



INDIAN INSTITUTE OF TECHNOLOGY TIRUPATI
DEPARTMENT OF MATHEMATICS AND STATISTICS
MA5191 - PROGRAMMING LABORATORY

Lab Project - IX - Characteristic Polynomial Libraries

I MSc (Mathematics and Statistics)
SEMESTER II

Max. MARKS: 500
Submission Date: 21 March 2021

Scientific Project

1. Verrier Algorithm: Consider the following matrix A .

$$A = \begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{pmatrix}$$

Calculate, A^2, A^3, A^4 and then calculate its traces. That is,

$$t_i = Tr(A^i), i = 1, 2, 3, 4$$

Construct the following linear system

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ t_1 & 2 & 0 & 0 \\ t_2 & t_1 & 3 & 0 \\ t_3 & t_2 & t_1 & 4 \end{pmatrix} \begin{pmatrix} c_1 \\ c_2 \\ c_3 \\ c_4 \end{pmatrix} = \begin{pmatrix} t_1 \\ t_2 \\ t_3 \\ t_4 \end{pmatrix}$$

Solve the above system using forward substitution method.

Construct the following polynomial:

$$f(x) = -x^4 + c_1x^3 + c_2x^2 + c_3x + c_4$$

- If A is an idempotent matrix, how many calculations will be reduced in the above algorithm? A matrix is said to be idempotent, if $A^2 = A$.
- Use scipy libraries to find the roots of the above polynomial.
- Check whether eigenvalues computed using Verrier algorithm and eigenvalues from scipy libraries produce same output?

Gaming Project

Write a Sujiko Game using Python Language

1. Sujiko game is mostly published in The Telegraph and The Times newspaper in UK
2. It is similar to magic square but having circle sum
3. For more details <https://en.wikipedia.org/wiki/Sujiko>