

Developing Lesson Plans Using Polynomiography

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Outline

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- Definition
- The Underlying Math in Polynomiography
- What are Polynomiographs?
- The Polynomiograph (Roots, Julia Sets, Voronoi Regions)
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Polynomiography Software

Definition

Polynomiography

Artistic and scientific method to visualize approximation of the roots of a polynomial using a set of iteration functions.

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Definition

Polynomiography

Artistic and scientific method to visualize approximation of the roots of a polynomial using a set of iteration functions.

Remarks:

- Polynomiographs (polynomiography images) and fractal images are not necessarily the same.
- In fact, polynomiography gives more meaning to fractal images.

The Underlying Math in Polynomiography

Complex Numbers

Numbers of the type $a + bi$ where a and b are the coordinates of the point (a, b) in the Euclidean Plane and i is an "imaginary" number satisfying $i^2 = -1$. Complex numbers turn points in the plane into numbers to which we can apply the four elementary operations.

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The Underlying Math in Polynomiography

Complex Numbers

Numbers of the type $a + bi$ where a and b are the coordinates of the point (a, b) in the Euclidean Plane and i is an "imaginary" number satisfying $i^2 = -1$. Complex numbers turn points in the plane into numbers to which we can apply the four elementary operations.

The Basic Family

The Basic Family is a set of iteration functions, algebraically derived from the Fundamental Theorem of Algebra, which generates polynomiographs.

The Basic Family

$$B_2(z) = z - \frac{p(z)}{p'(z)}$$

$$B_3(z) = z - \frac{p(z)p'(z)}{p'(z)^2 - 0.5p(z)p''(z)}$$

The Basic Family

$$B_2(z) = z - \frac{p(z)}{p'(z)}$$

$$B_3(z) = z - \frac{p(z)p'(z)}{p'(z)^2 - 0.5p(z)p''(z)}$$

Remarks:

If you want to know more you can look at professor Kalantari's book.

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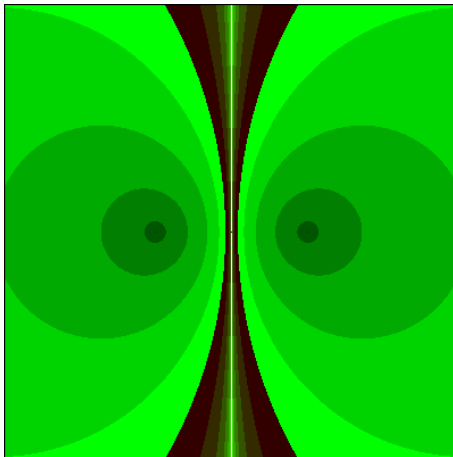
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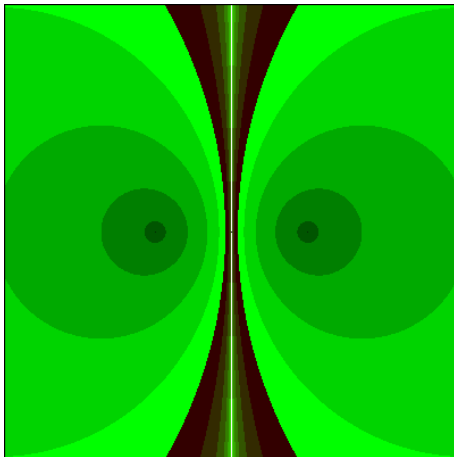


Figure: Polynomiograph of $p(z) = z^2 - 1$.

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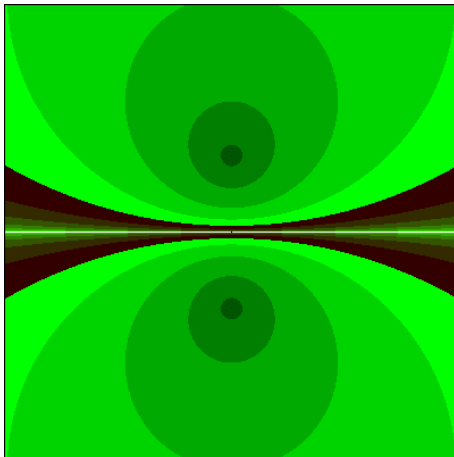
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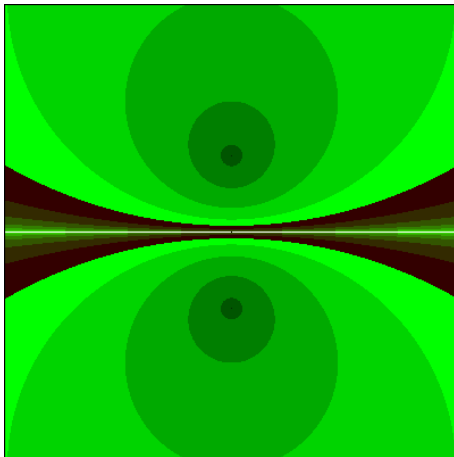


Figure: Polynomiograph of $p(z) = z^2 + 1$.

