Polynomiography

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Polynomial:

$$a_n z^n + a_{n-1} z^{n-1} + \cdots + a_1 z + a_0$$

where a_n, ... , a_0 are coefficients, n is the degree, a_n nonzero, and z is a variable.
A **polynomial equation** is

$$a_n z^n + a_{n-1} z^{n-1} + \cdots + a_1 z + a_0 = 0$$

A **solution**, or **root** of a polynomial is any specific value of z that would satisfy the polynomial equation

Polynomiography

- a visual art form that involves visualization of complex polynomials
- created by Bahman Kalantari, early 2000s

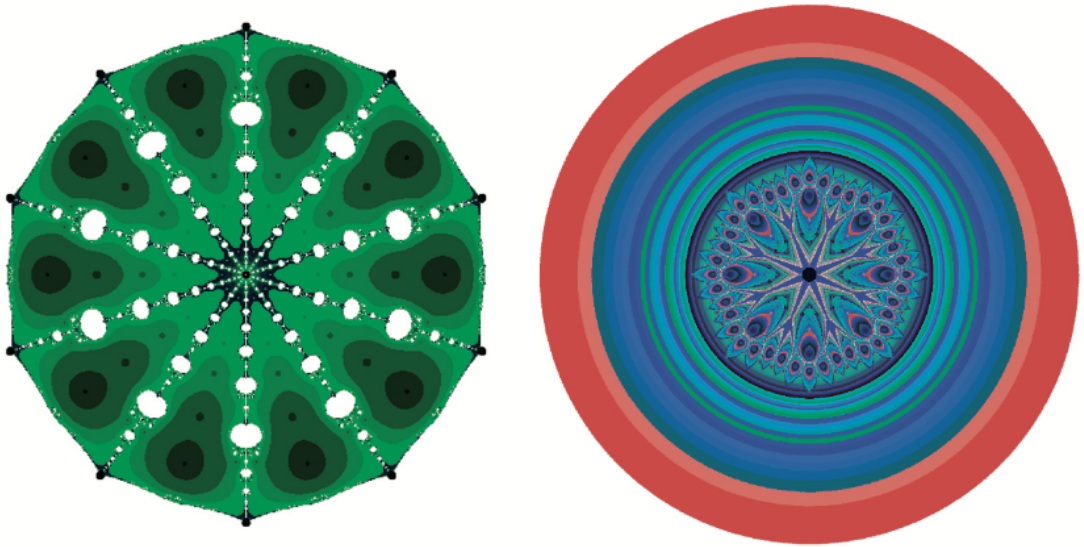


Figure: Some examples from Kalantari [2008]

Project Definition

- Explore new methods to generate artistic images/image sequences from polynomial(s)
- Create a python library that helps to use these methods
- Examine the root distributions of polynomial groups with common features from the results

