İSTANBUL ANALYSIS SEMINARS

HIDDEN SYMMETRIES IN EVERYDAY OPERATORS

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Abstract: What do the following matrices have in common?

$$\begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}, \quad \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}, \quad \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}, \quad \begin{pmatrix} 5 & 2 & 2 \\ 7 & 0 & 0 \\ 7 & 0 & 0 \end{pmatrix},$$

$$\begin{pmatrix} 1 & i & 2 \\ -i & 2 & 1+3i \\ 2 & 1-3i & 4 \end{pmatrix}, \quad \begin{pmatrix} 1 & i & 0 \\ 0 & 0 & -i \\ 0 & 0 & 1 \end{pmatrix}, \quad \begin{pmatrix} -2 & -1 & 2 \\ 5 & -3 & -2 \\ 2 & 4 & 1 \end{pmatrix},$$

$$\begin{pmatrix} 3 & 4 & 5 \\ 2 & 3 & 4 \\ 1 & 2 & 3 \end{pmatrix}, \quad \begin{pmatrix} 1+4i & (-2-i)\sqrt{2} & -1-4i \\ i\sqrt{2} & 0 & i\sqrt{2} \\ -1 & (2-i)\sqrt{2} & 1 \end{pmatrix}.$$

What do a 2×2 matrix, a Jordan block, a complex Hankel matrix, the adjacency matrix of a graph, $\int_0^x f(y)\,dy$, and the Fourier transform have in common? They each enjoy hidden symmetries (can you find them?) which are part of a general theory, only recently developed by the speaker and his collaborators. This talk should be accessible to graduate students and advanced undergraduates. (Partially supported by NSF Grant DMS-0638789).

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