Research Summary for Nirav B. Shah

1994-95
"Use of Infrared Sensors to Regulate Energy Usage in Homes"

Student Energy Research Competition — First Round Winner
Presented in Albany, New York to the New York State Energy Authority and the New York State Energy Office
Presented at Student Research Support Program in Computer Science and Mathematics
N.B.: I completed this project with a partner.

Programmed and designed a system to control temperature and electricity using an EXPLOR-32a microcontroller. Involved reading input from both analog and binary sensors, e.g., temperature (analog) and occupancy (binary), and then adjusting the temperature and other appliances accordingly.

"Mersenne Prime Generation Using the Lucas-Lehmer Test"

Long Island Al Kalfus Math Fair — Silver Medal

Discovered an optimization of the Lucas-Lehmer test that increases performance by 10%. The Lucas-Lehmer test is used to determine the primality of large Mersenne numbers.

1995-96
"The Development of a Lattice Gas Cellular Automata System for a Shared Memory MIMD Parallel Computer"

This research was supported by the National Institute of Health's K-12 Teachers and High School Students Program
Long Island Science and Engineering Fair — Semi-Finalist
Long Island Al Kalfus Math Fair — Gold Medal
Lea Ronal Invitational Science Fair — Highest Honors and First Place

In this paper, a unique implementation of a Lattice Gas Cellular Automaton is presented. This implementation is unique because it is designed to run on a shared memory MIMD parallel computer as opposed to the more conventional SIMD computer. The basic algorithm for the automaton, which is based upon the CAM cellular automata machine, is discussed first. Then a variety of different graphical displays for the automaton in the square, hexagonal, and cubic paradigms are proposed (Graphics in X, SRGP, and OpenGL are discussed). Having developed a working model for the MIMD machine, a simple yet flexible user interface for the lattice gas is designed and demonstrated. The model is analyzed by discussing a variety of examples of the model's use as well as further optimization of the basic algorithm. This research was done at Brandeis University through its Summer Odyssey Science Research Internship program under the guidance of Dr. Timothy Hickey (tim@cs.brandeis.edu).

"The Smell of Cellular Guidance and Homing"

Toshiba / NTSA ExploraVision - The purpose of this competition is to encourage students to combine their imaginations with the tools of science and technology to create and explore a vision of the future.
N.B.: I completed this project with a group of three other students.

In the future, it will be known that certain cellular responses are triggered by a mechanism similar to that of smell. Also, certain specific smell response generating molecules will be identified and then reproduced on a mass scale. Some examples of such olfactory responses and their associated stimuli will include (1) a molecule that the ovum releases to attract sperm and (2) a molecule released by cells at the site of infection that would attract white blood cells to the area of infection. It is theorized that these interactions are based upon smell responses for several reasons. It would explain the mechanism by which fish sperm locate fish eggs despite the ever-changing conditions encountered during external fertilization. Furthermore, the mechanism by which white blood cells migrate to the site of an infection would also be explained by this theory.

1996-97
"Three Dimensional Interval Graphing: Issues, Methods and Techniques"

Presented at Student Research Support Program in Computer Science and Mathematics
Westinghouse Science Talent Search
Long Island Science and Engineering Fair
Metropolitan New York Junior Science and Humanities Symposium — Finalist
Lea Ronal Invitational Science Fair
Long Island Al Kalfus Math Fair — Gold Medal and Westinghouse STS Award

With the advent of faster, more efficient computer algebra systems, the implementation of 3-D honest plotting through interval arithmetic has become a reality. The purpose of this paper is to provide a foundation for future work in this form of scientific visualization. First, the issues involved in developing scientific visualization systems for plotting such data are defined. Then, a series of different visualization methods and techniques that attempt to deal with those issues are described. Finally, the presented methods and techniques are evaluated in terms of plot accuracy and user interface through a series of case studies. This project was done at Brandeis University through its Summer Odyssey Science Research Internship program under the guidance of Dr. Timothy Hickey (tim@cs.brandeis.edu).

1997-98
"Non-trivial Choice: A case study in investment choices"

This project is being conducted at the Sloan School of Management, Massachusetts Institute of Technology under the direction of Dr. Sheena Iyengar (sheena@mit.edu) through the Undergraduate Research Opportunities Program

Choice is one of the fundamental factors in the workings of organizations today. If one has an understanding of the role of choice and its impact on people both in a general sense and in terms of future choices, one can take advantage of a person's ability to make decisions.

Much of the previous work done in this field has focused on trivial or non-existent choices, such as which flavor of jam to eat or numbers in a lottery. From this work conclusions have been made about the method by which people make choices. It was then inferred that these conclusions also apply to less trivial choices. There has been lack of studies on the process and effects of making non-trivial choices. One possible reason for this is that it is much more difficult to study non-trivial choice, because if the condition being studied has a negative impact on the subject, that impact will be just as non-trivial as the choice. For example, it is easy to duplicate the trivial choice condition (e.g. choosing a game to play), by providing a list of non-trivial choices (a fork in the road on a hike); however, if one wished to duplicate the no-choice condition (giving the subject a game to play), it would be difficult, since the subjects would most likely question why that choice is being made for them.

The preceding example leads us to the first possible difference between trivial and non-trivial choice, i.e. when faced with a situation in which a non-trivial choice has been made for them, subjects may be more likely to question the choice (e.g. if college students are randomly assigned seats in an auditorium, they are much less likely to object, than if they are randomly assigned classes). Some of the other conclusions drawn about trivial choice may not apply to non-trivial choice. For example, it is commonly believed that, to an extent, more choice is better than less choice. This may be true for a trivial choice such as ice-cream flavor, but may not be true for a non-trivial choice such as choosing stocks.

The current study attempts to analyze the decision process associated with non-trivial choice by close observation of the participants in a stock market trading game. The participants, all MBA students, are given $100,000 to invest. Their choices are closely monitored and they are asked to keep a record of their decision processes. Their aggregate behavior as well as their personal trading logs are then analyzed in an attempt to understand the underlying decision processes being used by the participants.