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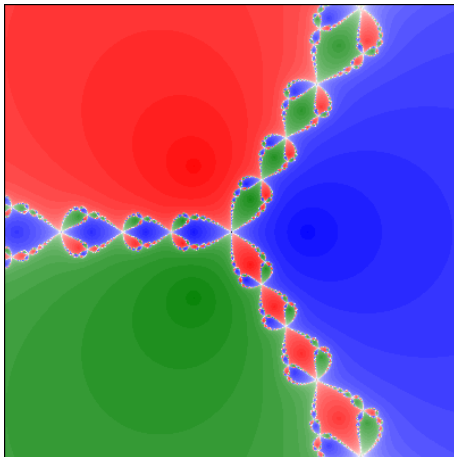
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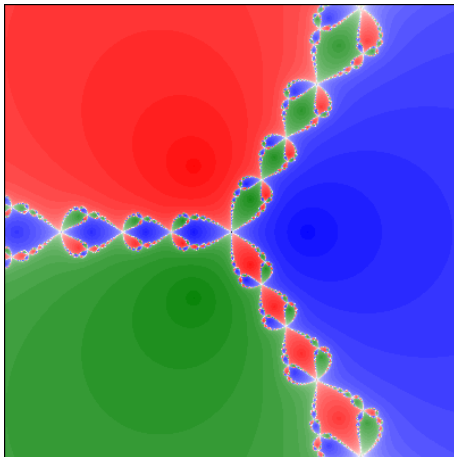


Figure: Polynomiograph of $p(z) = z^3 - 1$.

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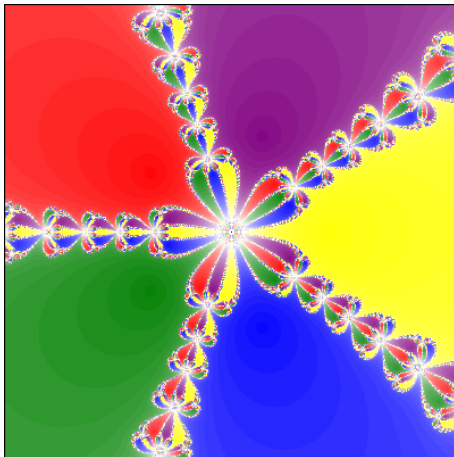
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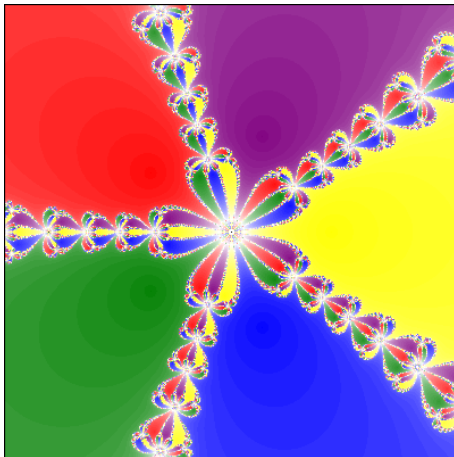


Figure: Polynomiograph of $p(z) = z^5 - 1$.

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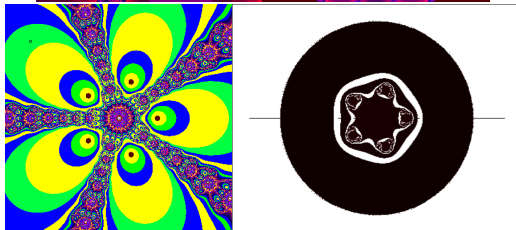
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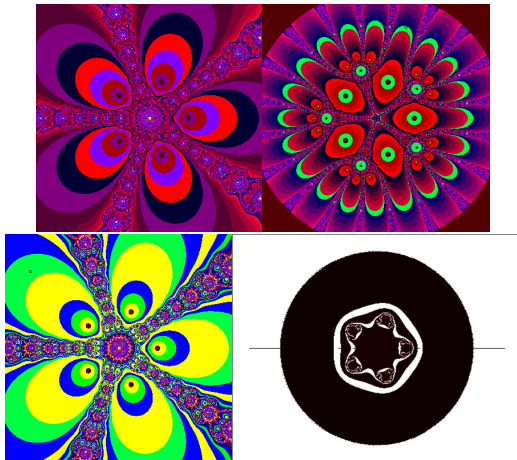


Figure: Variations of the polynomiograph of $p(z) = z^5 - 1$ using the Polynomiography Demo 1.06 software.