Project Design

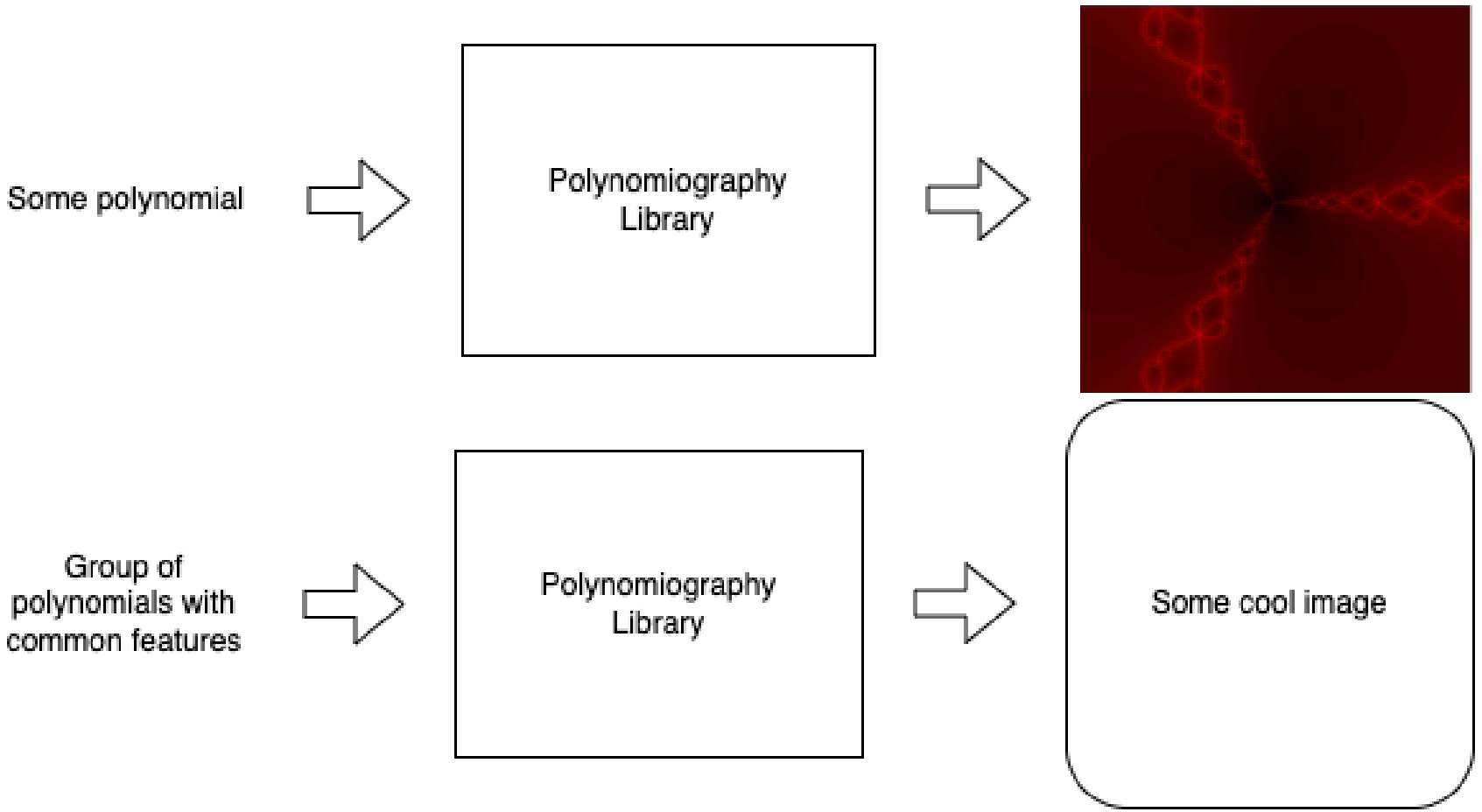


Figure: Use Case 1

Project Design

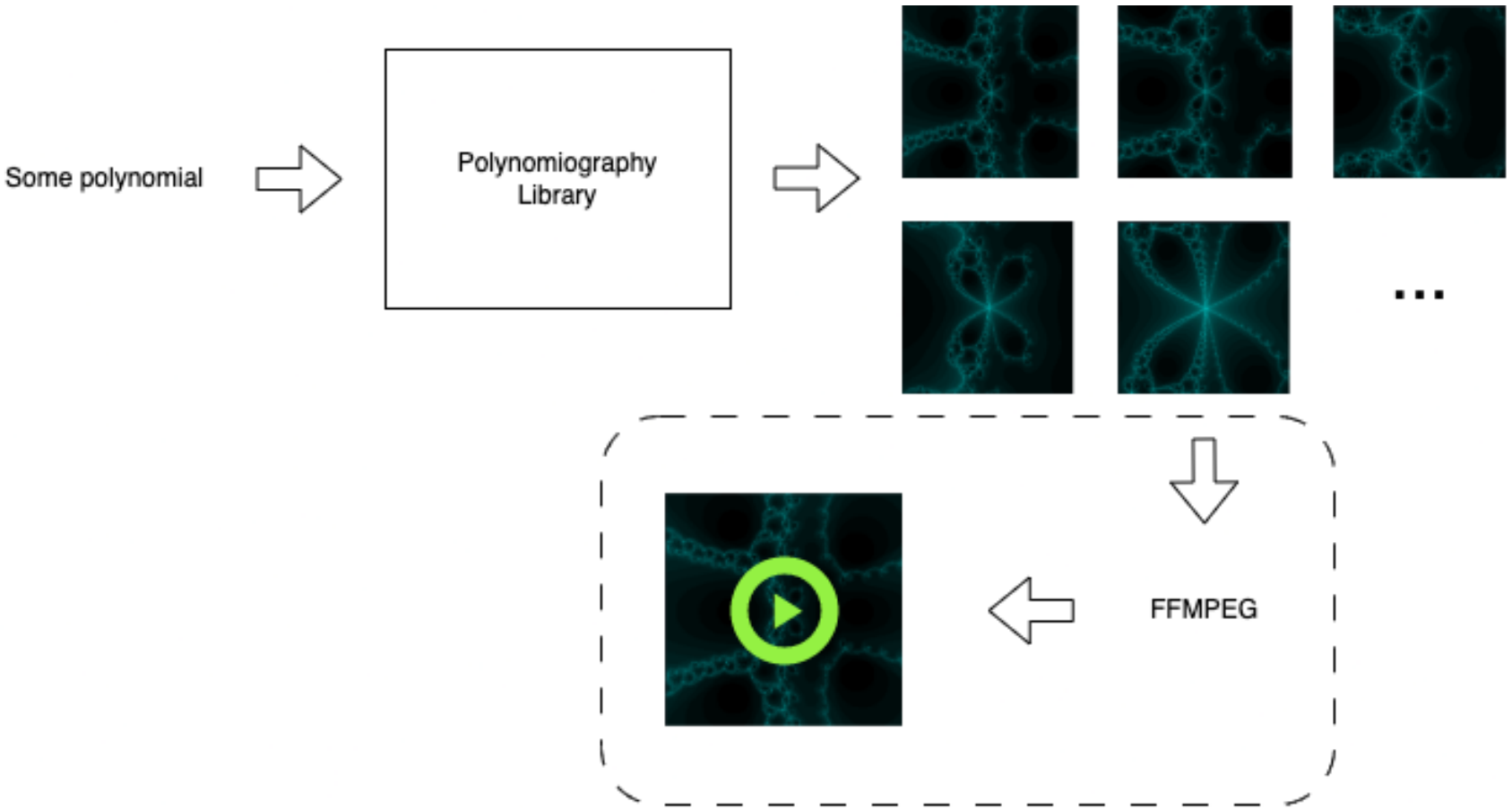


Figure: Use Case 2

1 - Start with some x

2 - Iterate the following formula until the difference between x_n and x_{n+1} is less then some ϵ

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

3 - Return the approximated value [and iteration count]

