Non-programmable calculator tricks

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1 Calculating characteristic polynomial of matrix using a non-programmable caluclator

1.1 Notations

1. Matrix corresponding to which characteristic polynomial is to identified is denoted by $A \in \mathbb{R}^{n \times n}$

1.2 Assumptions

1. Calculator supports matrix operation and simultaneous equation solver feature.
2. Cyclic index of matrix A is 1 (Using small trick this requirement can be avoided)

1.3 Algorithm

1. Choose a random vector $b \in \mathbb{R}^n$
2. Find sequence of vectors $b, Ab, \ldots, A^n b$
3. Identify the coefficients $a_i \forall i$ in the equation $A^n b = \sum_{i=0}^{n-1} a_i A^i b$ using simultaneous equation solver (Solution exists due to Cayley-Hamilton theorem [1])
4. Characteristic polynomial is then given by $s^n - \sum_{i=0}^{n-1} a_i s^i$

1.4 To avoid the requirement of cyclic index = 1

Use the previous algorithm to obtain m number of minimal polynomials where m=cyclic index of matrix A. One should ensure that A-invariant subspaces corresponding to different minimal polynomials are disjoint. Moreover, sum of degrees of m minimal polynomials should be equal to n.

2 Reference

[1] Wikipedia, ed. *Cayley-Hamilton theorem*. URL: `https://en.wikipedia.org/wiki/Cayley%E2%80%93Hamilton_theorem`.