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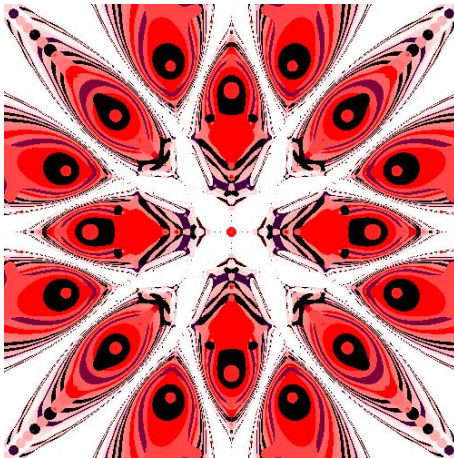
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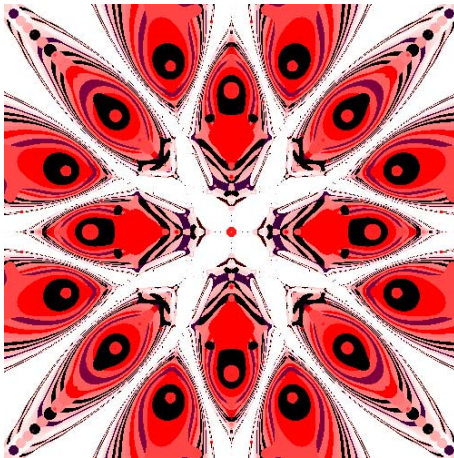
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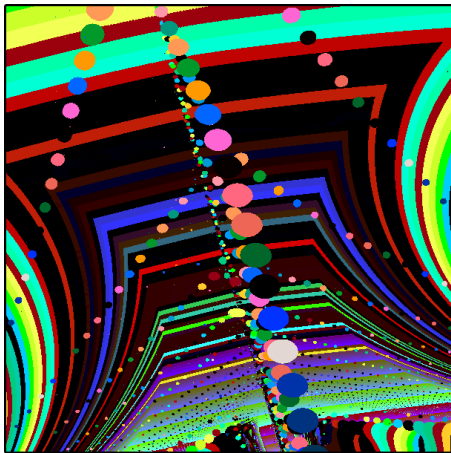
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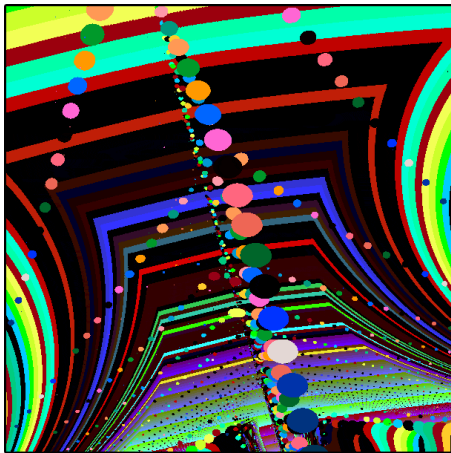
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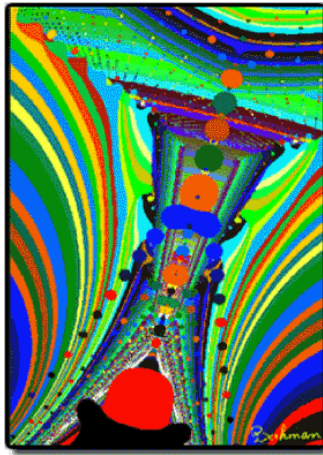
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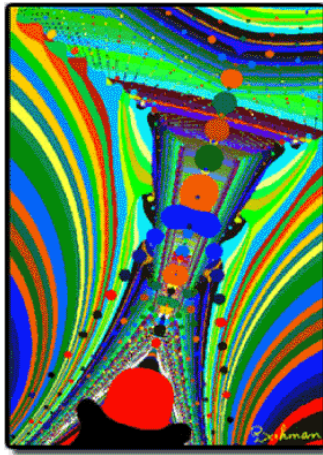


