What Makes Good Research in Software Engineering?

Structured Testing: A Software Testing Methodology Using the Cyclomatic Complexity Metric (McCabe 1982)

Quick Overview
- Introduction to the Cyclomatic Complexity Metric
- Fundamental idea behind CCM
- What CCM addressed
- Research techniques used
- Testing research time line

Cyclomatic Complexity Metric
- \( V(G) \) of a graph with \( n \) vertices and \( e \) edges.
- \( V = e - n + 2 \)
- In this example the \( V = 5 \)

Creating Test Paths
- Start with a “baseline” path through the program.
- Identify a second path by switching the first choice while keeping as many of the previous choices as possible.
- Next, reset the first choice and flip the second choice, while keeping as many of the decisions as possible...
- Continue...
  - ABCX
  - # (any char but A)
  - ACX
  - ABX
  - ABC (any char but X)
**Solution Technique**

- \( V \) identifies the number of test cases needed to test a program. If the number of test cases is less than:
  - more test can be added
  - complexity can be reduced
  - portions of the code can be made to be in line code.
- Keep the complexity of the program at \( V < 10 \)
- Complexity can be reduced by “modularizing”.

**Problems Facing CCM**

- Defensive programming, Hardware mistrust, and Fault Tolerant programming.
- Branching in maintenance (see below)
- Event driven programs (not addressed in 1982)

**Solutions for a real world**

- The cause behind errors is that inherently programs and their testing are complex.
- To avoid problems, limit program complexity.
- Through graph theory, it is shown that every statement/decision is tested.
- Through post-implementation studies, it is shown that less complex code has less errors.
Pro Forma Abstracts

- Existing software metrics have shown deficiencies in addressing complexity. The CCM model is described, capable of providing more accurate analysis of complexity in software. The model has been shown with post-analyzed of successful software to hold true.

- Existing decomposition methods are deficient in dealing with complexity. An enhanced method using the CCM is described that reduced the complexity of the modules. The method has been shown using the CCM to produce less complex programs than previous methods.

- Existing testing techniques are deficiencies in systematic test path selection. An enhanced solution using the CCM is described that provides a systematic way of selection test cases. The method has been shown through graph theory to traverse each decision and each line.
Evolution of Testing

1956
- Turing: Proof of correctness '49
- Baker: runs and solves the problem '57
- 1960
- 1970
- 1980
- 1990
- 2K
- ANSI/IEEE Standard '84
- McCabe: CCM '82
- Myers: finding errors '79

The End – Questions?