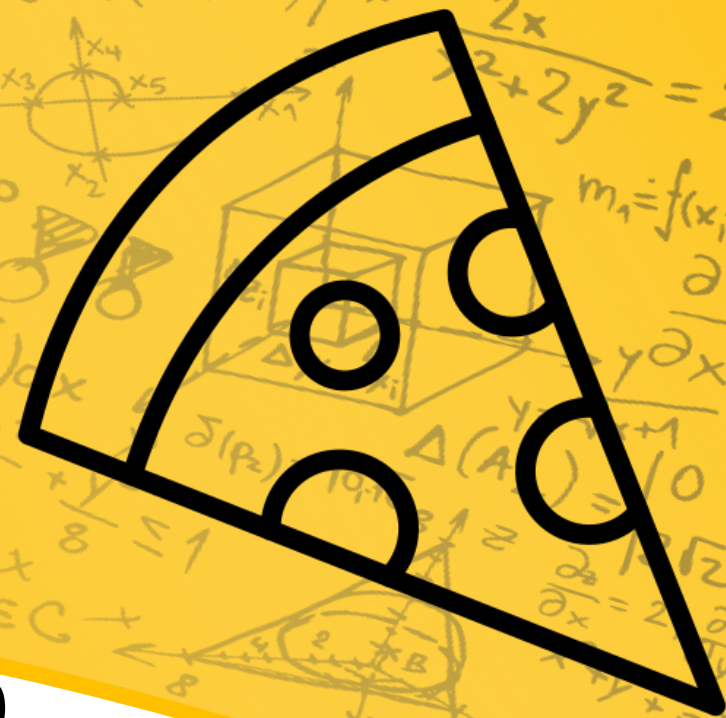




The Faculty of Mathematics
Invites you to the

Pizza seminar



Time & Place

Wednesday, December 31, 13:30
8th floor lounge, Amado bldg

Title

**Spectral GNNs are Incomplete on Graphs
with a Simple Spectrum**

Speaker

Snir Hordan (Technion)

Abstract

Spectral features are widely incorporated within Graph Neural Networks (GNNs) to improve their expressive power, or their ability to distinguish among non-isomorphic graphs. One popular example is the usage of graph Laplacian eigenvectors for positional encoding in MPNNs and Graph Transformers. The expressive power of such Spectrally-enhanced GNNs (SGNNs) has recently received growing attention, yet current approaches only rely on combinatorial isomorphism measures to evaluate these spectral methods, yielding limited insight. We leverage a well-studied paradigm of classifying graphs by their largest eigenvalue multiplicity to introduce an expressivity hierarchy for SGNNs. We then prove that many SGNNs are incomplete even on graphs with distinct eigenvalues. To mitigate this deficiency, we adapt rotation equivariant neural networks to the graph spectra setting to propose a method to provably improve SGNNs' expressivity on simple spectrum graphs. We empirically verify our theoretical claims via an image classification experiment on the MNIST Superpixel dataset and eigenvector canonicalization on graphs from ZINC.