Figure: Polynomiography created using newton's method for $x^3 + 1$

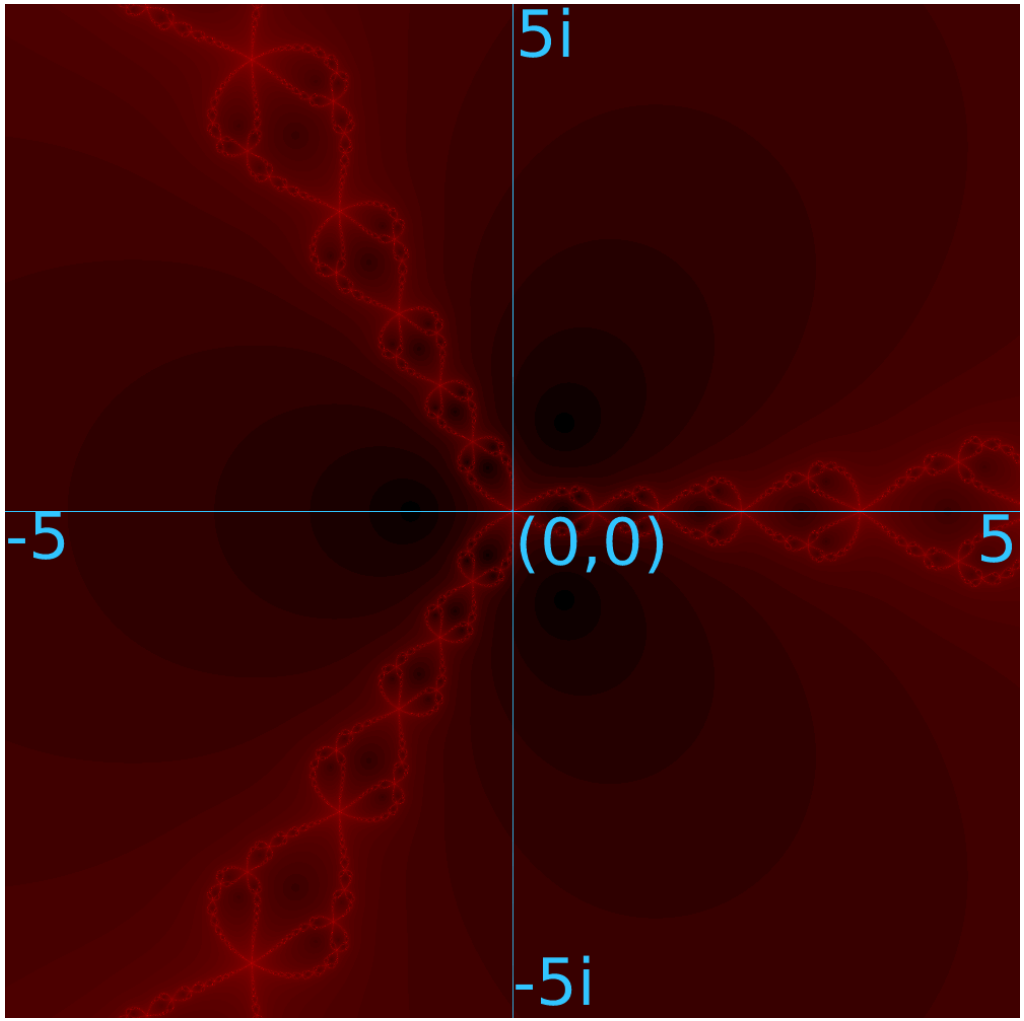
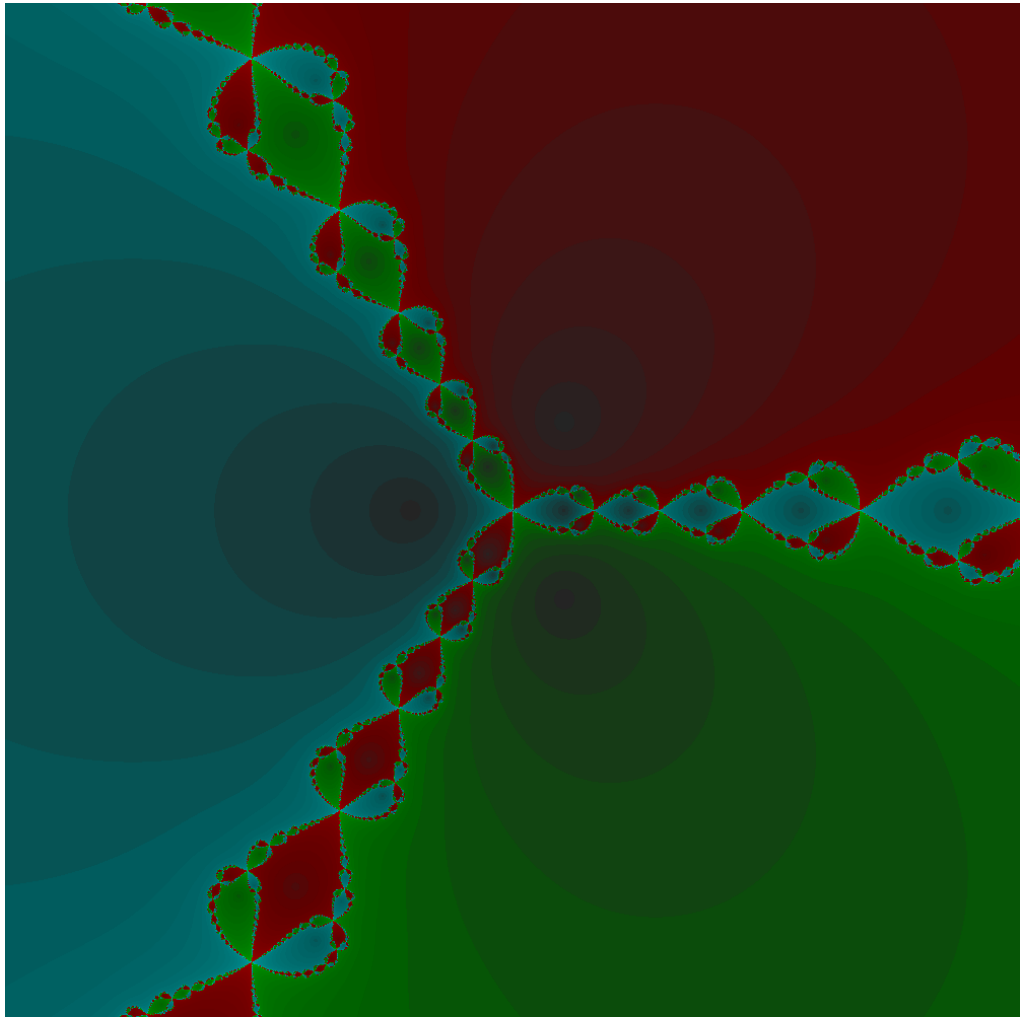


Figure: Polynomiography created using newton's method for $x^3 + 1$, multicolored



Project Requirements

- A complete python library that is ready to use for end-user
- Code documentation
- Simple GUI for demonstration

Timeline

Apr 05: Preliminary Presentation

Apr 05 - Apr 26: Research about previously implemented methods and root finding algorithms

Apr 27 - May 18: Implementation of the library

May 17: 2^{nd} Meeting

May 18 - Jun 4: Implementation of GUI, updating documentation

Jun 4 - Jun 18: Preparing the final draft of the report and trailer

Jun 18: Report Trailer Submissions

Jun 21: Final Presentation

Jun 22: Demo

Success Criteria

- 1000x1000 image, 10 deg polynomial, less than 1 min
- At least 3 different methods that gives different result for the same polynomial
- At least 1 method that generates an image displaying the root distribution of a set of polynomials that share common features

References I

B. Kalantari. *Polynomial Root-Finding and Polynomiography*. WORLD SCIENTIFIC, nov 2008. doi: 10.1142/6265. URL https://doi.org/10.1142%2F6265.