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Math 201 – Lecture Participation Assignment 3

1) Definition 1: Let $A \in M_{n\times n}(\mathbb{R})$. Consider $T_A: \mathbb{R}^n \to \mathbb{R}^n$ given by $T_A(x) = Ax$.
A nonzero vector $x \in \mathbb{R}^n$ is called an eigenvector of A (or T_A) if $Ax = \lambda x$ for some $\lambda \in \mathbb{R}$.
The scalar λ is called the eigenvalue of A (or T_A) corresponding to the eigenvector x.

2) Definition 2: $P_A(\lambda) = \det(\lambda I_n - A) = \lambda^n + c_{n-1}\cdot\lambda^{n-1} + \dots + c_1\lambda + c_0 \in \mathbb{R}[\lambda]$
is called the characteristic polynomial of A.
The roots of $P_A(\lambda)$ are the eigenvalues of A.

3) Definition 3: The algebraic multiplicity of an eigenvalue λ, denoted by $AM(\lambda)$, is the multiplicity of λ as a root of the characteristic polynomial.

4) Definition 4: The geometric multiplicity of eigenvalue λ, denoted by $GM(\lambda)$, is equal to the dimension of the eigenspace corresponding to λ, i.e.

$$GM(\lambda) = \dim(E_A(\lambda)) = \dim(\text{null}(\lambda I_n - A)).$$

→ In the beginning, I could not understand the equation in the definition 2. However, when I saw the example in the lecture, it made sense to me.

→ Definition 1 also makes sense but why do we call it "eigenvector"? OK, I learned from the lecture it means "special" in Dutch. But why do we use a Dutch term?