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Excellent discrete Morse functions on graphs and surfaces

Abstract: Nicolaescu studied excellent discrete Morse functions defined on S^1 and S^2 in the differentiable setting. We carry out the analogous study in the discrete setting for any finite graph and any infinite locally finite graph by means of homological sequences associated to such functions. Next we extend this study to connected compact surfaces using persistence pairs to detect the essential or superfluous critical simplices, and indicate an extension to 2-pseudomanifolds.