Give an example of an operator T on a complex vector space s.t. $T^9 = T^8$ but $T^2 \neq T$.

As opposed to a normal operator.

Let $T\in\mathcal{L}(\mathbb{C}^3)$ defined by

$$T(x, y, z) = (y, z, 0)$$

Then

$$T^{2}(x, y, z) = T(y, z, 0) = T(z, 0, 0) \neq (y, z, 0) = T$$

and yet

$$T^{8}(x, y, z) = (0, 0, 0) = T^{9}(x, y, z)$$

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