, and recently Deep Blue had a match with the world champion. The experimental chess programs have taught a lot about heuristics and what computational abilities are required to match human performance. The failure to make good Go programs illustrates that we still don't understand how to make a program that breaks a situation up into components that can be analyzed separately at first, following this by an analysis of their interaction. Jonathan Schaeffer of the University of Alberta, (jonathan@cs.ualberta.ca) has written about the role of experiment in game playing. There are **html**² and **postscript**³ versions.

automatic theorem proving Again the experimental work has shown us the strengths and weaknesses of various theoretical ideas. Alan Bundy (bundy@edinburgh.ac.uk) has already finished a draft. It is Experimental Work in ATP⁴.

planning Most of the research in planning under uncertainty has a strong experimental component. Subbarao Kambhampati (rao@asu.edu) has agreed to write about this.

experiments with NP-complete problems Problems that are NP-complete in general are often much easier in the average case. This has been explored experimentally, and a phase change phenomenon between cases with many solutions and cases with no solutions has turned up. This seems to be analogous to phase changes in physics.

²<http://www.cs.ualberta.ca/~jonathan/Papers/expcs.html>

³<http://www.cs.ualberta.ca/~jonathan/Papers/expcs.ps>

⁴http://www.dai.ed.ac.uk/staff/personal_pages/bundy/mccarthy.ps

Bart Selman (selman@research.att.com) will write about experimental study of NP-completeness in AI including phase transitions, search and reasoning.

Andrew Goldberg (avg@research.nj.nec.com) has written about experimental algorithms. We have **html**⁵ and **.ps**⁶ versions.

Actually Goldberg and Selman will divide up their topics in a way they will shortly specify more precisely.

natural language Fernando Pereira (PEREIRA@RESEARCH.ATT.COM) will write about experimental research in natural language.

vision Tom Binford (binford@cs.stanford.edu) will write about vision.

neural nets Jordan Pollack (pollack@cs.brandeis.edu) will write about neural nets and evolutionary programming.

connectionism Geoffrey Hinton (hinton@cs.toronto.edu) will write about connectionism. Hinton dropped out for lack of time, so we need someone to write about connectionism.

machine learning Tom Dietterich, TGD@CS.ORST.EDU has written about experimental research in machine learning. We have **.html**⁷ and **gzipped postscript**⁸ versions.

References

[Cou95] National Research Council. Academic careers for experimental computer scientists and engineers, 1995.

⁵<http://www.neci.nj.nec.com/homepages/avg/jmc/alg-perf.html>

⁶<http://www.neci.nj.nec.com/homepages/avg/jmc/alg-perf.ps>

⁷<http://www.cs.orst.edu/~tgd/experimental-research/index.html>

⁸<ftp://ftp.cs.orst.edu/pub/tgd/papers/experimental-research.ps.gz>