Figure: Artwork from professor Kalantari. Can be find at www.polynomiography.com

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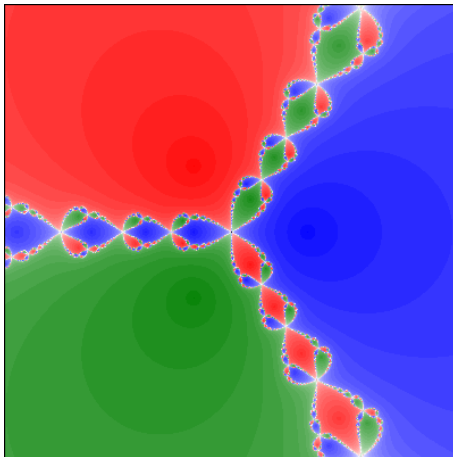
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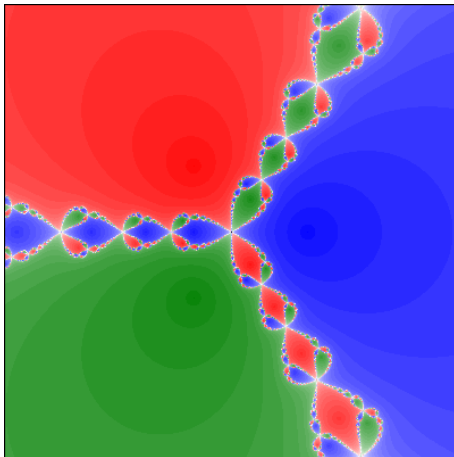


Figure: Polynomiograph of $p(z) = z^3 - 1$.

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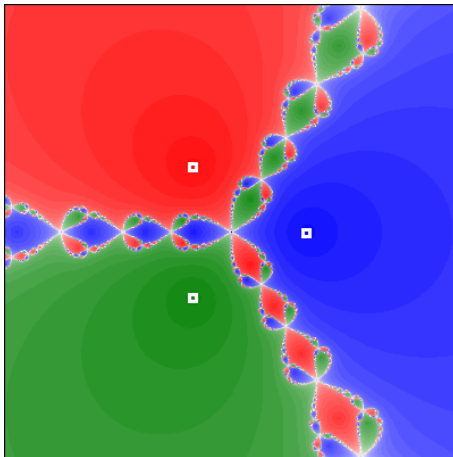
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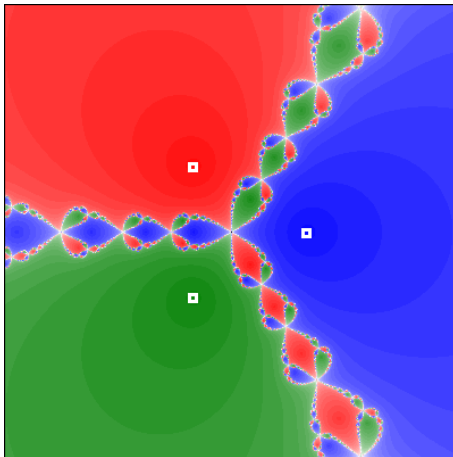


Figure: Roots of $p(z) = z^3 - 1$.

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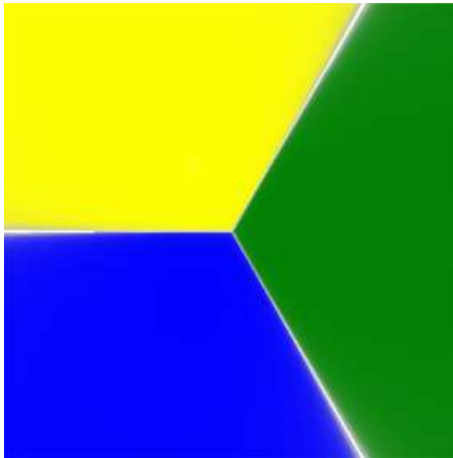
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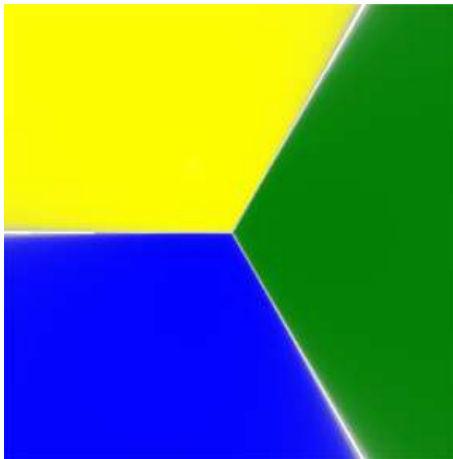


Figure: Voronoi regions of $p(z) = z^3 - 1$.

