

Bi-immune Sets, Reducibilities, and a Question of Complexity

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Let \mathcal{C} be a complexity class. A recursive set A is \mathcal{C} -immune if no infinite subset of A is in \mathcal{C} . The set A is \mathcal{C} -bi-immune if A is \mathcal{C} -immune and \bar{A} is \mathcal{C} -immune. We present hierarchy theorems for deterministic time and space complexity classes that show we can separate traditional complexity classes by bi-immune sets with a very “thin” band of complexity. That is, the lower bound acceptance for all but finitely many instances and the upper-bound complexity are separated by a relatively small ϵ -value.

In a very real sense, these bi-immune sets are the “hardest” sets in a given complexity class. We examine some of the properties of these sets, and we show that these sets defy classification using standard complexity measures. In particular, we show that it is possible for bi-immune sets of equivalent complexity can lie within different $\equiv_{\mathcal{C}}^{\mathbb{P}}$ degrees. Finally, we discuss alternative approaches to capturing the complexity of these sets and current research on describing these sets.

Education

- Ph.D.** (1987) Computer Science, Iowa State University, Ames, Iowa
Ph.D. Dissertation: *On the Structure of Intractable Sets*
Thesis Advisor: Alan Selman
- M.S.** (1979) Electrical Engineering, Iowa State University.
- B.S.** (1974) Computer Science, Iowa State University.

Experience

1994 – Present

Department Head, Department of Computer Science (2007 --)

Administrative responsibility for all facets of the computer science program, including budgeting, class scheduling and staffing, program assessment, student recruitment, retention, and placement assistance. Led the ABET accreditation of the Computer Science Degree.

Director of Computer Science (1995-2007)

Led the design and implementation team for a new computer science degree program and curriculum. Created the Computer Science Directorate, led the recruitment of faculty, and the creation of the Computer Science laboratories and department

Associate Professor of Computer Science and Mathematics (1994-2008)

Primary areas of teaching: Object-Oriented Programming; Design and Analysis of Algorithms; Discrete Mathematics and Logic; Software Engineering; Theoretical Computer Science.

Primary areas of research: Computational Complexity; Foundations of Computer Science; Mathematical Logic; Software Engineering

1987 – 1994

Assistant Professor Computer Science, Michigan State University.

Graduate teaching: Design and Theory of Algorithms; Foundations of Computing; Computational Complexity, Software Engineering.

Graduate seminars: Cryptography; Denotational Semantics; Recursive Function Theory.

1977 – 1987

Systems Manager, Iowa State University Computation Center.