GUEST EDITOR’S INTRODUCTION

This volume contains the proceedings of the colloquium, “Science and Engineering in Software Development: a Recognition of Harlan D. Mills’ Legacy”, held in Los Angeles, California on May 18, 1999. The one-day colloquium acknowledged the contributions of Dr. Harlan Mills to the theory and practice of software engineering and their widespread application to the emerging challenges in software engineering.

Dr. Mills’ contributions to software engineering were numerous, but a few should receive special note. The most pervasive theme of his work was to devise and promulgate methodology that would support the intellectual control of software product development. Within the industrial environment, this was realized through the deployment of formal methods, the blending of best practice into the total software lifecycle, and the introduction of technical management standards focused on zero-defect product quality. To ensure that the software engineer would be equipped for this challenge, he devoted his energy to advancing education in software engineering, both in academia and industry. The proceedings attempt to capture these contributions in a short article recounting the legacy of Harlan Mills.

The goal of the 1999 colloquium was to bring together members of the software engineering community and share experiences on the application, adaptation, and extension of Mills’ work in their professional careers. It is hoped that this will be the first of an annual event so that these contributions can continue to flourish for the betterment of the software industry. To that end, a special award, the Harlan D. Mills Practical Visionary Award, has been established to be presented to a person who has excelled at promoting and extending these ideas into the development workplace.

These proceedings contain the texts of five papers delivered at the colloquium. These papers were selected by referees from a larger body of submitted articles and were judged on their own qualities and for their relevance to Dr. Mills’ ongoing contribution to software engineering.

The first paper, entitled “Coupling and Strength, a la Harlan Mills”, discusses an underlying theme of Mill’s work of emphasizing function over algorithm that naturally lead to the fostering of modularity in software. Building on this idea, the paper introduces the method of message tables for documenting the design of functionality and data flow among modules. The paper includes worked-out simple examples, noted that the approach has been successfully used from the design through testing of software, and discusses its applicability for defining improved measures of module coupling and strength.

The second paper, entitled “Developing Black Box Specification through Sequence Enumeration”, discusses Mills’ significant contribution to the management of requirements for software products, the box structure methodology. The “black box” specification can provide an arguably complete, consistent, and traceable specification for a software product that accurately represents the desired external system behavior. The paper provides a detailed discussion of sequence enumeration is a powerful technique for creating and managing such specifications.

The third paper, entitled “Partition Testing with Usage Models”, discusses an extension of the software testing ideas promoted by Mills, namely the use of
statistical based testing methods that would allow the making of statistical inferences about software quality. The paper discusses the application to software testing of a fundamental strategy in statistics of improving sampling efficiency by partitioning the sampling population. Usage models that underlie much of the methodology in the statistical testing of software support many strategies for automated partitioning and for generating software test cases from a partitioned sampling population. Two specific strategies are discussed in this paper with a demonstration of the efficiency gains in sampling from each strategy.

The fourth paper, entitled “Applying a Generalization of a Theorem of Mills to Generalize Looping Structures”, describes some ongoing research into the mathematical underpinning of software structures that was key to Mills’ tenet that correct software could be routinely constructed. The research uses a generalization of a theorem by Mills, known as the while statement verification rule, and applies it to three forms of looping structures that have been proposed in the software literature. The paper reports on the results of the initial research that indicate some advantage to iterative forms of looping structures - an advantage that has been mostly ignored by the formal programming community.

The fifth and final paper, entitled “Application of Statistical Science to Testing and Evaluating Software Intensive Systems”, discusses how well statistical methods address the complexity of software testing and how they provide a mathematical underpinning to what was a heuristic based validation practice. The paper describes how statistics provides a structure for collecting data and transforming that data into information that can improve decision making under uncertainty. Statistical testing of software should not be viewed as just the use of randomly generated test cases, but rather as the comprehensive application of statistical science to the total problem of software testing. The paper discusses the roles that statistical methods can play in population characterization, sampling, inference, design of experiments, etc. and the benefits realized.

It is hoped that these proceedings will shed some light on the breadth and scope of the contribution that Harlan Mills made to the field of software engineering. It is also hoped that the proceedings reflect how Mills’ work continues to spawn further research and practice to establish software as an engineering science. As he was so often heard to remark, “when the science of geometry was just 25 years old, the ancient Egyptians hadn’t discovered the right triangle, so we have a ways to go in formulating a software science”.

In editing this volume, we have been helped by many others, and would like to take this opportunity to thank them all. Specifically, our thanks and appreciation go first to the contributors for their work in preparing and revising the manuscripts, then to the organizers of the colloquium, and finally to all who participated in the colloquium.

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