**STUDENT PAPER SESSIONS**
**Friday, November 22, 2002**

**Session I** – Hemenway Hall 212

5:00 - 5:10 p.m. **Relating Cellular Automata to Determining Patterns in Brain Functions**
Lisa Balducci, Framingham State College

Can brain functions be transposed to the computational model of cellular automata? The fundamental concept of CAs has been used to predict weather patterns; to explain the Game of Life, which captures life, birth, growth, evolution, and death; and in the Ant program, which displays the simulation of an ant to analyze the varied patterns marked out by its wanderings. This paper will present these examples, relate them to brain functions, and briefly survey the history of cellular automata.

5:15 - 5:25 p.m. **Speech Recognition: Theory and Design**
George Mechael and Azmy Sukkoor, Framingham State College

Speech recognition is a process of converting an acoustic signal to text. The knowledge-driven model requires word and syntax level knowledge to identify a word from the sound. An alternative approach is based on auditory perception and modeled after humans' tendency to automatically categorize speech sounds. Unlike knowledge driven systems, phonetic recognition is user independent. This paper will discuss speech input, prefiltering, feature extraction, comparison and matching techniques, and the basic concepts in probability theory used in speech recognition.

5:30 - 5:40 p.m. **Neural Networks and Parallel Computing**
Amuche Onyemelukwe, Framingham State College

Bottom-up theorists in artificial intelligence seek to build electronic replicas of the human brain's complex networks of neurons. This paper explains that approach and relates the workings of the human mind to Boolean logic. It discusses artificial neural networks as computational prototypes that implement simplified models of their biological counterparts. Three levels of such network units are presented, along with the notion of learning as the alteration of the effectiveness of synapses that join neurons, and the calculation of error derivatives by the backpropagation algorithm. A review of the contributions of McCulloch and Pitts to neural-network theory, using earlier theoretical work by George Boole, is included.

5:45 - 5:55 p.m. **Taylor, Maclaurin, and Polynomial Approximations**
John Meany, Framingham State College

Taylor and Maclaurin made contributions to mathematics beyond those of series and function approximations. I will present a brief history of their contributions to mathematics as well as a discussion of those who contributed to the development of polynomial approximations.

**Session II** – Hemenway Hall 307

5:00 - 5:10 p.m. **Maximizing Products of Partitions**
Brian Bayerle, Providence College

For any positive integer $k$, we define a partition of $k$ to be a set of positive integers whose sum equals $k$. We define the product of a partition to be the product of the elements of the set. A maximized partition is the partition of $k$ whose product is maximal among all partitions of $k$. This project investigates properties of products of partitions, including maximized products, and maximized products with respect to the size of their partition. General rules, equations, and algorithms will be discussed. Results include partitions extended to the rational and real positive numbers.

5:15 - 5:25 p.m. **The Babylonians Had It First**
Mike Lopez, Bates College

This paper will focus on the Babylonian culture's derivation of floating point arithmetic in ancient history. I will discuss the basics of sexagesimal notation and how the Babylonians came up with one of the world's most important and fascinating number systems. I will conclude with how this culture found a close approximation to the square root of two, something that more "civilized" cultures down the road struggled to do.

5:30 - 5:40 p.m. **Complex Numbers and Geometry**
Rebecca Keleher, Eastern Connecticut State University

The topic of my senior honors thesis is complex numbers, specifically, their use in proving geometric theorems. This method, one that is not typically used in the United States, is useful in creating simple, yet elegant, proofs. I intend to present the portion of my thesis that involves areas of figures and rotation of vectors. The purpose of my thesis is to bring attention to this technique as a supplemental method of geometric proof that can be taught at both high schools and universities. Technology can also be used a s a method of instruction with this approach.

**Session III** – Hemenway Hall 305

5:00 - 5:10 p.m. **Periodic Doubling Bifurcations of a Periodically Forced Biological Oscillator**
Jason White, Bates College

According to Glass, et al. (1984), there is convincing evidence that certain types of arrhythmias exhibit chaotic dynamics. Using techniques including finite difference equations, Fourier transforms and Poincare maps, the heartbeats can be modeled and problems can be predicted. When someone with a heart problem exercises the heart rate normally hastens, however occasionally the heart starts beating at abnormal intervals, and chaos has set in. Experimental results have been successful in obtaining results that fit known complicated mappings such as Poincare maps. In this paper I explore the mathematics behind chaotic cardiac rhythms and discuss how the mathematics can aid doctors and researchers in their study of the heart.

5:15 - 5:25 p.m. **Nonlinear Problems Inspired by the Millennium Suspension Bridge**
Ron Pepino, University of Connecticut

In the beginning of the year 2000, a new pedestrian suspension bridge was opened in England in order to celebrate the millennium. There was a large party held on the bridge for its opening. The bridge started to exhibit rather alarming oscillations in the horizontal plane. This puzzled many, and the bridge was shut down two days after its opening. In this talk I will present the work of Joe McKenna, Cory Merow, and myself on just how such an occurrence could have happened and why the possibility of the episode might have been overlooked. The result of running several numerical experiments showed that the peculiar geometry of the system might be the cause of unpredictable nonlinear phenomena such as solution-dependent initial conditions, which (along with a coupling of the degrees of freedom) might have been overlooked in the engineer's models. The method for extracting information from our derived nonlinear system that represents the Millennium Bridge will be explained and the data from the numerical experiments will be presented to support our claim.

5:30 - 5:40 p.m. **New Variables in the Coupon Collector's Problem**
Erin LeDell, Trinity College

The Stein-Chen Method is a valuable and powerful technique for approximating the distribution of a random variable. Using this method, one can establish an upper bound for the error. This error defines the accuracy of the approximation.
We have devised suitable "couplings" which allow us to apply the Stein-Chen Method to several random variables defined in the Coupon Collector's Problem. Further, our results have shown that the distribution of these variables is approximately Poisson.