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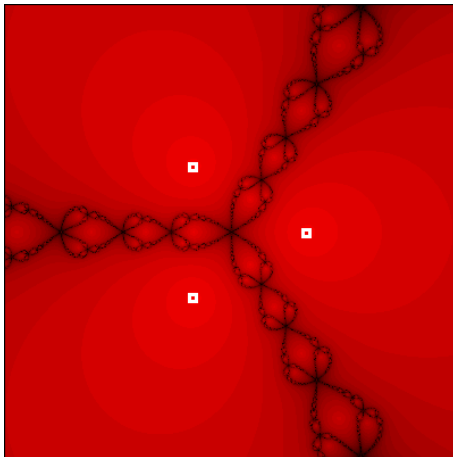
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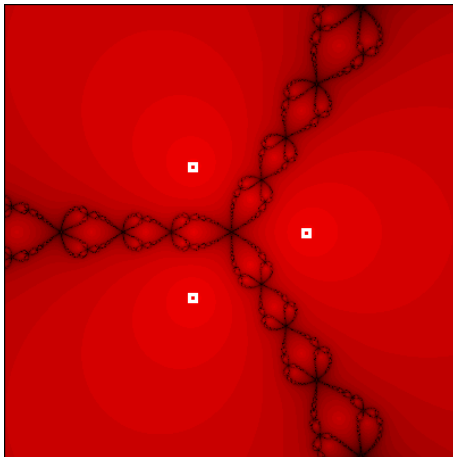


Figure: Julia Sets of $p(z) = z^3 - 1$.

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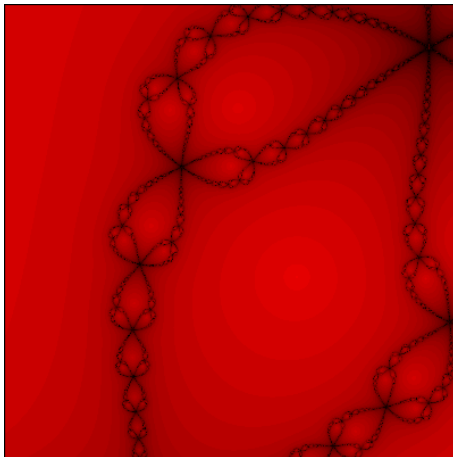
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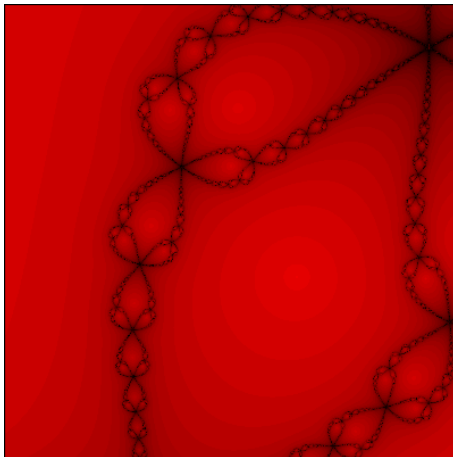


Figure: Closer look of the Julia Sets of $p(z) = z^3 - 1$.

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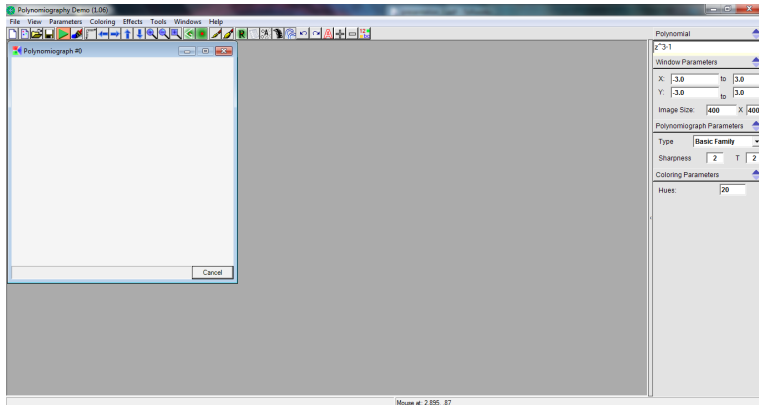


Figure: Screenshot of the software.

Figure: Source: <http://scholasticadministrator.typepad.com/>

Connecting Polynomiography and Education

Why Relate Polynomiography with Education?

Connecting Polynomiography and Education

Why Relate Polynomiography with Education?

- Different

Connecting Polynomiography and Education

Why Relate Polynomiography with Education?

- Different
- Interesting

Connecting Polynomiography and Education

Why Relate Polynomiography with Education?

- Different
- Interesting
- Easy

Lesson Plans

Develop lesson plans using polynomiography in order to make math more interesting and enhance the student's curiosity on polynomials and math in general.

Lesson Plans

Develop lesson plans using polynomiography in order to make math more interesting and enhance the student's curiosity on polynomials and math in general.

Remark:

- Focus : High School students

Conclusion

Thank You