Byrne Seminar
Learn To Do Art With Software That Turns Equations Into Colorful Images

FIVE SESSIONS IN COMPUTER LAB Plus PIZZA
January 21 - February 18, 2016

Spring Semester 2016, 1 Credit, Pass/No Credit (PA/NC)
Course Number: 01:090:101 section 35 index 18111

Creating 2D and 3D Innovation with Polynomiography

Instructor: Bahman Kalantari, Professor of Computer Science, Rutgers University
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Location: ARC (Allison Road Classroom Building), Rm 116 - BUSCH Campus

Seminar Description: Through a unique software, called Polynomiography (now several apps are also available on Apple Store under the name Poly-z-Vision), you will be introduced to a fantastic and very powerful visualization medium, easy to use, where polynomials turn into 2D and 3D objects that can be used to create artwork of diverse types, to invent games, and to discover many new concepts as well as creative and innovative ideas that can be applied to many subject areas. Students of Polynomiography courses have found its applications in many fields of study: art, math, computer science, dance, linguistics, psychology, physics, chemistry, architecture, cryptography, and more. Working with Polynomiography software is similar to learning to work with a sophisticated camera: one needs to learn the basics, the rest is up to the photographer.

Goals: To introduce students to polynomiography, its foundation, and its software. Each student will have access to a computer and the software and will produce images in each of the lectures. Bring a Memory Stick to save your images. The goals of the course are: to have fun, to gain new insights into math of polynomials, their visualizations and connections with art, to learn the role of computer algorithms in polynomiography and how it creates 2D images from
a polynomial equation, to learn the math of polynomials and techniques in polynomiography in order to make interesting art, to be creative and innovative, to learn about other possible auxiliary software that can complement polynomiography images to make new artwork such as 3D art. Students are encouraged to be creative and innovative and to think of ways to make interesting art and design or to find interesting applications. Some reading material will be provided.

**Requirements:** Students must attend all classes, participate in class, be willing to learn and experiment with the software, be creative and innovative, think of ways to create 2D and 3D art based on polynomiography, and think of a project connecting the subjects learned in the seminar to a field of their interest, e.g. art, math, science, games. There are also several related apps available on Apple Store under the name Poly-z-Vision. If you have iPhone or iPad you can download at least the free version of the app.

**Project:** Write a formal 5 page paper that describes your experimentation with polynomiography towards the intended goals and requirements of the course. Joint student projects are possible and will be discussed in the lectures.

**January 21:** Did you say you don’t care for polynomials? Students will be introduced to polynomiography and its software, they will learn to run the software and generate many interesting images during the first lecture. Students will use polynomiography to learn some new and fancy math, and then use these as techniques to make some fancy art. Students will be encouraged to give feedback and think of their project starting from this first lecture.

**January 28:** Think of polynomiography as a combination of and a tool for fine art and science. Polynomiography is like photography, the polynomiographer has access to a tool - the software - with different settings and choices for selecting a polynomial equation and methods from which images are rendered. There is much room for personal creativity - you be the polynomiographer like photography, learning techniques is important. Students will learn various techniques in selecting a polynomial, selecting a method, adjusting colors and other parameters to render an image (polynomiograph). They can also invent their own techniques. Will show previous student experiences and projects based on polynomiography. Students will learn the basics of polynomiography software. Students are encourage to give feedback in class and informally discuss what projects they want to consider.

**February 4:** How does polynomiography work? Learning the deeper foundation of polynomiography, the dual nature of points and numbers. A point or a dot in the Euclidean plane is a complex number and a complex number is a dot in the plane. Learning elementary operations on complex numbers and their corresponding geometry. Solving a polynomial equation is
a game of hide-and-seek with dots on a canvas. The historical significance of solving a polynomial equation, the famous fundamental theorem of algebra. Iterative method to solve equations: Newton’s method and fixed point iteration. The limitations of the high school quadratic formula and why iterative methods are needed. How to explore the iterative methods to the benefit of art-making. Learning about fractals and connections with polynomiography, different types of fixed points, creating fractal polynomiographs. Playing with polynomials.

**February 11:** What have you learned? What projects have you considered? What progress have you made? What artwork have you created? Where do you think polynomiography can go? Why do you think are polynomials important in science and math? Do you thing polynomials could also be important in art? What lies beyond polynomials?

**February 18:** Each student will have five minutes to present his/her project in an informal way. The instructor and other students will critique the project and students will make use of this opportunity and the commentary in the preparation of the final five page paper, to be handed out at an informal meeting over a pizza the following week.

Sample student projects and artwork: While these are based on 3-credit courses (SAS-Horns Course or summer projects where students had more time than the students of Byrne Seminar, they demonstrate diversity and richness in the use of Polynomiography-related projects:

- Ecology and Polynomiography: Nature and Technology
- Bridging the Brains Hemisphere through Polynomiography
- Simulating Neuroscience Through Visualization with Polynomiography
- The Transformation of the Julia Set in Polynomial Root-Finding
- Making Math Fun: Potential Uses for Polynomiography in Special Education
- Calculating Bach by Appreciating Polynomiography
- Art Inspired by Math?! Are You Kidding Me?
- Integrating Polynomiography into the World of Games
- An Experimental Fusion of Music and Polynomiography
- Polynomiography and Chemistry
- Polynomiography and Electric Fields
- Polynomiography and Linguistics
- Polynomiography and Henna Designs
- Polynomiography and Dance
- Polynomiography and Symbology
- Polynomiography Inspired by Art and Art Inspired by Polynomiography
- Threshold Ciphers and Polynomiography: How to be Sneaky with Polynomials
- Traversing Trees with Polynomiography
- Broadway Theater and Polynomiography
- Polynomiography as Inkblot: A New Phycological Method?
- God, Christ, and Mathematics: Exploring Genesis through Polynomiography