PROJECT TITLE: Exploring Patterns and Re-inventing Numbers.

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Project Description

An awareness of mathematical structure and pattern recognition are crucial to mathematical competence. I am proposing a variety of projects involving pattern recognition and further examination of the body of mathematical objects observed through a certain mathematical operation. This will allow students the opportunity to acquire active knowledge of the structure of various sets that possess similar underlying characteristics. I am proposing a collection of projects for students to select from. Some such projects will involve the concepts of operation modulo, translation, reflection, and rotation operations of Triangle, and Permutations.

Ideally, the student must have the minimum mathematical background of College Algebra. The level and scope of these projects can be adjusted to the level of competence and interest of students. I will meet with students and introduce them to the concepts, and provide examples. As an example for the concept of modulo operation, that is fundamental to computer programming, cryptography etc., students will start by observing patterns of \( \mathbb{Z}_4 \), \( \mathbb{Z}_4 \), etc., and in later stages they will explore interesting properties of numbers at higher levels. The beginning levels of the projects require only paper, pencil, and a basic calculator. Eventually wolfram alpha or MATLAB could be used to analyze interesting patterns in bigger numbers. To provide an example, how do you write 2,490,808,320 using solely the digits 1, 2, 3, 4 exactly once?

The student selected for the project will have the opportunity to work independently in our research facility, following guidelines provided to them, and meet with me regularly.

The student must commit to 40 hours of research effort per week. Students must
have a notebook and weekly activities must be documented in it. Reading materials will be provided and students are expected to write a report, or solve problems in detail etc. These assignments will lead towards the analysis of results, pattern recognition, and categorizing various sets of objects into various groups that possess similar characteristics.

Graphing calculator or computer software will be used in the end, and I will assist students with the technology tools as needed. Students are not required to buy any software since I will be using software that are already available for student and faculty uses. Students are required to meet with me two hours per week in the beginning and the number of face-to-face contact hours may increase with the progress of the project.

You are not required to be present on campus all the time, however, our undergraduate research office is available for you if you choose to work on campus.