Should Computer Scientists Experiment More?

By Walter Tichy

Presented by Hazel Asuncion

Outline

- Is Computer Science a Science?
- Why should we experiment?
  - Eight fallacies exposed
- Why substitutes won’t work
- Inherent problems with experimentation

Is Computer Science a Science?

- No, an engineering discipline (F Brooks)
- Yes, much more than synthetic results
  - Study of info structures & processes
  - Synthetic results (computers & programs) are models
  - Difference: work with information – neither energy or matter

Why should we experiment?

- Theory testing and exploration
  - Theory falsification
  - Knight and Leveson experiments
- Aid with induction or theory derivation
  - exploration

Eight Fallacies Exposed

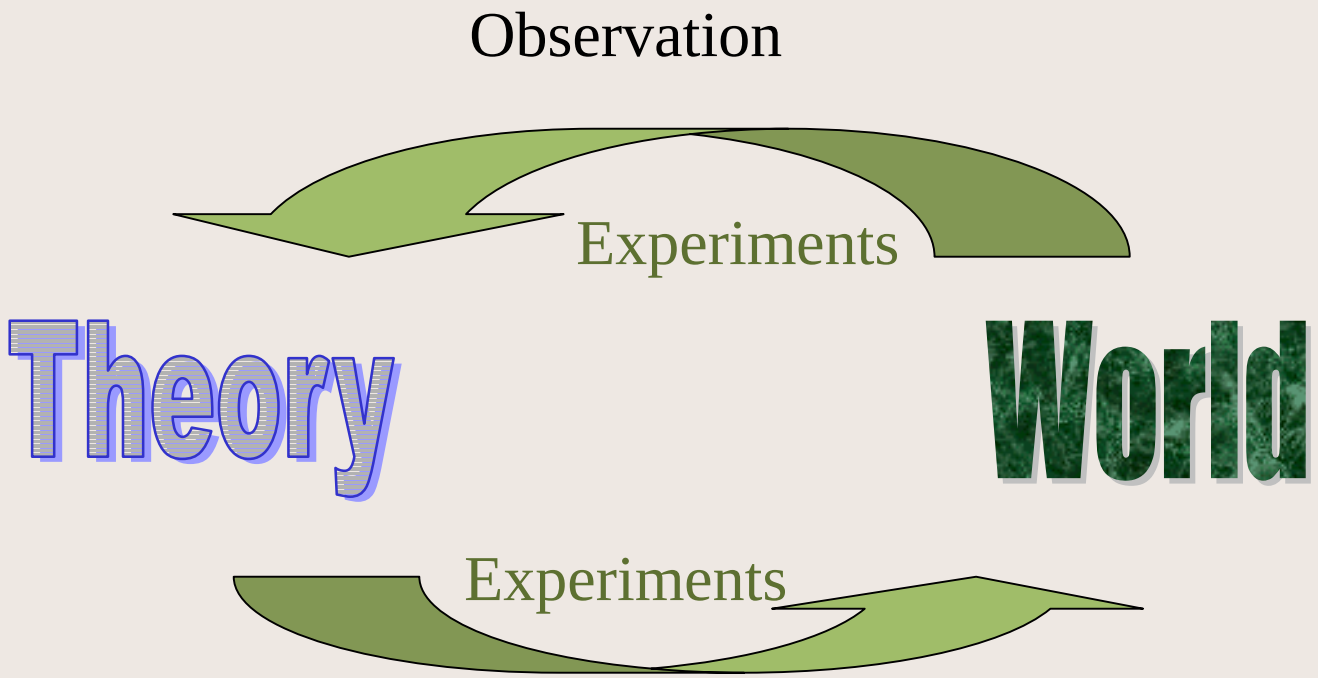
- Traditional scientific method isn’t applicable
- The current level of experimentation is good enough
- Experiments cost too much
- Demonstrations will suffice
- There’s too much noise in the way
- Experimentation will slow progress
- Technology changes too fast
- You’ll never get it published

Eight Fallacies Exposed (#1)

Traditional scientific method isn't applicable

- *Rebuttal: To understand info processes, computer scientists must observe phenomena, formulate explanations, and test them. This is the scientific method.*
- Repeatability

Eight Fallacies Exposed (#1)



Eight Fallacies Exposed (#2)

The current level of experimentation is good enough

- *Rebuttal: Relative to other sciences, the data shows that computer scientists validate a smaller percentage of their claims*
- Balancing theory and engr with experiment
  - Build reliable base & reduce uncertainties
  - Leads to new areas of investigation where engr progress is slow
  - Accelerate progress by pruning fruitless approaches

Eight Fallacies Exposed (#3)

Experiments cost too much

- *Rebuttal: Meaningful experiments can fit into small budgets; expensive experiments can be worth more than their cost*
- Constrained by cost
  - Plan appropriate research programs
  - Look for affordable experimental techniques
  - Intermediate steps with partial results
- Experiments in the industry
- Experiments in other areas
  - Pharmaceuticals, aeronautics, biology

Eight Fallacies Exposed (#4)

Demonstrations will suffice

- *Rebuttal: Demos can provide incentives to study a question further. Too often, however, these demos merely illustrate a potential*
- Proof of concept
- No solid evidence
- Require clear question, experimental apparatus to test the question, data collection, interpretation, sharing of results

Eight Fallacies Exposed (#5)

There's too much noise in the way

- *Rebuttal: Fortunately, benchmarking can be used to simplify variables and answer questions*
- Benchmarks
  - allow repeatable and objective comparisons
  - Aids in identifying promising approaches and discarding poor ones
- Experiments involving humans also repeatable

Eight Fallacies Exposed (#6)

Experimentation will slow progress

- *Rebuttal: Increasing the ratio of papers with meaningful validation has a good chance of actually accelerating progress*
- Good conceptual papers will continue to be published
- Need to get beyond assertion

Eight Fallacies Exposed (#7)

Technology changes too fast

- *Rebuttal: If a question becomes irrelevant quickly, it is too narrowly defined and not worth spending a lot of effort on.*
- Probe for fundamental and not the ephemeral

Eight Fallacies Exposed (#8)

You'll never get it published

- *Rebuttal: Smaller steps are still worth publishing because they improve our understanding and raise new questions*
- Non-theoretical journals and conferences accept papers on solid experimentation
- Respectable experimentalists articulate how their systems contribute to our knowledge

Why Substitutes Won't Work

- Feature comparisons vs formulation of models, hypothesis and tests (experimentation)
- Intuition – good starting point but need solid evidence as backup
- Experts – don't always present evidence; maintain healthy skepticism

Inherent Problems with Experimentation

- Competing Theories
  - Weak reasoning gives way or combines with other theory
  - Rarely produce falsifiable theories
- Unbiased Results – involve managers and other decision-makers

Discussion

- Do you agree that we should experiment more?
- Are there weaknesses in his arguments?
- How can we empirically collect data and ensure that variables are controlled?
- Why does Computer Science have the word "Science"?